



Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

OCT 0 5 1995

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of) Docket Nos. 50-390
Tennessee Valley Authority) 50-391

WATTS BAR NUCLEAR PLANT (WBN) - FIRE BARRIER PENETRATION SEAL
ENGINEERING EVALUATIONS

The purpose of this letter is to submit TVA's engineering evaluations which describe the adequacy of WBN fire barrier penetration seals. TVA has recently completed revising these evaluations to address questions raised during recent inspections of the WBN Fire Protection Program. The evaluations are contained in the enclosed "Engineering Report for Penetration Seal Program Assessment" (Enclosure 1). The report:

- Documents the typical fire barrier seal configurations used at WBN
- Defines the basis for the acceptability of fire rated penetration seal typical details
- Establishes the bounding parameters for each fire barrier penetration seal
- Provides a detailed description of the extent to which WBN meets appropriate penetration seal testing standards
- Documents the applicable fire test data which shows the acceptability of the typical penetration seal designs

The engineering evaluations contained in the report are split into two types - Type A and Type B. Type A evaluations were performed on those penetration seal designs that are clearly bounded by

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TO: Peter Tam (Pm)
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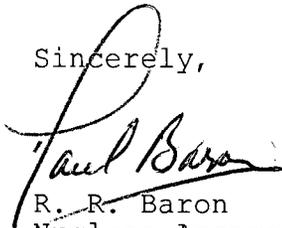
existing fire tests. The Type A evaluations have been clarified to address NRC questions and more clearly show the applicability and acceptability of fire test results.

Type B evaluations were performed on penetration seal designs that require engineering analysis in addition to the test information to show the acceptability of the penetration seal. The Type B evaluations are documented in an expanded format to provide the engineering analyses. They have also been clarified to more clearly show the applicability and acceptability of fire test results.

As discussed with NRC inspection personnel on September 22, 1995, TVA has agreed to perform additional penetration seal fire testing. The testing is being conducted to provide additional evidence that cable tray penetration seals will perform satisfactorily. TVA's test plan for conducting the fire testing is provided in Enclosure 2.

The commitment contained in this submittal is provided in Enclosure 3. If you should have any questions, please contact P. L. Pace at (423) 365-1824.

Sincerely,



R. R. Baron
Nuclear Assurance
and Licensing Manager (Acting)

Enclosures

cc: See page 3

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cc (w/o Enclosures except as noted):

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the minimum allowable of 25. As indicated in Dow Corning product literature, Dow Corning 3-6548 RTV Silicone Foam (parts A and B) (installed in penetrations #5 and #6) possesses an ASTM E 84-79A flame spread rating of 15 which is less than the maximum allowable of 25.

Justification: Not Applicable

C.12 Fire Test ICC0582007

Fire Test Number: ICC0582007

Fire Test Title/Date: Fire and Hose Stream Tests for Penetration Seal Systems, dated March 1986

Fire Test Summary: This test report documents the results of a fire test conducted on 4 penetration seal configurations installed in a single test slab. The review of this fire test report includes penetration seal configurations required to support WBN typical seal details. Specifically, these penetration seal configurations are identified as penetration 1, penetration 2, penetration 3 and penetration 4. A brief description of each of these configurations is as follows:

Penetration 1 was a 10 inch sleeved opening penetrated by a coaxially positioned 2" steel pipe which was capped on the exposed side of the penetration. Seal material consisted of a 1 inch thick Carborundum Hotboard back dam attached to the exposed side of the test slab with a 7 inch depth of Dow Corning 3-6548 Silicone Foam injected into the penetration flush with the exposed side of the test slab.

Penetration 2 was a 10 inch sleeved opening penetrated by an 2" steel pipe eccentrically positioned against the sleeve which was capped on the exposed side of the penetration. Seal material consisted of a 1 inch thick Carborundum Hotboard back dam pressure fitted into the exposed side of the test slab with a 7 inch depth of Dow Corning 3-6548 Silicone Foam injected into the penetration flush with the unexposed side of the test slab.

Penetration 3 was a 32 inch by 7 inch by 12 inch deep blackout representing a seismic gap. Seal material consisted of layer of silicone impregnated fiberglass fabric installed approximately 7 inches deep into the seismic gap. A 5 inch depth of Carborundum Durablanket was installed in the penetration on top of the silicone fabric. An additional layer of silicone fabric was installed on top of the Durablanket. The silicone fabric sheets were adhered to the concrete utilizing Dow Corning 732 Silicone Adhesive and anchored metal strips.

Penetration 4 was a 32 inch by 7 inch by 12 inch deep blackout representing a seismic gap. Seal material consisted of layer of silicone impregnated fiberglass fabric installed approximately 7 inches deep into the seismic gap. A 5 inch depth of Carborundum bulk fiber was installed

in the penetration on top of the silicone fabric. An additional layer of silicone fabric was installed on top of the Durablanket. The silicone fabric sheets were adhered to the concrete utilizing Dow Corning 732 Silicone Adhesive and anchored metal strips.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test report states that the furnace temperature was measured by three thermocouples. (Reference section "Fire Test", page 14 of the test report).

Justification: The furnace used to perform this fire test was the slab furnace at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this furnace provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is described as a down draft type furnace with interior dimensions of approximately 36" x 36". Temperatures within the furnace are generally monitored by three (3) thermocouples located 12" from the test slab. The furnace is heated by three (3) burners, and due to small area of the test furnace, conditions across the exposure area of the test furnace are expected to have been consistent. Internal tests performed by CTL substantiate that there was a uniform heat flux across the exposed test slab within the furnace. Based on this

information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report listed furnace temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Appendix B of the test report, table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.108% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0582007).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible

pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: See Justification

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple pads provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), it was general practice for CTL to use thermocouple pads to cover thermocouples placed on the unexposed side of test specimens. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall

include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 1 and penetration 2 each had three thermocouples located on the unexposed surface of the penetration seal assembly. One at the interface of the pipe and seal material and two on the unexposed surface of the seal material. Penetration 3 and penetration 4 each had three thermocouples located on the unexposed surface of the penetration seal assembly. (Reference Figure 9 "Thermocouple plan", page 13, and Appendix B of the fire test report, table "Thermocouple Reference Chart").

Justification: Penetrations 1 through 4 each satisfy the ASTM E814 requirement to have three thermocouples record unexposed side surface temperatures. However, the requirement to have one thermocouple placed approximately 1 to 3 inches above the unexposed side surface of the penetration seal is not satisfied for each. Although a thermocouple is not placed specifically on the pipe penetrant 1 to 3 inches from the seal surface, the thermocouple placement is considered to meet the intent of the review criteria. This is based on the fact that only the temperature readings from the thermocouples located on the surface of the seal material are considered when determining acceptance of a penetration seal assembly based on limiting endpoint temperature (Refer to checklist item "q").

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Appendix B of the test report, table "Unexposed Temperature Readings").

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix B of the test report includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test. Also, "Summary" as identified on page 15 of the test report describes resulting conditions of each penetration following the test.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable, therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to

simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Test Assembly ", page 2 of the fire test report)

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate the seal material nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to three hose streams in all, each applied for a 14 second duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third test used a standard

playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen. The third hose stream satisfies the review criteria based on a 32 inch square test region.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The third hose stream test applied to the test specimen used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The nozzle was at a distance of 20' from the test specimen and the test was for a duration of 14 seconds.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature at the beginning of the specimen for this test is between 50°F to 90°F.

Justification: This value is based on the "Furnace Atmosphere Temperature" table located in Appendix B of the fire test report, which lists the average thermocouple temperature at time 0:00 as

73°F inside the test furnace and on the "Unexposed Temperature Readings" table located in Appendix B of the fire test report, which indicates thermocouple temperatures at time 0:00 as between 68°F and 72°F. As for the velocity of air across the unexposed surface of the test specimen, this test was performed at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this facility provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is located indoors at a conditioned laboratory. Unexposed side air velocity within the test environment was not significant, and although actual conditions were not recorded in the test report, unexposed side laboratory conditions were not expected to have adversely affected the test results. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetrations 1 through 4 were mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that

for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 1 through 4 successfully passed the fire endurance portion of the test without passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours. Additionally, penetration 3 and penetration 4 successfully passed the fire endurance portion of the test without transmission of sufficient heat to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature for a duration of 3 hours. (Reference "Synopsis" on page 1 of the fire test report). Penetration 1 through 4 each therefore achieve an F rating of 3 hours.

The maximum temperature achieved by either of the surface thermocouples on penetration 3 was 283°F (Reference tables "Thermocouple Reference Chart" and "Unexposed Temp. Readings" in Appendix B of the fire test report). The maximum temperature achieved by either of the surface thermocouples on penetration 4 was 108°F (Reference tables "Thermocouple Reference Chart" and "Unexposed Temp. Readings" in Appendix B of the fire test report). The limiting endpoint temperature of 393°F (325°F plus ambient) was not exceeded (Reference checklist item "o" for a discussion of ambient temperature). Penetration 3 and penetration 4 each therefore achieve a T rating of 3 hours.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis on page 1 and the "Test Comments" in Appendix B of the fire test report states that no water projected beyond the unexposed side of the test assembly at penetrations 1 through 4 during the three hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetrations 1 through 4 were mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.13 Fire Test ICC0386023

Fire Test Number: ICC0386023

Fire Test Title/Date: Fire and Hose Stream Tests for Penetration Seal Systems (WE-PSS1), dated May 1986

Fire Test Summary: This test report documents the results of a fire test conducted on 3 penetration seal configurations installed in a single test slab. Specifically, the penetration seal configurations of importance are penetration 1 and the two penetrating conduit seal configurations. A brief description of each of these configurations is as follows:

Penetration 1 was 12" opening penetrated by a 2" thin wall conduit with conduit fittings at each end and a 4" rigid conduit with conduit fittings at each end. Seal material in Penetration 1 consisted of a 12" thickness of ICMS Product 50 with no damming material. Seal material in both the 2" and the 4" conduits consisted of full depth thickness of Dow Corning 3-6548 silicone foam with Carborundum Fiberfrax Durablanket damming material installed in the conduit fittings at both ends of each conduit.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by three thermocouples located 12"

below the test slab (Reference section "Fire Test", page 8 of the test report).

Justification: The furnace used to perform this fire test was the slab furnace at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this furnace provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is described as a down draft type furnace with interior dimensions of approximately 36" x 36". Temperatures within the furnace are generally monitored by three (3) thermocouples located 12" from the test slab. The furnace is heated by three (3) burners, and due to small area of the test furnace, conditions across the exposure area of the test furnace are expected to have been consistent. Internal tests performed by CTL substantiate that there was a uniform heat flux across the exposed test slab within the furnace. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report listed furnace temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Appendix B of the test report, table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the

corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.027% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0386023). The fire test report indicates that the percent difference between the area under the furnace time-temperature curve and the area under the standard time-temperature curve was 0.0289% (Reference Appendix A of the fire test report, table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: See Justification

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple pads provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), it was general practice for CTL to use thermocouple pads to cover thermocouples placed on the unexposed side of test specimens. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test provides two examples of penetration seal systems, which will be reviewed separately as follows:

- 1) The penetration and the two conduit penetrating items meet the intent of the review criteria. The penetration had six thermocouples located on the unexposed surface of the penetration seal assembly. One at the interface of the penetration and seal material, one at the interface of each conduit and seal material and three on the unexposed surface of the seal material (Reference Appendix B of the fire test report, table "Thermocouple Reference Chart").
 - 2) The two internal conduit seal systems will be reviewed as hot gas/smoke seals and not as internal conduit fire stops due to the
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tested configuration having one seal on each side of the test slab (Refer to checklist item "p").

Justification: 1) The penetration satisfies the ASTM E814 requirement to have three thermocouples record unexposed side surface temperatures. However, the requirement to have one thermocouple placed approximately 1 to 3 inches above the unexposed side surface of the penetration seal is not satisfied. Although a thermocouple is not placed specifically on the conduit penetrants 1 to 3 inches from the seal surface, the thermocouple placement is considered to meet the intent of the review criteria. This is based on the fact that only the temperature readings from the thermocouples located on the surface of the seal material are considered when determining acceptance of a penetration seal assembly based on limiting endpoint temperature (Refer to checklist item "q").

2) Due to the use of two conduit fire seals in each conduit, one on the exposed side and one on the unexposed side, the internal conduit seal systems will be reviewed as hot gas/smoke seals, as such, thermocouple placement will not be part of this review (Refer to checklist item "p").

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Appendix B of the test report, table "Unexposed Temperature Readings").

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of

smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix B of the test report includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test. (Reference Appendix B - "Test Comments")

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The

selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Test Assembly WE-PSS1", page 1 of the fire test report)

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate penetration 1 nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to three hose streams in all, each applied for a 24 second duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third test used a standard playpipe with a 1-1/8" diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen. The third hose stream satisfies the review criteria.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The third hose stream test applied to the test specimen used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The nozzle was at a distance of 20' from the test specimen and the test was for a duration of 24 seconds.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature on the unexposed surface of the specimen for this test is assumed to be 79°F.

Justification: This value is based on the "Unexposed Temperature Readings" table located in Appendix B of the fire test report, which lists the temperature at time 0:00 as 79°F for several thermocouples. Use of the lowest recorded initial temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen, this test was performed at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this facility provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on

conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is located indoors at a conditioned laboratory. Unexposed side air velocity within the test environment was not significant, and although actual conditions were not recorded in the test report, unexposed side laboratory conditions were not expected to have adversely affected the test results. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Penetration 1 contained conduits as penetrating items. Therefore, penetration 1 itself was reviewed as a mechanical penetration seal, IEEE-634 requirements do not apply. The two conduit seal systems satisfy the review criteria by successfully passing the fire endurance portion of the test without passage of flame through the conduit seals or flaming on the unexposed side of the conduit seals for a duration of 3 hours (Reference "Synopsis" of the fire test report). The two conduit seal systems are considered hot gas/smoke seals and will not be used to justify specific WBN typical penetration seal details. Therefore, hot gas/smoke seals will not be reviewed against this checklist item for unexposed surface temperatures.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83

requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration 1 successfully passed the fire endurance portion of the test without passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours (Reference "Synopsis" of the fire test report). Penetration 1 therefore achieved an F rating of 3 hours.

The maximum temperature achieved by any of the surface thermocouples on penetration 1 was 158°F (Reference tables "Thermocouple Reference Chart" and "Unexposed Temp. Readings" in Appendix B of the fire test report). The limiting endpoint temperature of 404°F (325°F plus ambient) was not exceeded (Reference checklist item "o" for a discussion of ambient temperature). Penetration 1 therefore achieved a T rating of 3 hours.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report states that no water projected beyond the unexposed side of the test assembly at penetration 1 during the three hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration 1 itself was reviewed as a mechanical penetration seal, IEEE-634 requirements do not apply. The two conduit seal systems utilized Dow Corning 3-6548 RTV silicone foam material and Carborundum Fiberfrax Durablanket material. Dow Corning 3-6548 has a flame spread rating of 15. The Carborundum Fiberfrax Durablanket is generally accepted as "non-combustible" material.

Justification: Not Applicable

C.14 Fire Test ICO1091035

Fire Test Number: ICO1091035

Fire Test Title/Date: 3 Hour Fire Resistance Evaluation of Ten Different Fire Penetration Seal Designs, dated October 12, 1990

Fire Test Summary: This test report documents the results of a fire test conducted on 10 penetration seal configurations installed in a two 12" thick test slabs. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, the penetration seal configurations of importance are penetrations 1, 2, 3, 4, 5, 7 and 9. A brief description of each of these configurations is as follows:

Penetration 1 was a 24"x24" steel lined opening cast into slab 1. The opening was further subdivided into 12"x24" openings utilizing an 18 gauge sheet steel divider installed flush to the exposed side of the slab, measuring 24"x8³/₄". One opening was penetrated by a 4"x18" solid back cable tray and the other opening was penetrated by a 4"x18" ladder back cable tray. Each tray was loaded with 134% visual cable fill consisting of 33-1/3% each of power, control and instrumentation cable. The power cable had PVC jacketing, control and instrumentation cables each had XLPE insulation and PVC jacketing. Seal material for both openings consisted of 8³/₄" ± 1/8" of Dow Corning 3-6548 Silicone RTV Foam (23.7 pcf density), Carborundum 1" thick Duraboard LD installed on the exposed side of the slab using mechanical fasteners and Carborundum 1" thick Duraboard LD installed on the unexposed seal surface, pressure fit into the opening. Carborundum Durablanket S was used to complete damming, (e.g. around cables, etc.).

Penetration 2 was a 6" x 20" rectangular blackout lined with 1/4" thick steel plate cast into slab 1. The opening was penetrated by a cable bundle (100% visual fill) consisting of a combination of power, control and instrumentation cables. Cables consisted of 17.89% actual fill of power cable, 16.67% actual fill of control cable and 16.68% actual fill of instrumentation cable. The power cable had PVC jacketing, control and instrumentation cables each had XLPE insulation and PVC jacketing. Seal material for the penetration consisted of a 12" depth of Dow Corning 3-6548 Silicone RTV Foam (22.6 pcf density), without damming material.

Penetration 3 was 14" diameter, schedule 40 steel sleeve cast into slab 1. The sleeve had no penetrations. Seal material for the penetration configuration consisted of a 12" depth of Dow Corning 3-6548 Silicone RTV Foam (19.5 pcf density).

Penetration 4 was a 6" x 20" rectangular blackout lined with 1/4" thick steel plate cast into slab 2. The steel liner was installed flush with the unexposed side of the test slab and extended 4" beyond the exposed side of the test slab. The opening was penetrated by a cable bundle (100% visual fill) consisting of a combination of power, control and instrumentation cables. Cables consisted of 17.89% actual fill of power cable, 16.67% actual fill of control cable and 16.68% actual fill of instrumentation cable. The power cable had PVC jacketing, control and instrumentation cables each had XLPE insulation and PVC jacketing. Seal material for the penetration consisted of a 12" \pm 1/4" depth of Dow Corning 3-6548 Silicone RTV Foam (23.3 pcf density). A 1" thickness of Carborundum Duraboard LD damming material was secured with mechanical fasteners to the bottom of the sleeve extension, 4" below the exposed face of the test slab. No damming was present on the unexposed seal surface.

Penetration 5 was a 14" diameter steel sleeve cast into slab 2. The sleeve was penetrated by a 2" diameter schedule 40 steel pipe that was sealed on the exposed side with a steel plate welded to the bottom of the pipe. Additionally the pipe was installed eccentric to the sleeve so at one point the distance from the pipe edge to the inside sleeve surface was 8". Sleeve extension inserts consisting of 16 gauge galvanized steel sheet metal were installed inside the 14" diameter sleeve using Dow Corning 96-081 Silicone RTV Adhesive/Sealant. Seal material for the penetration configuration consisted of a dual layer boot system, comprised of an inner layer of Carborundum Fibersil 36-400-U and an outer layer of Arlon 56493F031 fabric. These double later boots were attached on both the exposed and unexposed surfaces to the sleeve extension inserts and to the 2" pipe with stainless steel bands. The 2" pipe had a heat shields consisting of a 1" thickness of calcium silicate insulation applied at the point where the boot systems were attached and along its length inside the boots.

Penetration 6 is not used to support WBN typical penetration seal details, and is therefore not included in the review of this fire test report.

Penetration 7 was a 12" diameter, schedule 40 steel sleeve cast into slab 2. The sleeve was penetrated by a 2" diameter schedule 40 steel pipe installed concentric to the sleeve and sealed on the exposed side with a steel plate welded to the bottom of the pipe. Sleeve extension inserts consisting of 16 gauge galvanized steel sheet metal were installed inside the 14" diameter sleeve using Dow Corning 96-081 Silicone RTV Adhesive/Sealant. Seal material for the penetration configuration consisted of a dual layer boot system, comprised of an inner layer of Carborundum Fibersil 36-400-U and an outer layer of Arlon 56493F031 fabric. These double later boots were attached on both the exposed and unexposed surfaces to the sleeve extension inserts and to the 2" pipe with stainless steel bands. The 2" pipe had a heat shields consisting of 18 gauge sheet steel inner and outer collars separated by a radial fin. A 2" thickness of calcium silicate insulation was installed on the pipe between the point where the boot systems were attached, along its length inside the boots.

Penetration 8 is not used to support WBN typical penetration seal details, and is therefore not included in the review of this fire test report.

Penetration 9 was a 6" diameter steel electrical conduit sleeve cast into slab 1, consisting of a 6" diameter short nipple with a 6" diameter conduit connector screwed on to each end. The total length of this assembly was 12" and it contained female threads on each end. The assembly was cast into the concrete slab with both ends flush with the slab surfaces. A standard male-threaded 6" diameter steel cap was installed on both the exposed and unexposed sides of the conduit assembly. This specimen did not contain a penetrating item and represented a blank or spare opening.

Penetration 10 is not used to support WBN typical penetration seal details, and is therefore not included in the review of this fire test report.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable

penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by four thermocouples located 12" below the test slabs (Reference section "Test Procedure", page 2 of the test report).

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report lists furnace temperatures every 1 minute throughout the 3 hour duration of the fire endurance test for both slab 1 and slab 2 (Reference Appendix B1 and Appendix B2 of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve for slab 1 was calculated to be within -0.780% of the standard time-temperature curve. The area under the furnace time-temperature curve for slab 2 was calculated to be within -1.677% of the standard time-temperature curve. (Refer to the calculation and graph provided in Attachment 3 of this report). The fire test report indicates that, "the furnace temperature during the fire test is controlled such that the area under the time/temperature curve is within 5% of the corresponding area under the standard time/temperature curve for the three hour test period" (Reference section "Test Procedure", page 3 of the test report).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Thermocouples were covered by 2" x 2" x 0.4" felted mineral fiber pads, (Refer to section "Test Procedure", page 3 of the test report).

Justification: Not applicable

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:

1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple

was such that unexposed side surface temperatures for the entire penetration seal were represented.

2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 1 had, as a minimum, at least one thermocouple at each of the following locations; on the top surface of the steel liner, on the surface of the penetration seal, at the cable tray/seal interface, on the cable tray 1" above the seal surface, on each type of cable at the cable/seal interface and on each type of cable 1" above the seal surface. Penetration 1 therefore satisfies the review criteria.

Penetration 3 had two thermocouples on the top surface of the steel liner and two thermocouples on the silicone foam seal surface. Penetration 3 therefore satisfies the review criteria.

Penetration 5 had, as a minimum, at least one thermocouple at each of the following locations; on the side of the steel liner close to the top of the slab, on the boot material approximately half way up, on the 2" pipe at the interface with the pipe insulation, on the 2" pipe 1" above the interface with the pipe insulation and on the top surface of the pipe insulation. Penetration 5 therefore satisfies the review criteria.

Penetration 7 had, as a minimum, at least one thermocouple at each of the following locations; on the side of the steel liner close to the top of the slab, on the boot material approximately half way up, on the 2" pipe at the pipe/heat shield interface, on the 2" pipe 1" above the pipe/heat shield interface, on the side of the heat

shield under the strap and on the top surface of the heat shield. Penetration 7 therefore satisfies the review criteria.

Penetration 9 had two thermocouples on the top surface of the steel liner, one thermocouple on the steel plug at a high point and one thermocouple on the steel plug at a low point. Penetration 9 therefore satisfies the review criteria.

Reference Appendix A, "Thermocouple Placement Figures".

Penetration 2 had, as a minimum, at least one thermocouple at each of the following locations; on the top surface of the steel liner, on each type of cable at the cable/seal interface and on each type of cable 1" above the seal surface. Penetration 2 meets the intent of the thermocouple configuration requirements of this checklist item (See Justification)

Penetration 4 had, as a minimum, at least one thermocouple at each of the following locations; on the top surface of the steel liner, on each type of cable at the cable/seal interface and on each type of cable 1" above the seal surface. Penetration 4 meets the intent of the thermocouple configuration requirements of this checklist item (See Justification).

Reference Appendix A, "Thermocouple Placement Figures".

Justification: Penetrations 2 and 4 are representative of through barrier penetrations with high cable fill condition. The penetration seal configurations tested provided for thermocouples to be placed at conductor/seal interfaces, but lacked sufficient free seal surface area to place a surface thermocouple as required per IEEE-634. However, based on the discussion above, the available thermocouple placements provide an acceptable alternative to the method described in IEEE-634 (Refer to checklist item "q").

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report lists

specimen thermocouple temperatures every 1 minute throughout the 3 hours of the test (Reference Appendix B1 and B2 of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The section "Test Results", pages 25 through 33 of the test report, documents observations made of the test assembly during and after the fire test and after the hose stream test.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable; therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configurations.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in

floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items for penetrations 1, 2, 4, 5 and 7 extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. Penetration 9 was flush with both slab surfaces, but this is acceptable since it is typical of an actual spared conduit sleeve. Penetration 3 had no penetrations, (Reference "Test Assemblies", page 8 and Appendix A "Construction Drawings" of the fire test report)

Justification: Not Applicable.

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The section "Test Results", page 25 through 33, of the fire test report indicates that the tested configurations were exposed to a 3 hour fire test and no flaming occurred on the unexposed surface of any of the penetrations. Therefore, the test specimens are considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The section "Test Result", pages 25 and 29 of the fire test, states that

immediately after the fire test, the test assembly was removed from the furnace and subjected to two hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Each test assembly was subjected to two hose streams in all, each applied

for a 1:41 (min:sec) duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second test used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The hose stream was delivered at an estimated angle of 30° away from normal, so the nozzle tip was positioned 17 feet from the center of the exposed face of the test slab. The applied hose stream tests satisfy the requirements of the review criteria for both the electrical and mechanical penetration seals contained in each test slab.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The first test used a 1 1/2" hose discharging through a nozzle producing a 30° included angle of spray, with a nozzle pressure of 75 psi, from a distance of 10 feet. The second test used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The hose stream was delivered at an estimated angle of 30° away from normal, so the nozzle tip was positioned 17 feet from the center of the exposed face of the test slab.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient temperature at the beginning of the test for slab #1 was documented as 78°F and for slab #2 as 77°F, (Reference "Test Results", page 25 through 33 of the fire test).

As for the velocity of air across the unexposed surface of the test specimen and the use of mechanical ventilation, this test was conducted at the Omega Point Laboratories fire test facility which uses furnaces that are indoors. Wind velocities over the unexposed surface of the test assembly are insignificant (Refer to Attachment 4 of this report).

Justification: Not Applicable.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 1 satisfies the fire endurance portion of the review criteria based on the documented fire test observations found on page 25. Penetration 1 meets the intent of the transmission of heat criteria as a single thermocouple exceeded the temperature limitation at 179 minutes into the test and only exceeded the limit by a minor 6°F. The table of discrete thermocouple readings provided in the test report for Penetration 2 documents the maximum temperature for any thermocouples as 748°F on a 250 MCM cable at the cable/seal interface and at 904°F on a 250 MCM cable 1" above the seal surface. The table of discrete thermocouple readings provided in the test report for Penetration 4 documents applicable thermocouple temperatures as below the limiting criteria. Penetrations 3, 5, 7, and 9 are reviewed as

mechanical penetration fire stops and therefore were not reviewed against this review item.

Justification: Penetration 1 had a total of 21 thermocouples recording temperatures at the surface of the seal. Sixteen (16) of which were at seal/cable and seal/tray interfaces. Of these, only one (1) thermocouple (T/C#31) reading, at 179 minutes into the test, exceeded the IEEE-634 limitation of 700°F by a margin of 2°F. Thermocouple T/C#31, positioned at a power type cable, reached 706°F at 180 minutes. Whereas, three (3) similarly positioned T/C's, 18,19 & 30, reached 532°F,523°F & 699°F respectively. All thermocouple temperatures were well below the lowest auto-ignition temperature of 835°F for WBN cabling. Based on the above, the fire test results for Penetration 1 meet the intent of the review criteria. Penetration 2 did not meet the requirements for 180 minutes however testing does qualify this configuration for a 2:32 (hr:min) duration. Additionally, penetration 2 did not allow passage of flame or gases hot enough to ignite the cable or fire stop material on the unexposed side of the penetration for the entire 180 minute fire duration.

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report for Penetrations 3, 5, 7 and 9 documents applicable unexposed seal surface thermocouple temperatures as below the limiting criteria for penetrations 3, 5 and 7. Therefore, based on this test review Penetrations 3, 5 and 7 meet the requirements for an F rating of 180 minutes and a T rating of 180 minutes. Penetration 9 exceeded the limiting temperature at 108 minutes into the test. Therefore, based on this fire test review. Penetration 9 meets the

requirements for an F rating of 180 minutes and a T rating of 107 minutes. Penetrations 1 and 4 are reviewed as electrical penetration fire stops and therefore were not reviewed against this review item.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 3, 5, 7 and 9 are reviewed as mechanical penetrations and therefore, subject to the hose stream test requirements of ASTM E-814-83 and based on fire test results, these penetrations passed all hose stream tests. Penetrations 1 and 4 are reviewed as electrical penetrations and therefore, subject to the hose stream test requirements of IEEE-634 and based on the fire test results, Penetration 1 successfully passed the required IEEE-634 hose stream test and failed the mechanical hose stream test. Penetration 4 passed all hose stream tests. (Reference section "Test Results", pages 25 through 33 of the test report).

Justification: Since Penetration 1 is not reviewed against the hose stream test requirements of ASTM E-814-83. The results of a E-814-83 hose stream test are not applied to this penetration.

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 1, 2 and 4 seal system utilized Dow Corning 3-6548 Silicone RTV Foam and Carborundum Fiberfrax Duraboard LD and Durablanket S material. Dow Corning 3-6548 has a flame spread rate of 15.

The Carborundum Fiberfrax Duraboard LD and Durablanket S are generally accepted as "non-combustible" material. Since penetrations 3, 5, 7 and 9 were reviewed as mechanical seal systems, IEEE-634 requirements do not apply.

Justification: Not Applicable

C.15 Fire Test ICS0879002

Fire Test Number: ICS0879002

Fire Test Title/Date: Fire Qualification Test on Floor Penetration Seals,
dated November 30, 1979.

Fire Test Summary: This test report documents the results of a fire test conducted on 18 penetration seal configurations installed in a single test slab. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, the penetration seal configurations of importance are penetrations 3, 6 and 9. A brief description of each of these configurations is as follows:

Penetration 3 was a 4" diameter galvanized steel conduit embedded flush, 12" long, with the test slab surfaces. The conduit was penetrated by 100% visual loading of PVC jacketed instrumentation and control cables. Seal material for the penetration configuration consisted of 6" thickness of Dow Corning 3-6548 RTV silicone foam and 1" thickness of Carborundum Fiberfrax Durablanket as damming material.

Penetration 6 was a 4" diameter galvanized steel conduit embedded flush, 12" long, with the test slab surfaces. The conduit was penetrated by 100% visual loading of PVC jacketed instrumentation and control cables. Seal material for the penetration configuration consisted of 2" thickness of Dow Corning 96-081 RTV Adhesive/Sealant and 1" thickness of Carborundum Fiberfrax Durablanket as damming material.

Penetration 9 was a 42"x36" blockout. The blockout was penetrated by two (2) 4"x12" aluminum ladder back cable trays with 100% visual loading of PVC jacketed instrumentation and control cables. Seal material for the penetration configuration consisted of 9" thickness of Dow Corning 3-6548 RTV silicone foam and 1" thickness of Carborundum Fiberfrax Hotboard as damming material.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by six thermocouples located 12" below the test slab (Reference section "Test Facility", page 48 of the test report).

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report lists the average furnace temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter, (Reference section "Test Facility" Table 3, page 51 of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the

corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.543% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICS0879002). The fire test report does not specifically address differences between the area under the furnace time-temperature curve and the standard time-temperature curve. The test report does provide a table and graph of averaged furnace thermocouple temperatures, (Reference "Figure 25", page 50 and "Table 3", page 51 of the fire test report).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The test specimen was subjected to a three hour fire test in accordance with the standard time-temperature relationship set forth in ASTM E-119 (Reference "Summary" of the fire test report).

Justification: ASTM E-119 requires that the thermocouples be placed under flexible, dry, felted asbestos pads. This method of attachment protects thermocouples from possible cooling effects of unexposed side ambient air temperatures, (e.g., the influence of air velocity across the unexposed side of the seal assembly). The method of thermocouple attachment is not described in the text of

Fire Test Report ICS0879002. However, credit is taken for the qualification of the testing establishment (Southwest Research Institute). Therefore, based on the above discussion, the method of thermocouple attachment provides an acceptable alternative to the method described in ASTM E-814-83 and IEEE 634-1978.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 3 and 6 were each thermocoupled at the seal surface, seal/cable interface and on a cable 3" up from the seal surface. Penetrations 3 and 6 did not contain a through metallic component. Penetration 9 was thermocoupled as delineated in this checklist item. Based on the discussion above Penetrations 3,6 and 9 meet the requirements of IEEE-634. Since Penetrations 3,6 and 9 are electrical seal systems, ASTM E-814-83 is not applicable, (Reference section "Unexposed Surface Thermocouple Data", page 59 of the fire test report).

Justification: Not Applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 15 seconds throughout the 3 hours of the test, (Reference section "Unexposed Surface Thermocouple Data", page 59 of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Observations of the test assembly were documented during and after the fire test and after the hose stream test, (Reference "Test Results", Table 4, page 54 of the test report).

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of

the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The test specimens were constructed to be representative of actual field configurations, that is, with penetrating items protruding from both sides of the barrier. The test report does address penetrant lengths for mechanical configurations in section "Penetration Loading", page 8 of the test report.

Justification: IEEE 634-1978 requires that the cable within the penetration or the raceway passing through the penetration protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. The distance of protrusion for electrical penetrations is not described in the text of Fire Test ICS0879002. However, Appendix II "Photographs of Installations and Fire Exposure Period" provides evidence that penetrating items did in fact extend from the exposed and unexposed surfaces of the test slab and credit is taken for the qualification of the testing establishment (Southwest Research Institute). Therefore, based on the above discussion, there is reasonable assurance that penetrating items did extend from the exposed and unexposed surfaces of the test slab as described in ASTM E-814-83 and IEEE-634-1978.

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions
-

for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Summary of Test Results" of the fire test report indicates flame did not penetrate nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- I. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The fire test documents that immediately after the fire test, the test assembly was removed from the furnace and subjected to hose stream tests, (Reference section "Test Observations", Table 4, page 55 of the fire test report).

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test assembly was subjected to one hose stream of 120 second duration and then two additional hose streams of 30 second duration were applied to Penetration 9. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second and third hose stream applied to Penetration 9 will not be discussed as the first hose stream satisfies the review criteria.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the

distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The first hose stream test applied to the test specimen used a 1-1/2" diameter hose with a nozzle set at a 30° angle delivered from a distance of 10 feet and the test was for a duration of 120 seconds, (Reference section "Test Procedures", page 53 and "Test Observations- Table 4", page 55 of the test report).

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature on the unexposed surface of the specimen for this test is assumed to be 83°F.

Justification: This value is based on the "Unexposed Surface Thermocouple Data" of the fire test report, which lists the temperature at time 0:00 as 83°F for two thermocouples. Use of the lowest recorded ambient temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen. The test report indicates that a building was erected specifically for this test to meet ASTM E-119 standards and that the structure was adequate to prevent excessive air currents across the unexposed surface of the slab (Reference "Test Facility", page 48 and "Unexposed Surface Thermocouple Data", page 59 of the test report).

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The fire test indicates that there was no passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the tested configurations. The table of thermocouple temperature readings in the fire test report, for the reviewed penetrations, documents applicable thermocouple temperatures as below the limiting criteria.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetrations 3,6 and 9 were electrical penetration seals, ASTM E-814-83 requirements are not applied.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to
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have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Summary of Test Results" on page 58 of the fire test report states that no water projected beyond the unexposed side of the penetration seals as a result of the hose stream test.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 3 and 9 seal system utilized Dow Corning 3-6548 RTV silicone foam and Carborundum Fiberfrax Durablanket and Hotboard material. Penetration 6 seal system utilized Dow Corning 96-081 RTV Adhesive/Sealant and Carborundum Fiberfrax Durablanket. Dow Corning 3-6548 has a flame spread rate of 15 and the Dow Corning 96-081 has a LOI of 35. The Carborundum Fiberfrax Durablanket and Hotboard are generally accepted as "non-combustible" material.

Justification: Not Applicable

C.16 Fire Test CTP-1002

Fire Test Number: CTP-1002

Fire Test Title/Date: Three Hour Fire Qualification Test of HDLE & Radflex Radiation Seals Flexible Boot Fire Seals, July 25, 1980

Fire Test Summary: This test report documents the results of a fire test conducted on a test slab (8' x 10' x 12" thick) containing two (2) blackout, eight (8) pipe penetrations and four (4) electrical sleeve penetrations with various penetrating items and seal materials. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, these penetration seal configurations of importance are blackout 2 and penetrations 5 and C. A brief description of each of these configurations is as follows:

Blockout 2 was a 26" x 42" rectangular unsleeved opening with no penetrating items. Seal material consisted of a 4" thickness of Dow Corning 3-6548 silicone foam with 2 layers of 1/2" marinite board damming material on the exposed side of the penetration.

Penetration 5 was a 12" diameter sleeved opening penetrated by a 4" diameter steel pipe which was capped on the exposed side of the penetration. Seal material consisted of a 6" thickness of Dow Corning 3-6548 silicone foam with a 1" depth of alumina-silica damming material on the exposed side of the penetration.

Penetration 6 was a 12" diameter sleeved opening penetrated by a 6" diameter steel pipe which was capped on the exposed side of the penetration. Seal material consisted of 12" depth of JM Cerablanket (alumina-silica) with Keene PE 2141 Silicone impregnate fiberglass cloth boots on the exposed and unexposed sides of the slab. The boots were assembled using Dow Corning 732 Silicone RTV Adhesive/Sealant and stainless steel bands.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM
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E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1002 indicates that eight thermocouples were located inside the furnace and were used to monitor the furnace temperature. The test report states that these thermocouples were arranged so as to yield an average furnace temperature. The test report also states that the furnace thermocouples were located 2 1/2 feet inside each wall at 2 feet centers with the first pair of thermocouples 1 1/2 feet from the flue-end of the furnace at the 24 inch elevation. Page 35 of the same test report states that furnace temperatures were taken at 12 inches from the exposed specimen surface.

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1002 contains a time-temperature graph which presents furnace temperature as a plot of the average of six furnace thermocouple readings versus time. The test report also includes a table listing discrete thermocouple readings from which the continuous plot was generated. The table shows that furnace temperatures were taken at one minute intervals during the first 30 minutes of the test, at 5 minute intervals during the next 90

minutes, and at 10 minute intervals during the last 60 minutes of the fire endurance test.

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 1.439% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test CTP-1002).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire tests meets the intent of this review criteria. (See Justification)

Justification: The method of thermocouple attachment is described in the text of Fire Test Report CTP-1002 in that thermocouples on the unexposed side were embedded in the seal material for Blockout 2 and Penetration 5. This is considered an acceptable

alternative to the ASTM E-814 method because the thermocouples will be adequately protected from the atmosphere and will also give more conservative temperature readings due to their closer proximity to the fire. Penetration 6 had three (3) thermocouples on the unexposed surfaces and one on the unexposed surface of the Cerablanket. The test report also states that since the test was conducted outdoors, a building was erected around the furnace to meet ASTM E-119 standards. The report also states that the structure was adequate to prevent excessive air currents over the unexposed surface of the slab. Fire Test CTP-1002 is therefore deemed to satisfy the intent of this checklist item.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test report satisfies the review criteria for the penetrations of interest, which are mechanical penetrations. Test report Figure IV-8 shows that 3 thermocouples were located on the penetration seal surface for Blockout No. 2 (there were no

penetrating items, so E-814 requirement no. 2 is not considered applicable to the blockout). Figure IV-14 shows that thermocouples were located as follows for penetration No. 5: 1) mounted to the penetrating item, 2) mounted at the interface of the penetrant and the seal material, and 3) mounted directly on top of the seal surface. Figure IV-15 shows that thermocouples were located as follows for penetration No. 6: 1) mounted to the penetrating item, 2) mounted at the interface of the penetrant and the seal material, 3) mounted directly on top of the seal surface and 4) mounted interior of the boot atop the Cerablanket. Page 35 of the same test report also states that the total number of unexposed surface thermocouples for the entire test slab is seventy-nine.

Justification: Not applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1002 contains forty-two pages of thermocouple readings for unexposed side seal temperatures. These pages indicate that temperature readings were taken during the entire three hour fire endurance test at 15 second intervals for seal configurations 1.1 through 2.1 and at 5 minute intervals for seal configurations 3.1 through 11.

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included.

(ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Observations of significant details are contained on pages 41 and 42 of Fire Test Report CTP-1002. Some of the observations include no passage of flame through any penetration, some passage of light smoke through the seals, (the smoke was cool to the touch), and the condition of the test specimen after the fire endurance and hose stream tests. In addition, Appendix II of the test report provides numerous photographs of the test specimen taken prior to, during, and after the fire test. Also, Appendix II of Fire Test Report CTP-1002 contains photographs of the test specimen at various points throughout the test

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The

selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The penetrating pipe for penetrations 5 and 6 extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. Blockout no. 2 contained no penetrants. (Reference drawing B-119, sheet 5 and 9, Test Report CTP-1002).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. As stated throughout Fire Test Report CTP-1002, the classification desired for the tested configuration was a three hour fire rating. Pages 1, 39, and 42 of the test report indicate that the test specimen was exposed to the ASTM E-119 time/temperature curve for a three hour period and that the fire did not penetrate the test specimen nor did flaming occur on the unexposed side as a result of heat conduction.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Per Fire Test Report CTP-1002, a hose stream test (IEEE 634 and ANI) was performed on the entire test slab for a duration of 2 minutes. The hose stream test was performed "immediately following the fire endurance test".

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 39 of Fire Test Report CTP-1002 indicates that the test specimen was subjected to a hose stream test in accordance with IEEE 634, section 5.3.12. The hose stream was delivered through a 1 1/2" fire hose set at 15° and located 10 feet from the test specimen with a water pressure of 75 PSI and minimum flow of 75 GPM. According to Fire Test Report CTP-1002 the actual hose stream was applied to an exposed surface area of 80 sq. ft. for a duration of 2 minutes. Based on Table 1 above, this is also the required ASTM E-814 duration:

$$80 \text{ ft}^2 \times 1.5 \text{ sec./ft}^2 = 120 \text{ sec.} = 2 \text{ min.}$$

Justification: The hose stream test administered was per IEEE 634 requirements, which were adhered to throughout the test. This is appropriate, since the majority of penetrants in the tested assembly were cable raceways.

Even though the hose stream test was not performed in accordance with ASTM E-814 requirements, the alternate method selected is considered acceptable. This position is supported by information contained in NRC Information Notice No. 88-04, "Inadequate Qualification and Documentation of Fire Barrier Penetration Seals". Specifically, Appendix A of IN 88-04 provides guidance for conducting hose stream tests and lists three approved methods for performing hose stream tests. IN 88-04 also states that the duration of the hose stream test should meet the requirements ASTM E-119. Therefore, since any one of the three specified methods is acceptable provided the duration requirement is met, it can be concluded that subjecting a test specimen to the IEEE 634-1978 hose stream test satisfies the intent of performing a hose stream test as defined by the staff through guidance provided in 88-04.

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Since an acceptable alternate method of hose stream testing was selected, this section of the checklist is not applicable to test report CTP-1002. Refer to checklist item "m" for a discussion of the alternate hose stream method and basis for acceptability.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air

across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient air temperature at the beginning of Fire Test CTP-1002 was 85°F. This temperature is within the specified range and is thereby acceptable. As for the velocity of air across the unexposed surface of the test specimen and the use of mechanical ventilation, this test was conducted at the SwRI fire test facility. Page 35 of Fire Test Report CTP-1002 states that since the test was conducted outdoors, a building was erected around the furnace to meet ASTM E-119 standards. Page 35 further states that this structure was adequate to prevent excessive air currents over the unexposed surface of the slab. This provides reasonable evidence that Fire Test CTP-1002 was performed in compliance to this checklist item.

Justification: Not Applicable.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since blackout no. 2 and penetration no. 5 and 6 were mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83

requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Blockout no. 2, Penetrations no. 5 and 6 all achieve 3 hour F ratings, as no passage of flame occurred during the test duration. (Reference "Results", pages 41-44 of the test report).

The maximum temperature achieved by the surface thermocouple on penetration no. 5 was 235°F (Reference page IV-103 of the test report) and on penetration no. 6 was 330°F (Reference page IV-103 of the test report), which is less than the limiting temperature of 410°F (85°F + 325°F). Penetrations no. 5 and 6 therefore achieve a T rating of 3 hours.

One surface thermocouple on Blockout no. 2 exceeded 410°F just after 93 minutes into the test (Reference page IV-87 of the test report). Blockout no. 2 therefore achieved a T rating of 93 minutes.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test results of page 42 of the fire test report state that no water projected beyond the unexposed side of the test assembly through any of the penetrations during the hose stream test.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable

shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since blockout no. 2 and penetrations no. 5 and 6 were mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.17 Fire Test No. CTP-1001A

Fire Test Number: CTP-1001A

Fire Test Title/Date: Three Hour Fire Qualification Test 10" and 6" Silicone RTV Foam for Electrical and Mechanical Penetrations Seals, May 20, 1980

Fire Test Summary: This test report documents the results of a fire test conducted on 6 penetration seal configurations installed in a single test slab. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, these penetration seal configurations of importance are Blockout 1, Blockout 2 and Blockout 6. A brief description of each of these configurations is as follows:

Blockout 1 was a 46" x 42" blackout through the 12" thick concrete test slab. Within this blackout were eight (8) penetrating cable trays of various types and cable fills. Penetration 1.1 was an 18" x 4" solid bottom cable tray with 100% visual cable fill. Penetration 1.2 was an 18" x 4" solid bottom cable tray with 50% visual cable fill. Penetration 1.3 was an 18" x 4" solid bottom cable tray with no cable fill. Penetration 1.4 was an 18" x 4" solid bottom cable tray with a single layer of cable fill. Penetration 1.5 was an 18" x 4" ladder back cable tray with 100% visual cable fill. Penetration 1.6 was an 18" x 4" ladder back cable tray with 50% visual cable fill. Penetration 1.7 was an 18" x 4" ladder back cable tray with no cable fill. Penetration 1.8 was an 18" x 4" ladder back cable tray with a single layer of cable fill. The blackout was sealed with a 10" depth of Dow Corning 3-6548 Silicone RTV Foam over 1" of ceraboard damming.

Blockout 2 was a 42" x 26" blackout through the 12" thick concrete test slab. Within the blackout were two (2) penetrating cable trays. Penetration 2.1 was a 36" x 4" ladder back cable tray with 100% visual cable fill. Penetration 2.2 was a 36" x 4" solid bottom cable tray with 100% visual cable fill. The blackout was sealed with a 10" depth of Dow Corning 3-6548 Silicone RTV Foam over 1" of ceraboard damming.

Blockout 6 tested a 54" x 12" opening with two (2) 6" diameter conduits, two (2) 3" diameter conduits and a 4" x 4" wireway as penetrating items. The blockout was sealed with a 6" thickness of Dow Corning 3-6548 Silicone RTV Foam installed over 1" of ceramic fiber damming board. The internal wireway seal and internal conduit seals for all conduits except 6.1 and 6.2 are not required to support WBN configurations and, therefore, are not specifically addressed in this fire test review. Conduit 6.1 was a 6 in. diameter conduit with a 100% visual cable fill, filled with a 6" depth of Dow Corning 3-6548 Silicone RTV Foam and 1 in. of Alumina-silica damming material. Conduit 6.2 was a 6 in diameter conduit with a 0% cable fill and 6" depth of Dow Corning 3-6548 Silicone RTV Foam and 1 in. thick of Alumina-silica damming material.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by six thermocouples located 12" below the test slab (Reference section "Test Facility", page 43 of the test report).

Justification: Not Applicable.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals

may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report listed furnace temperatures every 15 seconds throughout the three (3) hour fire endurance portion of the test. (Reference pages IV-69 through IV-135 of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within -0.467% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix A of this engineering report for fire test CTP-1001A).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: Although not explicitly stated in the test report, fire test CTP-1001A is considered to have satisfied the intent of this review criteria. Refer to the justification provided below for further information associated with this item.

Justification: ASTM E-814-83 requires that thermocouples be placed under 2" x 2" flexible, dry pads. This method of attachment protects thermocouples from the possible cooling effects of unexposed side ambient air temperatures, (e.g., the influence of air velocity across the unexposed side of the seal assembly). The method of thermocouple attachment is not described in the text of Fire Test Report CTP-1001A. However, credit is taken for the qualification of the testing establishment (Southwest Research Institute). This is supported by other tests which have been reviewed (CTP-1139 and CTP-1076) and performed by the same testing establishment and at the same location. The method of thermocouple attachment described in Fire Tests Reports CTP-1139 and CTP-1076 consisted of covering unexposed surface thermocouples with flexible, dry, felted mineral fiber pads, 2" x 2" in size. This method of attachment negates the effects the unexposed side environment may have on thermocouple readings, thus providing similar results and serving as an acceptable alternative to the method described in ASTM E-814-83. Based on this, fire test CTP-1001A is considered to have satisfied the intent of this review criteria.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
 - 1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 - 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal.
-

At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Blockout 1 had eight (8) thermocouples located on the unexposed surface of the penetration seal assembly. Blockout 2 had two (2) thermocouples located on the unexposed seal surface. Blockout 6 had three (3) thermocouples located on the unexposed seal surface. A total of 24 thermocouples was used to monitor unexposed side conditions for Blockout 1, while a total of six (6) thermocouples was used for Blockout 2. (Reference page IV-7 through IV-16 and IV-33 of the fire test report)

Justification: Fire Test Report CTP-1001A, Section III, contains drawings which depict unexposed side thermocouple locations for the specimen tested. Thermocouples were located as follows for all penetrants contained in Blockouts 1 and 2: 1) a thermocouple was mounted to the penetrating item approximately 2" above the seal for each of the cable tray penetrants, 2) a thermocouple was mounted at the interface of the penetrant and the seal material for each of the cable tray penetrants, and 3) a thermocouple was mounted directly on top of the seal's unexposed surface in the vicinity of each cable tray penetrant. Table IV-1 of the test report indicates that the total number of thermocouples used for Blockouts 1 and 2 was 30. For Blockout 6, three (3) thermocouples were mounted on the unexposed surface of the seal. The five items penetrating the blockout contained a total of 11 thermocouples, located at internal seal surface, interface, and penetrating item placements. For the internal conduit seal on conduit 6.1 a thermocouple was located on each the seal-conduit interface, seal surface and on the penetrating cables. For the internal conduit seal on conduit 6.2, one thermocouple was located on the unexposed side field of the seal. Table IV-1 indicates that the total number of thermocouples used for blockout 6 was 14.

Fire Test Report CTP-1001A therefore satisfies the intent of this checklist item.

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Section IV of Fire Test Report CTP-1001A contains individual thermocouple reading charts which document the intervals at which unexposed surface measurements were taken. Examination of these charts reveals that the maximum time interval for any thermocouple throughout the 3 hour test duration was 5 minutes. The requirements of this checklist item are therefore satisfied.

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: Observations of significant details are contained on page 49 of Fire Test Report CTP-1001A. Some of the observations include a fast rise in furnace temperature, light smoke, and the condition of the test specimen after the fire endurance and hose stream tests. The requirements for this checklist item are therefore satisfied.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to

establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 7.2 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' on the exposed side of the slab and 3' on the unexposed side. (Reference page I-16 of the fire test report)

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Post Test Observations" section of the fire test report (page 50) indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate Blockouts 1, 2 or 6 nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- i. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Test Procedure" section of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to the hose stream test.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90°

set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the intent of the review criteria. The test was subjected to a hose stream test per the provisions of the ANI guidelines section 2.B.2 for a 120 second duration. This hose stream test method is an acceptable alternative to the WBN criteria as justified below.

Justification: The hose stream was applied through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The hose stream was applied for a 2 minute duration based on the test slab size of 8' x 10'. The discharge was at a rate of 75 gpm and a distance of 10'. The only difference between this test and the IEEE 634-1978 requirements is that in this hose stream a nozzle angle of 15° was used instead of 30° as required by the review criteria. Using a nozzle set at a narrower angle results in a more severe exposure provided that all other settings, such as discharge rate, hose size, distance from slab and duration remain constant. Since this was the case, the actual hose stream applied was an acceptable alternative, and therefore satisfies the intent of the review criteria.

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The nozzle was at a distance of 10' from the test specimen.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient air temperature at the beginning of Fire Test CTP-1001A was 85°F. This temperature is within the specified range and is thereby acceptable. As for the velocity of air across the unexposed surface of the test specimen and the use of mechanical ventilation, this test was conducted at the SwRI fire test facility. Page 43 of Fire Test Report CTP-1001A states that since the test was conducted outdoors, a building was erected around the furnace to meet ASTM E-119 standards. Page 43 of the same report further states that this structure was adequate to prevent excessive air currents over the unexposed surface of the slab. This provides reasonable evidence that Fire Test CTP-1001A was performed in compliance to this checklist item.

Justification: Not Applicable.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the cable jacketing, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies this review criteria. The "Post Test Observations" section of the fire test report (page 50) indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate Blockouts 1, 2 or 6 nor did flaming occur on the unexposed side as a result of heat conduction. The highest temperature recorded for Blockout 1 was at an interface thermocouple on penetration 1.6 (648°F). The

highest temperature recorded for Blockout 2 was also at an interface thermocouple, penetration 2.2 (580°F). The highest temperature recorded for Blockout 6 was at a surface thermocouple (290°F). The thermocouples for the internal conduit seal in conduit 6.1 had a high temperature of (140°F) on the internal seal unexposed interface with the conduit and the internal conduit seal in conduit 6.2 had a high temperature of (446°F) on the internal seal unexposed surface. These values as well as the temperature of all other thermocouples used for these penetrations were below the 700°F limit.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: This item is not applicable to the penetrations reviewed for this test. Even though the internal conduit seal for conduit 6.2 has no penetrating cable, it is not considered a mechanical penetration seal. The internal seal for conduit 6.2 is considered an electrical seal and was addressed as such in checklist item p. above. Blockouts 1, 2 and 6 are also considered electrical penetrations and have been evaluated using the requirements of IEEE 634-1978.

Justification: Not applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Post Test Observations" section of the test, page 50 of the fire test report, states that no water projected beyond the unexposed side of Blockouts 1, 2 and 6 during the hose stream test.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. As indicated in Dow Corning product literature, Dow Corning 3-6548 RTV Silicone Foam (parts A and B) possesses an ASTM E 84-79A flame spread rating of 15 which is less than the maximum allowable of 25. The ceraboard and alumina-silica damming material is generally accepted as a non-combustible type of damming material.

Justification: Not Applicable

C.18 Fire Test PR0293036

Fire Test Number: PR0293036

Fire Test Title/Date: Three Hour Fire Qualification Test - Comparison Test (ICMS Product 90, D.C. 170 and G.E. 6428 Elastomer), February 28, 1993

Fire Test Summary: This test report documents the results of a fire test conducted on 4 penetration seal configurations installed in a single test slab. A brief description of each of these configurations is as follows:

The penetrations seals in this test were installed in two 25" x 12" blockouts divided into two sections each using a 12" x 12" x 1" thick piece of "M" board. This configuration resulted in four 12" x 12" individual penetrations numbered 1173.1-1, 1173.2-1, 1173.4-1 and 1173.5-1.

Penetration 1173.1-1 was sealed with a 12 inch depth of ICMS Product 90 formulated with General Electric RTV 6428. Within this blockout two 2-1/2" diameter plugs were removed. One opening (1173.2-2) was sealed with a 12" depth of ICMS Product 90 formulated with Dow Corning Sylgard 170. The other opening (1173.3-1) was sealed with a 12" depth of Promatec HDSE. There were no penetrants in this blockout.

Penetration 1173.2-1 was sealed with a 12 inch depth of ICMS Product 90 formulated with Dow Corning Sylgard 170. Within this blockout two 2-1/2" diameter plugs were removed. One opening (1173.1-2) was sealed with a 12" depth of ICMS Product 90 formulated with General Electric RTV 6428. The other opening (1173.3-2) was sealed with a 12" depth of Promatec HDSE. There were no penetrants in this blockout.

Penetration 1173.4-1 was sealed with a 6 inch depth of General Electric RTV 6428. Within this blockout one 2-1/2" diameter plug was removed. This opening (1173.5-2) was sealed with a 6" depth of Dow Corning Sylgard 170. There were no penetrants in this blockout.

Penetration 1173.5-1 was sealed with a 6 inch depth of Dow Corning Sylgard 170. Within this blockout one 2-1/2" diameter plug was removed. This opening (1173.4-2) was sealed with a 6" depth of General Electric RTV 6428. There were no penetrants in this blockout.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by four thermocouples located 12" below the test slab (Reference page 88 of the fire test report).

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of thermocouple readings provided in the test report lists average furnace temperatures every minute throughout the three (3) hour fire endurance portion of the test. (Reference pages 49 through 53 of the fire test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for

fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within -0.598% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test #293036).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. 2" x 2" x 0.4" thick dry, felted pads were placed over thermocouples on the unexposed side of the test assembly (Reference "Temperatures of Unexposed Surfaces", page 4 of the fire test report).

Justification: Not Applicable

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:

1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple

was such that unexposed side surface temperatures for the entire penetration seal were represented.

2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. At least three thermocouples were used to record unexposed side surface temperatures. Each penetration had thermocouples located at least on the surface of each type of seal material; at the interface of the seal material and the penetration opening; and at the interface of the seal material and the "M" board divider.

Justification: Not Applicable.

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 49 of the fire test report is the first page of a table which contains individual thermocouple readings which document the intervals at which unexposed surface measurements were taken. Examination of this table reveals that the maximum time interval for any thermocouple throughout the 3 hour test duration was 1 minutes. The requirements of this checklist item are therefore satisfied.

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: Observations of significant details are contained on page 8 of the fire test report. Some of the observations include a fast rise in furnace temperature, light smoke, and the condition of the test specimen after the fire endurance and hose stream tests. The requirements for this checklist item are therefore satisfied.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration

fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: This checklist item is not applicable since no penetrating items existed in this test assembly.

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Test Results and Observations" section of the fire test report (page 7) indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate any of the seals nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Test Results and Observations" section, page 8 of the fire test report states that following the fire test, the test assembly was removed from the furnace and subjected to the hose stream test.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to a hose stream test delivered through a 2-1/2" hose and discharged through a 1-1/8" discharge tip for a duration of 74 seconds at a pressure of 30 psi and at a distance of 20' (Reference page 5 and 7 of the fire test report).

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft.

from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. As stated on page 7 of the test report, the nozzle was at a distance of 20' from the test specimen.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient air temperature at the beginning of the fire test was 64°F (Reference page 7 of the fire test report). This temperature is within the specified range and is thereby acceptable.

As for the velocity of air across the unexposed surface of the test specimen and the use of mechanical ventilation, this test was conducted at the Omega Point Laboratories fire test facility which uses furnaces that are indoors. Wind velocities over the unexposed surface of the test assembly are insignificant (Reference 0006-00922-ROC-002, Ref. 7.30).

Justification: Not Applicable.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: This checklist item is not applicable since there were no electrical penetrants in the test assembly. IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 10 of the fire test report, "Conclusions" states that the penetrations tested met the fire resistance requirements for F and T ratings of 3 hours per ASTM E-814.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Test Results and Observations" section, page 8 of the fire test report, states that no water projected beyond the unexposed side of any of the seals during the hose stream test.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by

ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: This checklist item is not applicable since there were no electrical penetrants in this test assembly. The requirements of IEEE 634 do not apply.

Justification: Not Applicable

C.19 Fire Test ICC0382004

Fire Test Number: ICC0382004

Fire Test Title/Date: Fire and Hose Stream Tests for Penetration Seal Systems, dated April 1982

Fire Test Summary: This test report documents the results of a fire test conducted on 16 penetration seal configurations installed in a single test slab. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, these penetration seal configurations of importance are penetrations 4 (excluding the internal conduit seal), 8 and 14. A brief description of each of these configurations is as follows:

Penetration 4 was a 36"x36" steel lined blackout. The blackout was penetrated by one (1) 24"x6" galvanized steel ladder back cable tray with 100% visual loading of PVC jacketed power, instrumentation and control cables, one (1) 24"x6" galvanized steel solid back cable tray with 100% visual loading of PVC jacketed power, instrumentation and control cables and one (1) 6" diameter conduit. Seal material for the penetration configuration consisted of a 12" thickness of ICMS Product 90 (High Density Silicone Elastomer).

Penetration 8 was a 12" diameter steel sleeve. The sleeve was penetrated by a 2" diameter steel pipe. Seal material for the penetration configuration consisted of a 12" thickness of ICMS Product 90 (High Density Silicone Elastomer).

Penetration 14 was a 12" diameter steel sleeve. The sleeve was penetrated by a 2" diameter steel pipe with 1" thickness of calcium silicate insulation. Seal material for the penetration configuration consisted of 7" thickness of Dow Corning 3-6548 RTV Silicone Foam and 1" thickness of Carborundum Duraboard LD as permanent damming.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE
-

634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire exposure followed the standard time/temperature relationship given in ASTM E-119. Furnace temperature was measured by 15 thermocouples located in the furnace and monitored throughout the 3 hour fire test (Reference section "Fire Test", page 33 of the test report).

Justification: ASTM E-119, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. The exposed length and placement of furnace thermocouples is not described in the text of Fire Test Report ICC0382004. However, credit is taken for the qualification of the testing establishment (Construction Technologies Laboratories). Therefore, based on the above discussion, there is reasonable assurance that the placement of furnace thermocouples satisfy the requirements described in ASTM E-814-83 and IEEE 634-1978.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report lists the average furnace temperature every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Appendix B of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.225% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0382004). The fire test report documents the temperature difference between the area under the furnace time-temperature curve and the area under the standard time-temperature curve at each reading interval (Reference Appendix B of the fire test report).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire exposure followed the standard time/temperature relationship given in ASTM E-119 (Reference "Fire Test", page 33 of the fire test report).

Justification: ASTM E-119 requires that the thermocouples be placed under flexible, dry, felted asbestos pads. This method of attachment protects thermocouples from possible cooling effects of unexposed side ambient air temperatures, (e.g., the influence of air velocity across the unexposed side of the seal assembly). The method of thermocouple attachment is not described in the text of Fire Test Report ICC0382004. However, credit is taken for the qualification of the testing establishment (Construction Technologies Laboratories). Therefore, based on the above discussion, the method of thermocouple attachment provides an acceptable alternative to the method described in ASTM E-814-83 and IEEE 634-1978.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 4 was thermocoupled as delineated under IEEE-634 above, thereby satisfying the review criteria. Penetrations 8 and 14 each had three thermocouples located on the unexposed side of the penetration seal assemblies. One at the interface of the pipe and seal material, one on the unexposed surface of the seal material and one at the penetration sleeve and seal material interface (Reference Appendix B, "Thermocouple Plan", page 32 of the fire test report).

Justification: Per this checklist item, ASTM E814-83 requires that at least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented. On through penetrating items thermocouples are required approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly. However, based on the size and configuration of the two seal assemblies, the single thermocouple on the unexposed seal surface provides a representative reading of the entire seal surface and satisfies the single thermocouple allowance criteria of this checklist item. The requirement to have one thermocouple placed approximately 1 to 3 inches above the unexposed side surface of the penetration seal is not satisfied. Although a thermocouple is not placed specifically on the pipe penetrant 1 to 3 inches from the seal surface, the thermocouple placement is considered to meet the intent of the review criteria. This is based on the fact that only the temperature readings from the thermocouples located on the surface of the seal material are considered when determining acceptance of a penetration seal assembly based on limiting endpoint temperature (Refer to checklist item "q").

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)
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Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Appendix B of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix B of the test report includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test (Reference Appendix B "Test Comments").

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Test Assembly", page 3 of the fire test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that the specimen was exposed to a 3 hour fire test and that the fire did not penetrate penetrations 4,8 or 14 nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the reviewed penetrations are considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to two hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The test specimen was subjected to two hose streams in all, each applied for a 2:52 (min:sec) duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The first hose stream test satisfies the review criteria as it applies to penetration 4. The hose streams applied did not directly satisfy the ASTM E-814-83 hose stream required for mechanical penetrations 8 and 14.

Justification: Neither of the two individual hose stream tests performed satisfy ASTM E-814-83 for Penetrations 8 and 14. However, NRC Information Notice 88-04, "Inadequate Qualification and Documentation of Fire Barrier Penetration Seals", provides additional guidance in the performance of hose stream tests. Specifically, IN 88-04 Appendix A contains guidance for conducting hose stream tests and lists three acceptable methods for applying those hose streams. Since the two hose streams applied are in accordance with said notice, it can be concluded that subjecting the test specimen to the cooling, impact and erosion effects of two consecutive full time duration hose streams adequately meets the intent of the review criteria.

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The hose streams applied satisfy the review criteria, IEEE-634, as it relates to Penetration 4. Since the hose stream described above for ASTM E-814-83 was not applied, this test will not be reviewed

against this checklist item. Acceptability of the applied hose streams tests against mechanical penetration seals (i.e. Penetrations 8 and 14) is justified in checklist item "m".

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature on the unexposed surface of the specimen for this test is assumed to be 63°F.

Justification: This value is based on the "Unexposed Temperature Readings" table located in Appendix B of the fire test report, which lists the lowest temperature at time 0:00 as 63°F. Use of the lowest recorded ambient temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen, Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is located indoors at a conditioned laboratory. Unexposed side air velocity within the test environment was not significant, and although actual conditions were not recorded in the test report, unexposed side laboratory conditions were not expected to have adversely affected the test results. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The fire test indicates that there was no passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of Penetration 4. The table of thermocouple temperature readings in the fire test report, for the reviewed penetration, documents that two thermocouple temperatures exceeded the limiting criteria (700°F) at reading 3:00 (hr:min), from a previously acceptable (147°F) reading at 2:40 (hr:min).

Justification: Fire test report ICC0382004 does not discuss the exceeded endpoint temperature in the test sections entitled Synopsis, Observations or Fire Test. However, it is noted in the test Observations section that penetration 5 experienced structural failure) at 2:40 (hr/min. The next reading at 2:50 (hr/min) for Penetration 4 thermocouples T/C 15 and 19 indicates spiked readings. The seal surface thermocouple for Penetration 5, T/C 23, indicated nearly identical temperature reading spikes. Therefore, it can be reasonably concluded that Penetration 4 in fact did not fail. Rather, the exceeded temperatures recorded at thermocouples T/C 15 and 19 were most likely caused by failure of the adjacent penetration seal system (Penetration 5).

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 8 and 14 successfully passed the fire endurance portion of the test without passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours (Reference "Synopsis" on page 2 of the fire test report). Penetrations 8 and 14 each therefore achieve an F rating of 3 hours.

The maximum temperature achieved by the surface thermocouple on penetration 8 was 150°F. The maximum temperature achieved

by the surface thermocouple on penetration 14 was 194°F. The limiting endpoint temperature of 388°F (325°F plus ambient) was not exceeded (Reference checklist item "o" for a discussion of ambient temperature). Penetrations 8 and 14 each therefore achieve a T rating of 3 hours (Reference Appendix B of the fire test report).

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Synopsis of the fire test report states that no water projected beyond the unexposed side of reviewed seal assemblies during the two hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent the review criteria. Penetration 4 seal system utilizes ICMS Product 90, which uses a proprietary blend of silicone elastomer and gamma attenuating material.

Justification: Based on the use/application, Product 90 is a High Density Silicone Elastomer consisting of non-foaming silicone elastomer (e.g. Dow Corning 170 or General Electric RTV 6428 - Reference Fire Test PR0293036) which has an LOI of 43 and pulverized metallic material, which is added to provide equivalent density to that of concrete. Therefore, there is reasonable assurance that ICMS Product 90 satisfies the review criteria.

C.20 Fire Test ICC0386022-1 (GPC-PSS1)

Fire Test Number: ICC0386022 (GPC-PSS1)

Fire Test Title/Date: Fire and Hose Stream Test for Penetration Seal Systems (GPC-PSS1), dated December 1986

Fire Test Summary: This test report documents the results of a fire test conducted on 1 penetration seal configuration installed in a single test slab. A brief description of the configuration is as follows:

Penetration 1 is a 12" sleeved opening penetrated by a 2" steel pipe. The penetration seal system consisted of two boots, both attached to the steel pipe on the exposed surface of the slab. The boots consisted of an inner layer of Carborundum 36-400U fibersil cloth and an outer layer of Keene Chase Grade 5643F031 Silicone Impregnated Fiberglass Fabric Sheeting. A 2-in layer of Carborundum Fiberfrax damming material was used between the boots.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by three thermocouples located 12" below the test slab (Reference section "Fire Test", page 6 of the test report for penetration seal system GPC-PSS2).

Justification: The furnace used to perform this fire test was the slab furnace at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this furnace provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 729), the slab furnace at CTL is described as a down draft type furnace with interior dimensions of approximately 36" x 36". Temperatures within the furnace are generally monitored by three (3) thermocouples located 12" from the test slab. The furnace is heated by three (3) burners, and due to small area of the test furnace, conditions across the exposure area of the test furnace are expected to have been consistent. Internal tests performed by CTL substantiate that there was a uniform heat flux across the exposed test slab within the furnace. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report listed furnace temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Penetration Seal System (GPC-PSS1), table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-

temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.027% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0386022-1). The fire test report indicates that the percent difference between the area under the furnace time-temperature curve the area under the standard time-temperature curve was 0.028% (Reference Penetration Seal System(GPC-PSS1), table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: See Justification

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple pads provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), it was general practice for CTL to use thermocouple pads to cover thermocouples placed on the unexposed side of test specimens. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:

1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 1 has five thermocouples located on the unexposed surface of the penetration seal assembly. One at the interface of the pipe and seal material, three on the unexposed surface of the seal material and one at the penetration interface (Reference Penetration Seal System (GPC-PSS1), table "Thermocouple Reference Chart").

Justification: Penetration 1 satisfies the ASTM E814 requirement to have three thermocouples record unexposed side surface temperatures (Reference Penetration Seal System GPC-PSS2). However, the requirement to have one thermocouple placed approximately 1 to 3 inches above the unexposed side surface of the penetration seal is not satisfied. Although a thermocouple is not placed specifically on the pipe penetrant 1 to 3 inches from the seal surface, the thermocouple placement is considered to meet the intent of the review criteria. This is based on the fact that only the temperature readings from the thermocouples located on the surface of the seal material are considered when determining

acceptance of a penetration seal assembly based on limiting endpoint temperature (Refer to checklist item "q").

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Penetration Seal System GPC-PSS1, table "Unexposed Temperature Readings").

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration Seal System (GPC-PSS1) includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that it may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Synopsis", page 1 of the fire test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate penetration 1 nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure. (Reference Penetration Seal System GPC-PSS1 page 1 of the fire test report)

Justification: Not Applicable

- I. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used.

The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to three hose streams in all, each applied for a 24 second duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third test used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen. The third hose stream satisfies the review criteria.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The third hose stream test applied to the test specimen used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The nozzle was at a distance of 20' from the test specimen and the test was for a duration of 24 seconds.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature rise on the unexposed surface of the specimen for this test is assumed to be 79°F.

Justification: This value is based on the "Unexposed Temperature Readings" table located in the Penetration Seal System GPC-PSS1 of the fire test report, which lists the temperature at time 0:00 as 79°F for several thermocouples. Use of the lowest recorded ambient temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen, this test was performed at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this facility provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is located indoors at a conditioned laboratory. Unexposed side air velocity within the test environment was not significant, and although actual conditions were not recorded in the test report, unexposed side laboratory conditions were not expected to have adversely affected the test results. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetration 1 is a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration 1 successfully passed the fire endurance portion of the test without passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours (Reference Penetration Seal System GPC-PSS1 of the fire test report). Penetration 1 achieved an F rating of 3 hours.

The maximum temperature achieved by the surface thermocouples on penetration 1 was 239°F (Reference tables "Thermocouple Reference Chart" and "Unexposed Temp. Readings" in the Penetration Seal System GPC-PSS1 fire test report). The limiting endpoint temperature (325°F above its initial temperature) for penetration 1 (239°F) was not exceeded. (Reference checklist item "o" for a discussion of ambient temperature). Penetration 1 achieved a T rating of 3 hours.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis on page 2 of the fire test report (Penetration Seal System GPC-PSS1) states that no water projected beyond the unexposed side of the test assembly at penetration 1 during the three hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetrations 1 and 6 were mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.21 Fire Test ICC0386022-2 (GPC-PSS2)

Fire Test Number: ICC0386022-2 (GPC-PSS2)

Fire Test Title/Date: Fire and Hose Stream Tests for Penetration Seal Systems (GPC-PSS2), dated June 1986

Fire Test Summary: This test report documents the results of a fire test conducted on 1 penetration seal configuration installed in a single test slab. A brief description of the configuration is as follows:

Penetration 1 is a 12" sleeved opening penetrated by a 2" steel pipe. The penetration seal system consisted of two boots, both attached to the steel pipe on the exposed surface of the slab. The boots consisted of an inner layer of Carborundum 36-400U fibersil cloth and an outer layer of Keene Chase Grade 56493F031 Silicone Impregnated Fiberglass Fabric Sheeting. A 2-in. layer of Carborundum Fiberfrax damming material was used between the boots.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by three thermocouples located 12" below the test slab (Reference section "Fire Test", page 6 of the test report).

Justification: The furnace used to perform this fire test was the slab furnace at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this furnace

provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is described as a down draft type furnace with interior dimensions of approximately 36" x 36". Temperatures within the furnace are generally monitored by three (3) thermocouples located 12" from the test slab. The furnace is heated by three (3) burners, and due to small area of the test furnace, conditions across the exposure area of the test furnace are expected to have been consistent. Internal tests performed by CTL substantiate that there was a uniform heat flux across the exposed test slab within the furnace. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report listed furnace temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Appendix A of the test report, table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.007% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0386022-2). The fire test report indicates that the percent difference between the area under the furnace time-temperature curve the area under the standard time-temperature curve was 0.006% (Reference Appendix A of the fire test report, table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: See Justification

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple pads provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), it was general practice for CTL to use thermocouple pads to cover thermocouples placed on the unexposed side of test specimens. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where

physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.

2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 1 has five thermocouples located on the unexposed surface of the penetration seal assembly. One at the interface of the pipe and seal material, three on the unexposed surface of the seal material and one at the penetration interface (Reference Appendix A of the fire test report, table "Thermocouple Reference Chart").

Justification: Penetration 1 satisfies the ASTM E814 requirement to have three thermocouples record unexposed side surface temperatures. However, the requirement to have one thermocouple placed approximately 1 to 3 inches above the unexposed side surface of the penetration seal is not satisfied. Although a thermocouple is not placed specifically on the pipe penetrant 1 to 3 inches from the seal surface, the thermocouple placement is considered to meet the intent of the review criteria. This is based on the fact that only the temperature readings from the thermocouples located on the surface of the seal material are considered when determining acceptance of a penetration seal assembly based on limiting endpoint temperature (Refer to checklist item "q").

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Appendix A of the test report, table "Unexposed Temperature Readings").

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix A of the test report includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that it may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Synopsis", page 1 of the fire test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate penetration 1 nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure. (Reference "Synopsis", page 1 of the fire test report).

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to three hose streams in all, each applied for a 24 second duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third test used a standard playpipe with a 1-1/8" diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen. The third hose stream satisfies the review criteria.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The third hose stream test applied to the test specimen used a standard playpipe with a 1-1/8" diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The nozzle was at a distance of 20' from the test specimen and the test was for a duration of 24 seconds.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature rise on the unexposed surface of the specimen for this test is assumed to be 72°F.

Justification: This value is based on the "Unexposed Temperature Readings" table located in Appendix B of the fire test report, which lists the temperature at time 0:00 as 72°F for several thermocouples. Use of the lowest recorded ambient temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen, this test was performed at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this facility provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is located indoors at a conditioned laboratory. Unexposed side air velocity within the test environment was not significant, and although actual conditions were not recorded in the test report, unexposed side laboratory conditions were not expected to have adversely affected the test results. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetration 1 is a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of

flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration 1 successfully passed the fire endurance portion of the test without passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours (Reference "Synopsis" on page 1 of the fire test report). Penetration 1 achieved an F rating of 3 hours.

The maximum temperature achieved by the surface thermocouples on penetration 1 was 398°F, recorded at 3 hours into the test (Reference tables "Thermocouple Reference Chart" and "Unexposed Temp. Readings" in Appendix A of the fire test report). The limiting endpoint temperature (325°F above its initial temperature) for penetration 1 (398°F) was therefore not exceeded. Penetration 1 achieved a T rating of 3 hours.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis on page 1 of the fire test report states that no water projected beyond the unexposed side of the test assembly at penetration 1 during the three hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetrations 1 and 6 were mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.22 Fire Test 93-H-72449

Fire Test Number: 93-H-72449

Fire Test Title/Date: 3 Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained within Two Different Slabs, dated November 22, 1993.

Fire Test Summary: This test report documents the results of a fire test conducted on 12 penetration seal configurations installed in two test slabs. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, these penetration seal configurations of importance are penetrations 2,3,4,7,8,9,11 and 12. A brief description of each of these configurations is as follows:

Penetration 2 was a 6" diameter steel sleeve in slab #1. The sleeve was penetrated by 100% visual loading of cable (refer to page 9 of the test report for installed cable). Seal material consisted of a 6" thickness of Dow Corning Sylgard 170.

Penetration 3 was a 6" diameter steel sleeve in slab #1. The sleeve was penetrated by 100% visual loading of cable (refer to page 10 of the test report for installed cable). Seal material consisted of a 4" thickness of Dow Corning Sylgard 170 and a 1" thickness of ceramic fiber damming material.

Penetration 4 was a 6" diameter steel sleeve in slab #1. The sleeve was penetrated by 100% visual loading of cable (refer to page 11 of the test report for installed cable). Seal material consisted of a 6" thickness of Dow Corning 3-6548 and a 1" thickness of ceramic fiber damming material.

Penetration 7 was a 14" diameter steel sleeve in slab #1. The sleeve was penetrated by an 8" diameter steel pipe. The pipe was mounted concentric to the sleeve. Seal material consisted of a 6" thickness of Dow Corning Sylgard 170 and a 1" thickness of ceramic fiber board damming material.

Penetration 8 was a 26" diameter steel sleeve in slab #1. The sleeve was penetrated by an 18" diameter steel pipe. The pipe was mounted concentric to the sleeve. Seal material consisted of a 12" thickness of PROMATEC HDSE.

Penetration 9 was a 30" diameter steel sleeve in slab #2. The sleeve was penetrated by an 20" diameter steel pipe. The pipe was mounted concentric to the sleeve. Seal material consisted of a 12" thickness of Ceramic Fiber installed within the plane of the slab with Flexible Boots attached between the pipe and sleeve extension on both sides of the slab.

Penetration 11 was a 20" diameter steel sleeve in slab #2. The sleeve was penetrated by an 16" diameter steel pipe. The pipe was mounted concentric to the sleeve. Seal material consisted of a 12" thickness of Dow Corning 3-6548.

Penetration 12 was a 20" diameter steel sleeve in slab #2. The sleeve was penetrated by an 16" diameter steel pipe. The pipe was mounted concentric to the sleeve. Seal material consisted of a 12" thickness of Dow Corning Sylgard 170.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by ten thermocouples located 12"

below the test slabs (Reference section "Test Procedure", page 2 and Appendix C1 and C2 "Test Data" of the test report).

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report list furnace temperatures every 1 minute throughout the 3 hours of the tests (Reference Appendix C1 and C2 "Test Data" of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within -0.608% of the standard time-temperature curve for slab #1 and within -0.471% of the standard time-temperature curve for slab #2 (Reference the calculations and graphs provided in Appendix D of this engineering report for fire test 93-H-72449). The fire test report indicates that the percent difference between the area under the furnace time-temperature curve the area under the standard time-temperature curve was controlled within 5% for the 3 hour test

periods (Reference section "Test Procedure", page 3 of the test report).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Thermocouples were covered by 2"x2"x0.4" felted mineral fiber pads, (Refer to section "Test Procedure", page 3 of the test report).

Justification: Not Applicable

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, .2) the interface

between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetrations 2,3 and 4 each had thermocouples located on the unexposed surface of the penetration seal assembly, four to five thermocouples on penetrating cable 1" above the seal surface, and two thermocouples on the seal surface. There were no through metallic components.

Penetrations 7,8,9,11 and 12 each had thermocouples located on the unexposed surface of the penetration seal assembly, two thermocouples on the seal surface and one on the penetrating pipe 1" above the seal surface. These thermocouple placements satisfy the review criteria for ASTM E-814-83.

Justification: The use of thermocouple pads, combined with the limited space in the area of the seal / cable interface, precluded the placement of thermocouples precisely at the interface location. The presence of three thermocouples located on cable jacketing approx. 1" above the seal surface is considered to provide an adequate representation of temperatures on the unexposed side in the vicinity of the interface area. Penetrations 2,3 and 4 therefore meet the intent of the review criteria.

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 1 minute throughout the 3 hours of the tests (Reference Appendix C1 and C2 "Test Data" of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Observations of the test assembly were documented during and after the fire test and after the hose stream test (Reference section "Test Results-Slab #1", page 15 and "Test Results-Slab #2", page 20 of the test report).

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard for both slabs was acceptable, therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For

cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side (Reference section "Penetrating Items", page 4 of the fire test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Test Results", page 15 for slab #1 and page 20 for slab #2 of the fire test report indicate that the tested configurations being reviewed were exposed to a 3 hour fire test and that the fire did not penetrate penetrations 2,3,4,7,8,9,11 and 12 nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimens are considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Test Results", page 15 for slab #1 and page 20 for slab #2 of the fire test report indicate that the tested configurations were exposed to a hose stream test immediately after the flame exposure.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern

without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The hose stream test applied to both slab #1 and slab #2 was applied in accordance with ASTM E-814-83. The hose stream test applied to Penetrations 7,8,9,11 and 12 satisfy the review criteria for these penetrations.

Justification: The hose stream test performed on slab #1 did not satisfy the IEEE-634 review criteria for Penetrations 2,3 and 4. However, NRC Information Notice 88-04, "Inadequate Qualification and Documentation of Fire Barrier Penetration Seals", provides additional guidance in the performance of hose stream tests. Specifically, IN 88-04 Appendix A contains guidance for conducting

hose stream tests and lists three acceptable methods for applying those hose streams. Since the hose stream applied in fire test 93-H-72449 is in accordance with said notice. It can be concluded that subjecting the reviewed electrical seal assemblies of slab #1 to the cooling, impact and erosion effects of a hose stream delivered by the following method; a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice, discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, with the hose stream delivered at an estimated angle of 30° away from normal, with the nozzle tip positioned 17 feet from the center of the exposed face of the test slab, meets the intent of the review criteria.

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The hose stream test applied to the test specimens of slab #1 and 2 used a nozzle angle of 30° to the slabs at distance of 17' from the test slabs (Reference "Test Results-Slab #1", page 15 and "Test Results-Slab #2", page 21 of the test report).

Justification: Per IEEE 634-1978, for electrical fire stops, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. Although the hose stream test applied to Penetrations 2,3 and 4 does not satisfy the review criteria of this checklist item, acceptability of the hose stream test used is provided in checklist item "m".

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air
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across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient temperature at the time slab #1 was tested was 72°F and the ambient temperature at the time slab #2 was tested was 68°F (Reference "Test Results-Slab #1", page 15 and "Test Results-Slab #2", page 20 of the test report).

As for the velocity of air across the unexposed surface of the test specimen and the use of mechanical ventilation, this test was conducted at the Omega Point Laboratories fire test facility which uses furnaces that are indoors. Wind velocities over the unexposed surface of the test assembly are insignificant (Reference 7.30).

Justification: Not Applicable

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report for Penetrations 2,3 and 4 documents applicable thermocouple temperatures as below the limiting criteria (Reference Appendix C1 "Test Data" of the test report).

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming

on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 2,3 and 4, electrical penetration seal assemblies, are not reviewed against this checklist item.

When Penetration 7 is reviewed against the review criteria, the following ratings are established. 1) Penetration 7 satisfies the review criteria for an F rating of 180 minutes. 2) Penetration 7 satisfies the review criteria to the extent that the seal assembly receives a T rating of 163 minutes.

When Penetration 8 is reviewed against the review criteria, the following ratings are established. 1) Penetration 8 satisfies the review criteria for an F rating of 180 minutes. 2) Penetration 8 satisfies the review criteria for a T rating of 180 minutes

When Penetration 9 is reviewed against the review criteria, the following ratings are established. 1) Penetration 9 satisfies the review criteria for an F rating of 180 minutes. 2) Penetration 9 satisfies the review criteria to the extent that the seal assembly receives a T rating of 106 minutes.

When Penetration 11 is reviewed against the review criteria, the following ratings are established. 1) Penetration 11 satisfies the review criteria for an F rating of 180 minutes. 2) Penetration 11 satisfies the review criteria to the extent that the seal assembly receives a T rating of 90 minutes.

When Penetration 12 is reviewed against the review criteria, the following ratings are established. 1) Penetration 12 satisfies the review criteria for an F rating of 180 minutes. 2) Penetration 12 satisfies the review criteria for a T rating of 180 minutes.

Justification: For the purposes of this checklist item. The determination of F rating is based on the findings of checklist item

"k". The determination of T rating is based on the time duration, at which, a reviewed thermocouple (unexposed seal surface) temperature reading is determined to have exceeded the limiting temperature as defined by this checklist item.

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The "Test Result-Slab #1" section states that Penetrations 2,3,4,7 and 8 withstood the hose stream test successfully. The "Test Result-Slab #2" section states that Penetration 11 allowed water to pass through the seal during the hose stream test and Penetrations 9 and 12 withstood the hose stream test successfully (Reference "Test Result-Slab #1", page 17 and "Test Result-Slab #2", page 22).

Justification: Although Penetration 11 has been identified as failing the review criteria of this checklist item, review of the "Post-Test Observations During Disassembly of Seals" revealed the following:
1) The seal was raised approximately $\frac{3}{4}$ " above the top of the slab.
2) The majority of the material was consumed and a layer of material was still in contact with the sleeve for a distance of approximately $7\frac{1}{2}$ " from the top of the slab. Therefore, based on the fire test observations, it can be concluded that although there was a passage of water to the unexposed side of the seal assembly, the seal assembly remained in place within the penetration. As allowed by ASTM E-814-83, if a duplicate specimen was to be subjected to a one (1) hour fire endurance test, and then the hose stream test applied, it is certain that the assembly would pass the hose stream test. In this scenario, the configuration tested in Penetration 11 would be rated for three (3) hours with respect to an F rating only. It is on this basis that the configuration tested in Penetration 11 is used to support WBN typical details for three (3) hour F rated configurations only.

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by
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ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration 4 seal system utilized Dow Corning 3-6548 RTV silicone foam and Thermal Ceramics Kaowool ceramic fiber damming material. Penetrations 2 and 3 seal systems utilized Dow Corning Sylgard 170 RTV silicone elastomer. Penetration 3 also has Thermal Ceramics Kaowool ceramic fiber damming material. Dow Corning 3-6548 has a flame spread rate of 15. Dow Corning Sylgard 170 has an LOI of 43. The Thermal Ceramics Kaowool ceramic fiber damming material is generally accepted as "non-combustible" material. Since Penetrations 7,8,9,11 and 12 were reviewed as mechanical seal systems, IEEE-634 requirements do not apply.

Justification: Not Applicable

C.23 Fire Test CTP-1076

Fire Test Number: CTP-1076

Fire Test Title/Date: Three Hour Fire Qualification Test of Nine Inch Silicone Foam Without Damming, March 28, 1985

Fire Test Summary: This test report documents the results of a fire test conducted on a test slab (14' x 8' x 12" thick) containing two (2) blockouts and eight (7) pipe penetrations with various penetrating items and seal materials. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, the penetration seal configuration of importance is penetration C.1.17. A brief description of each of this configuration is as follows:

Penetration C.1.17 was a 12" sleeved opening penetrated by a 2" steel pipe which was capped on the exposed side of the penetration. The pipe was offset in the sleeve, allowing 0" clearance at one point. Seal material consisted of a 9" thickness of Dow Corning 3-6548 silicone foam without any permanent damming material.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by twelve thermocouples located 12" below the test slab (Reference Appendix B20 of Test Report CTP-1076).

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1076 contains a time-temperature graph which presents furnace temperature as a plot of the average of twelve furnace thermocouple readings versus time. The test report also includes a table listing discrete thermocouple readings from which the continuous plot was generated. The table shows that furnace temperatures were recorded at 20 second intervals throughout the duration of the fire endurance test (Reference Appendix B20 of the fire test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.107% of the standard time-temperature curve (Reference

the calculation and graph provided in Appendix D of this engineering report for fire test CTP-1076).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire tests satisfies the review criteria. The method of thermocouple attachment described in Fire Test Report #CTP-1076 consisted of placing the tip of each thermocouple under a 2" x 2" flexible, dry, felted mineral fiber pad.

Justification: Not Applicable

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface

between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test report satisfies the review criteria for the penetrations of interest, which are mechanical penetrations. Test report Figure B-390 (Appendix A) shows that 3 thermocouples were located on the penetration seal surface for Penetration No. C.1.17. Figure IV-14 shows that thermocouples were located as follows for penetration No. C.1.17: 1) mounted to the penetrating item, 2) mounted at the interface of the penetrant and the seal material, and 3) mounted directly on top of the seal surface.

Justification: Not applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1076 Appendix B20 indicate that temperature readings were taken during the entire three hour fire endurance test at 20 second intervals.

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix C of the test report entitled "Visual Observations" in which observations of the test assembly were documented during and after the fire test and after the hose stream test.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that

are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The penetrating pipe for penetration no. C.1.17 extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference Appendix A drawing B-390, Test Report CTP-1076).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. As stated throughout Fire Test Report CTP-1076, the classification desired for the tested configuration was a three hour fire rating. The test specimen was exposed to the ASTM E-119 time/temperature curve for a three hour period and that the fire did not penetrate the test specimen nor did flaming occur on the unexposed side as a result of heat conduction.

Justification: Not Applicable

- I. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Per Fire Test Report CTP-1076, immediately after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to three hose streams in all, each applied for a 168 second duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third test used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen. The third hose stream satisfies the review criteria.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The third hose stream test applied to the test specimen used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The nozzle was at a distance of 20' from the test specimen and the test was for a duration of 168 seconds.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient air temperature at the beginning of Fire Test CTP-1076 was 72°F. This temperature is within the specified range and is thereby acceptable. As for the velocity of air across the unexposed surface of the test specimen and the use of mechanical ventilation, this test was conducted at the SwRI fire test facility. Test Report CTP-1076 states that since the test was conducted outdoors, a building was erected around the furnace to meet ASTM E-119 standards. This structure was adequate to prevent excessive air currents over the unexposed surface of the slab. This provides reasonable evidence that Fire Test CTP-1076 was performed in compliance to this checklist item.

Justification: Not Applicable.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetration C.1.17 is a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration C.1.17 achieved 3 hour F rating, as no passage of flame occurred during the test duration. (Reference "Conclusion", of the test report).

The maximum temperature achieved by the surface thermocouple on penetration no. C.1.17 was 366°F (Reference Appendix B8 page 21 of the test report), which is less than the limiting temperature of 397°F (72°F + 325°F). Penetration no. C.1.17 therefore achieves a T rating of 3 hours.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test results of Appendix A of the fire test report states that no water projected beyond the unexposed side of the test assembly through the penetration during the hose stream test.

Justification: Not Applicable

- s. Per IEEE 634-1978, individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetration no. C.1.17 is a mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.24 Fire Test TS-TP-0006

Fire Test Number: TS-TP-0006

Fire Test Title/Date: Fire and Hose-Stream tests of Penetration Seal Systems. dated April 1978

Fire Test Summary: This test report documents the results of 11 fire tests conducted on 31 penetration seal configurations. Only penetrations 5 and 27 were used to support WBN typical penetration seal details so this review is limited to those two penetrations. A brief description of each of these configurations is as follows:

Penetration 5 was 4" steel sleeve with couplings and sealed only with steel conduit plugs at both ends. The penetration was tested in Test 4 in Slab B which was a 46" X 46" X 24" thick concrete slab.

Penetration 27 was 4" steel sleeve with couplings and sealed only with steel conduit plugs at both ends. The penetration was tested in Test 7 in Slab D which was a 48" X 48" X 12" thick concrete slab.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the intent of the review criteria. This fire test utilized two shielded chromel alumel thermocouples

located inside the furnace 12 inches down from the top of the furnace to monitor the furnace temperature.

Justification: This does not meet the minimum 3 requirement of ASTM E-814-83 but is acceptable because the small slab furnace was used with only a 32" X 32" opening at the top, heated by 4 gas burners which resulted in a uniform blanket of flame and in close adherence to the time-temperature curve as indicated in Review Item c.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the intent of the review criteria. Table 12 of the test report indicates that temperature readings were taken at 10 minute intervals throughout the 3 hour fire endurance test and not every 5 minutes during the first two hours.

Justification: Although temperature readings were not recorded every 5 minutes during the first two hours of the test, the temperatures recorded during this period were distributed such as to provide sufficient assurance that no temperature peaks or dips were present during the fire test. Therefore, the assertion that the temperatures were recorded at intervals to show an acceptable representation of a standard fire test is supported by the fire test report. The assertion that the temperatures were recorded at acceptable intervals is supported by other fire test reports performed by the same testing laboratory.

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within -0.416 % of the standard time-temperature curve. Reference the calculation and graph provided in Appendix D of this engineering report).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: See Justification

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple pads provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), it was general practice for CTL to use thermocouple pads to cover thermocouples placed on the unexposed side of test specimens. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:

1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a

single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.

2. On-through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetrations 5 and 27 each had 2 thermocouples measuring surface temperature, one embedded in the wall sleeve and the other on the cap of the penetrant (Reference Table 4 of the test report).

Justification: The tested configurations are empty 4" pipe sleeves with couplings embedded in the slab (no penetrating seal material was used) with plugs in the end which are flush with the slab on both the exposed and unexposed sides with no through penetrating items. The location of the two thermocouples is such that the unexposed side surface temperatures for the entire penetration is represented.

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 15 of the fire test report indicates that thermocouple readings for the unexposed side seal temperatures were taken at 3 minute

intervals. Although Appendix B (containing complete temperature information for each thermocouple) was not available at the time of this review, sufficient assurance exists that this portion of the standard checklist has been met.

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Pages 16, 17 and 18 of the test report and Table 13 documented observations during the fire tests. Since penetrations 5 and 27 involved testing of embedded sleeves with a steel conduit plug at each end, flush with the test slab, there was no penetration seal material involved.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable, therefore, this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configurations.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 7.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing

through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the checklist criteria. The penetration involves an empty embedded sleeve plugged at the surface of the test slab.

Justification: This test configuration is representative of actual field conditions where an empty sleeve is plugged at both ends. This satisfies the requirements of ASTM E-814-83 which states that you extend the penetrating item "unless either or both of these extensions are not typical of actual field installations."

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate either penetration 5 or 27 nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 16 of the fire test report indicates that immediately after the fire test, the

test assembly was removed from the furnace and subjected to the hose stream test.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 16 of the fire test report indicates that the specimen was subjected to a

hose stream test for 10 seconds based on a C.25 square foot area of the slab containing the penetration seal systems. ASTM E-814-83 requires that configurations with a resistance period 2 hours and over, but less than 4 hours, be subjected to the hose stream test for a duration of 2 1/2 minutes per 100 square feet of exposed area. This equates to 9.4 seconds based on the following:

$$\frac{2 \frac{1}{2} \text{ min}}{100 \text{ sq. ft.}} \times \frac{60 \text{ sec}}{1 \text{ min}} \times \frac{C.25 \text{ sq. ft.}}{1} = 9.4 \text{ sec}$$

The hose test was the ASTM E-119 standard methods hose stream test which means a standard playpipe with a 1 1/8" tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen. This is the same as the requirement for ASTM E-814-83.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The hose stream test was a standard playpipe with a 1 1/8" tip discharging a solid stream of water at a distance of 20' from the test specimen (Reference page 1 of the test report).

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Page 1 of the test report indicates that the ambient temperature was 70°F.

Justification: As for the velocity of air across the unexposed surface of the test specimen, this test was performed at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this facility provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is located indoors at a conditioned laboratory. Unexposed side air velocity within the test environment was not significant, and although actual conditions were not recorded in the test report, unexposed side laboratory conditions were not expected to have adversely affected the test results. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the cable jacketing, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetrations 5 and 27 were mechanical penetration seals, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that

for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 5 and 27 successfully passed the fire endurance portion of the test without passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours (Reference page 1 of the test report). Penetrations 5 and 27 each therefore achieve an F rating of 3 hours. The maximum temperature achieved by either of the surface thermocouples on penetration 5 was 180°F and on penetration 27 was 280°F (Reference Table 7 of test report). The limiting endpoint temperature of 395°F (325°F plus ambient) was not exceeded (Reference checklist item "o" for a discussion of ambient temperature). Penetrations 5 and 27 each therefore achieve a T rating of 3 hours.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis on page 1 of the fire test report states that no water projected beyond the unexposed side of the test assembly at penetrations 5 and 27 during the hose stream test.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable

shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Penetrations 5 and 27 are required to comply with ASTM E-814-83. Also no fire stop material was used on either of these penetrations.

Justification: Not Applicable

C.25 Fire Test ICC0286018

Fire Test Number: ICC0286018

Fire Test Title/Date: Fire and Hose-Stream Tests for Penetration Seal Systems (NMP2-PSS9), dated April 1986

Fire Test Summary: This test report documents the results of a fire test conducted on 7 penetration seal configurations installed in a single test 4' x 4' x 1' concrete slab. Because only two of the 7 penetration seal configurations covered by this fire test are used to support WBN typical penetration seal details, the review of this fire test report is limited to only two penetration seal configurations, penetrations 1 and C. A brief description of penetration seal configurations 1 and 6 is as follows:

Penetration 1 consisted of a 12" long 6" diameter embedded steel sleeve. Penetration 1 did not contain any penetrants. Temporary damming was installed in the bottom of the opening and a 6" depth of Dow Corning 170 RTV Silicone Elastomer was injected into the penetration. The temporary damming was removed after the elastomer cured.

Penetration 6 consisted of a 5' long 6" diameter embedded steel conduit. A conduit coupling was installed on the unexposed side of the slab and the upper portion of the seal was installed above the conduit coupling joint. The conduit contained a 50% cross sectional (125% visual) cable fill of PVC jacketed cable. After installing a 1" thickness of Pittsburg Corning Temp-Mat permanent damming material at each end of the conduit, Dow Corning 170 Silicone Elastomer was injected into each end to a depth of 4". The permanent damming material was left in place.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the
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sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Furnace temperature was measured by three thermocouples located 12" below the test slab (Reference section "Fire Test", page 8 of the test report).

Justification: The furnace used to perform this fire test was the slab furnace at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this furnace provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is described as a down draft type furnace with interior dimensions of approximately 36" x 36". Temperatures within the furnace are generally monitored by three (3) thermocouples located 12" from the test slab. The furnace is heated by three (3) burners, and due to small area of the test furnace, conditions across the exposure area of the test furnace are expected to have been consistent. Internal tests performed by CTL substantiate that there was a uniform heat flux across the exposed test slab within the furnace. Based on this information in conjunction with the information contained in the fire test report satisfies the review criteria.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report listed furnace temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Appendix B of the test report, table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within -0.011% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0286018). The fire test report indicates that the percent difference between the area under the furnace time-temperature curve and the area under the standard time-temperature curve was -0.0092% (Reference Appendix B of the fire test report, table "Furnace Atmosphere Temperature").

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: See Justification

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple pads provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN

test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), it was general practice for CTL to use thermocouple pads to cover thermocouples placed on the unexposed side of test specimens. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria because one thermocouple is representative of the seal surface temperature. Penetration 1 complies with ASTM E-814-83. Penetration 1 has 2 thermocouples mounted to the unexposed surface of the test specimen with thermocouples placed at the following locations: 1 at the interface between the fire stop and the sleeve, and 1 at the surface of the fire stop material. (Reference Fig 4 Thermocouple

Layout for Test Assembly of fire test report). (Reference Appendix B of the test report, Thermocouple Reference Chart)

Penetration 6 complies with IEEE 634. Penetration 6 has 5 thermocouples mounted to the unexposed surface of the test specimen with thermocouples placed at the following locations: 3 at the cable jacket/fire stop interfaces (1 ea. @ power, control and instrument cables), 1 at the interface between the fire stop and the conduit, and 1 at the surface of the fire stop material. (Reference Fig 4 Thermocouple Layout for Test Assembly of fire test report). (Reference Appendix B of the test report, Thermocouple Reference Chart)

Justification: Not Applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Appendix B of the test report, table "Unexposed Temperature Readings").

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix B of the test report includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test. (Reference Appendix B "Test Comments")

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Since the furnace accuracy was within the +/- 5% required by the review criteria (refer to item c above), a correction formula need not be applied to the test.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops

which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that the fire test report may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The penetrating items extended 1' on the exposed side of the slab and 3' on the unexposed side. (Reference "Test Assembly", page 1 of the fire test report)

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions

for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that penetrations 1 and 6 were exposed to a 3 hour fire test and that the fire did not penetrate, nor did flaming occur on the unexposed side of either penetration 1 or 6 as a result of heat conduction. Therefore, the test specimens are considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 10 of the fire test states that after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to three hose streams in all, each applied for a 24 second duration. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third test used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen. The first test satisfies electrical penetration 6 and the third test satisfies penetration 1.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The first hose stream test satisfies IEEE 634-1978 and the third hose stream test satisfies ASTM 814-83.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature on the unexposed surface of the specimen for this test is assumed to be 72°F.

Justification: This value is based on the "Unexposed Temperature Readings" table located in Appendix B of the fire test report, which lists the temperature at time 0:00 as 72°F for several thermocouples. Use of the lowest recorded ambient temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen, this test was performed at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this facility provided in the test report, it was necessary to contact CTL to obtain sufficient information to determine compliance with the WBN test requirements. Based on conversations with CTL personnel documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is located indoors at a conditioned laboratory.

Unexposed side air velocity within the test environment was not significant, and although actual conditions were not recorded in the test report, unexposed side laboratory conditions were not expected to have adversely affected the test results. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Since penetration 1 has no penetrants, it is considered a mechanical penetration and not subject to the requirements of IEEE 634.

The fire endurance test was performed for the full three hour duration. During the test penetrations 6 did not allow the passage of flame, or smoke and gas hot enough to ignite the cable jacketing or an other material on the unexposed side of the test assembly. The unexposed side temperatures for penetrations 6 were below the acceptance limit of 700°F and are summarized as follows:

Penetration 6: The seal surface thermocouple was TC#6 which recorded a temperature of 126 °F. The highest cable jacket / seal surface thermocouple was TC#7 which recorded a temperature of 179 °F. The conduit/concrete interface thermocouple, TC#15, which was the highest overall, recorded 256 °F.

Therefore, based on the temperatures summarized above, this test is considered to satisfy the review criteria.

Justification: Not Applicable.

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: Penetration 6 is an electrical penetration and therefore it is not subject to the requirements of ASTM 814.

Penetration 1 successfully passed the fire endurance portion of the test without the passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours (Reference "Synopsis" of the fire test report). Penetration 1 therefore achieved an F rating of 3 hours.

The limiting endpoint temperature is 397 °F (325 °F plus ambient) (Reference checklist item "o" for discussion of ambient temperature). The maximum temperature achieved on the unexposed surface thermocouple was 252 °F, which is well below the limiting endpoint temperature. Therefore, penetration 1 achieved a T rating of 3 hours. (Reference tables "Thermo-couple Reference Chart" and "Unexposed Temp. Readings" in Appendix B of the fire test report).

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis at the beginning of the fire test report states that no water projected beyond the unexposed side of the test assembly during the three hose stream tests.

Justification: Not applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: For Penetration 6: The materials used in the construction of Penetration 6, are Dow Corning 170 Elastomer and Pittsburg Corning Temp-Mat damming material. The silicone elastomer has a limiting oxygen index (LOI) of 43 and although not tested the damming material is nearly all non-combustible. The fire test satisfies the review criteria. Pittsburg Corning Temp-Mat material, which was left in place during the test, was not tested for flammability. See Record of Conversation 0006-00922-ROC-004 (Reference 7.32)

Justification: Although, the Pittsburg Corning Temp-Mat was not tested for its flame spread characteristics, the product is 99.6 % noncombustible glass fiber and 0.4 % combustible starch lubricant. Since the Temp- Mat is 99.6 % non-combustible, the fire test was successful, and the damming material used at WBN are fully qualified, this condition does not prevent the use of this test to bound WBN typical details.

C.26 Fire Test CTP-1139

Fire Test Number: CTP-1139

Fire Test Title/Date: Three Hour Fire Qualification Test of Fire Rated Boot Seal with Expansion Ring, 36" Diameter Pipe Sleeve / 10" Diameter Pipe Penetrant, August 5, 1987

Fire Test Summary: This test report documents the results of a fire test conducted on a test slab (7' x 7' x 12" thick with an exposed area of 25 ft²) containing a single 36" diameter steel lined opening centered in the slab. Review of this fire test report will be to support WBN typical seal details. A brief description of the configuration, (hereinafter referred to as Penetration 1) is as follows:

Penetration 1 was a 36" diameter steel sleeve 16" long cast with 2" (nom.) of sleeve extending from both sides of the slab and penetrated by a 10" diameter steel pipe mounted eccentric with the sleeve. Seal material consisted of 14" depth of Kaowool blanket and Keene grade 56493F031 Silicone impregnated fiberglass cloth flexible boots on the exposed and unexposed sides of the slab. The boots were assembled using Dow Corning 96-081 Silicone RTV Adhesive/Sealant and steel bands.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1139 indicates that the fire test is controlled according to the standard time/temperature curve, as indicated by the average temperature obtained from the readings of four thermocouples symmetrically located across the face of the specimen, 12" away (Reference "Test Procedure", page 2 of the test report).

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1139 contains a time-temperature graph which presents furnace temperature as a plot of the average of four furnace thermocouple readings versus time. The test report also includes a table listing discrete thermocouple readings from which the continuous plot was generated. The table shows that furnace temperatures were taken at five minute intervals during the entire 180 minutes of the test (reference "Appendix C", of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 1.544% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test CTP-1139).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire tests satisfies the review criteria. Per the Test Procedure section of the fire test, thermocouples were covered with pads which meet the requirements of the review criteria (Reference "Test Procedure", page 2 of the test report).

Justification: Not Applicable.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:

1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test report satisfies the review criteria. Per the Test Procedure section of the fire test and as located in Figure 5, the thermocouple requirements of this review item are satisfied (Reference "Test Procedure", page 3 and Figure 5 of the test report).

Justification: Not applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1139 contains discrete thermocouple reading from the unexposed surface of the test specimen. These readings were recorded every five minutes for the entire 180 minute duration of the fire exposure (Reference "Appendix C" of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included.

(ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Observations of significant details are contained in the Test Results section of the test report (Reference "Test Results", on page 4 of the test report).

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops

which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that the test may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The penetrating pipe for penetration 1 extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side (Reference "Test Assembly", page 4 and Figure 1 of the test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions

for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. As referenced in the Test Procedure section of the test report, the desired classification is for a three hour rating. Based on the Test Result section of the test report, the test specimen was exposed to the ASTM E-119 time/temperature curve for a three hour period and that the fire did not penetrate the test specimen nor did flaming occur on the unexposed side as a result of heat conduction (Reference "Test Procedure", page 3 and "Test Results", page 3 of the test report).

Justification: Not Applicable

- I. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Per the Test Results section of the fire test, immediately following the fire endurance test, the specimen was subjected to three successive hose stream tests (Reference "Test Results", page 5 of the test report).

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 5 of Fire Test Report CTP-1139 documents that the test specimen was subjected to three successive hose stream tests. These tests were performed in the order described on pages 3 & 4 of the Hose Stream Test section of the test report. The third hose stream applied satisfies the review criteria under ASTM E-814-83. According to Fire Test Report CTP-1139 the hose stream tests were applied to an exposed surface area of 25 sq. ft. for a duration of 37.5 seconds. Based on Table 1 above, this is also the required ASTM E-814-83 duration:

$$25 \text{ ft}^2 \times 1.5 \text{ sec./ft}^2 = 37.5 \text{ sec.}$$

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The applicable hose stream test was as required per ASTM E-814-83 and per the Test Results section of the test report the hose stream was directed from 20 feet away (Reference "Test Results", page 5 of the test report).

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient air temperature at the beginning of Fire Test CTP-1139 was not specifically stated in the test report, therefore the lowest initial exposed surface thermocouple temperature of 81°F will be utilized, thereby yielding a conservative end point temperature of 406°F (325°F +81°F) This temperature is within the specified range and is thereby acceptable. As for the velocity of air across the unexposed surface of the test specimen, this test was conducted at the SwRI fire test facility using SwRI's small-scale horizontal furnace and through photographic record found in Appendix B of the test report, it is apparent that the test was conducted within a structure (Reference "Appendix B and Appendix C of the test report).

Justification: Not Applicable.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since Penetration 1 was a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration 1 achieved a 3 hour F rating, as no passage of flame or flaming occurred during the test duration. (Reference "Test Results", page 4 of the test report).

The maximum temperature achieved by a surface thermocouple on the unexposed seal surface will be taken from thermocouple F-1 at 180 minutes which was 332°F. Based on the discussion in the Test Results section of the test report concerning the moving of thermocouple wiring for F-1 and F-5. It is reasonable to use

temperature readings from the said thermocouples recorded after the readings had begun to increase after steadily decreasing temperatures had ceased. The three other surface thermocouples were placed further from the penetrant and consequently did not see temperatures over 199°F. Penetration 1 therefore achieved a T rating of 3 hours. (Reference "Test Results", on page 4 and "Appendix C" of the test report).

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Test Results section of the fire test report states that the penetration seal was not penetrated by any of the hose streams. (Reference "Test Results", page 5 of the test report).

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since Penetration 1 was a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.27 Fire Test CTP-1142

Fire Test Number: CTP-1142

Fire Test Title/Date: Three Hour Fire Qualification Test of Six (6) Inch Depth LDSE w/ Aluminum and Steel Penetrants (XLPE/PVC Cable), August 5, 1987

Fire Test Summary: This test report documents the results of a fire test conducted on a test slab (7' x 7' x 12" thick with an exposed area of 25 ft²) containing a single 48" X 48" blackout, steel lined on two sides, centered in the slab. The blackout contained 12 penetrants and 2 seal repairs and was sealed with a 6 inch depth of LDSE with no damming. This test review specifically addresses only the 6" LDSE seal around the conduit penetrant containing penetration seal 1142.11. Review of this fire test report will be to support WBN typical seal details which are comprised of 6" of silicone elastomer (either Dow Corning Sylgard 170 or GE RTV 6428). A brief description of the configuration, (hereinafter referred to as Penetration 1) is as follows:

Penetration 1142.11 was 6" diameter steel conduit containing 25% cable fill installed in the 48" x 48" blackout. The blackout seal material consisted of 6" of LDSE with no damming. The 6" conduit had an internal seal with 4" of LDSE and 1" of damming. The internal conduit seal was installed above the plane of the barrier on the unexposed side of the penetration.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1142 indicates that the fire test is controlled according to the standard time/temperature curve, as indicated by the average temperature obtained from the readings of four thermocouples symmetrically located across the face of the specimen, 12" away (reference "Test Procedure", page 3 of the test report).

Justification: Not Applicable

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1142 contains a time-temperature graph which presents furnace temperature as a plot of the average of four furnace thermocouple readings versus time. The test report also includes a table listing discrete thermocouple readings from which the continuous plot was generated. The table shows that furnace temperatures were taken at five minute intervals during the entire 180 minutes of the test (reference "Appendix C", of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 3.028% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test CTP-1142).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire tests satisfies the review criteria. Per the Test Procedure section of the fire test, thermocouples were covered with pads which meet the requirements of the review criteria (Reference "Test Procedure", page 3 of the test report).

Justification: Not Applicable.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.
-

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test report satisfies the review criteria. Per the Test Procedure section of the fire test and as located in Figures 12 and 13, the thermocouple requirements of this review item for the 6" steel conduit are satisfied (reference "Test Procedure", page 3 and Figures 12 and 13 of the test report).

Justification: Not applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report CTP-1142 contains discrete thermocouple reading from the unexposed surface of the test specimen. These readings were recorded every five minutes for the entire 180 minute duration of the fire exposure (Reference "Appendix C" of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included.

(ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Observations of significant details are contained in the Test Results section of the test report (Reference "Test Results", on page 5 of the test report).

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops

which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that the test may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The 6" conduit containing penetration seal 1142.11 extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side (Reference "Test Assembly", page 4 and Figure 1 of the test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions
-

for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. As referenced in the Test Procedure section of the test report, the desired classification is for a three hour rating. Based on the Test Result section of the test report, the test specimen was exposed to the ASTM E-119 time/temperature curve for a three hour period and fire did not penetrate the test specimen nor did flaming occur on the unexposed side as a result of heat conduction (Reference "Test Procedure", page 3 and "Test Results", page 5 of the test report).

Justification: Not Applicable

- I. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Per the Test Results section of the fire test, immediately following the fire endurance test, the specimen was subjected to three successive hose stream tests (Reference "Test Results", page 6 of the test report).

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 6 of Fire Test Report CTP-1139 documents that the test specimen was subjected to three successive hose stream tests. These tests were performed in the order described on pages 4 & 5 of the Hose Stream Test section of the test report. The third hose stream applied satisfies the review criteria under ASTM E-814-83. According to Fire Test Report CTP-1142 the hose stream tests were applied to an exposed surface area of 16 sq. ft. for a duration of 37.5 seconds. Based on Table 1 above, this exceeds the required ASTM E-814-83 duration:

$$16 \text{ ft}^2 \times 1.5 \text{ sec./ft}^2 = 24 \text{ sec.}$$

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The applicable hose stream test was as required per ASTM E-814-83 and per the Test Results section of the test report the hose stream was directed from 20 feet away (Reference "Test Results", page 6 of the test report).

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The ambient air temperature at the beginning of Fire Test CTP-1142 was not specifically stated in the test report, therefore the lowest initial exposed surface thermocouple temperature of 84°F will be utilized, thereby yielding a conservative end point temperature of 409°F (325°F +84°F) This temperature is within the specified range and is therefore acceptable. As for the velocity of air across the unexposed surface of the test specimen, this test was conducted at the SwRI fire test facility using SwRI's small-scale horizontal furnace and through photographic record found in Appendix B of the test report, it is apparent that the test was conducted within a structure (Reference "Appendix B" and "Appendix C" of the test report).

Justification: Not Applicable.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since Penetration 1 was a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The LDSE seal within the 48" x 48" blockout achieved a 3 hour F rating, as no passage of flame or flaming occurred during the test duration. (Reference "Test Results", page 6 of the test report).

The maximum temperature achieved by a surface thermocouple on the unexposed seal surface within 1 inch of the 6" conduit was taken from thermocouple F-14 at 150 minutes which was 365°F. Two other surface thermocouples were placed further from the penetrant but within 1" of other penetrants did not see

temperatures over 345°F. The 6" LDSE seal with respect to the 6" conduit penetrant therefore is considered to have achieved a T rating of 3 hours. (Reference "Test Results" and "Conclusions", on page 6 and "Appendix C" of the test report). -

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Test Results section of the fire test report states that the penetration seal was not penetrated by any of the hose streams. (Reference "Test Results", page 6 of the test report).

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since Penetration 1 was a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.28 Fire Test 748-49

Fire Test Number: 748-49

Fire Test Title/Date: Fire Test Configuration for a Three Hour Rated Fire Seal Utilizing BISCO SF-20 where; a Steel Sleeve Condition with Pipe Penetrant Exists, Dated: July 9, 1981.

Fire Test Summary: This test report documents the results of a fire test conducted on two (2) penetration seal configurations installed in a single test slab. The review of this fire test report includes a single penetration seal configuration required to support WBN typical seal details. Specifically, the penetration seal configuration identified as penetration 2. A brief description of the configuration is as follows:

Penetration 2 was a 12 inch diameter sleeved opening penetrated by an 8 inch diameter steel pipe which was capped on the exposed side of the penetration and filled with ceramic fiber to simulate a continuous pipe run. Seal material consisted of a 12 inch depth of Dow Corning 3-6548 Silicone Foam injected into the penetration flush with the exposed and unexposed side of the test slab.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The test report states that the furnace temperature was measured by three thermocouples and monitored throughout the test. (Reference section "Fire Test", of the test report).

Justification: The furnace used to perform this fire test was the slab furnace at Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited description of this furnace provided in the test report, credit is taken for the qualifications of the testing facility Construction Technology Laboratories (CTL) in Skokie, Illinois. There is reasonable assurance that the furnace and facility utilized were the same as documented by Record of Conversation 0006-00922-ROC-001 (Reference 7.29), the slab furnace at CTL is described as a down draft type furnace with interior dimensions of approximately 36" x 36". Temperatures within the furnace are generally monitored by three (3) thermocouples located 12" from the test slab. The furnace is heated by three (3) burners, and due to small area of the test furnace, conditions across the exposure area of the test furnace are expected to have been consistent. Internal tests performed by CTL substantiate that there was a uniform heat flux across the exposed test slab within the furnace. Based on this information in conjunction with the information contained in the fire test report, the intent of this review criteria has been satisfied by the fire test.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire test report states that the fire exposure followed the standard time/temperature relationship as described in ASTM E-119 (Reference "Fire Test", in the test report).

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple readings provided in the test report information to determine compliance with the WBN test requirements, it is necessary to take credit for the qualifications of the testing facility Construction Technology Laboratories (CTL) in Skokie, Illinois. Based on other fire tests reviewed in this report which were performed by the (CTL) facility there is reasonable assurance that the requirements of the review criteria were met.

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire test report states that the fire exposure followed the standard time/temperature relationship as described in ASTM E-119 (Reference "Fire Test", in the test report).

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple readings provided in the test report information to determine compliance with the WBN test requirements, it is necessary to take credit for the qualifications of the testing facility Construction Technology Laboratories (CTL) in Skokie, Illinois. Based on other fire tests reviewed in this report which were performed by the (CTL) facility there is reasonable assurance that the requirements of the review criteria were met.

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire test report states that the fire exposure followed the standard time/temperature relationship as described in ASTM E-119 (Reference "Fire Test", in the test report).

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple pads provided in the test report information to determine compliance with the WBN test requirements, it is necessary to take credit for the qualifications of the testing facility Construction Technology Laboratories (CTL) in Skokie, Illinois. Based on other fire tests reviewed in this report which were performed by the (CTL) facility there is reasonable assurance that the requirements of the review criteria were met.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 2 each had five thermocouples located on the unexposed surface of the penetration seal assembly pursuant to ASTM E-119 and IEEE 634-1978 requirements (Reference "Fire

Test", section, Table 01 and (CTL) correspondance #CR-4802-4324 of the test report).

Justification: Penetration 2 satisfies the ASTM E814 requirement to have three thermocouples record unexposed side surface temperatures. However, the requirement to have one thermocouple placed approximately 1 to 3 inches above the unexposed side surface of the penetration seal is not adequately stated. Although a thermocouple placement is not specifically described on the pipe penetrant, the thermocouple data provided is considered adequate to meet the intent of the review criteria. This is based on the fact that only the temperature readings from the thermocouples located on the surface of the seal material are considered when determining acceptance of a penetration seal assembly based on limiting endpoint temperature (Refer to checklist item "q").

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire test report states that the fire exposure followed the standard time/temperature relationship as described in ASTM E-119 (Reference "Fire Test", in the test report).

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple readings provided in the test report information to determine compliance with the WBN test requirements, it is necessary to take credit for the qualifications of the testing facility Construction Technology Laboratories (CTL) in Skokie, Illinois. Based on other fire tests reviewed in this report which were performed by the (CTL) facility there is reasonable assurance that the requirements of the review criteria were met.

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off,

including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Fire Test and Summary & Findings sections of the test report include observations of the test assembly during and after the fire test and after the hose stream test.

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard is expected to be within acceptable tolerances based on checklist item "c" above, therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable

arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the

slab and 3' minimum on the unexposed side. (Reference "Fabrication of Test Assembly ", of the fire test report)

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Summary & Findings of the fire test report indicates that the tested configuration was exposed to a 3 hour fire test and that the fire did not penetrate the seal material nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure.

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Summary & Findings of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to a hose stream test.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern

without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test was subjected to a hose stream applied for a 12 second duration using a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle, at a distance of 20' from the test specimen as required by ASTM E-119. The hose stream satisfies the review criteria based on the test region.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The hose stream test applied to the test specimen used a standard playpipe with a 1-1/8 diameter tip discharging a solid stream of water at a pressure of 30 psi at the base of the nozzle. The nozzle was at a distance of 20' from the test specimen and the test was for a duration of 12 seconds.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: See Justification

Justification: The facility used to perform this fire test was Construction Technology Laboratories (CTL) in Skokie, Illinois. Because of the limited information with respect to thermocouple readings and the facility provided in the test report information to determine compliance with the WBN test requirements, it is necessary to take credit for the qualifications of the testing facility Construction Technology Laboratories (CTL) in Skokie, Illinois. Based on other fire tests reviewed in this report which were performed by the (CTL) facility there is reasonable assurance that the requirements of the review criteria were met.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetration 2 was a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetration 2 successfully passed the fire endurance portion of the test without passage of flame through the penetration or flaming on the unexposed side of the penetration for a duration of 3 hours. Additionally, penetration 2 successfully passed the fire endurance portion of the test without transmission of sufficient heat to raise the temperature on any unexposed surface thermocouple more than 325°F above the lowest (most conservative) allowed initial temperature for a duration of 3 hours. (Reference "Table 01" of the fire test report). Penetration 2 therefore achieves an F rating of 3 hours.

The maximum temperature achieved by any of the surface thermocouples on penetration 2 was 369°F (Reference "Thermocouple Reference Chart in Table 01" of the fire test report. Penetration 2 therefore achieves a T rating of 3 hours.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Summary & Findings of the fire test report states that penetration 2 successfully passed the hose stream criteria of ASTM E-119.

Justification: Not Applicable

- s. Per IEEE 634-1978, individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since penetration 2 is a mechanical penetration seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

C.29 Fire Test ICC0483010

Fire Test Number: ICC0483010

Fire Test Title/Date: Fire and Hose Stream Tests for Penetration Seal Systems, dated May 1983

Fire Test Summary: This test report documents the results of a fire test conducted on 2 penetration seal configurations installed in a single test slab. A brief description of these configurations are as follows:

Penetration 1 is a 4" diameter cable bundle positioned inside a 4" diameter x 12" long Kellem Grip. The Kellem Grip contains the following types of cables: 2/C-12 AWG 600V-EPR Hypolon CSPE, 4/C-16 AWG Rockbestos KLPE/NEO 600V, 2/C-16 AWG Rockbestos KLPE/NEO 600V, 5/C-12 AWG 600V-EPR Hypolon CSPE, and 063-12 AWG 600V-EPR/NEO/CPSE

Penetration 2 is a 3" diameter thermocouple cable. The bundle contains the following types of cables: BLW Boston 2621-1-002 (1977) Code 141-300V KAP-KAP T.G. Type KX #20 AWG and BLW Boston 2620-T002 (1980) Code 140-3000V KAP-KAP TX #20 AWG.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire exposure followed the standard time/temperature relationship given in ASTM E-119. Furnace temperature was measured by 6 thermocouples located in the furnace and monitored throughout the 3 hour fire test (Reference section "Fire Test", page 10 of the test report).

Justification: ASTM E-119, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. The exposed length and placement of furnace thermocouples is not described in the text of Fire Test Report ICC0483010. However, credit is taken for the qualification of the testing establishment (Construction Technologies Laboratories). Therefore, based on the above discussion, there is reasonable assurance that the placement of furnace thermocouples satisfy the requirements described in ASTM E-814-83 and IEEE 634-1978.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report lists the average furnace temperature every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Appendix B of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-

temperature curve for fire tests exceeding 2 hours in duration.
(ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.078% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0483010). The fire test report documents the temperature difference between the area under the furnace time-temperature curve and the area under the standard time-temperature curve at each reading interval (Reference Appendix B of the fire test report).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire exposure followed the standard time/temperature relationship given in ASTM E-119 (Reference "Fire Test", page 10 of the fire test report).

Justification: ASTM E-119 requires that the thermocouples be placed under flexible, dry, felted asbestos pads. This method of attachment protects thermocouples from possible cooling effects of unexposed side ambient air temperatures, (e.g., the influence of air velocity across the unexposed side of the seal assembly). The method of thermocouple attachment is not described in the text of Fire Test Report ICC0483010. However, credit is taken for the qualification of the testing establishment (Construction Technologies Laboratories). Therefore, based on the above discussion, the method of thermocouple attachment provides an acceptable alternative to the method described in ASTM E-814-83 and IEEE 634-1978.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 2 used a total of 6 thermocouples for measuring temperature of the unexposed surface of the seal material, cable and seal interface, and seal and concrete surface interface (Reference "Instrumentation", page 9 of the test report).

Justification: Not Applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed

specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Appendix B of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix B of the test report includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test (Reference Appendix B - "Test Comments").

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to

simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Test Assembly", page 2 of the fire test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test report indicates that the specimen was exposed to a 3 hour fire test and that the fire not penetrate any penetration nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure (Reference "Synopsis", page 1 of the test report).

Justification: Not Applicable

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The test specimen was subjected to three hose streams in all, each applied for 14 seconds. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third hose-stream was through a 1-1/8" Standard Playpipe discharging a solid stream

at a pressure of 30 psi, at a distance of 20 ft. The first hose stream test satisfies the review criteria as it applies to both penetration 1 and 2.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The first hose stream test applied to the test specimen was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and at a distance of 10' for 14 seconds.

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature on the unexposed surface of the specimen for this test is assumed to be 72°F.

Justification: This value is based on the "Unexposed Temperature Readings" table located in Appendix B of the fire test report, which lists the lowest temperature at time 0:00 as 72°F. Use of the lowest recorded ambient temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen, reference 7.29 of this Engineering Report.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Penetrations 1 and 2 successfully passed the fire endurance portion of the test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a duration of 3 hours (Reference "Synopsis", page 1 of the fire test report).

The maximum temperature achieved by any of the unexposed surface thermocouples was 325°F on penetration 2 (thermocouple #14) (Reference tables "Thermocouple Reference Chart" and "Unexposed Temperature Readings" in Appendix B of the fire test report). The limiting endpoint temperature of 700°F was not exceeded.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since all penetrations were electrical and therefore no subject to ASTM E-814 requirements..

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Synopsis of the fire test report states that no water projected beyond the unexposed side of reviewed seal assemblies during the three hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The materials used in the construction of the penetration seal specimen for this fire test consisted of a 1" thick Carborundum Hotboard, and Dow Corning 3-6548 RTV silicon foam, the silicone foam has a flame spread rating of 15. Carborundum Hotboard is considered flame resistant.

Justification: Not Applicable

C.30 ICC1182009

Fire Test Number: ICC1182009

Fire Test Title/Date: Fire and Hose Stream Tests for Penetration Seal Systems, dated December 1982

Fire Test Summary: This test report documents the results of a fire test conducted on 3 penetration seal configurations installed in a single test slab. Because some of the penetration seal configurations covered by this fire test were not used to support WBN typical penetration seal details, the review of this fire test report is limited to those penetration seal configurations required to support WBN typical seal details. Specifically, the penetration seal configurations of importance is penetration 2, this penetration is evaluated as a 2 hour configuration. A brief description of this configurations is as follows:

Penetration 2 was a 28"x8" steel lined blockout in a 4' x4' x 1' thick concrete slab. The blockout was penetrated by one (1) 24"x6" galvanized steel ladder back cable tray in contact with 2 sides of blockout. 100% visual load consisting of 33% each of 350 MCM-XHHW power cable, 14/2 XLP-Neoprene TC cable, and 16/2 TC 600V cable. A 2" deep x 1" wide angle was attached to the concrete on the exposed side of the test slab. Seal material for the penetration configuration consisted of a 1" thickness of Carborundum Hotboard, and a 9" thickness of Dow Corning 3-6548 Silicone Foam.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire exposure followed the standard time/temperature relationship given in ASTM E-119. Furnace temperature was measured by 3 thermocouples located in the furnace and monitored throughout the 3 hour fire test (Reference section "Fire Test", page 12 of the test report).

Justification: ASTM E-119, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. The exposed length and placement of furnace thermocouples is not described in the text of Fire Test Report ICC1182009. However, credit is taken for the qualification of the testing establishment (Construction Technologies Laboratories). Therefore, based on the above discussion, there is reasonable assurance that the placement of furnace thermocouples satisfy the requirements described in ASTM E-814-83 and IEEE 634-1978.

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the test report lists the average furnace temperature every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter. (Reference Appendix B of the test report).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the

corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.003% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC1182009). The fire test report documents the temperature difference between the area under the furnace time-temperature curve and the area under the standard time-temperature curve at each reading interval (Reference Appendix B of the fire test report).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire exposure followed the standard time/temperature relationship given in ASTM E-119 (Reference "Fire Test", page 12 of the fire test report).

Justification: ASTM E-119 requires that the thermocouples be placed under flexible, dry, felted asbestos pads. This method of attachment protects thermocouples from possible cooling effects of unexposed side ambient air temperatures, (e.g., the influence of air velocity across the unexposed side of the seal assembly). The method of thermocouple attachment is not described in the text of Fire Test Report ICC1182009. However, credit is taken for the qualification of the testing establishment (Construction Technologies Laboratories). Therefore, based on the above discussion, the method of thermocouple attachment provides an

acceptable alternative to the method described in ASTM E-814-83 and IEEE 634-1978.

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:
1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
 2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. Penetration 2 used a total of 5 thermocouples for measuring temperature of the unexposed surface of the seal material, tray and seal interface, seal and metal interface, and cable and seal interface (Reference "Instrumentation", page 12 of the test report).

Justification: Not Applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The table of discrete thermocouple readings provided in the report listed specimen thermocouple temperatures every 5 minutes throughout the first 2 hours of the test and every 10 minutes thereafter (Reference Appendix B of the test report).

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Appendix B of the test report includes a section entitled "Test Comments" in which observations of the test assembly were documented during and after the fire test and after the hose stream test (Reference Appendix B - "Test Comments").

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing

through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Test Assembly", page 2 of the fire test report).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The synopsis of the fire test report indicates that the specimen was exposed to a 3 hour fire test. A flamethrough occurred on the unexposed surface of penetration 2 at 2 hr 55 min. after start of test..

Justification: Penetration 2 is being qualified as a 2 hr seal, therefore, the fire test satisfies the review criteria

- l. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to three hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The test specimen was subjected to three hose streams in all, each applied for 14 seconds. The first was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The second was through a 1-1/2" diameter hose with a nozzle set at a 15° angle. The discharge was at a rate of 75 gpm and a distance of 10'. The third hose-stream was through a 1-1/8" Standard Playpipe discharging a solid stream

at a pressure of 30 psi, at a distance of 20 ft. The first hose stream test satisfies the review criteria as it applies to penetration 2.

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft. from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The first hose stream test applied to the test specimen was through a 1-1/2" diameter hose with a nozzle set at a 30° angle. The discharge was at a rate of 75 gpm and at a distance of 10' for 14 seconds

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature on the unexposed surface of the specimen for this test is assumed to be 76°F.

Justification: This value is based on the "Unexposed Temperature Readings" table located in Appendix B of the fire test report, which lists the lowest temperature at time 0:00 as 76°F. Use of the lowest recorded ambient temperature results in the most conservative limiting endpoint temperatures. As for the velocity of air across the unexposed surface of the test specimen, reference 7.29 of the Engineering Report.

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire test indicates that there was no passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of Penetration 2.

The maximum temperature achieved by the surface thermocouple was 564°F on penetration 2 (thermocouple #5) (Reference tables "Thermocouple Reference Chart" and "Unexposed Surface Temperature" Appendix B of the test report). The limiting endpoint temperature of 700F was not exceeded.

Justification: The fire test indicates a flamethrough of penetration 2 at 2 hr 55 min after the start of the fire test. The 700F on the unexposed surface, was not exceeded. The desired classification for penetration 2, is 2 hours. Therefore, the fire test satisfies the review criteria

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable This checklist item is not applicable since all penetrations were electrical and therefore not subject to ASTM E-814 requirements.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Synopsis of the fire test report states that no water projected beyond the unexposed side of reviewed seal assemblies during the three hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The materials used in the construction of the penetration seal specimen for this fire test consisted of a 1" thick Carborundum Hotboard, and Dow Corning 3-6548 RTV silicon foam, the silicone foam has a flame spread rating of 15. Carborundum Hotboard is considered flame resistant.

Justification: Not Applicable

C.31 Fire Test TS-TP-0014

Fire Test Number: TS-TP-0014

Fire Test Title/Date: Fire and Hose Stream Tests for Penetration Seal Systems, dated July 1978

Fire Test Summary: This test report documents the results of a fire test on one penetration seal assembly. This assembly was used to simulate a 32" x 32" x 12" (deep) penetration with multiple mechanical and electrical penetrating members sealed with silicone foam. The actual fire test was conducted to evaluate the performance of a number of different types of penetrating members passing through a penetration which was lined with steel on two sides (to simulate steel lined penetrations) and regular density cast concrete on the other two sides (to simulate concrete substrates).

This test report is only concerned with the seal performance of the 32" x 32" x 12" (deep) blockout which was lined with steel on two sides (to simulate steel lined penetrations) and regular density cast concrete on the other two sides (to simulate concrete substrates). The blockout was sealed to a depth of 9" with silicone foam and a 1" damming board.

- a. The temperature fixed by the standard time-temperature curve (defined by Annex A1 of ASTM E-814-83 and Appendix A1 of IEEE 634-1978) shall be deemed to be the average furnace temperature obtained from the readings of furnace thermocouples. Per ASTM E-814-83, use a minimum of three thermocouples, with not fewer than five thermocouples per 100 ft² of floor surface, and not fewer than nine thermocouples per 100 ft² of wall surface. Per IEEE 634-1978, use not less than three thermocouples for each cable penetration fire stop. For both standards, the exposed length of the pyrometer tube and thermocouple in the furnace chamber shall not be less than 12 inches. The junction of the thermocouples shall be placed 12 inches away from the exposed face of the sample for floors and 6 inches for walls, and shall not touch the sample during the test as a result of deflection. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. This fire test utilized two shielded chromel alumel thermocouples

located inside the furnace 12" down from the top of the furnace to monitor the furnace temperature.

Justification: This does not meet the minimum 3 requirement of ASTM E-814-83 but is acceptable because the small slab furnace was used with only a 32" x 32" opening at the top, heated by 4 gas burners which resulted in a uniform blanket of flame and in close adherence to the time-temperature curve. (Reference "Fire Test Method", page 31).

- b. The furnace temperatures shall be read at intervals not exceeding 5 minutes during the first two hours, and thereafter the intervals may be increased to not more than 10 minutes. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace temperature was measured continuously throughout the fire test (Reference "Fire Test Method" page 31).

Justification: Not Applicable

- c. The accuracy of the furnace control shall be such that the area under the time-temperature curve, obtained by averaging the results from the pyrometer readings, is within 10% of the corresponding area under the standard time-temperature curve for fire tests of 1 hour or less duration, within 7.5% of the corresponding area under the standard time-temperature curve for fire tests greater than 1 hour but no more than 2 hours in duration, and within 5% of the corresponding area under the standard time-temperature curve for fire tests exceeding 2 hours in duration. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The area under the furnace time-temperature curve was calculated to be within 0.054% of the standard time-temperature curve (Reference the calculation and graph provided in Appendix D of this engineering report for fire test ICC0483010).

Justification: Not Applicable

- d. ASTM E-814-83 requires that temperatures of unexposed surfaces shall be measured with thermocouples placed under 2" x 2" flexible pads of a suitable inorganic material. IEEE 634-1978 requires that, for cable penetration fire stops, temperatures on the penetration cold side surfaces be measured with thermocouples. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The end of the thermocouple was placed under strips of asbestos pads and weighted down so that true readings were obtained (Reference "Thermocouple Mounting And Recording" page 34).

Justification: Not Applicable

- e. For ASTM E-814-83 tests, unexposed side temperatures shall have been measured at the following locations, as a minimum:

1. On the unexposed surface of the penetration seal assembly. At least three thermocouples shall have recorded unexposed side surface temperatures, except where physical placement of multiple surface thermocouples was not feasible. In those instances, a single thermocouple may have been used to record unexposed side surface temperatures provided that the location of the thermocouple was such that unexposed side surface temperatures for the entire penetration seal were represented.
2. On through-penetrating items approximately 1 to 3 inches above the unexposed side surface of the penetration seal. At least one thermocouple shall have been used to record the temperature for each type of through-penetrating item contained in the test assembly.

IEEE-634 requires that, for cable fire stops, readings shall be taken at a minimum of three points on the fire stop surface, which shall include 1) the cable jacket/fire stop interface, 2) the interface between the fire stop and through metallic components other than the insulated cable conductor, and 3) the surface of the fire stop material.

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The penetration had 10 thermocouples. 5 located on the sleeved side, and 5 located on the non-sleeved side. Each set of thermocouples were embedded in the seal material, thermocouples were located 2", 4", 6" 8", and 10" down from unexposed surface of test slab.

Justification: Not Applicable

- f. Temperature readings shall have been taken at intervals not exceeding 15 minutes until a reading exceeding 212°F had been obtained. Thereafter the readings may have been taken more frequently. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Fire Test Report #TS-TP-0014 contains individual thermocouple "strip charts" which were used to record unexposed surface temperatures at various points. these charts indicate that temperature readings were taken and plotted for individual thermocouples at approximately 3 minute intervals throughout the 3 hour fire endurance test.

Justification: Not Applicable

- g. Per ASTM E-814-83 requirements, reports shall include observations of significant details of the behavior of the material or construction during the test and after the furnace is cut off, including information on deformation, burning of the specimen or its component parts, continuance of flaming, and production of smoke. Per IEEE-634 requirements, data shall be provided as necessary to document satisfactory compliance. Type test data derived from tests shall be organized to present the results in an orderly manner so as to be easily understood and located. Specific types of data, as listed in the standard, shall be included. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. Page 72 of the test report includes a section entitled "Test Results" in which observations of the test assembly were documented during and after the fire test and after the hose stream test (Reference "Test Results" page 72).

Justification: Not Applicable

- h. Per ASTM E-814-83 requirements, when the indicated resistance period is 1 hour or over a correction shall be applied for variation of the furnace exposure from the prescribed, where it will affect the classification. This shall be performed per section 11.2 of ASTM E-814-83 only when furnace control was not in accordance with checklist item c. above. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The furnace exposure variation from the standard was acceptable therefore this checklist item is not applicable.

Justification: Not Applicable

- i. ASTM E-814-83 requires that the test specimen shall be actual size and *truly representative* of the fire stop for which classification is desired. Furthermore, the periphery of the fire stop shall not be closer than 1-1/2 times the thickness of the test assembly or a minimum of 12" from the furnace edge, whichever is greater. For cable penetration fire stops, per IEEE-634, the cable penetration fire stop shall be tested as a complete system. The raceway mounting and anchoring to the fire stop assembly, the cable arrangement, including attachment to raceway and the raceway fill, shall be representative of the actual installed conditions. The selection of the sizes, construction, and materials of the cables and cable penetration opening fill to be used in the test shall be representative of the cables used in the fire stop under actual installed conditions. Cables may penetrate these openings either directly without a raceway or within a metallic raceway depending on the intended installed configuration. Cable penetration fire stops which are tested in the floor-ceiling position qualify the cable penetration fire stop for either a floor or wall penetration provided the fire stop is constructed symmetrically so as to provide equal resistance to fire from either side. Cable penetration fire stops that

are unsymmetrical with respect to design and location in the wall-floor may require fire testing on both sides for qualification.

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The process of reviewing the fire tests to the standard checklist is essential to establish the validity of the fire tests so that they may be used to support typical seal detail configuration.

The process of evaluating the test specimen to determine if it is "truly representative of the fire stop for which classification is desired" is addressed in Section 3.0 of this report.

Justification: Not Applicable

- j. Per ASTM E-814-83 requirements, through-penetrating items shall be installed so that they extend 12 in. on the exposed side and 36 in. on the unexposed side, unless either or both of these extensions are not typical of actual field installations. Per IEEE 634-1978, the cable within the penetration or the raceway passing through the penetration shall protrude 3 to 5 ft. on the unexposed side and a minimum of 1 ft. on the exposed side. Vertical cables in floor penetration tests shall be supported on the unexposed side to simulate continuous cables in an actual installation. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. All penetrating items extended 1' minimum on the exposed side of the slab and 3' minimum on the unexposed side. (Reference "Test Report", pages 10-24).

Justification: Not Applicable

- k. The fire endurance test shall be continued on the specimen until failure occurs, or until the specimen withstands the test conditions for a period equal to that for which classification is desired. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test results indicates that the specimen was exposed to a 3 hour fire test and that the fire did not penetrate any penetration nor did flaming occur on the unexposed side as a result of heat conduction. Therefore, the test specimen is considered to have withstood the fire test conditions without failure (Reference "Test Results", page 72 of the fire test report).

Justification: Not Applicable

- I. The hose stream test shall be performed on the test specimen immediately following the expiration of the fire endurance test. (ASTM E-814-83 and IEEE 634-1978), or the hose stream test may be performed on a duplicate test specimen subjected to a reduced fire exposure period (ASTM E-814-83).

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The synopsis of the fire test states that immediately after the fire test, the test assembly was removed from the furnace and subjected to two hose stream tests.

Justification: Not Applicable

- m. Per ASTM E-814-83 requirements, the stream shall have been delivered through a 2-1/2 inch hose discharging through a National Standard Playpipe of corresponding size equipped with a 1-1/8 inch discharge tip of the standard taper smooth bore pattern without shoulder at the orifice. The water pressure and duration shall have been as prescribed in Table 1.

Table 1 - Conditions for Hose Stream Test

Resistance Period	Water Pressure at Base of Nozzle, psi (kPa)	Duration of Application Seconds per ft ² (m ²) of Exposed Area
240 minutes and over if less than 480 min	45 (310)	3.0 (32)
120 min and over if less than 240 min	30 (210)	1.5 (16)
90 min and over if less than 120 min	30 (210)	0.9 (10)
60 min and over if less than 90 min	30 (210)	0.6 (6)
less than 60 min if desired	30 (210)	0.6 (6)

For cable penetration fire stops, per IEEE 634-1978, a 1-1/2 inch hose discharging through a nozzle approved for use on fires in electrical equipment, producing a long-range-narrow angle (30-90° set at 30° included angle) high velocity spray only shall be used. The hose stream shall be applied to the exposed side. The water pressure shall be 75 psi, calculated, at the base of the nozzle and minimum flow of 75 gpm with a duration of application of 2 1/2 min. per 100 ft² of test slab. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The test specimen was subjected to the ASTM E-119 hose stream test. According to this report the actual hose stream was applied for a duration of 11 seconds (Reference "Hose-Stream Test Method" pages 33 and 71).

Justification: Not Applicable

- n. Per ASTM E-814-83 requirements, the nozzle orifice shall have been 20 feet from the center of the exposed surface and shall have been perpendicular to the test specimen. If otherwise located, the distance from the center of the exposed surface shall have been less than 20 feet by an amount equal to 1 foot for each 10° of deviation from the perpendicular position. For cable penetration fire stops, per IEEE 634-1978, the nozzle distance shall be 10 ft.

from the center of the exposed surface of the test specimen. (ASTM E-814-83, as described above and IEEE 634-1978, as described above)

Yes No Meets Intent (See Justification)

Discussion: The hose streams applied satisfy the review criteria, ASTM E-814-83, as it relates to the penetration (Reference "Hose-Stream Test Methods" pages 33 and 71).

Justification: Not Applicable

- o. The ambient air temperature at the beginning of the test shall have been within the range of 50°F to 90°F, and the velocity of air across the unexposed surface of the sample shall not exceed 4.4 ft/sec. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The ambient temperature on the unexposed surface of the specimen for this test is assumed to be 80°F. This value is based on the "strip charts" contained in this report. As for the velocity of air across the test specimen, this test was conducted at the Portland Cement Association's fire test facility. This building is described as "virtually draft free."

Justification: Not Applicable

- p. Per IEEE 634-1978 requirements, the assembly shall have withstood the fire endurance test without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side of the penetration for a period equal to that for which classification is desired. Additionally, transmission of heat through the fire stop shall not have been such as to raise the temperature on the unexposed surface above 700°F or the auto-ignition temperature of the outer cable covering, whichever is lower. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since this penetration is a mechanical seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

- q. Per ASTM E-814-83 requirements for an F rating, the assembly shall have withstood the fire endurance test without passage of flame through the opening nor shall there have been any flaming on the unexposed side of the penetration for a period equal to that for which classification is desired. Per ASTM E-814-83 requirements for a T rating, the penetration must have successfully satisfied the F rating criteria. In addition, to obtain a T rating the transmission of heat through the assembly during the fire endurance test shall not have been such to raise the temperature on any unexposed surface thermocouple more than 325°F above its initial temperature. (ASTM E-814-83)

Yes No Meets Intent (See Justification)

Discussion: The fire test meets the intent of the review criteria. The fire test indicates that there was no passage of flame or gases on the unexposed side of the penetration.

The maximum temperature achieved by the surface thermocouple for the steel substrate was 330°F on thermocouple #1 (Reference "strip charts" of the test report).

The maximum temperature achieved by the surface thermocouple for the concrete substrate was 390°F on thermocouple #6 (Reference "strip charts" of the test report).

Both concrete substrate, and the steel substrate did not exceed the 405°F (325°F plus ambient) temperature.

Justification: Not Applicable

- r. The assembly shall have withstood the hose stream test without passage of water. The assembly shall have been considered to have failed if a through opening had developed which permitted a projection of water beyond the unexposed surface at any time during the hose stream test. (ASTM E-814-83 and IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: The fire test satisfies the review criteria. The Summary of the fire test report states that no water projected beyond the unexposed side of reviewed seal assembly during the hose stream tests.

Justification: Not Applicable

- s. Per IEEE 634-1978, Individual components of the fire stop system shall have a flame spread rating of 25 or less as determined by ASTM E-84. Components to which ASTM E-84 is not applicable shall be tested in accordance with ASTM D2863 and shall have a minimum limiting oxygen index of 25. (IEEE 634-1978)

Yes No Meets Intent (See Justification)

Discussion: Not Applicable. Since this penetration is a mechanical seal, IEEE 634 requirements do not apply.

Justification: Not Applicable

APPENDIX D

**AREA COMPARISON OF THE
ASTM E-119 STANDARD TIME VS. TEMPERATURE CURVE
TO THE TESTED TIME VS. TEMPERATURE CURVES**

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1.0 INTRODUCTION

The purpose of this attachment was to provide a method of determining the percent difference between the area under the standard time vs. furnace temperature curve (from ASTM E-119-73) and the areas under actual time vs. furnace temperature curves plotted from data generated during penetration seal fire tests. The results of this calculation are used to support the resolution of standard checklist item "c" for each fire test reviewed in Section 6.0 of this appendix.

2.0 SCOPE

The scope of this calculation included penetration seal fire tests referenced in Sections 7.2 through 7.32 of this appendix.

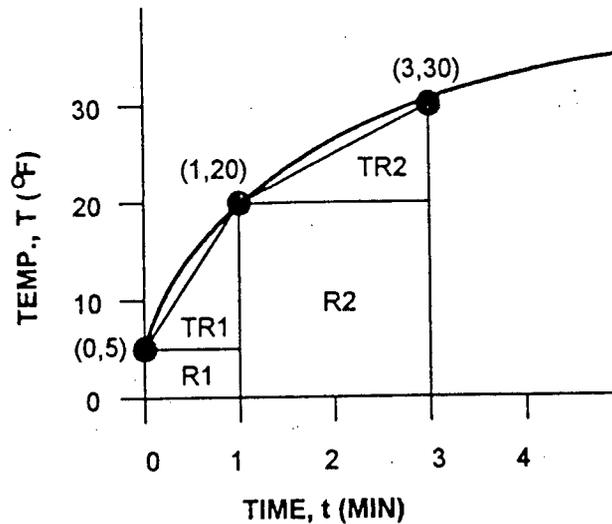
3.0 ASSUMPTIONS/ LIMITATIONS

- 3.1 For any given time vs. furnace temperature curve, dividing the area under the curve into rectangular and triangular areas based on recorded data and then calculating and summing these smaller areas results in the area under the curve.
- 3.2 If the method described in Section 3.1 was consistently applied to all time vs. temperature curves within the scope of this calculation, then, when two curve areas were compared, the accuracy of the comparison was reasonably high.

4.0 METHODOLOGY

- 4.1 Plot time vs. furnace temperature data in graph form using data from ASTM E-119, 1973 edition (HRS:MIN vs. °F). Sketch a curve established by the data points.
 - 4.2 Divide the area under the curve into rectangles and triangles whose areas can be easily calculated (i.e.; base and height dimensions are defined by all the data points provided). An example is shown at the top of the next page.
-

EXAMPLE:



4.3 Calculate the area ($^{\circ}\text{F} \times \text{MIN}$) for all triangles and rectangles as follows:

For rectangles, the formula for calculating area is:

$$\text{Area} = b \times h$$

Where: b = Time increment between temperature readings (Min.)

h = Temperature at the start of the time increment " b " ($^{\circ}\text{F}$)

In the example above, area of $R1 = b \times h$
 $= (1)(5)$
 $= 5 \text{ } ^{\circ}\text{F} \times \text{MIN}$

For triangles, the formula for calculating area is:

$$\text{Area} = 1/2 (b \times h)$$

Where: b = Time increment between temperature readings (MIN.)

h = Temperature at the end of the time increment " b " minus the temperature at the start of time increment " b " ($^{\circ}\text{F}$)

$$\begin{aligned}\text{In the example above, area of } TR1 &= 1/2 (b \times h) \\ &= 1/2 (1)(20-5) \\ &= 7.5^\circ\text{F} \times \text{MIN}\end{aligned}$$

- 4.4 Sum the triangular and rectangular areas calculated in Section 4.3. The total is the area under the time vs. furnace temperature curve.
- 4.5 For each fire test containing time vs. temperature data, calculate the area under the curve using the sequence outlined in Sections 4.2 through 4.4.
- 4.6 Calculate percent difference between each fire test and the E-119 time vs. temperature curve as follows:

$$\frac{(\text{Fire Test Area}) - (\text{E-119 Area})}{\text{E-119 Area}} \times 100 = \% \text{ Difference}$$

Tabulate this value for each fire test and summarize in section **6.0 RESULTS** of this appendix.

5.0 CALCULATIONS

5.1 ASTM E-119 and Fire Test Report Curve Calculations

The following sections contain calculations based on the methodology described in section 4.0. For each Fire Test, calculation spreadsheets are provided for the ASTM E-119 Curve as well as for the actual furnace atmosphere thermocouple readings from the applicable fire test.

Each table lists time and temperature data and provides individual rectangular and triangular areas which were then summed to determine the curve area calculation. The calculated percent difference is provided, and a graph containing both time vs. temperature curves is shown on the following page. Results of the Percent Difference calculations are tabulated in section 6.0 of this appendix.

5.1.1 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0985011

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0985011

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	80	0	0
00:05	1100	400	2550
00:10	1355	5500	637.5
00:15	1416	6775	152.5
00:20	1457	7080	102.5
00:25	1521	7285	160
00:30	1562	7605	102.5
00:35	1585	7810	57.5
00:40	1615	7925	75
00:45	1639	8075	60
00:50	1641	8195	5
00:55	1679	8205	95
01:00	1694	8395	37.5
01:05	1708	8470	35
01:10	1735	8540	67.5
01:15	1752	8675	42.5
01:20	1760	8760	20
01:25	1774	8800	35
01:30	1777	8870	7.5
01:35	1799	8885	55
01:40	1811	8995	30
01:45	1818	9055	17.5
01:50	1831	9090	32.5
01:55	1836	9155	12.5
02:00	1842	9180	15
02:10	1862	18420	100
02:20	1865	18620	15
02:30	1883	18650	90
02:40	1888	18830	25
02:50	1902	18880	70
03:00	1908	19020	30

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302145 deg.F-min.
 Sum of Triangular Areas: 4735 deg.F-min.

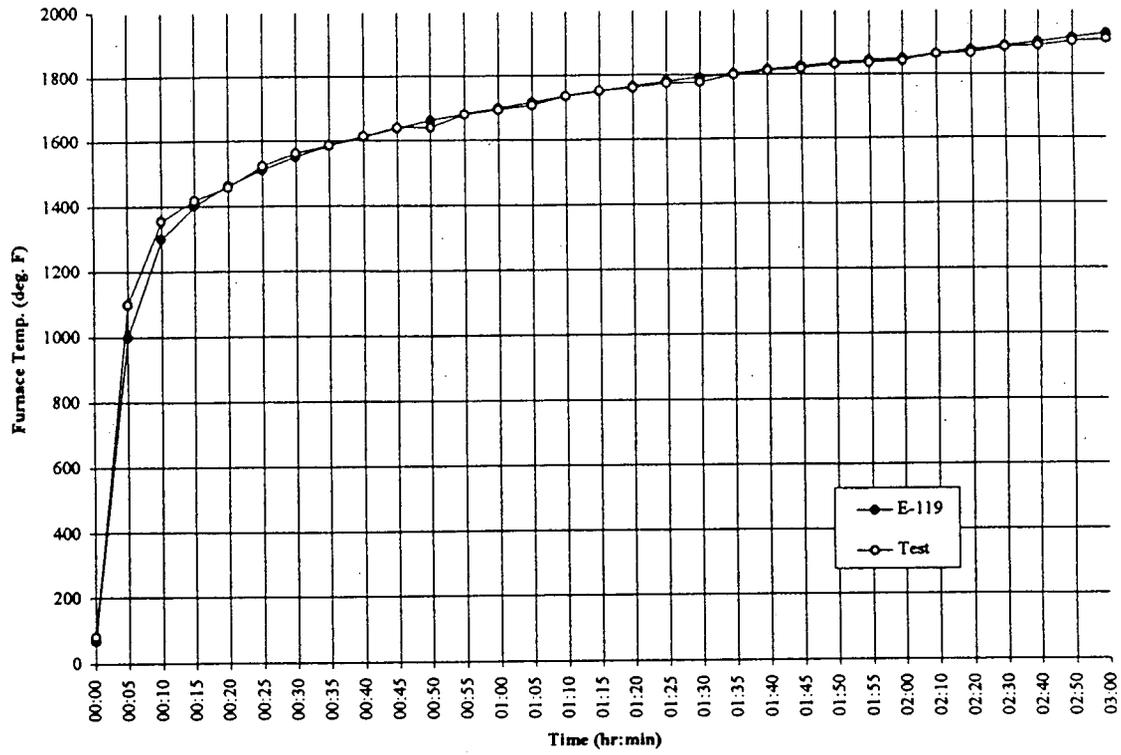
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306880 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.013%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0985011



5.1.2 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC1185020

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC1185020

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	83	0	0
00:05	1015	415	2330
00:10	1311	5075	740
00:15	1382	6555	177.5
00:20	1462	6910	200
00:25	1510	7310	120
00:30	1549	7550	97.5
00:35	1581	7745	80
00:40	1606	7905	62.5
00:45	1629	8030	57.5
00:50	1659	8145	75
00:55	1686	8295	67.5
01:00	1705	8430	47.5
01:05	1722	8525	42.5
01:10	1728	8610	15
01:15	1740	8640	30
01:20	1766	8700	65
01:25	1778	8830	30
01:30	1797	8890	47.5
01:35	1807	8985	25
01:40	1813	9035	15
01:45	1821	9065	20
01:50	1830	9105	22.5
01:55	1846	9150	40
02:00	1859	9230	32.5
02:10	1865	18590	30
02:20	1877	18650	60
02:30	1881	18770	20
02:40	1899	18810	90
02:50	1921	18990	110
03:00	1926	19210	25

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302150 deg.F-min.
 Sum of Triangular Areas: 4775 deg.F-min.

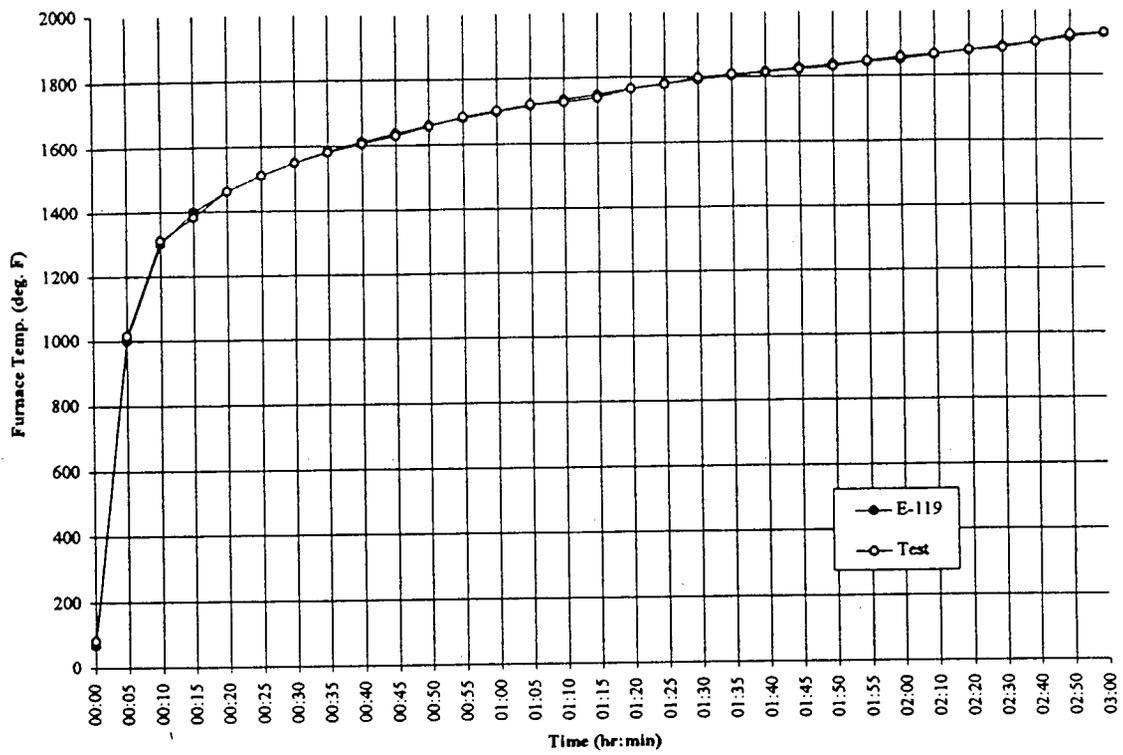
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306925 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.028%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC1185020



5.1.3 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0386021

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # 386021

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	75	0	0
00:05	1050	375	2437.5
00:10	1374	5250	810
00:15	1421	6870	117.5
00:20	1444	7105	57.5
00:25	1441	7220	-7.5
00:30	1527	7205	215
00:35	1573	7635	115
00:40	1610	7865	92.5
00:45	1635	8050	62.5
00:50	1671	8175	90
00:55	1683	8355	30
01:00	1681	8415	-5
01:05	1704	8405	57.5
01:10	1727	8520	57.5
01:15	1766	8635	97.5
01:20	1776	8830	25
01:25	1787	8880	27.5
01:30	1787	8935	0
01:35	1796	8935	22.5
01:40	1805	8980	22.5
01:45	1825	9025	50
01:50	1834	9125	22.5
01:55	1845	9170	27.5
02:00	1850	9225	12.5
02:10	1862	18500	60
02:20	1872	18620	50
02:30	1887	18720	75
02:40	1900	18870	65
02:50	1910	19000	50
03:00	1922	19100	60

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 301995 deg.F-min.
 Sum of Triangular Areas: 4797.5 deg.F-min.

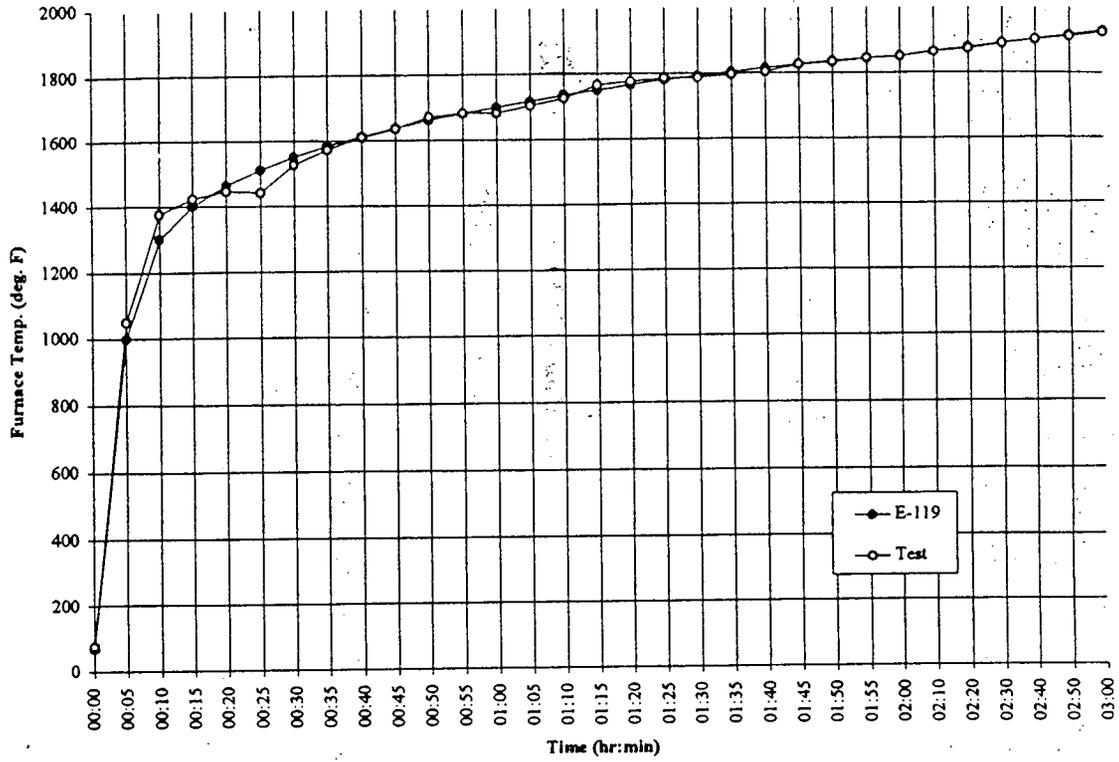
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306792.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.015%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # 386021



5.1.4 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0483032

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # 483032

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	73	0	0
00:05	1051	365	2445
00:10	1291	5255	600
00:15	1391	6455	250
00:20	1465	6955	185
00:25	1507	7325	105
00:30	1553	7535	115
00:35	1578	7765	62.5
00:40	1611	7890	82.5
00:45	1642	8055	77.5
00:50	1654	8210	30
00:55	1689	8270	87.5
01:00	1689	8445	0
01:05	1720	8445	77.5
01:10	1721	8600	2.5
01:15	1758	8605	92.5
01:20	1757	8790	-2.5
01:25	1765	8785	20
01:30	1785	8825	50
01:35	1816	8925	77.5
01:40	1819	9080	7.5
01:45	1831	9095	30
01:50	1843	9155	30
01:55	1848	9215	12.5
02:00	1854	9240	15
02:10	1870	18540	80
02:20	1875	18700	25
02:30	1885	18750	50
02:40	1903	18850	90
02:50	1911	19030	40
03:00	1927	19110	80

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302265 deg.F-min.
 Sum of Triangular Areas: 4817.5 deg.F-min.

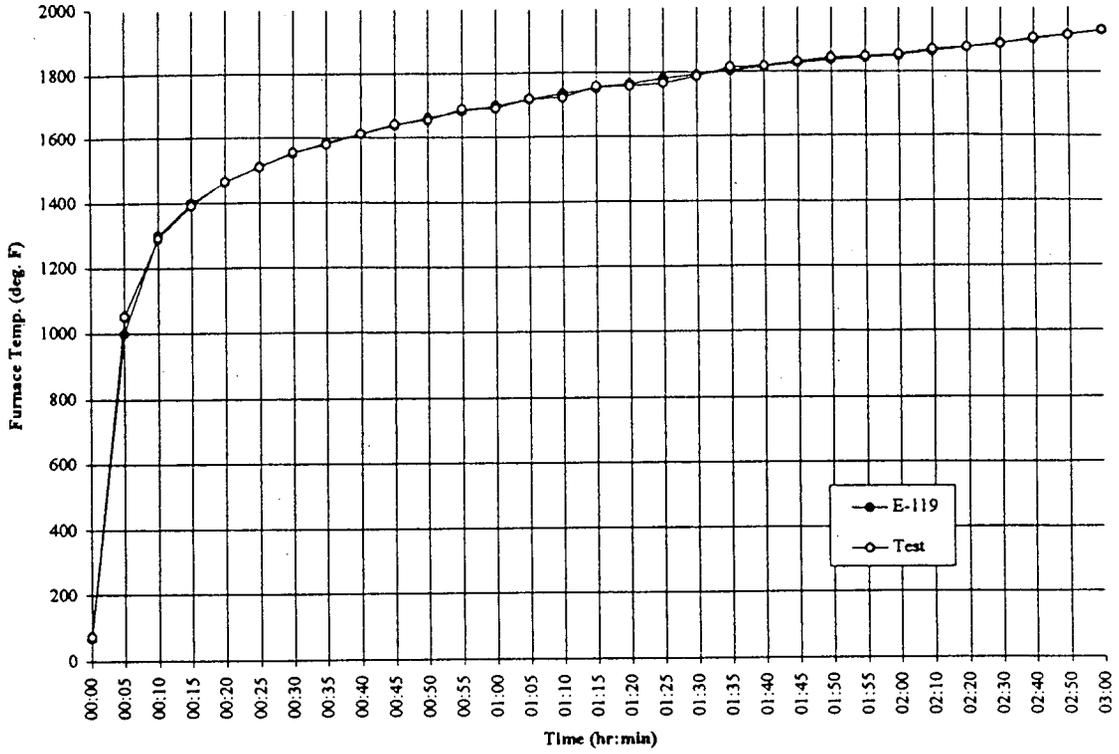
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 307082.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.079%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # 483032



5.1.5 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0386017

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0386017

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	79	0	0
00:05	984	395	2262.5
00:10	1384	4920	1000
00:15	1434	6920	125
00:20	1437	7170	7.5
00:25	1541	7185	260
00:30	1587	7705	115
00:35	1580	7935	-17.5
00:40	1622	7900	105
00:45	1650	8110	70
00:50	1645	8250	-12.5
00:55	1667	8225	55
01:00	1692	8335	62.5
01:05	1715	8460	57.5
01:10	1730	8575	37.5
01:15	1744	8650	35
01:20	1768	8720	60
01:25	1782	8840	35
01:30	1780	8910	-5
01:35	1795	8900	37.5
01:40	1800	8975	12.5
01:45	1822	9000	55
01:50	1834	9110	30
01:55	1837	9170	7.5
02:00	1851	9185	35
02:10	1868	18510	85
02:20	1859	18680	-45
02:30	1874	18590	75
02:40	1893	18740	95
02:50	1914	18930	105
03:00	1915	19140	5

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302135 deg.F-min.
 Sum of Triangular Areas: 4750 deg.F-min.

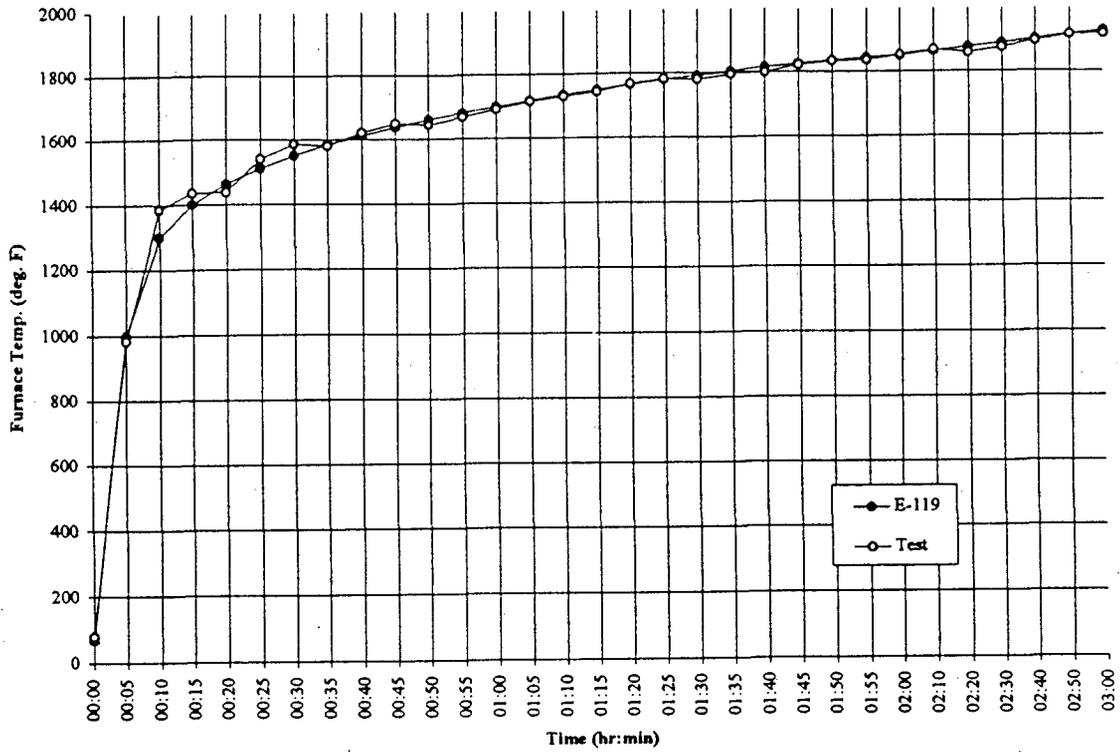
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306885 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.015%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0386017



5.1.6 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0286016

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0286016

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	77	0	0
00:05	923	385	2115
00:10	1325	4615	1005
00:15	1409	6625	210
00:20	1483	7045	185
00:25	1527	7415	110
00:30	1559	7635	80
00:35	1589	7795	75
00:40	1616	7945	67.5
00:45	1638	8080	55
00:50	1654	8190	40
00:55	1669	8270	37.5
01:00	1693	8345	60
01:05	1709	8465	40
01:10	1733	8545	60
01:15	1743	8665	25
01:20	1750	8715	17.5
01:25	1775	8750	62.5
01:30	1788	8875	32.5
01:35	1807	8940	47.5
01:40	1824	9035	42.5
01:45	1828	9120	10
01:50	1837	9140	22.5
01:55	1858	9185	52.5
02:00	1862	9290	10
02:10	1880	18620	90
02:20	1886	18800	30
02:30	1885	18860	-5
02:40	1899	18850	70
02:50	1897	18990	-10
03:00	1917	18970	100

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302160 deg.F-min.
 Sum of Triangular Areas: 4737.5 deg.F-min.

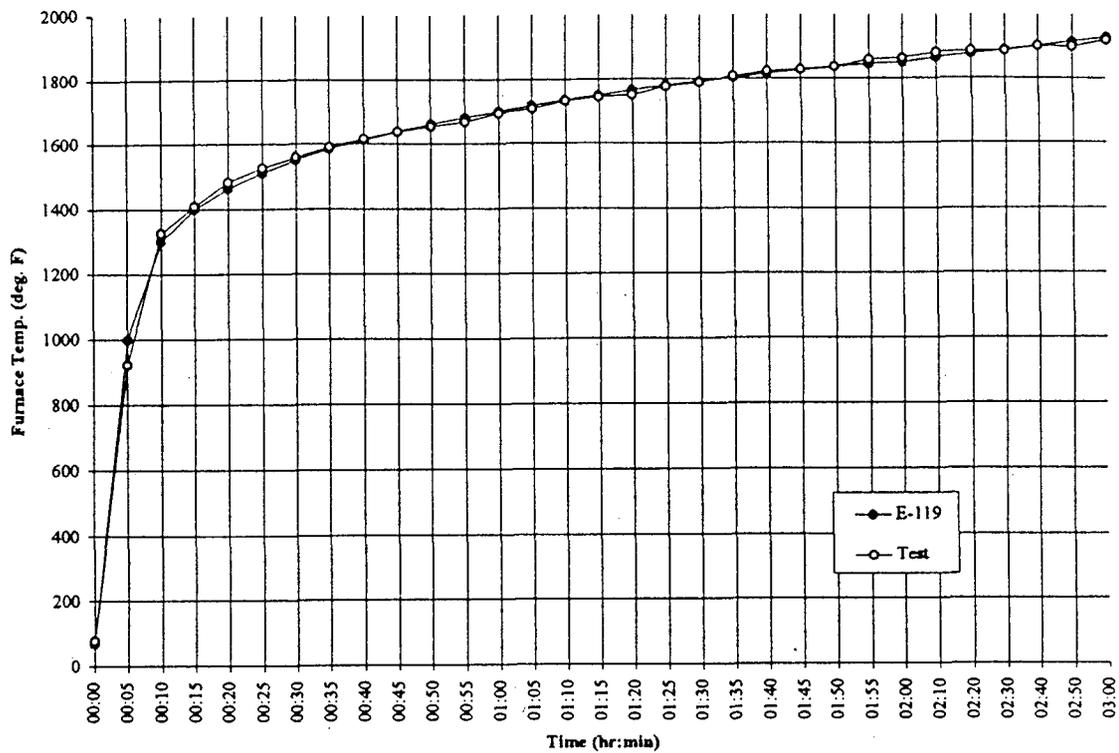
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306897.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.019%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0286016



5.1.7 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC1088024

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC1088024

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	76	0	0
00:05	1067	380	2477.5
00:10	1372	5335	762.5
00:15	1463	6860	227.5
00:20	1485	7315	55
00:25	1481	7425	-10
00:30	1536	7405	137.5
00:35	1588	7680	130
00:40	1626	7940	95
00:45	1637	8130	27.5
00:50	1659	8185	55
00:55	1691	8295	80
01:00	1711	8455	50
01:05	1728	8555	42.5
01:10	1743	8640	37.5
01:15	1762	8715	47.5
01:20	1780	8810	45
01:25	1796	8900	40
01:30	1798	8980	5
01:35	1797	8990	-2.5
01:40	1797	8985	0
01:45	1796	8985	-2.5
01:50	1821	8980	62.5
01:55	1829	9105	20
02:00	1834	9145	12.5
02:10	1851	18340	85
02:20	1870	18510	95
02:30	1878	18700	40
02:40	1880	18780	10
02:50	1889	18800	45
03:00	1911	18890	110

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302215 deg.F-min.
 Sum of Triangular Areas: 4780 deg.F-min.

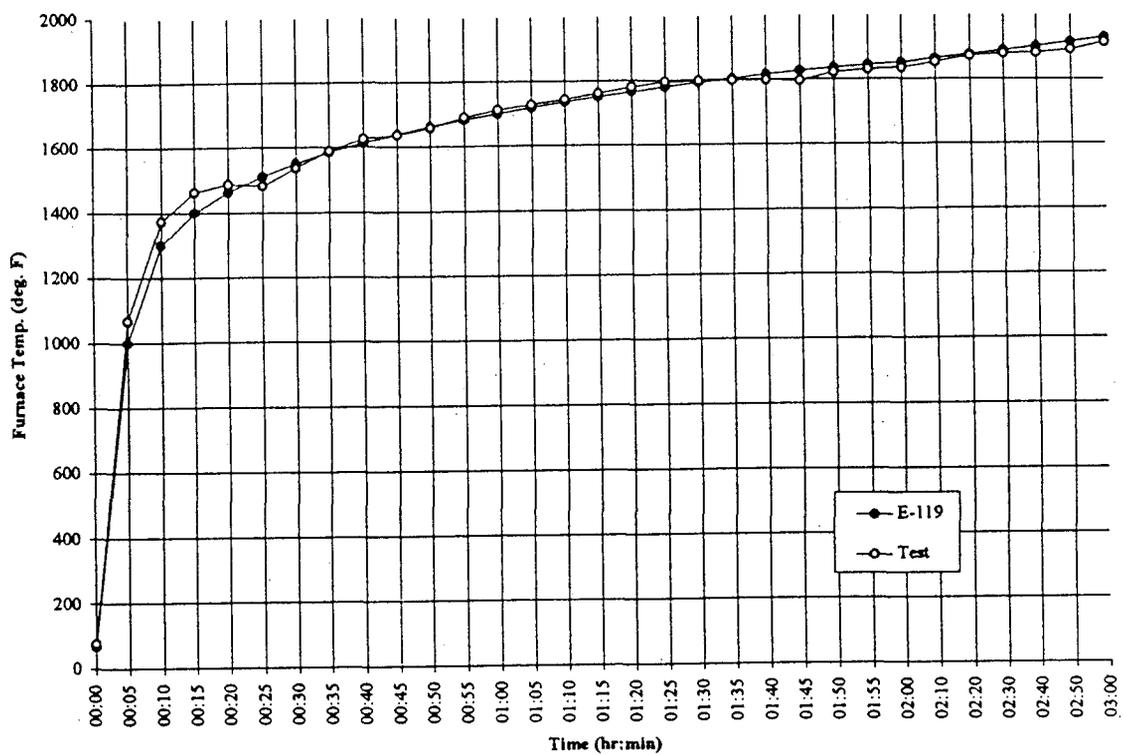
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306995 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.051%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC1088024



5.1.8 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0682008

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0682008

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	71	0	0
00:05	1137	355	2665
00:10	1293	5685	390
00:15	1416	6465	307.5
00:20	1456	7080	100
00:25	1502	7280	115
00:30	1537	7510	87.5
00:35	1595	7685	145
00:40	1609	7975	35
00:45	1629	8045	50
00:50	1665	8145	90
00:55	1679	8325	35
01:00	1700	8395	52.5
01:05	1711	8500	27.5
01:10	1730	8555	47.5
01:15	1752	8650	55
01:20	1760	8760	20
01:25	1777	8800	42.5
01:30	1793	8885	40
01:35	1797	8965	10
01:40	1823	8985	65
01:45	1844	9115	52.5
01:50	1846	9220	5
01:55	1848	9230	5
02:00	1852	9240	10
02:10	1867	18520	75
02:20	1882	18670	75
02:30	1883	18820	5
02:40	1903	18830	100
02:50	1900	19030	-15
03:00	1943	19000	215

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302720 deg.F-min.
 Sum of Triangular Areas: 4907.5 deg.F-min.

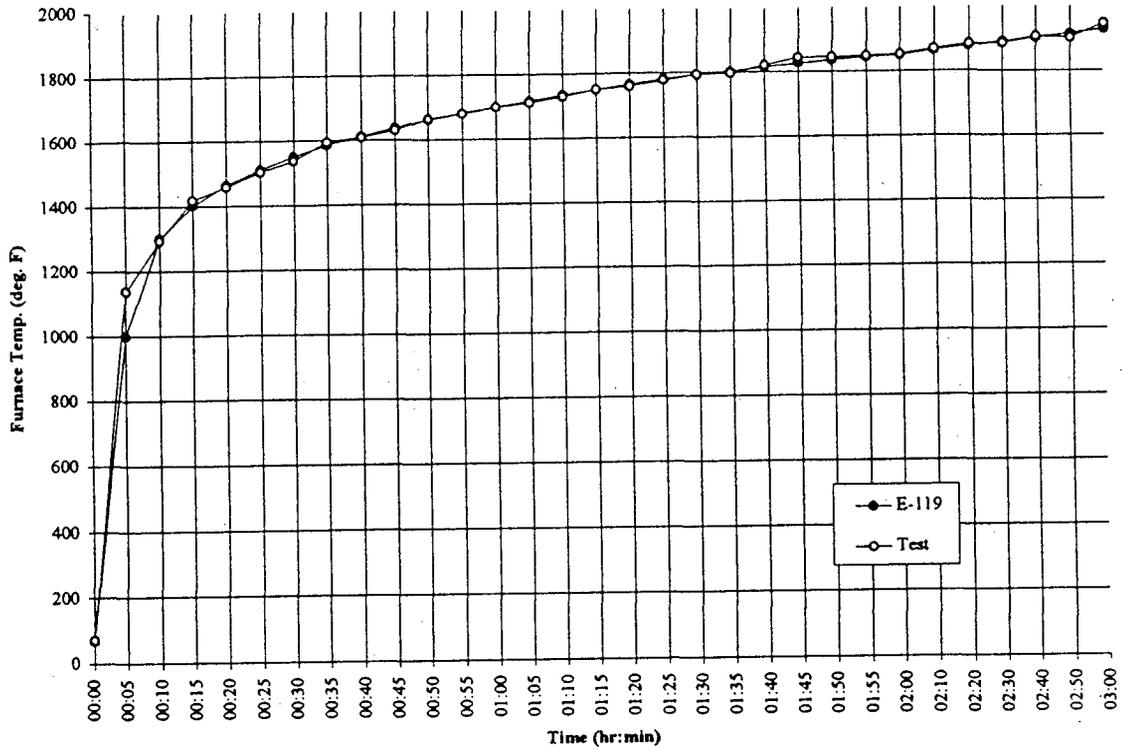
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 307627.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.257%

Based on the three hour duration of this fire test, the the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0682008



5.1.9 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICF0277001

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

*Fire Test Report # ICF0277001 (minimum)**

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	60	0	0
00:05	1080	300	2550
00:10	1180	5400	250
00:15	1320	5900	350
00:20	1400	6600	200
00:25	1420	7000	50
00:30	1540	7100	300
00:35	1560	7700	50
00:40	1590	7800	75
00:45	1620	7950	75
00:50	1660	8100	100
00:55	1700	8300	100
01:00	1710	8500	25
01:05	1720	8550	25
01:10	1740	8600	50
01:15	1750	8700	25
01:20	1760	8750	25
01:25	1780	8800	50
01:30	1780	8900	0
01:35	1810	8900	75
01:40	1820	9050	25
01:45	1830	9100	25
01:50	1840	9150	25
01:55	1840	9200	0
02:00	1850	9200	25
02:10	1860	18500	50
02:20	1880	18600	100
02:30	1900	18800	100
02:40	1880	19000	-100
02:50	1890	18800	50
03:00	1860	18900	-150

Sum of Rectangular Areas: deg.F-min.
 Sum of Triangular Areas: deg.F-min.

Sum of Rectangular Areas: deg.F-min.
 Sum of Triangular Areas: deg.F-min.

Total Area Under E-119 Curve: deg.F-min.

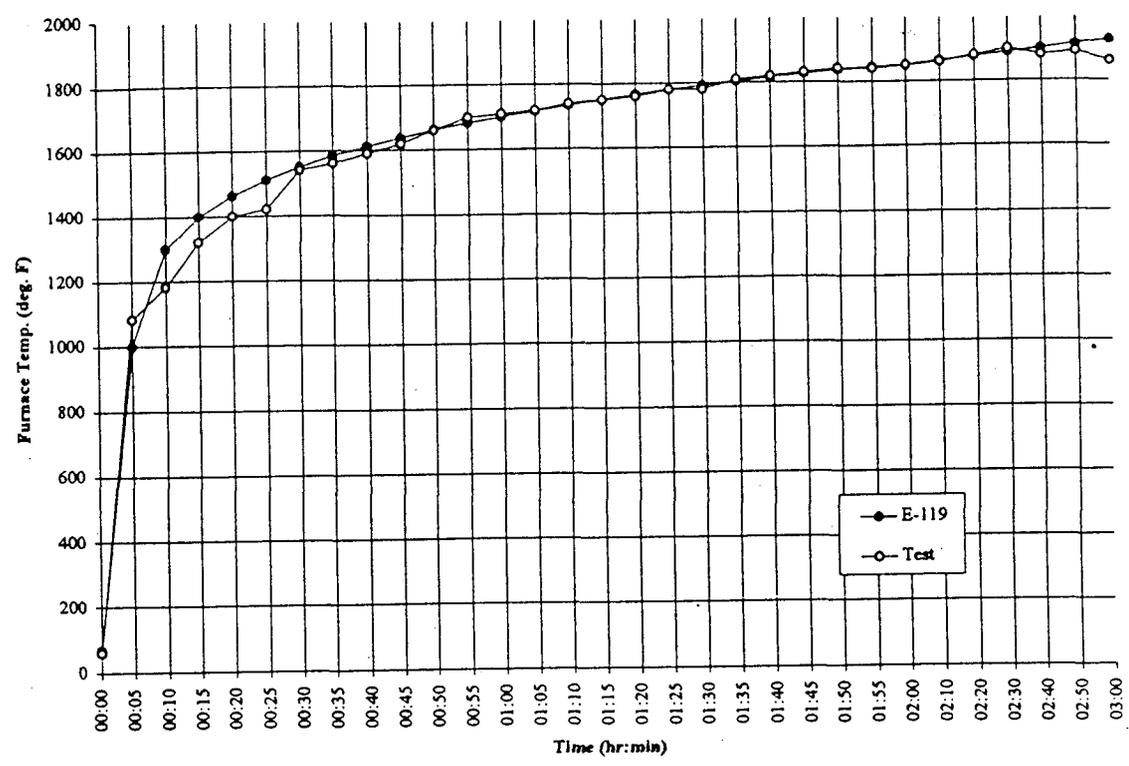
Total Area Under Test Curve: deg.F-min.

% Difference (E-119 Area vs. Test Area):

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

* Due to the print quality of the furnace thermocouple "strip charts", a maximum and minimum set of temperature values were derived. By evaluating the results of each set, it can be established whether the average area under the actual time vs. temperature curve is within the 5% limit of the ASTM E-119 curve.

Fire Test Report # ICF0277001 (minimum)*



ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Total Area Under E-119 Curve: 306840 deg.F-min.

Fire Test Report # ICF0277001 (maximum)*

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	60	0	0
00:05	1260	300	3000
00:10	1340	6300	200
00:15	1405	6700	162.5
00:20	1480	7025	187.5
00:25	1520	7400	100
00:30	1600	7600	200
00:35	1650	8000	125
00:40	1660	8250	25
00:45	1690	8300	75
00:50	1720	8450	75
00:55	1740	8600	50
01:00	1760	8700	50
01:05	1760	8800	0
01:10	1770	8800	25
01:15	1790	8850	50
01:20	1820	8950	75
01:25	1820	9100	0
01:30	1830	9100	25
01:35	1850	9150	50
01:40	1850	9250	0
01:45	1860	9250	25
01:50	1870	9300	25
01:55	1870	9350	0
02:00	1880	9350	25
02:10	1900	18800	100
02:20	1920	19000	100
02:30	1930	19200	50
02:40	1910	19300	-100
02:50	1930	19100	100
03:00	1920	19300	-50

Sum of Rectangular Areas: 309575 deg.F-min.
 Sum of Triangular Areas: 4750 deg.F-min.

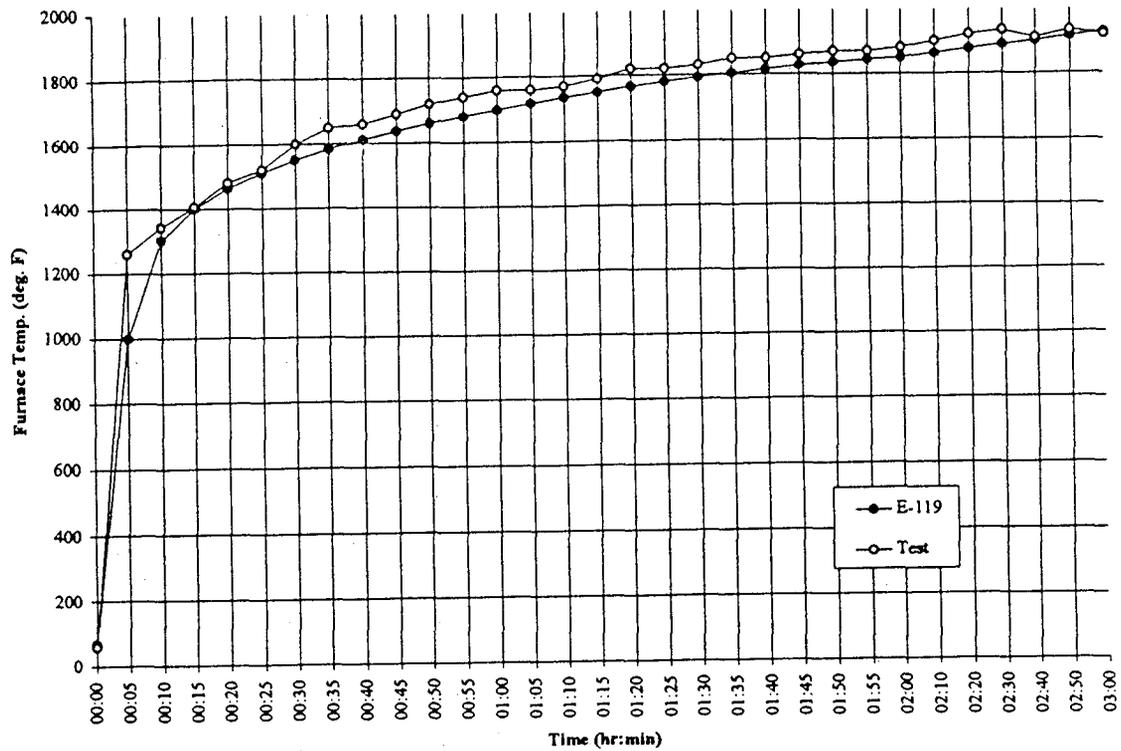
Total Area Under Test Curve: 314325 deg.F-min.

% Difference (E-119 Area vs. Test Area): 2.439%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

* Due to the print quality of the furnace thermocouple "strip charts", a maximum and minimum set of temperature values were derived. By evaluating the results of each set, it can be established whether the average area under the actual time vs. temperature curve is within the 5% limit of the ASTM E-119 curve.

Fire Test Report # ICF0277001 (maximum)*



5.1.10 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0186015

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0186015

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	71	0	0
00:05	939	355	2170
00:10	1309	4695	925
00:15	1412	6545	257.5
00:20	1479	7060	167.5
00:25	1522	7395	107.5
00:30	1562	7610	100
00:35	1594	7810	80
00:40	1624	7970	75
00:45	1640	8120	40
00:50	1640	8200	0
00:55	1670	8200	75
01:00	1686	8350	40
01:05	1705	8430	47.5
01:10	1727	8525	55
01:15	1752	8635	62.5
01:20	1760	8760	20
01:25	1775	8800	37.5
01:30	1784	8875	22.5
01:35	1804	8920	50
01:40	1818	9020	35
01:45	1833	9090	37.5
01:50	1839	9165	15
01:55	1844	9195	12.5
02:00	1852	9220	20
02:10	1876	18520	120
02:20	1883	18760	35
02:30	1898	18830	75
02:40	1904	18980	30
02:50	1903	19040	-5
03:00	1930	19030	135

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302105 deg.F-min.
 Sum of Triangular Areas: 4842.5 deg.F-min.

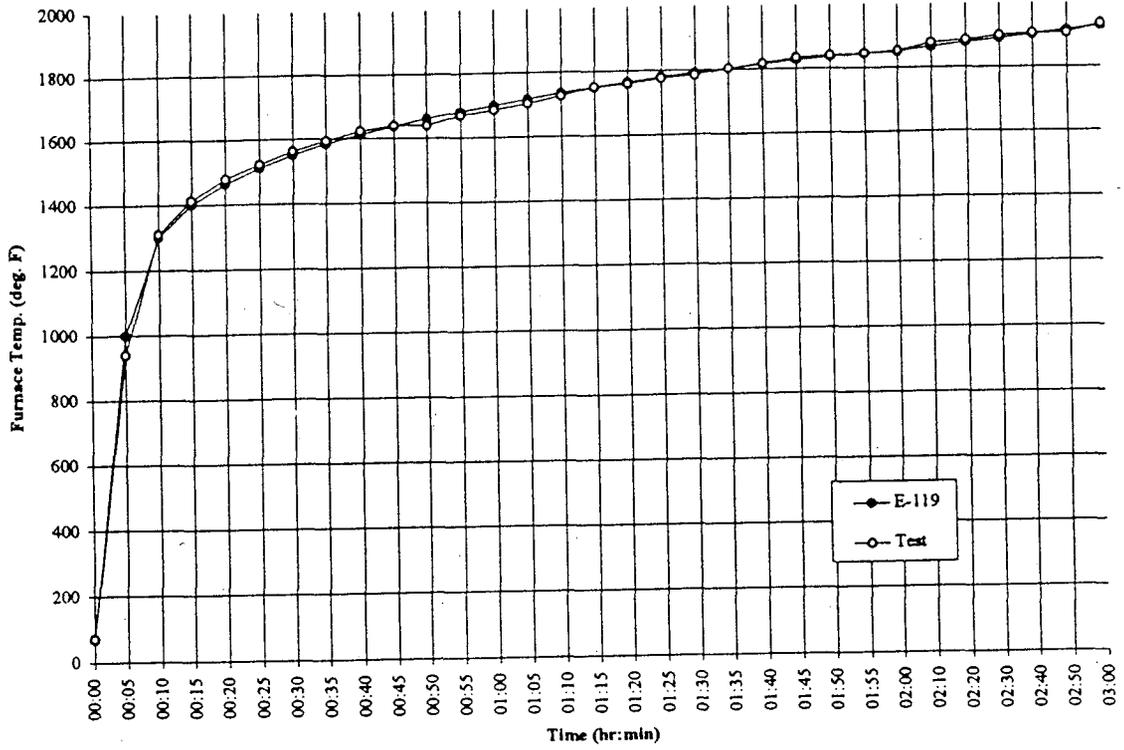
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306947.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.035%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0186015



5.1.11 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0386014

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0386014

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	72	0	0
00:05	948	360	2190
00:10	1342	4740	985
00:15	1451	6710	272.5
00:20	1541	7255	225
00:25	1631	7705	225
00:30	1697	8155	165
00:35	1682	8485	-37.5
00:40	1657	8410	-62.5
00:45	1624	8285	-82.5
00:50	1656	8120	80
00:55	1650	8280	-15
01:00	1664	8250	35
01:05	1725	8320	152.5
01:10	1732	8625	17.5
01:15	1760	8660	70
01:20	1750	8800	-25
01:25	1760	8750	25
01:30	1756	8800	-10
01:35	1764	8780	20
01:40	1798	8820	85
01:45	1837	8990	97.5
01:50	1822	9185	-37.5
01:55	1803	9110	-47.5
02:00	1794	9015	-22.5
02:10	1866	17940	360
02:20	1887	18660	105
02:30	1860	18870	-135
02:40	1938	18600	390
02:50	1933	19380	-25
03:00	1895	19330	-190

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 303390 deg.F-min.
 Sum of Triangular Areas: 4810 deg.F-min.

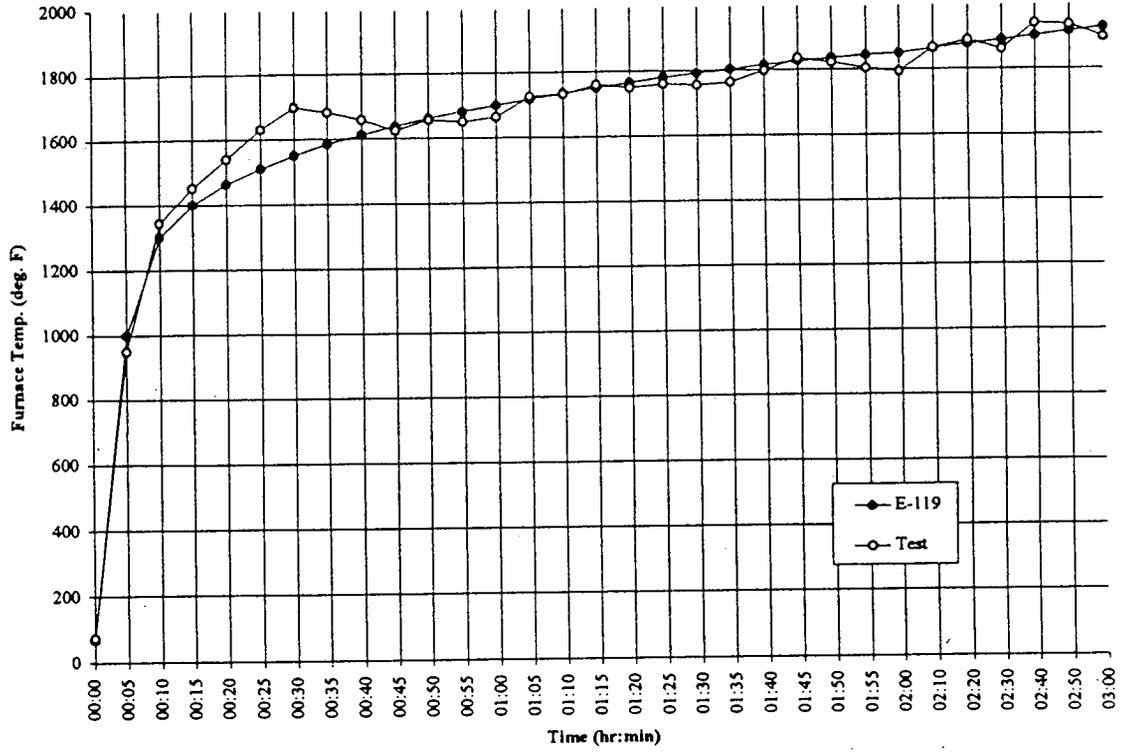
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 308200 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.443%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0386014



5.1.12 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0582007

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0582007

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	78	0	0
00:05	1007	390	2322.5
00:10	1262	5035	637.5
00:15	1392	6310	325
00:20	1461	6960	172.5
00:25	1515	7305	135
00:30	1547	7575	80
00:35	1582	7735	87.5
00:40	1613	7910	77.5
00:45	1629	8065	40
00:50	1650	8145	52.5
00:55	1665	8250	37.5
01:00	1703	8325	95
01:05	1716	8515	32.5
01:10	1738	8580	55
01:15	1745	8690	17.5
01:20	1764	8725	47.5
01:25	1772	8820	20
01:30	1793	8860	52.5
01:35	1805	8965	30
01:40	1811	9025	15
01:45	1827	9055	40
01:50	1834	9135	17.5
01:55	1847	9170	32.5
02:00	1852	9235	12.5
02:10	1872	18520	100
02:20	1874	18720	10
02:30	1882	18740	40
02:40	1900	18820	90
02:50	1911	19000	55
03:00	1929	19110	90

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 301690 deg.F-min.
 Sum of Triangular Areas: 4820 deg.F-min.

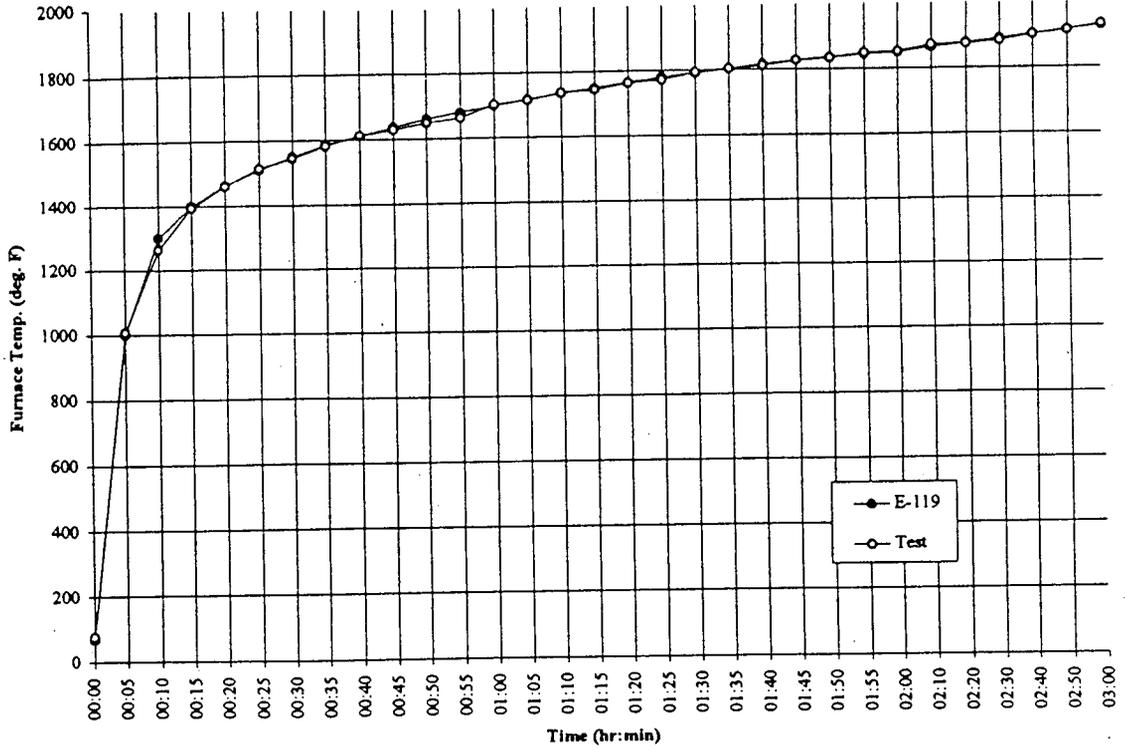
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306510 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.108%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0582007



5.1.13 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0386023

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0386023

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	81	0	0
00:05	543	405	1155
00:10	1261	2715	1795
00:15	1503	6305	605
00:20	1535	7515	80
00:25	1589	7675	135
00:30	1594	7945	12.5
00:35	1598	7970	10
00:40	1639	7990	102.5
00:45	1666	8195	67.5
00:50	1683	8330	42.5
00:55	1683	8415	0
01:00	1697	8415	35
01:05	1740	8485	107.5
01:10	1747	8700	17.5
01:15	1764	8735	42.5
01:20	1782	8820	45
01:25	1790	8910	20
01:30	1805	8950	37.5
01:35	1812	9025	17.5
01:40	1821	9060	22.5
01:45	1829	9105	20
01:50	1838	9145	22.5
01:55	1850	9190	30
02:00	1860	9250	25
02:10	1867	18600	35
02:20	1863	18670	-20
02:30	1876	18630	65
02:40	1897	18760	105
02:50	1923	18970	130
03:00	1933	19230	50

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302110 deg.F-min.
 Sum of Triangular Areas: 4812.5 deg.F-min.

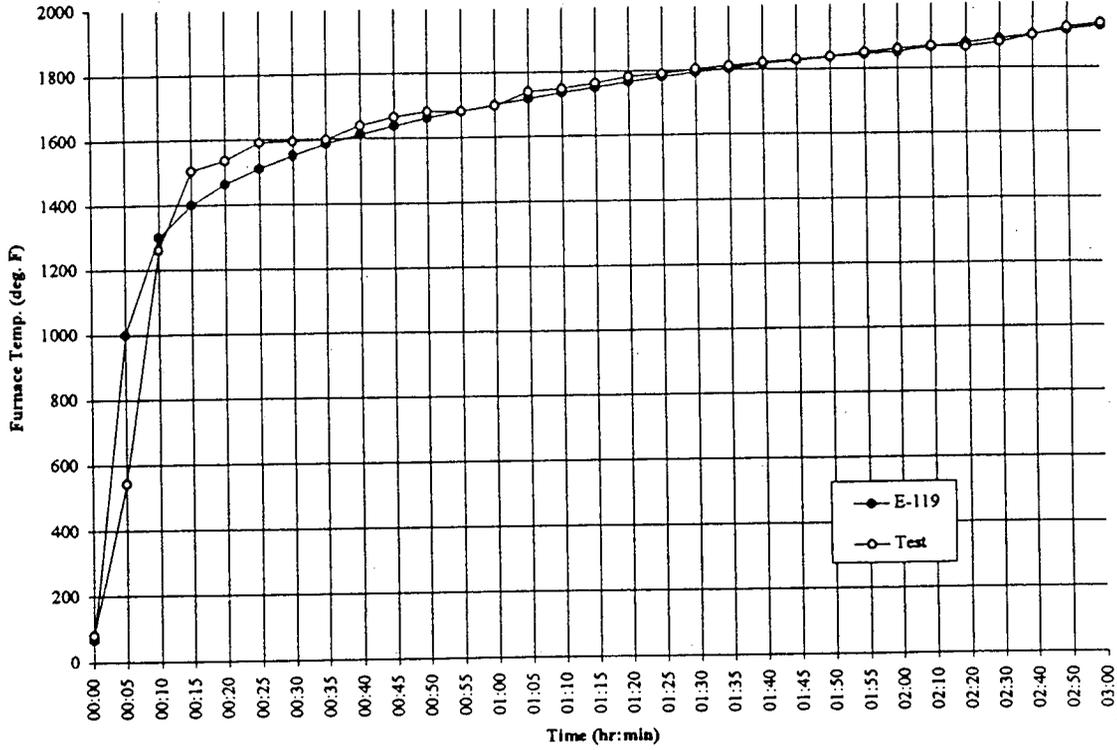
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306922.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.027%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0386023



5.1.14 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0109035

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # IC01091035 (slab #1)

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	83	0	0
00:05	881	415	1995
00:10	1275	4405	985
00:15	1397	6375	305
00:20	1474	6985	192.5
00:25	1509	7370	87.5
00:30	1545	7545	90
00:35	1585	7725	100
00:40	1622	7925	92.5
00:45	1630	8110	20
00:50	1665	8150	87.5
00:55	1688	8325	57.5
01:00	1696	8440	20
01:05	1703	8480	17.5
01:10	1718	8515	37.5
01:15	1734	8590	40
01:20	1751	8670	42.5
01:25	1764	8755	32.5
01:30	1775	8820	27.5
01:35	1790	8875	37.5
01:40	1797	8950	17.5
01:45	1815	8985	45
01:50	1833	9075	45
01:55	1841	9165	20
02:00	1848	9205	17.5
02:10	1843	18480	-25
02:20	1865	18430	110
02:30	1865	18650	0
02:40	1884	18650	95
02:50	1879	18840	-25
03:00	1916	18790	185

Sum of Rectangular Areas: deg.F-min.
 Sum of Triangular Areas: deg.F-min.

Sum of Rectangular Areas: deg.F-min.
 Sum of Triangular Areas: deg.F-min.

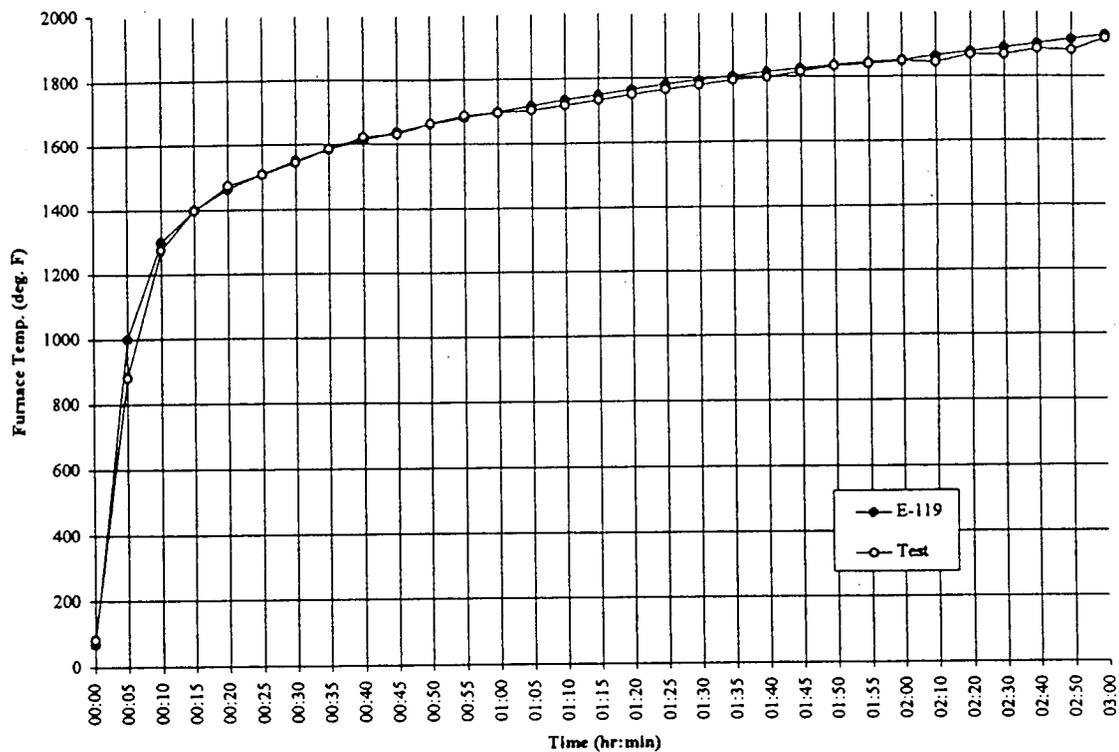
Total Area Under E-119 Curve: deg.F-min.

Total Area Under Test Curve: deg.F-min.

% Difference (E-119 Area vs. Test Area):

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # IC01091035 (slab #1)



ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # IC01091035 (slab #2)

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	78	0	0
00:05	697	390	1547.5
00:10	1153	3485	1140
00:15	1467	5765	785
00:20	1405	7335	-155
00:25	1490	7025	212.5
00:30	1532	7450	105
00:35	1549	7660	42.5
00:40	1559	7745	25
00:45	1608	7795	122.5
00:50	1634	8040	65
00:55	1647	8170	32.5
01:00	1659	8235	30
01:05	1672	8295	32.5
01:10	1693	8360	52.5
01:15	1729	8465	90
01:20	1748	8645	47.5
01:25	1759	8740	27.5
01:30	1773	8795	35
01:35	1778	8865	12.5
01:40	1785	8890	17.5
01:45	1811	8925	65
01:50	1843	9055	80
01:55	1852	9215	22.5
02:00	1866	9260	35
02:10	1856	18660	-50
02:20	1869	18560	65
02:30	1858	18690	-55
02:40	1874	18580	80
02:50	1901	18740	135
03:00	1942	19010	205

Sum of Rectangular Areas: 302010 deg.F-min.
Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 296845 deg.F-min.
Sum of Triangular Areas: 4850 deg.F-min.

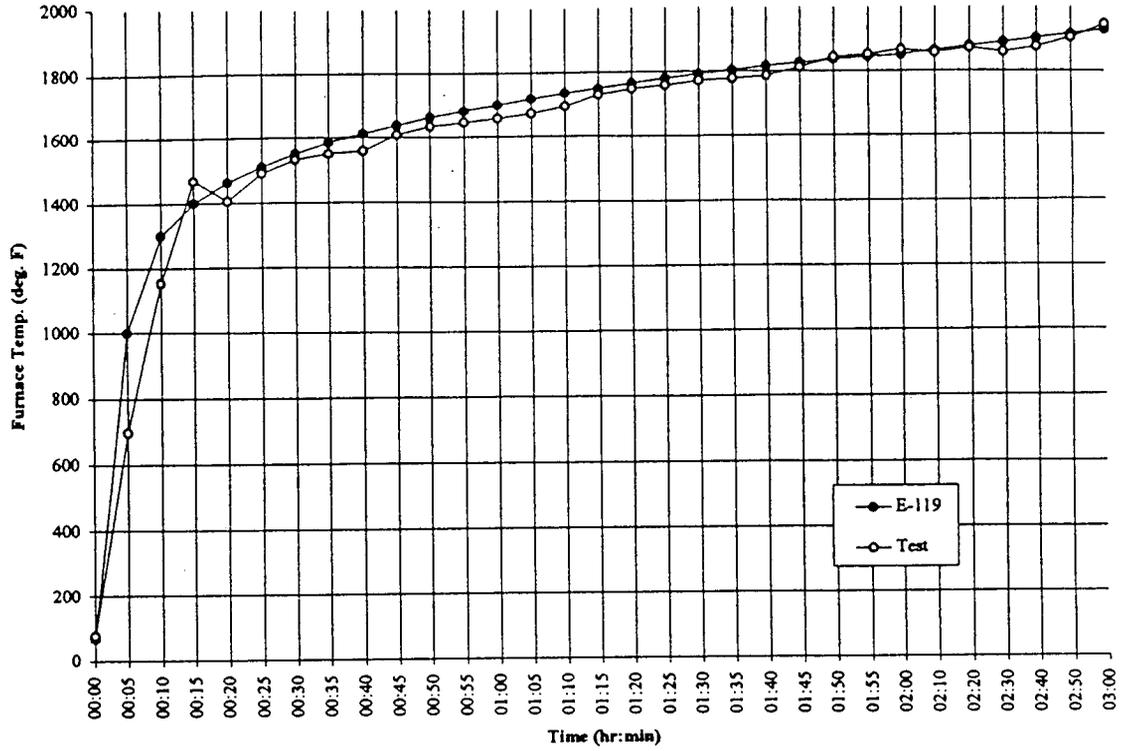
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 301695 deg.F-min.

% Difference (E-119 Area vs. Test Area): -1.677%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # IC01091035 (slab #2)



5.1.15 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICS0879002

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICS0879002

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	86	0	0
00:05	1330	430	3110
00:10	1429	6650	247.5
00:15	1463	7145	85
00:20	1461	7315	-5
00:25	1495	7305	85
00:30	1538	7475	107.5
00:35	1571	7690	82.5
00:40	1603	7855	80
00:45	1632	8015	72.5
00:50	1657	8160	62.5
00:55	1675	8285	45
01:00	1691	8375	40
01:05	1711	8455	50
01:10	1713	8555	5
01:15	1747	8565	85
01:20	1759	8735	30
01:25	1773	8795	35
01:30	1783	8865	25
01:35	1800	8915	42.5
01:40	1811	9000	27.5
01:45	1824	9055	32.5
01:50	1834	9120	25
01:55	1842	9170	20
02:00	1849	9210	17.5
02:10	1855	18490	30
02:20	1864	18550	45
02:30	1894	18640	150
02:40	1893	18940	-5
02:50	1906	18930	65
03:00	1919	19060	65

Sum of Rectangular Areas: deg.F-min.
 Sum of Triangular Areas: deg.F-min.

Sum of Rectangular Areas: deg.F-min.
 Sum of Triangular Areas: deg.F-min.

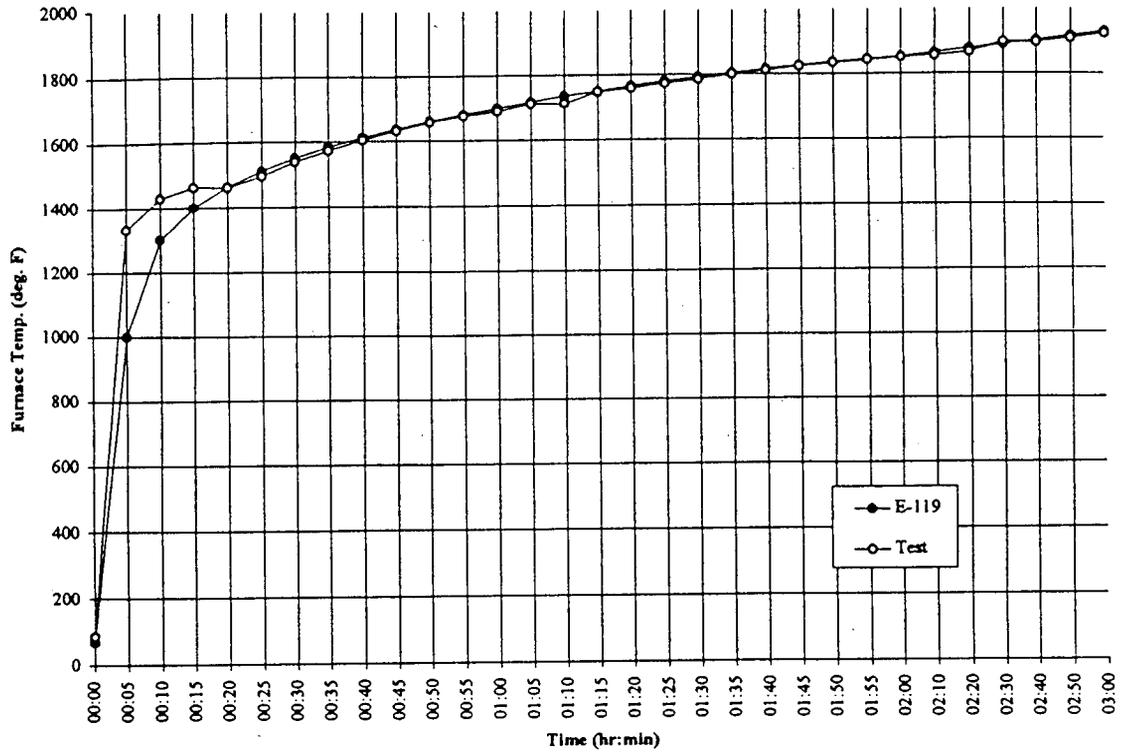
Total Area Under E-119 Curve: deg.F-min.

Total Area Under Test Curve: deg.F-min.

% Difference (E-119 Area vs. Test Area):

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICS0879002



5.1.16 Time vs. Temperature Data For ASTM E-119 vs. Fire Test CTP-1002

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # CTP-1002

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	85	0	0
00:05	460	425	937.5
00:10	691	2300	577.5
00:15	745	3455	135
00:20	1316	3725	1427.5
00:25	1393	6580	192.5
00:30	1467	6965	185
00:35	1626	7335	397.5
00:40	1697	8130	177.5
00:45	1757	8485	150
00:50	1808	8785	127.5
00:55	1850	9040	105
01:00	1880	9250	75
01:05	1906	9400	65
01:10	1935	9530	72.5
01:15	1919	9675	-40
01:20	2021	9595	255
01:25	1903	10105	-295
01:30	1844	9515	-147.5
01:35	1803	9220	-102.5
01:40	1805	9015	5
01:45	1811	9025	15
01:50	1817	9055	15
01:55	1821	9085	10
02:00	1827	9105	15
02:10	1831	18270	20
02:20	1845	18310	70
02:30	1850	18450	25
02:40	1865	18500	75
02:50	1875	18650	50
03:00	1895	18750	100

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 297730 deg.F-min.
 Sum of Triangular Areas: 4695 deg.F-min.

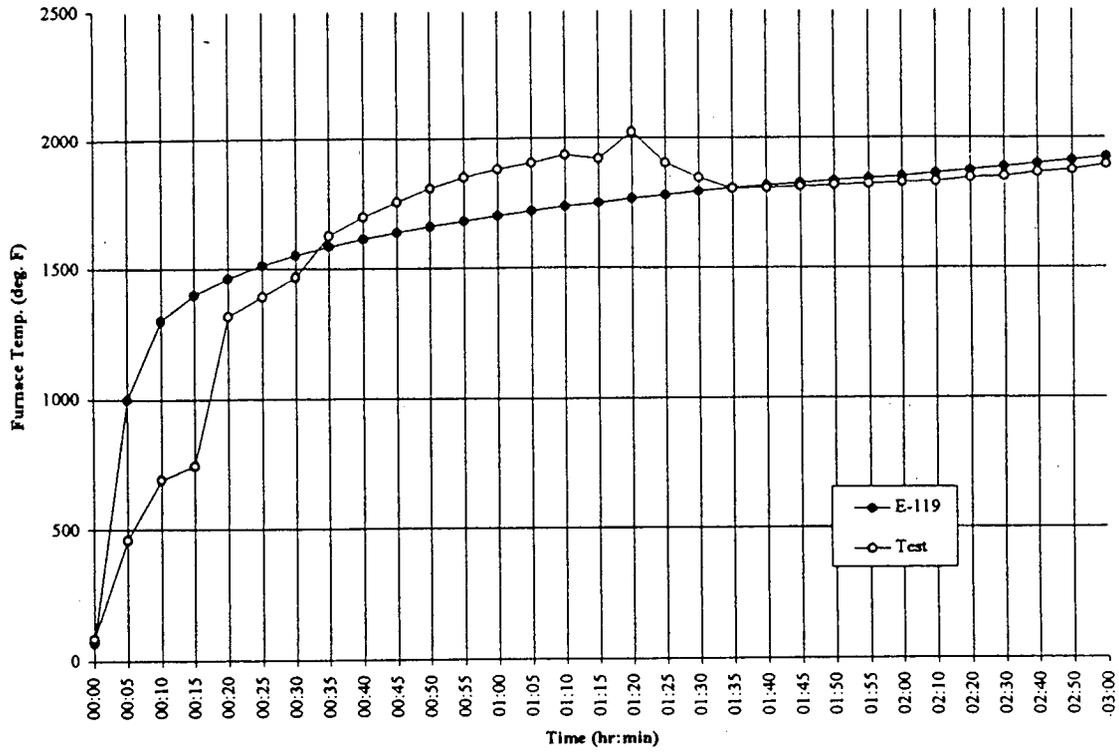
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 302425 deg.F-min.

% Difference (E-119 Area vs. Test Area): -1.439%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # CTP-1002



5.1.17 Time vs. Temperature Data For ASTM E-119 vs. Fire Test CTP-1001A

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # CTP-1001A

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	75	0	0
00:05	1326	375	3127.5
00:10	1547	6630	552.5
00:15	1569	7735	55
00:20	1549	7845	-50
00:25	1542	7745	-17.5
00:30	1531	7710	-27.5
00:35	1531	7655	0
00:40	1577	7655	115
00:45	1590	7885	32.5
00:50	1605	7950	37.5
00:55	1630	8025	62.5
01:00	1652	8150	55
01:05	1681	8260	72.5
01:10	1679	8405	-5
01:15	1711	8395	80
01:20	1726	8555	37.5
01:25	1736	8630	25
01:30	1751	8680	37.5
01:35	1743	8755	-20
01:40	1775	8715	80
01:45	1798	8875	57.5
01:50	1804	8990	15
01:55	1816	9020	30
02:00	1812	9080	-10
02:10	1826	18120	70
02:20	1844	18260	90
02:30	1856	18440	60
02:40	1868	18560	60
02:50	1880	18680	60
03:00	1909	18800	145

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 300580 deg.F-min.
 Sum of Triangular Areas: 4827.5 deg.F-min.

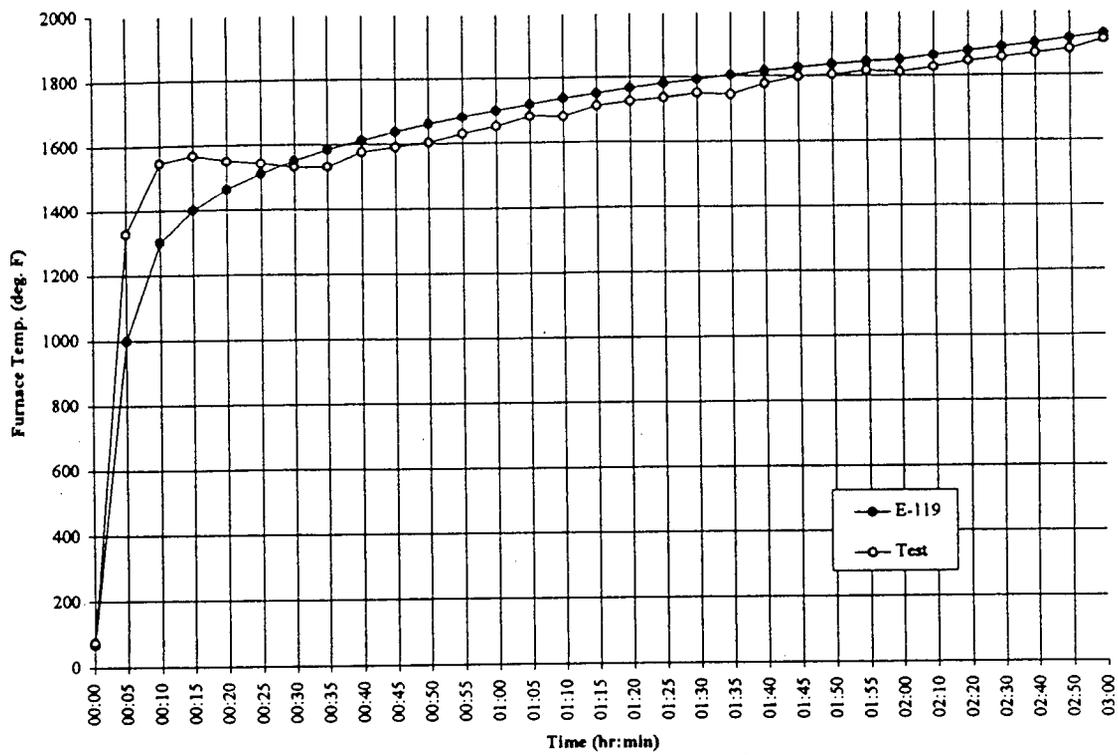
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 305407.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.467%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119, Standard Time-Temperature Curve.

Fire Test Report # CTP-1001A



5.1.18 Time vs. Temperature Data For ASTM E-119 vs. Fire Test PR0293036

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report #PR0293036

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	64	0	0
00:05	894	320	2075
00:10	1264	4470	925
00:15	1399	6320	337.5
00:20	1490	6995	227.5
00:25	1488	7450	-5
00:30	1533	7440	112.5
00:35	1578	7665	112.5
00:40	1629	7890	127.5
00:45	1620	8145	-22.5
00:50	1660	8100	100
00:55	1686	8300	65
01:00	1689	8430	7.5
01:05	1706	8445	42.5
01:10	1727	8530	52.5
01:15	1749	8635	55
01:20	1765	8745	40
01:25	1778	8825	32.5
01:30	1796	8890	45
01:35	1805	8980	22.5
01:40	1796	9025	-22.5
01:45	1821	8980	62.5
01:50	1835	9105	35
01:55	1840	9175	12.5
02:00	1840	9200	0
02:10	1861	18400	105
02:20	1868	18610	35
02:30	1890	18680	110
02:40	1891	18900	5
02:50	1861	18910	-150
03:00	1919	18610	290

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 300170 deg.F-min.
 Sum of Triangular Areas: 4835 deg.F-min.

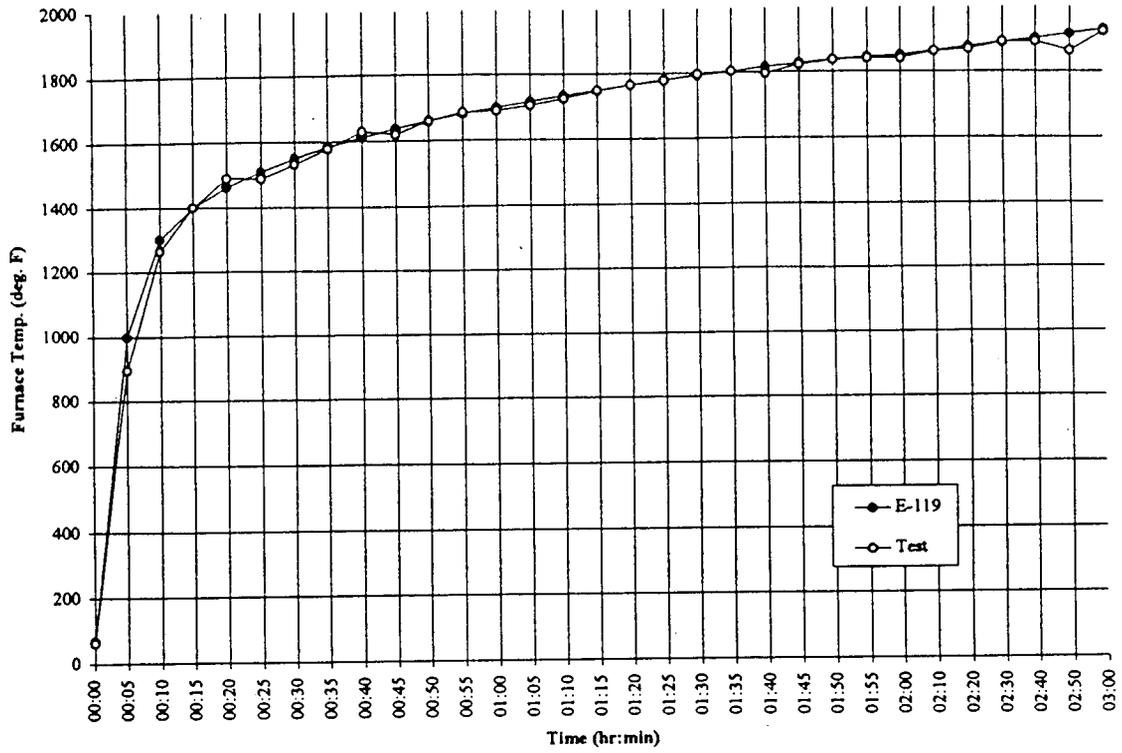
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 305005 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.598%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report #PR0293036



5.1.19 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0382004

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0382004

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	59	0	0
00:05	1047	295	2470
00:10	1292	5235	612.5
00:15	1410	6460	295
00:20	1474	7050	160
00:25	1519	7370	112.5
00:30	1554	7595	87.5
00:35	1581	7770	67.5
00:40	1616	7905	87.5
00:45	1638	8080	55
00:50	1655	8190	42.5
00:55	1679	8275	60
01:00	1706	8395	67.5
01:05	1716	8530	25
01:10	1731	8580	37.5
01:15	1748	8655	42.5
01:20	1771	8740	57.5
01:25	1788	8855	42.5
01:30	1792	8940	10
01:35	1796	8960	10
01:40	1814	8980	45
01:45	1826	9070	30
01:50	1831	9130	12.5
01:55	1846	9155	37.5
02:00	1857	9230	27.5
02:10	1867	18570	50
02:20	1880	18670	65
02:30	1892	18800	60
02:40	1910	18920	90
02:50	1918	19100	40
03:00	1927	19180	45

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302685 deg.F-min.
 Sum of Triangular Areas: 4845 deg.F-min.

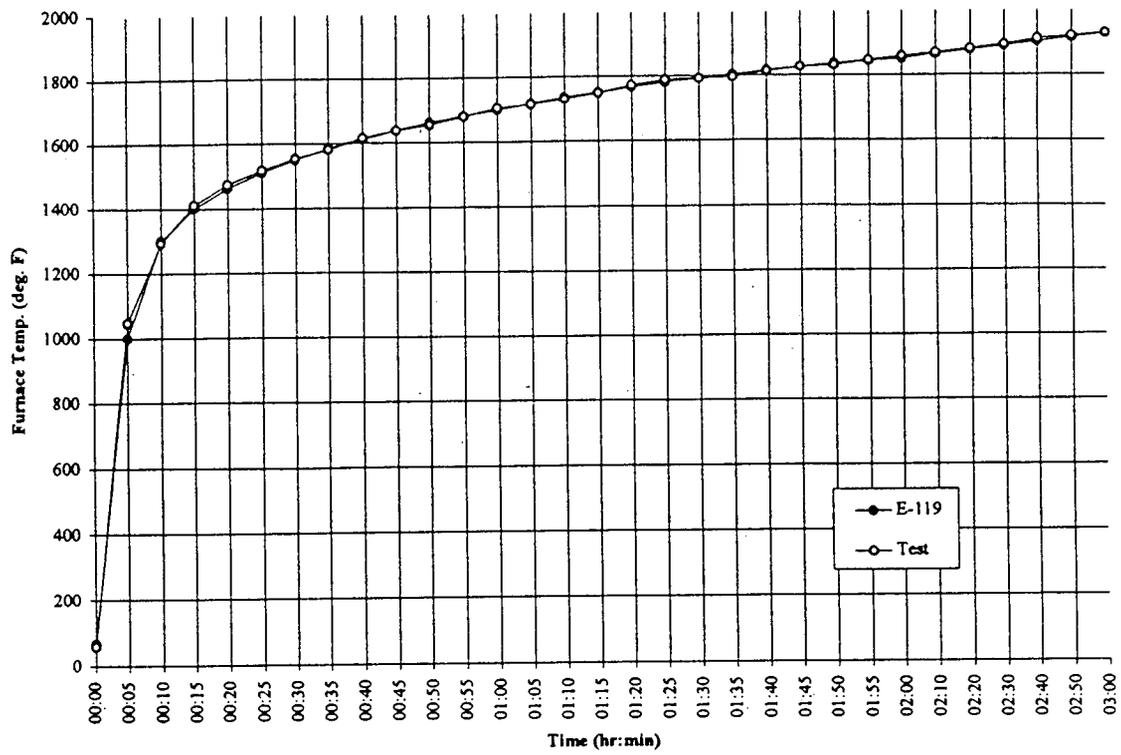
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 307530 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.225%

Based on the three hour duration of this fire test, the the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0382004



5.1.20 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0386022-1

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0386022 (slab #1)

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	81	0	0
00:05	543	405	1155
00:10	1261	2715	1795
00:15	1503	6305	605
00:20	1535	7515	80
00:25	1589	7675	135
00:30	1594	7945	12.5
00:35	1598	7970	10
00:40	1639	7990	102.5
00:45	1666	8195	67.5
00:50	1683	8330	42.5
00:55	1683	8415	0
01:00	1697	8415	35
01:05	1740	8485	107.5
01:10	1747	8700	17.5
01:15	1764	8735	42.5
01:20	1782	8820	45
01:25	1790	8910	20
01:30	1805	8950	37.5
01:35	1812	9025	17.5
01:40	1821	9060	22.5
01:45	1829	9105	20
01:50	1838	9145	22.5
01:55	1850	9190	30
02:00	1860	9250	25
02:10	1867	18600	35
02:20	1863	18670	-20
02:30	1876	18630	65
02:40	1897	18760	105
02:50	1923	18970	130
03:00	1933	19230	50

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302110 deg.F-min.
 Sum of Triangular Areas: 4812.5 deg.F-min.

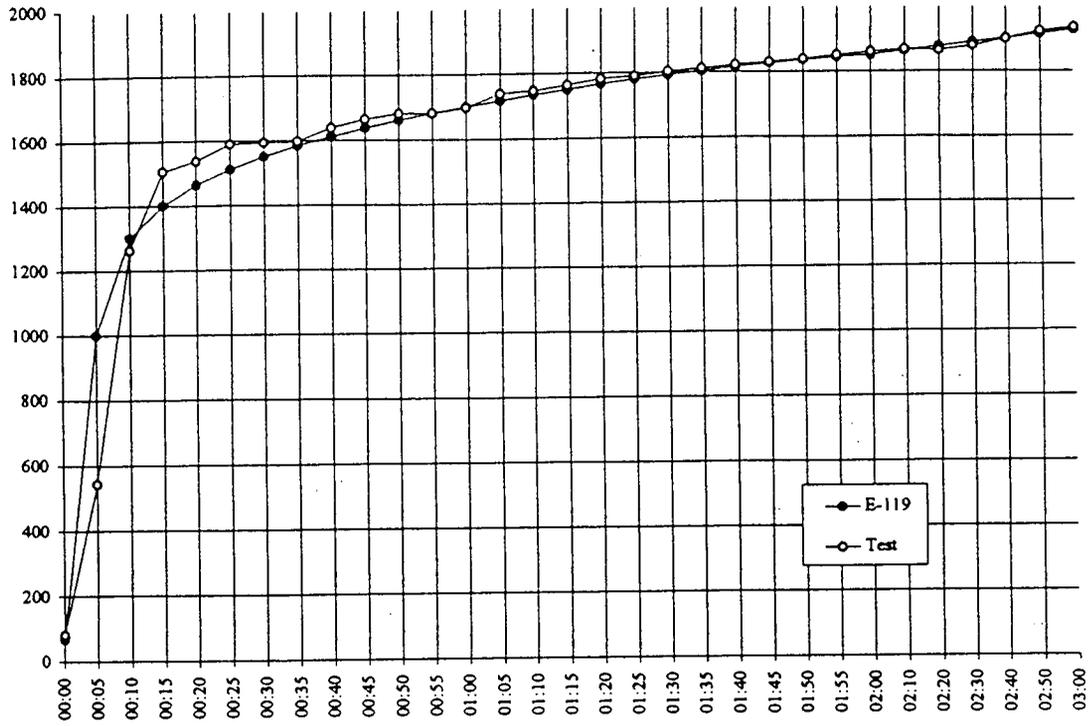
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306922.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.027%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0386022 (slab #1)



5.1.21 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0386022-2

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0386022 (slab #2)

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	76	0	0
00:05	1035	380	2397.5
00:10	1187	5175	380
00:15	1411	5935	560
00:20	1488	7055	192.5
00:25	1496	7440	20
00:30	1497	7480	2.5
00:35	1557	7485	150
00:40	1619	7785	155
00:45	1649	8095	75
00:50	1676	8245	67.5
00:55	1698	8380	55
01:00	1718	8490	50
01:05	1733	8590	37.5
01:10	1753	8665	50
01:15	1771	8765	45
01:20	1773	8855	5
01:25	1785	8865	30
01:30	1787	8925	5
01:35	1798	8935	27.5
01:40	1811	8990	32.5
01:45	1817	9055	15
01:50	1835	9085	45
01:55	1845	9175	25
02:00	1856	9225	27.5
02:10	1866	18560	50
02:20	1875	18660	45
02:30	1887	18750	60
02:40	1902	18870	75
02:50	1914	19020	60
03:00	1923	19140	45

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302075 deg.F-min.
 Sum of Triangular Areas: 4785 deg.F-min.

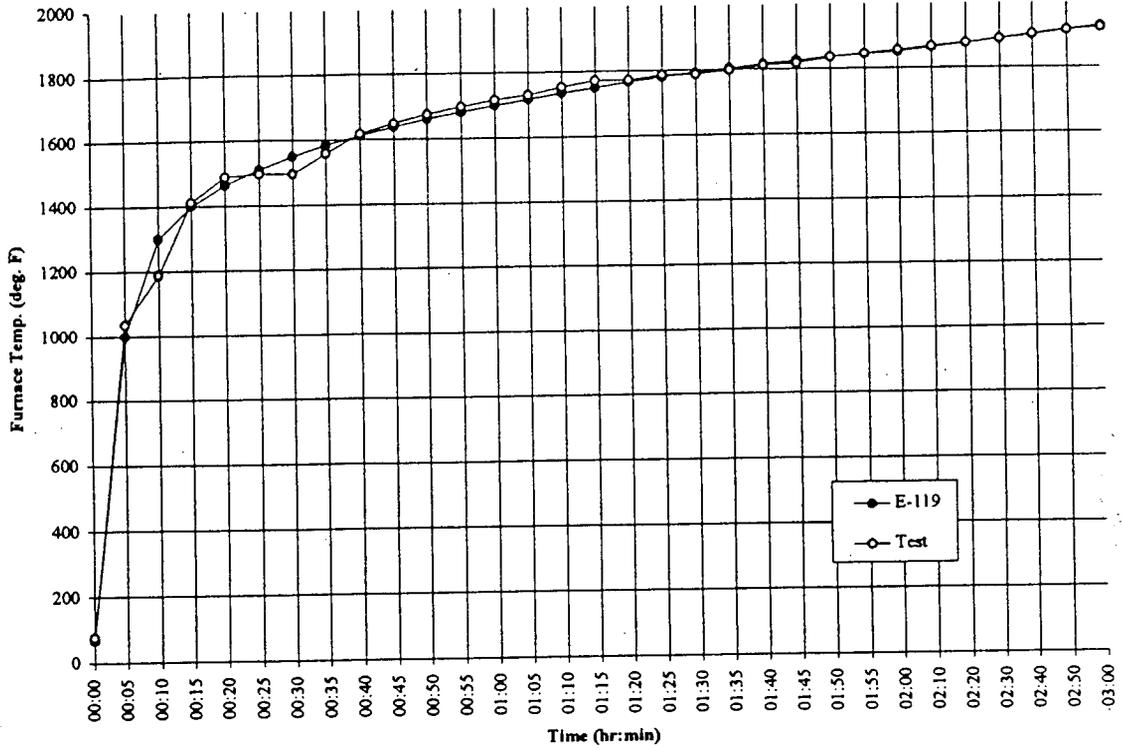
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306860 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.007%

Based on the three hour duration of this fire test, the the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0386022 (slab #2)



5.1.22 Time vs. Temperature Data For ASTM E-119 vs. Fire Test 73-H-72449

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # 93-H-72449 (slab #1)

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	72	0	0
00:05	875	360	2007.5
00:10	1255	4375	950
00:15	1402	6275	367.5
00:20	1482	7010	200
00:25	1536	7410	135
00:30	1524	7680	-30
00:35	1597	7620	182.5
00:40	1629	7985	80
00:45	1643	8145	35
00:50	1670	8215	67.5
00:55	1670	8350	0
01:00	1703	8350	82.5
01:05	1720	8515	42.5
01:10	1740	8600	50
01:15	1751	8700	27.5
01:20	1776	8755	62.5
01:25	1790	8880	35
01:30	1793	8950	7.5
01:35	1785	8965	-20
01:40	1863	8925	195
01:45	1823	9315	-100
01:50	1636	9115	-467.5
01:55	1864	8180	570
02:00	1688	9320	-440
02:10	1869	16880	905
02:20	1897	18690	140
02:30	1932	18970	175
02:40	1875	19320	-285
02:50	1906	18750	155
03:00	1942	19060	180

Sum of Rectangular Areas: deg. F-min.
 Sum of Triangular Areas: deg. F-min.

Sum of Rectangular Areas: deg. F-min.
 Sum of Triangular Areas: deg. F-min.

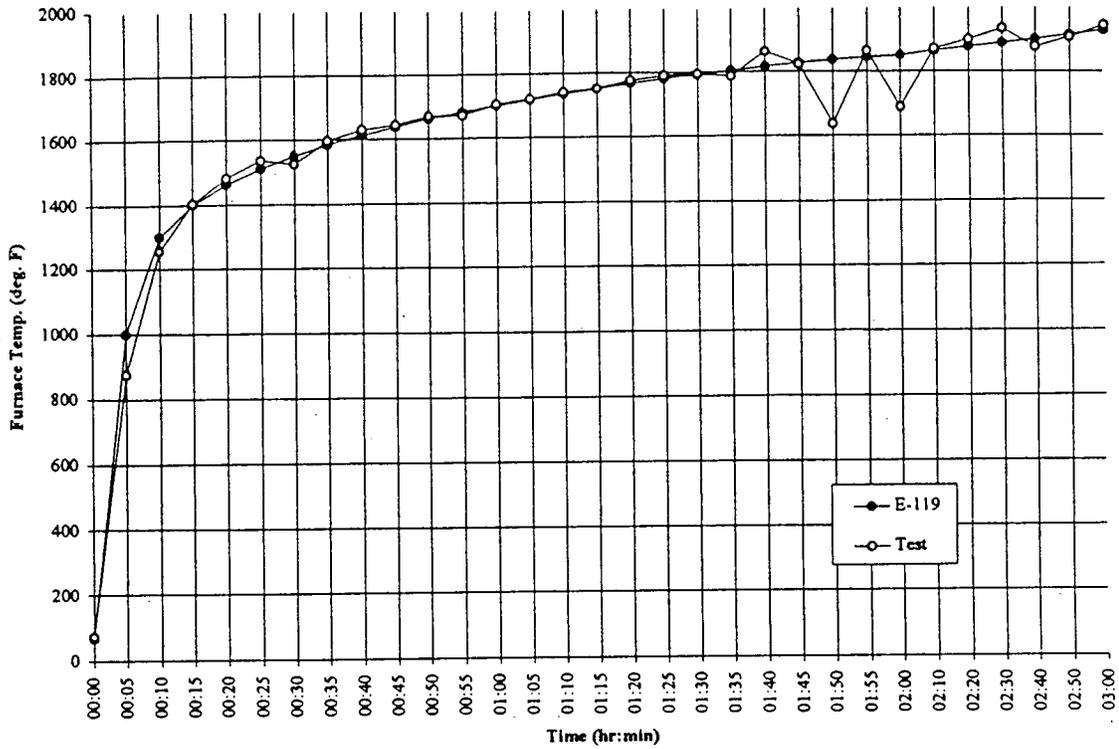
Total Area Under E-119 Curve: deg. F-min.

Total Area Under Test Curve: deg. F-min.

% Difference (E-119 Area vs. Test Area):

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # 93-H-72449 (slab #1)



ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # 93-H-72449 (slab #2)

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	73	0	0
00:05	824	365	1877.5
00:10	1259	4120	1087.5
00:15	1403	6295	360
00:20	1466	7015	157.5
00:25	1507	7330	102.5
00:30	1550	7535	107.5
00:35	1583	7750	82.5
00:40	1617	7915	85
00:45	1644	8085	67.5
00:50	1666	8220	55
00:55	1688	8330	55
01:00	1705	8440	42.5
01:05	1719	8525	35
01:10	1736	8595	42.5
01:15	1751	8680	37.5
01:20	1741	8755	-25
01:25	1771	8705	75
01:30	1792	8855	52.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1824	9075	22.5
01:50	1844	9120	50
01:55	1838	9220	-15
02:00	1843	9190	12.5
02:10	1854	18430	55
02:20	1869	18540	75
02:30	1885	18690	80
02:40	1896	18850	55
02:50	1906	18960	50
03:00	1911	19060	25

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 300630 deg.F-min.
 Sum of Triangular Areas: 4765 deg.F-min.

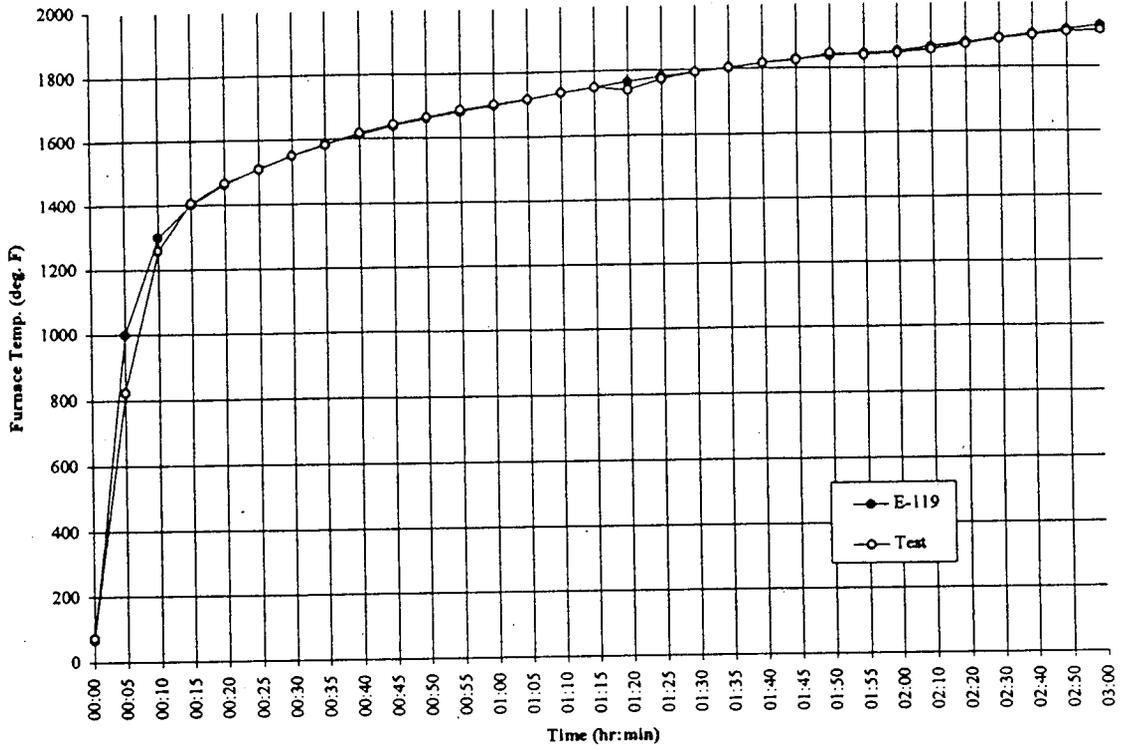
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 305395 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.471%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # 93-H-72449 (slab #2)



5.1.23 Time vs. Temperature Data For ASTM E-119 vs. Fire Test CTP-1076

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # CTP-1076

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	76	0	0
00:05	1104	380	2570
00:10	1305	5520	502.5
00:15	1359	6525	135
00:20	1470	6795	277.5
00:25	1519	7350	122.5
00:30	1541	7595	55
00:35	1586	7705	112.5
00:40	1603	7930	42.5
00:45	1629	8015	65
00:50	1655	8145	65
00:55	1687	8275	80
01:00	1708	8435	52.5
01:05	1718	8540	25
01:10	1733	8590	37.5
01:15	1752	8665	47.5
01:20	1766	8760	35
01:25	1779	8830	32.5
01:30	1792	8895	32.5
01:35	1806	8960	35
01:40	1817	9030	27.5
01:45	1823	9085	15
01:50	1838	9115	37.5
01:55	1845	9190	17.5
02:00	1851	9225	15
02:10	1858	18510	35
02:20	1875	18580	85
02:30	1885	18750	50
02:40	1900	18850	75
02:50	1912	19000	60
03:00	1924	19120	60

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302365 deg.F-min.
 Sum of Triangular Areas: 4802.5 deg.F-min.

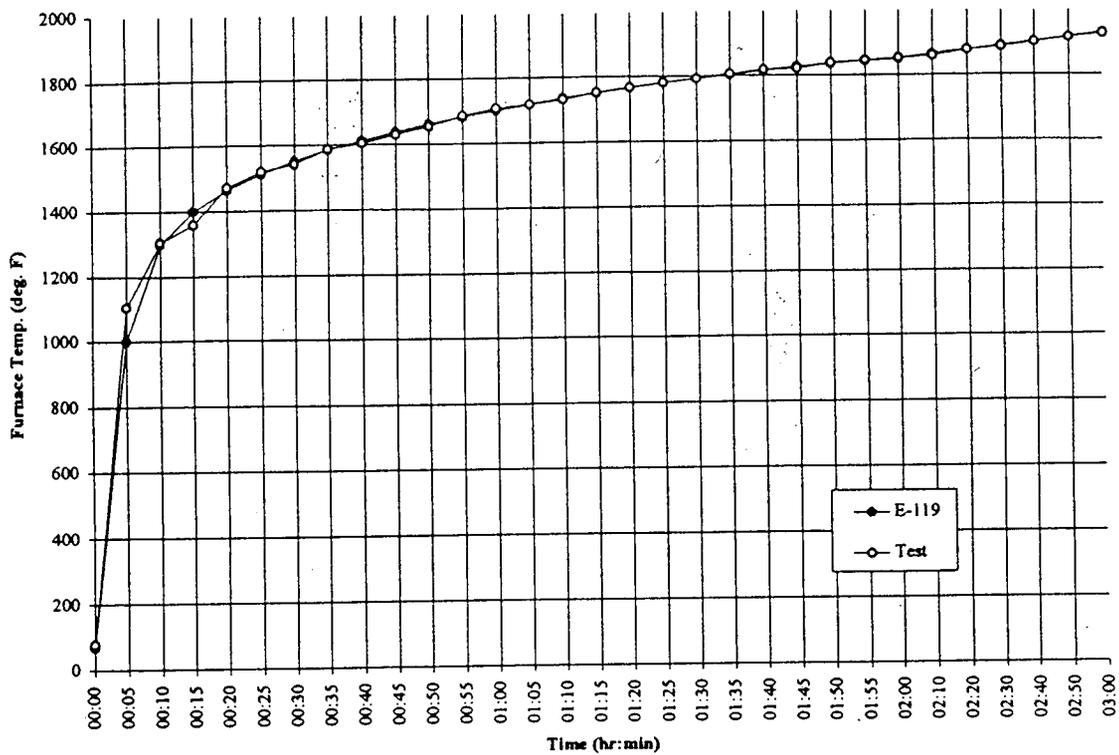
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 307167.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.107%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # CTP-1076



5.1.24 Time vs. Temperature Data For ASTM E-119 vs. Fire Test TS-TP-0006

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # TS-TP-0006-12-77

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	70	0	0
00:05	693	350	1557.5
00:10	1315	3465	1555
00:15	1390	6575	187.5
00:20	1465	6950	187.5
00:25	1515	7325	125
00:30	1565	7575	125
00:35	1585	7825	50
00:40	1605	7925	50
00:45	1633	8025	70
00:50	1660	8165	67.5
00:55	1679	8300	47.5
01:00	1698	8395	47.5
01:05	1716	8490	45
01:10	1733	8580	42.5
01:15	1747	8665	35
01:20	1760	8735	32.5
01:25	1775	8800	37.5
01:30	1790	8875	37.5
01:35	1800	8950	25
01:40	1810	9000	25
01:45	1822	9050	30
01:50	1834	9110	30
01:55	1840	9170	15
02:00	1845	9200	12.5
02:10	1865	18450	100
02:20	1875	18650	50
02:30	1890	18750	75
02:40	1905	18900	75
02:50	1930	19050	125
03:00	1950	19300	100

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 300600 deg.F-min.
 Sum of Triangular Areas: 4962.5 deg.F-min.

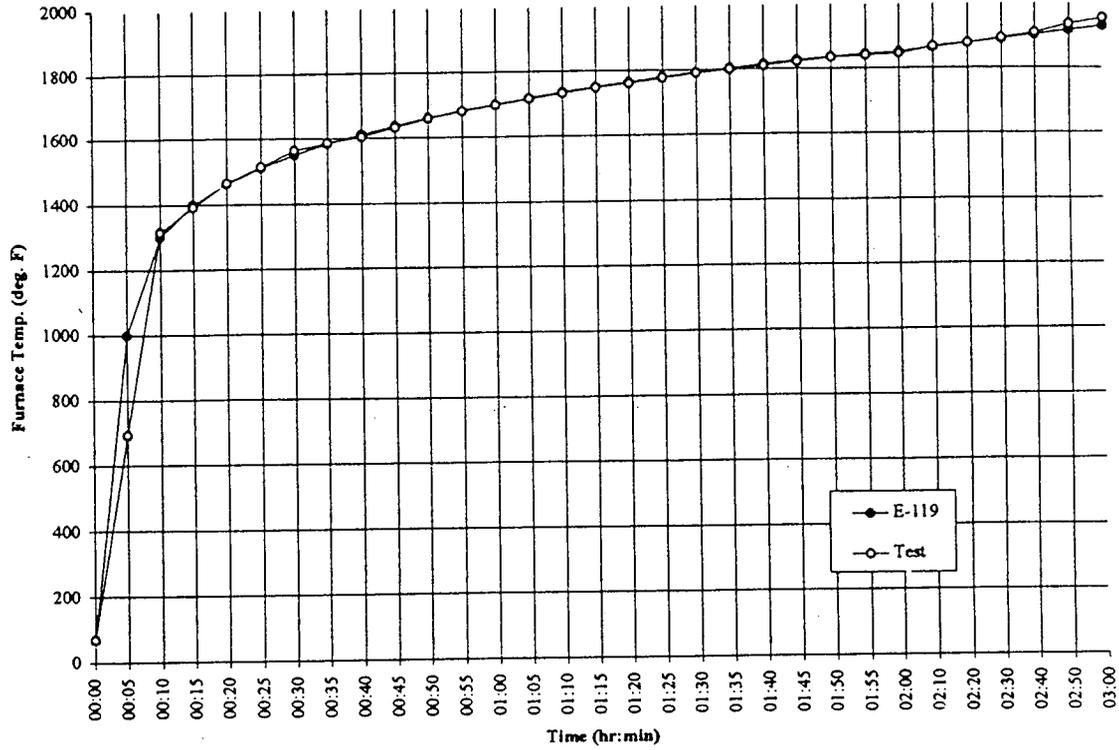
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 305562.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.416%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # TS-TP-0006-12-77



5.1.25 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0286018

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC0286018

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	76	0	0
00:05	1006	380	2325
00:10	1347	5030	852.5
00:15	1413	6735	165
00:20	1465	7065	130
00:25	1521	7325	140
00:30	1559	7605	95
00:35	1582	7795	57.5
00:40	1614	7910	80
00:45	1638	8070	60
00:50	1669	8190	77.5
00:55	1664	8345	-12.5
01:00	1678	8320	35
01:05	1713	8390	87.5
01:10	1726	8565	32.5
01:15	1718	8630	-20
01:20	1749	8590	77.5
01:25	1743	8745	-15
01:30	1790	8715	117.5
01:35	1806	8950	40
01:40	1805	9030	-2.5
01:45	1860	9025	137.5
01:50	1850	9300	-25
01:55	1856	9250	15
02:00	1862	9280	15
02:10	1861	18620	-5
02:20	1866	18610	25
02:30	1892	18660	130
02:40	1892	18920	0
02:50	1903	18920	55
03:00	1930	19030	135

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302000 deg.F-min.
 Sum of Triangular Areas: 4805 deg.F-min.

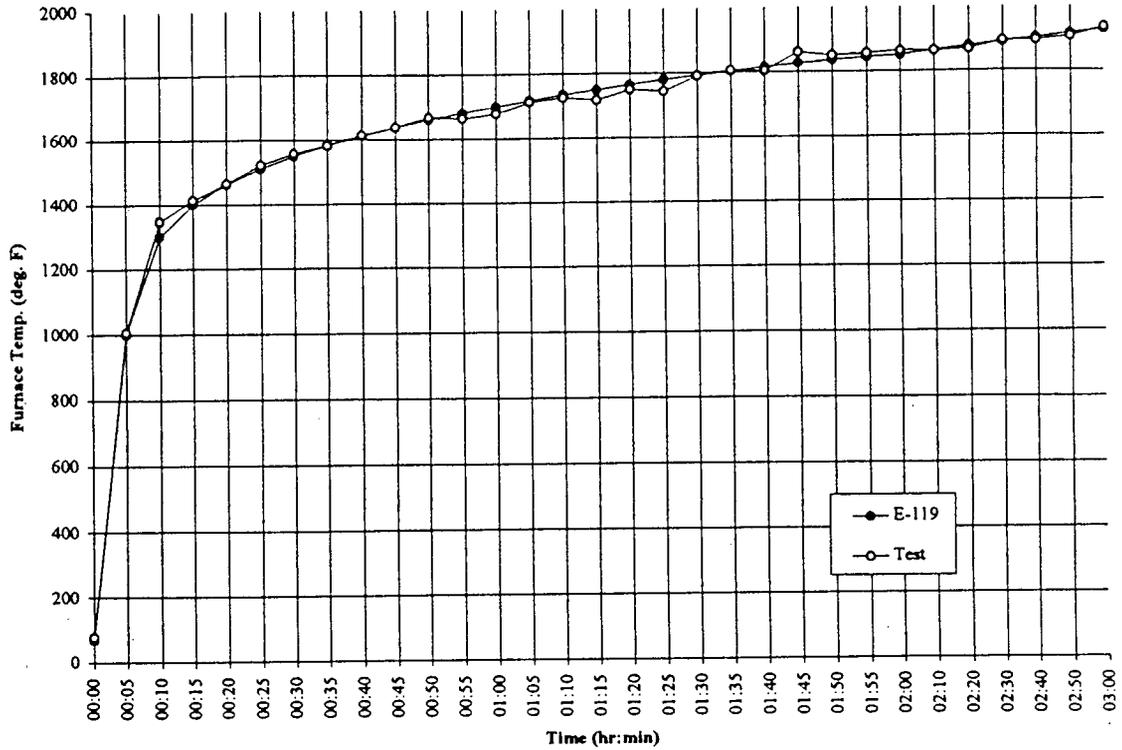
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306805 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.011%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC0286018



5.1.26 Time vs. Temperature Data For ASTM E-119 vs. Fire Test CTP-1139

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report #CTP-1139

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	96	0	0
00:05	1112	480	2540
00:10	1177	5560	162.5
00:15	1331	5885	385
00:20	1483	6655	380
00:25	1525	7415	105
00:30	1560	7625	87.5
00:35	1584	7800	60
00:40	1615	7920	77.5
00:45	1651	8075	90
00:50	1677	8255	65
00:55	1691	8385	35
01:00	1701	8455	25
01:05	1720	8505	47.5
01:10	1738	8600	45
01:15	1753	8690	37.5
01:20	1769	8765	40
01:25	1784	8845	37.5
01:30	1798	8920	35
01:35	1811	8990	32.5
01:40	1822	9055	27.5
01:45	1830	9110	20
01:50	1840	9150	25
01:55	1892	9200	130
02:00	1907	9460	37.5
02:10	1929	19070	110
02:20	1943	19290	70
02:30	1958	19430	75
02:40	1968	19580	50
02:50	1980	19680	60
03:00	1987	19800	35

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 306650 deg.F-min.
 Sum of Triangular Areas: 4927.5 deg.F-min.

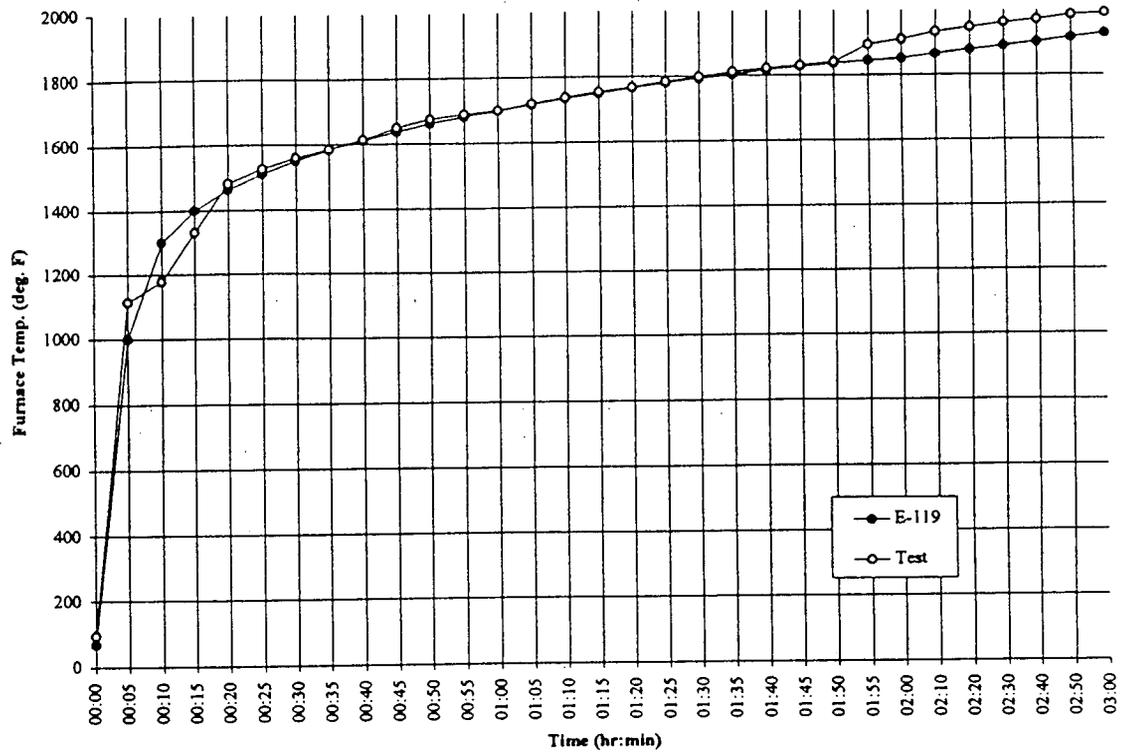
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 311577.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 1.544%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report #CTP-1139



5.1.27 Time vs. Temperature Data For ASTM E-119 vs. Fire Test CTP-1142

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # CTP-1142

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	107	0	0
00:05	1006	535	2247.5
00:10	1386	5030	950
00:15	1546	6930	400
00:20	1728	7730	455
00:25	1869	8640	352.5
00:30	1989	9345	300
00:35	1890	9945	-247.5
00:40	1847	9450	-107.5
00:45	1755	9235	-230
00:50	1719	8775	-90
00:55	1776	8595	142.5
01:00	1697	8880	-197.5
01:05	1853	8485	390
01:10	1751	9265	-255
01:15	1800	8755	122.5
01:20	1778	9000	-55
01:25	1760	8890	-45
01:30	1815	8800	137.5
01:35	1780	9075	-87.5
01:40	1734	8900	-115
01:45	1721	8670	-32.5
01:50	1751	8605	75
01:55	1774	8755	57.5
02:00	1808	8870	85
02:10	1859	18080	255
02:20	1874	18590	75
02:30	1872	18740	-10
02:40	1907	18720	175
02:50	1911	19070	20
03:00	1890	19110	-105

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 311470 deg.F-min.
 Sum of Triangular Areas: 4662.5 deg.F-min.

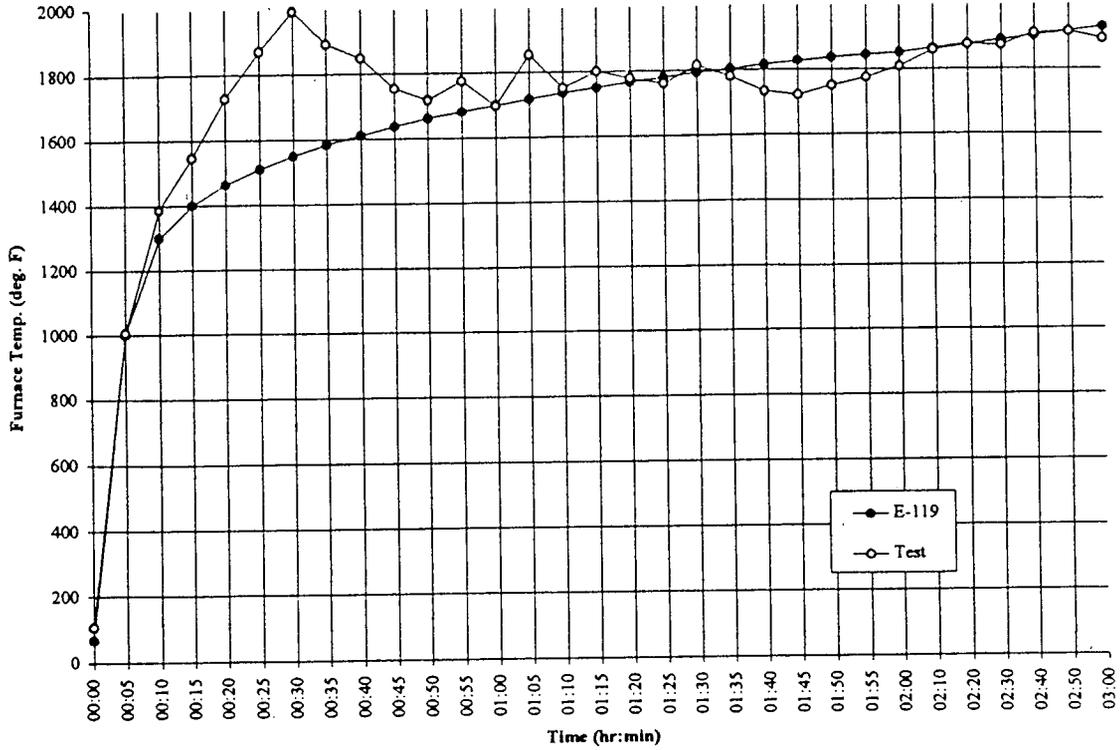
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 316132.5 deg.F-min.

% Difference (E-119 Area vs. Test Area): 3.028%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # CTP-1142



5.1.28 Time vs. Temperature Data For ASTM E-119 vs. Fire Test 748-49

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # 748-49

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00		0	0
00:05		0	0
00:10		0	0
00:15		0	0
00:20		0	0
00:25		0	0
00:30		0	0
00:35		0	0
00:40		0	0
00:45		0	0
00:50		0	0
00:55		0	0
01:00		0	0
01:05		0	0
01:10		0	0
01:15		0	0
01:20		0	0
01:25		0	0
01:30		0	0
01:35		0	0
01:40		0	0
01:45		0	0
01:50		0	0
01:55		0	0
02:00		0	0
02:10		0	0
02:20		0	0
02:30		0	0
02:40		0	0
02:50		0	0
03:00		0	0

Sum of Rectangular Areas: 302010 deg.F-min.

Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 0 deg.F-min.

Sum of Triangular Areas: 0 deg.F-min.

Total Area Under E-119 Curve: 306840 deg.F-min.

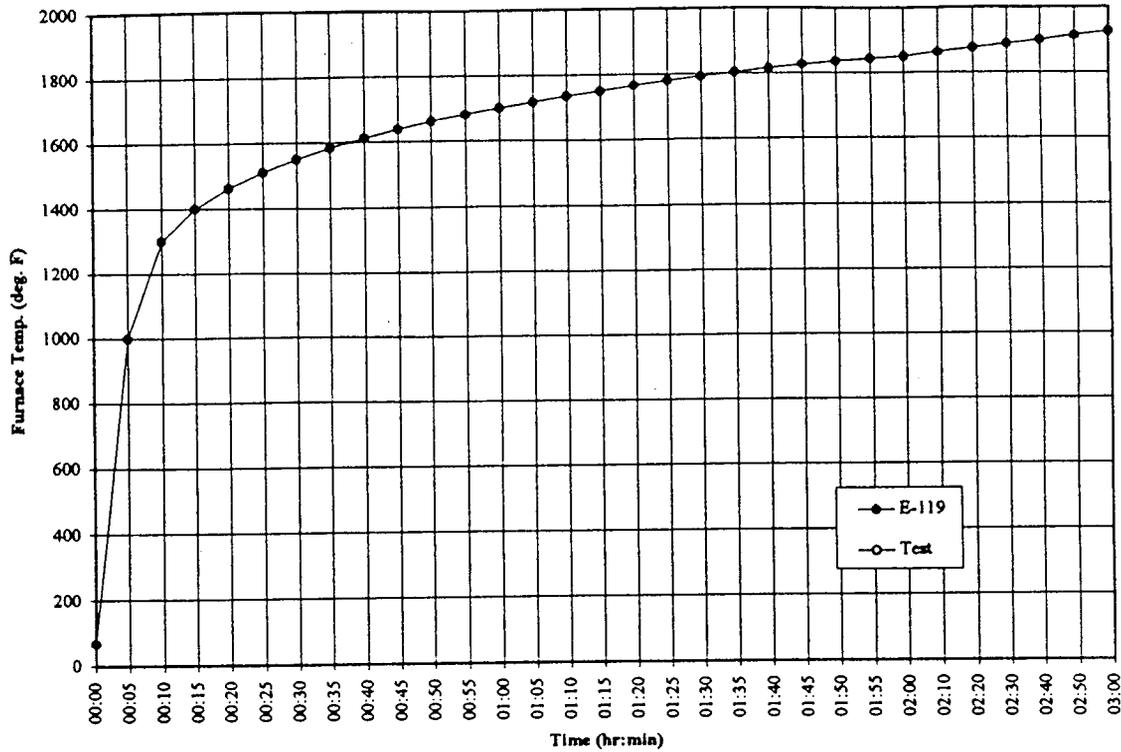
Total Area Under Test Curve: 0 deg.F-min.

% Difference (E-119 Area vs. Test Area): -100.000%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Note: Furnace thermocouple data was not available for this fire test. However, credit is being taken for the qualification of the test lab facility and it is assumed that the furnace exposure was within 5% of the ASTM E-119 curve. Efforts are being made to obtain the furnace thermocouple data for this fire test.

Fire Test Report # 748-49



Note: Furnace thermocouple data was not available for this fire test. However, credit is being taken for the qualification of the test lab facility and it is assumed that the furnace exposure was within 5% of the ASTM E-119 curve. Efforts are being made to obtain the furnace thermocouple data for this fire test.

5.1.29 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC0483010

ASTM E-119 Standard Time/Temp.

Time	Temp E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report #ICC0483010

Time	Temp Test	Rectangular Areas	Triangular Areas
00:00	72	0	0
00:05	1051	360	2447.5
00:10	1291	5255	600
00:15	1391	6455	250
00:20	1465	6955	185
00:25	1507	7325	105
00:30	1553	7535	115
00:35	1578	7765	62.5
00:40	1611	7890	82.5
00:45	1642	8055	77.5
00:50	1654	8210	30
00:55	1689	8270	87.5
01:00	1689	8445	0
01:05	1720	8445	77.5
01:10	1721	8600	2.5
01:15	1758	8605	92.5
01:20	1757	8790	-2.5
01:25	1765	8785	20
01:30	1785	8825	50
01:35	1816	8925	77.5
01:40	1819	9080	7.5
01:45	1831	9095	30
01:50	1843	9155	30
01:55	1848	9215	12.5
02:00	1854	9240	15
02:10	1870	18540	80
02:20	1875	18700	25
02:30	1885	18750	50
02:40	1903	18850	90
02:50	1911	19030	40
03:00	1927	19110	80

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 302260 deg.F-min.
 Sum of Triangular Areas: 4820 deg.F-min.

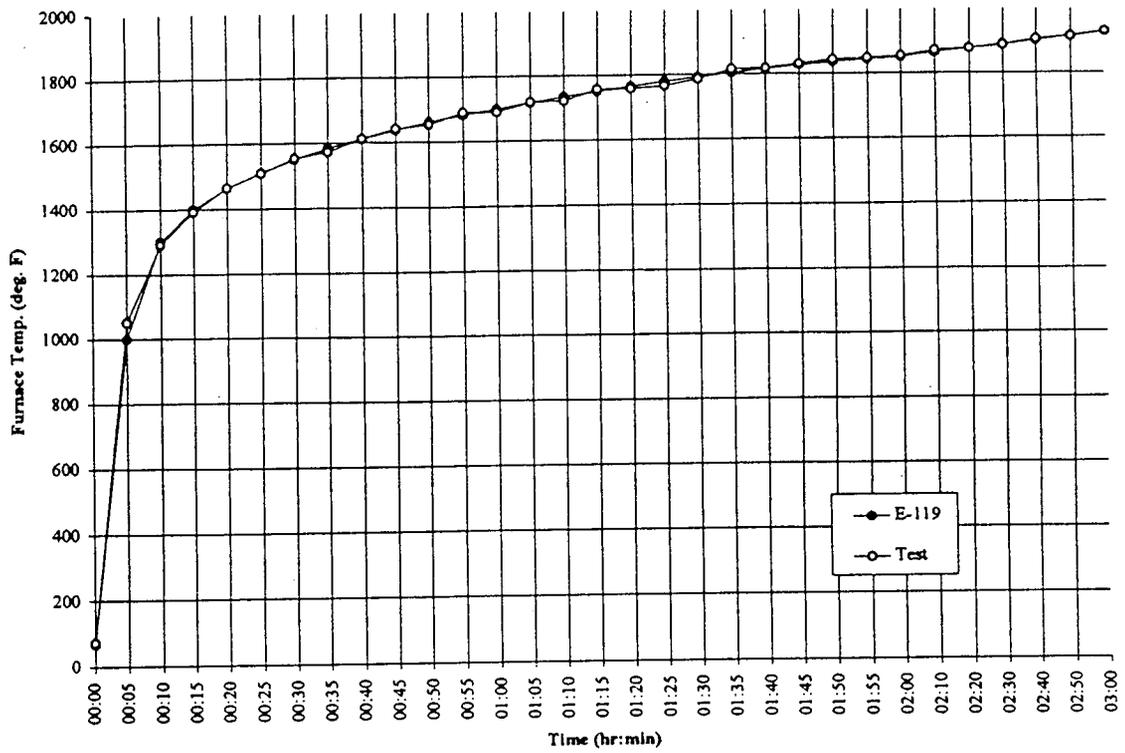
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 307080 deg.F-min.

% Difference (E-119 Area vs. Test Area): 0.078%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report #ICC0483010



5.1.30 Time vs. Temperature Data For ASTM E-119 vs. Fire Test ICC1182009

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # ICC1182009

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	73	0	0
00:05	1030	365	2392.5
00:10	1295	5150	662.5
00:15	1384	6475	222.5
00:20	1452	6920	170
00:25	1511	7260	147.5
00:30	1538	7555	67.5
00:35	1559	7690	52.5
00:40	1597	7795	95
00:45	1655	7985	145
00:50	1660	8275	12.5
00:55	1694	8300	85
01:00	1701	8470	17.5
01:05	1711	8505	25
01:10	1733	8555	55
01:15	1751	8665	45
01:20	1756	8755	12.5
01:25	1781	8780	62.5
01:30	1788	8905	17.5
01:35	1795	8940	17.5
01:40	1808	8975	32.5
01:45	1841	9040	82.5
01:50	1842	9205	2.5
01:55	1844	9210	5
02:00	1845	9220	2.5
02:10	1875	18450	150
02:20	1875	18750	0
02:30	1886	18750	55
02:40	1901	18860	75
02:50	1915	19010	70
03:00	1932	19150	85

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 301965 deg.F-min.
 Sum of Triangular Areas: 4865 deg.F-min.

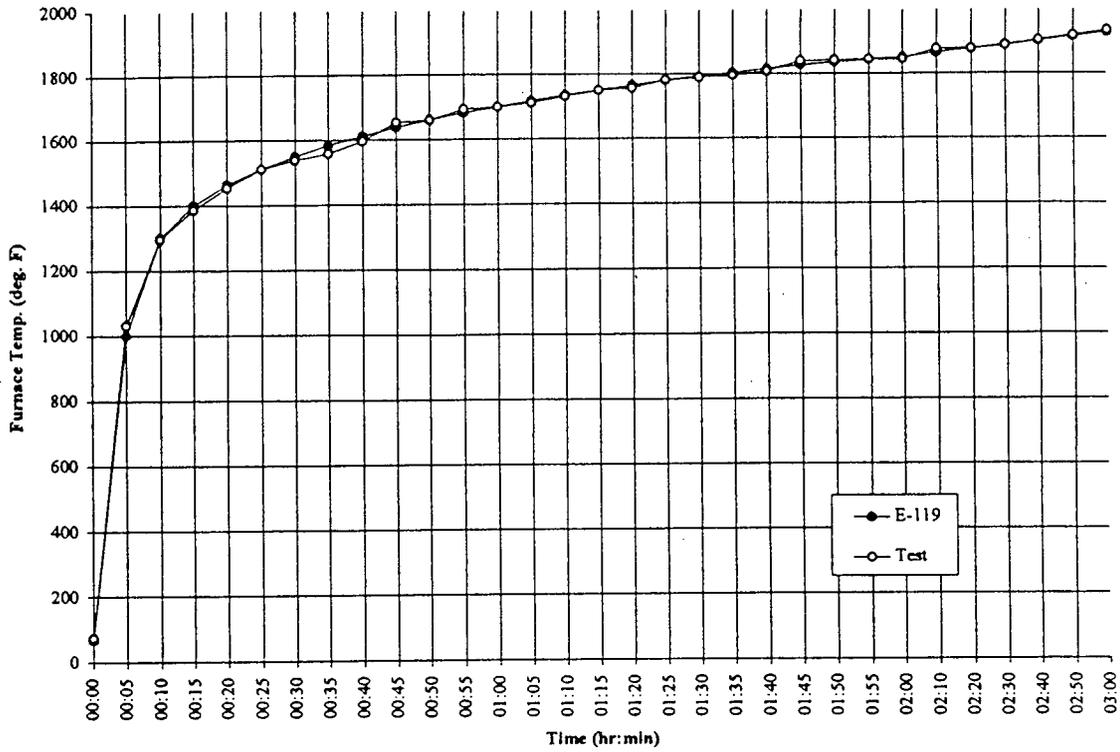
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306830 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.003%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # ICC1182009



5.1.31 Time vs. Temperature Data For ASTM E-119 vs. Fire Test TS-TP-0014

ASTM E-119 Standard Time/Temp.

Time	Temp. E-119	Rectangular Areas	Triangular Areas
00:00	68	0	0
00:05	1000	340	2330
00:10	1300	5000	750
00:15	1399	6500	247.5
00:20	1462	6995	157.5
00:25	1510	7310	120
00:30	1550	7550	100
00:35	1584	7750	85
00:40	1613	7920	72.5
00:45	1638	8065	62.5
00:50	1661	8190	57.5
00:55	1681	8305	50
01:00	1700	8405	47.5
01:05	1718	8500	45
01:10	1735	8590	42.5
01:15	1750	8675	37.5
01:20	1765	8750	37.5
01:25	1779	8825	35
01:30	1792	8895	32.5
01:35	1804	8960	30
01:40	1815	9020	27.5
01:45	1826	9075	27.5
01:50	1835	9130	22.5
01:55	1843	9175	20
02:00	1850	9215	17.5
02:10	1862	18500	60
02:20	1875	18620	65
02:30	1888	18750	65
02:40	1900	18880	60
02:50	1912	19000	60
03:00	1925	19120	65

Fire Test Report # TS-TP-0014

Time	Temp. Test	Rectangular Areas	Triangular Areas
00:00	80	0	0
00:05	920	400	2100
00:10	1320	4600	1000
00:15	1390	6600	175
00:20	1440	6950	125
00:25	1510	7200	175
00:30	1550	7550	100
00:35	1580	7750	75
00:40	1620	7900	100
00:45	1640	8100	50
00:50	1660	8200	50
00:55	1680	8300	50
01:00	1700	8400	50
01:05	1720	8500	50
01:10	1740	8600	50
01:15	1750	8700	25
01:20	1760	8750	25
01:25	1780	8800	50
01:30	1790	8900	25
01:35	1800	8950	25
01:40	1810	9000	25
01:45	1850	9050	100
01:50	1850	9250	0
01:55	1850	9250	0
02:00	1850	9250	0
02:10	1870	18500	100
02:20	1870	18700	0
02:30	1890	18700	100
02:40	1900	18900	50
02:50	1910	19000	50
03:00	1930	19100	100

Sum of Rectangular Areas: 302010 deg.F-min.
 Sum of Triangular Areas: 4830 deg.F-min.

Sum of Rectangular Areas: 301850 deg.F-min.
 Sum of Triangular Areas: 4825 deg.F-min.

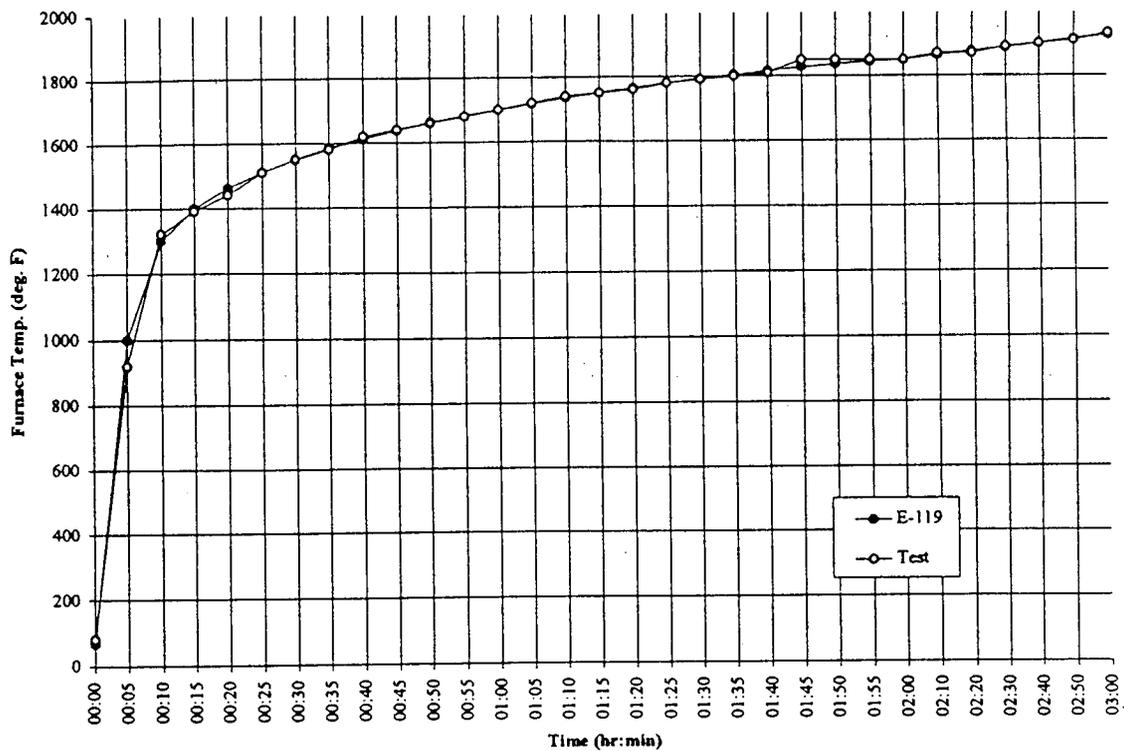
Total Area Under E-119 Curve: 306840 deg.F-min.

Total Area Under Test Curve: 306675 deg.F-min.

% Difference (E-119 Area vs. Test Area): -0.054%

Based on the three hour duration of this fire test, the furnace must be within +/- 5.0% of the ASTM E-119 Standard Time-Temperature Curve.

Fire Test Report # TS-TP-0014



6.0 RESULTS

The following is a tabulation of the results obtained from the calculations in Section 5.0 of this attachment. The percent difference column indicates the variance that the individual fire test furnace was from the area under the ASTM E-119 Standard Time vs. Temperature curve.

Test Report Number	Percent Difference
ICC0985011	+0.013%
ICC1185020	+0.028%
ICC0386021	-0.015%
ICC0483032	+0.079%
ICC0386017	+0.015%
ICC0286016	+0.019%
ICC1088024	+0.051%
ICC0682008	+0.257%
ICF0277001 (min)	-0.706%*
ICF0277001 (max)	+2.439%*
ICC0186015	+0.035%
ICC0386014	+0.443%
ICC0582007	+0.108%
ICC0386023	+0.027%
ICO1091035 (slab 1)	-0.780%
ICO1091035 (slab 2)	-1.677%
ICS0879002	+0.543%
CTP-1002	-1.439%
CTP-1001A	-0.467%
PRO293036	-0.598%
ICC0382004	+0.225%
ICC0386022-1	+0.027%
ICC0386022-2	+0.007%
93-H-72449 (slab 1)	-0.608%
93-H-72449 (slab 2)	-0.471%
CTP-1076	+0.107%
TS-TP-0006	-0.416%
ICC0286018	-0.011%
CTP-1139	+1.544%
CTP-1142	+3.028%
748-49	Refer to Section 5.1.28
ICC0483010	+0.078%
ICC1182009	-0.003%
TS-TP-0014	-0.054%

* Data points for this calculation were obtained from strip charts which had slight deviations in the redundant sensors. Two sets of curves were evaluate to obtain the most conservative value.

7.0 REFERENCES AND TECHNICAL INPUT

- 7.1 ASTM E-119-73, "Standard Methods of Fire Tests of Building Construction and Materials."
 - 7.2 Factory Mutual Research Fire Endurance Test ICF0277001, "Fire Endurance Test - Penetration Seal Systems in Precast Concrete Floor Utilizing Silicone Elastomers - Carborundum Design FC-246," dated May 18, 1977
 - 7.3 Construction Technology Laboratories Fire Test ICC0286016, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS7)," dated March 1986.
 - 7.4 Construction Technology Laboratories Fire Test ICC1088024, "Fire and Hose Stream Tests of Four Mechanical Penetration Seal Systems," dated November 1988.
 - 7.5 Construction Technology Laboratories Fire Test ICC0386021, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS12)," dated April 1986.
 - 7.6 Construction Technology Laboratories Fire Test ICC0582007, "Fire and Hose Stream Tests For Penetration Seal Systems and Seismic Gaps - Small Test Slab No. 1," dated June 1982.
 - 7.7 Construction Technology Laboratories Fire Test ICC0483032, "Fire and Hose Stream Tests For Penetration Seal Systems," dated May 1983.
 - 7.8 Construction Technology Laboratories Fire Test ICC0386023, "Fire and Hose Stream Tests For Penetration Seal Systems (WE-PSS1)," dated May 1986.
 - 7.9 Construction Technology Laboratories Fire Test ICC0386014, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS5)," dated April 1986.
 - 7.10 Construction Technology Laboratories Fire Test ICC0386017, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS8)," dated April 1986.
 - 7.11 Construction Technology Laboratories Fire Test ICC0985011, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS2)," dated October 1985.
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- 7.12 Construction Technology Laboratories Fire Test ICC1185020, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS11)," dated January 1986.
 - 7.13 Construction Technology Laboratories Fire Test ICC0186015, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS6)," dated March 1986.
 - 7.14 Southwest Research Institute Fire Test ICS0879002, "Fire Qualification Test on Floor Penetration Seal," dated November 30, 1979.
 - 7.15 Construction Technology Laboratories Fire Test ICC0382004, "Fire and Hose Stream Tests For Penetration Seal Systems," dated April 1982.
 - 7.16 Construction Technology Laboratories Fire Test ICC0386022, "Fire and Hose Stream Tests For Penetration Seal Systems (GPC-PSS1)," dated June 1986 (Slab 1).
 - 7.17 Construction Technology Laboratories Fire Test ICC0386022, "Fire and Hose Stream Tests For Penetration Seal Systems (GPC-PSS2)," dated December 1986 (Slab 2).
 - 7.18 Promatec Fire Test PRO293036, "Three Hour Fire Qualification Test, Comparison Test of ICMS Product 90 with D.C. Sylgard 170 and G.E. 6428 Elastomers," dated February 1993.
 - 7.19 Construction Technology Laboratories Fire Test ICC0682008, "Fire and Hose Stream Tests For Penetration Seal Systems," dated June 1982.
 - 7.20 Construction Technology Laboratories Fire Test ICO1091035, "Fire and Hose Stream Tests For Penetration Seal Systems," dated October 1990.
 - 7.21 CTP-1001A, "Three Hour Fire Qualification Test, 10" and 6" Depth Silicone RTV Foam for Electrical and Mechanical Penetration Seals," dated July 25, 1980.
 - 7.22 CTP-1002, "Three Hour Fire Qualification Test, HDLE and Radflex Radiation Seals Flexible Boot Fire Seals For Electrical and Mechanical Penetration Seals," dated July 25, 1980.
 - 7.23 GSU P.O. No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Withing Two Different Test Slabs," dated November 22, 1993.
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- 7.24 CTP-1076, "Three Hour Fire Qualification Test, HDLE, HDSE/HDLE Comparison, Radflex/Foam Composite Seal, Adhesive Sealant Conduit Seal, Nine Inch Silicone Foam W/O Damming, Radflex/Radflex B Comparison For Electrical and Mechanical Penetration Seals," dated March 28, 1985.
 - 7.25 TS-TP-0006, "Fire and Hose-Stream Tests of Penetration Seal Systems," dated April 1978.
 - 7.26 Construction Technology Laboratories Fire Test ICC0286018, "Fire and Hose Stream Tests for Penetration Seal Systems (NMP2-PSS9)", dated April 1986.
 - 7.27 CTP-1139, "Three Hour Fire Qualification Test, Fire Rated Boot Seal w/ Expansion Ring, 36 In. Dia. Pipe Sleeve/10 In. Dia. Penetrant", dated August 5, 1987.
 - 7.28 CTP-1142, "Three Hour Fire Qualification Test, Six (6) Inch Depth LDSE w/ Aluminum & Steel Penetrants, XLPE/PVC Cable", dated November 23, 1987.
 - 7.29 BISCO Report No.: 748-49, "Fire Test Configuration For A Three Hour Rated Fire Seal Utilizing BISCO SF-20 Where A Steel Sleeve Condition With Pipe Penetrant Exists", dated July 9, 1981.
 - 7.30 Construction Technology Laboratories Fire Test ICC0483010, "Fire and Hose Stream Tests for Penetration Seal Systems", dated May 1983.
 - 7.31 Construction Technology Laboratories Fire Test ICC1182009, "Fire and Hose Stream Tests for Penetration Seal Systems and Seismic Gap", dated December 1982
 - 7.32 TS-TP-0014, "Fire and Hose-Stream Test of Penetration Configuration Sealed With Silicone Foam (15-23 LBS/FT³) and Silicone Gel (75-95 LBS/FT³)", dated July 12, 1978
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APPENDIX E

SPECIAL SERVICES INVESTIGATION OF DOW CORNING SYLGARD 170 SILICONE ELASTOMER

(Note: This appendix contains 345 pages in addition to this page. Individual pages of this appendix have not been sequentially numbered. If it is suspected that a page is missing from a copy of this document, a complete copy of this appendix (i.e., the 345 pages following this page) can be obtained by requesting a copy of TVA RIMS No.: T24 950912 342)



QA Record

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July 21, 1995

RE: Update on SYLGARD® 170 Silicone Elastomer, SYLGARD® 170 Silicone Fast Cure Elastomer, and DOW CORNING® 96-081 RTV Adhesive/Sealant

Dear Sir or Madam:

This letter is the final communication regarding Sylgard® 170 Silicone Elastomer Part A, Sylgard® 170 Silicone Fast Cure Elastomer Part A and 96-081 RTV Adhesive Sealant that deviated from our sales specifications. In November of 1994, Dow Corning notified customers that we had provided Sylgard® 170 Silicone Elastomer Part A, Sylgard® 170 Silicone Fast Cure Elastomer Part A and 96-081 RTV Adhesive Sealant that deviated from our sales specifications. While the materials met all sales specifications at the time of manufacture, retesting showed deviations from sales specifications in specific areas. Sylgard® 170 Silicone Elastomer Part A and Sylgard® 170 Silicone Fast Cure Elastomer Part A showed an increase in the cure time of the materials. 96-081 RTV Adhesive Sealant showed an increase in the flame extinguishing time of the material.

At the time of notification we advised that we would be taking steps to correct the cause of the problem and implement appropriate corrective actions to prevent a reoccurrence of the problem. These steps have been completed and appropriate corrective actions implemented.

A testing program was also developed in conjunction with Underwriters Laboratories to determine whether there was any difference in performance between material that met our specification and this suspect material when used in Through Penetration Firestop Systems. This testing has been completed. Attached are reports from Underwriters Laboratories and a letter that summarizes the findings from the test program.

The United States Nuclear Regulatory Commission (NRC) also conducted an inspection of Dow Corning facilities in Midland, MI and Elizabethtown, KY. A copy of the NRC Inspection Report is also attached for your review (NRC Inspection No. 99901284/95-01). Please note that the report also addresses NRC Staff observations of activities that we performed to investigate the Sylgard® 170 Silicone Elastomer Part A, Sylgard® 170 Silicone Fast Cure Elastomer Part A and 96-081 RTV Adhesive Sealant that deviated from our sales specifications.

Please review these reports. If after reviewing the reports you have any questions or additional concerns regarding this matter, please contact me.

Robert M. Schroeder
Fire Protection Engineer

RMS:jml
cc: NRC



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

1995-I0000-40432

Proprietary External

May 31, 1995

Mr. Ronald J. Woodward
Director Total Quality & Supply
Dow Corning U.S.A.
Dow Corning Corporation
Midland, MI 48686-0994

SUBJECT: NRC Inspection No. 99901284/95-01

Dear Mr. Woodward:

This letter transmits the report of the U.S. Nuclear Regulatory Commission (NRC) inspection of Dow Corning Corporation (Dow Corning) facilities in Midland, Michigan, and Elizabethtown, Kentucky, conducted by Messrs. P. Koltay and J. Petrosino of this office on March 23-24, 1995, and April 3-5, 1995. The report also addresses the NRC staff observations on March 21-23, and April 18-21, 1995, of activities that Dow Corning performed to investigate its concern regarding cure time and flame self-extinguishing time parameters of its silicone products that are used in nuclear power plant fire barrier applications.

The inspection was conducted to evaluate Dow Corning's quality assurance program and its implementation in selected areas such as (1) manufacturing process control, (2) product design control, (3) procurement document control, and (4) a review of its program for implementing Part 21, "Reporting Defects and Noncompliance," of Title 10 of the Code of Federal Regulations (10 CFR Part 21).

As part of the inspection the inspectors examined procedures and representative records, conducted discussions and interviews with personnel, and observed several of Dow Corning silicone product manufacturing and testing processes. The inspectors observations were discussed with the Dow Corning staff at the conclusion of the inspection activities, on April 5, 1995.

Based upon the NRC staff observations and discussions during this review, it was concluded that the Dow Corning silicone products used in nuclear power plant fire barrier applications and which Dow Corning manufactures at its Elizabethtown, Kentucky facility are *commercial grade items*, as defined in 10 CFR § 21.3. The team also concluded that although Dow Corning's silicone products supplied for nuclear plant fire barrier applications are not subject to the NRC's Part 21 regulation, it appears to have adequately established and implemented a system which meets the intent of certain 10 CFR Part 21 requirements, such as 10 CFR § 21.21(b). Areas examined during the NRC activities and our conclusions are discussed in the enclosed inspection report.

Mr. Ronald J. Woodward

2

In accordance with 10 CFR 2.790 of the NRC's "Rules of Practice," a copy of this letter and the enclosed inspection report will be placed in the NRC Public Document Room. If there are any questions concerning this inspection we will be pleased to discuss them with you. No response to this letter is required.

Sincerely,



Robert M. Gallo, Chief
Special Inspection Branch
Division of Technical Support
Office of Nuclear Reactor Regulation

Docket No. 99901284

Enclosure: Inspection Report 99901284/95-01

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
DIVISION OF TECHNICAL SUPPORT

ORGANIZATION: Dow Corning U.S.A.
Dow Corning Corporation
Midland, Michigan 48686-0994

REPORT NO.: 99901284/95-01

ORGANIZATIONAL CONTACT: Mr. Robert M. Schroeder, Fire Protection Engineer
(517)496-8330

NUCLEAR INDUSTRY ACTIVITY: Manufactures commercial grade silicone products used in fire barrier penetration seal assemblies for the nuclear industry. The products are sold to six customers who either supply and/or develop and test the fire barrier penetration configurations before installation at nuclear power plants.

INSPECTION CONDUCTED: March 23-24; April 3-5, 1995, and April 18-21, 1995

LEAD INSPECTOR:



Peter S. Koltay, Team Leader
Special Inspection Section
Special Inspection Branch (TSIB)

5/23/95
Date

OTHER INSPECTORS:

J. J. Petrosino
Vendor Inspection Section, TSIB

E. Connell, Plant Systems Branch
Division of Systems Safety and Analysis

T.L. Tinkel, Brookhaven National Laboratory

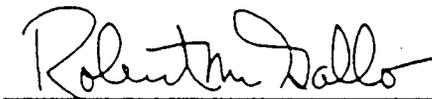
REVIEWED:



Gregory E. Cwalina, Chief
Vendor Inspection Section, TSIB

5/23/95
Date

APPROVED:



Robert M. Gallo, Chief
Special Inspection Branch
Division of Technical Support

6/1/95
Date

1 INSPECTION SUMMARY

Based on the scope of this inspection, the team determined that the Dow Corning Corporation (Dow Corning) does not manufacture and supply any "basic components" as defined in Part 21, "Reporting Defects and Noncompliance," of Title 10 of the Code of Federal Regulations (10 CFR Part 21). While some customers contractually imposed the requirements of 10 CFR Part 21 on Dow Corning for silicone products supplied for use in nuclear power plant fire barrier penetration seal applications, the inspectors verified that the products met the definition of *commercial grade items*, as defined in 10 CFR § 21.3. Therefore, the team concluded that Dow Corning is not subject to the requirements of 10 CFR Part 21. However, the inspectors found that Dow Corning has established and implemented a program which meets the intent of certain sections of 10 CFR Part 21, such as 10 CFR § 21.21(b). Dow Corning personnel stated to the team that although the inspectors determined that Dow Corning is not subject to the requirements of Part 21, it will continue its existing program for meeting the intent of 10 CFR Part 21, but will discontinue issuing certifications to its customers indicating that Dow Corning products were manufactured in compliance to 10 CFR Part 21.

2 STATUS OF PREVIOUS INSPECTION FINDINGS

This was the first NRC staff inspection which was conducted at either of the two Dow Corning facilities discussed in this report; thus, there were no previous findings.

3 INSPECTION FINDINGS AND OBSERVATIONS

3.1 Entrance and Exit Meetings

The entrance meeting on March 23, 1995, was held at the Dow Corning Corporate headquarters in Midland, Michigan. The meeting was attended by corporate personnel responsible for the product line. The exit meeting on April 5, 1995, was held at the Elizabethtown, Kentucky manufacturing facility with the plant manager and the manufacturing team responsible for the product line in attendance. A staff attorney and the fire protection engineer responsible for product applications participated in both meetings.

3.2 Background and Description of Facilities

Dow Corning manufactures four products that have commercial applications and are typically used in fire barrier penetration seals at nuclear power plants, (1) Sylgard 170 Silicone Elastomer, (2) 3-6559 Cure Accelerator (typically used in conjunction with Sylgard 170), (3) 3-6548 Silicone RTV Foam, and (4) 96-081 RTV Adhesive/Sealant (typically used in conjunction with 3-6548 RTV foam). These products, available through published product description, are sold by Dow Corning to commercial customers including six customers who either supply or facilitate the installation of the materials at NRC licensees as part of fire barrier penetration seal assemblies associated with 10 CFR § 50.48, "Fire Protection." The six customers who procure the silicone products from Dow Corning are (1) Brand Fire Protection, (2) North Brothers Company, (3) Promatec, (4) PCI-ICMS, (5) Radian Corporation, and (6) Transco Products, Incorporated.

By letter dated November 17, 1994, Dow Corning informed the NRC and their customers of a deviation which it had identified regarding sales specifications for flame self-extinguishing time of certain lots of RTV Adhesive Sealant 96-081. The letter to the NRC stated that certain customers were being advised of a sales specification deviation on flame self-extinguishing time for 96-081 RTV Adhesive/Sealant. Dow Corning further stated that this product was supplied to certain customers under 10 CFR Part 21. In the letter sent to the customers, Dow Corning advised that tests on retained samples¹ from three lots of the product showed a flame self-extinguishing time ranging from 35 to 130 seconds. According to Dow Corning, tests on these lots at the time they were originally produced showed a flame self-extinguishing time that met the sales specification of 10 seconds or less.

By letter dated November 28, 1994, Dow Corning informed the NRC and their customers of another deviation that it had identified regarding sales specifications for cure time of Sylgard 170 silicone elastomer. The letter to the NRC stated that certain customers of Sylgard 170 Elastomer and Sylgard 170 Fast Cure Elastomer were being advised that the cure rate for certain lots which they had received from Dow Corning was slower than the sales specification. Dow Corning further stated that these products were supplied to certain customers under 10 CFR Part 21. In the letter sent to the customers, Dow Corning advised that tests on retained samples of certain lots of material manufactured between May 1994 and November 23, 1994, indicated that the silicone products did not meet the sales specification for cure rate. According to Dow Corning, tests on these lots at the time the product was manufactured indicated the lots did meet the sales specification for cure rate. Dow Corning stated their belief that the slow cure rate was traceable to an ingredient used in Part A of these materials. Dow Corning further stated that tests on retained samples of Dow Corning 3-6548 RTV Silicone Foam manufactured within the last year showed that this material met specifications and was satisfactory. Dow Corning offered to provide replacement silicone products to their customers.

3.3 Identification of Deviations to Sales Specification

3.3.1 Initial Product Performance Indicators and Investigation

In June-July 1994, Dow Corning received reports from a commercial electronics customer indicating that it had observed slower cure times of the silicone products in its electronic component applications. As a result of the customer notification, Dow Corning started an investigation to resolve the customer report. Dow Corning started its investigation by testing retained samples and determined cure times were slower than normal, but the cure times

¹At the Dow Corning Elizabethtown, Kentucky silicone product manufacturing facility, it was observed by the NRC inspectors that Dow Corning typically tests each silicone product lot for its specification characteristics for baseline data, and also obtains and stores samples of each silicone product lot for future analysis as required.

were still within specifications. In early August 1994, Dow Corning received reports from another electronics customer regarding slow snap time² on Sylgard 170 fast cure. Consequently, Dow Corning performed tests on the applicable retained lot specimens and confirmed that the snap time was slower than as stated in the specification.

In mid-August 1994, additional testing by Dow Corning identified that the cure rate of Sylgard 170A was changing as the product aged, but the cure rate was still within specifications. In late August-September 1994, Dow Corning identified that a certain ingredient used in the Sylgard 170 Part A component appeared to be related to the slower cure time observed in the Sylgard 170 and the slow snap time observed in the Sylgard 170 Fast Cure. Significant variability in cure time from lot to lot was observed. In September 1994, Dow Corning observed that cure rate increased if the mixing time for the ingredient was increased. Dow Corning also determined that a certain vacuum process during the mixing of the ingredient into the Part A compound also improved the cure rate. This latter observation indicated to Dow Corning that possible contaminants were affecting the cure rate. In October 1994, Dow Corning received additional reports from customers about the slow cure time of Sylgard 170, and subsequent testing on retained samples for six lots of the Sylgard 170 now showed that the cure time on two lots were out of specification.

3.3.2 Dow Corning Investigation Findings and Corrective Actions

As a result of inquiry letters that Dow Corning had sent out earlier to its suppliers, Dow Corning received a November 1994 letter from the supplier of the suspect ingredient stating that certain lots of the ingredient contained higher than typical levels of sulphur. Sulphur is a known contaminant that can affect the cure rate and flame self-extinguishing time of the products. Dow Corning also noted that it had not specifically required the supplier to monitor or control sulphur content in that ingredient. In November 1994, Dow Corning concluded that the slower cure rate of Sylgard 170 was related to the sulfur content of the ingredient used in the mixture and advised their customers and the NRC of the problem. Additionally, Dow Corning confirmed that varying levels of sulphur in that ingredient appeared to correlate with the variations in Sylgard 170 cure rate. As a result, Dow Corning switched to a new manufacturer that was capable of supplying the ingredient with higher purity and less potential for sulphur contamination.

As part of its corrective action plan Dow Corning, in conjunction with Underwriters Laboratory, Incorporated (UL), engineering services staff from UL's Northbrook, Illinois facility developed a fire endurance test program of its silicone products used at nuclear power plants. Dow Corning contracted UL to perform and monitor the fire endurance test program to determine if the manufacturing changes, that resulted in the deviations reported to the NRC and

²Snap time is a certain point in the curing process of Sylgard 170 elastomer and 3-6548 Foam just prior to the solidification of the silicone product.

licensees (self-extinguishing time and cure rate), had any significant affect upon the material's performance as a fire barrier penetration seal. The test program was developed to encompass the product sales specification parameters for each product. Dow Corning obtained sample lots from the suspect time period as well as post and pre-suspect time periods for testing. The UL testing was set up to test multiple configurations of each lot. For example, the tests at UL included four different lots of Sylgard 170 Elastomer that met Dow Corning's sales specification and three different lots of the material that deviated from it's sales specifications. The UL staff also tested one lot of 96-081 RTV Adhesive Sealant that met Dow Corning's sales specification and one lot of the material that deviated from it's sales specifications. The test program was established to ensure that it encompassed the following aspects.

- Non-suspect lots of Sylgard 170 and RTV Adhesive/Sealant 96-081 & 3-6548 Foam 96-081 produced with the old source of the suspect ingredient
- Suspect lots of Sylgard 170 RTV Adhesive/Sealant 96-081 & 3-6548 Foam and 96-081 which were produced with the old source of the suspect ingredient
- Lots of Sylgard 170 and RTV Adhesive/Sealant 96-081 & 3-6548 Foam produced with the new source of suspect the ingredient

3.3.3 Fire Endurance Test at the UL facility in Northbrook, Illinois

During the week of March 20, 1995, the team observed the fabrication of the Dow Corning fire endurance test specimens, and during the week of April 17, 1995, the inspector witnessed the performance of fire endurance tests for Dow Corning's 3-6548 Silicone RTV Foam, 96-081 RTV Adhesive and Sylgard 170 Elastomer. The inspector noted that the fire endurance test program was established and conducted in accordance with the requirements of ASTM E-119, "Standard Test Methods for Fire Tests of Building Construction and Materials." A total of five tests were witnessed by the inspector which encompassed all three types of materials from both the suspect group, manufactured between May 1994 and November 1994, and newly manufactured materials. Dow Corning conducted a total of approximately 25 fire tests under this effort. No variations or anomalies of significance were observed in the fire barrier performance of penetration seals constructed with materials from the suspect lots and the newly manufactured materials. Dow Corning completed its test program on April 29, 1995.

3.4 Procurement Document Control and Product Data Sheets

3.4.1 Procurement Document Control

On March 23-24, 1995, the team reviewed a sample of Dow Corning customer procurement records associated with the six suppliers identified in Section 3.2. The team reviewed some recent customer purchase orders (POs) and discussed the process with the Dow Corning personnel who are actually

responsible for receiving and processing the nuclear customer orders. The inspectors observed that none of the customer's POs imposed any nuclear power plant safety-related design, qualification, manufacturing, test or other unique nuclear requirements upon Dow Corning. The team found that two of the six customers contractually imposed the provisions of 10 CFR Part 21 on Dow Corning, while the other four customers did not impose 10 CFR Part 21 requirements on Dow Corning. All of the customer POs which were reviewed by the inspectors ordered Dow Corning products by silicone product name and formulation number, such as "Sylgard 170 (fast Cure Silicone Elastomer), Part B," and did not specify any nuclear design or specification requirements. Some POs required Dow Corning to have an "approved quality assurance [QA] program" for the manufacture of its silicone products.

The typical Dow Corning nuclear customer PO package also contained a Dow Corning "certificate of analysis." A review of several certificates of analysis by the inspectors, for both commercial customers and nuclear customers noted only one difference between the nuclear and commercial certificates for like-products. The certificates that were in the PO package for the customers who imposed 10 CFR Part 21 contained a note which stated, "Complies With 10 CFR 21;" the others did not. The inspectors informed Dow Corning staff that its note certifications that stated compliance with Part 21 were not applicable, since Dow Corning manufactured and supplied *commercial grade items* for nuclear power plant use. The Dow Corning staff stated that they would discontinue issuing the certificates of analysis stating compliance with 10 CFR Part 21.

3.4.2 Product Data Sheets

The NRC inspectors reviewed several Dow Corning product data sheets, application guide specifications, and silicone foam cell structure and color comparison charts. The product data sheets reviewed were for, Sylgard 527 primerless silicone dielectric gel; 3-6548 silicone RTV foam; 96-081 RTV adhesive/sealant; and Sylgard 170 A & B silicone elastomer. None of the Dow Corning specification sheets indicated any specific end-use applications or industry specific use, such as chemical or nuclear.

3.5 10 CFR Part 21 & Associated Programs

The inspectors reviewed the program that Dow Corning had adopted to implement the provisions of 10 CFR Part 21, and evaluated the applicability of 10 CFR Part 21 to Dow Corning in regard to the silicone products used at nuclear power plants. The inspectors found that Dow Corning had developed procedures to address the provisions of 10 CFR Part 21, "Dow Corning Corporation Standard 071, "Reporting of Deviations and Noncompliance as Required by Federal Regulation 10 CFR Part 21," and had also established an associated quality system which ensured that the subject deviations were reported to its customers. Since Dow Corning was not subject to Part 21, the inspectors did not verify compliance with the provisions of 10 CFR Part 21. However, the inspectors did verify that the established Dow Corning program met the intent of certain elements of the Part 21 regulation, such as 10 CFR § 21.21(b), which requires that vendors inform its customers of deviations and failures to comply with regulations.

The NRC inspectors also reviewed associated quality systems that typically would interface and provide input into a 10 CFR Part 21 program. The team concluded that Dow Corning's International Organization for Standardization (ISO) 9002 quality system controls regarding customer complaints appeared to ensure that the 10 CFR § 21.21(b) aspect of informing customers of deviations to procurement specifications was effectively executed. For example, the subject deviations initially were received from customers who used the silicone products in their commercial electronics applications, and the problems were documented and logged into the customer complaint system by the Dow Corning customer service personnel. Once the problems were documented and logged into the Dow Corning quality system, an investigation of the potential product problems were initiated. As a result, Dow Corning found that the problem was generic to certain lots, was caused by sulfur in a particular ingredient, and customers were informed.

Therefore, the team concluded that the quality system controls which Dow Corning had established would appear adequate to meet the intent of certain provisions of 10 CFR Part 21, such as 10 CFR § 21.21(b).

3.6 Manufacturing Process Control and Product Design Control

The NRC inspectors conducted discussions, reviewed documents and observed manufacturing process controls related to the Dow Corning silicone products used at nuclear power plants. No difference was identified by the inspectors between the commercial and nuclear products or their associated design or manufacturing processes.

3.7 Inspection Team Conclusions

The team concluded that the silicone products which are procured from Dow Corning by its six nuclear customers identified in Section 3.2 are *commercial grade items* as defined in 10 CFR § 21.3. Further, the team noted to Dow Corning that a *commercial grade item* can not be transformed into a *basic component*, as defined in 10 CFR § 21.3, merely by imposing the provisions of Part 21 in a PO without imposing other unique nuclear requirements for the design, manufacturing, testing and supply of that item.

Based upon the document reviews, observations by the team, and discussions with Dow Corning manufacturing and corporate personnel the inspectors also concluded that Dow Corning satisfactorily performed its investigative and corrective actions of its silicone product concerns regarding cure time parameters of its silicone products that are used in nuclear power plant fire barrier applications. Additionally, the portions of Dow Corning's quality system controls reviewed by the inspectors were found to be effectively executed.

4.0 PERSONNEL CONTACTED

Dow Corning Corporation Corporate Office

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J. Boone	Total Quality & Supply
R. Schroeder	Fire Protection
R. Loveland	Building Materials
L. Krauss, Esq.	Legal
R. McKellar, Esq.	Legal
M. Gill	Customer Service
M. Heminger	Customer Service
L. Bergman	Product Steward
M. Ladenburger	Product Line

Dow Corning Elizabethtown Manufacturing Facility

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May 26, 1995



Dow Corning Corporation
Mr. Robert M. Schroeder
2200 W. Salzburg Road
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Auburn, MI 48611

Our Reference: R8196, 95NK3179

Subject: Special Services Investigation of Sylgard 170 F.C. Silicone Elastomer

Dear Mr. Schroeder:

The subject of this Letter Report is the fire test investigation of various lots of Dow Corning Corporation Sylgard 170 F.C. Silicone Elastomer in through-penetration firestop systems in concrete floors. The sole purpose of the fire test investigation was to develop fire performance data on Sylgard 170 F.C. Silicone Elastomer produced with the Part A component having pigmentation of different purities. We understand that the information developed in this investigation is to be submitted only to the United States Nuclear Regulatory Commission and to the Dow Corning Corporation customers which have received shipments of the Sylgard 170 F.C. Silicone Elastomer Part A component which were produced during the period of May through November, 1994.

In no event shall UL be responsible to anyone for whatever use or nonuse is made of the information contained in this Report and in no event shall UL, its employees, or its agents incur any obligations or liabilities for damages, including, but not limited to, consequential damages, arising out of or in connection with the use or inability to use the information contained in this Letter Report.

The test program consisted of constructing nine concrete floor slabs, each of which contained four nominal 8 in. diameter steel sleeved or unsleeved through openings. Nominal 4 in. diameter Type L copper tubes were centered in 18 of the 36 through openings. No penetrating items were installed in the 18 remaining through openings. Firestop systems incorporating Dow Corning Corporation Sylgard 170 F.C. Silicone Elastomer were installed in the through openings of each assembly. The test assemblies were subjected to fire exposure tests conducted in accordance with the Standard, Fire Tests of Through-Penetration Firestops, UL 1479 (ASTM E814).

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Information conveyed by his Letter Report applies only to the specimens actually involved in these tests.

MATERIALS:

The following materials were used in the construction of the test assemblies:

Normal Weight Concrete - The ready-mixed concrete consisted of Type I Portland cement, sand and siliceous normal weight aggregate mixed with water and an air entraining agent. The average compressive strength and density of the concrete at 28 days, as determined from eight standard 6 by 12 in. cylinders, averaged 3463 psi and 144.8 pcf, respectively.

Welded Wire Fabric - The welded wire fabric reinforcement for the concrete floor slabs was a 6 by 6 in. welded wire mesh of No. 10 SWG uncoated steel wire (6 x 6 - W1.4 x W1.4).

Steel Sleeves - The sleeves consisted of 4-1/2 in. lengths of nominal 8 in. diameter Schedule 40 steel pipe. The steel sleeves had an inside diameter of 8.025 in. and a wall thickness of 0.300 in. Four 1/4-20 by 1 in. long hex-head steel bolts, symmetrically located, were welded to the exterior of each steel sleeve at the sleeve midheight to anchor the sleeve in the concrete slab.

Circular Forms - The circular forms for the unsleeved through openings consisted of 4-1/2 in. lengths of waxed cardboard tube having an outside diameter of 8-1/4 in.

Copper Tubes - The nominal 4 in. diameter Type L copper tubes were 52-1/2 in. long with an outside diameter of 4.12 in. and a wall thickness of 0.103 in. Each tube was marked "4" "L" COPPER PIPE MUELLER COPPER TUBE USA STREAMLINE". One end of each tube was sealed by a screw-attached steel cap in conjunction with a ceramic fiber gasket.

Forms - The forms that were used to prevent leakage of the fill material while in its liquid state were nominal 2 in. thick foam plastic sheets. The edge of each sheet was marked "LOT AH95022307 ETHAFOAM 'R' 220 2 X 48 X 108 3216959."

Fill, Void or Cavity Materials - The fill material was manufactured by Dow Corning Corporation and designated Type 170 F.C. Silicone Elastomer. The fill material was a two component silicone elastomer system mixed and applied under pressure with specially designed application equipment. The mixing ratio of Parts A and B was 1:1 on a volume basis and application was made in accordance with the manufacturer's application instructions. Eight different batches of the Part A component were submitted for testing along with a single "control" batch of the Part B component. The eight fill materials used in the fire test investigation were identified as shown in the following table:

<u>Sylgard 170 Silicone Elastomer - Part A</u>	<u>Sylgard 170 F.C. Silicone Elastomer - Part B</u>	<u>Fill Material Reference</u>
ET123417	ET104682	A
ET123430	ET104682	B
ET123431	ET104682	C
ET084513	ET104682	D
ET054480	ET104682	P
ET114538	ET104682	Q
ET025559	ET104682	E
ET025560	ET104682	F

Each pail of the Sylgard 170 F.C. Silicone Elastomer - Part B component bore the UL Classification Marking under the Fill, Void or Cavity Materials and Joint Treatment Materials categories. At the time of production, each lot of each fill material component conformed with the Dow Corning Corporation sales specification and with the specifications in Follow-Up Service Procedure, R8196, Volume 1, Section 3. Following the fire test investigation, each Sylgard 170 F.C. Silicone Elastomer - Part A component was retested by the Quality Assurance personnel at the Elizabethtown, KY plant. The Sylgard 170 F.C. Silicone Elastomer finished product tests were also repeated with each lot of Part A mixed with an equal amount of Sylgard 170 F.C. Silicone Elastomer - Part B (Lot No. ET104682). The repeat tests were conducted on May 11, 1995. With the exception of the specification for Snap Time (3 to 10 minutes, Dow Corning Corporation Corporate Test Method 0092A) for Sylgard 170 F.C. Silicone Elastomer samples made with Part A from Lot Nos. ET054480 and ET084513, each lot of fill material conformed with the Dow Corning Corporation sales specification and with the specifications in Follow-Up Service Procedure, R8196, Volume 1, Section 3. For Lot No. ET054480, the snap time was 27 min. For Lot No. ET084513, the snap time was 12.5 min.

CONSTRUCTION OF TEST ASSEMBLIES:

The test assemblies were constructed in accordance with the method specified by the submittor. The construction of the test assemblies was observed by members of the technical and engineering staff of Underwriters Laboratories Inc.

The 48 by 48 by 4 1/2 in. thick concrete floor assemblies were constructed in lumber frames and were each reinforced with a nominal 48 by 48 in. piece of welded wire fabric. Prior to concrete placement, steel sleeves and/or cardboard tube forms were positioned in the lumber frames to create the through openings, as shown in ILLS. 1, 3 and 5. The concrete was poured into the frames, internally vibrated and was finished to a smooth, flat surface with a trowel and wood float. During the placement of the concrete, the welded wire fabric was lifted to approximately the middepth of the concrete. After the concrete had cured, the lumber frames and cardboard

tube forms were removed. Prior to installation of the firestop systems, the steel sleeves and unsleeved openings were sand-blasted to remove any loose dirt, scale and oil.

A nominal 4 in. diameter copper tube was centered in each of the eighteen steel-sleeved through openings in five of the concrete floor assemblies. The support racks for the copper tubes were attached to the top surface of the concrete floor assemblies by means of expansion type masonry fasteners. The cross members of the support racks were located approximately 12 in. and 30 in. above the top surface of the concrete floor assembly for support and attachment of the copper tubes. Each copper tube was positioned such that it projected 12 in. and 36 in. beyond the exposed and unexposed surfaces of the concrete floor assembly, respectively.

Nominal 16 by 16 in. pieces of the foam plastic form board were placed against the underside of the floor assembly beneath each through opening. The form board pieces were initially adhered to the concrete by a small dab of Dow Corning Corporation Type 96-081 Silicone adhesive/sealant at each corner and were then secured in place with steel band straps which encircled the concrete slab. For the eighteen steel-sleeved openings penetrated by copper tubes, a nominal 4 in. diameter opening was hole-sawed in each form board to tightly follow the contour of the tube with a slit at the center of one edge to permit installation about the tube.

A nominal 4-1/2 in. depth of Type 170 silicone elastomer fill material was applied to fill each through opening flush with the top and bottom surfaces of the floor assembly. First, a nominal 1 in. depth of the liquid mixture was poured into the through opening atop the form board and was allowed to cure for a short time before filling the remainder of the through opening with a second pour. The form boards were removed after the liquid fill materials had cured.

The details of the nine test assemblies are summarized in the following table:

Test Assembly No.	ILL. No.	Opening Size	Penetrating Item	Opening No.	Fill Material Reference
1	1	8 in. Unsleeved	None	1,2	E
		8 in. Unsleeved	None	3,4	D
2	1	8 in. Unsleeved	None	1,2,3,4	A
3	1	8 in. Unsleeved	None	1,2	P
		8 in. Unsleeved	None	3,4	Q
4	1	8 in. Unsleeved	None	1,2	B
		8 in. Unsleeved	None	3,4	C

<u>Test Assembly No.</u>	<u>ILL. No.</u>	<u>Opening Size</u>	<u>Penetrating Item</u>	<u>Opening No.</u>	<u>Fill Material Reference</u>
5	3	8 in. Sch 40 Slv	4 in. Copper Tube	1,2	F
		8 in. Unsleeved	None	3,4	F
6	5	8 in. Sch 40 Slv	4 in. Copper Tube	1,2	B
		8 in. Sch 40 Slv	4 in. Copper Tube	3,4	C
7	5	8 in. Sch 40 Slv	4 in. Copper Tube	1,2	E
		8 in. Sch 40 Slv	4 in. Copper Tube	3,4	D
8	5	8 in. Sch 40 Slv	4 in. Copper Tube	1,2,3,4	A
9	5	8 in. Sch 40 Slv	4 in. Copper Tube	1,2	P
		8 in. Sch 40 Slv	4 in. Copper Tube	3,4	Q

FIRE EXPOSURE TESTS:

The fire exposure tests were each conducted in accordance with the Standard, Fire Tests of Through-Penetration Firestops, UL 1479.

SAMPLES

The fire exposure tests were conducted on Test Assembly Nos. 1 through 9, constructed as described previously in this Letter Report under the section entitled "Construction of Test Assemblies" and as shown in ILLS. 1, 3 and 5.

Prior to installation of the firestop systems, the floor assemblies were each subjected to low-level fire exposure to drive the free moisture from the concrete. The humidity of each concrete floor assembly, as determined from a moisture-sensitive probe inserted in holes drilled into the concrete, was less than 75 percent at the time of each fire exposure test.

METHOD

The test assemblies were tested on the horizontal furnace of Underwriters Laboratories Inc. The furnace consists of a steel shell lined with refractory brick with castable refractory ledges. The samples are exposed to radiant flames generated by burning natural gas delivered through four nominal 85,000 Btu/hr capacity multijet pipe burners located in the floor of the furnace. The actual surface of each sample exposed to fire is approximately 40 by 40 in. For each of the nine fire tests described herein, the walls of the furnace were additionally lined with ceramic fiber blanket material to allow faster cooling of the furnace between fire tests. The furnace

temperatures for each fire test were adjusted to follow the standard time-temperature curve as specified in the Standard, UL 1479 (ASTM E814). The temperatures were measured by three thermocouples symmetrically located 12 in. below the exposed surface of the test assemblies. The four edges of each test assembly were insulated with mineral wool batts.

Temperatures on the fill materials, penetrating items and unexposed surface of each test assembly were measured by 29 thermocouples. The thermocouples for Test Assembly Nos. 1, 2, 3 and 4 were located as shown in ILL. 2. The thermocouples for Test Assembly No. 5 were located as shown in ILL. 4. The thermocouples for Test Assembly Nos. 6, 7, 8 and 9 were located as shown in ILL. 6. The thermocouples were covered with nominal 2 by 2 in. dry ceramic fiber pads.

The differential pressure between the furnace chamber and the laboratory was measured with two stainless steel pressure probes connected to pressure transducers. The pressure probes were located approximately 0.78 in. (Channel No. 56) and 12 in. (Channel No. 57) below the exposed surface of each test assembly.

Throughout each fire exposure test, observations were made of the character of the fire and its control, the condition of the unexposed surface, and all developments pertaining to the performance of the firestop systems with special reference to integrity and flame passage through the test assembly. In addition to visual observations, each fire test was videotaped.

RESULTS

Character And Distribution Of Fire - For each fire exposure test, the fire was luminous and well distributed, and the furnace temperatures followed the standard time-temperature curve as outlined in the Standard, UL 1479, and as shown in the graphs and tables listed below:

Test Assembly No.	Graph of Average Furnace Temperature	Table of Average Furnace Temperature
1	ILL. 7	Appendix A, Pages 1, 2 and 3
2	ILL. 8	Appendix A, Pages 4, 5 and 6
3	ILL. 9	Appendix A, Pages 7, 8 and 9
4	ILL. 10	Appendix A, Pages 10, 11 and 12
5	ILL. 11	Appendix A, Pages 13, 14 and 15
6	ILL. 12	Appendix A, Pages 16, 17 and 18
7	ILL. 13	Appendix A, Pages 19, 20 and 21
8	ILL. 14	Appendix A, Pages 22, 23 and 24
9	ILL. 15	Appendix A, Pages 25, 26 and 27

Pressure Within The Furnace - The differential pressure between the furnace and the laboratory was positive throughout each fire test. The differential pressures between the furnace and the laboratory recorded during each fire exposure test is shown in the tables listed below:

<u>Test Assembly No.</u>	<u>Table of Average Furnace Pressure</u>
1	Appendix B, Pages 1, 2 and 3
2	Appendix B, Pages 4, 5 and 6
3	Appendix B, Pages 7, 8 and 9
4	Appendix B, Pages 10, 11 and 12
5	Appendix B, Pages 13, 14 and 15
6	Appendix B, Pages 16, 17 and 18
7	Appendix B, Pages 19, 20 and 21
8	Appendix B, Pages 22, 23 and 24
9	Appendix B, Pages 25, 26 and 27

Observations During Tests - For each of the 18 firestop systems consisting of a nominal 8 in. diameter unsleeved "blank" opening (Test Assembly Nos. 1 through 5), the Sylgard 170 F.C. Silicone Elastomer crowned up approximately 1/2 in. to 1-1/2 in. at the center of the opening by 180 min. With the exception of Opening 4 in Test Assembly No. 2, no flaming occurred on the top surface of the "blank" firestop systems. For Opening No. 4 in Test Assembly No. 2, flaming occurred on the unexposed surface of the firestop system after 246 min of fire exposure. For each of the 18 firestop systems consisting of a nominal 4 in. diameter copper tube centered in a nominal 8 in. Schedule 40 steel pipe sleeve (Test Assembly Nos. 5 through 9), the Sylgard 170 F.C. Silicone Elastomer raised up approximately 1 to 1-1/2 in. above the top of the steel sleeve at the base of the copper tube by 60 min. With the exception of Opening 3 in Test Assembly No. 6, no flaming occurred on the top surface of the firestop systems containing the copper tubes. For Opening No. 3 in Test Assembly No. 6, flaming occurred on the unexposed surface of the firestop system after 177 min of fire exposure. Each of the nine fire exposure tests was terminated at 270 min.

Temperature Of The Assemblies - The temperatures measured on the unexposed surface of the firestop systems during each fire exposure test are shown in the tables in the following list:

Test Assembly No.	Tabulated Temperature Data
1	Appendix C, Pages 1 through 15
2	Appendix C, Pages 16 through 30
3	Appendix C, Pages 31 through 45
4	Appendix C, Pages 46 through 60
5	Appendix C, Pages 61 through 75
6	Appendix C, Pages 76 through 90
7	Appendix C, Pages 91 through 105
8	Appendix C, Pages 106 through 120
9	Appendix C, Pages 121 through 135

The Standard, UL 1479, contains a provision whereby T Ratings are established for firestop systems based upon the temperature rise on the unexposed surface. The T Rating is defined as the time at which the hottest point on the unexposed surface of the firestop system rises 325°F above the initial starting temperature. The time at which the limiting temperature was reached on the fill material of each firestop system, disregarding the temperature measured on the copper tube, is shown in the following table:

Test Assembly No.	Opening No.	Fill Material Reference	T Rating Time, min (T.C. No.)
1	1	E	190 (6)
	2	E	172 (13)
	3	D	149 (21)
	4	D	158 (27)
2	1	A	153 (7)
	2	A	125 (13)
	3	A	150 (20)
	4	A	150 (27)
3	1	P	173 (6)
	2	P	163 (13)
	3	Q	161 (21)
	4	Q	155 (27)

Test Assembly No.	Opening No.	Fill Material Reference	T Rating Time, min (T.C. No.)
4	1	B	164 (6)
	2	B	168 (13)
	3	C	172 (20)
	4	C	186 (27)
5	1	F	115 (4)
	2	F	102 (10)
	3	F	174 (20)
	4	F	184 (28)
6	1	B	110 (3)
	2	B	128 (13)
	3	C	87 (20)
	4	C	87 (27)
7	1	E	90 (3)
	2	E	107 (9)
	3	D	72 (20)
	4	D	69 (27)
8	1	A	81 (5)
	2	A	98 (12)
	3	A	90 (16)
	4	A	73 (27)
9	1	P	85 (6)
	2	P	114 (13)
	3	Q	78 (20)
	4	Q	99 (24)

As stated earlier under "Observations During Tests", the Sylgard 170 F.C. Silicone Elastomer "crowned" up or otherwise raised up during each fire test and remained crowned until flaming occurred or until the end of the fire exposure test. When the silicone elastomer fill material crowned or raised up, the thermocouple pad and weight typically fell away from the thermocouple bead and the thermocouple bead lost contact with the silicone foam fill material. No attempt was made to replace the thermocouple pads, weights or the thermocouples themselves to their pretest positions once they had fallen away due to fill material movement. As a result of the thermocouple beads being uncovered and/or moving from contact with the Sylgard

170 F.C. Silicone Elastomer, the temperature data from the fire tests appears somewhat erratic after "crowning" of the silicone elastomer occurred .

S U M M A R Y

Nine nominal 48 by 48 by 4-1/2 in. thick normal concrete floor slabs, each containing four nominal 8 in. diameter steel sleeved or unsleeved through openings, were constructed. A nominal 4 in. diameter Type L copper tube was centered in each of 18 steel sleeved openings such that a nominal 2 in. annular space was present. No penetrating items were installed in the 18 unsleeved openings. Nominal 2 in. thick foam plastic form boards were placed against the underside of the concrete floor slab beneath each through opening as a temporary form. Each opening was filled with a nominal 4-1/2 in. depth of Sylgard 170 F.C. Silicone Elastomer. After the Sylgard 170 F.C. Silicone Elastomer in each through opening had fully-cured, the form board was removed.

The test assemblies were each subjected to a fire exposure test conducted in accordance with the Standard, Fire Tests of Through-Penetration Firestops, UL 1479 (ASTM E814). Flaming occurred on the unexposed surface of one of the 18 unsleeved, unpenetrated ("blank") firestop systems and on one of the 18 steel sleeved firestop systems containing a copper tube penetrant during the fire exposure tests. The time at which flaming occurred and the time at which the limiting temperature for the T Rating was reached on each firestop system is shown in the following tables:

Firestop Systems For Nominal 8 in. Diameter Unsleeved And Unpenetrated
("Blank") Through Openings

Test Assembly No.	Opening No.	Fill Material Reference	Flame Time, min	T Rating Time, min	Fire Test Duration, min
1	1	E	N.A.	190	270
	2	E	N.A.	172	
	3	D	N.A.	149	
	4	D	N.A.	158	
2	1	A	N.A.	153	270
	2	A	N.A.	125	
	3	A	N.A.	150	
	4	A	246	150	

Test Assembly No.	Opening No.	Fill Material Reference	Flame Time, min	T Rating Time, min	Fire Test Duration, min
3	1	P	N.A.	173	270
	2	P	N.A.	163	
	3	Q	N.A.	161	
	4	Q	N.A.	155	
4	1	B	N.A.	164	270
	2	B	N.A.	168	
	3	C	N.A.	172	
	4	C	N.A.	186	
5	3	F	N.A.	174	270
	4	F	N.A.	184	

Firestop Systems For Nominal 8 in. Diameter Steel Sleeved Through Openings
Containing Nominal 4 in. Diameter Copper Tube

Test Assembly No.	Opening No.	Fill Material Reference	Flame Time, min	T Rating Time, min	Fire Test Duration, min
5	1	F	N.A.	115	270
	2	F	N.A.	102	
6	1	B	N.A.	110	270
	2	B	N.A.	128	
	3	C	177	87	
	4	C	N.A.	87	
7	1	E	N.A.	90	270
	2	E	N.A.	107	
	3	D	N.A.	72	
	4	D	N.A.	69	
8	1	A	N.A.	81	270
	2	A	N.A.	98	
	3	A	N.A.	90	
	4	A	N.A.	73	
9	1	P	N.A.	85	270
	2	P	N.A.	114	
	3	Q	N.A.	78	
	4	Q	N.A.	99	

N.A. - Not applicable. No flaming occurred.

In consideration of the nature of this investigation, the foregoing Letter Report is to be construed as information only and should not be regarded as containing any conclusions or recommendations on the part of Underwriters Laboratories Inc. regarding the acceptability of the fill materials for use in firestop systems as specified in Appendix R to 10CFR50, or for any other purpose.

Report by:



C. J. JOHNSON (Ext. 42649)
Senior Engineering Associate
Engineering Services, 411B

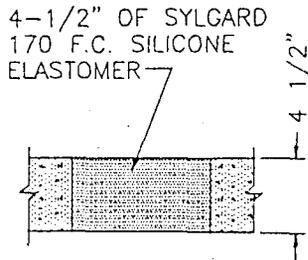
Reviewed by:



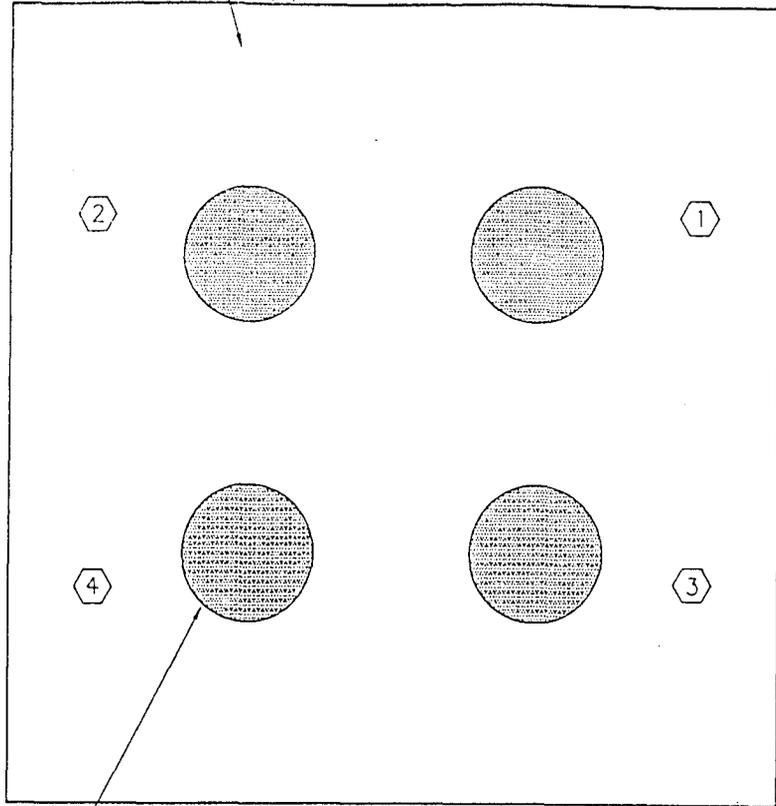
RICHARD N. WALKE (Ext. 43084)
Engineering Group Leader
Engineering Services, 411B

NORTH

NOM 48" x 48" x 4-1/2" THICK
STEEL-REINFORCED NORMAL
WEIGHT CONCRETE SLAB



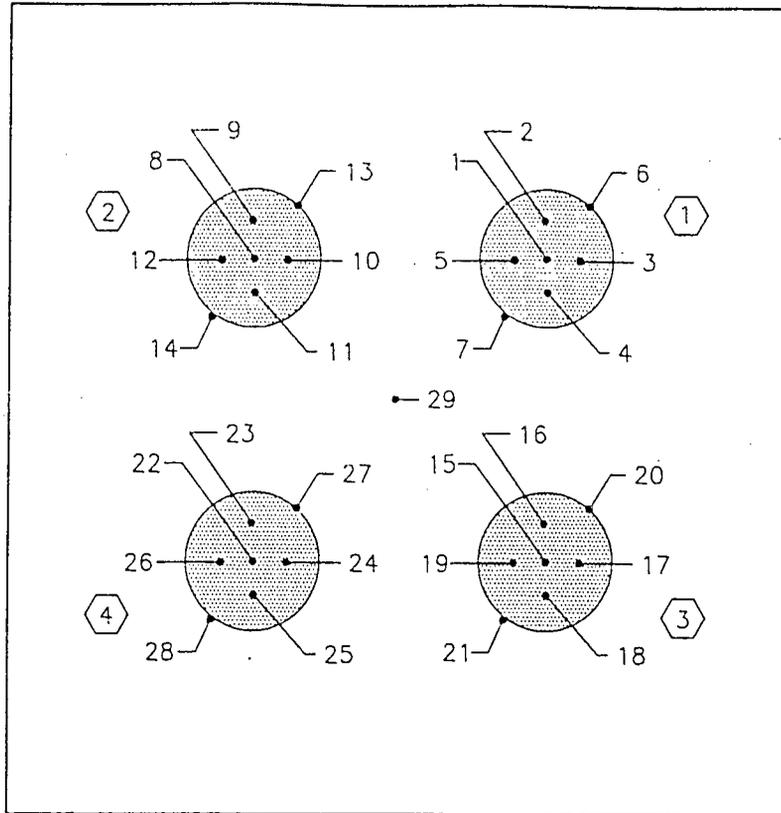
TYPICAL
SECTION



NOM 8" DIAM UNSLEEVED THROUGH
OPENINGS (TYP. - 4 PLCS.)

<u>TEST DATE</u>	<u>TEST ASSEMBLY NO.</u>	<u>OPENING NOS.</u>	<u>TYPE 3-6548 FILL MATERIAL REFERENCE</u>
4-4-95	1	1, 2 3, 4	E D
4-5-95	2	1 - 4	A
4-6-95	3	1, 2 3, 4	P Q
4-7-95	4	1, 2 3, 4	B C

NORTH



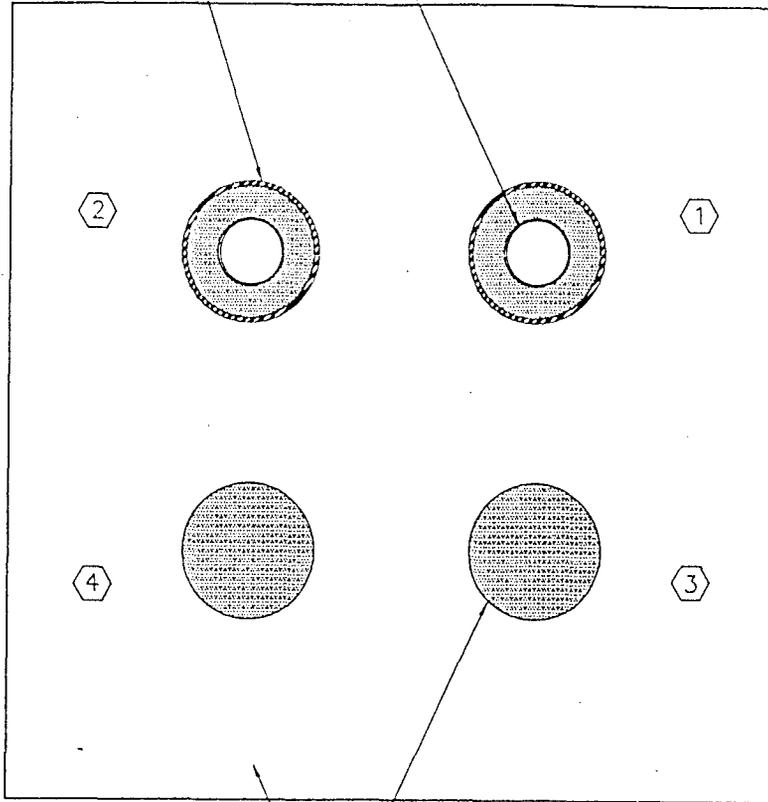
T.C. NO.	LOCATION
1,8,15,22	ON FILL MATERIAL AT CENTER OF OPENING
2,3,4,5,9,10,11,12, 16,17,18,19,23,24,25,26	ON FILL MATERIAL AT QUARTERPOINTS OF OPENING
6,7,13,14,20,21,27,28	ON FILL MATERIAL AT EDGE OF OPENING
29	ON CONCRETE AT CENTER OF FLOOR SLAB

THERMOCOUPLE LOCATIONS -
TEST ASSEMBLY NOS. 1, 2, 3 & 4

NORTH

NOM 8" DIAM x 4-1/2" LONG
SCH 40 STEEL PIPE SLEEVE
(TYP. - 2 PLCS.)

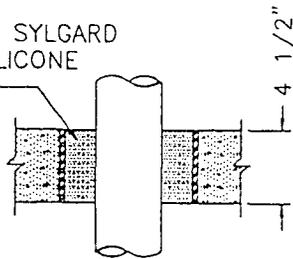
NOM 4" DIAM x 52-1/2" LONG TYPE L
COPPER TUBE CENTERED IN SLEEVED
OPENING (TYP. - 2 PLCS.)



NOM 48" x 48" x 4-1/2" THICK
STEEL-REINFORCED NORMAL
WEIGHT CONCRETE SLAB

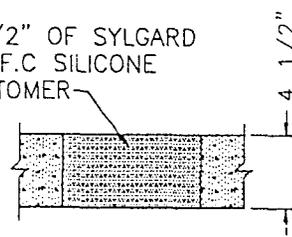
NOM 8" DIAM UNSLEEVED THROUGH
OPENING (TYP. - 2 PLCS.)

4-1/2" OF SYLGARD
170 F.C SILICONE
ELASTOMER



TYPICAL SECTION
OPENINGS 1 & 2

4-1/2" OF SYLGARD
170 F.C SILICONE
ELASTOMER



TYPICAL SECTION
OPENINGS 3 & 4

TEST
DATE
4-14-95

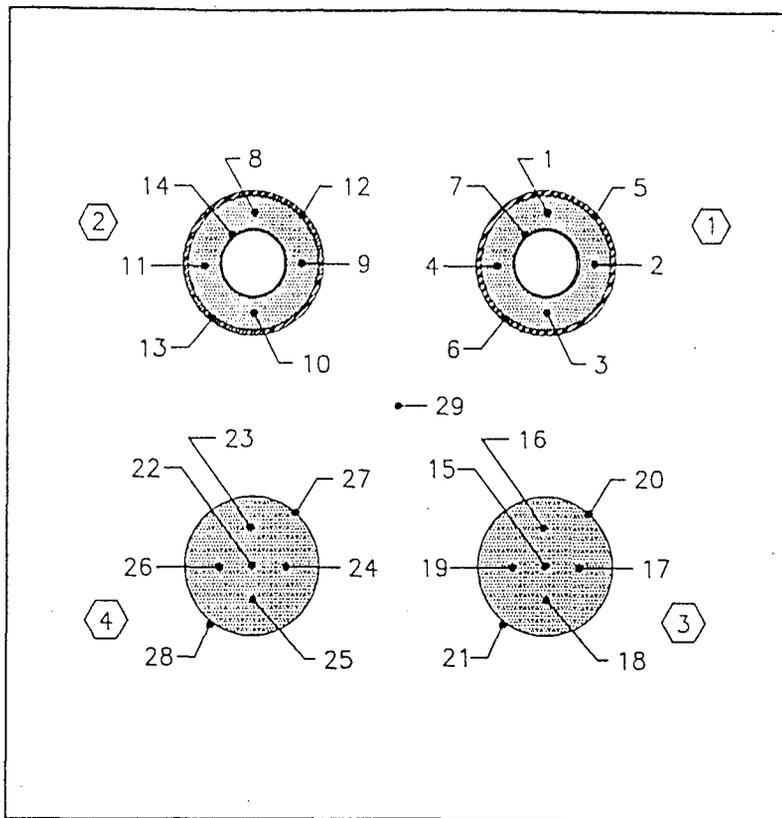
TEST
ASSEMBLY NO.
5

OPENING
NOS.
1 - 4

TYPE 3-6548 FILL
MATERIAL REFERENCE
F

CONSTRUCTION DETAILS -
TEST ASSEMBLY NO. 5

NORTH



T.C. NO.	LOCATION
1,2,3,4,8,9,10,11	ON FILL MATERIAL AT CENTER OF ANNULAR SPACE
5,6,12,13	ON EDGE OF STEEL SLEEVE
7,14	ON COPPER PIPE 1" ABOVE FILL MATERIAL
15,22	ON FILL MATERIAL AT CENTER OF OPENING
16,17,18,19,23,24,25,26	ON FILL MATERIAL AT QUARTERPOINTS OF OPENING
20,21,27,28	ON FILL MATERIAL AT EDGE OF OPENING
29	ON CONCRETE AT CENTER OF FLOOR SLAB

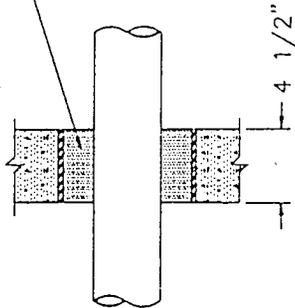
THERMOCOUPLE LOCATIONS -
TEST ASSEMBLY NO. 5

NORTH

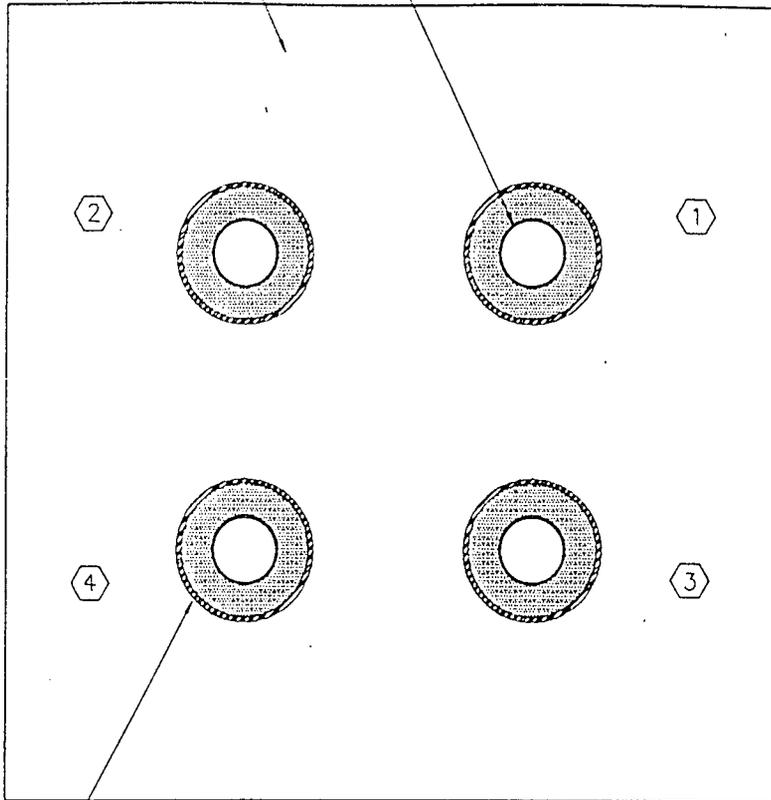
NOM 48" x 48" x 4-1/2" THICK
STEEL-REINFORCED NORMAL
WEIGHT CONCRETE SLAB

NOM 4" DIAM x 52-1/2" LONG TYPE L
COPPER TUBE CENTERED IN SLEEVED
OPENING (TYP. - 4 PLCS.)

4-1/2" OF SYLGARD
170 F.C. SILICONE
ELASTOMER



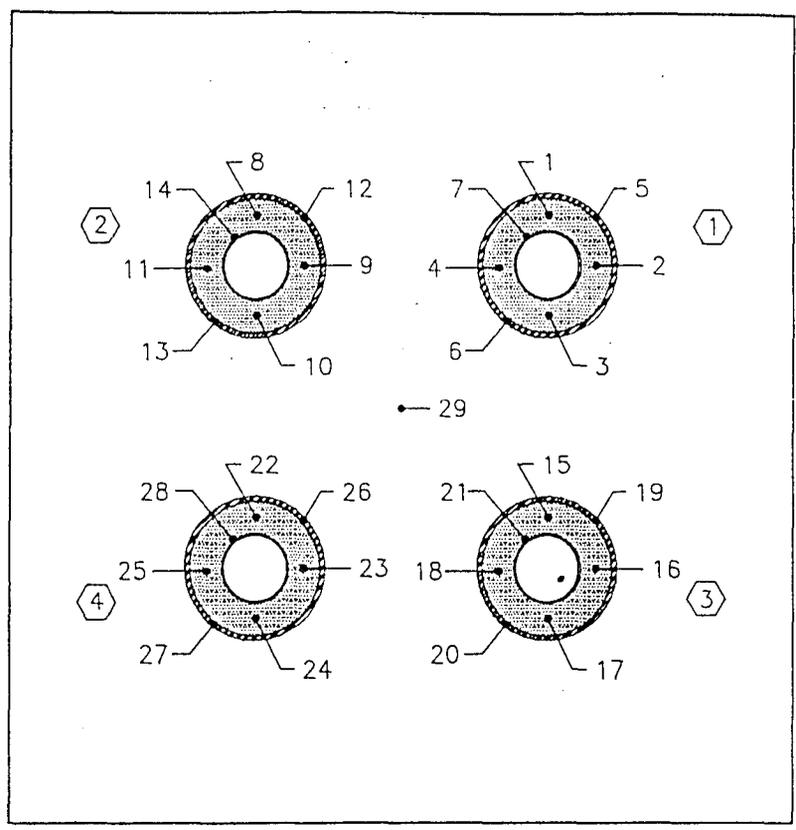
TYPICAL
SECTION



NOM 8" DIAM x 4-1/2" LONG SCH 40 STEEL
PIPE SLEEVE (TYP. - 4 PLCS.)

<u>TEST DATE</u>	<u>TEST ASSEMBLY NO.</u>	<u>OPENING NOS.</u>	<u>TYPE 3-6548 FILL MATERIAL REFERENCE</u>
4-17-95	6	1, 2 3, 4	B C
4-20-95	7	1, 2 3, 4	E D
4-21-95	8	1 - 4	A
4-24-95	9	1, 2 3, 4	P Q

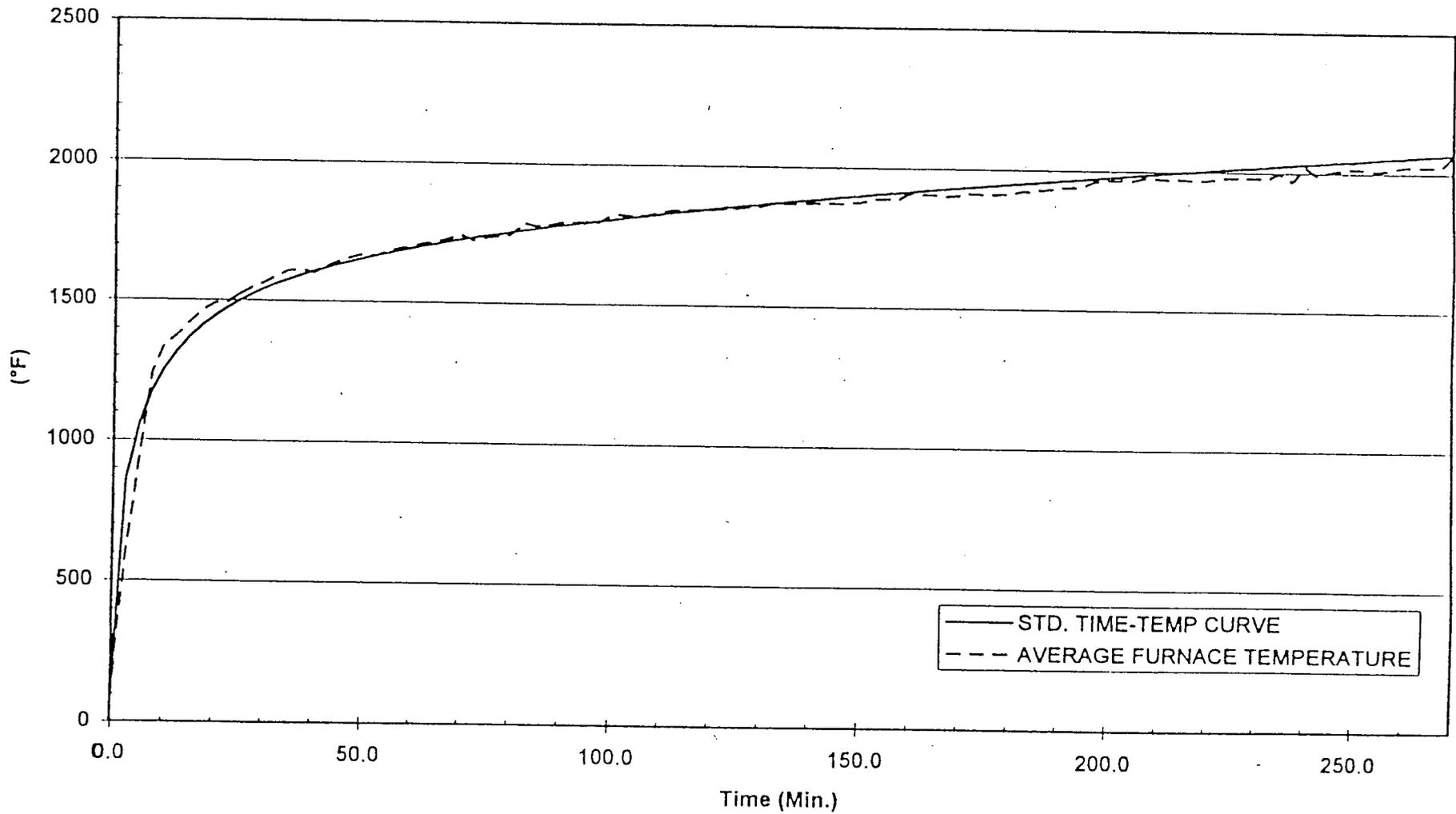
NORTH



T.C. NO.	LOCATION
1,2,3,4,8,9,10,11,15, 16,17,18,22,23,24,25	ON FILL MATERIAL AT CENTER OF ANNULAR SPACE
5,6,12,13,19, 20,26,27	ON EDGE OF STEEL SLEEVE
7,14,21,28	ON COPPER PIPE 1" ABOVE FILL MATERIAL
29	ON CONCRETE AT CENTER OF FLOOR SLAB

THERMOCOUPLE LOCATIONS -
TEST ASSEMBLY NOS. 6, 7, 8 & 9

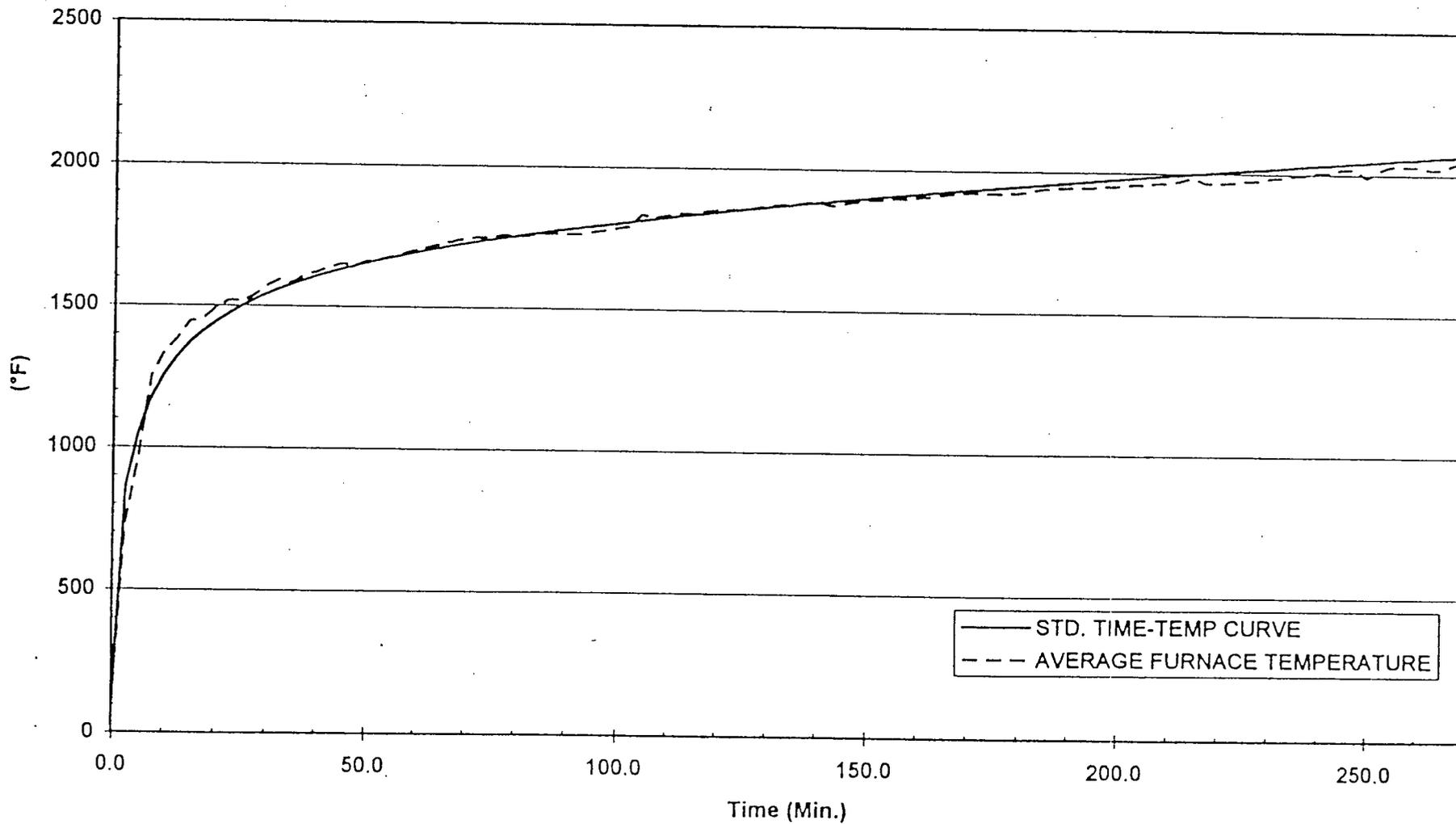
DOW CORNING CORP.
TEST ASSEMBLY NO. 1
FURNACE TEMPERATURE



R8196
ILL. 7

R8196/95NK3179
Test Date : APRIL 4, 1995

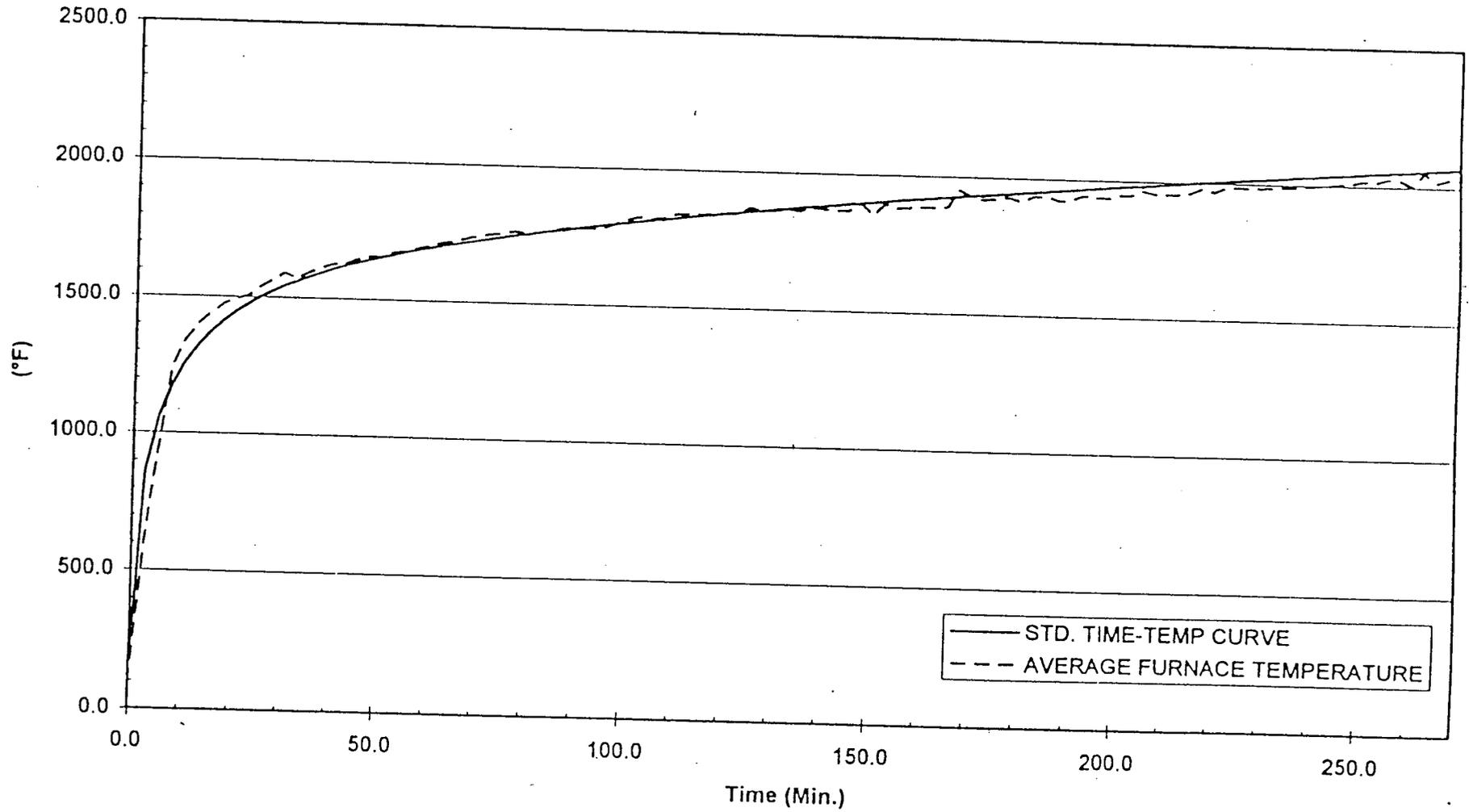
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
FURNACE TEMPERATURES



R8196
ILL. 8

R8196/95NK3179
Test Date : APRIL 5, 1995

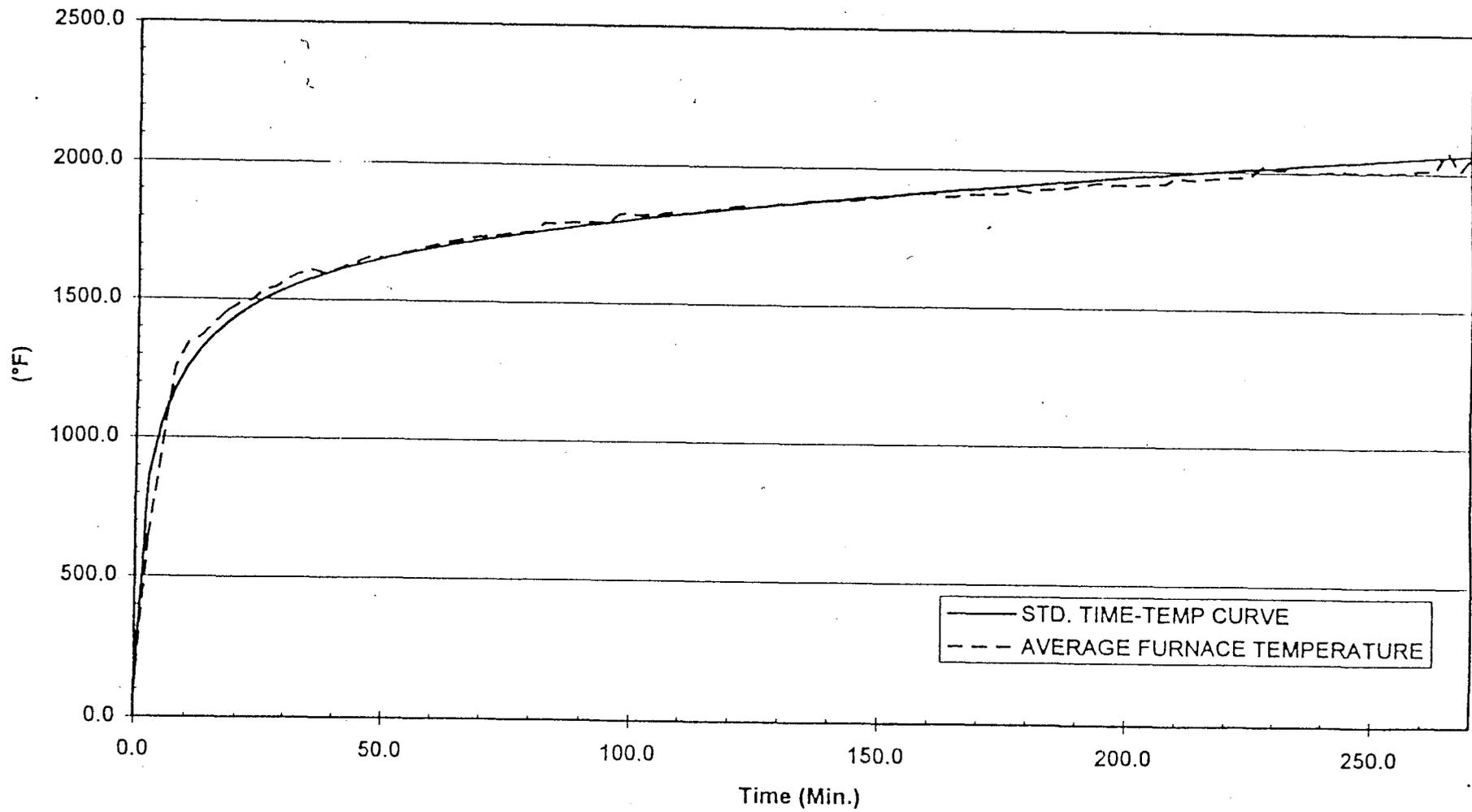
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
FURNACE TEMPERATURES



R8196
ILL. 9

R8196/95NK3179
Test Date : APRIL 6, 1995

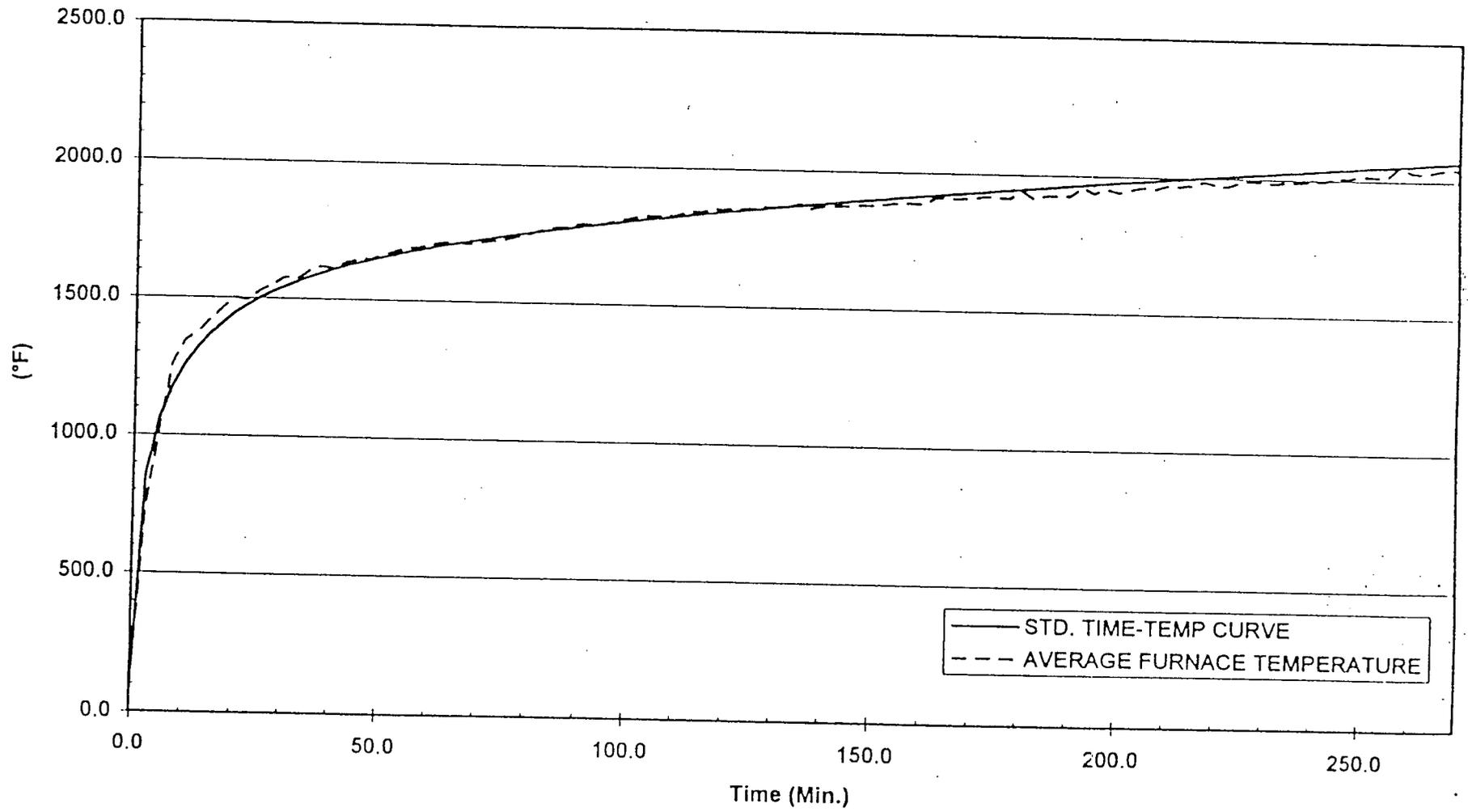
DOW CORNING CORP.
TEST ASSEMBLY NO. 4
FURNACE TEMPERATURES



R8196
APR 10

R8196/95NK3179
Test Date : APRIL 7, 1995

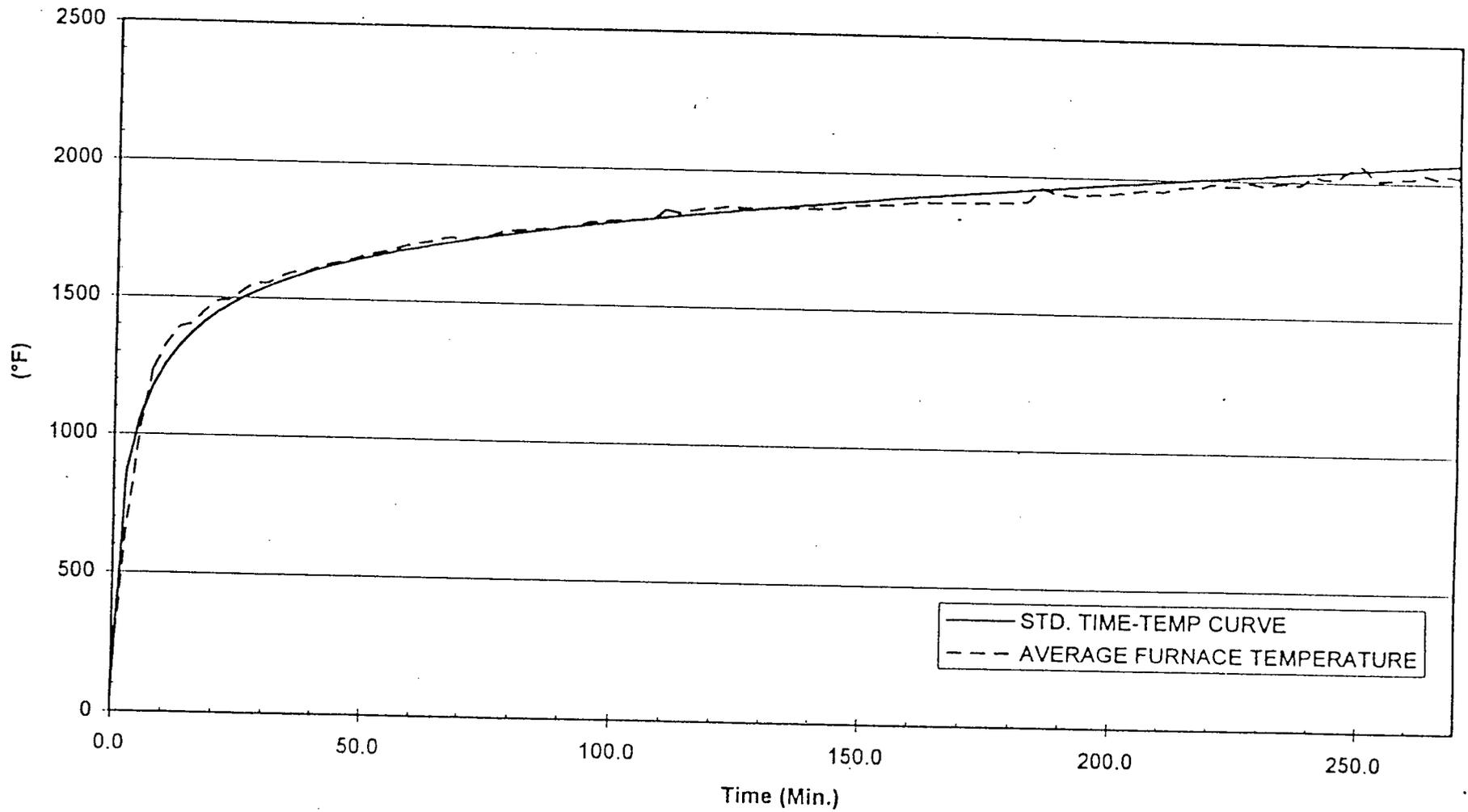
DOW CORNING CORP.
TEST ASSEMBLY NO. 5
FURNACE TEMPERATURES



R8196
ILL. 11

R8196/95NK3179
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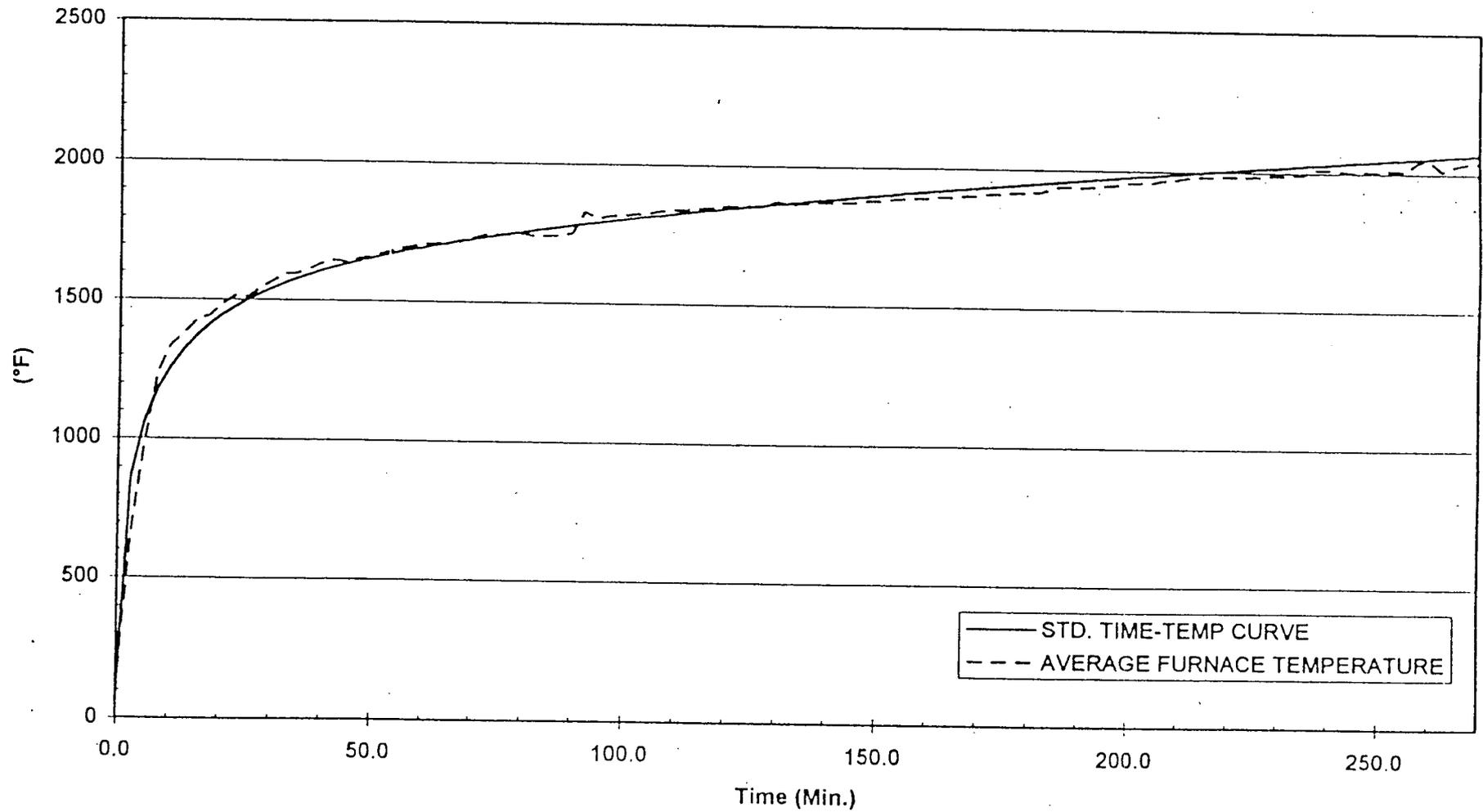
DOW CORNING CORP.
TEST ASSEMBLY NO. 6
FURNACE TEMPERATURES



R8196
ILL. 12

R8196/95NK3179
Test Date : APRIL 17, 1995

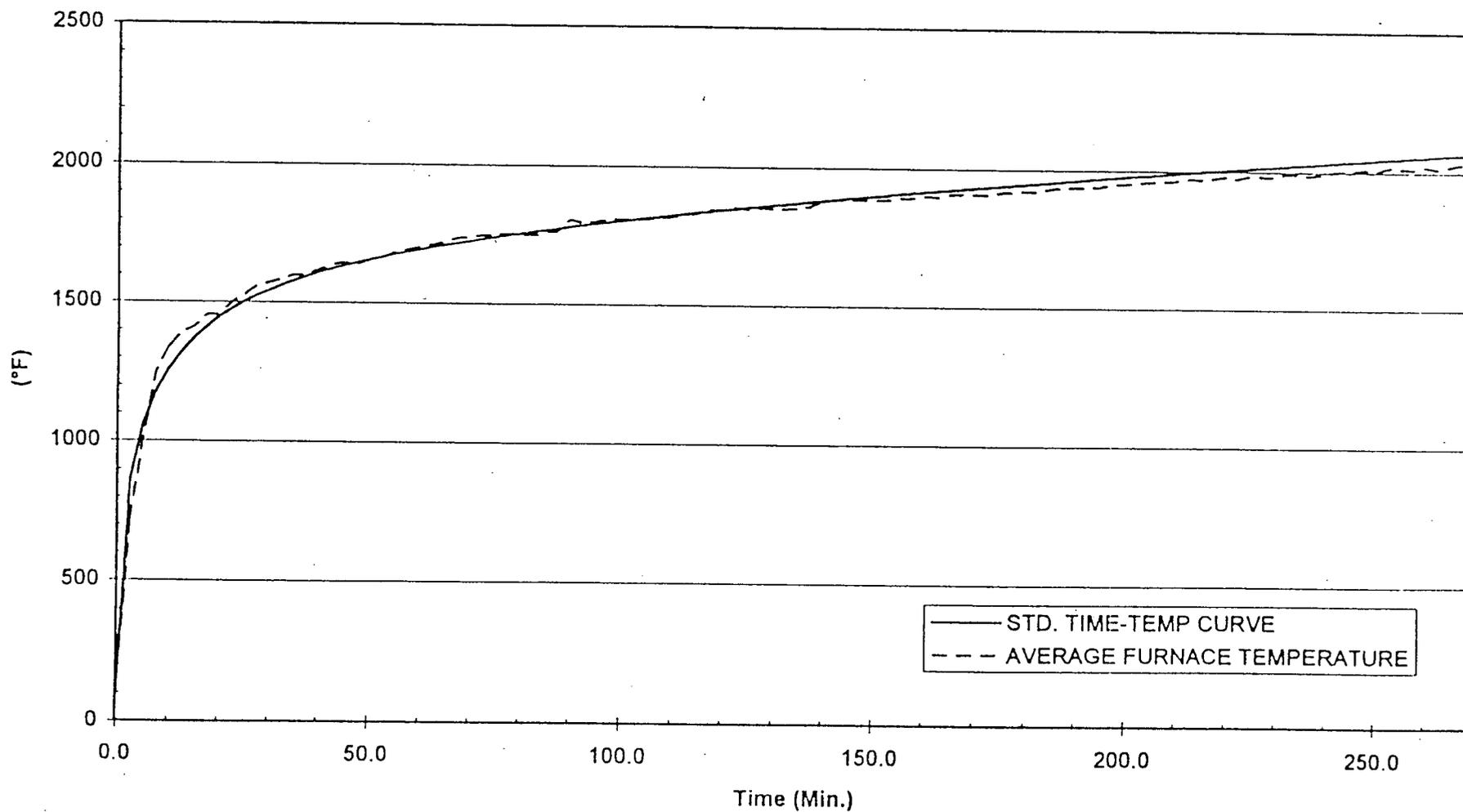
DOW CORNING CORP.
TEST ASSEMBLY NO. 7
FURNACE TEMPERATURES



96196
96196
13

R8196/95NK3179
Test Date : APRIL 20, 1995

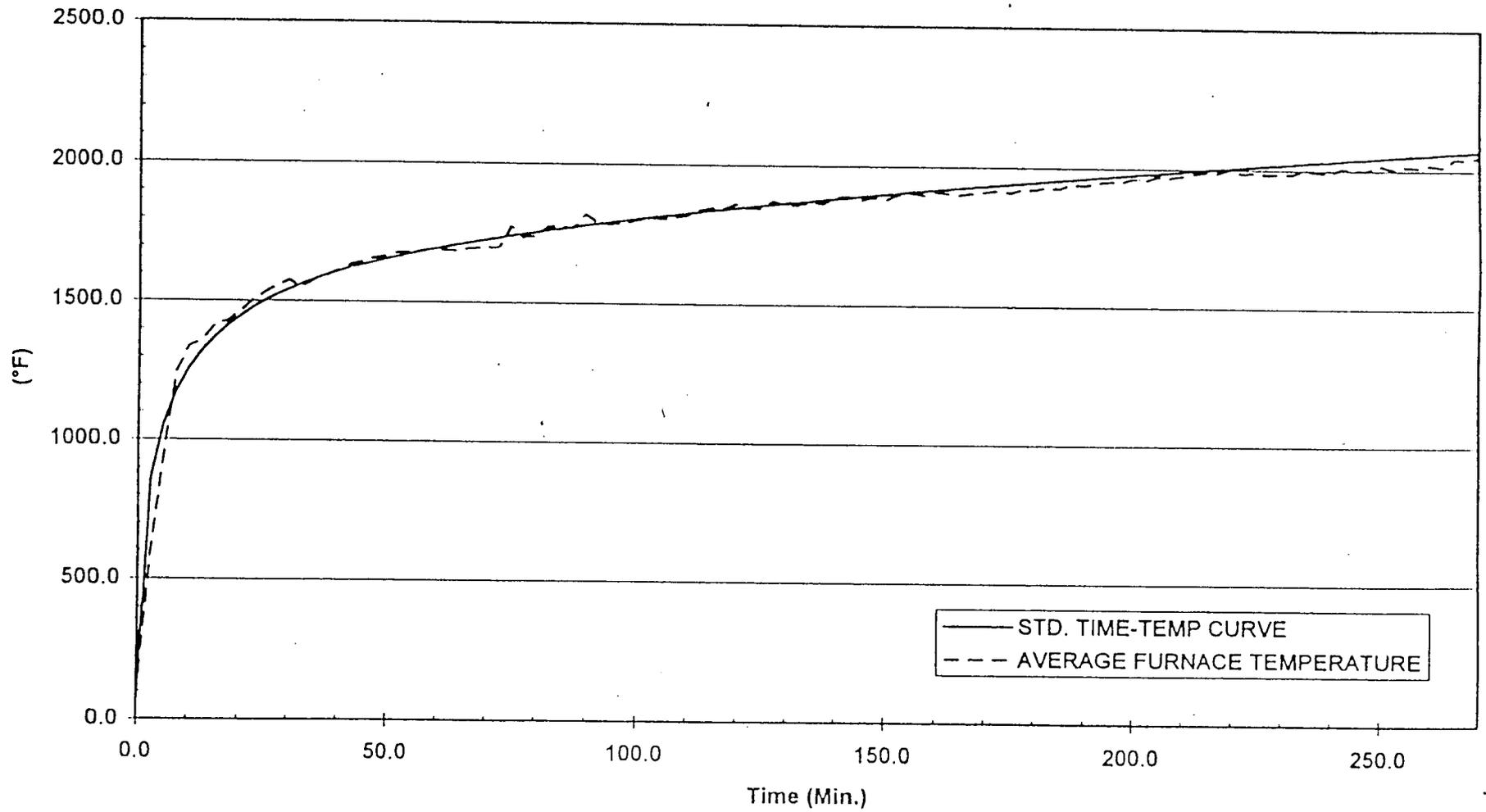
DOW CORNING CORP.
TEST ASSEMBLY NO. 8
FURNACE TEMPERATURES



R8196
FL 14

R8196/95NK3179
Test Date : APRIL 21, 1995

DOW CORNING CORP.
TEST ASSEMBLY NO. 9
FURNACE TEMPERATURES



R8196
ILL. 15

R8196/95NK3179
Test Date : APRIL 24, 1995

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	78.6
0:02:30	581.9
0:05:00	930.0
0:07:30	1240.4
0:10:00	1343.5
0:12:30	1377.3
0:15:00	1422.7
0:17:30	1464.6
0:20:00	1489.5
0:22:30	1493.9
0:25:00	1522.5
0:27:30	1546.2
0:30:00	1565.8
0:32:30	1589.7
0:35:00	1608.9
0:37:30	1612.3
0:40:00	1601.3
0:42:30	1625.9
0:45:00	1643.7
0:47:30	1659.7
0:50:00	1671.9
0:52:30	1666.8
0:55:00	1683.6
0:57:30	1693.5
1:00:00	1702.3
1:02:30	1712.0
1:05:00	1720.8
1:07:30	1731.7
1:10:00	1745.0
1:12:30	1724.7
1:15:00	1733.2
1:17:30	1740.6
1:20:00	1746.0
1:22:30	1789.4
1:25:00	1778.4
1:27:30	1781.5
1:30:00	1792.9
1:32:30	1791.9
1:35:00	1796.1
1:37:30	1794.4
1:40:00	1818.8
1:42:30	1821.4
1:45:00	1818.4
1:47:30	1821.6
1:50:00	1831.7
1:52:30	1839.9
1:55:00	1842.1
1:57:30	1841.8
2:00:00	1842.1

R8196/95NK3179

Test Date : APRIL 4, 1995

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:30	1847.0
2:05:00	1847.4
2:07:30	1855.4
2:10:00	1856.0
2:12:30	1868.2
2:15:00	1869.3
2:17:30	1867.8
2:20:00	1870.3
2:22:30	1873.4
2:25:00	1871.3
2:27:30	1875.6
2:30:00	1874.9
2:32:30	1887.4
2:35:00	1889.7
2:37:30	1890.3
2:40:00	1912.4
2:42:30	1906.3
2:45:00	1905.5
2:47:30	1900.9
2:50:00	1905.8
2:52:30	1913.2
2:55:00	1909.3
2:57:30	1910.8
3:00:00	1913.6
3:02:30	1922.1
3:05:00	1927.1
3:07:30	1930.2
3:10:00	1936.6
3:12:30	1939.2
3:15:00	1945.8
3:17:30	1961.6
3:20:00	1966.1
3:22:30	1966.4
3:25:00	1966.0
3:27:30	1976.2
3:30:00	1974.3
3:32:30	1971.5
3:35:00	1972.5
3:37:30	1969.6
3:40:00	1968.4
3:42:30	1976.3
3:45:00	1982.8
3:47:30	1980.1
3:50:00	1981.5
3:52:30	1977.9
3:55:00	2000.3
3:57:30	1969.0
4:00:00	2024.9
4:02:30	1993.0

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:05:00	2003.5
4:07:30	2010.7
4:10:00	2017.2
4:12:30	2013.2
4:15:00	2007.3
4:17:30	2015.4
4:20:00	2023.9
4:22:30	2026.2
4:25:00	2023.6
4:27:30	2021.6
4:30:00	2069.3

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	79.3
0:02:30	724.4
0:05:00	968.6
0:07:30	1252.2
0:10:00	1335.8
0:12:30	1385.2
0:15:00	1445.3
0:17:30	1454.4
0:20:00	1492.9
0:22:30	1521.8
0:25:00	1514.8
0:27:30	1540.3
0:30:00	1572.3
0:32:30	1594.9
0:35:00	1584.2
0:37:30	1608.6
0:40:00	1623.1
0:42:30	1639.3
0:45:00	1653.6
0:47:30	1647.2
0:50:00	1662.4
0:52:30	1668.6
0:55:00	1680.2
0:57:30	1690.7
1:00:00	1704.0
1:02:30	1714.6
1:05:00	1725.0
1:07:30	1735.7
1:10:00	1745.3
1:12:30	1751.5
1:15:00	1749.6
1:17:30	1760.3
1:20:00	1755.6
1:22:30	1757.1
1:25:00	1763.6
1:27:30	1763.9
1:30:00	1766.3
1:32:30	1764.4
1:35:00	1770.9
1:37:30	1779.5
1:40:00	1787.1
1:42:30	1794.8
1:45:00	1837.2
1:47:30	1823.5
1:50:00	1832.6
1:52:30	1840.6
1:55:00	1840.2
1:57:30	1847.7
2:00:00	1852.9

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:30	1854.6
2:05:00	1856.4
2:07:30	1859.5
2:10:00	1868.2
2:12:30	1873.6
2:15:00	1873.8
2:17:30	1879.9
2:20:00	1885.8
2:22:30	1872.6
2:25:00	1876.3
2:27:30	1885.6
2:30:00	1893.7
2:32:30	1896.0
2:35:00	1898.1
2:37:30	1898.6
2:40:00	1904.6
2:42:30	1908.8
2:45:00	1913.9
2:47:30	1919.8
2:50:00	1923.6
2:52:30	1925.7
2:55:00	1920.2
2:57:30	1923.2
3:00:00	1925.6
3:02:30	1932.4
3:05:00	1939.6
3:07:30	1943.9
3:10:00	1944.3
3:12:30	1945.5
3:15:00	1947.3
3:17:30	1950.2
3:20:00	1952.1
3:22:30	1955.4
3:25:00	1959.5
3:27:30	1963.0
3:30:00	1964.5
3:32:30	1971.8
3:35:00	1985.0
3:37:30	1965.2
3:40:00	1965.7
3:42:30	1969.6
3:45:00	1975.2
3:47:30	1976.6
3:50:00	1983.5
3:52:30	1986.9
3:55:00	1994.8
3:57:30	1997.9
4:00:00	2006.4
4:02:30	2006.5

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:05:00	2020.0
4:07:30	2018.2
4:10:00	1991.6
4:12:30	2017.1
4:15:00	2031.0
4:17:30	2029.3
4:20:00	2029.1
4:22:30	2021.7
4:25:00	2020.9
4:27:30	2038.3
4:30:00	2043.6

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:01	85.1
0:02:31	598.3
0:05:01	939.8
0:07:31	1243.8
0:10:01	1338.8
0:12:31	1398.5
0:15:01	1438.2
0:17:31	1474.3
0:20:01	1492.0
0:22:31	1503.3
0:25:01	1537.9
0:27:31	1565.1
0:30:01	1592.2
0:32:31	1572.5
0:35:01	1595.5
0:37:31	1613.0
0:40:01	1626.5
0:42:31	1628.5
0:45:01	1647.3
0:47:31	1658.1
0:50:01	1657.9
0:52:31	1673.6
0:55:01	1680.5
0:57:31	1691.2
1:00:01	1701.7
1:02:31	1714.0
1:05:01	1722.9
1:07:31	1733.9
1:10:01	1744.0
1:12:31	1750.5
1:15:01	1757.0
1:17:31	1764.5
1:20:01	1755.7
1:22:31	1761.8
1:25:01	1770.1
1:27:31	1779.8
1:30:01	1782.1
1:32:31	1779.9
1:35:01	1781.8
1:37:31	1797.9
1:40:01	1816.1
1:42:31	1827.4
1:45:01	1820.0
1:47:31	1824.8
1:50:01	1840.8
1:52:31	1840.2
1:55:01	1841.2
1:57:31	1843.9
2:00:01	1847.2

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:31	1845.4
2:05:01	1871.1
2:07:31	1859.5
2:10:01	1861.9
2:12:31	1869.2
2:15:01	1861.8
2:17:31	1876.5
2:20:01	1870.6
2:22:31	1866.6
2:25:01	1867.4
2:27:31	1897.6
2:30:01	1856.4
2:32:31	1894.7
2:35:01	1879.7
2:37:31	1883.3
2:40:01	1885.8
2:42:31	1887.9
2:45:01	1888.2
2:47:31	1952.4
2:50:01	1931.3
2:52:31	1919.1
2:55:01	1924.7
2:57:31	1928.8
3:00:01	1916.3
3:02:31	1934.7
3:05:01	1940.1
3:07:31	1921.5
3:10:01	1925.9
3:12:31	1943.2
3:15:01	1938.4
3:17:31	1934.6
3:20:01	1946.8
3:22:31	1948.4
3:25:01	1965.5
3:27:31	1953.6
3:30:01	1953.7
3:32:31	1957.2
3:35:01	1961.4
3:37:31	1978.5
3:40:01	1967.2
3:42:31	1986.2
3:45:01	1983.9
3:47:31	1984.4
3:50:01	1986.3
3:52:31	1986.2
3:55:01	1991.0
3:57:31	1991.9
4:00:01	1998.8
4:02:31	1998.5

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:05:01	2005.6
4:07:31	2007.3
4:10:01	2019.6
4:12:31	2014.1
4:15:01	2027.2
4:17:31	2027.0
4:20:01	2003.7
4:22:31	2054.5
4:25:01	2017.2
4:27:31	2031.1
4:30:01	2026.4

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	82.2
0:02:30	637.7
0:05:00	955.7
0:07:30	1255.5
0:10:00	1342.3
0:12:30	1365.1
0:15:00	1413.3
0:17:30	1456.0
0:20:00	1485.5
0:22:30	1496.7
0:25:00	1534.6
0:27:30	1545.5
0:30:00	1575.8
0:32:30	1597.1
0:35:00	1610.4
0:37:30	1598.9
0:40:00	1612.2
0:42:30	1628.6
0:45:00	1647.8
0:47:30	1662.7
0:50:00	1653.9
0:52:30	1671.0
0:55:00	1680.0
0:57:30	1693.8
1:00:00	1705.2
1:02:30	1714.4
1:05:00	1723.5
1:07:30	1733.8
1:10:00	1740.1
1:12:30	1741.9
1:15:00	1750.7
1:17:30	1755.6
1:20:00	1759.0
1:22:30	1790.3
1:25:00	1786.4
1:27:30	1792.6
1:30:00	1793.3
1:32:30	1794.5
1:35:00	1794.8
1:37:30	1826.7
1:40:00	1820.4
1:42:30	1823.2
1:45:00	1821.3
1:47:30	1833.1
1:50:00	1824.3
1:52:30	1830.3
1:55:00	1840.2
1:57:30	1846.3
2:00:00	1852.9

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:30	1858.5
2:05:00	1853.3
2:07:30	1859.1
2:10:00	1866.8
2:12:30	1867.4
2:15:00	1876.3
2:17:30	1880.5
2:20:00	1883.1
2:22:30	1881.0
2:25:00	1884.1
2:27:30	1889.6
2:30:00	1896.1
2:32:30	1901.7
2:35:00	1907.1
2:37:30	1911.9
2:40:00	1915.1
2:42:30	1902.4
2:45:00	1900.7
2:47:30	1913.3
2:50:00	1911.1
2:52:30	1912.9
2:55:00	1914.2
2:57:30	1930.4
3:00:00	1919.7
3:02:30	1931.5
3:05:00	1933.1
3:07:30	1934.6
3:10:00	1944.3
3:12:30	1950.4
3:15:00	1955.9
3:17:30	1949.2
3:20:00	1948.9
3:22:30	1947.9
3:25:00	1954.4
3:27:30	1953.7
3:30:00	1979.4
3:32:30	1969.8
3:35:00	1974.0
3:37:30	1977.2
3:40:00	1980.8
3:42:30	1983.8
3:45:00	1988.7
3:47:30	2023.6
3:50:00	2010.6
3:52:30	2009.9
3:55:00	1998.6
3:57:30	2000.8
4:00:00	2001.8
4:02:30	2005.5

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:05:00	2005.0
4:07:30	2003.2
4:10:00	2003.3
4:12:30	2002.3
4:15:00	2003.7
4:17:30	2007.6
4:20:00	2013.5
4:22:30	2010.3
4:25:00	2085.5
4:27:30	2008.4
4:30:00	2064.3

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	81.0
0:02:29	731.4
0:04:59	1008.0
0:07:29	1255.9
0:09:59	1343.5
0:12:29	1374.1
0:14:59	1423.9
0:17:29	1463.0
0:19:59	1502.5
0:22:29	1491.8
0:24:59	1527.4
0:27:29	1547.3
0:29:59	1577.2
0:32:29	1572.8
0:34:59	1600.5
0:37:29	1619.6
0:39:59	1612.6
0:42:29	1635.1
0:44:59	1646.6
0:47:29	1648.8
0:49:59	1663.0
0:52:29	1679.0
0:54:59	1690.9
0:57:29	1696.1
0:59:59	1706.2
1:02:29	1714.7
1:04:59	1719.0
1:07:29	1708.7
1:09:59	1717.2
1:12:29	1723.1
1:14:59	1728.3
1:17:29	1740.0
1:19:59	1751.1
1:22:29	1766.0
1:24:59	1775.3
1:27:29	1778.7
1:29:59	1790.8
1:32:29	1793.2
1:34:59	1792.6
1:37:29	1805.9
1:39:59	1813.1
1:42:29	1823.3
1:44:59	1826.0
1:47:29	1825.4
1:49:59	1829.7
1:52:29	1844.6
1:54:59	1844.2
1:57:29	1854.0
1:59:59	1855.3

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:29	1855.9
2:04:59	1859.0
2:07:29	1864.2
2:09:59	1867.5
2:12:29	1867.8
2:14:59	1879.6
2:17:29	1862.5
2:19:59	1872.5
2:22:29	1872.8
2:24:59	1876.9
2:27:29	1878.6
2:29:59	1878.9
2:32:29	1883.9
2:34:59	1892.2
2:37:29	1889.3
2:39:59	1887.9
2:42:29	1912.4
2:44:59	1908.0
2:47:29	1911.1
2:49:59	1911.4
2:52:29	1919.3
2:54:59	1913.7
2:57:29	1914.4
2:59:59	1943.5
3:02:29	1916.0
3:04:59	1925.4
3:07:29	1925.7
3:09:59	1925.4
3:12:29	1959.3
3:14:59	1936.9
3:17:29	1954.6
3:19:59	1941.9
3:22:29	1952.4
3:24:59	1961.2
3:27:29	1956.9
3:29:59	1969.1
3:32:29	1968.0
3:34:59	1973.9
3:37:29	1987.1
3:39:59	1975.5
3:42:29	1972.4
3:44:59	1987.9
3:47:29	1992.0
3:49:59	1988.6
3:52:29	1984.0
3:54:59	1992.7
3:57:29	1990.9
3:59:59	1995.8
4:02:29	1998.9

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:04:59	2007.1
4:07:29	2009.8
4:09:59	2018.0
4:12:29	2013.4
4:14:59	2016.1
4:17:29	2052.9
4:19:59	2032.9
4:22:29	2028.5
4:24:59	2036.3
4:27:29	2047.2
4:29:59	2042.6

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	103.3
0:02:30	651.4
0:05:00	994.1
0:07:30	1237.4
0:10:00	1328.4
0:12:30	1391.5
0:15:00	1403.3
0:17:30	1450.4
0:20:00	1487.3
0:22:30	1492.2
0:25:00	1526.1
0:27:30	1554.2
0:30:00	1556.8
0:32:30	1580.3
0:35:00	1597.5
0:37:30	1597.9
0:40:00	1615.7
0:42:30	1632.0
0:45:00	1638.4
0:47:30	1651.6
0:50:00	1667.0
0:52:30	1675.9
0:55:00	1685.9
0:57:30	1701.2
1:00:00	1711.7
1:02:30	1718.2
1:05:00	1730.3
1:07:30	1737.2
1:10:00	1727.1
1:12:30	1738.6
1:15:00	1744.3
1:17:30	1762.8
1:20:00	1768.0
1:22:30	1771.6
1:25:00	1774.1
1:27:30	1777.1
1:30:00	1785.4
1:32:30	1787.1
1:35:00	1804.8
1:37:30	1806.7
1:40:00	1812.0
1:42:30	1813.9
1:45:00	1813.9
1:47:30	1816.9
1:50:00	1854.4
1:52:30	1843.4
1:55:00	1851.0
1:57:30	1859.0
2:00:00	1861.3

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:30	1869.1
2:05:00	1866.5
2:07:30	1865.9
2:10:00	1863.9
2:12:30	1866.5
2:15:00	1866.2
2:17:30	1866.0
2:20:00	1866.9
2:22:30	1868.6
2:25:00	1870.7
2:27:30	1882.4
2:30:00	1883.3
2:32:30	1886.8
2:35:00	1885.9
2:37:30	1891.3
2:40:00	1896.9
2:42:30	1898.9
2:45:00	1897.4
2:47:30	1899.7
2:50:00	1900.3
2:52:30	1900.1
2:55:00	1903.1
2:57:30	1902.4
3:00:00	1904.9
3:02:30	1908.0
3:05:00	1959.3
3:07:30	1943.4
3:10:00	1937.8
3:12:30	1932.1
3:15:00	1939.2
3:17:30	1939.6
3:20:00	1944.4
3:22:30	1948.5
3:25:00	1956.0
3:27:30	1962.9
3:30:00	1954.7
3:32:30	1968.7
3:35:00	1973.0
3:37:30	1972.4
3:40:00	1986.0
3:42:30	1981.2
3:45:00	1979.1
3:47:30	1992.6
3:50:00	1982.9
3:52:30	1988.3
3:55:00	1994.4
3:57:30	1987.1
4:00:00	2022.7
4:02:30	2011.4

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:05:00	2014.9
4:07:30	2043.0
4:10:00	2060.0
4:12:30	2009.5
4:15:00	2011.2
4:17:30	2014.6
4:20:00	2015.2
4:22:30	2032.4
4:25:00	2018.9
4:27:30	2030.3
4:30:00	2021.2

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	80.4
0:02:30	643.1
0:05:00	961.9
0:07:30	1233.1
0:10:00	1336.1
0:12:30	1376.0
0:15:00	1427.9
0:17:30	1441.9
0:20:00	1483.8
0:22:30	1513.9
0:25:00	1510.1
0:27:30	1543.6
0:30:00	1569.3
0:32:30	1593.1
0:35:00	1597.4
0:37:30	1613.9
0:40:00	1634.2
0:42:30	1646.1
0:45:00	1638.4
0:47:30	1654.7
0:50:00	1662.0
0:52:30	1675.4
0:55:00	1687.9
0:57:30	1697.6
1:00:00	1708.4
1:02:30	1710.9
1:05:00	1709.9
1:07:30	1722.7
1:10:00	1730.4
1:12:30	1742.9
1:15:00	1745.0
1:17:30	1746.8
1:20:00	1749.0
1:22:30	1742.3
1:25:00	1741.4
1:27:30	1744.6
1:30:00	1752.6
1:32:30	1831.0
1:35:00	1807.6
1:37:30	1816.8
1:40:00	1819.3
1:42:30	1824.4
1:45:00	1829.2
1:47:30	1836.4
1:50:00	1840.8
1:52:30	1841.6
1:55:00	1846.3
1:57:30	1850.5
2:00:00	1856.2

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:30	1855.2
2:05:00	1857.4
2:07:30	1855.4
2:10:00	1874.8
2:12:30	1863.3
2:15:00	1868.6
2:17:30	1873.1
2:20:00	1872.5
2:22:30	1871.7
2:25:00	1873.2
2:27:30	1882.3
2:30:00	1879.5
2:32:30	1886.0
2:35:00	1890.4
2:37:30	1891.0
2:40:00	1892.6
2:42:30	1897.1
2:45:00	1899.8
2:47:30	1902.6
2:50:00	1905.4
2:52:30	1910.3
2:55:00	1911.8
2:57:30	1915.7
3:00:00	1919.0
3:02:30	1920.5
3:05:00	1936.1
3:07:30	1941.4
3:10:00	1936.4
3:12:30	1940.8
3:15:00	1944.5
3:17:30	1949.6
3:20:00	1955.5
3:22:30	1957.8
3:25:00	1958.9
3:27:30	1967.5
3:30:00	1971.0
3:32:30	1978.2
3:35:00	1981.5
3:37:30	1981.6
3:40:00	1982.2
3:42:30	1982.8
3:45:00	1984.8
3:47:30	1988.4
3:50:00	1988.5
3:52:30	1992.3
3:55:00	1992.6
3:57:30	2011.5
4:00:00	2012.9
4:02:30	2007.8

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:05:00	2002.1
4:07:30	2007.8
4:10:00	2003.4
4:12:30	2011.5
4:15:00	2008.1
4:17:30	2038.8
4:20:00	2051.8
4:22:30	2010.9
4:25:00	2028.4
4:27:30	2037.5
4:30:00	2041.6

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	73.3
0:02:29	713.6
0:04:59	993.8
0:07:29	1243.1
0:09:59	1336.0
0:12:29	1390.5
0:14:59	1407.8
0:17:29	1453.2
0:19:59	1456.3
0:22:29	1497.6
0:24:59	1526.8
0:27:29	1556.9
0:29:59	1570.5
0:32:29	1584.4
0:34:59	1599.6
0:37:29	1600.4
0:39:59	1618.5
0:42:29	1635.2
0:44:59	1646.6
0:47:29	1636.4
0:49:59	1654.3
0:52:29	1664.1
0:54:59	1682.2
0:57:29	1693.9
0:59:59	1702.5
1:02:29	1712.8
1:04:59	1723.1
1:07:29	1737.6
1:09:59	1740.7
1:12:29	1749.6
1:14:59	1750.1
1:17:29	1756.2
1:19:59	1749.8
1:22:29	1749.4
1:24:59	1758.0
1:27:29	1763.5
1:29:59	1808.5
1:32:29	1796.9
1:34:59	1801.2
1:37:29	1809.0
1:39:59	1809.8
1:42:29	1813.4
1:44:59	1810.1
1:47:29	1818.1
1:49:59	1820.0
1:52:29	1826.2
1:54:59	1832.5
1:57:29	1847.6
1:59:59	1846.1

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:02:29	1855.0
2:04:59	1849.9
2:07:29	1854.7
2:09:59	1851.6
2:12:29	1851.5
2:14:59	1856.0
2:17:29	1860.8
2:19:59	1879.7
2:22:29	1887.2
2:24:59	1885.5
2:27:29	1885.8
2:29:59	1885.3
2:32:29	1886.8
2:34:59	1893.3
2:37:29	1893.3
2:39:59	1902.4
2:42:29	1899.3
2:44:59	1908.3
2:47:29	1910.4
2:49:59	1908.4
2:52:29	1909.4
2:54:59	1915.7
2:57:29	1919.9
2:59:59	1923.0
3:02:29	1923.7
3:04:59	1932.1
3:07:29	1938.8
3:09:59	1938.0
3:12:29	1936.9
3:14:59	1941.0
3:17:29	1950.0
3:19:59	1951.7
3:22:29	1954.3
3:24:59	1959.8
3:27:29	1962.9
3:29:59	1964.3
3:32:29	1973.1
3:34:59	1970.2
3:37:29	1974.3
3:39:59	1980.8
3:42:29	1974.0
3:44:59	1985.0
3:47:29	1983.6
3:49:59	1980.6
3:52:29	1994.7
3:54:59	1989.5
3:57:29	1986.5
3:59:59	1996.4
4:02:29	2001.5

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:04:59	2002.6
4:07:29	2011.2
4:09:59	2001.8
4:12:29	2017.8
4:14:59	2014.3
4:17:29	2010.9
4:19:59	2020.3
4:22:29	2013.6
4:24:59	2022.4
4:27:29	2032.4
4:29:59	2034.7

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
0:00:00	74.9
0:02:30	594.0
0:05:00	931.0
0:07:30	1241.7
0:10:00	1335.9
0:12:30	1355.1
0:15:00	1414.5
0:17:30	1428.0
0:20:00	1464.0
0:22:30	1499.5
0:25:00	1530.1
0:27:30	1552.5
0:30:00	1576.8
0:32:30	1551.1
0:35:00	1574.5
0:37:30	1592.7
0:40:00	1612.4
0:42:30	1635.4
0:45:00	1643.8
0:47:30	1659.0
0:50:00	1667.6
0:52:30	1681.3
0:55:00	1679.5
0:57:30	1688.6
1:00:00	1690.7
1:02:30	1686.1
1:05:00	1690.5
1:07:30	1695.5
1:10:00	1697.1
1:12:30	1699.6
1:15:00	1776.4
1:17:30	1735.3
1:20:00	1740.5
1:22:30	1776.1
1:25:00	1777.6
1:27:30	1770.8
1:30:00	1821.0
1:32:30	1793.5
1:35:00	1785.0
1:37:30	1791.8
1:40:00	1799.3
1:42:30	1812.6
1:45:00	1806.4
1:47:30	1809.8
1:50:00	1818.1
1:52:30	1837.0
1:55:00	1846.0
1:57:30	1843.7

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
2:00:00	1861.2
2:02:30	1846.2
2:05:00	1848.6
2:07:30	1873.0
2:10:00	1856.9
2:12:30	1859.3
2:15:00	1869.9
2:17:30	1864.3
2:20:00	1885.7
2:22:30	1891.5
2:25:00	1878.9
2:27:30	1887.2
2:30:00	1879.6
2:32:30	1898.1
2:35:00	1905.3
2:37:30	1896.8
2:40:00	1909.6
2:42:30	1902.9
2:45:00	1898.8
2:47:30	1907.0
2:50:00	1909.9
2:52:30	1916.4
2:55:00	1908.7
2:57:30	1922.3
3:00:00	1919.8
3:02:30	1929.8
3:05:00	1926.6
3:07:30	1943.1
3:10:00	1937.3
3:12:30	1946.5
3:15:00	1952.2
3:17:30	1950.5
3:20:00	1964.5
3:22:30	1958.7
3:25:00	1970.7
3:27:30	1967.0
3:30:00	1974.9
3:32:30	1981.3
3:35:00	1987.9
3:37:30	1987.4
3:40:00	2001.8
3:42:30	1984.8
3:45:00	1990.0
3:47:30	1983.6
3:50:00	1988.9
3:52:30	1984.9
3:55:00	2002.7
3:57:30	1994.7

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE, °F
4:00:00	1988.3
4:02:30	2008.1
4:05:00	2000.7
4:07:30	2001.4
4:10:00	2019.2
4:12:30	2004.9
4:15:00	2014.9
4:17:30	2010.5
4:20:00	2021.0
4:22:30	2014.1
4:25:00	2044.5
4:27:30	2038.1
4:30:00	2048.8

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.028	0.015
0:02:30	0.025	0.013
0:05:00	0.026	0.015
0:07:30	0.028	0.016
0:10:00	0.029	0.017
0:12:30	0.029	0.017
0:15:00	0.030	0.017
0:17:30	0.029	0.017
0:20:00	0.030	0.018
0:22:30	0.030	0.018
0:25:00	0.030	0.018
0:27:30	0.030	0.018
0:30:00	0.031	0.019
0:32:30	0.031	0.018
0:35:00	0.031	0.018
0:37:30	0.032	0.019
0:40:00	0.031	0.018
0:42:30	0.031	0.018
0:45:00	0.032	0.018
0:47:30	0.032	0.018
0:50:00	0.033	0.019
0:52:30	0.033	0.019
0:55:00	0.032	0.019
0:57:30	0.033	0.019
1:00:00	0.033	0.019
1:02:30	0.033	0.019
1:05:00	0.033	0.019
1:07:30	0.033	0.019
1:10:00	0.034	0.019
1:12:30	0.034	0.020
1:15:00	0.034	0.020
1:17:30	0.035	0.019
1:20:00	0.035	0.020
1:22:30	0.035	0.020
1:25:00	0.035	0.019
1:27:30	0.036	0.020
1:30:00	0.036	0.020
1:32:30	0.036	0.020
1:35:00	0.036	0.021
1:37:30	0.036	0.020
1:40:00	0.038	0.021
1:42:30	0.037	0.021
1:45:00	0.037	0.020
1:47:30	0.037	0.020
1:50:00	0.037	0.020
1:52:30	0.038	0.020
1:55:00	0.038	0.020
1:57:30	0.038	0.020

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.038	0.020
2:02:30	0.039	0.021
2:05:00	0.038	0.020
2:07:30	0.039	0.021
2:10:00	0.039	0.020
2:12:30	0.039	0.021
2:15:00	0.039	0.021
2:17:30	0.039	0.020
2:20:00	0.040	0.022
2:22:30	0.039	0.020
2:25:00	0.039	0.021
2:27:30	0.040	0.021
2:30:00	0.040	0.022
2:32:30	0.040	0.021
2:35:00	0.039	0.021
2:37:30	0.039	0.021
2:40:00	0.039	0.021
2:42:30	0.040	0.022
2:45:00	0.040	0.021
2:47:30	0.039	0.021
2:50:00	0.039	0.022
2:52:30	0.039	0.021
2:55:00	0.039	0.021
2:57:30	0.039	0.021
3:00:00	0.039	0.021
3:02:30	0.040	0.021
3:05:00	0.039	0.022
3:07:30	0.039	0.022
3:10:00	0.039	0.022
3:12:30	0.040	0.022
3:15:00	0.039	0.021
3:17:30	0.040	0.022
3:20:00	0.040	0.022
3:22:30	0.039	0.022
3:25:00	0.040	0.022
3:27:30	0.040	0.022
3:30:00	0.040	0.022
3:32:30	0.040	0.022
3:35:00	0.040	0.022
3:37:30	0.040	0.022
3:40:00	0.039	0.022
3:42:30	0.040	0.022
3:45:00	0.039	0.022
3:47:30	0.039	0.022
3:50:00	0.039	0.022
3:52:30	0.039	0.023
3:55:00	0.039	0.022
3:57:30	0.039	0.022

APPENDIX B
DCW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.039	0.022
4:02:30	0.039	0.022
4:05:00	0.039	0.021
4:07:30	0.038	0.021
4:10:00	0.039	0.022
4:12:30	0.039	0.022
4:15:00	0.038	0.022
4:17:30	0.039	0.022
4:20:00	0.038	0.021
4:22:30	0.038	0.021
4:25:00	0.038	0.021
4:27:30	0.039	0.022
4:30:00	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.006	0.004
0:02:30	0.025	0.014
0:05:00	0.026	0.015
0:07:30	0.026	0.016
0:10:00	0.028	0.017
0:12:30	0.028	0.017
0:15:00	0.029	0.018
0:17:30	0.030	0.018
0:20:00	0.031	0.018
0:22:30	0.032	0.018
0:25:00	0.031	0.018
0:27:30	0.031	0.018
0:30:00	0.032	0.018
0:32:30	0.032	0.019
0:35:00	0.032	0.019
0:37:30	0.035	0.019
0:40:00	0.032	0.019
0:42:30	0.032	0.019
0:45:00	0.032	0.019
0:47:30	0.033	0.020
0:50:00	0.032	0.019
0:52:30	0.032	0.019
0:55:00	0.032	0.019
0:57:30	0.033	0.020
1:00:00	0.033	0.020
1:02:30	0.033	0.020
1:05:00	0.034	0.020
1:07:30	0.033	0.020
1:10:00	0.033	0.020
1:12:30	0.033	0.020
1:15:00	0.033	0.020
1:17:30	0.033	0.020
1:20:00	0.034	0.021
1:22:30	0.034	0.021
1:25:00	0.033	0.020
1:27:30	0.034	0.021
1:30:00	0.033	0.020
1:32:30	0.034	0.021
1:35:00	0.034	0.020
1:37:30	0.034	0.021
1:40:00	0.034	0.021
1:42:30	0.034	0.020
1:45:00	0.035	0.021
1:47:30	0.035	0.020
1:50:00	0.035	0.021
1:52:30	0.035	0.022
1:55:00	0.035	0.022
1:57:30	0.035	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.035	0.021
2:02:30	0.035	0.021
2:05:00	0.035	0.021
2:07:30	0.035	0.022
2:10:00	0.035	0.021
2:12:30	0.036	0.021
2:15:00	0.035	0.021
2:17:30	0.036	0.022
2:20:00	0.036	0.021
2:22:30	0.036	0.022
2:25:00	0.035	0.021
2:27:30	0.036	0.022
2:30:00	0.036	0.022
2:32:30	0.036	0.022
2:35:00	0.036	0.022
2:37:30	0.036	0.022
2:40:00	0.036	0.022
2:42:30	0.036	0.021
2:45:00	0.037	0.022
2:47:30	0.036	0.022
2:50:00	0.036	0.022
2:52:30	0.037	0.022
2:55:00	0.036	0.022
2:57:30	0.037	0.022
3:00:00	0.037	0.022
3:02:30	0.036	0.022
3:05:00	0.037	0.022
3:07:30	0.037	0.022
3:10:00	0.037	0.022
3:12:30	0.037	0.022
3:15:00	0.037	0.022
3:17:30	0.038	0.023
3:20:00	0.037	0.022
3:22:30	0.038	0.022
3:25:00	0.037	0.022
3:27:30	0.037	0.022
3:30:00	0.037	0.022
3:32:30	0.038	0.022
3:35:00	0.037	0.022
3:37:30	0.037	0.022
3:40:00	0.037	0.021
3:42:30	0.038	0.022
3:45:00	0.038	0.023
3:47:30	0.038	0.023
3:50:00	0.037	0.022
3:52:30	0.037	0.022
3:55:00	0.037	0.022
3:57:30	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.037	0.022
4:02:30	0.038	0.022
4:05:00	0.038	0.023
4:07:30	0.038	0.022
4:10:00	0.038	0.022
4:12:30	0.038	0.022
4:15:00	0.038	0.022
4:17:30	0.038	0.022
4:20:00	0.038	0.021
4:22:30	0.038	0.021
4:25:00	0.038	0.022
4:27:30	0.038	0.023
4:30:00	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:01	0.027	0.015
0:02:31	0.025	0.013
0:05:01	0.027	0.015
0:07:31	0.029	0.016
0:10:01	0.029	0.017
0:12:31	0.028	0.016
0:15:01	0.030	0.017
0:17:31	0.029	0.017
0:20:01	0.030	0.018
0:22:31	0.030	0.018
0:25:01	0.031	0.018
0:27:31	0.030	0.018
0:30:01	0.030	0.018
0:32:31	0.031	0.018
0:35:01	0.031	0.018
0:37:31	0.031	0.019
0:40:01	0.031	0.020
0:42:31	0.031	0.019
0:45:01	0.031	0.019
0:47:31	0.031	0.019
0:50:01	0.032	0.019
0:52:31	0.031	0.019
0:55:01	0.032	0.020
0:57:31	0.032	0.020
1:00:01	0.032	0.019
1:02:31	0.032	0.020
1:05:01	0.032	0.020
1:07:31	0.032	0.020
1:10:01	0.033	0.020
1:12:31	0.033	0.020
1:15:01	0.032	0.020
1:17:31	0.033	0.020
1:20:01	0.033	0.020
1:22:31	0.033	0.020
1:25:01	0.033	0.020
1:27:31	0.033	0.021
1:30:01	0.033	0.020
1:32:31	0.033	0.020
1:35:01	0.033	0.020
1:37:31	0.033	0.021
1:40:01	0.034	0.021
1:42:31	0.033	0.021
1:45:01	0.033	0.020
1:47:31	0.034	0.021
1:50:01	0.034	0.021
1:52:31	0.034	0.021
1:55:01	0.034	0.021
1:57:31	0.034	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:01	0.034	0.021
2:02:31	0.034	0.021
2:05:01	0.034	0.021
2:07:31	0.035	0.021
2:10:01	0.035	0.021
2:12:31	0.034	0.021
2:15:01	0.034	0.020
2:17:31	0.035	0.021
2:20:01	0.035	0.020
2:22:31	0.035	0.021
2:25:01	0.035	0.021
2:27:31	0.035	0.021
2:30:01	0.035	0.021
2:32:31	0.035	0.021
2:35:01	0.035	0.021
2:37:31	0.036	0.021
2:40:01	0.035	0.021
2:42:31	0.035	0.021
2:45:01	0.036	0.021
2:47:31	0.036	0.021
2:50:01	0.036	0.021
2:52:31	0.036	0.021
2:55:01	0.036	0.022
2:57:31	0.036	0.022
3:00:01	0.036	0.022
3:02:31	0.036	0.022
3:05:01	0.036	0.021
3:07:31	0.036	0.022
3:10:01	0.036	0.021
3:12:31	0.036	0.021
3:15:01	0.036	0.022
3:17:31	0.036	0.022
3:20:01	0.036	0.022
3:22:31	0.036	0.021
3:25:01	0.036	0.021
3:27:31	0.036	0.021
3:30:01	0.036	0.021
3:32:31	0.036	0.021
3:35:01	0.036	0.022
3:37:31	0.036	0.022
3:40:01	0.036	0.021
3:42:31	0.036	0.021
3:45:01	0.036	0.022
3:47:31	0.036	0.022
3:50:01	0.036	0.021
3:52:31	0.036	0.022
3:55:01	0.036	0.022
3:57:31	0.036	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:01	0.036	0.022
4:02:31	0.036	0.022
4:05:01	0.036	0.021
4:07:31	0.036	0.022
4:10:01	0.036	0.022
4:12:31	0.036	0.022
4:15:01	0.036	0.022
4:17:31	0.035	0.021
4:20:01	0.036	0.022
4:22:31	0.036	0.022
4:25:01	0.036	0.022
4:27:31	0.036	0.022
4:30:01	0.035	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.030	0.015
0:02:30	0.025	0.014
0:05:00	0.028	0.015
0:07:30	0.028	0.017
0:10:00	0.029	0.017
0:12:30	0.029	0.017
0:15:00	0.029	0.017
0:17:30	0.029	0.017
0:20:00	0.028	0.017
0:22:30	0.030	0.017
0:25:00	0.030	0.018
0:27:30	0.031	0.018
0:30:00	0.031	0.018
0:32:30	0.031	0.019
0:35:00	0.032	0.019
0:37:30	0.032	0.019
0:40:00	0.032	0.019
0:42:30	0.032	0.019
0:45:00	0.032	0.019
0:47:30	0.032	0.019
0:50:00	0.032	0.019
0:52:30	0.032	0.018
0:55:00	0.033	0.019
0:57:30	0.033	0.020
1:00:00	0.033	0.020
1:02:30	0.033	0.019
1:05:00	0.033	0.020
1:07:30	0.033	0.020
1:10:00	0.033	0.019
1:12:30	0.033	0.019
1:15:00	0.033	0.019
1:17:30	0.034	0.020
1:20:00	0.034	0.020
1:22:30	0.034	0.020
1:25:00	0.034	0.019
1:27:30	0.033	0.020
1:30:00	0.034	0.020
1:32:30	0.034	0.021
1:35:00	0.034	0.020
1:37:30	0.034	0.020
1:40:00	0.034	0.020
1:42:30	0.035	0.020
1:45:00	0.035	0.020
1:47:30	0.035	0.020
1:50:00	0.035	0.020
1:52:30	0.035	0.020
1:55:00	0.035	0.020
1:57:30	0.035	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.035	0.021
2:02:30	0.036	0.021
2:05:00	0.035	0.021
2:07:30	0.035	0.020
2:10:00	0.035	0.020
2:12:30	0.036	0.021
2:15:00	0.036	0.020
2:17:30	0.036	0.021
2:20:00	0.035	0.021
2:22:30	0.036	0.021
2:25:00	0.036	0.021
2:27:30	0.035	0.020
2:30:00	0.036	0.021
2:32:30	0.036	0.020
2:35:00	0.036	0.021
2:37:30	0.036	0.021
2:40:00	0.035	0.020
2:42:30	0.036	0.021
2:45:00	0.036	0.020
2:47:30	0.036	0.021
2:50:00	0.035	0.020
2:52:30	0.036	0.020
2:55:00	0.036	0.021
2:57:30	0.036	0.020
3:00:00	0.036	0.021
3:02:30	0.036	0.020
3:05:00	0.036	0.020
3:07:30	0.036	0.020
3:10:00	0.036	0.021
3:12:30	0.037	0.021
3:15:00	0.036	0.021
3:17:30	0.036	0.021
3:20:00	0.036	0.021
3:22:30	0.035	0.020
3:25:00	0.036	0.020
3:27:30	0.036	0.021
3:30:00	0.036	0.021
3:32:30	0.035	0.020
3:35:00	0.035	0.020
3:37:30	0.036	0.020
3:40:00	0.036	0.021
3:42:30	0.036	0.021
3:45:00	0.036	0.022
3:47:30	0.037	0.022
3:50:00	0.036	0.021
3:52:30	0.036	0.021
3:55:00	0.036	0.021
3:57:30	0.037	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.036	0.021
4:02:30	0.036	0.021
4:05:00	0.037	0.021
4:07:30	0.036	0.021
4:10:00	0.036	0.021
4:12:30	0.036	0.021
4:15:00	0.036	0.021
4:17:30	0.036	0.021
4:20:00	0.036	0.021
4:22:30	0.035	0.021
4:25:00	0.036	0.021
4:27:30	0.036	0.021
4:30:00	0.037	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.015	0.011
0:02:29	0.027	0.016
0:04:59	0.027	0.015
0:07:29	0.029	0.017
0:09:59	0.030	0.017
0:12:29	0.030	0.017
0:14:59	0.030	0.018
0:17:29	0.030	0.018
0:19:59	0.031	0.018
0:22:29	0.031	0.018
0:24:59	0.031	0.018
0:27:29	0.033	0.019
0:29:59	0.032	0.018
0:32:29	0.032	0.019
0:34:59	0.033	0.019
0:37:29	0.033	0.020
0:39:59	0.033	0.019
0:42:29	0.033	0.019
0:44:59	0.033	0.020
0:47:29	0.033	0.020
0:49:59	0.033	0.020
0:52:29	0.034	0.020
0:54:59	0.034	0.020
0:57:29	0.034	0.020
0:59:59	0.034	0.020
1:02:29	0.034	0.020
1:04:59	0.034	0.020
1:07:29	0.034	0.020
1:09:59	0.034	0.020
1:12:29	0.034	0.020
1:14:59	0.034	0.020
1:17:29	0.034	0.020
1:19:59	0.034	0.020
1:22:29	0.034	0.020
1:24:59	0.035	0.021
1:27:29	0.035	0.021
1:29:59	0.035	0.021
1:32:29	0.035	0.021
1:34:59	0.035	0.021
1:37:29	0.036	0.022
1:39:59	0.035	0.021
1:42:29	0.036	0.022
1:44:59	0.036	0.021
1:47:29	0.036	0.021
1:49:59	0.036	0.022
1:52:29	0.036	0.022
1:54:59	0.036	0.022
1:57:29	0.036	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
1:59:59	0.036	0.021
2:02:29	0.036	0.022
2:04:59	0.036	0.022
2:07:29	0.036	0.022
2:09:59	0.036	0.021
2:12:29	0.037	0.022
2:14:59	0.036	0.022
2:17:29	0.037	0.022
2:19:59	0.037	0.022
2:22:29	0.037	0.022
2:24:59	0.037	0.022
2:27:29	0.036	0.022
2:29:59	0.036	0.022
2:32:29	0.036	0.022
2:34:59	0.036	0.022
2:37:29	0.037	0.022
2:39:59	0.037	0.022
2:42:29	0.037	0.022
2:44:59	0.037	0.022
2:47:29	0.037	0.022
2:49:59	0.037	0.022
2:52:29	0.037	0.022
2:54:59	0.036	0.022
2:57:29	0.037	0.022
2:59:59	0.037	0.022
3:02:29	0.036	0.022
3:04:59	0.037	0.022
3:07:29	0.037	0.022
3:09:59	0.037	0.022
3:12:29	0.037	0.022
3:14:59	0.036	0.021
3:17:29	0.037	0.022
3:19:59	0.037	0.022
3:22:29	0.037	0.022
3:24:59	0.038	0.022
3:27:29	0.037	0.022
3:29:59	0.038	0.021
3:32:29	0.038	0.022
3:34:59	0.037	0.022
3:37:29	0.037	0.022
3:39:59	0.037	0.022
3:42:29	0.036	0.022
3:44:59	0.037	0.023
3:47:29	0.038	0.022
3:49:59	0.038	0.022
3:52:29	0.037	0.022
3:54:59	0.037	0.022
3:57:29	0.037	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
3:59:59	0.038	0.022
4:02:29	0.038	0.022
4:04:59	0.038	0.023
4:07:29	0.037	0.022
4:09:59	0.038	0.022
4:12:29	0.038	0.022
4:14:59	0.037	0.022
4:17:29	0.038	0.022
4:19:59	0.038	0.022
4:22:29	0.038	0.022
4:24:59	0.038	0.023
4:27:29	0.038	0.022
4:29:59	0.037	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.018	0.010
0:02:30	0.027	0.015
0:05:00	0.027	0.015
0:07:30	0.029	0.016
0:10:00	0.030	0.018
0:12:30	0.030	0.017
0:15:00	0.030	0.017
0:17:30	0.031	0.018
0:20:00	0.031	0.018
0:22:30	0.031	0.018
0:25:00	0.031	0.018
0:27:30	0.032	0.018
0:30:00	0.032	0.019
0:32:30	0.033	0.019
0:35:00	0.033	0.019
0:37:30	0.032	0.019
0:40:00	0.033	0.020
0:42:30	0.033	0.019
0:45:00	0.033	0.020
0:47:30	0.033	0.020
0:50:00	0.034	0.020
0:52:30	0.034	0.020
0:55:00	0.034	0.020
0:57:30	0.034	0.020
1:00:00	0.034	0.021
1:02:30	0.035	0.020
1:05:00	0.035	0.021
1:07:30	0.034	0.021
1:10:00	0.034	0.021
1:12:30	0.035	0.021
1:15:00	0.035	0.021
1:17:30	0.035	0.021
1:20:00	0.035	0.021
1:22:30	0.035	0.021
1:25:00	0.035	0.021
1:27:30	0.036	0.021
1:30:00	0.035	0.021
1:32:30	0.036	0.021
1:35:00	0.036	0.021
1:37:30	0.036	0.021
1:40:00	0.035	0.021
1:42:30	0.036	0.021
1:45:00	0.036	0.022
1:47:30	0.035	0.022
1:50:00	0.036	0.022
1:52:30	0.036	0.022
1:55:00	0.036	0.022
1:57:30	0.036	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER -	
	TC. NO. 56	TC. NO. 57
2:00:00	0.036	0.022
2:02:30	0.037	0.022
2:05:00	0.037	0.022
2:07:30	0.036	0.022
2:10:00	0.036	0.022
2:12:30	0.036	0.022
2:15:00	0.037	0.022
2:17:30	0.037	0.022
2:20:00	0.036	0.022
2:22:30	0.037	0.022
2:25:00	0.036	0.022
2:27:30	0.037	0.022
2:30:00	0.037	0.022
2:32:30	0.037	0.022
2:35:00	0.036	0.022
2:37:30	0.037	0.022
2:40:00	0.037	0.021
2:42:30	0.037	0.022
2:45:00	0.037	0.022
2:47:30	0.037	0.022
2:50:00	0.037	0.022
2:52:30	0.037	0.022
2:55:00	0.037	0.022
2:57:30	0.036	0.022
3:00:00	0.037	0.022
3:02:30	0.036	0.022
3:05:00	0.037	0.022
3:07:30	0.038	0.023
3:10:00	0.037	0.022
3:12:30	0.037	0.022
3:15:00	0.037	0.022
3:17:30	0.037	0.022
3:20:00	0.037	0.022
3:22:30	0.037	0.022
3:25:00	0.037	0.022
3:27:30	0.037	0.023
3:30:00	0.037	0.022
3:32:30	0.037	0.022
3:35:00	0.037	0.022
3:37:30	0.037	0.022
3:40:00	0.037	0.022
3:42:30	0.037	0.022
3:45:00	0.037	0.021
3:47:30	0.037	0.022
3:50:00	0.037	0.022
3:52:30	0.037	0.022
3:55:00	0.037	0.022
3:57:30	0.037	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.037	0.022
4:02:30	0.037	0.022
4:05:00	0.037	0.023
4:07:30	0.037	0.022
4:10:00	0.036	0.022
4:12:30	0.037	0.022
4:15:00	0.037	0.021
4:17:30	0.037	0.022
4:20:00	0.037	0.022
4:22:30	0.037	0.022
4:25:00	0.037	0.022
4:27:30	0.037	0.022
4:30:00	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.016	0.007
0:02:30	0.026	0.015
0:05:00	0.028	0.015
0:07:30	0.029	0.017
0:10:00	0.030	0.018
0:12:30	0.031	0.018
0:15:00	0.031	0.018
0:17:30	0.031	0.018
0:20:00	0.032	0.018
0:22:30	0.031	0.018
0:25:00	0.032	0.019
0:27:30	0.033	0.019
0:30:00	0.033	0.020
0:32:30	0.033	0.019
0:35:00	0.033	0.020
0:37:30	0.033	0.021
0:40:00	0.033	0.020
0:42:30	0.033	0.020
0:45:00	0.034	0.021
0:47:30	0.034	0.020
0:50:00	0.034	0.021
0:52:30	0.034	0.020
0:55:00	0.034	0.021
0:57:30	0.034	0.021
1:00:00	0.035	0.021
1:02:30	0.034	0.020
1:05:00	0.034	0.021
1:07:30	0.034	0.021
1:10:00	0.035	0.021
1:12:30	0.035	0.021
1:15:00	0.035	0.021
1:17:30	0.035	0.021
1:20:00	0.035	0.021
1:22:30	0.036	0.021
1:25:00	0.035	0.021
1:27:30	0.035	0.021
1:30:00	0.035	0.022
1:32:30	0.036	0.022
1:35:00	0.036	0.021
1:37:30	0.036	0.021
1:40:00	0.036	0.021
1:42:30	0.036	0.021
1:45:00	0.037	0.021
1:47:30	0.036	0.021
1:50:00	0.037	0.021
1:52:30	0.036	0.021
1:55:00	0.037	0.022
1:57:30	0.037	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.037	0.022
2:02:30	0.036	0.021
2:05:00	0.037	0.022
2:07:30	0.037	0.022
2:10:00	0.036	0.022
2:12:30	0.038	0.022
2:15:00	0.037	0.022
2:17:30	0.037	0.021
2:20:00	0.037	0.022
2:22:30	0.037	0.022
2:25:00	0.037	0.022
2:27:30	0.038	0.022
2:30:00	0.037	0.022
2:32:30	0.037	0.022
2:35:00	0.037	0.022
2:37:30	0.037	0.022
2:40:00	0.037	0.022
2:42:30	0.038	0.022
2:45:00	0.037	0.022
2:47:30	0.038	0.022
2:50:00	0.037	0.022
2:52:30	0.037	0.022
2:55:00	0.038	0.023
2:57:30	0.038	0.023
3:00:00	0.038	0.022
3:02:30	0.039	0.023
3:05:00	0.037	0.022
3:07:30	0.038	0.023
3:10:00	0.038	0.022
3:12:30	0.038	0.023
3:15:00	0.038	0.023
3:17:30	0.038	0.023
3:20:00	0.038	0.023
3:22:30	0.038	0.022
3:25:00	0.038	0.023
3:27:30	0.038	0.023
3:30:00	0.038	0.022
3:32:30	0.038	0.022
3:35:00	0.038	0.023
3:37:30	0.038	0.023
3:40:00	0.038	0.023
3:42:30	0.038	0.022
3:45:00	0.038	0.023
3:47:30	0.038	0.022
3:50:00	0.038	0.023
3:52:30	0.038	0.022
3:55:00	0.038	0.022
3:57:30	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.038	0.022
4:02:30	0.038	0.023
4:05:00	0.038	0.022
4:07:30	0.038	0.022
4:10:00	0.038	0.022
4:12:30	0.038	0.022
4:15:00	0.038	0.023
4:17:30	0.038	0.022
4:20:00	0.038	0.022
4:22:30	0.038	0.023
4:25:00	0.038	0.022
4:27:30	0.038	0.023
4:30:00	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.019	0.009
0:02:29	0.026	0.015
0:04:59	0.027	0.015
0:07:29	0.027	0.016
0:09:59	0.029	0.017
0:12:29	0.029	0.017
0:14:59	0.031	0.018
0:17:29	0.031	0.018
0:19:59	0.031	0.018
0:22:29	0.031	0.019
0:24:59	0.026	0.019
0:27:29	0.028	0.019
0:29:59	0.030	0.019
0:32:29	0.033	0.020
0:34:59	0.032	0.020
0:37:29	0.034	0.020
0:39:59	0.034	0.020
0:42:29	0.034	0.020
0:44:59	0.034	0.021
0:47:29	0.034	0.020
0:49:59	0.034	0.020
0:52:29	0.034	0.020
0:54:59	0.034	0.020
0:57:29	0.034	0.020
0:59:59	0.035	0.021
1:02:29	0.035	0.021
1:04:59	0.035	0.021
1:07:29	0.035	0.021
1:09:59	0.035	0.021
1:12:29	0.035	0.021
1:14:59	0.035	0.021
1:17:29	0.035	0.021
1:19:59	0.035	0.021
1:22:29	0.035	0.021
1:24:59	0.035	0.021
1:27:29	0.035	0.020
1:29:59	0.036	0.021
1:32:29	0.036	0.021
1:34:59	0.036	0.021
1:37:29	0.036	0.021
1:39:59	0.036	0.021
1:42:29	0.036	0.021
1:44:59	0.036	0.021
1:47:29	0.036	0.021
1:49:59	0.037	0.021
1:52:29	0.037	0.021
1:54:59	0.037	0.021
1:57:29	0.037	0.021
		0.022

R8196/95NK3179
Test Date : APRIL 21, 1995

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
1:59:59	0.004	0.021
2:02:29	0.038	0.021
2:04:59	0.038	0.021
2:07:29	0.038	0.021
2:09:59	0.039	0.022
2:12:29	0.038	0.021
2:14:59	0.038	0.021
2:17:29	0.038	0.021
2:19:59	0.038	0.021
2:22:29	0.038	0.021
2:24:59	0.038	0.022
2:27:29	0.038	0.021
2:29:59	0.038	0.021
2:32:29	0.038	0.021
2:34:59	0.038	0.021
2:37:29	0.037	0.021
2:39:59	0.038	0.021
2:42:29	0.037	0.021
2:44:59	0.038	0.022
2:47:29	0.037	0.022
2:49:59	0.037	0.021
2:52:29	0.038	0.022
2:54:59	0.038	0.021
2:57:29	0.037	0.022
2:59:59	0.037	0.021
3:02:29	0.037	0.021
3:04:59	0.038	0.022
3:07:29	0.037	0.022
3:09:59	0.038	0.022
3:12:29	0.038	0.021
3:14:59	0.038	0.022
3:17:29	0.037	0.022
3:19:59	0.038	0.022
3:22:29	0.038	0.022
3:24:59	0.038	0.022
3:27:29	0.039	0.022
3:29:59	0.038	0.021
3:32:29	0.038	0.022
3:34:59	0.038	0.021
3:37:29	0.038	0.022
3:39:59	0.038	0.022
3:42:29	0.038	0.022
3:44:59	0.038	0.022
3:47:29	0.038	0.022
3:49:59	0.038	0.022
3:52:29	0.038	0.022
3:54:59	0.038	0.022
3:57:29	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
3:59:59	0.038	0.022
4:02:29	0.038	0.022
4:04:59	0.038	0.022
4:07:29	0.038	0.022
4:09:59	0.038	0.022
4:12:29	0.038	0.021
4:14:59	0.037	0.022
4:17:29	0.038	0.022
4:19:59	0.037	0.021
4:22:29	0.038	0.021
4:24:59	0.038	0.022
4:27:29	0.037	0.022
4:29:59	0.038	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC .NO. 56	TC .NO. 57
0:00:00	0.023	0.018
0:02:30	0.024	0.013
0:05:00	0.028	0.015
0:07:30	0.028	0.016
0:10:00	0.029	0.016
0:12:30	0.030	0.016
0:15:00	0.029	0.017
0:17:30	0.029	0.016
0:20:00	0.030	0.016
0:22:30	0.030	0.017
0:25:00	0.031	0.017
0:27:30	0.031	0.017
0:30:00	0.031	0.016
0:32:30	0.031	0.017
0:35:00	0.031	0.016
0:37:30	0.031	0.016
0:40:00	0.031	0.017
0:42:30	0.031	0.017
0:45:00	0.031	0.017
0:47:30	0.032	0.017
0:50:00	0.032	0.017
0:52:30	0.032	0.017
0:55:00	0.032	0.018
0:57:30	0.032	0.017
1:00:00	0.032	0.018
1:02:30	0.032	0.018
1:05:00	0.033	0.018
1:07:30	0.033	0.018
1:10:00	0.033	0.018
1:12:30	0.033	0.018
1:15:00	0.034	0.019
1:17:30	0.033	0.018
1:20:00	0.033	0.018
1:22:30	0.033	0.019
1:25:00	0.033	0.019
1:27:30	0.033	0.018
1:30:00	0.033	0.019
1:32:30	0.034	0.019
1:35:00	0.034	0.019
1:37:30	0.034	0.019
1:40:00	0.034	0.019
1:42:30	0.034	0.019
1:45:00	0.035	0.019
1:47:30	0.034	0.019
1:50:00	0.034	0.020
1:52:30	0.034	0.019
1:55:00	0.035	0.019
1:57:30	0.035	0.019

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC .NO. 56	TC .NO. 57
2:00:00	0.034	0.020
2:02:30	0.035	0.020
2:05:00	0.035	0.019
2:07:30	0.035	0.020
2:10:00	0.035	0.020
2:12:30	0.035	0.019
2:15:00	0.035	0.019
2:17:30	0.035	0.020
2:20:00	0.035	0.019
2:22:30	0.036	0.020
2:25:00	0.035	0.019
2:27:30	0.035	0.019
2:30:00	0.035	0.020
2:32:30	0.036	0.020
2:35:00	0.036	0.020
2:37:30	0.035	0.019
2:40:00	0.035	0.020
2:42:30	0.035	0.020
2:45:00	0.035	0.020
2:47:30	0.036	0.020
2:50:00	0.035	0.019
2:52:30	0.035	0.019
2:55:00	0.035	0.019
2:57:30	0.035	0.019
3:00:00	0.036	0.019
3:02:30	0.035	0.019
3:05:00	0.036	0.019
3:07:30	0.036	0.019
3:10:00	0.036	0.019
3:12:30	0.036	0.019
3:15:00	0.035	0.019
3:17:30	0.036	0.019
3:20:00	0.036	0.018
3:22:30	0.036	0.018
3:25:00	0.036	0.018
3:27:30	0.036	0.018
3:30:00	0.036	0.018
3:32:30	0.036	0.018
3:35:00	0.036	0.018
3:37:30	0.036	0.017
3:40:00	0.036	0.017
3:42:30	0.036	0.017
3:45:00	0.036	0.017
3:47:30	0.036	0.017
3:50:00	0.036	0.017
3:52:30	0.036	0.017
3:55:00	0.036	0.017
3:57:30	0.036	0.017

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC .NO. 56	TC .NO. 57
4:00:00	0.036	0.017
4:02:30	0.036	0.017
4:05:00	0.036	0.017
4:07:30	0.036	0.017
4:10:00	0.036	0.016
4:12:30	0.036	0.016
4:15:00	0.036	0.016
4:17:30	0.036	0.016
4:20:00	0.036	0.016
4:22:30	0.037	0.016
4:25:00	0.037	0.015
4:27:30	0.036	0.015
4:30:00	0.036	0.015

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	74.8	75.0	74.8	74.8	74.7	74.7
0:02:30	74.7	74.9	74.9	74.7	74.6	74.7
0:05:00	74.9	75.0	74.9	74.9	74.6	74.8
0:07:30	74.9	74.9	74.9	74.8	74.7	74.8
0:10:00	74.7	74.8	74.7	74.8	74.5	74.7
0:12:30	74.7	74.8	74.8	74.7	74.5	75.0
0:15:00	75.0	75.0	74.9	75.0	74.6	75.7
0:17:30	74.9	74.9	74.9	74.9	74.7	76.8
0:20:00	74.9	75.0	75.0	74.9	74.7	78.5
0:22:30	74.9	74.9	75.1	74.9	74.6	81.0
0:25:00	74.8	74.8	74.9	74.9	74.5	84.4
0:27:30	75.0	75.0	75.4	75.1	74.8	89.0
0:30:00	75.0	75.3	75.6	75.4	75.0	93.6
0:32:30	75.1	75.3	76.0	75.7	75.1	99.2
0:35:00	75.0	75.4	76.3	76.0	75.3	105.3
0:37:30	75.2	75.7	76.9	76.6	75.6	112.0
0:40:00	75.4	76.4	77.9	77.6	76.3	119.2
0:42:30	75.7	77.0	78.9	78.3	76.7	126.6
0:45:00	76.1	77.8	80.1	79.5	77.4	134.1
0:47:30	76.4	78.7	81.5	80.7	78.3	141.5
0:50:00	76.8	79.7	83.1	82.3	79.1	148.7
0:52:30	77.6	81.1	84.9	84.3	80.4	155.7
0:55:00	78.2	82.4	86.9	86.3	81.6	162.2
0:57:30	78.8	83.9	88.8	88.2	82.8	168.0
1:00:00	79.9	85.7	91.2	90.5	84.7	173.9
1:02:30	80.6	87.3	93.4	92.6	86.0	178.7
1:05:00	81.6	89.2	95.8	94.8	87.9	183.9
1:07:30	82.7	91.1	98.1	96.9	89.5	189.1
1:10:00	84.2	93.3	100.8	99.5	91.6	194.7
1:12:30	85.4	95.2	103.1	101.7	93.3	199.9
1:15:00	86.7	97.1	105.5	103.9	95.3	205.0
1:17:30	88.3	99.4	108.0	106.4	97.3	210.7
1:20:00	89.8	101.9	110.9	108.8	99.5	216.3
1:22:30	91.7	104.1	113.4	111.3	101.6	221.8
1:25:00	93.3	106.6	116.3	113.8	104.0	227.5
1:27:30	95.1	109.1	119.1	116.4	106.3	232.9
1:30:00	97.4	111.8	122.0	119.0	108.7	238.4
1:32:30	99.1	114.1	124.8	121.6	111.0	243.6
1:35:00	101.3	116.9	127.7	124.2	113.5	248.9
1:37:30	103.5	119.6	130.9	127.0	116.1	254.2
1:40:00	105.8	122.3	133.7	129.6	118.5	259.1
1:42:30	108.0	125.1	136.7	132.5	121.0	264.2
1:45:00	110.4	128.0	139.8	135.3	123.7	269.1
1:47:30	112.9	130.9	142.9	138.2	126.5	274.2
1:50:00	115.5	133.7	146.0	141.1	129.2	278.9
1:52:30	117.9	136.5	149.1	143.9	131.9	283.6
1:55:00	120.5	139.3	152.3	146.6	134.3	288.3
1:57:30	123.3	142.3	155.5	149.8	137.3	292.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
2:00:00	125.9	145.3	158.5	152.7	140.0	296.7
2:02:30	128.7	148.3	161.6	155.7	143.0	301.0
2:05:00	131.4	151.2	164.7	158.5	145.7	305.2
2:07:30	134.2	154.3	167.8	161.3	148.2	309.6
2:10:00	137.0	157.1	170.8	164.3	151.1	314.1
2:12:30	139.6	159.8	173.6	167.0	153.7	318.0
2:15:00	142.6	162.9	176.9	170.1	156.4	322.3
2:17:30	145.3	165.9	180.2	173.0	159.3	326.1
2:20:00	148.4	168.9	183.5	176.0	162.1	330.2
2:22:30	151.2	171.9	186.6	179.0	164.9	334.0
2:25:00	153.9	174.8	189.5	181.6	167.5	337.7
2:27:30	156.7	177.7	192.7	184.6	170.1	341.3
2:30:00	159.5	180.7	195.6	187.4	172.9	344.9
2:32:30	162.6	183.7	198.6	190.3	175.6	348.6
2:35:00	165.6	186.8	201.4	193.0	178.6	352.2
2:37:30	168.6	189.6	204.6	195.9	181.4	355.6
2:40:00	171.6	192.7	207.8	198.9	184.2	359.4
2:42:30	174.7	195.7	210.7	201.6	187.1	363.2
2:45:00	178.1	198.7	213.7	204.7	189.9	366.5
2:47:30	181.5	201.5	216.8	207.8	192.9	369.9
2:50:00	184.7	204.4	219.7	210.5	195.8	372.9
2:52:30	188.5	207.7	223.3	213.9	198.9	375.9
2:55:00	192.0	210.6	226.3	217.1	201.8	379.0
2:57:30	195.7	213.8	229.4	220.2	205.0	382.7
3:00:00	199.5	216.9	232.8	223.5	208.2	386.4
3:02:30	203.3	220.0	236.0	226.9	211.5	389.9
3:05:00	207.2	223.2	239.3	230.2	214.9	393.5
3:07:30	211.1	226.7	242.6	233.8	218.2	395.5
3:10:00	215.2	230.3	246.0	237.4	221.8	399.5
3:12:30	219.4	233.7	249.3	241.1	225.2	403.3
3:15:00	223.7	237.5	252.7	245.0	229.1	406.7
3:17:30	227.8	240.7	255.8	248.4	232.8	409.7
3:20:00	232.1	244.7	259.2	252.2	236.5	412.9
3:22:30	236.3	248.1	262.6	256.0	240.4	416.2
3:25:00	240.6	251.9	266.0	260.0	244.3	419.6
3:27:30	245.0	255.6	269.4	263.8	248.5	422.9
3:30:00	249.1	259.7	272.9	267.9	252.6	426.7
3:32:30	252.7	263.4	276.4	271.5	256.6	430.3
3:35:00	256.2	267.2	280.3	275.5	260.9	434.3
3:37:30	259.2	270.3	283.8	279.2	264.5	438.0
3:40:00	262.3	273.8	287.8	283.2	268.2	441.2
3:42:30	265.0	276.8	291.6	286.9	271.6	445.5
3:45:00	268.3	280.0	295.4	290.9	275.2	449.0
3:47:30	271.9	283.4	299.5	294.6	278.7	453.4
3:50:00	275.3	286.6	303.5	298.1	282.1	457.3
3:52:30	278.7	290.1	307.5	301.9	285.9	460.3
3:55:00	282.0	293.6	311.4	305.2	289.1	462.6
3:57:30	285.6	297.4	315.5	308.9	293.2	465.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TC. NO. 1	TC. NO. 2	TEMPERATURES, °F		TC. NO. 5	TC. NO. 6
			TC. NO. 3	TC. NO. 4		
4:00:00	289.0	300.9	319.5	312.4	296.4	468.9
4:02:30	292.4	304.4	323.7	315.9	299.7	472.1
4:05:00	296.0	308.2	327.8	319.4	303.4	475.5
4:07:30	299.9	312.2	331.9	322.8	307.3	478.7
4:10:00	302.9	315.9	335.7	326.2	310.5	482.0
4:12:30	306.4	319.6	339.4	329.2	313.8	484.6
4:15:00	309.0	323.2	343.0	331.8	317.4	488.5
4:17:30	312.1	327.0	346.7	334.2	321.2	491.8
4:20:00	315.6	331.0	350.2	337.1	324.9	494.5
4:22:30	318.6	334.4	353.5	340.1	328.5	497.4
4:25:00	322.3	338.5	357.1	342.7	332.1	500.3
4:27:30	325.6	342.5	360.3	345.9	335.9	502.9
4:30:00	329.0	346.5	363.8	346.5	339.2	505.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	74.7	74.7	74.7	74.7	74.6	74.6
0:02:30	74.7	74.6	74.7	74.6	74.4	74.6
0:05:00	74.8	74.8	74.8	74.8	74.6	74.6
0:07:30	74.8	74.8	74.8	74.7	74.7	74.7
0:10:00	74.7	74.7	74.7	74.5	74.5	74.5
0:12:30	74.8	74.5	74.7	74.5	74.4	74.4
0:15:00	75.3	74.7	74.7	74.9	74.7	74.6
0:17:30	75.9	74.7	74.7	74.7	74.6	74.4
0:20:00	77.3	74.6	74.7	74.9	74.7	74.7
0:22:30	79.1	74.6	74.8	74.9	74.6	74.6
0:25:00	81.6	74.6	74.8	74.8	74.6	74.5
0:27:30	85.3	74.7	75.3	75.1	74.8	74.8
0:30:00	89.5	74.8	75.3	75.3	75.0	75.0
0:32:30	94.3	74.8	75.7	75.6	75.1	75.1
0:35:00	100.1	74.8	75.9	76.0	75.3	75.3
0:37:30	106.6	75.0	76.3	76.5	75.5	75.6
0:40:00	114.2	75.4	77.1	77.3	76.0	76.4
0:42:30	122.1	75.6	77.9	78.2	76.4	76.9
0:45:00	131.0	75.8	79.0	79.1	76.9	77.7
0:47:30	140.7	76.2	80.0	80.4	77.8	78.6
0:50:00	149.4	76.5	81.5	81.8	78.6	79.7
0:52:30	156.5	77.2	83.0	83.3	79.6	80.9
0:55:00	162.9	77.7	84.6	85.1	80.8	82.4
0:57:30	167.4	78.2	86.2	86.8	82.0	83.7
1:00:00	171.2	79.0	88.2	88.9	83.4	85.7
1:02:30	174.7	79.8	90.1	90.8	84.6	87.2
1:05:00	178.7	80.8	92.3	93.1	86.3	89.4
1:07:30	181.8	81.8	94.1	94.8	87.8	91.2
1:10:00	185.5	83.1	96.5	97.1	89.5	93.3
1:12:30	189.2	84.2	98.6	99.1	91.2	95.3
1:15:00	193.0	85.5	100.7	101.4	93.1	97.6
1:17:30	197.1	87.0	103.1	103.7	94.8	99.9
1:20:00	201.4	88.5	105.5	105.9	96.8	102.1
1:22:30	205.8	90.2	107.8	108.4	98.8	104.5
1:25:00	210.3	92.0	110.4	110.6	100.8	107.0
1:27:30	215.2	93.5	112.8	113.0	103.0	109.4
1:30:00	220.1	95.7	115.5	115.7	105.4	112.1
1:32:30	225.0	97.4	118.0	118.2	107.4	114.5
1:35:00	230.2	99.5	120.8	120.8	109.7	117.2
1:37:30	235.2	101.7	123.7	123.6	112.1	120.0
1:40:00	240.1	103.7	126.3	126.1	114.5	122.6
1:42:30	244.7	105.9	129.2	128.8	116.9	125.6
1:45:00	249.4	108.5	132.0	131.6	119.5	128.4
1:47:30	254.2	110.9	134.9	134.4	122.1	131.3
1:50:00	258.6	113.2	137.9	137.2	124.7	134.0
1:52:30	263.2	115.8	140.8	139.9	127.2	137.0
1:55:00	267.2	118.2	143.6	142.7	129.7	139.7
1:57:30	271.7	121.0	146.7	145.6	132.5	142.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
2:00:00	275.5	123.6	149.4	148.5	135.0	145.6
2:02:30	279.8	126.3	152.6	151.4	138.0	148.6
2:05:00	283.8	129.2	155.4	154.3	140.7	151.7
2:07:30	287.9	132.0	158.4	157.3	143.4	154.7
2:10:00	292.0	135.0	161.5	160.1	146.3	157.7
2:12:30	295.5	137.8	164.3	162.9	149.1	160.6
2:15:00	299.4	140.8	167.5	166.0	152.1	163.9
2:17:30	303.4	143.7	170.4	169.0	155.2	166.9
2:20:00	307.3	146.9	173.7	172.3	158.3	170.0
2:22:30	310.9	150.0	176.6	175.2	161.5	173.2
2:25:00	314.6	152.9	179.6	178.1	164.5	176.2
2:27:30	318.0	156.7	183.2	181.3	167.8	179.4
2:30:00	321.8	159.8	186.2	184.2	170.9	182.5
2:32:30	325.3	163.2	189.4	187.6	174.2	185.5
2:35:00	328.8	166.4	192.4	190.6	177.2	188.5
2:37:30	332.6	169.6	195.4	193.6	180.2	191.3
2:40:00	336.6	172.7	198.7	196.6	183.3	194.3
2:42:30	339.5	175.7	201.5	199.4	186.3	197.3
2:45:00	342.5	179.1	204.6	202.2	189.1	200.2
2:47:30	345.5	182.4	207.6	205.1	192.2	203.1
2:50:00	348.9	185.5	210.5	207.8	195.3	205.8
2:52:30	352.2	189.3	213.9	211.0	198.5	209.1
2:55:00	355.3	193.3	216.8	214.1	201.8	212.4
2:57:30	358.4	197.4	219.9	217.5	205.2	215.7
3:00:00	360.9	201.5	223.1	221.1	208.6	219.3
3:02:30	363.7	206.1	226.4	224.7	211.9	223.0
3:05:00	366.9	211.0	229.6	228.3	215.4	226.8
3:07:30	370.9	215.8	233.2	232.3	218.9	230.7
3:10:00	373.6	220.9	236.8	236.2	222.7	234.8
3:12:30	376.1	226.0	240.4	240.2	226.5	238.9
3:15:00	379.5	231.5	244.4	244.4	230.5	243.3
3:17:30	383.4	236.3	248.2	248.5	234.3	247.2
3:20:00	385.1	241.5	252.0	252.7	238.3	251.5
3:22:30	389.5	246.5	255.9	256.6	242.1	255.5
3:25:00	392.2	251.4	260.0	260.6	246.3	259.6
3:27:30	396.0	256.4	263.8	264.7	250.2	262.1
3:30:00	410.4	261.3	268.5	268.5	254.3	266.5
3:32:30	424.7	266.2	272.6	272.0	258.4	269.3
3:35:00	431.4	270.8	276.8	276.0	262.6	272.2
3:37:30	435.6	275.1	280.8	279.6	266.3	274.7
3:40:00	440.3	279.6	285.1	283.2	270.6	277.7
3:42:30	442.8	283.4	289.1	287.1	274.5	280.2
3:45:00	446.8	287.7	293.6	290.7	278.3	283.0
3:47:30	449.4	291.5	297.9	294.6	282.4	286.2
3:50:00	452.5	295.4	302.0	298.7	286.6	289.4
3:52:30	455.8	299.1	305.9	302.2	290.7	292.6
3:55:00	459.0	302.6	310.0	305.7	294.3	296.1
3:57:30	463.2	306.4	313.4	308.9	297.6	299.5

R8196/95NK3179
Test Date : APRIL 4, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
4:00:00	465.9	309.8	317.9	312.4	301.9	302.8
4:02:30	468.9	313.1	320.5	315.4	305.7	306.4
4:05:00	472.6	316.5	323.6	318.8	310.4	310.4
4:07:30	475.7	320.1	327.1	322.6	314.4	314.4
4:10:00	478.1	323.3	330.4	326.1	318.4	318.1
4:12:30	482.1	326.9	333.9	329.4	322.1	322.1
4:15:00	483.8	330.5	337.4	333.1	325.9	326.2
4:17:30	488.3	334.6	341.0	336.8	330.1	330.7
4:20:00	489.1	338.6	344.2	340.4	334.0	334.9
4:22:30	494.2	342.4	347.7	344.0	337.9	339.1
4:25:00	497.3	346.6	351.0	347.0	342.5	343.1
4:27:30	499.1	350.6	354.4	350.2	346.4	347.5
4:30:00	501.7	354.5	358.0	353.4	349.8	351.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	74.7	74.3	75.0	75.0	75.0	75.0
0:02:30	74.6	74.1	75.2	75.0	75.0	75.0
0:05:00	74.8	74.2	75.0	75.0	75.0	75.0
0:07:30	74.8	74.4	75.2	75.1	75.2	74.9
0:10:00	74.7	74.2	75.0	75.0	75.0	75.0
0:12:30	75.0	74.4	75.0	75.0	75.0	74.8
0:15:00	75.6	75.0	75.1	75.1	75.1	75.0
0:17:30	76.6	75.6	75.0	75.0	75.2	75.0
0:20:00	78.3	76.7	75.1	75.1	75.1	75.1
0:22:30	81.0	78.6	75.2	75.1	75.2	75.2
0:25:00	84.4	81.0	75.1	74.9	75.1	75.1
0:27:30	89.1	84.3	75.1	75.3	75.3	75.4
0:30:00	94.3	88.2	75.3	75.6	75.6	75.4
0:32:30	100.2	92.6	75.3	75.7	75.7	75.7
0:35:00	107.0	97.2	75.3	76.0	75.7	76.0
0:37:30	114.2	102.4	75.5	76.5	76.2	76.3
0:40:00	122.6	106.8	75.8	77.1	76.7	77.1
0:42:30	131.4	112.9	76.0	78.0	77.2	77.8
0:45:00	141.2	119.2	76.3	79.0	77.8	78.7
0:47:30	151.7	126.0	76.8	80.0	78.7	79.7
0:50:00	162.3	132.5	77.1	81.5	79.7	81.2
0:52:30	170.9	138.3	77.7	82.8	80.8	82.7
0:55:00	177.3	144.1	78.4	84.8	82.2	84.4
0:57:30	181.8	149.1	79.1	86.3	83.4	86.0
1:00:00	185.7	153.4	80.0	88.6	85.3	88.2
1:02:30	189.1	158.5	80.8	90.5	86.7	90.1
1:05:00	193.9	163.6	82.1	93.0	88.8	92.6
1:07:30	199.0	166.8	83.0	94.9	90.5	94.5
1:10:00	204.6	172.0	84.3	97.5	92.7	97.1
1:12:30	209.8	176.5	85.5	99.7	94.5	99.3
1:15:00	215.6	181.4	87.0	102.2	96.7	101.7
1:17:30	221.5	185.7	88.4	104.7	98.9	104.2
1:20:00	227.5	190.8	90.1	107.1	101.0	106.8
1:22:30	233.6	194.8	92.0	109.9	103.3	109.5
1:25:00	239.8	200.3	93.6	112.5	105.7	112.1
1:27:30	245.8	204.8	95.5	115.2	108.2	114.9
1:30:00	251.8	210.6	97.5	118.0	110.9	117.6
1:32:30	257.5	214.9	99.5	120.6	113.2	120.2
1:35:00	263.2	219.0	101.6	123.4	115.9	123.2
1:37:30	269.0	224.3	104.0	126.3	118.6	126.0
1:40:00	274.5	228.6	106.1	129.1	121.2	128.8
1:42:30	280.1	232.4	108.2	132.0	123.7	131.8
1:45:00	285.7	238.2	110.7	134.9	126.5	134.7
1:47:30	291.1	242.3	113.2	137.9	129.4	137.8
1:50:00	296.2	246.1	115.6	140.8	132.2	140.6
1:52:30	301.5	250.4	118.2	143.7	135.0	143.7
1:55:00	306.5	254.0	120.6	146.7	137.9	146.7
1:57:30	311.5	257.9	123.4	149.8	140.8	150.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
2:00:00	316.2	261.5	126.0	152.5	143.5	153.1
2:02:30	321.3	265.9	129.0	155.8	146.6	156.1
2:05:00	325.9	269.1	131.7	158.7	149.6	159.1
2:07:30	330.5	274.2	134.4	161.8	152.5	161.9
2:10:00	335.2	277.5	137.2	164.8	155.5	165.3
2:12:30	339.4	280.7	140.0	167.7	158.2	168.3
2:15:00	344.1	285.9	143.2	170.8	161.4	171.4
2:17:30	348.2	291.3	146.3	173.8	164.2	174.5
2:20:00	352.6	295.1	149.1	177.2	167.5	177.7
2:22:30	356.7	303.0	152.1	180.4	170.4	180.5
2:25:00	360.7	307.9	155.3	183.3	173.4	183.4
2:27:30	364.3	335.8	158.4	186.3	176.3	186.6
2:30:00	368.0	343.3	161.5	189.6	179.4	189.7
2:32:30	372.0	350.7	164.7	192.5	182.4	192.5
2:35:00	375.6	356.7	168.1	195.5	185.3	195.5
2:37:30	379.3	361.6	171.4	198.7	188.5	198.3
2:40:00	382.9	365.7	174.9	201.5	191.5	201.2
2:42:30	386.6	370.6	178.4	204.5	194.5	204.8
2:45:00	389.9	374.7	181.7	207.3	197.4	208.3
2:47:30	393.6	379.1	185.2	211.6	200.7	211.3
2:50:00	396.7	382.5	188.2	214.2	203.3	214.1
2:52:30	400.4	386.4	191.5	216.9	206.7	216.9
2:55:00	403.5	389.9	194.4	219.5	209.7	219.6
2:57:30	406.8	394.0	197.8	221.8	213.0	222.3
3:00:00	409.8	397.3	201.2	224.2	216.2	225.4
3:02:30	413.6	401.2	204.1	226.8	219.4	228.1
3:05:00	417.0	405.5	207.5	229.3	222.4	231.2
3:07:30	420.3	408.8	211.0	232.1	225.7	234.2
3:10:00	424.1	413.3	214.7	234.9	228.8	237.4
3:12:30	427.2	417.3	218.4	237.8	232.1	240.6
3:15:00	431.1	422.1	222.6	240.9	235.6	243.9
3:17:30	434.6	424.1	226.3	243.7	238.7	247.0
3:20:00	438.1	429.2	230.0	246.6	242.2	250.1
3:22:30	441.5	433.1	234.2	249.5	245.6	253.2
3:25:00	445.2	436.9	238.3	252.5	249.1	256.5
3:27:30	448.8	440.6	242.7	255.7	252.5	259.4
3:30:00	452.7	444.4	246.9	258.9	256.0	262.5
3:32:30	456.0	449.2	251.3	262.1	259.4	265.9
3:35:00	460.0	451.9	256.2	265.4	263.3	269.0
3:37:30	462.9	455.7	260.5	268.7	266.6	271.8
3:40:00	466.9	459.8	265.3	272.1	270.3	274.8
3:42:30	470.4	461.9	269.9	275.2	273.8	278.3
3:45:00	473.6	466.3	274.9	278.8	277.3	281.5
3:47:30	476.5	468.5	279.8	282.1	280.7	285.1
3:50:00	479.3	471.0	284.9	285.8	284.6	289.1
3:52:30	482.4	475.2	290.5	289.4	287.9	291.7
3:55:00	485.2	478.8	302.3	292.9	291.7	297.5
3:57:30	487.8	480.4	307.5	296.5	295.4	299.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
hr:min:sec						
4:00:00	490.7	483.0	312.5	300.0	299.0	301.5
4:02:30	494.2	490.1	317.6	303.4	302.9	303.6
4:05:00	497.3	492.2	323.0	307.3	306.8	305.7
4:07:30	499.1	495.2	328.8	313.1	310.6	308.0
4:10:00	499.8	497.0	322.6	314.4	301.6	310.4
4:12:30	501.0	503.7	329.4	315.0	287.3	313.1
4:15:00	501.7	505.9	336.2	309.1	315.5	317.3
4:17:30	502.2	511.1	341.9	311.8	320.8	320.8
4:20:00	504.2	512.2	347.3	315.9	324.7	324.3
4:22:30	505.4	513.8	352.6	320.0	327.9	327.1
4:25:00	508.2	521.6	357.7	325.1	331.0	330.0
4:27:30	509.5	521.1	362.5	330.1	334.0	333.1
4:30:00	511.8	526.2	367.3	333.7	336.7	336.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	74.8	75.4	75.4	74.9	74.9	75.1
0:02:30	74.9	75.5	75.4	74.9	74.9	75.2
0:05:00	74.9	75.3	75.4	74.8	74.8	75.0
0:07:30	74.9	75.4	75.4	75.0	75.0	75.1
0:10:00	74.8	75.6	75.4	75.0	74.9	75.2
0:12:30	74.7	75.9	75.9	75.1	75.1	75.2
0:15:00	74.9	76.5	76.5	75.1	74.9	75.1
0:17:30	74.9	77.6	77.9	75.0	75.0	75.1
0:20:00	75.0	79.5	79.7	74.9	75.0	75.0
0:22:30	75.1	82.2	82.4	75.0	75.0	75.1
0:25:00	74.9	85.7	86.0	75.1	75.1	75.1
0:27:30	75.3	90.1	90.7	75.2	75.3	75.4
0:30:00	75.6	95.2	95.9	75.2	75.6	75.3
0:32:30	76.0	101.2	102.0	75.3	75.9	75.8
0:35:00	76.4	107.8	108.9	75.4	76.4	75.9
0:37:30	77.1	115.1	116.4	75.5	77.0	76.4
0:40:00	78.2	123.1	124.8	75.7	77.9	77.0
0:42:30	79.2	131.5	133.8	76.0	78.6	77.6
0:45:00	80.7	140.5	143.3	76.1	79.9	78.4
0:47:30	82.5	150.9	153.8	76.7	81.5	79.6
0:50:00	84.2	161.5	165.0	77.3	83.1	80.8
0:52:30	86.5	171.5	175.7	77.6	84.7	81.8
0:55:00	88.8	180.1	185.7	78.4	86.5	83.4
0:57:30	91.1	186.7	195.8	79.1	88.6	85.1
1:00:00	93.7	191.4	204.7	80.1	91.0	87.0
1:02:30	96.2	195.1	210.1	80.8	93.2	88.8
1:05:00	98.9	199.1	215.3	82.1	95.3	91.0
1:07:30	101.4	203.7	220.6	83.1	97.8	93.0
1:10:00	104.5	209.5	226.0	84.6	100.2	95.2
1:12:30	107.0	215.8	231.4	86.3	103.0	97.7
1:15:00	109.6	221.8	237.1	87.6	105.6	100.0
1:17:30	112.3	227.8	243.0	89.2	108.1	102.6
1:20:00	115.1	234.1	248.8	90.9	110.7	104.9
1:22:30	118.0	240.5	255.2	92.9	113.7	107.6
1:25:00	121.0	246.7	261.3	94.7	116.5	110.3
1:27:30	123.6	252.5	267.4	96.6	118.9	112.7
1:30:00	126.6	258.5	273.8	98.7	121.9	115.7
1:32:30	129.5	264.2	280.0	100.9	124.7	118.4
1:35:00	132.5	269.9	288.6	103.1	127.7	121.1
1:37:30	135.6	275.4	295.0	105.4	130.5	123.9
1:40:00	138.5	281.1	301.3	107.8	133.4	127.0
1:42:30	141.7	286.7	307.4	110.4	136.5	129.9
1:45:00	144.8	292.0	313.1	112.8	139.5	132.7
1:47:30	147.8	297.1	318.8	115.2	142.5	135.6
1:50:00	151.1	302.3	324.2	118.0	145.5	138.6
1:52:30	154.2	307.5	329.9	120.7	148.5	141.7
1:55:00	157.3	312.5	335.5	123.4	151.6	144.7
1:57:30	160.6	317.2	340.7	126.1	154.6	147.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
2:00:00	163.7	322.1	346.1	129.0	158.0	150.8
2:02:30	167.0	326.9	351.2	131.7	160.9	153.9
2:05:00	170.1	331.5	356.3	134.8	164.1	157.0
2:07:30	173.2	336.1	361.3	137.7	167.6	160.1
2:10:00	176.4	340.6	366.1	140.7	170.7	163.3
2:12:30	179.6	345.2	370.6	143.6	174.0	166.2
2:15:00	183.0	349.9	375.3	146.8	177.1	169.4
2:17:30	186.1	354.3	380.1	149.7	180.4	172.5
2:20:00	189.4	358.6	384.7	152.7	183.4	175.6
2:22:30	192.5	362.7	389.0	155.6	186.5	178.8
2:25:00	195.8	366.8	393.4	158.8	189.5	182.0
2:27:30	199.1	371.2	397.9	162.1	192.7	185.3
2:30:00	202.1	375.0	402.2	165.1	195.7	188.4
2:32:30	205.4	379.0	406.2	168.3	198.7	191.6
2:35:00	208.6	383.0	410.7	171.7	201.6	194.9
2:37:30	211.8	386.6	414.8	174.9	204.8	198.2
2:40:00	215.3	390.5	418.8	178.4	207.9	201.3
2:42:30	218.5	393.9	430.4	181.5	210.7	204.2
2:45:00	221.5	397.5	434.8	185.0	214.0	207.6
2:47:30	224.6	401.1	438.4	188.7	216.9	210.8
2:50:00	227.4	404.5	440.5	192.3	220.4	215.2
2:52:30	230.5	408.1	444.3	193.7	224.0	217.9
2:55:00	233.5	411.4	448.0	199.9	227.1	220.4
2:57:30	236.5	414.6	451.7	204.4	230.1	222.8
3:00:00	239.6	417.8	455.5	207.7	233.2	225.0
3:02:30	242.5	420.9	458.8	210.2	235.5	227.5
3:05:00	245.5	423.9	462.3	212.8	238.0	229.8
3:07:30	248.6	427.0	465.9	215.2	240.0	232.6
3:10:00	251.7	430.0	469.4	216.8	242.2	235.4
3:12:30	254.8	433.0	472.2	218.0	245.3	238.0
3:15:00	258.1	436.0	475.6	221.0	248.3	240.9
3:17:30	261.0	438.9	478.7	224.5	250.8	243.8
3:20:00	264.3	441.3	481.6	228.2	253.7	247.0
3:22:30	267.4	443.9	484.7	232.2	257.0	250.4
3:25:00	270.8	446.4	488.0	236.4	260.1	254.1
3:27:30	274.0	448.7	491.2	240.2	263.5	257.8
3:30:00	277.4	451.1	494.1	244.2	266.4	261.3
3:32:30	280.8	453.3	496.9	248.0	270.1	264.9
3:35:00	283.4	455.6	504.3	252.1	273.3	268.2
3:37:30	286.4	457.8	507.3	256.7	276.9	271.9
3:40:00	289.4	460.0	509.9	261.7	280.7	275.6
3:42:30	292.2	461.8	512.4	266.8	284.1	279.2
3:45:00	295.2	463.8	515.1	272.4	287.9	283.1
3:47:30	298.4	465.5	517.9	278.1	291.3	287.3
3:50:00	301.6	467.2	520.3	284.1	295.0	290.9
3:52:30	304.9	469.2	521.5	290.4	298.7	295.2
3:55:00	307.0	471.2	524.1	296.4	302.8	300.1
3:57:30	310.8	473.1	527.2	302.7	307.2	302.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
hr:min:sec						
4:00:00	313.9	475.2	529.8	309.9	311.9	304.9
4:02:30	317.0	477.0	532.0	313.3	316.2	307.0
4:05:00	320.0	479.2	534.5	315.5	320.3	309.5
4:07:30	323.6	481.0	536.7	317.2	323.6	312.0
4:10:00	327.2	482.9	538.4	318.3	326.3	314.8
4:12:30	329.7	484.7	540.4	319.4	329.7	317.8
4:15:00	332.4	487.1	550.3	320.6	332.3	321.0
4:17:30	336.1	489.0	558.1	322.5	336.2	324.2
4:20:00	339.1	490.6	560.2	324.4	338.7	327.5
4:22:30	342.0	492.2	562.2	326.9	342.6	330.5
4:25:00	345.2	493.8	563.3	329.6	346.2	333.9
4:27:30	347.7	495.4	557.7	331.7	348.9	336.8
4:30:00	350.4	497.3	559.3	334.8	352.4	340.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	74.9	74.6	74.9	74.5	75.1
0:02:30	74.9	74.9	75.1	74.6	75.2
0:05:00	74.8	74.7	75.0	74.4	75.1
0:07:30	75.0	74.7	75.1	74.7	75.4
0:10:00	74.9	74.7	75.3	74.7	75.6
0:12:30	74.9	74.8	75.6	75.1	76.4
0:15:00	74.9	74.8	76.2	75.5	78.1
0:17:30	75.0	74.8	77.6	76.6	80.9
0:20:00	74.9	74.9	79.7	78.2	84.9
0:22:30	75.1	74.8	82.8	80.6	90.7
0:25:00	75.1	75.1	87.0	83.7	97.5
0:27:30	75.3	75.3	92.8	87.5	105.9
0:30:00	75.5	75.5	99.4	92.1	115.7
0:32:30	75.8	75.9	108.6	97.2	126.7
0:35:00	76.1	76.4	122.2	103.0	138.4
0:37:30	76.5	77.1	138.4	109.1	150.7
0:40:00	77.3	78.2	157.0	115.9	163.7
0:42:30	77.8	79.2	173.3	122.9	176.7
0:45:00	78.7	80.4	182.7	130.4	189.1
0:47:30	80.0	82.1	191.8	138.3	200.3
0:50:00	81.1	83.7	196.2	146.7	210.1
0:52:30	82.4	85.6	199.5	154.6	217.9
0:55:00	83.9	87.5	200.8	162.1	224.7
0:57:30	85.5	89.9	202.2	169.2	231.1
1:00:00	87.5	92.3	203.7	175.9	238.0
1:02:30	89.4	94.3	204.5	181.9	245.1
1:05:00	91.6	97.0	205.0	187.9	252.3
1:07:30	93.6	99.4	206.5	193.7	260.3
1:10:00	95.9	102.2	210.4	198.9	268.3
1:12:30	98.3	104.8	215.3	204.3	276.4
1:15:00	100.8	107.7	220.3	209.8	284.5
1:17:30	103.2	110.4	226.2	215.2	292.4
1:20:00	105.6	113.1	232.8	220.6	300.3
1:22:30	108.3	116.2	239.9	226.4	308.3
1:25:00	111.1	119.2	247.1	231.9	315.9
1:27:30	113.7	121.9	254.1	237.6	323.0
1:30:00	116.5	125.0	261.4	243.3	330.5
1:32:30	119.4	128.1	268.0	248.8	337.5
1:35:00	122.2	131.1	274.4	254.2	344.5
1:37:30	125.0	134.2	280.5	259.5	351.2
1:40:00	128.0	137.3	287.0	264.7	357.7
1:42:30	131.0	140.5	292.9	269.8	364.1
1:45:00	133.7	143.6	298.8	274.9	370.3
1:47:30	136.7	146.7	304.8	279.8	376.4
1:50:00	139.7	149.9	310.6	284.7	382.3
1:52:30	142.8	153.1	316.4	289.6	388.1
1:55:00	146.0	156.4	322.1	294.3	393.8
1:57:30	149.1	159.4	327.5	299.0	399.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
2:00:00	152.2	162.8	333.0	303.6	404.9
2:02:30	155.3	166.0	338.0	308.2	410.4
2:05:00	158.6	169.0	342.9	312.5	415.5
2:07:30	161.6	172.3	347.9	316.9	420.6
2:10:00	164.7	175.4	352.4	321.2	425.4
2:12:30	167.8	178.7	356.9	325.4	430.4
2:15:00	170.9	182.0	361.5	329.5	435.2
2:17:30	174.0	185.2	366.0	333.7	439.7
2:20:00	177.3	188.2	370.0	337.8	444.4
2:22:30	180.6	191.5	374.2	341.8	449.0
2:25:00	183.6	194.6	378.3	346.0	453.3
2:27:30	187.4	197.8	382.8	350.1	457.8
2:30:00	190.4	201.0	386.6	353.7	461.8
2:32:30	193.7	204.0	390.8	357.3	465.7
2:35:00	197.4	207.3	394.9	361.3	469.9
2:37:30	200.8	210.5	398.8	364.8	473.6
2:40:00	204.0	213.6	402.8	368.5	477.6
2:42:30	207.5	216.7	406.3	371.5	481.0
2:45:00	211.0	219.8	410.2	374.7	484.6
2:47:30	214.3	223.2	413.7	378.1	488.1
2:50:00	218.0	226.5	417.5	380.7	491.6
2:52:30	221.7	229.8	420.7	383.5	494.8
2:55:00	224.6	233.3	424.0	386.3	498.3
2:57:30	228.0	236.5	427.4	389.3	501.5
3:00:00	232.5	240.5	430.5	392.8	504.4
3:02:30	236.0	243.6	433.1	395.7	507.2
3:05:00	239.3	246.8	435.6	398.9	510.2
3:07:30	242.3	250.5	438.3	401.7	513.2
3:10:00	245.1	253.1	441.2	404.7	516.0
3:12:30	246.7	255.1	445.1	406.9	518.6
3:15:00	249.4	257.5	448.4	408.8	521.3
3:17:30	252.2	260.0	451.2	411.2	523.7
3:20:00	254.8	262.5	453.8	412.7	526.2
3:22:30	257.8	265.3	456.4	414.8	528.8
3:25:00	260.7	268.3	458.6	417.3	531.1
3:27:30	263.5	271.3	460.8	419.2	533.5
3:30:00	267.0	274.4	463.0	421.5	535.7
3:32:30	270.7	277.6	465.7	423.2	537.8
3:35:00	273.6	280.8	468.9	424.4	540.0
3:37:30	277.2	284.1	471.7	426.0	542.1
3:40:00	280.7	287.5	474.2	427.1	544.2
3:42:30	283.8	290.8	476.5	428.2	546.0
3:45:00	287.6	294.6	478.5	429.5	548.0
3:47:30	290.9	298.2	479.9	430.4	549.7
3:50:00	295.0	301.7	481.0	431.7	551.6
3:52:30	298.6	305.3	482.6	433.1	553.1
3:55:00	303.1	309.5	484.2	434.6	555.1
3:57:30	307.8	313.5	485.6	435.8	556.9

R8196/95NK3179
Test Date : APRIL 4, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
4:00:00	311.2	317.9	487.3	437.3	558.3
4:02:30	307.8	322.2	489.0	439.1	559.8
4:05:00	302.0	326.6	491.0	441.8	561.6
4:07:30	305.0	330.0	493.0	444.5	563.3
4:10:00	308.7	333.6	495.2	446.9	564.7
4:12:30	313.0	337.6	497.4	449.6	566.3
4:15:00	317.2	341.4	500.0	452.6	567.9
4:17:30	322.0	345.6	502.0	455.7	569.4
4:20:00	327.2	349.6	504.4	458.4	571.0
4:22:30	332.6	354.0	506.3	461.9	572.4
4:25:00	337.3	358.0	508.7	464.0	573.8
4:27:30	342.2	361.7	510.7	466.3	575.1
4:30:00	347.3	365.7	513.0	468.4	576.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	73.9	72.7	73.9	73.7	73.4	73.7
0:02:30	74.0	72.9	74.0	73.8	73.5	74.0
0:05:00	73.9	73.6	73.9	73.6	73.6	73.9
0:07:30	73.7	73.0	73.8	73.7	73.6	73.7
0:10:00	73.9	73.6	73.9	73.8	73.6	73.9
0:12:30	73.8	72.6	73.8	73.5	73.5	74.4
0:15:00	73.9	73.2	73.9	73.6	73.5	75.1
0:17:30	73.7	73.1	73.9	73.6	73.4	76.5
0:20:00	73.9	73.2	74.1	73.8	73.5	78.9
0:22:30	73.9	74.0	73.9	73.9	73.5	81.9
0:25:00	73.9	74.1	74.1	74.4	73.5	85.7
0:27:30	73.9	74.5	74.2	74.5	73.7	90.5
0:30:00	73.9	74.8	74.8	75.2	73.9	95.9
0:32:30	74.2	75.1	75.2	75.8	74.2	102.4
0:35:00	74.4	75.6	76.0	76.4	74.6	109.5
0:37:30	74.5	76.1	76.9	78.2	75.3	118.0
0:40:00	75.2	76.8	78.2	79.8	76.1	129.3
0:42:30	75.3	76.8	79.3	81.0	76.7	143.6
0:45:00	75.6	77.1	80.9	82.7	77.5	157.1
0:47:30	76.2	77.0	82.6	85.2	78.6	165.6
0:50:00	76.8	77.5	84.4	86.8	79.8	172.7
0:52:30	77.6	78.0	86.6	88.8	81.4	177.4
0:55:00	78.6	78.1	88.9	90.5	82.9	181.6
0:57:30	79.2	78.4	91.1	92.4	84.4	185.0
1:00:00	80.4	77.7	93.6	94.5	86.3	187.9
1:02:30	81.4	77.6	95.8	96.7	87.8	190.3
1:05:00	82.5	77.7	98.3	99.0	89.7	194.3
1:07:30	84.0	78.5	101.0	101.3	92.0	198.7
1:10:00	85.2	78.4	103.6	103.2	93.9	206.0
1:12:30	86.7	79.2	106.2	106.2	95.7	212.9
1:15:00	88.5	101.6	109.1	108.8	98.2	219.9
1:17:30	90.2	104.1	111.9	111.5	100.4	227.2
1:20:00	92.0	106.8	114.7	113.7	102.9	234.6
1:22:30	93.7	109.4	117.4	116.7	105.0	241.0
1:25:00	95.8	112.1	120.3	119.1	107.5	245.7
1:27:30	97.6	114.9	123.1	121.4	109.9	251.6
1:30:00	99.9	117.7	126.2	124.0	112.7	258.8
1:32:30	102.4	120.7	129.5	127.0	115.4	264.3
1:35:00	104.7	123.7	132.5	130.0	118.1	270.6
1:37:30	107.0	126.8	135.7	133.0	120.8	276.3
1:40:00	109.4	129.8	138.7	135.0	123.4	282.6
1:42:30	111.9	132.9	141.7	138.3	126.4	288.1
1:45:00	114.6	136.0	144.8	139.7	129.1	293.2
1:47:30	117.1	139.0	148.0	144.1	131.9	299.4
1:50:00	119.9	142.1	151.3	146.3	134.7	304.1
1:52:30	122.6	145.2	154.2	149.7	137.6	309.4
1:55:00	125.4	148.5	157.6	151.9	140.8	314.4
1:57:30	128.5	151.8	160.8	154.8	144.0	319.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
2:00:00	131.1	154.8	163.7	157.5	146.7	324.3
2:02:30	134.0	158.2	166.8	160.6	149.9	329.0
2:05:00	137.1	161.3	169.9	163.1	152.7	333.8
2:07:30	140.0	164.5	173.0	166.1	155.6	338.5
2:10:00	143.1	167.8	176.2	169.4	158.7	343.3
2:12:30	146.3	171.2	179.3	170.5	161.5	347.4
2:15:00	149.5	174.5	182.6	173.8	164.6	351.1
2:17:30	152.7	177.8	185.6	175.8	167.5	356.8
2:20:00	155.9	181.2	188.4	178.4	170.6	360.7
2:22:30	159.3	184.3	191.7	181.2	173.6	364.0
2:25:00	163.0	187.9	195.1	183.5	177.0	368.6
2:27:30	166.4	191.1	198.2	187.1	180.1	372.4
2:30:00	169.7	194.3	201.2	189.6	183.1	376.2
2:32:30	173.4	197.8	204.2	192.0	186.7	380.6
2:35:00	177.1	201.1	207.3	194.9	190.0	384.7
2:37:30	180.6	204.2	210.4	198.0	192.9	387.3
2:40:00	184.3	207.8	213.6	199.8	196.6	392.1
2:42:30	188.2	211.1	216.8	203.3	200.1	396.6
2:45:00	191.9	214.4	219.9	205.7	203.3	399.2
2:47:30	195.8	217.9	222.7	208.2	206.8	403.4
2:50:00	199.6	221.5	225.6	211.5	210.1	407.4
2:52:30	203.3	225.0	228.6	215.2	213.5	410.6
2:55:00	207.2	228.8	231.5	218.3	217.1	414.1
2:57:30	211.1	232.4	234.2	220.9	220.6	416.7
3:00:00	214.8	235.7	237.0	219.1	223.9	420.9
3:02:30	219.0	239.5	239.9	223.6	227.6	422.5
3:05:00	222.9	243.0	242.6	227.0	231.0	426.7
3:07:30	226.9	246.3	245.7	230.7	234.7	429.4
3:10:00	230.4	250.4	249.2	233.6	238.5	433.5
3:12:30	235.2	250.3	251.5	235.6	242.4	436.3
3:15:00	238.0	250.7	254.9	238.9	251.4	440.4
3:17:30	237.9	252.4	258.6	242.9	256.2	443.6
3:20:00	238.3	254.5	261.7	244.6	260.9	448.0
3:22:30	239.5	257.0	264.9	249.0	264.3	449.4
3:25:00	241.8	259.3	268.4	251.8	267.7	452.0
3:27:30	244.7	262.2	271.5	254.1	270.7	455.7
3:30:00	247.6	264.9	274.9	255.6	274.6	458.6
3:32:30	250.8	268.1	278.0	258.4	278.0	460.8
3:35:00	254.3	271.1	281.0	262.0	281.4	462.0
3:37:30	257.9	274.2	284.3	264.7	287.4	462.4
3:40:00	261.1	277.7	287.5	269.5	290.8	468.7
3:42:30	264.4	281.0	290.5	271.6	294.2	470.7
3:45:00	267.8	284.6	293.6	274.5	297.2	474.8
3:47:30	271.1	287.9	296.5	275.5	300.6	477.8
3:50:00	274.7	291.8	300.1	281.8	304.0	480.3
3:52:30	278.3	295.5	303.1	285.3	307.1	483.7
3:55:00	281.7	298.8	306.1	285.2	310.2	486.0
3:57:30	285.5	302.5	309.3	291.6	312.9	486.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
hr:min:sec						
4:00:00	289.2	306.1	312.5	292.4	315.9	489.2
4:02:30	292.7	309.8	315.5	296.3	318.9	493.0
4:05:00	296.4	313.6	319.0	300.1	321.7	494.0
4:07:30	299.9	317.3	321.2	301.3	323.0	497.6
4:10:00	303.3	321.0	324.1	305.4	328.0	499.0
4:12:30	306.6	324.7	327.1	309.1	330.8	503.4
4:15:00	310.5	328.7	330.5	311.1	334.2	503.0
4:17:30	313.9	332.2	333.2	313.7	336.7	508.1
4:20:00	317.1	336.0	336.5	319.2	340.0	512.0
4:22:30	320.3	339.7	339.2	322.5	342.7	513.6
4:25:00	323.3	343.4	342.1	325.7	345.7	513.4
4:27:30	325.5	347.1	345.2	326.7	348.4	518.4
4:30:00	328.4	350.7	347.8	327.8	351.3	521.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	73.7	73.7	73.6	73.6	73.6	73.6
0:02:30	73.8	73.8	73.7	73.8	73.7	73.7
0:05:00	73.8	73.8	73.8	73.8	73.6	73.6
0:07:30	73.8	73.7	73.6	73.6	73.6	73.6
0:10:00	74.1	73.8	73.6	73.6	73.6	73.6
0:12:30	74.5	73.7	73.7	73.7	73.5	73.7
0:15:00	75.8	73.8	73.6	73.6	73.6	73.6
0:17:30	77.6	73.7	73.6	73.7	73.6	73.4
0:20:00	80.8	73.8	73.6	73.8	73.6	73.6
0:22:30	84.7	73.6	73.6	73.8	73.8	73.5
0:25:00	89.8	73.8	73.8	73.8	73.9	73.6
0:27:30	95.8	73.7	73.9	73.9	74.1	73.8
0:30:00	102.7	73.9	74.2	74.3	74.6	74.2
0:32:30	111.0	74.1	74.8	74.8	75.2	74.8
0:35:00	120.1	74.3	75.3	75.1	75.9	75.3
0:37:30	130.8	74.7	76.0	76.0	77.0	76.3
0:40:00	142.1	75.2	77.1	77.2	78.2	77.5
0:42:30	153.1	75.5	78.1	78.1	79.6	78.5
0:45:00	164.3	76.1	79.5	79.5	81.3	80.1
0:47:30	174.3	76.7	81.1	81.2	83.3	81.8
0:50:00	183.3	77.7	82.8	82.9	85.4	83.8
0:52:30	190.3	78.6	84.9	84.9	87.6	86.0
0:55:00	196.6	79.6	87.0	87.0	90.0	88.2
0:57:30	202.6	80.5	88.9	89.1	92.4	90.4
1:00:00	207.8	82.0	91.4	91.6	94.8	93.0
1:02:30	212.7	83.0	93.3	93.6	97.1	95.0
1:05:00	218.2	84.5	95.6	95.8	99.6	97.3
1:07:30	222.5	86.2	98.2	98.5	102.3	99.9
1:10:00	227.7	87.8	100.8	101.1	104.8	102.6
1:12:30	233.6	89.6	103.3	103.5	107.4	105.0
1:15:00	238.8	91.7	106.2	106.5	110.3	108.1
1:17:30	244.1	93.5	109.1	109.2	113.0	111.0
1:20:00	250.5	95.5	111.9	112.0	116.0	113.9
1:22:30	257.1	97.5	114.7	114.9	118.7	116.7
1:25:00	262.5	99.9	117.8	117.6	121.5	119.6
1:27:30	267.5	102.2	120.7	120.7	124.3	122.5
1:30:00	274.4	104.7	123.8	123.8	127.3	125.5
1:32:30	280.0	107.3	127.1	127.1	130.6	128.8
1:35:00	286.5	109.9	130.4	130.2	133.6	131.9
1:37:30	291.2	112.6	133.4	133.4	136.6	134.8
1:40:00	298.1	115.2	136.7	136.8	139.8	138.0
1:42:30	303.6	118.1	140.0	140.1	143.1	141.4
1:45:00	307.6	120.9	143.4	143.5	146.3	144.6
1:47:30	314.5	123.9	146.8	146.9	149.6	147.9
1:50:00	319.5	126.8	150.1	150.3	153.1	151.3
1:52:30	325.4	129.8	153.4	153.7	156.5	154.7
1:55:00	330.3	133.1	157.1	157.4	160.0	158.0
1:57:30	335.4	136.4	160.5	160.8	163.5	161.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
2:00:00	339.9	139.4	164.1	164.4	166.8	164.7
2:02:30	345.0	142.8	167.7	167.9	170.2	168.1
2:05:00	350.2	146.5	171.2	171.6	173.4	171.4
2:07:30	354.3	150.1	174.4	175.3	176.7	174.8
2:10:00	359.0	153.9	178.0	179.0	180.3	178.3
2:12:30	362.8	157.7	181.6	182.8	183.8	181.8
2:15:00	366.6	161.4	185.0	186.5	187.4	185.3
2:17:30	373.2	165.3	188.3	190.3	190.5	188.6
2:20:00	378.6	169.5	191.9	194.2	194.0	192.1
2:22:30	380.8	173.5	195.5	198.0	197.9	195.5
2:25:00	386.2	178.0	199.1	201.9	201.2	199.1
2:27:30	390.9	182.4	202.6	206.1	205.0	202.4
2:30:00	393.4	186.1	206.0	209.8	208.5	205.7
2:32:30	397.6	190.1	209.5	213.8	212.5	209.0
2:35:00	403.1	194.2	213.1	217.7	216.4	212.3
2:37:30	403.5	197.9	216.3	221.4	220.1	215.4
2:40:00	410.0	201.2	219.9	225.1	223.6	218.7
2:42:30	413.5	205.2	223.6	229.0	227.4	221.9
2:45:00	417.1	208.9	227.0	232.8	231.3	225.2
2:47:30	421.3	212.9	230.8	236.6	234.8	228.7
2:50:00	425.2	217.1	234.6	240.5	238.5	232.1
2:52:30	428.6	221.1	238.5	244.3	242.0	235.5
2:55:00	431.7	225.2	242.5	248.5	245.8	239.1
2:57:30	433.3	229.3	246.7	253.1	248.7	242.6
3:00:00	434.8	233.6	250.6	256.5	252.6	245.9
3:02:30	436.7	238.4	254.8	260.1	256.7	249.7
3:05:00	442.1	243.3	259.0	263.3	260.2	253.4
3:07:30	446.2	248.0	263.3	267.3	264.6	256.6
3:10:00	449.5	252.8	267.6	270.7	268.3	259.2
3:12:30	453.6	257.7	272.0	274.6	272.0	262.0
3:15:00	454.8	262.0	276.0	278.3	275.6	264.0
3:17:30	457.4	266.5	280.0	282.1	279.2	266.8
3:20:00	461.6	271.0	283.7	286.2	282.7	269.8
3:22:30	462.0	275.3	287.6	290.5	286.8	272.8
3:25:00	464.7	279.7	291.0	294.6	289.7	275.6
3:27:30	468.2	284.3	294.5	298.9	293.4	279.3
3:30:00	471.5	288.5	297.5	303.0	296.9	282.4
3:32:30	473.1	293.1	300.6	307.5	300.6	286.2
3:35:00	474.5	297.4	303.8	311.8	304.1	289.7
3:37:30	477.7	301.5	306.9	316.0	307.5	293.1
3:40:00	479.5	305.5	310.3	320.2	310.7	296.5
3:42:30	482.1	309.3	313.7	324.4	314.1	299.7
3:45:00	484.1	312.8	317.0	328.5	317.6	303.4
3:47:30	489.5	316.2	320.2	332.3	320.7	306.7
3:50:00	488.6	319.6	323.8	336.5	323.8	310.4
3:52:30	491.1	322.7	326.9	340.6	327.1	313.7
3:55:00	495.6	325.5	330.1	344.1	329.5	317.0
3:57:30	490.8	328.2	333.2	347.9	332.4	320.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TC. NO. 7	TC. NO. 8	TEMPERATURES, °F			
			TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
4:00:00	493.5	331.3	336.1	351.6	335.2	323.7
4:02:30	496.4	334.1	339.2	355.4	338.2	327.1
4:05:00	496.4	336.9	342.2	359.6	341.2	330.8
4:07:30	500.1	339.6	344.9	362.0	345.5	334.2
4:10:00	495.0	342.4	347.9	365.1	349.4	337.9
4:12:30	488.7	345.0	350.8	368.2	353.5	341.5
4:15:00	475.5	348.0	354.1	371.6	358.3	345.4
4:17:30	504.5	350.7	356.8	374.7	361.1	348.8
4:20:00	496.6	353.5	359.3	377.8	364.1	352.0
4:22:30	499.9	356.3	361.6	380.7	367.6	355.4
4:25:00	501.7	359.3	364.5	383.7	370.5	359.1
4:27:30	502.3	361.8	367.0	386.6	372.4	362.5
4:30:00	509.1	364.6	369.1	388.9	375.7	365.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	73.7	73.6	73.6	73.6	73.6	73.4
0:02:30	73.8	73.7	73.8	73.8	73.8	73.5
0:05:00	73.9	73.6	73.8	73.8	73.8	73.6
0:07:30	73.8	73.7	73.6	73.6	73.7	73.6
0:10:00	74.4	74.1	73.8	73.8	73.8	73.6
0:12:30	75.3	74.5	73.7	73.7	73.7	73.5
0:15:00	77.1	76.0	73.6	73.6	73.8	73.6
0:17:30	80.1	78.1	73.6	73.6	73.7	73.6
0:20:00	84.3	81.5	73.8	73.6	73.8	73.6
0:22:30	89.5	86.1	73.6	73.6	73.8	73.6
0:25:00	96.2	92.3	73.5	73.8	73.8	73.8
0:27:30	104.4	99.2	73.7	73.8	73.9	73.8
0:30:00	114.7	107.8	73.8	73.9	74.2	74.2
0:32:30	126.4	117.5	74.1	74.4	74.5	74.5
0:35:00	138.5	129.3	74.0	74.6	75.0	75.0
0:37:30	150.3	144.4	74.3	75.1	75.6	75.7
0:40:00	161.4	160.6	74.6	75.8	76.3	76.5
0:42:30	171.7	175.1	74.8	76.2	76.9	77.1
0:45:00	181.6	187.1	75.0	76.8	77.9	78.1
0:47:30	189.3	194.8	75.4	77.9	78.9	79.5
0:50:00	195.3	198.8	75.9	79.0	80.4	80.9
0:52:30	202.3	200.2	76.6	80.4	82.0	82.5
0:55:00	208.2	201.9	77.2	81.8	83.5	84.2
0:57:30	213.4	204.8	77.9	83.2	85.3	86.1
1:00:00	220.3	207.8	78.9	85.0	87.3	88.2
1:02:30	226.8	213.0	79.6	86.8	89.4	90.3
1:05:00	233.5	219.5	80.7	88.7	91.3	92.5
1:07:30	241.1	225.8	81.9	91.0	93.6	94.8
1:10:00	248.7	232.7	83.0	93.1	95.9	97.1
1:12:30	254.5	240.5	84.2	94.9	97.8	99.3
1:15:00	263.6	248.5	85.8	97.0	100.3	102.0
1:17:30	272.1	256.0	87.4	99.4	102.7	104.5
1:20:00	279.7	264.1	88.9	101.7	105.3	107.2
1:22:30	287.4	271.3	90.7	104.1	107.7	109.7
1:25:00	292.8	278.2	92.5	106.5	110.3	112.4
1:27:30	302.0	283.2	94.0	108.9	112.6	114.9
1:30:00	309.3	290.5	96.1	111.5	115.3	117.5
1:32:30	316.3	297.0	98.1	114.2	118.1	120.5
1:35:00	323.8	304.6	100.2	116.7	120.9	123.2
1:37:30	330.5	311.0	102.3	119.4	123.8	126.1
1:40:00	336.7	317.9	104.5	122.1	126.5	128.9
1:42:30	343.7	323.8	106.8	125.0	129.5	131.9
1:45:00	350.5	329.9	109.1	127.7	132.5	134.7
1:47:30	356.4	336.2	111.3	130.5	135.3	137.9
1:50:00	362.6	341.8	113.7	133.2	138.3	140.8
1:52:30	368.7	347.6	116.0	136.2	141.2	143.8
1:55:00	375.1	353.4	118.7	139.2	144.3	146.8
1:57:30	380.8	358.8	121.3	142.2	147.3	150.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
2:00:00	386.3	363.9	123.7	145.0	150.1	152.8
2:02:30	392.0	369.0	126.3	148.0	153.3	155.9
2:05:00	397.8	374.5	128.9	151.0	156.3	158.9
2:07:30	402.6	380.1	131.8	153.8	159.3	162.1
2:10:00	408.5	384.9	134.5	156.8	162.5	165.3
2:12:30	412.6	389.2	137.5	160.0	165.7	168.4
2:15:00	418.1	394.9	140.1	163.1	168.7	171.7
2:17:30	420.7	399.4	143.1	166.0	171.8	174.7
2:20:00	425.1	404.3	146.6	168.8	174.8	177.7
2:22:30	432.2	409.3	149.7	171.9	178.0	180.7
2:25:00	435.8	414.3	153.0	174.9	181.2	184.0
2:27:30	441.7	419.1	156.0	177.7	184.5	187.2
2:30:00	446.5	423.0	158.8	180.6	187.5	190.2
2:32:30	450.4	427.7	162.0	183.7	190.8	193.4
2:35:00	455.3	432.4	165.1	186.7	194.1	196.6
2:37:30	459.5	435.9	168.1	189.7	197.0	199.7
2:40:00	464.1	441.2	171.0	192.8	200.1	202.6
2:42:30	469.6	445.9	174.3	195.9	203.2	205.9
2:45:00	473.0	450.3	177.4	199.0	206.2	209.0
2:47:30	474.5	452.6	180.8	202.1	209.4	212.1
2:50:00	480.7	458.0	184.5	205.4	212.5	215.2
2:52:30	484.1	462.3	188.5	208.7	215.8	218.5
2:55:00	488.2	465.0	192.8	212.4	219.0	222.0
2:57:30	494.1	468.9	197.1	216.1	222.0	225.5
3:00:00	493.6	473.2	201.3	219.9	225.2	228.9
3:02:30	496.4	466.5	205.6	224.3	228.9	232.6
3:05:00	503.3	474.5	210.1	228.8	231.9	236.1
3:07:30	507.1	488.6	214.5	233.4	235.2	239.5
3:10:00	510.5	486.9	218.9	238.0	238.7	242.9
3:12:30	514.2	490.5	223.5	242.8	242.4	246.5
3:15:00	514.6	494.8	227.7	247.3	245.7	249.9
3:17:30	517.3	494.7	232.2	251.8	249.2	253.4
3:20:00	527.0	495.5	236.6	256.2	253.0	256.8
3:22:30	534.0	505.0	241.2	260.8	256.7	260.4
3:25:00	533.2	496.5	245.7	265.1	260.4	263.8
3:27:30	537.0	509.2	250.4	269.7	264.3	267.6
3:30:00	535.5	496.3	254.9	273.9	268.0	271.2
3:32:30	543.4	508.6	259.1	278.0	271.9	274.6
3:35:00	547.6	506.3	263.4	282.1	275.7	278.0
3:37:30	549.1	496.8	267.7	286.2	279.6	281.7
3:40:00	551.2	500.6	271.9	289.9	283.7	285.3
3:42:30	556.6	509.9	276.0	294.0	287.8	288.8
3:45:00	557.8	506.5	280.3	298.0	291.9	292.0
3:47:30	566.1	504.9	284.7	301.6	295.9	295.4
3:50:00	558.7	515.3	289.0	305.5	300.2	298.8
3:52:30	567.5	506.6	293.3	307.6	304.5	302.2
3:55:00	571.9	503.6	296.9	310.6	308.4	305.2
3:57:30	569.6	507.0	300.7	313.8	312.4	308.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
4:00:00	572.6	503.5	304.4	317.2	316.3	312.2
4:02:30	576.9	514.3	307.9	320.2	320.0	315.7
4:05:00	578.4	505.4	312.0	323.9	321.0	318.5
4:07:30	579.2	518.3	315.3	326.6	319.5	320.5
4:10:00	584.3	524.1	317.9	329.9	318.8	322.7
4:12:30	585.4	524.9	320.4	333.0	320.2	325.1
4:15:00	582.2	528.7	323.3	336.4	322.8	327.8
4:17:30	589.4	529.2	325.4	339.0	325.2	330.2
4:20:00	585.0	535.5	327.9	341.9	328.3	333.0
4:22:30	588.1	533.9	330.2	344.2	331.4	335.8
4:25:00	593.1	524.6	332.2	346.5	333.5	338.3
4:27:30	589.6	537.2	334.0	348.8	338.0	341.2
4:30:00	584.0	538.9	335.6	351.8	342.7	344.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	73.4	74.2	74.0	74.0	73.9	73.7
0:02:30	73.4	74.3	74.1	74.1	74.0	74.0
0:05:00	73.5	74.4	74.1	74.1	73.9	73.9
0:07:30	73.3	74.3	74.3	74.2	74.0	74.0
0:10:00	73.5	74.5	74.4	74.1	73.9	73.9
0:12:30	73.4	75.3	74.8	74.1	74.1	74.0
0:15:00	73.5	76.1	75.4	74.1	73.9	73.8
0:17:30	73.3	77.8	76.9	74.0	73.9	74.0
0:20:00	73.4	80.5	78.9	74.1	74.1	73.9
0:22:30	73.5	83.9	81.9	74.0	74.0	74.3
0:25:00	73.6	88.2	85.6	74.1	74.1	74.5
0:27:30	73.7	93.7	90.4	74.4	74.5	75.1
0:30:00	74.0	99.8	95.8	74.3	74.8	75.3
0:32:30	74.4	106.8	102.1	74.2	75.1	75.6
0:35:00	74.7	115.1	109.2	74.6	75.8	77.1
0:37:30	75.3	123.9	116.6	74.8	76.4	78.0
0:40:00	76.1	133.3	124.8	75.2	77.5	79.7
0:42:30	76.8	143.2	133.8	75.8	78.6	80.8
0:45:00	77.7	152.8	142.8	76.1	79.9	81.9
0:47:30	78.8	162.5	152.9	76.8	81.4	83.6
0:50:00	80.1	172.3	163.8	77.4	82.9	85.2
0:52:30	81.5	182.4	173.1	78.2	84.9	87.8
0:55:00	83.2	190.5	180.8	79.0	86.5	88.6
0:57:30	85.0	196.4	187.2	80.1	88.7	90.3
1:00:00	87.0	201.7	192.4	81.1	90.9	92.0
1:02:30	88.9	207.6	198.0	82.3	93.1	93.5
1:05:00	91.1	213.4	202.8	83.5	94.8	95.4
1:07:30	93.3	218.6	207.5	84.7	97.1	97.9
1:10:00	95.3	224.6	213.5	86.3	99.4	99.8
1:12:30	97.4	230.2	218.7	87.9	102.0	102.3
1:15:00	100.0	237.0	224.5	89.5	104.4	104.0
1:17:30	102.3	243.2	230.9	91.3	107.0	107.0
1:20:00	104.8	249.7	236.3	93.0	109.5	108.6
1:22:30	107.4	256.3	243.7	94.9	112.2	111.0
1:25:00	109.7	262.3	250.1	96.9	114.7	113.4
1:27:30	112.2	268.0	254.1	98.8	117.5	116.0
1:30:00	114.6	274.2	260.2	101.1	120.6	119.9
1:32:30	117.4	279.7	264.9	103.3	123.5	122.5
1:35:00	120.1	286.9	272.1	105.9	126.5	124.0
1:37:30	122.8	293.0	278.9	108.3	129.3	127.2
1:40:00	125.5	298.6	283.8	110.6	132.1	129.1
1:42:30	128.2	304.9	290.0	113.0	134.9	131.0
1:45:00	131.1	311.0	296.2	115.6	138.1	134.3
1:47:30	133.9	316.7	302.0	118.1	140.7	136.2
1:50:00	136.7	322.8	306.6	120.5	143.5	138.9
1:52:30	139.5	328.1	312.5	123.5	146.6	141.5
1:55:00	142.7	333.2	317.0	126.7	149.6	143.9
1:57:30	145.6	338.5	321.3	129.4	152.8	147.0

R8196/95NK3179

Test Date : APRIL 5, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
2:00:00	148.4	344.0	326.3	132.5	156.1	149.7
2:02:30	151.4	349.3	331.6	135.4	159.1	152.1
2:05:00	154.2	354.2	336.2	138.5	162.3	155.1
2:07:30	157.2	359.5	341.3	141.2	165.3	158.3
2:10:00	160.3	364.5	346.4	144.3	168.3	161.2
2:12:30	163.1	368.7	348.8	147.0	171.2	164.1
2:15:00	166.1	373.0	353.3	149.9	174.0	166.3
2:17:30	168.9	377.7	358.2	152.9	176.9	168.4
2:20:00	171.7	381.6	362.3	155.9	179.9	171.4
2:22:30	175.0	386.1	366.6	158.8	182.7	174.6
2:25:00	178.1	389.1	369.7	161.9	185.6	176.5
2:27:30	181.1	394.6	375.2	165.2	188.7	179.6
2:30:00	184.1	399.1	378.6	168.2	191.5	182.6
2:32:30	187.5	403.1	381.4	171.3	194.4	184.9
2:35:00	190.7	407.4	385.5	174.6	197.2	187.6
2:37:30	193.8	411.4	390.6	177.8	200.0	190.3
2:40:00	197.0	416.0	393.0	181.1	202.7	193.4
2:42:30	200.4	420.2	398.3	184.6	205.8	196.2
2:45:00	203.2	424.3	401.7	187.8	209.3	198.8
2:47:30	206.4	428.3	405.2	190.8	214.5	202.9
2:50:00	209.8	432.6	408.3	194.2	216.3	206.0
2:52:30	213.1	436.4	412.3	199.2	219.8	209.1
2:55:00	216.6	440.8	414.9	201.9	223.1	212.5
2:57:30	220.2	443.2	416.3	204.7	226.1	215.3
3:00:00	223.6	448.3	421.5	206.9	228.6	216.4
3:02:30	226.3	452.1	425.4	209.1	231.5	215.2
3:05:00	229.8	455.2	428.6	211.2	234.3	218.1
3:07:30	233.2	459.4	432.1	213.5	236.9	221.7
3:10:00	237.0	463.7	437.6	215.8	239.6	223.7
3:12:30	240.4	467.3	439.8	218.5	242.7	226.7
3:15:00	243.6	470.9	446.6	221.4	245.3	227.2
3:17:30	247.1	474.2	448.6	224.4	248.8	230.5
3:20:00	250.7	477.7	452.1	227.6	251.2	234.2
3:22:30	254.5	481.5	457.2	231.9	254.6	235.3
3:25:00	258.0	485.9	450.4	236.6	257.9	239.1
3:27:30	261.6	489.8	457.7	242.0	261.7	242.6
3:30:00	265.4	493.8	463.7	247.5	265.7	243.1
3:32:30	268.8	497.8	461.3	253.7	269.4	246.7
3:35:00	272.3	501.7	466.3	260.1	273.0	252.3
3:37:30	276.4	506.0	468.2	266.6	276.9	256.5
3:40:00	280.0	508.4	461.2	273.4	281.1	259.5
3:42:30	283.5	513.8	474.0	280.2	285.4	263.0
3:45:00	287.5	517.3	472.1	287.2	289.6	266.6
3:47:30	291.0	520.8	467.5	293.7	293.6	270.8
3:50:00	294.9	524.8	472.7	300.3	297.7	276.4
3:52:30	298.3	528.4	472.2	307.1	301.8	279.3
3:55:00	301.6	531.2	477.5	313.7	306.6	282.2
3:57:30	304.9	533.5	481.3	320.3	308.2	282.6

R8196/95NK3179

Test Date : APRIL 5, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
4:00:00	308.0	537.9	486.3	326.1	312.0	291.0
4:02:30	311.0	540.3	481.6	332.0	304.2	292.9
4:05:00	314.6	544.3	489.4	337.7	249.2	233.7
4:07:30	317.7	548.6	482.6	330.8	496.3	384.7
4:10:00	321.1	551.6	490.6	350.9	610.2	489.5
4:12:30	324.1	554.4	490.4	377.9	689.0	570.5
4:15:00	324.0	557.8	496.1	408.8	662.4	636.1
4:17:30	325.8	558.2	491.4	427.0	862.5	700.9
4:20:00	327.5	563.6	503.2	469.2	914.0	731.1
4:22:30	329.1	565.9	497.2	510.0	964.4	765.7
4:25:00	330.8	567.0	496.9	548.4	1026.5	874.0
4:27:30	333.8	570.1	497.7	596.8	1213.9	1119.8
4:30:00	337.3	570.4	497.8	643.0	1249.8	1291.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	73.9	73.9	74.0	73.9	74.2
0:02:30	74.0	74.1	74.3	74.0	74.3
0:05:00	73.9	73.9	74.2	74.1	74.2
0:07:30	74.0	74.0	74.3	74.2	74.4
0:10:00	73.9	73.9	74.5	74.2	74.7
0:12:30	74.1	74.0	75.1	74.8	75.9
0:15:00	73.9	73.8	76.3	75.7	77.7
0:17:30	74.2	73.9	78.1	77.4	81.0
0:20:00	74.1	73.9	81.1	79.6	85.6
0:22:30	74.2	74.0	85.1	82.7	91.9
0:25:00	74.1	74.1	90.1	87.1	99.5
0:27:30	74.4	74.5	96.4	92.3	108.8
0:30:00	74.5	74.8	103.9	98.0	119.2
0:32:30	74.9	75.2	112.7	104.8	130.9
0:35:00	75.4	76.1	122.6	112.6	143.9
0:37:30	76.0	76.9	133.1	120.7	157.5
0:40:00	76.8	77.9	143.4	129.3	171.5
0:42:30	77.9	79.2	154.4	138.3	185.4
0:45:00	78.9	80.5	165.5	147.5	197.6
0:47:30	80.2	82.3	176.9	157.1	207.2
0:50:00	81.9	83.9	187.1	166.5	215.2
0:52:30	83.7	86.1	191.6	175.1	223.3
0:55:00	85.4	88.0	194.3	182.0	231.3
0:57:30	87.5	90.3	198.3	188.2	239.1
1:00:00	89.6	92.6	202.3	193.7	246.7
1:02:30	91.9	94.8	207.1	199.0	254.5
1:05:00	94.1	97.1	212.3	203.8	262.2
1:07:30	96.5	99.5	217.2	208.8	270.2
1:10:00	98.9	102.0	223.0	214.5	278.1
1:12:30	101.6	104.7	229.5	220.4	286.1
1:15:00	104.0	107.3	236.7	226.4	294.3
1:17:30	106.7	109.8	242.9	232.3	302.1
1:20:00	109.4	112.7	250.2	238.5	310.0
1:22:30	112.2	115.5	257.2	244.8	317.7
1:25:00	114.7	118.1	263.3	251.3	325.4
1:27:30	117.5	120.7	268.9	257.3	332.7
1:30:00	120.6	123.7	275.6	263.6	340.1
1:32:30	123.5	126.8	282.7	270.1	347.2
1:35:00	126.8	130.0	289.6	276.3	354.4
1:37:30	129.6	132.7	295.2	282.2	361.0
1:40:00	132.4	135.7	301.5	287.7	367.4
1:42:30	135.3	138.7	308.1	293.7	373.8
1:45:00	138.5	141.9	313.4	299.4	380.4
1:47:30	141.3	144.8	319.7	305.0	386.5
1:50:00	144.2	147.6	324.1	310.6	392.3
1:52:30	147.3	150.7	330.1	316.0	398.3
1:55:00	151.6	153.4	335.7	321.2	403.9
1:57:30	154.5	156.2	339.8	326.0	409.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
2:00:00	157.7	159.4	344.6	331.2	415.2
2:02:30	160.7	162.1	350.3	336.5	420.3
2:05:00	163.9	165.3	355.6	341.4	425.5
2:07:30	166.9	168.2	360.2	346.1	430.3
2:10:00	170.0	171.5	365.0	350.9	435.4
2:12:30	173.0	174.3	369.7	355.9	440.1
2:15:00	176.0	177.0	373.4	360.5	444.7
2:17:30	179.2	179.9	377.7	365.0	449.2
2:20:00	182.4	183.0	382.2	368.5	453.8
2:22:30	185.4	186.1	387.0	373.9	458.4
2:25:00	188.5	188.9	390.0	377.7	462.4
2:27:30	191.8	192.2	395.9	382.4	466.6
2:30:00	194.8	195.3	398.7	385.6	470.6
2:32:30	197.6	198.3	403.1	389.7	474.6
2:35:00	200.5	201.3	408.4	393.7	478.7
2:37:30	203.4	204.1	409.8	397.8	482.5
2:40:00	205.9	207.5	415.4	400.6	486.0
2:42:30	208.9	210.7	419.8	404.7	489.9
2:45:00	212.0	213.5	424.1	408.7	493.4
2:47:30	214.8	216.6	426.3	411.9	496.8
2:50:00	217.8	220.2	429.9	415.2	500.5
2:52:30	220.8	222.5	433.1	419.0	503.6
2:55:00	224.4	226.0	436.6	421.6	506.8
2:57:30	227.7	229.1	436.4	423.6	510.0
3:00:00	230.5	231.3	435.6	428.1	513.1
3:02:30	233.3	233.5	434.7	432.9	516.3
3:05:00	236.2	236.2	430.6	437.3	519.1
3:07:30	238.9	239.2	434.8	438.8	522.1
3:10:00	241.3	241.9	443.1	443.7	524.9
3:12:30	244.0	243.6	429.3	449.7	527.6
3:15:00	247.0	245.1	432.0	450.9	530.5
3:17:30	249.6	247.6	439.1	442.5	533.1
3:20:00	252.7	251.3	451.2	460.0	535.7
3:22:30	255.9	253.8	434.3	456.7	538.1
3:25:00	259.3	257.0	456.0	463.1	540.5
3:27:30	262.8	259.9	447.9	469.6	542.8
3:30:00	266.8	263.1	534.3	476.0	545.1
3:32:30	271.1	266.4	543.4	475.6	547.2
3:35:00	275.1	269.6	547.3	482.6	549.6
3:37:30	279.5	273.7	551.7	488.1	551.7
3:40:00	284.2	277.7	548.4	485.3	554.0
3:42:30	289.0	282.1	554.1	494.8	556.0
3:45:00	294.1	286.1	547.8	501.3	557.9
3:47:30	298.9	290.2	547.9	496.6	559.5
3:50:00	303.7	294.8	473.9	498.3	561.3
3:52:30	308.9	298.6	472.7	504.9	563.4
3:55:00	313.7	303.1	465.1	508.8	565.2
3:57:30	318.7	306.3	465.7	510.8	566.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
4:00:00	324.2	311.4	491.4	519.3	568.3
4:02:30	330.1	315.7	438.3	517.0	570.2
4:05:00	336.0	318.8	418.3	520.1	571.8
4:07:30	339.9	444.2	703.9	530.8	573.9
4:10:00	352.6	553.2	844.2	541.8	577.0
4:12:30	369.3	624.8	941.2	553.7	580.6
4:15:00	388.7	658.9	1023.4	563.8	584.9
4:17:30	423.3	893.2	1186.7	583.9	590.5
4:20:00	451.0	936.6	1258.7	599.6	594.7
4:22:30	479.1	977.4	1323.2	614.1	597.6
4:25:00	510.0	1024.2	1378.1	627.8	601.4
4:27:30	543.5	1087.0	1391.7	642.8	605.3
4:30:00	582.4	1121.6	1412.0	664.1	608.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:01	77.8	77.7	77.8	77.8	77.5	77.5
0:02:31	77.8	77.7	77.7	77.8	77.5	77.5
0:05:01	77.6	77.4	77.6	77.6	77.3	77.3
0:07:31	77.8	77.7	77.8	77.8	77.5	77.5
0:10:01	77.7	77.5	77.7	77.7	77.4	77.5
0:12:31	77.4	77.4	77.4	77.4	77.3	77.7
0:15:01	77.8	77.6	77.6	77.8	77.6	78.7
0:17:31	77.6	77.6	77.8	77.6	77.6	80.1
0:20:01	77.7	77.8	77.7	77.7	77.6	82.4
0:22:31	77.8	78.0	77.9	77.8	77.8	85.6
0:25:01	77.6	77.9	77.8	77.8	77.8	89.4
0:27:31	77.8	78.1	77.9	77.8	77.9	94.2
0:30:01	77.9	78.5	78.1	78.1	78.2	100.1
0:32:31	78.0	79.0	78.4	78.3	78.4	106.4
0:35:01	78.2	79.7	79.0	78.7	79.0	113.4
0:37:31	78.5	80.4	79.5	79.1	79.5	121.7
0:40:01	78.6	81.1	80.0	79.4	79.8	129.6
0:42:31	79.0	82.5	81.1	80.3	80.9	138.3
0:45:01	79.4	83.7	82.0	81.0	81.7	147.7
0:47:31	79.9	85.4	83.2	81.9	82.8	157.9
0:50:01	80.4	87.2	84.6	83.0	84.0	166.2
0:52:31	81.1	89.1	86.2	84.4	85.3	173.6
0:55:01	81.7	91.1	87.9	85.8	87.0	179.9
0:57:31	82.6	93.3	89.8	87.3	88.5	185.3
1:00:01	83.4	95.3	91.6	89.0	90.3	191.1
1:02:31	84.4	97.6	93.4	90.8	92.1	196.5
1:05:01	85.5	100.2	95.7	92.8	94.0	202.0
1:07:31	86.7	102.6	98.0	94.4	96.0	207.1
1:10:01	88.0	105.2	100.1	96.6	98.2	213.1
1:12:31	89.3	107.6	102.5	98.6	100.3	218.8
1:15:01	90.8	110.2	104.9	100.7	102.2	225.9
1:17:31	92.4	113.2	107.4	103.1	104.8	232.3
1:20:01	94.0	115.8	110.1	105.4	107.1	239.1
1:22:31	95.7	118.8	112.5	107.7	109.7	245.0
1:25:01	97.6	121.7	115.2	110.2	112.3	251.3
1:27:31	99.3	124.6	117.8	112.6	114.7	256.7
1:30:01	101.4	127.5	120.7	115.1	117.3	262.6
1:32:31	103.5	130.6	123.4	117.6	119.8	267.3
1:35:01	105.6	133.6	126.3	120.2	122.3	275.0
1:37:31	107.8	136.6	129.1	122.9	125.0	280.4
1:40:01	110.2	139.9	132.1	125.6	127.7	286.3
1:42:31	112.4	142.8	134.9	128.3	130.4	291.5
1:45:01	114.8	145.8	138.0	131.1	133.2	295.0
1:47:31	117.0	148.5	140.6	133.5	135.5	297.8
1:50:01	119.4	151.4	143.4	136.1	137.9	303.3
1:52:31	122.1	154.7	146.5	139.2	140.9	311.9
1:55:01	124.6	157.7	149.5	141.8	143.7	314.1
1:57:31	127.0	160.4	152.2	144.4	146.1	317.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
2:00:01	129.5	163.4	155.2	147.3	148.7	321.9
2:02:31	132.2	166.3	158.1	150.0	151.6	326.6
2:05:01	134.8	169.1	160.9	152.7	154.2	328.7
2:07:31	137.5	172.1	163.7	155.4	156.8	336.5
2:10:01	140.2	174.9	166.6	158.2	159.5	341.6
2:12:31	142.6	177.8	169.4	161.0	162.0	346.0
2:15:01	145.6	181.2	172.6	164.0	164.8	351.7
2:17:31	148.5	184.3	175.4	166.8	167.4	354.2
2:20:01	151.3	187.2	178.3	169.7	169.7	358.3
2:22:31	154.0	190.0	181.1	172.3	172.2	360.9
2:25:01	156.9	192.9	184.2	175.4	174.8	366.8
2:27:31	159.7	195.4	186.7	178.1	176.9	369.4
2:30:01	162.5	198.4	189.5	180.8	179.8	372.6
2:32:31	165.6	201.2	192.3	183.7	182.4	376.0
2:35:01	168.4	203.8	195.1	186.2	184.4	380.0
2:37:31	171.2	206.2	197.8	188.9	187.5	383.5
2:40:01	174.5	209.1	200.8	191.9	190.0	385.7
2:42:31	177.3	211.8	203.6	194.6	192.7	386.6
2:45:01	180.1	214.2	206.1	197.1	195.5	391.5
2:47:31	183.3	217.1	209.0	200.1	198.4	395.0
2:50:01	186.1	219.7	211.6	202.6	201.0	399.9
2:52:31	189.1	222.5	214.5	205.6	203.5	401.0
2:55:01	192.3	225.4	217.7	208.2	206.3	406.8
2:57:31	195.3	228.5	220.2	211.2	209.0	409.0
3:00:01	198.5	231.2	223.1	214.2	212.0	409.9
3:02:31	201.3	234.1	225.7	215.7	214.5	416.9
3:05:01	204.6	238.5	228.6	220.1	216.8	416.7
3:07:31	207.8	241.0	231.3	224.0	218.7	414.9
3:10:01	210.5	241.9	232.8	225.4	221.6	417.7
3:12:31	213.5	244.0	234.6	227.1	224.2	420.8
3:15:01	217.0	245.7	238.9	228.1	225.8	424.5
3:17:31	218.9	247.0	242.9	230.1	229.5	423.8
3:20:01	219.3	249.4	245.4	232.5	232.1	425.2
3:22:31	219.0	251.2	247.5	234.5	234.7	431.5
3:25:01	219.4	253.6	249.9	236.7	237.2	429.2
3:27:31	220.4	255.8	252.0	239.0	238.1	433.2
3:30:01	220.8	257.3	254.0	241.2	239.2	429.8
3:32:31	222.1	259.2	255.8	243.8	240.7	433.6
3:35:01	223.7	260.7	257.6	246.3	241.7	432.9
3:37:31	226.7	263.6	259.6	249.3	243.6	442.6
3:40:01	229.0	265.5	261.6	251.9	245.3	446.2
3:42:31	231.5	268.1	263.7	254.8	246.7	456.0
3:45:01	233.7	270.3	266.2	257.8	248.9	436.2
3:47:31	235.6	272.2	268.8	260.7	251.1	449.8
3:50:01	238.6	274.6	271.2	263.4	252.8	451.9
3:52:31	241.5	277.3	273.6	266.5	255.3	460.4
3:55:01	244.8	280.1	276.3	269.5	257.9	468.7
3:57:31	247.5	282.8	278.5	272.3	260.2	463.1

R8196/95NK3179

Test Date : APRIL 6, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
4:00:01	250.9	285.6	281.0	275.5	262.8	474.7
4:02:31	254.0	288.6	283.5	278.4	265.6	482.7
4:05:01	256.4	291.1	286.4	281.1	268.2	470.4
4:07:31	259.4	293.2	289.0	283.8	270.3	482.2
4:10:01	262.1	295.6	291.8	286.7	272.7	483.5
4:12:31	264.3	297.9	294.5	289.3	274.8	476.7
4:15:01	267.4	300.4	297.2	292.1	277.7	486.4
4:17:31	271.1	303.6	299.5	294.7	280.4	498.3
4:20:01	273.7	305.7	302.4	297.4	282.9	496.6
4:22:31	276.3	308.4	304.9	300.1	286.1	503.4
4:25:01	278.7	310.5	307.3	302.4	288.4	503.1
4:27:31	280.8	312.5	309.9	304.6	290.4	498.6
4:30:01	283.3	314.6	312.0	307.0	293.1	504.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:01	77.8	77.7	77.5	77.7	77.7	77.5
0:02:31	77.8	77.5	77.7	77.5	77.7	77.5
0:05:01	77.6	77.6	77.4	77.4	77.6	77.4
0:07:31	77.8	77.7	77.7	77.7	77.8	77.7
0:10:01	77.8	77.7	77.5	77.5	77.7	77.5
0:12:31	77.7	77.3	77.3	77.3	77.4	77.3
0:15:01	78.2	77.6	77.5	77.5	77.6	77.5
0:17:31	78.7	77.5	77.5	77.5	77.6	77.5
0:20:01	79.6	77.6	77.6	77.6	77.7	77.7
0:22:31	81.2	77.6	77.6	77.6	77.8	77.8
0:25:01	83.3	77.6	77.5	77.5	77.6	77.6
0:27:31	86.2	77.6	77.8	77.8	77.9	78.1
0:30:01	89.7	77.8	78.1	78.1	78.1	78.4
0:32:31	93.7	77.9	78.3	78.3	78.4	78.6
0:35:01	98.6	78.2	79.0	79.0	79.0	79.3
0:37:31	103.7	78.3	79.5	79.5	79.4	79.8
0:40:01	109.4	78.5	80.0	80.1	79.8	80.5
0:42:31	115.8	79.0	80.9	81.2	80.8	81.6
0:45:01	122.6	79.2	82.0	82.3	81.6	82.6
0:47:31	129.9	79.9	83.4	83.8	82.9	84.0
0:50:01	137.2	80.5	84.6	85.3	84.2	85.5
0:52:31	144.1	81.1	86.2	86.9	85.5	86.9
0:55:01	150.8	81.9	88.0	88.9	87.3	88.6
0:57:31	157.1	82.8	89.9	90.9	88.9	90.5
1:00:01	162.3	83.6	91.9	93.0	90.6	92.3
1:02:31	167.5	84.6	93.8	95.1	92.7	94.1
1:05:01	172.7	85.8	95.9	97.4	94.5	96.1
1:07:31	177.5	86.8	98.0	99.7	96.4	98.0
1:10:01	182.3	88.1	100.3	102.0	98.4	100.3
1:12:31	187.0	89.5	102.4	104.2	100.4	102.1
1:15:01	191.5	90.8	104.6	106.8	102.4	104.2
1:17:31	196.3	92.3	107.2	109.1	104.7	106.4
1:20:01	200.9	93.8	109.8	111.6	107.0	108.6
1:22:31	205.4	95.4	112.1	114.2	109.2	111.1
1:25:01	210.1	97.3	114.8	116.8	111.7	113.4
1:27:31	214.9	99.1	117.4	119.4	114.0	115.7
1:30:01	219.6	101.1	120.1	122.0	116.3	118.2
1:32:31	224.3	103.0	122.9	124.8	118.8	120.6
1:35:01	229.0	105.2	125.7	127.7	121.3	123.2
1:37:31	233.8	107.2	128.5	130.4	124.0	125.7
1:40:01	238.7	109.5	131.4	133.4	126.6	128.3
1:42:31	243.2	111.7	134.2	136.2	129.3	130.9
1:45:01	248.0	114.1	137.2	139.1	132.1	133.3
1:47:31	252.2	116.5	139.9	142.0	134.5	135.7
1:50:01	256.6	118.7	142.7	144.7	136.9	138.0
1:52:31	261.1	121.2	145.7	147.8	139.9	140.9
1:55:01	265.5	123.8	148.6	150.7	142.6	143.4
1:57:31	269.4	126.3	151.3	153.6	145.3	145.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
2:00:01	273.7	128.7	154.3	156.5	147.9	148.3
2:02:31	277.6	131.1	157.2	159.4	150.7	150.7
2:05:01	281.7	133.5	160.0	162.3	153.4	153.0
2:07:31	285.6	136.1	163.0	165.1	156.1	155.5
2:10:01	289.5	138.3	165.9	168.0	158.8	158.1
2:12:31	293.2	140.8	168.6	170.7	161.4	160.4
2:15:01	297.0	143.6	171.7	173.9	164.4	163.3
2:17:31	300.7	146.5	174.7	176.8	167.1	165.8
2:20:01	304.0	149.0	177.6	179.8	169.7	168.4
2:22:31	307.7	151.9	180.5	182.7	172.5	170.8
2:25:01	311.1	154.8	183.5	185.6	175.3	173.6
2:27:31	314.0	157.4	185.8	188.4	177.9	175.9
2:30:01	317.5	160.1	188.8	191.4	180.8	178.4
2:32:31	320.6	163.2	191.7	194.2	183.7	181.1
2:35:01	323.9	165.9	194.7	197.1	186.4	183.7
2:37:31	326.9	168.5	197.2	199.6	189.2	186.3
2:40:01	330.4	172.2	199.9	202.7	192.1	188.9
2:42:31	333.2	176.9	202.7	206.0	195.0	191.6
2:45:01	335.9	179.9	205.3	208.7	197.8	194.1
2:47:31	339.0	183.0	208.0	211.7	200.6	197.0
2:50:01	341.7	185.6	210.7	214.3	203.4	199.5
2:52:31	344.6	188.5	213.4	217.1	206.3	202.1
2:55:01	347.3	191.3	216.0	219.7	209.2	204.3
2:57:31	349.8	193.9	219.0	222.2	212.3	206.9
3:00:01	352.6	196.6	221.8	224.9	215.0	209.6
3:02:31	354.9	199.4	224.5	227.6	217.8	212.1
3:05:01	356.9	201.9	227.2	230.1	220.5	214.7
3:07:31	359.5	204.8	230.1	233.0	223.4	217.4
3:10:01	361.8	207.7	232.8	235.6	226.0	219.9
3:12:31	364.0	210.3	235.4	238.2	228.7	222.0
3:15:01	366.8	213.3	238.3	241.0	231.4	224.7
3:17:31	369.0	216.4	241.2	243.7	234.1	226.8
3:20:01	371.0	219.0	244.0	246.4	236.9	229.4
3:22:31	373.1	221.8	246.8	249.1	239.6	231.6
3:25:01	375.2	225.0	249.8	251.8	242.3	233.8
3:27:31	377.9	228.0	252.6	254.6	245.2	236.0
3:30:01	380.4	230.3	255.7	256.0	247.8	238.3
3:32:31	382.7	233.4	258.5	259.2	250.2	240.7
3:35:01	385.4	236.0	261.6	262.3	252.4	243.3
3:37:31	387.7	237.5	264.3	264.0	254.6	245.7
3:40:01	389.6	240.9	268.2	264.8	256.5	247.8
3:42:31	391.8	247.0	270.7	265.9	258.2	251.2
3:45:01	393.7	249.7	273.3	267.2	260.6	254.4
3:47:31	396.0	251.9	275.6	268.7	262.7	257.5
3:50:01	398.0	253.9	277.7	270.4	265.1	260.4
3:52:31	399.9	256.0	279.7	272.5	267.4	263.5
3:55:01	401.5	258.1	281.8	274.7	269.6	266.6
3:57:31	403.2	259.5	283.5	276.7	272.0	269.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
4:00:01	405.0	261.7	286.0	279.3	275.2	272.1
4:02:31	407.1	263.5	288.4	281.6	277.9	275.0
4:05:01	409.0	265.5	290.6	284.4	280.7	277.7
4:07:31	410.5	267.3	292.8	286.7	283.2	280.1
4:10:01	412.5	269.6	295.3	289.2	286.4	282.8
4:12:31	414.1	272.0	297.6	291.6	289.3	285.2
4:15:01	415.8	274.4	300.4	294.2	292.1	287.8
4:17:31	416.7	277.1	302.7	296.6	294.4	290.2
4:20:01	418.9	279.6	305.2	299.0	297.3	292.6
4:22:31	420.3	282.1	307.7	301.6	299.7	295.2
4:25:01	421.8	284.4	310.0	304.0	302.1	297.6
4:27:31	423.3	286.4	312.5	306.4	304.5	299.8
4:30:01	424.6	280.8	316.4	308.5	293.8	300.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:01	77.7	77.7	78.1	77.9	77.9	78.1
0:02:31	77.5	77.7	78.0	78.0	78.0	78.0
0:05:01	77.6	77.4	77.9	77.7	77.7	77.9
0:07:31	77.7	77.7	77.9	77.9	77.9	77.9
0:10:01	77.7	77.7	77.8	77.8	77.8	77.9
0:12:31	77.7	77.7	77.7	77.5	77.5	77.7
0:15:01	78.8	78.4	77.9	77.8	77.8	77.9
0:17:31	80.0	79.2	77.8	77.8	77.8	77.9
0:20:01	82.4	80.8	78.0	78.0	78.0	77.8
0:22:31	85.8	83.3	78.0	78.0	78.0	78.0
0:25:01	89.7	86.1	77.9	77.9	78.1	78.1
0:27:31	95.0	90.3	78.1	78.1	78.2	78.2
0:30:01	101.1	95.1	78.2	78.2	78.5	78.5
0:32:31	108.2	101.2	78.3	78.4	78.9	78.9
0:35:01	116.4	108.2	78.5	78.8	79.4	79.4
0:37:31	125.8	116.0	78.6	79.2	79.9	80.1
0:40:01	136.5	124.2	78.6	79.5	80.4	80.7
0:42:31	149.0	133.8	79.2	80.2	81.2	81.9
0:45:01	161.0	144.2	79.4	80.7	82.0	82.9
0:47:31	173.0	158.8	79.9	81.6	83.2	84.4
0:50:01	182.1	171.9	80.2	82.6	84.6	86.0
0:52:31	188.3	182.1	80.7	83.6	86.0	87.8
0:55:01	194.5	188.0	81.5	84.9	87.6	89.7
0:57:31	199.1	190.9	82.1	86.1	89.2	91.8
1:00:01	202.7	193.1	82.8	87.5	90.8	93.6
1:02:31	206.2	194.6	83.7	89.2	92.6	95.8
1:05:01	209.8	196.5	84.8	90.9	94.2	98.1
1:07:31	213.9	198.1	85.9	92.5	96.1	100.4
1:10:01	218.8	200.4	87.0	94.1	98.0	103.0
1:12:31	223.7	203.2	88.1	96.0	100.0	105.4
1:15:01	229.1	208.3	89.6	97.7	101.8	107.8
1:17:31	235.0	214.7	91.1	99.9	104.1	110.3
1:20:01	241.0	221.0	92.6	102.0	106.4	113.0
1:22:31	247.4	227.5	94.1	104.0	108.7	115.7
1:25:01	254.1	234.5	95.9	106.2	111.0	118.5
1:27:31	260.6	241.4	97.8	108.5	113.2	121.4
1:30:01	266.8	248.1	99.5	110.7	115.6	123.9
1:32:31	273.1	254.0	101.4	113.1	117.9	127.0
1:35:01	279.2	260.6	103.4	115.4	120.3	129.8
1:37:31	285.5	267.2	105.5	117.8	122.9	132.6
1:40:01	291.4	273.0	107.7	120.2	125.3	135.6
1:42:31	297.5	279.5	109.8	122.8	127.8	138.6
1:45:01	303.3	285.8	112.3	125.4	130.4	141.7
1:47:31	308.6	291.0	114.3	127.8	132.3	144.4
1:50:01	313.8	296.5	116.4	130.1	134.8	147.1
1:52:31	319.0	302.2	118.8	132.8	137.6	150.2
1:55:01	324.4	307.1	121.4	135.5	140.2	153.3
1:57:31	329.4	312.7	123.7	137.8	142.2	156.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
2:00:01	334.1	318.3	126.3	140.6	144.9	158.8
2:02:31	339.3	322.4	128.7	143.1	147.6	161.8
2:05:01	343.9	326.9	131.2	145.6	149.6	164.7
2:07:31	348.3	331.8	133.7	148.3	152.4	167.4
2:10:01	352.9	336.0	136.2	150.9	155.3	170.1
2:12:31	356.9	340.5	138.7	153.5	157.9	173.0
2:15:01	361.6	345.1	141.5	156.3	160.9	175.8
2:17:31	366.3	349.5	144.2	159.0	163.6	178.8
2:20:01	370.4	353.5	146.9	161.6	165.7	181.5
2:22:31	374.0	357.9	149.5	164.2	167.8	184.2
2:25:01	378.0	361.9	152.2	166.9	170.0	187.0
2:27:31	381.9	365.8	154.9	169.3	172.3	189.6
2:30:01	385.7	369.6	157.6	171.9	174.7	192.5
2:32:31	389.4	373.7	160.5	174.5	177.2	195.5
2:35:01	393.1	376.9	163.3	177.2	179.9	198.2
2:37:31	396.3	379.7	166.3	179.8	182.8	201.0
2:40:01	399.3	382.9	169.1	182.5	185.9	203.8
2:42:31	402.7	386.1	172.1	185.3	188.5	206.6
2:45:01	405.9	389.7	174.9	187.8	190.6	209.2
2:47:31	409.3	393.8	178.1	190.8	193.3	212.1
2:50:01	411.7	397.2	180.8	193.4	196.1	214.9
2:52:31	415.3	400.3	184.1	196.6	199.7	217.9
2:55:01	418.4	403.4	187.3	199.6	202.6	220.9
2:57:31	421.4	407.0	190.4	202.4	205.4	223.8
3:00:01	424.8	409.5	193.7	205.7	208.4	226.8
3:02:31	427.5	412.8	197.0	208.9	211.3	229.9
3:05:01	430.5	415.4	200.8	212.1	214.3	231.1
3:07:31	433.2	419.2	205.2	215.4	217.3	236.4
3:10:01	436.3	421.9	205.3	218.7	220.3	243.3
3:12:31	438.8	425.3	207.8	222.2	223.3	246.0
3:15:01	441.4	428.4	211.2	225.1	226.7	248.9
3:17:31	444.2	430.8	214.1	229.0	230.0	252.1
3:20:01	446.8	434.3	217.6	232.2	233.3	255.0
3:22:31	449.2	436.6	221.1	235.3	236.6	258.0
3:25:01	451.6	439.1	224.8	238.6	240.2	261.0
3:27:31	453.8	441.9	228.8	241.9	243.5	264.2
3:30:01	456.2	445.0	232.6	245.3	246.9	267.3
3:32:31	457.9	447.1	236.7	248.8	250.3	270.5
3:35:01	459.7	450.3	240.6	252.4	252.4	274.1
3:37:31	461.8	452.0	244.7	255.9	256.4	277.6
3:40:01	463.2	454.9	248.4	259.4	259.6	281.1
3:42:31	464.7	458.1	252.4	263.0	262.7	284.9
3:45:01	467.9	459.6	256.0	266.3	265.6	288.3
3:47:31	470.1	461.0	259.4	270.4	268.7	291.7
3:50:01	471.7	464.0	262.8	272.6	272.1	295.3
3:52:31	473.5	465.7	265.9	275.0	275.2	298.7
3:55:01	475.5	469.3	269.1	277.1	278.1	302.2
3:57:31	476.6	471.1	272.0	279.1	281.1	305.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
4:00:01	479.4	473.8	275.0	281.9	284.3	308.9
4:02:31	480.0	476.0	278.1	284.5	287.5	312.3
4:05:01	482.9	475.9	281.2	287.3	291.5	315.6
4:07:31	483.4	478.5	284.2	289.9	293.5	318.8
4:10:01	485.9	478.5	287.6	292.8	297.3	322.4
4:12:31	487.1	479.2	290.2	295.6	300.1	325.8
4:15:01	488.0	482.3	293.5	298.2	303.3	329.0
4:17:31	490.3	480.9	296.0	300.5	306.0	332.2
4:20:01	491.7	484.3	299.2	303.6	309.4	335.8
4:22:31	492.3	489.2	301.7	306.2	312.0	339.1
4:25:01	494.4	488.9	304.6	308.8	314.9	342.5
4:27:31	494.9	489.9	306.9	311.6	317.9	345.9
4:30:01	495.8	488.6	308.9	313.4	319.7	348.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:01	77.9	78.4	78.5	78.4	78.2	78.4
0:02:31	77.8	78.3	78.4	78.2	78.2	78.2
0:05:01	77.7	78.5	78.7	78.4	78.4	78.4
0:07:31	77.9	78.5	78.5	78.4	78.2	78.2
0:10:01	77.8	78.3	78.4	78.1	78.0	78.1
0:12:31	77.5	78.8	78.9	78.3	78.2	78.2
0:15:01	77.8	79.2	79.9	78.2	78.0	78.2
0:17:31	77.8	80.6	81.6	78.4	78.1	78.1
0:20:01	77.8	82.5	84.3	78.3	78.3	78.3
0:22:31	77.9	85.2	87.9	78.3	78.3	78.2
0:25:01	77.8	89.0	92.6	78.4	78.5	78.4
0:27:31	78.1	93.5	98.2	78.3	78.6	78.6
0:30:01	78.2	99.3	105.0	78.7	79.1	78.8
0:32:31	78.4	105.9	112.4	78.6	79.4	78.8
0:35:01	79.0	113.7	121.0	78.5	80.0	79.1
0:37:31	79.5	123.1	130.3	78.9	81.0	79.8
0:40:01	79.8	133.6	141.0	79.0	81.9	80.5
0:42:31	80.8	144.8	153.0	79.2	83.1	81.2
0:45:01	81.4	155.2	169.0	79.6	84.5	82.2
0:47:31	82.8	169.5	180.2	79.9	86.1	83.4
0:50:01	84.0	186.1	187.6	80.2	88.1	84.6
0:52:31	85.5	190.9	192.7	80.7	90.0	86.2
0:55:01	87.0	192.3	197.3	81.2	92.2	87.9
0:57:31	88.7	192.8	200.9	81.8	94.3	89.8
1:00:01	90.4	193.6	203.8	82.4	96.7	91.7
1:02:31	92.6	193.3	206.5	83.2	99.0	93.6
1:05:01	94.5	194.2	210.0	84.2	101.7	95.7
1:07:31	96.6	197.4	213.7	85.0	103.8	97.9
1:10:01	98.9	201.0	218.4	86.0	106.4	100.0
1:12:31	101.0	206.9	224.6	87.0	108.8	102.3
1:15:01	103.1	212.2	231.0	88.2	111.2	104.4
1:17:31	105.5	218.7	237.7	89.5	113.8	106.7
1:20:01	108.1	224.4	245.2	91.1	116.6	109.2
1:22:31	110.5	230.3	252.5	92.3	119.0	111.5
1:25:01	113.0	236.5	259.4	93.8	121.6	114.1
1:27:31	115.6	242.6	266.2	95.4	124.4	116.5
1:30:01	118.2	248.6	273.0	97.3	127.0	119.2
1:32:31	120.9	254.2	279.4	99.1	129.6	121.9
1:35:01	123.6	260.1	285.9	101.1	132.5	124.5
1:37:31	126.4	265.9	291.9	103.0	135.3	127.1
1:40:01	129.1	271.8	298.1	104.9	138.2	130.0
1:42:31	131.9	277.2	303.8	106.8	141.0	132.8
1:45:01	134.8	282.8	308.8	108.9	143.8	135.4
1:47:31	137.4	288.8	313.4	111.3	146.6	138.4
1:50:01	140.0	293.6	319.0	113.2	149.2	140.9
1:52:31	143.1	299.0	324.7	115.8	152.5	143.9
1:55:01	145.9	304.3	329.6	117.9	155.3	146.6
1:57:31	148.6	309.3	334.2	120.1	158.0	149.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
2:00:01	151.7	314.1	338.7	122.5	160.9	152.2
2:02:31	154.6	318.7	343.5	125.3	164.1	155.2
2:05:01	157.2	322.8	346.4	127.6	166.6	157.8
2:07:31	159.9	326.8	351.8	130.1	169.3	160.5
2:10:01	162.6	331.3	356.8	132.9	172.3	163.4
2:12:31	165.3	335.7	361.0	135.5	175.2	166.3
2:15:01	168.3	340.0	366.0	138.2	178.3	169.3
2:17:31	171.2	344.2	370.1	140.9	181.3	172.4
2:20:01	174.0	348.2	373.8	143.7	183.7	175.2
2:22:31	176.7	352.2	377.3	146.7	186.8	178.3
2:25:01	179.6	355.7	381.3	149.5	189.4	181.0
2:27:31	182.0	359.6	385.0	152.4	192.4	183.9
2:30:01	184.9	363.2	389.1	155.5	195.2	186.9
2:32:31	187.6	367.0	392.3	158.3	198.0	189.5
2:35:01	190.3	370.8	396.4	161.5	200.5	192.6
2:37:31	193.1	374.7	399.8	164.4	202.8	195.2
2:40:01	196.1	378.3	402.9	167.4	205.3	198.0
2:42:31	198.9	381.8	405.7	170.2	207.7	200.7
2:45:01	201.4	385.3	409.6	173.0	210.6	203.7
2:47:31	204.6	389.1	413.3	175.9	213.3	206.5
2:50:01	207.2	391.9	417.0	178.5	215.8	209.3
2:52:31	210.4	395.3	419.6	181.2	218.4	212.1
2:55:01	213.3	398.9	424.3	184.2	221.4	215.0
2:57:31	216.1	402.3	426.4	186.8	223.7	217.9
3:00:01	219.0	405.6	428.2	189.8	226.7	220.9
3:02:31	221.9	409.1	431.4	192.6	229.1	223.7
3:05:01	222.6	412.2	434.7	195.4	231.5	226.3
3:07:31	223.2	415.3	439.9	198.5	234.0	229.1
3:10:01	230.5	418.6	443.5	201.5	236.5	232.1
3:12:31	232.9	421.7	447.1	204.3	239.0	234.8
3:15:01	235.9	424.6	450.8	207.6	241.4	237.7
3:17:31	239.0	427.4	453.9	211.0	243.9	240.6
3:20:01	241.9	430.3	456.7	214.2	246.4	243.5
3:22:31	244.7	433.1	459.0	217.6	248.7	246.3
3:25:01	247.8	435.9	462.5	220.9	251.3	249.1
3:27:31	250.9	439.1	465.5	224.3	254.0	252.0
3:30:01	253.9	441.8	467.6	228.0	256.3	254.9
3:32:31	257.1	444.6	471.6	231.5	258.9	257.5
3:35:01	260.4	447.4	472.7	235.0	261.3	260.3
3:37:31	263.7	451.1	476.5	238.7	263.9	263.4
3:40:01	266.7	454.1	479.6	242.2	266.5	266.0
3:42:31	270.0	456.9	482.1	246.1	268.9	269.1
3:45:01	273.0	460.0	484.2	249.9	271.5	272.2
3:47:31	276.5	462.3	485.3	253.7	273.9	274.9
3:50:01	279.6	464.9	489.3	257.8	277.1	275.0
3:52:31	282.8	467.6	493.5	262.3	279.8	276.2
3:55:01	286.3	470.9	498.1	265.7	282.9	277.8
3:57:31	289.3	473.9	500.9	269.1	286.1	280.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
hr:min:sec						
4:00:01	292.6	477.5	504.1	272.0	289.2	283.3
4:02:31	296.0	480.7	507.7	274.9	292.1	286.8
4:05:01	299.4	483.4	509.3	277.2	295.0	289.8
4:07:31	302.7	485.9	511.8	279.8	298.2	292.8
4:10:01	306.2	489.2	514.9	282.4	300.9	295.8
4:12:31	309.4	491.4	516.4	285.0	303.8	298.7
4:15:01	312.6	494.5	520.6	287.5	306.6	301.5
4:17:31	315.8	497.5	523.4	290.2	309.4	304.2
4:20:01	319.1	499.0	525.2	292.8	312.0	306.9
4:22:31	322.2	501.1	529.0	295.9	315.3	309.8
4:25:01	325.2	503.8	531.6	298.9	318.2	312.4
4:27:31	328.0	505.3	531.8	301.6	321.1	314.8
4:30:01	330.6	507.6	536.9	304.5	323.8	317.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F.				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:01	78.4	78.2	78.4	78.2	78.2
0:02:31	78.2	78.2	78.3	78.2	78.2
0:05:01	78.4	78.4	78.4	78.4	78.4
0:07:31	78.4	78.2	78.4	78.4	78.4
0:10:01	78.1	78.0	78.3	78.1	78.3
0:12:31	78.3	78.2	78.8	78.3	78.9
0:15:01	78.2	78.2	79.5	78.3	80.1
0:17:31	78.3	78.3	80.9	78.9	82.3
0:20:01	78.3	78.3	83.2	79.3	85.7
0:22:31	78.3	78.3	86.5	80.2	90.3
0:25:01	78.4	78.4	90.8	81.4	96.0
0:27:31	78.4	78.4	95.9	83.2	103.3
0:30:01	78.7	78.7	102.1	85.5	111.7
0:32:31	78.8	78.8	108.8	88.0	121.3
0:35:01	78.8	79.0	116.5	91.2	132.0
0:37:31	79.2	79.5	124.9	94.7	144.0
0:40:01	79.6	79.9	133.5	98.6	157.1
0:42:31	80.0	80.3	143.1	103.0	170.9
0:45:01	80.4	81.0	152.6	107.6	184.7
0:47:31	81.0	81.8	162.0	112.7	196.6
0:50:01	81.8	82.7	170.8	118.0	206.0
0:52:31	82.7	83.9	179.7	123.4	213.5
0:55:01	83.6	85.1	186.8	128.9	218.9
0:57:31	84.7	86.5	193.3	134.5	225.8
1:00:01	85.9	88.0	198.8	140.0	231.6
1:02:31	87.1	89.6	205.2	145.3	237.8
1:05:01	88.6	91.5	212.8	150.8	244.3
1:07:31	89.8	93.1	218.9	155.6	250.7
1:10:01	91.4	94.8	224.9	160.7	257.5
1:12:31	92.8	96.8	231.0	165.0	264.3
1:15:01	94.4	98.6	236.7	169.2	271.4
1:17:31	96.3	100.6	242.8	173.5	278.7
1:20:01	98.2	103.0	249.2	178.0	286.3
1:22:31	100.1	104.9	255.4	182.1	293.6
1:25:01	102.1	107.1	260.8	186.4	301.1
1:27:31	104.0	109.4	267.1	190.9	308.3
1:30:01	106.2	111.7	273.3	195.3	315.6
1:32:31	108.3	114.0	278.9	199.7	322.6
1:35:01	110.5	116.3	285.3	204.0	329.5
1:37:31	112.7	118.8	291.2	208.3	336.3
1:40:01	115.1	121.1	297.8	212.8	342.9
1:42:31	117.3	123.5	303.3	217.2	349.0
1:45:01	119.6	125.8	309.4	221.5	355.2
1:47:31	122.0	128.3	314.6	225.7	361.1
1:50:01	124.2	130.7	319.8	229.6	366.6
1:52:31	126.8	133.4	325.9	233.8	372.7
1:55:01	129.2	135.8	330.7	237.8	378.3
1:57:31	131.4	138.5	336.2	241.9	383.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
2:00:01	134.0	141.0	341.3	245.7	388.7
2:02:31	136.5	143.8	346.6	249.6	394.2
2:05:01	138.9	146.1	351.3	253.0	398.7
2:07:31	141.4	148.6	356.4	256.7	403.6
2:10:01	144.0	151.5	360.8	260.3	408.6
2:12:31	146.6	154.1	365.6	264.1	413.3
2:15:01	149.3	157.0	370.8	267.8	418.1
2:17:31	151.9	159.7	375.3	271.3	422.8
2:20:01	154.6	162.5	379.6	274.8	427.0
2:22:31	157.3	165.5	384.1	278.2	431.4
2:25:01	159.9	168.0	386.9	281.2	435.4
2:27:31	162.7	171.1	391.7	285.0	439.6
2:30:01	165.4	174.0	395.7	288.5	443.5
2:32:31	168.1	176.8	399.2	291.6	447.2
2:35:01	171.1	179.8	404.3	295.0	451.4
2:37:31	173.7	182.9	407.8	298.2	455.0
2:40:01	176.5	185.9	411.3	301.4	458.6
2:42:31	179.4	188.4	414.3	304.4	462.1
2:45:01	182.2	191.5	418.9	307.8	465.5
2:47:31	185.0	194.4	423.3	310.7	469.0
2:50:01	187.8	197.2	424.7	313.7	472.2
2:52:31	190.5	199.7	429.8	316.5	475.3
2:55:01	193.5	202.2	433.6	319.9	478.8
2:57:31	196.1	204.9	436.3	322.6	481.7
3:00:01	198.9	207.8	439.2	325.5	485.1
3:02:31	201.6	210.5	444.5	328.4	488.1
3:05:01	204.3	213.1	447.8	330.9	491.0
3:07:31	207.0	215.9	450.1	333.6	493.6
3:10:01	210.0	218.8	452.9	336.4	496.7
3:12:31	212.6	221.6	454.8	338.9	499.4
3:15:01	215.4	224.3	458.2	341.5	502.3
3:17:31	218.3	227.3	461.2	344.1	504.9
3:20:01	221.0	230.2	463.9	346.7	507.6
3:22:31	223.9	233.1	466.3	349.0	510.2
3:25:01	226.6	235.7	469.3	351.2	512.5
3:27:31	229.3	238.6	471.9	353.9	515.1
3:30:01	232.4	241.6	475.4	356.5	517.5
3:32:31	235.2	244.6	477.6	359.1	519.7
3:35:01	237.9	247.1	479.4	361.3	521.9
3:37:31	241.1	250.0	479.9	363.7	524.2
3:40:01	243.9	252.9	486.0	365.8	526.4
3:42:31	247.1	255.7	486.2	368.5	528.6
3:45:01	250.2	258.6	486.0	371.1	530.7
3:47:31	253.3	261.5	490.5	373.7	532.8
3:50:01	256.5	264.2	494.0	376.6	534.6
3:52:31	260.2	267.7	498.0	380.2	536.6
3:55:01	263.3	271.3	503.4	384.4	538.7
3:57:31	266.1	273.1	502.2	387.7	540.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	TEMPERATURS, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
4:00:01	268.6	275.0	509.3	391.1	542.7
4:02:31	271.1	277.0	507.7	394.2	544.7
4:05:01	273.3	279.1	516.2	397.0	546.4
4:07:31	275.7	281.8	520.4	400.2	548.0
4:10:01	278.3	284.6	522.9	403.3	549.8
4:12:31	280.9	287.5	523.4	406.2	551.8
4:15:01	283.7	290.4	526.4	409.1	553.4
4:17:31	286.6	293.3	523.8	412.0	554.9
4:20:01	289.3	296.2	530.2	414.6	556.4
4:22:31	292.6	299.6	531.9	417.8	558.2
4:25:01	295.7	302.5	533.6	420.5	559.4
4:27:31	298.7	305.7	536.0	423.5	560.8
4:30:01	301.7	308.7	540.8	426.2	562.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	80.0	79.9	79.9	79.7	79.7	79.7
0:02:30	80.0	79.9	79.9	80.0	79.9	80.0
0:05:00	80.0	79.9	80.0	79.9	79.9	80.0
0:07:30	79.8	79.8	79.8	79.8	79.7	79.8
0:10:00	80.2	79.9	80.0	80.0	79.9	80.0
0:12:30	80.1	80.1	80.1	80.4	80.1	80.4
0:15:00	80.2	80.2	80.2	80.3	80.0	81.1
0:17:30	80.5	80.4	80.4	81.0	80.4	82.6
0:20:00	80.7	80.6	80.6	81.2	80.6	84.5
0:22:30	80.6	80.6	80.5	80.8	80.6	87.0
0:25:00	80.5	80.6	80.5	80.6	80.5	90.2
0:27:30	80.6	80.6	80.8	80.8	80.5	94.2
0:30:00	80.5	80.7	80.6	80.7	80.3	98.9
0:32:30	80.6	81.0	80.9	81.2	80.6	104.8
0:35:00	80.7	81.2	81.2	81.2	80.7	111.2
0:37:30	80.9	81.7	81.7	82.0	81.1	118.3
0:40:00	80.9	82.3	82.1	82.4	81.2	126.0
0:42:30	81.0	83.1	83.0	83.3	81.8	134.1
0:45:00	81.2	84.0	83.7	84.0	82.4	142.5
0:47:30	81.9	85.1	84.9	85.2	83.3	151.3
0:50:00	82.1	86.3	86.0	86.4	84.0	160.2
0:52:30	82.5	87.6	87.4	87.4	84.9	168.5
0:55:00	83.0	89.1	88.9	88.8	86.2	176.3
0:57:30	83.7	90.9	90.6	90.6	87.5	183.5
1:00:00	84.4	92.7	92.5	92.2	88.9	189.9
1:02:30	85.1	94.5	94.2	93.8	90.5	196.4
1:05:00	86.2	96.6	96.3	95.6	92.2	202.7
1:07:30	87.0	98.5	98.3	97.4	93.7	208.9
1:10:00	88.1	100.6	100.5	99.3	95.4	215.3
1:12:30	89.3	102.9	102.8	101.5	97.4	222.0
1:15:00	90.4	105.0	105.0	103.1	99.3	228.1
1:17:30	92.1	107.6	107.6	105.5	101.4	234.4
1:20:00	93.1	109.8	109.9	107.2	103.4	240.2
1:22:30	94.5	112.2	112.5	109.2	105.4	246.2
1:25:00	96.2	114.9	115.1	111.7	107.7	252.3
1:27:30	98.0	117.5	117.8	114.1	110.1	258.3
1:30:00	99.7	120.0	120.5	116.1	112.4	264.0
1:32:30	101.6	122.8	123.2	118.9	114.8	270.2
1:35:00	103.5	125.4	126.1	120.6	117.1	275.7
1:37:30	105.4	128.1	128.8	123.3	119.5	281.5
1:40:00	107.6	131.0	131.7	125.8	122.1	287.3
1:42:30	109.8	134.0	134.7	128.3	124.8	293.0
1:45:00	112.0	136.7	137.7	131.1	127.4	298.6
1:47:30	114.1	139.3	140.5	133.6	129.7	304.1
1:50:00	116.2	142.2	143.3	136.4	132.3	309.2
1:52:30	118.5	144.9	146.3	138.8	134.9	314.5
1:55:00	120.7	147.6	149.1	141.5	137.4	319.7
1:57:30	122.9	150.4	151.8	143.6	139.8	324.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
2:00:00	125.6	153.4	155.0	146.8	142.8	329.5
2:02:30	128.2	156.3	158.1	149.8	145.4	334.2
2:05:00	130.9	159.4	161.1	152.6	148.4	339.3
2:07:30	133.3	162.1	163.9	154.9	150.8	343.7
2:10:00	136.0	165.0	167.1	157.8	153.8	348.2
2:12:30	138.6	167.8	170.1	160.0	156.5	352.6
2:15:00	141.0	170.5	172.9	162.2	159.2	356.8
2:17:30	143.8	173.5	176.0	165.6	161.9	361.2
2:20:00	146.5	176.2	178.7	168.3	164.7	365.3
2:22:30	149.7	179.0	181.8	171.3	167.7	369.4
2:25:00	153.0	182.2	185.0	174.1	170.9	373.5
2:27:30	155.9	185.0	188.1	176.4	173.7	377.8
2:30:00	159.1	188.2	191.4	179.0	176.9	382.5
2:32:30	161.9	191.0	194.4	182.4	179.7	386.7
2:35:00	164.8	193.8	197.4	185.1	182.7	390.9
2:37:30	167.4	196.7	200.3	188.3	185.7	394.0
2:40:00	170.4	199.3	203.0	188.6	188.6	398.3
2:42:30	173.3	202.1	206.0	193.8	191.6	402.0
2:45:00	176.4	204.6	209.1	195.7	194.7	405.7
2:47:30	179.2	207.6	211.8	197.6	197.8	409.1
2:50:00	182.0	210.1	214.5	200.0	200.8	412.9
2:52:30	185.1	213.1	217.5	202.1	203.7	416.8
2:55:00	188.4	216.1	220.7	205.5	206.6	420.3
2:57:30	191.4	219.4	223.2	208.3	210.5	424.5
3:00:00	194.4	222.0	226.1	209.5	213.7	427.6
3:02:30	197.4	225.5	229.5	212.3	216.3	431.2
3:05:00	200.3	228.8	232.8	213.2	218.7	434.3
3:07:30	202.7	231.8	236.0	215.3	220.6	437.9
3:10:00	205.1	234.9	239.0	218.4	222.4	441.0
3:12:30	207.6	237.8	241.9	219.3	224.5	444.2
3:15:00	210.1	240.5	244.9	225.0	226.4	447.7
3:17:30	212.8	243.5	247.9	228.2	228.9	451.3
3:20:00	215.8	246.0	250.8	229.5	231.1	454.5
3:22:30	218.9	248.8	253.6	231.9	233.5	457.5
3:25:00	222.5	251.8	256.9	235.2	236.2	461.5
3:27:30	225.7	254.5	259.8	234.9	238.9	465.0
3:30:00	229.7	257.8	262.9	238.5	242.4	466.9
3:32:30	233.3	260.7	265.8	231.8	245.5	469.8
3:35:00	237.5	264.1	269.2	246.8	248.6	472.1
3:37:30	241.4	266.9	271.6	250.5	251.6	474.2
3:40:00	245.3	269.8	274.4	246.2	254.7	478.7
3:42:30	249.2	272.8	277.3	254.5	257.9	483.9
3:45:00	253.0	275.4	279.8	256.3	260.8	485.8
3:47:30	256.7	278.4	282.5	255.1	263.8	487.6
3:50:00	260.6	280.9	284.6	256.3	267.0	485.1
3:52:30	264.8	282.9	287.4	267.9	270.4	491.2
3:55:00	268.5	284.7	290.2	270.6	273.7	495.3
3:57:30	272.3	286.7	293.2	269.9	277.2	498.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
4:00:00	275.9	289.1	295.9	274.6	280.8	501.5
4:02:30	279.4	291.0	299.0	272.0	284.1	502.1
4:05:00	282.5	293.1	297.2	260.9	287.4	504.4
4:07:30	286.2	295.8	302.1	279.6	291.2	507.7
4:10:00	289.6	298.0	304.0	285.4	294.2	510.5
4:12:30	293.0	300.5	306.1	291.7	297.9	512.9
4:15:00	296.3	303.1	308.3	295.3	301.4	511.2
4:17:30	299.5	305.6	310.3	294.6	304.9	517.5
4:20:00	302.9	308.4	312.6	296.2	308.4	516.8
4:22:30	306.0	311.0	314.8	300.7	312.1	520.4
4:25:00	309.2	314.0	316.9	297.9	315.5	525.0
4:27:30	312.3	316.4	319.0	295.5	319.2	527.7
4:30:00	315.6	319.2	320.9	311.9	322.8	523.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	80.0	79.9	79.4	79.9	79.9	79.7
0:02:30	80.1	79.9	79.4	80.0	79.9	79.9
0:05:00	80.2	79.9	79.6	79.9	79.9	79.9
0:07:30	80.1	79.7	79.5	79.8	79.8	79.7
0:10:00	80.3	79.9	79.7	80.0	80.0	79.7
0:12:30	80.7	79.9	79.9	80.2	80.1	79.9
0:15:00	81.1	80.0	79.9	80.2	80.3	80.0
0:17:30	82.0	80.2	80.4	80.7	80.5	80.2
0:20:00	83.2	80.4	80.6	80.7	80.7	80.6
0:22:30	84.4	80.3	80.5	80.6	80.6	80.5
0:25:00	86.4	80.3	80.3	80.8	80.6	80.3
0:27:30	89.2	80.3	80.6	81.2	80.6	80.5
0:30:00	92.2	80.3	80.5	81.3	80.6	80.5
0:32:30	96.3	80.6	81.0	82.1	81.2	80.7
0:35:00	100.8	80.7	81.2	82.8	81.5	81.1
0:37:30	105.9	80.7	81.7	84.1	82.2	81.4
0:40:00	111.6	81.1	82.3	85.2	82.8	82.0
0:42:30	118.4	81.4	83.1	86.6	83.9	82.6
0:45:00	125.7	81.8	84.0	88.5	85.0	83.1
0:47:30	133.4	82.4	85.2	90.6	86.4	84.0
0:50:00	141.7	83.0	86.7	92.9	87.9	85.1
0:52:30	149.1	83.5	88.0	94.9	89.3	86.2
0:55:00	155.2	84.1	89.5	97.2	91.0	87.5
0:57:30	160.0	85.1	91.3	99.7	93.1	89.0
1:00:00	163.7	86.0	93.1	102.3	94.6	90.5
1:02:30	167.0	87.0	94.7	104.6	96.7	92.1
1:05:00	169.7	88.3	97.0	107.0	99.0	93.6
1:07:30	173.2	89.4	98.8	109.6	100.9	95.2
1:10:00	176.1	90.7	100.9	111.9	103.2	97.1
1:12:30	179.6	91.9	102.9	114.5	105.2	98.8
1:15:00	184.3	93.4	105.0	117.0	107.4	100.7
1:17:30	188.3	94.9	107.5	119.8	110.0	102.8
1:20:00	192.1	96.3	109.6	122.2	112.2	104.8
1:22:30	197.3	98.1	111.9	124.8	114.6	107.0
1:25:00	201.5	99.9	114.3	127.6	117.1	109.2
1:27:30	205.7	101.8	116.8	130.0	119.6	111.4
1:30:00	210.7	103.7	119.3	132.9	122.0	113.7
1:32:30	215.6	105.9	122.1	135.8	124.7	116.2
1:35:00	220.6	107.9	124.4	138.4	127.2	118.5
1:37:30	225.7	110.2	127.1	141.4	129.8	120.9
1:40:00	230.8	112.2	129.9	144.4	132.7	123.4
1:42:30	235.5	114.8	132.6	147.4	135.5	126.2
1:45:00	236.8	117.2	135.3	150.0	138.0	128.8
1:47:30	240.2	119.4	137.9	152.9	140.6	131.4
1:50:00	244.5	122.2	140.8	155.9	143.5	134.0
1:52:30	248.9	124.7	143.5	158.7	146.2	136.7
1:55:00	252.3	127.4	146.3	161.6	149.0	139.5
1:57:30	255.7	129.8	148.9	164.3	151.6	142.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
2:00:00	261.7	132.7	152.0	167.8	155.1	145.1
2:02:30	264.8	135.7	155.2	170.8	157.8	148.0
2:05:00	268.0	138.8	158.1	174.1	161.0	150.9
2:07:30	271.3	141.4	161.0	176.8	163.8	153.8
2:10:00	274.6	144.5	164.0	179.7	166.7	156.8
2:12:30	276.6	147.6	167.0	182.8	169.6	159.8
2:15:00	281.5	150.5	169.7	185.6	172.5	162.6
2:17:30	284.1	153.4	172.8	188.7	175.3	165.6
2:20:00	288.3	156.5	175.9	191.8	178.4	168.5
2:22:30	292.4	159.8	179.0	195.0	181.3	171.7
2:25:00	295.7	163.1	182.5	198.3	184.4	175.1
2:27:30	299.4	166.2	185.5	201.3	187.6	178.4
2:30:00	301.9	169.8	189.3	204.8	190.7	181.7
2:32:30	303.6	173.1	192.4	207.7	193.4	184.8
2:35:00	304.8	176.5	195.8	210.5	196.2	188.1
2:37:30	309.9	180.3	198.9	213.2	199.2	191.0
2:40:00	312.9	183.9	202.4	216.2	202.1	194.2
2:42:30	313.4	187.4	205.9	219.1	205.3	197.4
2:45:00	318.8	191.2	209.3	222.3	208.6	200.5
2:47:30	321.9	194.7	212.7	225.6	211.8	203.5
2:50:00	325.7	198.4	216.0	228.5	215.0	206.7
2:52:30	327.5	201.9	219.6	231.5	218.4	209.8
2:55:00	330.1	205.7	223.1	234.6	221.7	213.3
2:57:30	332.5	209.5	226.5	238.0	224.9	216.6
3:00:00	334.8	213.2	230.0	240.6	227.8	219.9
3:02:30	336.0	217.2	233.5	243.8	231.1	223.4
3:05:00	339.7	221.3	236.7	247.5	234.5	227.1
3:07:30	342.2	224.7	239.7	251.5	237.6	230.4
3:10:00	343.1	228.9	242.7	255.1	240.8	233.4
3:12:30	346.8	233.2	245.5	258.8	243.9	236.7
3:15:00	348.5	236.9	247.6	262.0	246.7	239.9
3:17:30	349.5	240.6	250.0	265.2	249.9	243.3
3:20:00	352.5	244.4	252.6	268.0	253.4	246.7
3:22:30	355.3	248.1	255.3	271.2	256.6	250.2
3:25:00	356.9	252.0	258.2	273.9	260.0	253.8
3:27:30	358.4	255.6	260.9	276.4	263.0	257.1
3:30:00	362.1	259.4	264.4	279.2	266.3	260.7
3:32:30	363.7	262.9	267.2	281.7	269.1	264.3
3:35:00	366.6	266.6	270.6	284.8	272.4	267.9
3:37:30	368.2	270.1	273.9	288.0	275.9	271.3
3:40:00	370.2	273.7	276.8	290.6	278.8	274.8
3:42:30	370.0	277.0	279.4	293.2	281.8	278.2
3:45:00	373.7	280.4	282.1	295.9	284.9	281.2
3:47:30	374.4	283.5	284.8	298.8	287.9	284.4
3:50:00	378.7	287.2	288.2	301.5	291.0	287.2
3:52:30	380.8	290.3	290.9	304.1	293.7	290.2
3:55:00	383.1	293.2	293.5	306.6	296.4	292.7
3:57:30	386.3	296.4	296.6	309.7	299.6	295.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
4:00:00	384.9	299.1	299.2	311.9	302.0	298.2
4:02:30	390.0	302.0	302.2	314.6	304.7	301.1
4:05:00	392.3	304.6	305.0	316.8	306.9	303.6
4:07:30	393.9	307.5	307.9	319.4	309.5	306.3
4:10:00	395.5	309.9	311.0	322.2	312.1	308.8
4:12:30	397.9	312.6	313.6	324.4	314.4	311.3
4:15:00	399.8	315.3	316.3	326.5	316.8	314.0
4:17:30	401.3	317.8	319.0	329.2	319.1	316.5
4:20:00	404.7	320.6	321.9	332.1	321.3	318.6
4:22:30	406.9	323.3	324.9	334.3	324.0	320.8
4:25:00	408.1	325.8	327.5	336.8	326.1	322.9
4:27:30	410.8	328.5	330.9	338.7	328.0	325.3
4:30:00	411.4	331.1	333.6	341.2	330.5	327.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	79.6	79.3	80.2	80.2	80.2	80.2
0:02:30	79.7	79.6	80.3	80.3	80.3	80.3
0:05:00	79.7	79.6	80.3	80.3	80.3	80.3
0:07:30	79.7	79.8	80.2	80.1	80.1	80.1
0:10:00	80.2	80.2	80.5	80.3	80.3	80.3
0:12:30	80.5	80.5	80.5	80.4	80.5	80.4
0:15:00	81.5	81.3	80.8	80.5	80.6	80.5
0:17:30	83.1	83.3	81.1	80.7	81.0	80.8
0:20:00	85.4	84.1	81.2	80.9	81.2	80.9
0:22:30	88.0	86.4	80.8	80.8	80.9	80.8
0:25:00	92.0	88.9	80.6	80.8	80.9	80.6
0:27:30	96.5	92.7	80.8	80.9	81.1	80.8
0:30:00	101.8	96.8	80.5	80.9	81.2	80.7
0:32:30	108.5	102.0	80.7	81.2	81.8	81.0
0:35:00	115.3	107.0	80.7	81.4	82.3	81.4
0:37:30	123.1	113.9	81.0	82.0	82.9	81.9
0:40:00	131.7	120.1	81.1	82.4	83.7	82.3
0:42:30	140.7	126.8	81.4	83.1	84.7	83.0
0:45:00	149.6	133.5	81.6	84.0	85.8	84.0
0:47:30	159.0	142.3	82.1	85.2	87.4	85.1
0:50:00	167.4	150.4	82.5	86.4	88.9	86.2
0:52:30	175.7	156.6	82.9	87.7	90.6	87.4
0:55:00	183.2	159.5	83.5	89.2	92.4	88.9
0:57:30	189.9	162.4	84.2	91.2	94.4	90.4
1:00:00	195.7	162.8	85.0	93.0	96.3	92.2
1:02:30	200.9	166.9	85.9	94.7	98.7	93.9
1:05:00	205.6	171.1	87.1	96.9	101.2	96.0
1:07:30	210.3	176.8	87.8	98.8	103.3	97.8
1:10:00	215.1	180.8	89.1	100.9	105.7	99.9
1:12:30	220.9	179.0	90.1	103.2	108.1	102.1
1:15:00	226.0	189.2	91.5	105.2	110.7	104.2
1:17:30	232.4	191.4	93.0	107.8	113.4	106.6
1:20:00	237.5	197.2	94.1	109.6	115.7	108.9
1:22:30	243.1	202.5	95.5	112.1	118.4	111.2
1:25:00	249.2	205.9	97.3	114.6	121.2	113.7
1:27:30	255.6	206.3	99.0	117.1	123.8	116.3
1:30:00	260.2	211.4	100.8	119.5	126.7	118.8
1:32:30	266.8	213.3	102.6	122.1	129.5	121.6
1:35:00	271.7	221.6	104.4	124.4	132.0	123.9
1:37:30	277.2	226.7	106.1	126.8	134.7	126.4
1:40:00	283.1	229.4	108.1	129.3	137.5	129.0
1:42:30	288.8	235.1	110.3	132.2	140.3	131.7
1:45:00	294.4	236.8	112.4	134.6	143.2	134.4
1:47:30	299.0	239.6	114.6	137.1	145.8	137.2
1:50:00	304.1	244.9	116.8	139.8	148.8	139.9
1:52:30	309.5	246.5	119.1	142.6	151.7	142.8
1:55:00	315.0	246.2	121.4	145.3	154.3	145.5
1:57:30	318.4	251.9	123.6	147.7	156.9	148.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
2:00:00	323.2	257.7	126.0	150.7	160.1	150.7
2:02:30	327.6	262.4	128.5	153.2	162.9	153.5
2:05:00	332.9	262.7	131.0	156.0	166.0	156.4
2:07:30	337.9	262.6	133.3	158.6	168.6	159.0
2:10:00	341.7	268.0	135.9	161.0	171.8	161.9
2:12:30	346.1	270.2	138.3	163.4	174.6	164.6
2:15:00	350.2	274.3	140.7	165.7	177.3	167.3
2:17:30	354.6	275.1	143.4	168.5	180.0	170.1
2:20:00	358.7	280.0	146.1	170.9	182.9	173.1
2:22:30	363.0	281.0	148.9	174.1	185.9	176.1
2:25:00	367.1	287.8	152.0	176.7	189.0	179.1
2:27:30	371.9	286.4	154.7	179.5	191.8	182.1
2:30:00	376.1	291.9	158.0	182.5	195.1	185.2
2:32:30	382.0	293.5	160.9	185.5	197.9	188.2
2:35:00	384.1	288.1	164.1	188.2	200.6	191.4
2:37:30	387.1	300.0	167.0	191.0	203.4	194.6
2:40:00	391.6	302.6	170.2	194.1	206.4	197.6
2:42:30	396.1	298.2	173.8	197.1	209.4	200.5
2:45:00	400.6	305.4	177.5	200.2	212.7	203.3
2:47:30	404.2	304.3	180.9	202.9	215.7	206.4
2:50:00	407.5	307.3	184.1	206.0	218.4	208.8
2:52:30	411.4	310.0	187.3	209.1	221.4	211.6
2:55:00	415.3	313.3	190.7	212.2	224.5	214.4
2:57:30	418.7	315.7	193.9	215.2	227.8	217.6
3:00:00	423.8	316.6	197.0	218.1	230.5	220.5
3:02:30	426.2	317.9	200.3	221.1	233.5	223.1
3:05:00	427.0	319.3	203.6	224.5	236.5	226.0
3:07:30	431.9	325.2	207.0	227.3	239.6	229.2
3:10:00	434.9	322.9	210.3	230.5	242.7	232.0
3:12:30	438.1	322.5	213.7	233.4	245.9	234.9
3:15:00	441.3	323.5	217.2	235.9	249.0	238.3
3:17:30	446.1	325.8	220.8	238.8	252.3	241.6
3:20:00	443.0	328.4	224.1	241.4	255.3	244.4
3:22:30	448.9	332.3	227.5	244.4	258.2	247.3
3:25:00	452.5	330.0	232.0	247.3	261.3	248.6
3:27:30	456.1	328.5	234.7	249.8	262.9	249.4
3:30:00	458.0	337.8	235.7	252.7	265.8	251.6
3:32:30	460.9	337.4	236.9	256.2	269.7	252.9
3:35:00	462.0	339.9	238.7	259.8	273.1	254.8
3:37:30	467.8	340.6	238.7	262.7	276.0	256.0
3:40:00	468.5	342.5	237.4	265.6	278.9	257.2
3:42:30	471.4	340.1	237.4	268.1	281.6	260.1
3:45:00	478.6	342.1	238.2	270.7	284.4	260.9
3:47:30	474.1	343.4	238.0	273.3	287.1	262.6
3:50:00	480.8	348.0	232.9	275.5	289.8	264.0
3:52:30	478.3	346.8	237.0	278.0	292.9	266.7
3:55:00	480.2	342.0	240.9	280.6	295.3	268.6
3:57:30	480.3	351.3	242.8	283.1	297.9	270.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
4:00:00	479.5	346.8	241.0	285.3	299.8	273.6
4:02:30	479.8	349.2	242.5	287.4	302.1	275.2
4:05:00	488.9	353.0	243.2	289.6	304.0	276.6
4:07:30	467.5	350.5	247.8	292.2	306.1	280.5
4:10:00	488.9	354.0	247.4	294.4	308.1	282.3
4:12:30	489.2	357.9	254.7	296.9	310.0	285.4
4:15:00	476.9	360.0	254.5	299.3	312.3	287.3
4:17:30	495.0	356.7	254.0	301.8	313.9	290.9
4:20:00	492.8	360.9	257.1	304.2	315.8	293.0
4:22:30	474.0	362.1	259.4	306.7	318.3	294.8
4:25:00	494.7	362.7	258.8	309.1	320.7	297.7
4:27:30	496.6	360.6	259.1	311.2	322.7	300.1
4:30:00	494.9	362.4	262.3	314.1	324.4	302.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	79.9	80.4	80.4	80.1	80.0	80.0
0:02:30	79.9	80.6	80.6	80.3	80.0	80.2
0:05:00	80.0	80.6	80.6	80.3	80.0	80.0
0:07:30	79.8	80.7	80.9	80.3	80.2	80.2
0:10:00	80.2	80.8	81.1	80.4	80.2	80.2
0:12:30	80.2	81.3	81.5	80.4	80.3	80.3
0:15:00	80.3	82.4	82.4	80.7	80.5	80.5
0:17:30	80.8	83.8	83.8	80.9	80.6	80.6
0:20:00	80.9	86.1	85.6	81.0	80.8	80.8
0:22:30	80.6	89.0	88.0	80.9	80.7	80.7
0:25:00	80.6	92.7	91.7	80.9	80.8	80.8
0:27:30	80.6	97.1	95.1	80.8	80.9	80.9
0:30:00	80.5	102.0	99.2	80.7	80.9	80.8
0:32:30	80.7	108.4	106.2	80.8	81.1	81.1
0:35:00	80.8	115.1	113.3	80.9	81.3	81.3
0:37:30	81.1	122.8	120.0	80.9	81.9	81.8
0:40:00	81.4	130.6	128.9	81.0	82.3	82.3
0:42:30	81.8	139.4	138.0	81.4	83.2	83.0
0:45:00	82.4	148.4	147.8	81.7	84.1	83.8
0:47:30	83.2	157.8	155.0	81.9	85.0	84.7
0:50:00	84.1	166.1	163.1	82.2	86.3	85.8
0:52:30	84.8	174.3	170.7	82.8	87.6	87.3
0:55:00	85.7	181.8	175.5	83.4	89.2	88.7
0:57:30	86.9	188.2	181.8	84.0	91.0	90.4
1:00:00	88.3	193.7	181.9	84.8	93.0	92.2
1:02:30	89.9	199.0	183.6	85.7	94.6	93.9
1:05:00	91.5	203.7	187.9	86.5	96.7	95.8
1:07:30	92.8	208.7	190.9	87.4	98.6	97.9
1:10:00	94.5	213.9	196.4	88.6	100.9	100.1
1:12:30	96.3	219.3	198.5	89.7	103.0	102.1
1:15:00	98.0	225.0	205.0	91.0	105.3	104.4
1:17:30	100.0	230.9	210.9	92.5	107.6	106.7
1:20:00	101.7	236.5	216.7	93.5	109.8	108.6
1:22:30	103.7	242.6	223.7	95.0	112.1	110.8
1:25:00	105.8	249.1	227.9	96.8	114.7	113.5
1:27:30	108.0	254.8	228.7	98.5	117.2	115.7
1:30:00	110.2	260.6	236.8	100.3	119.6	118.4
1:32:30	112.4	266.6	241.3	102.1	122.0	120.7
1:35:00	114.4	272.2	249.9	104.1	124.8	123.2
1:37:30	116.7	277.7	251.6	105.8	127.0	125.6
1:40:00	119.1	283.0	255.0	107.8	129.4	128.2
1:42:30	121.4	288.4	257.8	109.9	132.0	130.8
1:45:00	123.7	293.8	267.9	111.9	134.8	133.4
1:47:30	126.1	299.5	269.8	114.4	137.7	136.3
1:50:00	128.5	304.3	272.4	116.4	140.3	138.7
1:52:30	131.1	309.3	279.7	118.8	143.1	141.6
1:55:00	133.5	314.5	275.1	121.1	145.9	144.2
1:57:30	135.7	318.9	285.4	123.5	148.6	147.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
2:00:00	138.7	323.5	297.4	125.9	151.6	149.9
2:02:30	141.2	328.3	296.9	128.5	154.4	152.7
2:05:00	143.7	332.6	298.0	130.8	157.0	155.3
2:07:30	146.0	336.7	304.9	133.2	159.8	158.1
2:10:00	148.8	341.0	310.1	135.8	162.8	161.1
2:12:30	151.2	345.1	311.5	138.2	165.3	163.7
2:15:00	153.7	348.9	315.2	140.8	168.2	166.3
2:17:30	156.0	353.6	317.2	143.3	170.8	169.1
2:20:00	158.8	357.0	323.7	146.0	173.5	172.1
2:22:30	161.4	360.9	327.1	148.6	176.3	175.0
2:25:00	164.3	365.1	329.9	151.6	179.2	178.1
2:27:30	166.7	369.3	330.6	154.2	182.2	181.2
2:30:00	169.7	373.6	337.4	156.9	184.9	184.0
2:32:30	172.4	377.6	342.8	159.9	187.7	186.8
2:35:00	174.8	381.8	338.2	163.1	190.9	190.1
2:37:30	177.7	384.5	350.8	165.9	193.7	193.2
2:40:00	180.7	389.0	352.1	168.7	196.8	196.1
2:42:30	183.4	392.6	351.4	171.7	199.8	199.3
2:45:00	186.7	395.3	362.7	174.6	202.6	202.3
2:47:30	189.5	399.3	360.6	177.6	205.2	205.2
2:50:00	192.7	403.2	363.3	180.5	208.3	208.3
2:52:30	195.8	406.7	362.3	183.3	211.1	211.1
2:55:00	199.3	409.7	367.9	186.3	213.8	214.0
2:57:30	202.2	413.5	368.7	189.9	216.5	217.3
3:00:00	205.4	416.5	375.4	193.4	219.0	220.8
3:02:30	208.4	420.1	373.7	196.5	221.3	224.2
3:05:00	212.1	423.0	370.9	199.4	223.5	227.2
3:07:30	215.5	425.2	383.9	202.4	226.2	230.4
3:10:00	218.4	429.4	379.3	205.3	228.7	233.5
3:12:30	221.8	431.7	379.9	208.0	231.5	236.4
3:15:00	224.9	434.4	384.6	210.9	234.5	239.4
3:17:30	228.2	438.1	378.2	214.1	237.5	242.5
3:20:00	231.5	440.4	384.8	217.2	240.5	245.6
3:22:30	234.8	443.2	385.5	220.5	243.8	249.0
3:25:00	237.9	445.7	398.3	223.8	247.0	252.3
3:27:30	240.5	449.2	388.0	227.4	250.4	255.5
3:30:00	242.9	451.4	393.2	230.9	253.5	258.6
3:32:30	246.3	453.5	394.9	234.7	256.7	261.6
3:35:00	248.2	457.2	391.7	238.4	260.1	264.6
3:37:30	249.8	460.1	392.6	242.1	262.3	267.9
3:40:00	250.3	462.3	391.8	245.9	264.5	271.3
3:42:30	247.0	464.6	391.3	249.8	266.8	274.5
3:45:00	251.3	467.1	395.8	253.4	269.3	277.4
3:47:30	251.4	469.8	395.2	257.1	271.9	280.5
3:50:00	254.5	472.9	380.6	260.9	274.2	283.4
3:52:30	254.8	474.9	401.0	264.6	276.7	286.9
3:55:00	257.4	477.9	404.7	268.4	279.1	289.6
3:57:30	260.9	480.6	400.6	272.0	281.5	292.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
4:00:00	259.1	480.7	405.2	275.6	284.4	295.6
4:02:30	263.3	485.0	403.6	279.2	287.0	298.5
4:05:00	267.0	487.7	393.6	283.1	289.9	301.5
4:07:30	268.0	489.6	404.5	286.7	292.6	304.3
4:10:00	267.2	491.4	399.4	290.3	295.0	307.2
4:12:30	273.5	494.0	420.5	293.9	297.7	310.1
4:15:00	275.2	495.9	412.1	297.7	300.9	313.3
4:17:30	273.8	498.2	419.4	301.4	303.7	316.2
4:20:00	279.0	502.0	420.0	304.5	307.0	319.0
4:22:30	280.1	503.5	424.0	307.5	310.4	322.3
4:25:00	280.1	502.7	416.5	310.7	313.3	325.3
4:27:30	284.3	506.7	427.1	313.5	316.7	328.2
4:30:00	286.8	506.2	432.7	316.6	319.6	331.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	80.3	80.1	80.3	80.1	80.1
0:02:30	80.3	80.2	80.4	80.3	80.3
0:05:00	80.5	80.2	80.3	80.2	80.3
0:07:30	80.4	80.3	80.4	80.3	80.4
0:10:00	80.7	80.4	80.5	80.5	80.7
0:12:30	80.9	80.6	80.9	80.7	81.5
0:15:00	81.1	80.7	81.7	81.3	83.0
0:17:30	81.4	80.9	82.8	82.1	85.6
0:20:00	81.4	81.0	84.5	83.3	89.4
0:22:30	80.9	80.9	86.6	85.0	93.9
0:25:00	80.9	80.9	89.8	87.3	100.2
0:27:30	80.9	80.9	93.4	90.1	107.8
0:30:00	80.9	80.9	97.8	93.3	116.7
0:32:30	81.4	81.2	103.3	97.5	127.6
0:35:00	81.5	81.8	109.6	102.1	139.4
0:37:30	82.1	82.2	116.7	107.4	153.3
0:40:00	82.5	82.8	125.0	113.3	167.3
0:42:30	83.2	83.6	135.4	119.5	181.4
0:45:00	83.6	84.6	147.7	126.2	193.4
0:47:30	84.9	85.6	159.1	133.1	202.9
0:50:00	85.8	86.7	168.3	140.2	210.1
0:52:30	87.1	88.2	177.0	147.6	215.6
0:55:00	88.6	89.9	183.7	154.6	220.2
0:57:30	89.8	91.4	188.2	161.4	225.1
1:00:00	91.5	93.3	191.3	167.8	231.8
1:02:30	93.2	95.1	194.0	173.7	239.1
1:05:00	95.0	97.0	196.5	179.1	246.2
1:07:30	96.6	99.0	199.0	184.2	253.7
1:10:00	98.4	101.2	201.7	189.3	261.5
1:12:30	100.2	103.3	205.1	193.8	269.4
1:15:00	102.5	105.6	209.7	198.7	277.2
1:17:30	104.5	107.9	215.1	204.1	285.0
1:20:00	106.1	109.9	220.2	208.6	292.5
1:22:30	108.3	112.4	225.7	214.1	299.9
1:25:00	110.8	114.9	231.5	219.4	307.4
1:27:30	112.9	117.3	237.2	224.8	314.4
1:30:00	114.6	119.9	243.1	230.0	321.5
1:32:30	116.9	122.3	248.5	235.1	328.4
1:35:00	119.0	124.9	254.0	240.3	335.0
1:37:30	121.1	127.3	259.3	245.1	341.6
1:40:00	123.6	129.6	264.3	249.9	348.0
1:42:30	126.7	132.3	269.3	254.5	354.1
1:45:00	128.7	134.9	274.4	259.5	360.2
1:47:30	131.5	137.7	279.9	265.0	366.1
1:50:00	134.3	140.1	284.7	269.0	371.8
1:52:30	136.5	143.0	289.6	274.0	377.5
1:55:00	139.3	145.6	294.7	278.4	382.9
1:57:30	141.7	148.5	299.8	282.8	388.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
hr:min:sec					
2:00:00	143.5	151.0	304.5	287.0	393.5
2:02:30	145.9	153.4	309.2	290.3	398.5
2:05:00	147.7	155.9	313.4	294.2	403.2
2:07:30	150.7	158.3	317.8	298.6	408.0
2:10:00	153.1	160.8	321.8	302.4	412.8
2:12:30	155.5	163.2	325.8	306.1	417.4
2:15:00	157.6	165.6	330.1	310.1	421.9
2:17:30	161.1	168.0	334.2	313.4	426.3
2:20:00	162.4	170.6	338.6	317.6	430.6
2:22:30	164.7	173.2	342.3	320.7	435.1
2:25:00	167.5	176.0	346.8	325.2	439.4
2:27:30	168.7	178.6	351.4	330.4	443.6
2:30:00	172.0	181.0	355.5	334.1	447.7
2:32:30	173.6	183.7	359.7	337.7	451.6
2:35:00	177.8	186.8	363.0	340.3	455.5
2:37:30	180.7	189.8	366.3	342.6	459.4
2:40:00	182.7	192.7	370.4	347.3	463.0
2:42:30	183.7	195.6	374.3	351.0	466.6
2:45:00	186.1	198.2	378.1	354.5	470.1
2:47:30	187.0	200.9	381.7	359.3	473.7
2:50:00	188.8	203.3	385.0	361.3	477.0
2:52:30	191.1	205.7	388.5	364.9	480.2
2:55:00	192.5	208.3	391.6	367.7	483.3
2:57:30	195.3	211.1	394.1	369.7	486.7
3:00:00	197.5	214.3	397.7	373.4	489.6
3:02:30	200.3	216.7	401.2	376.6	492.6
3:05:00	202.9	218.5	404.1	380.1	495.4
3:07:30	207.2	220.9	407.1	383.1	498.6
3:10:00	210.1	223.2	411.2	386.9	501.2
3:12:30	212.1	225.3	414.1	388.8	504.1
3:15:00	214.9	227.4	417.5	391.9	506.7
3:17:30	218.7	230.0	420.4	395.5	509.4
3:20:00	219.6	232.6	423.2	397.9	512.1
3:22:30	224.2	235.1	425.9	400.9	514.7
3:25:00	227.2	237.4	428.7	403.1	517.2
3:27:30	227.7	240.1	432.4	406.9	519.7
3:30:00	232.2	242.8	433.7	408.9	522.0
3:32:30	235.7	246.0	436.6	412.0	524.6
3:35:00	236.8	248.6	439.9	415.9	526.8
3:37:30	230.8	251.2	442.4	417.7	529.3
3:40:00	237.9	254.0	446.9	421.6	531.4
3:42:30	236.9	256.6	450.1	425.4	533.5
3:45:00	241.2	259.4	452.1	426.6	535.5
3:47:30	241.8	261.9	455.0	430.0	537.5
3:50:00	242.6	264.6	457.7	431.7	539.3
3:52:30	245.1	267.5	460.2	434.5	541.5
3:55:00	248.8	269.8	462.0	435.7	543.2
3:57:30	243.9	272.4	465.9	439.4	545.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
4:00:00	249.5	274.8	466.9	440.8	546.8
4:02:30	249.8	277.4	469.9	442.6	548.6
4:05:00	250.6	280.4	470.1	443.1	550.4
4:07:30	248.1	283.0	474.5	446.1	552.0
4:10:00	250.7	285.7	477.5	450.2	553.6
4:12:30	257.9	288.5	477.4	451.3	555.2
4:15:00	251.4	291.6	480.9	453.2	557.2
4:17:30	259.0	294.6	484.1	456.5	558.6
4:20:00	260.3	297.4	484.2	458.2	560.0
4:22:30	249.7	300.5	487.9	460.8	561.6
4:25:00	258.1	303.3	491.5	463.4	562.9
4:27:30	263.0	306.1	492.6	463.6	564.3
4:30:00	267.8	309.0	493.2	465.7	566.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	73.4	73.6	73.3	73.0	73.8	73.8
0:02:29	73.6	73.7	73.4	73.1	74.0	74.9
0:04:59	74.1	74.0	74.1	74.0	76.3	79.8
0:07:29	76.5	75.7	76.9	76.8	81.0	87.2
0:09:59	81.5	79.7	82.3	82.2	88.3	97.7
0:12:29	89.4	86.2	90.4	89.9	98.0	110.5
0:14:59	99.2	95.0	100.0	99.2	109.5	124.8
0:17:29	110.5	105.2	110.7	109.4	121.8	140.7
0:19:59	121.5	116.6	122.1	120.6	135.2	157.4
0:22:29	134.0	128.9	134.1	132.4	149.7	174.1
0:24:59	146.7	141.3	146.3	144.7	164.2	190.9
0:27:29	159.3	154.0	158.5	156.9	178.7	206.5
0:29:59	171.6	166.2	170.6	169.9	193.1	221.9
0:32:29	183.6	132.8	181.8	181.0	181.2	238.0
0:34:59	193.7	166.2	193.0	191.4	171.7	253.6
0:37:29	195.5	129.1	177.8	86.7	172.7	126.1
0:39:59	187.9	123.2	184.8	87.8	172.6	115.3
0:42:29	167.6	118.6	194.7	92.0	173.3	114.9
0:44:59	135.7	127.0	207.9	90.9	177.7	127.0
0:47:29	103.4	124.4	216.8	95.1	181.8	125.2
0:49:59	98.9	132.5	230.0	92.7	186.9	131.9
0:52:29	91.6	134.8	231.1	96.1	191.6	145.5
0:54:59	86.0	135.9	228.3	93.9	197.2	142.4
0:57:29	77.3	139.0	236.9	98.3	203.7	142.5
0:59:59	78.1	149.9	241.9	98.4	210.0	151.2
1:02:29	81.7	158.0	248.5	99.9	216.3	156.3
1:04:59	79.3	151.7	243.5	102.0	222.5	166.0
1:07:29	237.6	189.2	243.3	226.4	230.8	158.7
1:09:59	263.7	143.5	244.2	256.2	237.3	135.6
1:12:29	276.3	156.3	252.0	267.4	240.7	152.2
1:14:59	285.7	163.6	253.3	278.1	244.9	158.3
1:17:29	292.9	157.0	250.5	285.3	246.6	152.6
1:19:59	298.9	160.7	261.4	293.8	250.0	165.7
1:22:29	303.8	156.9	258.6	296.7	255.4	168.3
1:24:59	309.1	259.0	305.2	365.0	264.1	262.7
1:27:29	315.0	264.6	322.6	354.8	267.2	287.0
1:29:59	319.3	274.9	335.6	363.0	272.6	292.6
1:32:29	323.9	274.9	345.8	360.7	274.5	298.3
1:34:59	327.7	279.6	354.1	366.5	275.1	299.7
1:37:29	331.2	283.2	361.4	367.7	280.6	312.4
1:39:59	334.6	285.2	367.8	368.2	282.6	316.3
1:42:29	337.9	292.9	373.7	381.2	287.4	325.9
1:44:59	341.9	294.9	378.8	380.8	289.0	313.3
1:47:29	345.4	295.6	383.3	383.2	289.6	317.7
1:49:59	349.2	301.3	387.9	390.0	292.7	296.6
1:52:29	352.7	300.5	392.3	389.0	293.1	323.9
1:54:59	355.8	304.8	396.3	397.0	296.8	325.0
1:57:29	360.6	313.5	400.6	405.5	305.5	323.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
1:59:59	364.3	308.3	404.8	402.7	303.5	330.6
2:02:29	368.6	308.9	409.0	404.2	302.5	345.9
2:04:59	374.7	318.3	414.0	414.9	309.0	344.0
2:07:29	383.1	321.8	419.4	417.4	312.5	354.9
2:09:59	391.7	326.9	425.5	425.2	317.3	354.4
2:12:29	400.0	330.1	430.8	432.0	320.0	358.5
2:14:59	408.2	332.7	436.4	432.9	324.1	355.6
2:17:29	415.0	330.8	441.2	432.9	322.2	376.1
2:19:59	421.5	337.5	445.9	440.8	329.2	378.0
2:22:29	427.6	338.4	450.6	439.3	332.0	388.8
2:24:59	433.5	344.0	455.6	445.5	344.3	448.2
2:27:29	439.1	347.6	460.3	450.7	344.5	565.4
2:29:59	445.4	356.4	465.4	458.4	356.2	577.8
2:32:29	452.5	362.6	470.8	464.7	361.0	713.9
2:34:59	459.4	372.1	475.8	468.1	370.5	766.2
2:37:29	466.9	378.7	480.4	477.0	376.5	805.1
2:39:59	475.7	385.9	484.6	481.5	381.2	867.7
2:42:29	486.3	401.0	489.3	486.6	392.1	749.8
2:44:59	500.0	414.1	494.6	498.0	406.5	802.4
2:47:29	513.8	429.6	500.5	507.5	415.8	811.9
2:49:59	528.9	448.0	507.3	517.2	425.0	814.0
2:52:29	545.5	462.3	515.6	523.1	431.0	779.5
2:54:59	562.3	481.7	525.5	533.0	439.4	857.6
2:57:29	578.9	484.2	536.4	540.9	449.6	899.8
2:59:59	594.0	489.2	548.9	547.5	458.4	916.7
3:02:29	611.2	490.1	561.8	560.3	470.3	979.2
3:04:59	630.3	523.8	576.4	500.5	481.7	959.0
3:07:29	649.1	544.9	592.6	500.5	492.0	906.4
3:09:59	674.1	567.5	612.7	496.6	498.2	948.7
3:12:29	699.3	617.2	633.8	664.2	511.4	958.1
3:14:59	725.0	657.6	655.3	726.9	524.8	981.7
3:17:29	749.4	690.8	680.4	775.2	542.8	1001.0
3:19:59	776.7	720.7	710.1	798.9	562.9	1039.1
3:22:29	801.1	744.2	744.3	818.9	575.2	1046.9
3:24:59	820.1	753.6	780.9	843.6	590.2	1073.7
3:27:29	841.1	752.2	818.3	867.4	593.6	1062.5
3:29:59	864.1	731.9	848.7	889.7	603.4	1090.9
3:32:29	885.2	704.7	878.0	913.0	624.8	1137.5
3:34:59	906.1	710.3	906.1	929.1	645.7	1124.8
3:37:29	924.8	725.8	929.9	957.0	672.2	1131.6
3:39:59	939.6	708.1	949.1	984.0	697.8	1080.5
3:42:29	954.3	747.3	968.5	1009.2	723.2	1102.2
3:44:59	976.3	744.5	985.4	1021.2	743.5	1084.6
3:47:29	1006.0	743.7	998.5	1033.2	758.9	1154.6
3:49:59	1032.0	738.6	1013.0	1053.4	768.1	1154.2
3:52:29	1052.7	671.4	1024.4	1060.5	732.1	1153.9
3:54:59	1062.7	742.4	1036.0	1072.1	802.3	1138.8
3:57:29	1075.0	668.0	1050.4	1078.2	840.2	1175.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
3:59:59	1079.6	688.8	1062.7	1086.0	874.2	1158.5
4:02:29	1086.5	702.3	1073.9	1090.9	896.4	1156.9
4:04:59	1092.9	753.6	1083.9	1097.9	903.7	1062.7
4:07:29	1099.6	724.9	1091.7	1097.3	895.3	1140.9
4:09:59	1103.9	722.7	1100.4	1102.8	890.2	1125.7
4:12:29	1106.7	738.3	1106.8	1107.2	897.7	1173.4
4:14:59	1111.4	777.9	1109.2	1113.7	899.0	1128.4
4:17:29	1113.2	740.2	1110.9	1111.4	872.6	1139.0
4:19:59	1115.0	753.3	1113.1	1112.5	869.3	1106.1
4:22:29	1113.7	750.7	1113.9	1114.9	864.5	1141.1
4:24:59	1112.6	719.3	1112.2	1112.3	842.6	1127.4
4:27:29	1109.4	779.1	1109.0	1118.6	871.2	1143.3
4:29:59	1110.5	763.7	1102.9	1139.5	932.8	986.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	73.3	73.3	73.3	73.8	73.7	74.0
0:02:29	105.6	73.6	73.4	74.0	73.9	74.3
0:04:59	161.0	74.8	74.5	74.8	74.7	76.6
0:07:29	223.8	78.4	77.8	78.5	77.8	82.0
0:09:59	294.5	84.7	84.4	85.1	84.2	89.9
0:12:29	354.7	93.1	92.9	95.0	94.0	99.7
0:14:59	398.1	102.7	102.6	107.2	106.4	110.9
0:17:29	448.9	113.2	113.2	120.0	119.8	122.8
0:19:59	483.9	124.4	124.8	133.5	133.8	135.8
0:22:29	512.2	135.4	136.8	147.0	148.1	148.1
0:24:59	536.7	146.7	149.4	160.8	162.5	160.3
0:27:29	563.1	157.6	161.3	174.7	177.1	168.8
0:29:59	588.8	168.3	173.7	187.8	186.3	175.3
0:32:29	612.0	178.1	184.5	201.4	193.4	165.3
0:34:59	629.5	187.8	195.7	214.3	206.1	159.9
0:37:29	648.5	196.0	203.9	227.2	219.9	177.7
0:39:59	663.6	202.1	210.9	239.5	227.6	175.3
0:42:29	675.3	209.9	219.0	250.8	234.6	161.9
0:44:59	687.4	218.9	227.5	261.4	239.9	172.9
0:47:29	696.5	224.4	234.3	271.9	246.9	170.8
0:49:59	704.5	231.6	243.2	279.7	254.7	189.8
0:52:29	712.9	237.3	252.1	287.8	261.7	185.8
0:54:59	721.7	244.1	260.7	295.3	268.5	177.4
0:57:29	730.7	250.9	268.2	302.6	275.3	193.5
0:59:59	738.2	256.9	275.9	309.3	282.6	187.1
1:02:29	744.4	260.7	282.1	315.9	290.4	200.5
1:04:59	750.4	267.3	289.5	322.2	297.3	217.0
1:07:29	754.5	274.3	292.9	327.5	303.1	200.2
1:09:59	760.0	281.7	283.7	333.0	308.0	244.0
1:12:29	764.8	287.4	296.2	338.7	316.5	244.6
1:14:59	769.4	293.2	298.1	344.7	323.1	249.7
1:17:29	773.6	297.7	303.2	350.2	329.0	253.9
1:19:59	777.9	301.8	311.2	355.4	334.9	258.4
1:22:29	783.9	307.7	314.3	360.1	339.9	263.9
1:24:59	789.7	311.9	324.1	364.7	344.5	233.0
1:27:29	794.8	318.0	338.0	369.3	349.5	280.8
1:29:59	801.4	322.3	342.6	373.9	354.6	284.9
1:32:29	806.2	327.9	352.2	378.8	360.1	288.6
1:34:59	811.3	335.5	358.8	384.0	364.2	295.4
1:37:29	817.1	339.2	363.8	389.4	369.0	297.9
1:39:59	822.1	342.8	368.7	394.7	373.5	301.5
1:42:29	827.8	351.4	377.6	400.0	377.6	308.6
1:44:59	833.5	356.7	384.5	405.9	381.6	312.6
1:47:29	838.9	360.9	389.7	411.8	385.8	316.3
1:49:59	843.0	365.7	392.4	417.4	391.3	319.6
1:52:29	848.4	370.9	399.4	422.6	396.2	324.5
1:54:59	853.8	378.3	404.3	427.7	400.7	329.4
1:57:29	857.6	381.4	407.1	433.0	405.2	333.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
1:59:59	861.0	390.2	415.4	438.4	409.7	336.5
2:02:29	863.8	400.2	422.0	444.4	413.0	340.7
2:04:59	868.6	406.7	420.3	450.7	415.6	344.0
2:07:29	871.7	413.9	428.3	456.1	420.0	351.2
2:09:59	875.6	419.2	429.6	461.3	424.3	356.0
2:12:29	880.5	427.6	438.4	466.7	427.4	366.5
2:14:59	886.0	435.9	443.4	472.7	429.7	370.0
2:17:29	892.7	442.5	452.1	479.3	432.2	378.4
2:19:59	898.1	449.6	455.4	486.6	434.7	380.7
2:22:29	904.3	456.4	461.9	493.9	438.2	388.6
2:24:59	911.0	462.1	469.1	501.3	443.1	394.9
2:27:29	918.9	468.8	476.5	509.7	447.1	399.5
2:29:59	927.2	476.1	484.2	518.3	452.8	405.3
2:32:29	936.4	483.5	491.5	527.7	458.9	408.9
2:34:59	944.9	492.1	496.4	536.8	465.6	416.6
2:37:29	952.7	502.2	504.9	548.1	473.0	423.8
2:39:59	959.9	513.4	522.4	560.2	478.9	432.6
2:42:29	969.0	525.5	531.9	572.8	484.6	440.1
2:44:59	978.8	538.6	551.9	586.0	490.9	448.7
2:47:29	989.5	552.7	576.2	602.0	496.6	465.1
2:49:59	995.9	567.5	602.1	621.1	501.4	479.3
2:52:29	1004.6	585.6	628.3	642.7	509.9	485.4
2:54:59	1011.3	602.7	658.0	672.3	521.8	491.8
2:57:29	1018.1	618.5	689.7	703.2	535.9	500.9
2:59:59	1024.9	635.1	723.8	734.1	549.7	512.3
3:02:29	1031.1	656.4	763.1	768.1	561.7	526.9
3:04:59	1037.6	671.0	797.5	803.2	579.4	541.6
3:07:29	1042.9	698.4	840.9	838.6	596.8	550.8
3:09:59	1046.6	720.1	896.2	867.5	618.7	568.6
3:12:29	1052.0	745.7	972.6	899.2	643.8	585.4
3:14:59	1058.5	768.6	1028.7	931.0	674.3	593.4
3:17:29	1062.5	794.3	1067.0	960.2	713.7	608.2
3:19:59	1068.4	819.9	1094.8	994.7	762.1	618.3
3:22:29	1074.9	843.4	1113.4	1027.9	807.3	627.4
3:24:59	1080.9	867.9	1124.1	1054.8	850.5	649.3
3:27:29	1085.3	891.2	1135.9	1079.9	896.8	645.8
3:29:59	1090.6	912.7	1144.9	1101.2	937.5	653.9
3:32:29	1094.1	934.6	1149.2	1116.2	984.4	684.5
3:34:59	1098.6	962.8	1155.6	1130.3	1039.6	695.0
3:37:29	1103.8	990.0	1159.3	1139.8	1090.1	697.2
3:39:59	1106.6	1010.6	1167.1	1151.1	1130.4	703.3
3:42:29	1109.6	1029.3	1173.4	1161.2	1166.3	715.0
3:44:59	1112.8	1048.0	1177.7	1173.1	1190.5	721.3
3:47:29	1115.7	1062.3	1180.9	1181.4	1210.6	740.5
3:49:59	1119.8	1074.7	1185.8	1192.6	1226.1	755.1
3:52:29	1118.5	1087.1	1189.0	1201.2	1237.8	744.9
3:54:59	1120.9	1096.5	1191.8	1210.8	1243.7	753.7
3:57:29	1120.6	1105.6	1194.2	1216.6	1252.2	769.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
3:59:59	1121.2	1113.7	1195.2	1224.2	1259.0	786.4
4:02:29	1123.9	1120.5	1197.6	1229.4	1263.4	793.1
4:04:59	1125.7	1128.3	1198.3	1234.0	1266.3	788.3
4:07:29	1128.0	1137.6	1199.2	1231.6	1268.5	765.3
4:09:59	1130.4	1145.0	1196.6	1230.0	1268.7	767.6
4:12:29	1130.1	1150.0	1196.5	1230.9	1273.2	772.0
4:14:59	1132.5	1153.8	1195.9	1229.1	1274.0	777.3
4:17:29	1132.1	1157.0	1192.2	1228.3	1270.5	768.8
4:19:59	1133.6	1160.7	1191.3	1224.2	1272.0	759.4
4:22:29	1135.4	1163.2	1189.6	1220.4	1272.5	766.4
4:24:59	1136.4	1165.8	1187.0	1217.9	1271.1	763.0
4:27:29	1138.1	1166.8	1185.7	100.0	1270.5	766.4
4:29:59	1139.2	1167.3	1185.9	710.5	356.6	768.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	73.8	73.0	74.4	74.4	74.3	74.1
0:02:29	74.3	102.1	74.6	74.4	74.4	74.1
0:04:59	78.0	161.7	74.5	74.4	74.4	74.2
0:07:29	84.2	228.2	74.3	74.3	74.1	74.0
0:09:59	93.2	301.8	74.5	74.5	74.5	74.3
0:12:29	103.8	356.6	74.4	74.4	74.4	74.3
0:14:59	115.4	404.2	74.5	74.7	74.5	74.5
0:17:29	127.6	444.4	74.6	74.6	74.6	74.4
0:19:59	144.1	480.4	74.6	74.6	74.4	74.4
0:22:29	157.3	508.1	74.7	74.9	74.7	74.6
0:24:59	173.0	530.3	74.7	75.0	74.9	74.7
0:27:29	187.1	553.0	74.8	75.4	75.1	74.9
0:29:59	204.8	571.7	74.9	75.8	75.6	75.2
0:32:29	158.1	589.5	75.3	76.6	76.1	75.5
0:34:59	156.0	602.9	75.4	77.0	76.7	75.9
0:37:29	168.1	621.5	75.8	78.4	78.0	76.5
0:39:59	158.4	636.1	76.3	79.6	79.2	77.3
0:42:29	167.3	646.5	76.6	81.1	80.6	78.2
0:44:59	190.1	656.6	77.1	82.9	82.0	79.1
0:47:29	172.9	667.5	77.8	84.7	84.0	80.2
0:49:59	196.6	676.2	78.7	87.0	86.1	81.5
0:52:29	193.6	685.3	79.3	89.2	88.2	82.8
0:54:59	207.9	691.9	80.3	91.7	90.5	84.4
0:57:29	208.8	700.0	81.2	94.1	92.7	86.0
0:59:59	226.4	706.0	82.4	96.7	94.9	87.7
1:02:29	216.0	711.9	83.7	99.3	97.4	89.5
1:04:59	225.8	717.6	85.1	102.0	99.9	91.5
1:07:29	240.7	720.3	86.5	104.4	102.2	93.3
1:09:59	249.2	724.3	88.1	107.2	104.8	95.2
1:12:29	262.7	729.0	89.7	110.0	107.2	97.3
1:14:59	257.1	735.0	91.7	112.6	109.6	99.3
1:17:29	270.4	738.7	93.3	115.6	112.2	101.6
1:19:59	272.0	745.1	95.2	118.2	114.7	103.8
1:22:29	274.1	749.0	97.1	121.1	117.2	106.0
1:24:59	261.1	756.3	99.3	124.0	119.9	108.2
1:27:29	259.5	773.0	101.5	126.9	122.6	110.7
1:29:59	262.8	787.3	103.7	129.8	125.2	113.0
1:32:29	264.7	798.5	106.1	132.8	127.9	115.4
1:34:59	267.0	805.0	108.7	136.4	130.9	118.2
1:37:29	271.8	814.2	111.1	139.2	133.6	120.6
1:39:59	273.8	819.2	113.6	142.3	136.3	122.9
1:42:29	280.8	825.3	116.3	145.6	139.2	125.7
1:44:59	282.9	832.7	119.1	149.0	142.2	128.5
1:47:29	286.3	838.0	121.9	152.3	145.3	131.5
1:49:59	296.5	844.7	125.0	155.8	148.6	134.5
1:52:29	293.7	849.6	127.9	159.2	151.8	137.5
1:54:59	293.7	854.1	131.0	162.6	155.0	140.6
1:57:29	299.9	859.6	134.1	166.1	158.3	143.6

R8196/95NK3179

Test Date : APRIL 14, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
1:59:59	291.9	864.8	137.2	169.5	161.5	146.7
2:02:29	297.6	867.6	140.5	173.1	164.8	150.0
2:04:59	308.0	873.8	143.8	176.8	168.2	153.1
2:07:29	316.3	877.3	146.9	180.1	171.5	156.4
2:09:59	310.7	883.7	150.3	183.6	174.7	159.4
2:12:29	282.9	886.4	153.6	187.1	178.2	162.6
2:14:59	302.0	894.7	156.7	190.6	181.5	165.9
2:17:29	289.6	898.8	160.3	194.2	184.9	169.2
2:19:59	311.2	903.8	163.9	198.1	188.5	172.5
2:22:29	318.7	908.7	167.3	201.3	191.7	175.4
2:24:59	302.7	914.2	170.6	204.5	195.2	178.8
2:27:29	347.5	921.0	174.1	208.0	198.5	182.1
2:29:59	345.8	926.8	177.4	211.4	201.8	185.4
2:32:29	367.9	935.3	180.7	214.5	204.9	188.7
2:34:59	362.5	941.9	183.9	217.7	208.1	191.8
2:37:29	364.0	949.3	187.3	221.0	211.5	195.4
2:39:59	380.6	953.0	190.5	224.0	214.8	198.2
2:42:29	379.9	959.0	193.9	227.3	218.0	201.3
2:44:59	362.2	969.6	197.1	230.5	221.2	204.6
2:47:29	377.4	975.9	200.6	234.1	224.6	207.8
2:49:59	372.5	981.5	204.0	237.4	227.7	211.1
2:52:29	401.9	990.6	207.9	240.8	230.9	215.0
2:54:59	411.9	995.6	211.9	244.2	234.0	218.3
2:57:29	422.9	1001.1	215.5	247.5	237.4	221.5
2:59:59	428.1	1006.1	219.1	250.7	240.7	224.9
3:02:29	431.5	1014.2	223.1	254.3	244.1	228.2
3:04:59	417.1	1020.5	226.8	257.5	247.4	231.8
3:07:29	453.9	1027.4	230.7	260.8	250.9	235.4
3:09:59	461.1	1031.4	234.5	264.2	254.4	238.9
3:12:29	470.5	1035.2	238.6	266.9	257.8	242.6
3:14:59	486.1	1044.0	242.5	268.9	261.2	245.9
3:17:29	487.9	1048.2	246.0	272.0	264.5	249.4
3:19:59	501.9	1053.7	249.8	274.7	267.7	253.1
3:22:29	513.9	1058.4	253.3	277.2	270.9	256.4
3:24:59	480.2	1061.1	256.8	280.1	273.7	260.0
3:27:29	514.5	1066.5	260.6	283.1	276.6	263.5
3:29:59	537.6	1070.8	264.7	286.5	279.4	267.2
3:32:29	512.6	1072.2	268.4	289.7	282.2	270.9
3:34:59	551.2	1078.8	272.4	293.2	285.4	274.7
3:37:29	538.4	1084.5	276.7	296.6	288.6	277.8
3:39:59	606.7	1087.7	280.5	299.5	291.5	281.0
3:42:29	593.2	1089.9	284.8	302.7	294.7	284.5
3:44:59	634.2	1094.0	288.9	306.0	297.9	288.0
3:47:29	623.0	1095.0	293.0	309.3	301.1	291.4
3:49:59	622.8	1099.0	296.8	312.2	304.2	294.7
3:52:29	657.7	1101.4	300.9	315.3	307.1	298.2
3:54:59	673.8	1101.6	304.8	318.4	309.7	298.9
3:57:29	648.3	1100.6	308.5	321.9	313.2	301.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
3:59:59	636.4	1101.9	312.1	325.6	316.6	304.4
4:02:29	655.2	1105.5	315.4	328.8	320.4	306.4
4:04:59	676.6	1111.8	318.9	332.1	323.6	308.9
4:07:29	663.4	1113.6	322.4	335.2	326.7	310.9
4:09:59	706.7	1113.7	326.1	338.3	330.0	313.9
4:12:29	707.0	1112.3	329.7	341.7	333.1	316.5
4:14:59	713.1	1113.3	333.4	345.3	336.3	319.3
4:17:29	700.6	1114.9	337.1	348.6	339.6	321.7
4:19:59	700.3	1117.7	340.5	352.3	343.0	324.2
4:22:29	720.0	1119.1	343.8	355.5	346.2	326.7
4:24:59	713.6	1120.2	347.2	359.2	349.3	329.3
4:27:29	711.6	1120.1	350.6	362.9	352.3	330.0
4:29:59	730.8	1120.9	354.5	366.8	355.3	302.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	73.7	74.1	74.4	74.4	74.3	74.0
0:02:29	73.9	74.1	74.4	74.4	74.1	74.0
0:04:59	73.7	74.3	74.6	74.6	74.3	74.1
0:07:29	73.7	74.5	74.6	74.6	74.5	74.3
0:09:59	74.1	74.5	74.8	74.6	74.5	74.3
0:12:29	74.0	74.9	75.2	74.8	74.5	74.4
0:14:59	74.2	76.1	76.2	74.9	74.8	74.6
0:17:29	74.3	77.9	77.9	75.1	75.0	74.8
0:19:59	74.4	80.2	80.2	74.9	74.9	74.9
0:22:29	74.6	84.1	83.8	75.1	75.2	75.1
0:24:59	74.7	89.3	88.5	75.2	75.5	75.2
0:27:29	75.1	95.7	94.2	75.2	75.8	75.5
0:29:59	75.3	103.7	100.9	75.3	76.1	75.9
0:32:29	76.0	113.1	108.6	75.6	76.9	76.4
0:34:59	76.5	123.8	116.8	75.7	77.6	76.9
0:37:29	77.3	134.4	125.7	75.9	78.4	77.5
0:39:59	78.3	145.0	135.1	76.3	79.6	78.3
0:42:29	79.5	155.3	144.1	76.6	81.0	79.6
0:44:59	80.7	163.3	152.3	77.0	82.7	80.8
0:47:29	82.1	170.4	159.1	77.6	84.4	82.3
0:49:59	83.8	176.8	164.9	78.2	86.1	83.9
0:52:29	85.5	180.2	169.2	79.0	87.6	85.7
0:54:59	87.3	182.1	173.0	79.7	89.6	87.7
0:57:29	89.3	183.6	176.3	80.6	92.8	89.7
0:59:59	91.4	185.5	179.3	81.5	94.1	91.9
1:02:29	93.4	187.1	182.3	82.6	95.6	94.1
1:04:59	95.6	188.8	185.7	83.8	97.2	96.2
1:07:29	98.0	191.1	188.7	85.0	98.5	98.5
1:09:59	100.3	193.7	193.1	86.3	100.5	100.9
1:12:29	102.8	196.9	197.4	87.9	102.3	103.2
1:14:59	105.1	200.4	201.4	89.3	104.4	105.5
1:17:29	107.7	204.7	206.3	91.0	106.3	108.2
1:19:59	110.2	209.3	211.3	92.7	108.5	110.5
1:22:29	112.8	214.0	216.4	94.2	110.8	112.8
1:24:59	115.3	219.7	221.7	96.1	113.5	115.5
1:27:29	118.0	225.8	227.5	98.0	116.4	118.1
1:29:59	120.8	231.5	233.5	100.1	119.5	120.7
1:32:29	123.6	238.0	239.4	102.2	122.9	123.4
1:34:59	126.6	244.2	245.5	104.2	126.4	126.0
1:37:29	129.3	250.4	251.3	106.3	129.9	128.5
1:39:59	132.2	256.5	257.2	108.6	134.1	131.4
1:42:29	135.4	262.5	263.1	110.9	138.6	134.3
1:44:59	138.4	268.5	268.6	113.4	142.5	137.0
1:47:29	141.7	274.4	273.9	115.6	146.1	139.9
1:49:59	144.9	280.0	279.6	118.2	149.7	142.9
1:52:29	148.1	286.2	285.0	120.9	153.1	146.1
1:54:59	151.4	291.7	290.4	123.2	156.3	148.8
1:57:29	154.9	297.2	296.0	126.0	159.6	151.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
1:59:59	158.2	302.9	300.8	128.5	162.7	154.8
2:02:29	161.8	308.0	306.1	131.4	166.3	157.8
2:04:59	165.1	312.9	310.6	134.1	169.5	161.1
2:07:29	168.4	318.5	315.6	136.8	173.0	164.4
2:09:59	172.0	323.1	320.5	139.4	176.3	167.4
2:12:29	175.4	328.1	325.2	142.4	179.4	170.4
2:14:59	179.1	332.6	330.3	145.3	182.5	173.6
2:17:29	182.6	337.4	335.2	147.9	185.4	176.6
2:19:59	186.3	341.5	339.4	150.8	188.5	179.6
2:22:29	189.8	346.9	344.3	153.9	191.9	182.9
2:24:59	193.3	351.6	348.4	156.8	195.2	186.3
2:27:29	196.7	356.0	352.6	160.2	198.2	189.4
2:29:59	200.4	360.4	356.6	162.6	201.3	193.0
2:32:29	203.5	364.6	359.8	166.1	204.9	196.4
2:34:59	206.9	368.7	363.9	168.9	208.4	199.2
2:37:29	210.9	373.1	367.4	172.0	212.0	202.5
2:39:59	214.3	377.5	370.9	174.5	215.1	205.3
2:42:29	217.9	381.6	375.2	177.7	218.5	208.7
2:44:59	221.0	385.5	379.1	180.6	221.9	211.9
2:47:29	220.0	389.6	382.4	183.8	224.9	214.6
2:49:59	221.9	393.7	386.7	186.9	228.2	217.7
2:52:29	224.7	397.5	389.7	189.9	231.7	220.5
2:54:59	233.0	401.4	391.7	193.4	235.2	223.9
2:57:29	236.0	405.8	396.6	196.9	238.6	227.3
2:59:59	239.1	409.3	400.9	200.5	241.7	230.3
3:02:29	242.2	413.0	402.8	204.2	245.6	233.8
3:04:59	245.3	416.8	404.8	208.2	248.9	237.5
3:07:29	248.4	420.6	409.8	212.2	252.2	241.0
3:09:59	251.6	422.8	411.9	215.9	255.9	244.5
3:12:29	254.8	425.7	415.3	219.8	259.4	248.2
3:14:59	258.2	429.8	418.1	224.1	263.4	252.5
3:17:29	261.8	432.7	419.7	228.4	266.8	256.0
3:19:59	265.3	436.3	426.4	232.6	270.6	259.7
3:22:29	268.7	439.9	428.1	236.7	274.1	263.6
3:24:59	272.6	443.3	427.6	240.6	277.8	267.4
3:27:29	276.3	445.4	435.2	245.1	281.8	271.7
3:29:59	279.9	447.8	436.6	249.6	285.9	275.6
3:32:29	283.5	452.6	442.4	254.0	289.6	279.6
3:34:59	287.4	454.6	446.2	259.6	293.5	283.8
3:37:29	290.9	457.2	444.8	264.1	297.6	288.3
3:39:59	294.1	459.6	448.2	268.3	301.7	292.8
3:42:29	297.1	462.6	450.7	273.5	306.0	297.7
3:44:59	300.2	464.8	455.7	277.6	309.8	301.2
3:47:29	303.2	468.7	460.1	281.5	313.6	304.4
3:49:59	305.7	467.5	457.3	285.8	317.2	307.9
3:52:29	308.6	469.3	461.6	290.1	321.2	310.9
3:54:59	311.7	472.6	461.1	293.7	325.3	314.1
3:57:29	315.1	477.1	469.1	297.4	329.0	316.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
3:59:59	318.0	479.9	470.4	300.8	331.5	319.0
4:02:29	320.8	479.2	467.3	304.3	334.9	322.1
4:04:59	323.7	479.7	467.3	307.9	338.3	325.0
4:07:29	326.3	484.7	475.6	310.8	342.5	328.5
4:09:59	329.1	482.7	472.6	313.2	346.4	332.1
4:12:29	331.9	488.9	478.4	316.0	349.6	335.5
4:14:59	334.7	490.8	479.3	318.7	353.1	339.0
4:17:29	337.3	494.5	482.9	321.4	356.7	342.5
4:19:59	340.2	494.1	487.8	323.8	359.9	345.4
4:22:29	342.9	496.5	484.9	326.6	363.7	348.5
4:24:59	345.6	497.0	486.2	329.7	367.0	352.0
4:27:29	348.5	503.4	496.7	332.5	370.7	356.6
4:29:59	349.3	502.8	492.4	335.5	374.1	362.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	74.7	74.7	74.4	74.6	74.1
0:02:29	74.7	74.7	74.4	74.6	74.1
0:04:59	74.8	74.8	74.6	74.7	74.3
0:07:29	74.9	74.9	74.8	74.8	74.5
0:09:59	74.8	74.9	74.6	74.9	74.9
0:12:29	74.9	74.9	75.1	75.1	76.0
0:14:59	75.0	75.2	75.6	75.9	78.2
0:17:29	75.2	75.2	76.7	77.0	81.8
0:19:59	75.0	75.3	77.9	78.5	86.9
0:22:29	75.4	75.5	80.2	81.0	93.9
0:24:59	75.4	75.7	82.9	84.1	103.3
0:27:29	75.6	75.9	86.7	88.0	114.9
0:29:59	75.7	76.1	91.6	92.9	130.3
0:32:29	76.1	76.8	97.0	98.4	147.2
0:34:59	76.4	77.3	103.4	105.3	162.7
0:37:29	76.9	78.1	110.7	113.8	176.5
0:39:59	77.6	78.9	119.0	125.0	187.6
0:42:29	78.3	80.1	127.6	136.2	196.4
0:44:59	79.0	81.4	135.8	145.9	202.1
0:47:29	80.4	82.8	143.6	154.4	206.2
0:49:59	81.6	84.3	150.8	161.5	209.7
0:52:29	82.9	86.3	157.2	168.2	213.3
0:54:59	84.6	88.2	162.5	171.7	217.6
0:57:29	86.3	90.5	166.5	174.8	221.9
0:59:59	87.9	92.3	170.1	177.2	227.1
1:02:29	89.8	94.5	173.2	179.2	232.3
1:04:59	91.8	96.9	176.1	181.0	238.5
1:07:29	93.7	98.9	178.8	183.4	244.9
1:09:59	95.8	101.6	181.9	185.8	252.0
1:12:29	98.0	103.8	185.3	188.5	259.7
1:14:59	100.1	106.1	188.5	192.8	267.9
1:17:29	102.4	108.7	192.2	197.0	276.4
1:19:59	104.7	110.8	196.2	201.9	285.0
1:22:29	107.0	113.4	200.4	207.6	293.5
1:24:59	109.2	115.6	204.7	213.5	301.6
1:27:29	111.6	118.2	209.5	219.4	310.0
1:29:59	114.2	120.7	214.6	225.3	318.1
1:32:29	116.7	123.5	220.0	231.5	325.9
1:34:59	119.3	126.1	225.7	236.8	333.0
1:37:29	121.7	128.6	231.1	243.0	340.4
1:39:59	124.4	131.6	236.6	248.7	347.5
1:42:29	127.1	134.2	241.9	254.4	354.4
1:44:59	130.0	137.0	247.4	259.7	361.2
1:47:29	132.6	139.9	252.4	265.3	367.7
1:49:59	135.5	143.0	257.9	270.5	374.5
1:52:29	138.6	145.9	263.1	275.9	381.3
1:54:59	141.2	148.7	268.0	280.5	387.2
1:57:29	144.2	151.7	272.7	285.4	393.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
1:58:59	146.9	154.4	277.5	290.8	399.4
2:02:29	150.0	157.7	282.4	295.9	405.3
2:04:59	153.0	160.8	287.2	300.6	411.0
2:07:29	156.2	163.9	292.3	305.7	417.2
2:09:59	158.9	166.8	297.1	309.7	422.8
2:12:29	161.9	169.5	301.3	314.4	428.3
2:14:59	164.9	172.5	305.7	318.4	433.7
2:17:29	167.9	174.9	309.2	323.2	439.2
2:19:59	170.8	178.2	313.7	327.4	444.5
2:22:29	174.0	181.3	317.8	331.8	449.8
2:24:59	177.0	183.8	322.4	335.9	455.1
2:27:29	179.9	187.2	326.7	340.3	459.7
2:29:59	183.5	191.3	331.1	344.8	464.3
2:32:29	186.3	194.9	335.6	348.9	468.9
2:34:59	189.4	198.1	340.2	353.3	473.5
2:37:29	192.6	201.3	344.3	357.0	477.9
2:39:59	195.6	204.2	348.1	361.9	481.9
2:42:29	198.7	207.6	352.3	365.9	486.1
2:44:59	201.7	210.7	356.1	369.5	490.1
2:47:29	204.8	213.9	359.3	373.9	494.1
2:49:59	208.2	217.0	362.8	378.5	498.1
2:52:29	211.3	220.2	367.0	381.4	502.0
2:54:59	214.4	223.9	371.3	386.5	506.0
2:57:29	217.0	227.3	375.4	390.4	509.9
2:59:59	219.2	230.7	378.9	393.9	513.4
3:02:29	222.2	234.3	383.3	398.0	517.0
3:04:59	224.9	237.7	386.9	401.5	520.9
3:07:29	227.8	241.3	391.1	405.9	524.3
3:09:59	230.4	245.0	395.3	409.3	527.8
3:12:29	232.9	246.4	399.8	410.7	531.1
3:14:59	234.9	252.5	403.6	410.3	534.3
3:17:29	237.9	255.7	407.2	412.9	537.4
3:19:59	240.8	259.3	411.3	418.1	540.6
3:22:29	244.2	262.5	414.7	421.0	543.5
3:24:59	247.4	265.6	418.6	426.3	546.3
3:27:29	251.0	269.2	422.6	428.4	549.6
3:29:59	254.4	272.7	426.3	430.9	552.7
3:32:29	257.9	276.3	428.7	434.7	555.1
3:34:59	261.7	279.4	432.5	437.0	557.7
3:37:29	265.1	282.8	436.0	440.2	560.5
3:39:59	268.6	287.5	441.1	442.5	563.0
3:42:29	272.3	291.3	442.1	445.6	565.6
3:44:59	275.9	295.9	444.0	447.2	568.3
3:47:29	279.6	299.9	445.0	451.5	570.5
3:49:59	283.7	303.7	447.7	454.2	572.8
3:52:29	287.4	308.1	450.2	458.1	575.3
3:54:59	291.3	313.1	453.8	462.4	577.5
3:57:29	295.1	316.6	452.9	465.1	579.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 5

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
3:59:59	299.2	319.1	450.9	466.8	581.2
4:02:29	303.1	322.5	455.6	470.7	583.2
4:04:59	307.3	326.3	459.7	471.2	585.1
4:07:29	310.6	330.8	462.6	474.6	587.2
4:09:59	314.7	334.3	463.7	476.7	589.3
4:12:29	318.5	337.1	469.3	480.0	591.0
4:14:59	322.1	340.6	474.6	484.2	592.6
4:17:29	325.9	344.2	474.9	485.6	594.3
4:19:59	329.5	347.1	0.0*	485.5	595.6
4:22:29	333.3	350.1	0.0*	490.5	597.1
4:24:59	337.3	352.9	0.0*	493.0	598.7
4:27:29	341.1	354.7	0.0*	495.1	600.4
4:29:59	313.9	355.6	0.0*	499.1	601.9

0.0* - THERMOCOUPLE MALFUNCTIONED.

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	75.8	76.0	75.8	75.7	78.8	75.8
0:02:30	76.1	76.1	76.0	76.0	78.5	76.3
0:05:00	76.8	76.8	76.5	76.9	75.0	80.0
0:07:30	78.9	78.8	77.9	79.4	68.5	86.5
0:10:00	83.5	83.2	81.6	83.9	59.3	95.9
0:12:30	90.4	89.9	87.3	90.7	47.9	106.9
0:15:00	99.4	99.6	95.1	98.9	34.8	120.0
0:17:30	109.8	111.0	104.5	108.6	21.0	134.4
0:20:00	121.3	123.5	114.6	118.7	5.9	149.2
0:22:30	133.0	136.9	125.3	129.5	0.0*	163.8
0:25:00	145.7	151.0	136.6	139.9	0.0*	179.5
0:27:30	158.9	166.0	148.6	150.7	0.0*	195.4
0:30:00	173.7	180.9	161.0	161.7	205.3	209.8
0:32:30	187.4	195.1	173.2	172.5	219.8	224.3
0:35:00	201.6	210.8	185.8	183.7	230.5	236.6
0:37:30	216.8	225.4	198.5	194.9	236.5	247.7
0:40:00	231.2	236.0	210.2	210.7	253.6	262.7
0:42:30	136.9	248.2	222.5	221.4	269.6	274.0
0:45:00	121.8	254.7	234.7	232.5	279.8	280.0
0:47:30	136.9	263.3	246.0	242.2	289.1	288.4
0:50:00	165.1	269.6	256.7	252.7	275.0	308.1
0:52:30	227.3	278.4	266.9	262.6	235.7	316.1
0:55:00	216.1	285.8	277.4	270.6	218.0	318.4
0:57:30	198.6	293.2	287.1	268.8	201.0	322.4
1:00:00	204.0	299.9	295.7	208.7	204.7	332.6
1:02:30	190.3	306.3	302.5	200.1	203.0	341.5
1:05:00	206.4	312.7	309.1	175.7	198.7	331.6
1:07:30	214.2	319.1	315.2	188.5	206.9	328.4
1:10:00	152.8	325.2	320.7	187.7	191.6	328.0
1:12:30	173.3	331.2	327.0	201.4	216.2	328.4
1:15:00	191.5	337.0	332.8	185.4	214.7	332.2
1:17:30	165.0	342.6	338.4	187.3	212.9	335.7
1:20:00	152.0	348.1	343.8	190.0	199.7	341.4
1:22:30	231.6	353.4	348.4	201.3	237.4	344.8
1:25:00	198.8	358.7	353.8	181.6	243.2	351.6
1:27:30	205.0	364.1	359.0	202.0	262.3	358.0
1:30:00	188.7	368.8	364.4	193.6	240.7	363.0
1:32:30	197.6	373.5	369.0	194.1	230.1	365.3
1:35:00	196.4	377.9	373.9	200.2	284.2	371.2
1:37:30	224.7	382.2	379.2	206.6	292.9	377.3
1:40:00	230.0	386.6	384.3	200.6	266.6	380.6
1:42:30	244.8	390.4	389.9	201.7	291.6	384.2
1:45:00	185.1	394.0	394.0	181.1	280.6	392.2
1:47:30	178.5	397.4	397.8	156.9	296.0	395.8
1:50:00	213.5	401.0	401.4	183.3	293.3	399.1

0.0* - THERMOCOUPLE MALFUNCTIONED.

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
hr:min:sec						
1:52:30	227.2	404.8	404.5	198.7	331.5	402.3
1:55:00	183.6	409.1	407.9	178.2	330.4	405.3
1:57:30	184.8	413.5	410.9	172.1	346.0	406.0
2:00:00	233.3	417.8	414.1	204.4	364.6	412.2
2:02:30	197.0	422.4	417.1	178.7	364.5	414.5
2:05:00	225.9	427.1	420.1	204.5	386.0	418.4
2:07:30	231.4	430.9	423.3	196.7	416.6	424.5
2:10:00	236.5	434.6	426.6	185.4	386.5	425.4
2:12:30	200.0	438.1	429.7	190.3	399.7	431.0
2:15:00	249.7	441.5	432.6	193.3	394.0	439.3
2:17:30	197.8	444.8	435.5	214.2	401.9	444.1
2:20:00	225.0	448.0	437.8	188.8	404.3	447.3
2:22:30	229.1	451.8	440.1	209.1	430.7	452.4
2:25:00	244.5	456.5	443.1	211.1	461.8	456.9
2:27:30	262.2	461.7	446.0	206.2	414.6	459.9
2:30:00	266.1	466.9	448.8	208.3	452.7	463.3
2:32:30	273.0	472.4	452.1	206.9	441.6	468.8
2:35:00	275.4	477.9	455.5	209.3	455.9	473.7
2:37:30	289.3	483.5	459.1	200.6	481.8	481.8
2:40:00	272.1	490.6	463.0	219.5	478.9	492.3
2:42:30	264.9	498.0	466.9	202.5	488.9	495.9
2:45:00	243.8	507.1	471.2	186.1	492.0	503.7
2:47:30	382.9	516.3	475.7	234.0	492.4	510.6
2:50:00	319.6	527.0	480.6	207.5	545.8	514.5
2:52:30	343.3	538.7	486.5	226.2	592.2	523.9
2:55:00	358.8	552.8	494.1	271.2	628.7	536.7
2:57:30	329.2	570.2	504.3	260.5	696.5	539.3
3:00:00	681.3	589.6	357.0	839.3	725.7	287.6
3:02:30	674.3	611.1	383.2	817.2	689.8	314.7
3:05:00	692.9	635.7	365.3	796.2	703.5	309.4
3:07:30	716.6	662.1	405.6	687.0	713.5	328.9
3:10:00	720.7	689.4	392.0	642.9	776.3	325.7
3:12:30	723.5	717.2	431.9	666.2	783.9	321.4
3:15:00	738.3	746.0	355.7	712.6	794.7	304.7
3:17:30	750.3	766.2	502.5	694.0	824.6	311.4
3:20:00	756.4	790.9	467.3	652.1	849.1	366.5
3:22:30	706.2	817.3	341.3	696.1	922.0	304.2
3:25:00	734.1	843.6	303.0	658.8	934.5	289.3
3:27:30	789.2	861.8	506.2	638.1	893.2	411.5
3:30:00	773.7	878.8	384.0	686.3	941.5	312.4
3:32:30	632.3	896.2	278.1	694.1	948.3	313.6
3:35:00	798.4	912.9	439.7	623.8	907.6	443.1
3:37:30	808.9	932.9	587.0	646.8	947.3	367.1
3:40:00	798.4	955.0	536.2	721.4	942.0	340.1
3:42:30	780.0	977.1	508.9	710.5	941.1	363.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
3:45:00	794.3	995.2	494.9	748.2	954.4	353.6
3:47:30	808.1	1009.4	547.0	712.6	947.7	361.5
3:50:00	812.4	1019.6	549.8	670.7	947.6	424.9
3:52:30	817.8	1026.5	593.7	748.6	924.2	408.1
3:55:00	809.5	1034.2	552.2	749.5	949.8	377.4
3:57:30	802.4	1041.0	452.5	765.0	964.7	379.5
4:00:00	814.9	1045.5	474.4	737.7	939.9	370.5
4:02:30	815.9	1046.7	348.5	753.8	968.8	347.5
4:05:00	825.1	1046.4	404.3	742.8	950.9	367.9
4:07:30	828.0	1041.5	548.5	769.6	914.7	393.5
4:10:00	822.3	1038.9	447.1	737.5	957.6	370.9
4:12:30	828.2	1042.0	480.0	738.9	963.9	386.0
4:15:00	823.7	1044.3	353.9	762.9	935.8	351.9
4:17:30	822.6	1044.1	367.7	745.3	970.7	338.5
4:20:00	828.8	1040.8	361.8	790.2	952.7	345.7
4:22:30	820.2	1036.3	465.9	758.9	960.3	412.0
4:25:00	831.6	1031.5	442.1	737.1	946.6	392.8
4:27:30	837.5	1027.1	538.4	770.7	916.0	385.2
4:30:00	829.8	1024.4	425.1	774.2	938.4	386.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	77.7	75.6	75.7	75.6	75.4	75.7
0:02:30	97.4	75.7	76.0	75.7	75.7	76.0
0:05:00	141.5	76.0	77.8	76.2	76.6	78.9
0:07:30	194.7	77.6	81.4	77.6	79.4	84.8
0:10:00	256.8	81.3	88.0	81.2	84.5	93.2
0:12:30	316.8	87.0	96.5	86.4	92.3	102.7
0:15:00	368.5	95.4	105.4	93.7	101.8	113.6
0:17:30	414.4	105.2	114.5	102.2	112.2	124.1
0:20:00	453.5	115.6	123.0	111.7	123.5	134.5
0:22:30	488.7	126.7	129.4	121.7	134.9	144.1
0:25:00	519.7	138.0	136.7	132.3	146.4	153.1
0:27:30	551.1	150.2	144.2	143.5	159.1	164.4
0:30:00	577.4	161.8	150.5	154.6	171.7	177.2
0:32:30	604.7	173.8	154.2	166.0	184.5	185.5
0:35:00	631.8	185.9	162.1	176.9	198.4	170.3
0:37:30	658.2	198.7	169.3	187.5	211.7	164.5
0:40:00	676.3	200.8	215.6	196.3	222.4	119.8
0:42:30	695.5	175.1	208.0	204.6	233.3	112.0
0:45:00	713.2	120.3	204.9	212.2	244.4	120.4
0:47:30	725.8	117.7	205.4	220.2	253.9	135.5
0:50:00	739.8	110.1	213.8	228.7	263.9	143.3
0:52:30	753.0	130.2	230.6	236.9	273.3	191.6
0:55:00	763.5	127.4	244.4	245.5	282.4	208.0
0:57:30	773.8	134.5	228.9	253.5	291.6	161.9
1:00:00	785.4	130.7	250.1	261.3	299.3	171.8
1:02:30	793.1	130.0	253.8	269.1	305.1	187.4
1:05:00	800.9	130.9	249.0	276.7	309.7	193.2
1:07:30	809.2	133.4	249.1	284.1	316.7	208.3
1:10:00	813.2	125.5	241.3	290.9	321.7	206.4
1:12:30	817.9	133.9	249.1	297.9	328.3	219.6
1:15:00	822.6	132.7	244.1	304.6	333.7	217.1
1:17:30	828.5	132.8	232.6	311.1	340.2	220.0
1:20:00	836.4	134.9	233.3	316.1	346.2	231.9
1:22:30	841.2	135.8	291.8	321.8	351.0	237.1
1:25:00	848.1	135.3	291.3	327.6	357.2	240.1
1:27:30	855.0	141.9	288.4	332.5	361.8	246.9
1:30:00	861.1	138.7	294.0	337.6	367.8	253.3
1:32:30	866.9	128.4	294.8	342.8	372.0	263.8
1:35:00	873.6	142.4	302.1	347.5	375.2	264.9
1:37:30	881.7	145.1	300.9	352.4	374.5	250.5
1:40:00	886.6	141.7	307.9	357.4	376.7	282.0
1:42:30	891.9	147.5	309.0	361.8	377.3	266.3
1:45:00	895.1	139.3	313.7	366.5	374.9	282.6
1:47:30	898.9	143.9	360.0	371.1	370.8	273.8
1:50:00	902.2	141.6	359.5	375.7	369.1	282.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
1:52:30	909.7	133.4	362.9	379.8	358.7	282.2
1:55:00	916.0	134.0	364.5	383.5	353.0	294.1
1:57:30	921.7	138.5	367.9	386.9	350.0	293.2
2:00:00	927.0	140.4	369.4	389.9	345.0	295.4
2:02:30	931.8	135.5	371.8	393.1	314.9	288.4
2:05:00	936.0	147.5	372.7	396.1	328.5	296.1
2:07:30	939.3	146.2	375.6	399.5	322.9	306.4
2:10:00	941.2	143.7	377.4	402.6	317.5	309.1
2:12:30	943.2	145.3	385.2	405.7	320.3	302.2
2:15:00	946.6	139.1	389.7	408.3	311.4	313.0
2:17:30	949.6	145.7	383.0	411.0	326.8	311.8
2:20:00	953.2	154.3	393.3	413.8	320.5	314.7
2:22:30	957.4	135.9	399.8	416.3	293.3	312.0
2:25:00	962.5	157.3	399.9	418.9	333.4	324.9
2:27:30	970.0	139.4	406.6	421.7	321.2	327.5
2:30:00	977.0	169.2	407.9	423.9	333.6	324.0
2:32:30	982.7	139.8	411.5	426.8	314.2	333.0
2:35:00	989.0	145.9	416.6	429.4	304.9	338.1
2:37:30	996.6	144.6	422.0	431.8	310.9	354.2
2:40:00	1003.6	152.5	424.2	434.9	335.3	339.3
2:42:30	1011.0	151.2	427.1	437.5	320.4	347.3
2:45:00	1020.8	161.4	432.3	440.2	322.8	345.2
2:47:30	1030.1	142.8	432.5	443.0	310.0	369.5
2:50:00	1040.9	163.4	433.8	445.5	340.7	361.7
2:52:30	1050.2	145.8	440.5	448.7	327.3	383.8
2:55:00	1058.9	149.5	447.8	451.6	318.9	385.8
2:57:30	1067.7	151.5	449.8	454.7	323.8	399.1
3:00:00	1075.4	145.4	285.3	457.4	313.1	223.0
3:02:30	1081.3	176.1	285.9	460.4	290.1	209.2
3:05:00	1086.1	153.4	291.7	463.7	273.2	213.4
3:07:30	1097.8	172.0	286.1	466.5	271.3	225.1
3:10:00	1105.5	176.9	293.2	470.1	282.0	223.7
3:12:30	1109.0	173.1	298.0	473.4	273.2	222.2
3:15:00	1113.8	171.0	283.6	476.5	264.5	215.8
3:17:30	1117.3	170.1	288.4	479.3	269.1	223.6
3:20:00	1122.0	172.8	292.8	482.3	269.4	225.3
3:22:30	1126.2	186.0	314.6	485.9	286.6	262.9
3:25:00	1130.6	214.9	308.4	490.8	299.4	253.4
3:27:30	1131.9	190.9	299.2	495.8	288.0	245.5
3:30:00	1136.4	223.7	304.0	501.3	303.5	250.1
3:32:30	1140.1	206.9	329.0	507.8	305.6	269.4
3:35:00	1142.7	225.2	304.3	515.0	306.9	248.4
3:37:30	1144.9	192.2	310.1	522.5	295.4	254.9
3:40:00	1147.1	196.9	328.6	530.0	303.9	289.6
3:42:30	1150.7	224.2	316.0	538.1	310.4	249.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
3:45:00	1153.1	248.5	325.3	546.9	328.5	273.7
3:47:30	1153.7	242.5	323.1	555.2	340.6	279.8
3:50:00	1153.7	211.6	311.0	562.8	318.8	245.5
3:52:30	1155.0	224.9	330.1	570.9	339.0	275.7
3:55:00	1154.8	227.9	315.4	580.3	344.8	250.9
3:57:30	1156.1	233.7	319.7	590.7	343.0	256.1
4:00:00	1155.4	221.8	329.5	602.0	341.5	273.7
4:02:30	1161.5	274.8	326.8	613.4	362.0	263.0
4:05:00	1163.9	236.0	322.5	626.6	359.8	259.5
4:07:30	1169.9	236.6	329.1	642.4	357.7	276.6
4:10:00	1174.2	254.6	322.4	657.9	363.6	260.6
4:12:30	1171.5	256.9	325.3	672.0	380.9	262.6
4:15:00	1168.3	282.1	338.6	688.0	389.6	270.2
4:17:30	1166.3	286.1	321.6	703.3	384.2	260.9
4:20:00	1166.5	245.8	348.6	720.2	392.5	281.7
4:22:30	1167.5	246.5	334.9	735.4	378.4	265.8
4:25:00	1167.5	273.9	329.7	748.4	393.8	257.6
4:27:30	1166.1	251.5	328.7	759.8	384.8	263.4
4:30:00	1166.2	287.0	336.1	774.7	429.5	224.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	75.4	77.6	76.0	76.3	76.1	75.8
0:02:30	75.6	96.2	76.1	76.1	76.3	76.1
0:05:00	75.7	139.5	76.8	76.9	76.8	76.5
0:07:30	76.3	191.8	78.8	78.8	78.7	77.9
0:10:00	77.7	252.4	83.0	83.2	82.8	81.7
0:12:30	79.7	311.3	89.1	90.1	89.2	87.7
0:15:00	83.3	363.7	97.1	99.5	98.5	96.1
0:17:30	88.0	407.6	106.3	110.6	109.3	106.5
0:20:00	93.6	447.5	116.9	122.5	121.1	117.7
0:22:30	100.7	482.7	128.4	135.6	133.9	129.8
0:25:00	109.9	512.3	139.5	148.7	147.2	142.2
0:27:30	120.5	540.7	151.6	162.2	160.8	155.1
0:30:00	132.0	566.8	163.5	175.9	174.2	168.2
0:32:30	143.4	591.1	174.9	189.6	187.1	181.3
0:35:00	155.1	615.3	187.2	203.3	199.4	194.4
0:37:30	166.2	636.8	166.2	218.6	209.5	206.3
0:40:00	175.7	657.1	150.4	194.6	216.1	218.8
0:42:30	184.7	674.9	161.7	188.7	225.4	230.9
0:45:00	192.0	691.4	141.5	188.9	234.2	242.0
0:47:30	197.8	703.4	151.4	212.2	243.2	255.4
0:50:00	201.8	714.4	165.8	221.9	219.8	266.7
0:52:30	205.3	724.3	171.9	230.0	101.9	278.2
0:55:00	208.7	734.3	160.0	245.5	115.1	288.5
0:57:30	212.8	743.6	164.3	234.3	105.4	297.2
1:00:00	214.9	754.1	165.0	251.7	112.1	305.6
1:02:30	217.3	761.9	164.2	251.8	109.0	312.8
1:05:00	219.5	767.2	176.5	257.8	116.6	320.0
1:07:30	226.4	774.9	174.5	264.0	113.8	327.0
1:10:00	230.4	778.7	165.1	264.2	114.4	333.2
1:12:30	236.2	782.3	199.0	274.8	100.5	340.2
1:15:00	241.2	787.5	194.2	285.7	109.7	346.5
1:17:30	247.1	793.1	180.7	272.5	116.3	353.0
1:20:00	254.9	799.8	175.2	274.6	127.6	358.5
1:22:30	260.7	804.8	207.6	293.3	112.6	362.7
1:25:00	268.2	809.4	236.5	315.8	105.5	367.9
1:27:30	275.0	813.6	237.2	306.5	105.5	372.2
1:30:00	285.0	817.8	211.2	301.1	125.5	375.6
1:32:30	292.9	822.8	186.6	290.6	128.6	374.5
1:35:00	302.1	827.9	265.1	298.9	105.0	376.1
1:37:30	310.2	834.0	247.7	291.0	103.9	376.3
1:40:00	320.1	840.3	228.0	299.3	123.9	384.9
1:42:30	328.5	844.9	259.6	298.7	110.9	390.4
1:45:00	337.2	848.5	265.7	196.9	120.1	395.0
1:47:30	345.0	852.3	246.0	207.9	135.0	398.0
1:50:00	354.3	855.2	240.9	202.6	128.0	398.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
1:52:30	362.2	858.9	287.7	199.4	119.9	401.9
1:55:00	369.8	864.9	240.5	190.9	138.0	402.9
1:57:30	376.3	870.9	223.6	211.7	143.5	402.8
2:00:00	383.4	876.2	285.9	205.0	114.3	406.1
2:02:30	388.3	880.3	247.3	184.4	144.1	408.7
2:05:00	394.5	884.6	294.2	193.8	118.1	412.7
2:07:30	400.5	888.2	301.8	200.1	112.6	415.9
2:10:00	405.4	891.3	297.6	186.7	119.0	418.5
2:12:30	409.9	893.1	279.2	246.0	140.2	421.8
2:15:00	416.7	894.9	302.5	219.3	125.7	426.3
2:17:30	423.5	897.0	312.4	234.6	134.5	429.9
2:20:00	427.5	898.0	325.1	237.5	130.9	431.8
2:22:30	431.8	898.7	295.1	261.3	142.0	435.3
2:25:00	439.4	901.6	356.1	233.7	118.6	439.1
2:27:30	444.9	905.6	318.2	319.9	154.7	443.1
2:30:00	450.8	908.3	366.0	288.5	136.2	447.9
2:32:30	455.8	909.3	327.6	326.3	138.7	451.0
2:35:00	460.3	911.6	419.2	272.7	126.1	454.0
2:37:30	464.2	914.9	430.8	303.4	126.6	457.6
2:40:00	471.4	917.6	398.3	361.7	150.9	462.5
2:42:30	476.2	919.0	460.4	307.8	137.5	465.5
2:45:00	481.1	921.7	571.8	317.8	144.2	471.6
2:47:30	486.1	923.0	631.7	301.1	155.1	475.9
2:50:00	491.7	926.6	756.4	295.6	159.3	483.0
2:52:30	496.6	930.4	760.9	279.8	161.3	489.5
2:55:00	501.4	933.0	734.3	275.0	164.0	493.7
2:57:30	506.3	936.9	1045.4	565.0	309.2	504.6
3:00:00	511.6	940.0	160.8	514.8	85.1	613.3
3:02:30	519.0	944.1	192.7	644.5	88.9	712.3
3:05:00	530.1	948.9	210.9	692.7	84.1	750.6
3:07:30	537.8	958.8	223.4	726.2	86.0	787.1
3:10:00	543.9	965.8	228.6	756.7	89.8	821.8
3:12:30	552.6	969.1	231.1	783.5	89.6	847.3
3:15:00	558.7	972.9	244.5	820.8	85.2	890.7
3:17:30	567.6	977.5	248.7	866.2	87.8	925.4
3:20:00	574.6	983.0	249.1	900.4	87.8	954.9
3:22:30	577.9	988.8	252.1	928.0	88.1	990.5
3:25:00	584.1	995.6	254.2	951.2	90.2	1023.5
3:27:30	589.6	1000.2	267.3	966.9	91.0	1057.8
3:30:00	598.5	1006.7	261.7	979.4	90.6	1083.5
3:32:30	601.5	1011.5	265.3	990.4	91.3	1096.9
3:35:00	604.6	1018.0	275.4	999.6	90.9	1108.6
3:37:30	613.5	1023.2	277.9	1008.2	92.3	1121.6
3:40:00	615.0	1028.5	274.8	1017.2	92.9	1136.3
3:42:30	622.4	1035.3	279.5	1025.1	90.5	1153.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
3:45:00	624.2	1041.0	281.8	1033.2	88.3	1170.8
3:47:30	628.3	1044.2	292.1	1040.0	89.5	1187.5
3:50:00	636.1	1047.6	293.0	1046.9	88.6	1204.7
3:52:30	639.6	1052.5	291.4	1053.6	90.2	1215.8
3:55:00	645.8	1056.5	291.2	1059.7	94.2	1226.9
3:57:30	653.8	1060.7	294.2	1065.5	90.3	1235.0
4:00:00	658.5	1063.7	299.5	1071.7	94.8	1248.7
4:02:30	664.7	1071.0	298.4	1076.9	94.3	1254.1
4:05:00	672.1	1076.5	297.9	1082.1	92.7	1265.2
4:07:30	677.6	1081.3	301.9	1087.8	93.3	1274.6
4:10:00	682.9	1088.0	301.6	1093.3	94.5	1283.0
4:12:30	689.4	1089.7	302.4	1097.8	94.1	1284.6
4:15:00	693.2	1088.9	305.6	1102.1	93.8	1288.3
4:17:30	695.9	1089.7	302.1	1107.4	94.2	1292.4
4:20:00	699.2	1093.2	309.0	1111.6	95.1	1295.6
4:22:30	703.0	1095.6	306.7	1116.0	93.2	1299.8
4:25:00	706.0	1097.6	311.0	1119.7	95.5	1302.5
4:27:30	710.4	1097.8	317.0	1123.2	94.8	1306.8
4:30:00	711.9	1099.5	311.3	1126.4	103.4	1311.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	76.1	76.8	78.0	76.4	76.3	76.3
0:02:30	76.4	77.0	95.7	76.3	76.3	76.3
0:05:00	79.1	79.9	139.3	76.8	76.8	76.5
0:07:30	84.3	85.7	192.4	78.6	78.4	77.8
0:10:00	91.8	93.6	255.9	82.8	82.2	80.8
0:12:30	100.2	103.3	316.2	89.3	88.1	85.5
0:15:00	110.2	114.2	366.1	97.1	95.6	91.9
0:17:30	120.4	125.8	406.7	106.5	104.2	99.7
0:20:00	132.0	138.4	444.1	116.8	114.0	108.7
0:22:30	143.5	152.0	471.0	127.8	124.6	118.9
0:25:00	154.9	166.9	491.8	139.6	136.8	129.9
0:27:30	167.1	181.9	512.6	150.8	148.8	141.3
0:30:00	178.6	195.7	530.5	162.4	160.6	119.8
0:32:30	192.2	208.2	551.5	173.7	172.6	165.4
0:35:00	205.1	219.0	572.0	184.2	184.2	177.4
0:37:30	218.1	229.1	595.6	195.2	195.5	190.6
0:40:00	230.0	240.5	612.1	180.4	207.1	205.4
0:42:30	244.8	252.2	628.8	172.7	217.5	216.1
0:45:00	243.0	251.8	642.5	180.9	227.3	228.7
0:47:30	259.6	271.6	652.3	189.8	234.1	240.1
0:50:00	277.8	281.5	666.1	199.6	243.9	251.6
0:52:30	290.3	292.7	676.4	204.6	249.2	262.5
0:55:00	305.2	301.2	686.7	208.9	201.2	273.5
0:57:30	196.2	310.5	693.8	213.8	228.0	285.5
1:00:00	209.4	320.9	702.9	218.9	269.7	296.6
1:02:30	216.5	328.6	708.7	222.5	273.3	306.5
1:05:00	218.1	335.3	714.5	225.4	277.6	316.0
1:07:30	217.7	342.9	720.7	231.0	257.6	324.8
1:10:00	216.2	349.7	722.7	235.8	241.6	333.8
1:12:30	212.8	358.0	727.9	240.4	246.2	341.9
1:15:00	219.2	365.8	733.6	244.5	248.9	350.2
1:17:30	221.1	373.2	738.5	247.9	253.1	357.8
1:20:00	211.9	380.9	743.2	112.9	257.6	365.4
1:22:30	204.7	389.5	746.4	112.6	259.7	372.3
1:25:00	198.3	396.5	755.5	114.2	266.7	379.4
1:27:30	201.9	403.9	759.9	110.5	272.4	385.7
1:30:00	212.6	412.4	762.8	117.3	273.1	391.4
1:32:30	209.1	427.1	765.2	114.4	276.0	397.0
1:35:00	185.5	428.1	774.9	119.3	281.7	402.7
1:37:30	191.6	428.7	780.6	119.8	283.8	407.5
1:40:00	205.4	430.3	782.4	122.7	289.5	412.5
1:42:30	193.3	431.5	785.5	123.0	284.7	416.5
1:45:00	201.3	429.9	791.2	126.6	287.5	420.4
1:47:30	210.6	431.2	795.0	127.5	285.7	423.4
1:50:00	204.6	433.0	796.0	127.8	294.7	426.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
1:52:30	207.1	434.5	801.9	127.1	297.1	428.9
1:55:00	210.4	437.2	806.2	127.6	298.1	431.8
1:57:30	224.6	443.1	809.1	134.5	303.3	434.7
2:00:00	220.7	447.5	816.5	138.3	317.0	437.9
2:02:30	213.1	452.6	819.1	132.8	311.2	440.7
2:05:00	218.7	458.5	822.0	134.7	321.6	444.0
2:07:30	210.4	463.3	826.7	144.2	337.0	447.8
2:10:00	216.6	468.3	824.2	135.9	369.0	450.9
2:12:30	229.6	473.9	830.1	134.6	403.0	454.9
2:15:00	239.1	479.3	832.3	144.5	399.6	459.1
2:17:30	267.1	485.0	835.2	137.2	382.6	463.3
2:20:00	240.6	492.1	837.7	140.8	386.2	467.3
2:22:30	245.1	498.4	845.8	140.4	399.8	471.4
2:25:00	247.4	504.4	850.9	136.6	416.2	476.3
2:27:30	262.1	509.5	855.6	141.7	439.7	481.4
2:30:00	257.4	515.2	862.7	142.4	485.5	486.7
2:32:30	288.0	519.8	867.8	142.5	464.4	493.0
2:35:00	283.2	526.8	874.3	146.1	463.1	499.3
2:37:30	288.7	529.6	883.2	156.7	469.6	505.7
2:40:00	302.1	532.9	888.2	136.0	453.7	512.0
2:42:30	330.0	544.7	895.3	143.7	488.7	518.8
2:45:00	340.5	561.4	903.8	154.4	507.3	525.3
2:47:30	333.6	574.5	912.1	143.7	508.3	533.1
2:50:00	414.9	589.0	922.7	147.9	486.3	541.0
2:52:30	523.7	601.7	930.5	146.0	469.1	550.5
2:55:00	644.3	613.7	935.5	154.5	464.1	560.9
2:57:30	838.3	645.3	950.2	158.3	450.8	572.7
3:00:00	738.4	682.1	1047.8	141.9	928.1	586.0
3:02:30	782.8	708.9	1040.8	135.7	876.2	602.4
3:05:00	846.1	774.3	1046.9	153.1	946.0	623.1
3:07:30	929.2	831.4	1062.4	150.4	977.7	649.6
3:10:00	1019.4	893.0	1078.7	134.0	1001.8	682.8
3:12:30	1098.2	987.8	1093.3	143.9	1071.8	718.7
3:15:00	1195.9	1125.1	1149.1	140.0	1057.0	755.4
3:17:30	1268.1	1163.9	1215.5	144.5	1071.6	788.6
3:20:00	1327.2	1207.2	1264.6	146.6	1113.1	819.8
3:22:30	1388.3	1192.4	1301.9	146.6	1166.6	856.7
3:25:00	1443.9	1198.4	1331.9	153.4	1190.5	888.6
3:27:30	1474.5	1222.8	1357.6	144.3	1212.0	920.3
3:30:00	1462.4	1255.5	1379.7	159.9	1244.1	944.5
3:32:30	1448.1	1284.8	1395.6	142.4	1265.0	970.9
3:35:00	1438.6	1304.9	1407.7	152.8	1287.7	990.2
3:37:30	1433.6	1315.0	1418.7	153.0	1310.0	1010.6
3:40:00	1431.1	1314.7	1425.1	148.5	1323.5	1028.3
3:42:30	1430.0	1311.6	1431.0	160.0	1338.4	1046.8

R8196/95NK3179
Test Date : APRIL 17, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
3:45:00	1429.6	1310.2	1435.4	155.1	1355.4	1062.6
3:47:30	1430.3	1311.2	1437.4	162.6	1367.2	1079.9
3:50:00	1431.3	1312.5	1439.6	154.0	1377.5	1097.4
3:52:30	1432.5	1314.9	1441.0	144.0	1384.4	1112.9
3:55:00	1433.9	1317.9	1441.1	166.0	1393.8	1128.6
3:57:30	1434.9	1319.4	1441.4	164.7	1401.9	1142.8
4:00:00	1436.8	1323.3	1441.5	157.0	1408.3	1154.8
4:02:30	1437.6	1324.8	1445.9	167.0	1413.5	1164.1
4:05:00	1439.5	1326.5	1449.2	165.8	1416.2	1171.7
4:07:30	1442.0	1329.9	1456.1	160.4	1421.9	1176.2
4:10:00	1445.9	1333.4	1460.5	174.7	1428.4	1181.9
4:12:30	1450.5	1335.5	1458.8	174.6	1431.3	1192.5
4:15:00	1453.0	1338.4	1457.3	198.1	1433.9	1201.0
4:17:30	1455.0	1340.5	1455.3	200.6	1438.3	1210.6
4:20:00	1456.0	1342.4	1455.7	183.3	1441.3	1218.1
4:22:30	1457.5	1344.1	1456.1	175.8	1445.0	1221.9
4:25:00	1459.1	1345.3	1456.6	179.9	1445.6	1227.0
4:27:30	1460.8	1347.6	1456.2	200.5	1449.7	1230.6
4:30:00	1462.2	1350.1	1456.0	186.1	1456.0	1231.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	76.4	76.5	76.5	78.0	77.3
0:02:30	76.3	76.7	76.7	95.4	77.4
0:05:00	77.3	79.6	79.0	135.3	77.1
0:07:30	79.6	85.5	83.5	182.8	77.0
0:10:00	84.6	93.8	90.4	238.6	77.3
0:12:30	91.9	104.2	98.7	292.2	76.9
0:15:00	101.1	115.8	108.3	341.2	76.2
0:17:30	112.3	128.2	118.9	379.9	76.3
0:20:00	123.8	141.4	130.1	416.9	76.8
0:22:30	136.3	155.1	142.2	447.9	76.7
0:25:00	149.1	169.1	155.0	472.9	76.3
0:27:30	161.3	182.4	167.6	496.5	76.3
0:30:00	172.7	195.2	179.5	519.3	76.8
0:32:30	184.0	207.5	191.2	545.8	76.7
0:35:00	194.5	218.8	203.1	571.0	76.1
0:37:30	209.8	229.3	212.2	596.1	76.2
0:40:00	216.0	239.0	222.4	612.9	76.2
0:42:30	226.8	249.4	233.5	634.0	76.4
0:45:00	204.7	261.5	244.7	653.7	77.5
0:47:30	174.1	272.6	255.7	671.1	77.5
0:50:00	202.2	287.3	265.9	686.8	77.0
0:52:30	201.5	300.1	276.8	698.4	77.2
0:55:00	219.7	304.2	285.7	708.9	77.4
0:57:30	233.2	308.9	294.4	716.9	219.6
1:00:00	229.4	325.7	310.1	727.3	222.9
1:02:30	226.6	316.7	0.0*	735.1	226.5
1:05:00	228.6	315.1	331.7	742.6	230.3
1:07:30	241.2	325.7	336.6	750.3	234.6
1:10:00	262.4	320.0	341.1	756.7	239.1
1:12:30	253.2	320.8	346.2	762.2	243.9
1:15:00	266.5	322.3	347.0	768.5	249.5
1:17:30	264.2	322.6	356.8	775.0	255.2
1:20:00	265.3	323.5	371.5	781.6	261.5
1:22:30	291.6	320.5	377.2	787.0	268.2
1:25:00	306.3	259.0	380.2	792.9	275.3
1:27:30	293.6	262.0	401.7	796.6	282.7
1:30:00	307.6	266.7	403.6	802.0	290.7
1:32:30	306.9	264.8	405.1	805.8	298.5
1:35:00	317.9	270.3	409.7	811.9	306.5
1:37:30	320.8	279.1	410.8	817.2	314.2
1:40:00	328.2	278.4	415.7	823.3	321.8
1:42:30	339.9	291.4	420.5	828.2	329.5
1:45:00	351.0	302.9	424.5	832.6	336.9
1:47:30	346.5	298.5	428.3	837.9	343.9
1:50:00	357.5	303.8	434.8	839.4	351.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
1:52:30	353.8	311.3	440.2	846.1	357.9
1:55:00	351.6	309.4	443.7	851.7	364.7
1:57:30	372.3	319.5	448.1	856.4	371.4
2:00:00	358.6	329.3	454.3	862.8	377.8
2:02:30	361.6	321.9	460.9	866.6	384.0
2:05:00	367.1	327.4	462.1	870.8	390.3
2:07:30	370.0	337.4	467.3	875.3	396.6
2:10:00	348.4	327.8	471.6	877.5	402.4
2:12:30	377.0	339.3	478.3	880.4	408.4
2:15:00	391.6	344.7	480.0	884.7	414.2
2:17:30	388.7	347.4	486.0	887.5	420.0
2:20:00	393.9	358.4	491.1	890.7	425.8
2:22:30	393.5	358.7	492.5	893.3	430.9
2:25:00	388.2	371.7	497.0	897.3	436.3
2:27:30	413.8	368.3	504.5	901.5	441.7
2:30:00	396.2	361.4	507.8	906.4	446.8
2:32:30	415.9	367.4	510.7	910.4	451.9
2:35:00	402.5	360.0	517.4	914.3	456.9
2:37:30	407.9	386.6	521.4	919.8	461.5
2:40:00	428.1	380.4	527.0	924.9	466.0
2:42:30	424.7	386.1	535.6	928.1	470.7
2:45:00	439.2	405.0	542.1	933.9	475.0
2:47:30	435.2	385.9	553.9	938.0	479.5
2:50:00	443.0	416.8	568.0	944.0	483.9
2:52:30	448.4	417.5	587.8	948.6	487.9
2:55:00	443.1	403.2	600.8	953.1	492.2
2:57:30	451.5	421.4	616.1	957.7	496.3
3:00:00	441.2	446.6	629.4	961.5	502.0
3:02:30	419.2	498.1	647.4	965.7	505.1
3:05:00	435.2	509.7	661.6	972.7	508.6
3:07:30	442.3	519.8	675.9	982.7	512.1
3:10:00	408.7	526.1	689.8	989.4	515.1
3:12:30	446.6	535.3	708.3	991.3	518.6
3:15:00	422.5	539.1	726.4	994.7	522.0
3:17:30	453.4	549.2	744.8	998.3	525.3
3:20:00	464.0	556.6	764.0	1002.5	528.4
3:22:30	450.3	561.8	782.3	1006.0	531.9
3:25:00	462.3	570.1	801.1	1012.0	535.6
3:27:30	442.3	574.6	820.4	1014.8	539.2
3:30:00	495.8	584.0	0.0*	1020.4	542.7
3:32:30	456.1	590.3	0.0*	1024.1	546.2
3:35:00	481.1	594.6	0.0*	1028.5	549.5
3:37:30	494.4	602.6	0.0*	1034.2	553.0
3:40:00	445.1	605.8	913.9	1037.9	556.1
3:42:30	452.2	610.1	924.0	1042.0	558.9

0.0* - THERMOCOUPLE MALFUNCTIONED.

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 6

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
3:45:00	443.7	615.1	0.0*	1045.4	562.4
3:47:30	450.0	617.8	0.0*	1048.9	565.2
3:50:00	458.9	622.5	0.0*	1051.9	568.2
3:52:30	435.2	626.4	0.0*	1054.9	570.7
3:55:00	425.6	630.9	0.0*	1056.3	573.6
3:57:30	410.4	634.5	0.0*	1059.1	576.5
4:00:00	391.7	637.1	0.0*	1060.9	579.3
4:02:30	395.9	642.2	0.0*	1068.3	581.8
4:05:00	421.1	645.7	0.0*	1072.3	584.3
4:07:30	446.4	647.7	0.0*	1080.2	586.8
4:10:00	395.6	651.9	0.0*	1085.1	589.2
4:12:30	449.5	656.3	0.0*	1084.5	591.6
4:15:00	464.1	659.0	0.0*	1083.1	593.9
4:17:30	446.2	662.5	0.0*	1082.1	596.4
4:20:00	472.9	666.0	0.0*	1084.0	598.7
4:22:30	441.2	668.4	0.0*	1086.2	600.8
4:25:00	468.4	669.8	0.0*	1087.4	603.2
4:27:30	473.8	673.1	0.0*	1087.8	605.5
4:30:00	633.4	673.3	0.0*	1088.0	607.5

0.0* - THERMOCOUPLE MALFUNCTIONED.

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	72.7	73.0	73.0	72.7	73.4	73.7
0:02:30	72.6	72.9	72.9	72.5	73.5	74.4
0:05:00	73.3	73.4	73.4	73.0	76.3	79.2
0:07:30	75.9	75.2	75.6	74.9	82.2	87.4
0:10:00	81.1	79.0	80.2	78.9	90.4	98.5
0:12:30	88.6	85.2	87.3	85.1	100.3	107.8
0:15:00	99.4	94.1	97.2	94.2	111.7	120.2
0:17:30	111.6	104.8	108.5	105.0	124.8	134.5
0:20:00	124.9	116.6	120.4	116.7	138.3	138.5
0:22:30	139.4	129.5	133.3	129.5	152.2	139.0
0:25:00	153.9	142.6	146.8	143.6	167.2	103.8
0:27:30	168.7	156.0	160.8	158.1	186.1	117.0
0:30:00	183.4	169.2	174.8	172.6	199.6	124.5
0:32:30	191.0	179.5	188.8	184.8	207.4	135.3
0:35:00	199.8	192.5	201.2	194.3	196.3	141.5
0:37:30	209.9	202.2	214.0	204.6	192.2	145.3
0:40:00	217.9	210.4	227.0	213.4	190.4	151.4
0:42:30	225.7	218.9	239.9	220.3	191.6	155.9
0:45:00	232.8	226.5	252.3	226.5	196.6	158.7
0:47:30	239.9	234.2	263.8	232.1	202.7	159.2
0:50:00	247.8	241.2	275.3	238.8	214.1	166.6
0:52:30	255.4	248.7	286.1	244.6	219.6	166.9
0:55:00	262.7	255.9	296.8	247.1	224.8	170.1
0:57:30	269.9	263.5	306.5	252.9	230.3	174.5
1:00:00	277.0	271.0	316.3	258.0	241.5	175.2
1:02:30	284.3	278.2	325.4	263.8	246.8	177.2
1:05:00	291.4	285.3	334.4	270.3	256.0	185.5
1:07:30	298.5	291.5	342.0	277.4	264.1	187.2
1:10:00	305.6	298.0	349.5	282.6	275.5	191.1
1:12:30	312.5	304.3	356.6	289.6	283.0	193.4
1:15:00	319.3	310.3	363.4	295.6	288.3	199.6
1:17:30	325.1	316.8	369.6	300.5	301.3	200.7
1:20:00	330.8	322.5	375.5	306.5	304.8	208.8
1:22:30	335.6	328.9	381.4	312.9	303.0	215.9
1:25:00	341.3	334.0	387.0	319.3	297.4	221.8
1:27:30	345.7	339.8	392.1	321.3	304.1	225.4
1:30:00	349.7	344.8	397.3	323.8	307.1	231.5
1:32:30	354.3	348.3	402.3	330.3	303.1	191.2
1:35:00	358.7	352.9	407.2	333.0	327.0	159.1
1:37:30	363.0	357.2	411.9	339.0	308.8	146.7
1:40:00	367.4	361.4	416.6	344.3	321.0	147.3
1:42:30	371.6	365.2	420.9	349.7	322.3	134.9
1:45:00	376.0	369.3	425.3	353.2	342.0	141.1
1:47:30	380.0	373.3	430.7	357.7	327.2	135.5
1:50:00	383.6	377.5	435.7	361.4	339.0	133.7
1:52:30	387.5	381.1	440.3	364.8	354.6	145.3
1:55:00	391.6	385.1	444.7	370.2	346.7	133.4
1:57:30	395.4	388.8	449.2	372.7	372.1	127.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
2:00:00	399.5	392.4	453.5	377.3	359.2	135.0
2:02:30	403.4	395.8	457.8	381.6	362.9	118.9
2:05:00	407.2	399.8	461.9	386.3	378.3	135.1
2:07:30	410.7	403.3	465.6	390.8	374.5	123.9
2:10:00	414.6	407.2	469.8	395.8	375.7	140.8
2:12:30	418.2	411.0	474.0	399.4	372.8	132.5
2:15:00	422.1	414.6	478.9	403.6	356.8	132.8
2:17:30	425.4	418.0	483.7	407.8	370.3	143.7
2:20:00	428.9	422.2	489.0	412.2	349.2	155.2
2:22:30	431.9	426.1	494.5	416.1	383.2	138.8
2:25:00	434.6	430.7	500.3	421.2	390.4	131.9
2:27:30	438.1	435.1	506.7	425.6	406.1	128.5
2:30:00	442.5	439.5	514.1	432.2	397.0	154.1
2:32:30	447.0	445.4	521.9	440.4	426.4	135.8
2:35:00	452.2	451.3	530.5	449.2	403.2	143.3
2:37:30	457.0	457.6	540.0	459.5	439.1	126.7
2:40:00	462.7	463.1	550.3	471.8	462.7	143.5
2:42:30	468.4	469.4	562.3	485.6	456.8	164.8
2:45:00	474.9	475.7	575.5	499.2	478.2	142.4
2:47:30	481.8	482.0	588.1	515.4	471.4	147.8
2:50:00	489.6	488.9	602.6	531.1	513.7	131.2
2:52:30	498.2	495.9	619.9	550.6	492.9	180.4
2:55:00	507.9	504.8	640.7	571.2	543.7	156.4
2:57:30	515.7	514.2	665.2	596.4	568.9	140.6
3:00:00	526.8	526.8	693.8	626.7	546.8	162.9
3:02:30	538.8	540.8	724.0	663.5	600.1	184.1
3:05:00	552.6	557.5	755.1	707.2	578.6	188.6
3:07:30	566.2	573.2	785.5	756.6	706.7	175.7
3:10:00	583.6	592.4	811.5	807.9	762.5	169.0
3:12:30	602.0	614.3	838.3	856.6	802.5	197.3
3:15:00	624.9	641.7	862.0	902.0	838.4	197.6
3:17:30	648.5	674.3	886.8	954.2	870.4	180.6
3:20:00	675.7	709.5	918.6	1004.4	870.1	174.7
3:22:30	709.9	744.4	952.1	1061.7	896.3	140.7
3:25:00	745.5	780.3	981.6	1116.0	967.8	198.6
3:27:30	787.5	815.8	1016.3	1152.5	964.3	161.3
3:30:00	827.0	850.6	1049.2	1176.4	987.3	176.2
3:32:30	853.2	882.6	1078.6	1190.6	960.8	182.1
3:35:00	883.2	915.4	1103.8	1201.5	985.0	146.6
3:37:30	912.3	949.0	1123.2	1211.5	1044.6	196.3
3:40:00	950.2	989.5	1138.6	1219.5	1101.1	182.3
3:42:30	986.1	1027.0	1152.2	1222.8	1019.9	172.2
3:45:00	1021.1	1057.6	1163.2	1225.9	1054.6	151.4
3:47:30	1053.6	1082.2	1175.4	1225.5	1107.7	177.0
3:50:00	1081.7	1104.2	1186.2	1224.4	1119.8	166.0
3:52:30	1109.4	1122.6	1196.7	1221.6	1098.2	152.8
3:55:00	1135.7	1137.5	1203.2	1217.1	1127.5	200.2
3:57:30	1157.5	1150.8	1211.4	1209.8	1132.0	188.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
4:00:00	1176.1	1159.6	1216.7	1204.4	1123.3	177.5
4:02:30	1193.3	1167.1	1222.4	1198.9	1148.4	184.8
4:05:00	1206.0	1175.5	1228.3	1193.0	1124.1	157.9
4:07:30	1216.8	1179.9	1231.5	1188.4	1140.9	183.5
4:10:00	1224.9	1184.6	1235.0	1182.7	1082.6	152.6
4:12:30	1231.1	1185.8	1238.2	1177.5	1076.3	156.6
4:15:00	1235.7	1184.7	1238.6	1171.3	1136.5	154.3
4:17:30	1233.0	1177.6	1236.8	1165.5	1123.1	205.1
4:20:00	1229.9	1172.2	1235.0	1161.1	1156.3	221.3
4:22:30	1235.4	1174.3	1235.4	1159.5	1169.0	177.4
4:25:00	1237.5	1172.8	1235.5	1154.7	1173.6	154.9
4:27:30	1238.3	1169.4	1234.0	1149.4	1152.6	180.6
4:30:00	1238.5	1166.3	1231.4	1144.9	1173.9	187.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	73.0	72.7	72.8	73.1	73.0	73.3
0:02:30	96.4	72.6	72.6	73.2	72.9	73.5
0:05:00	144.3	73.0	73.1	73.9	73.6	76.5
0:07:30	202.0	74.6	75.3	75.8	75.6	82.5
0:10:00	270.0	78.4	79.6	79.6	79.9	91.0
0:12:30	332.7	84.4	86.4	85.7	86.4	101.0
0:15:00	390.0	92.9	95.6	94.1	95.5	112.5
0:17:30	440.7	103.0	106.1	104.0	106.1	124.9
0:20:00	486.6	114.0	117.3	114.9	117.8	137.6
0:22:30	531.0	126.3	129.1	126.5	130.4	152.9
0:25:00	561.7	138.9	141.3	138.4	143.9	167.4
0:27:30	588.8	151.9	153.9	151.3	157.3	182.7
0:30:00	620.4	164.9	166.3	164.2	170.5	196.4
0:32:30	645.3	179.3	179.0	176.5	182.1	204.9
0:35:00	663.9	193.6	190.9	187.1	195.3	215.2
0:37:30	684.4	200.7	202.1	201.5	201.1	229.2
0:40:00	700.6	207.3	209.4	213.8	212.0	215.5
0:42:30	716.9	214.8	218.9	221.9	219.1	199.5
0:45:00	730.4	222.5	227.6	230.4	227.0	191.2
0:47:30	739.3	229.4	235.3	236.5	234.6	171.5
0:50:00	750.4	236.2	243.7	239.3	242.4	166.2
0:52:30	758.5	241.9	252.4	245.6	249.4	167.3
0:55:00	766.5	247.1	260.3	250.3	257.0	159.1
0:57:30	775.6	253.0	268.5	256.4	264.2	171.6
1:00:00	783.5	259.6	276.7	258.1	265.7	185.3
1:02:30	794.0	265.8	285.0	263.5	271.9	185.4
1:05:00	801.3	271.7	293.3	269.3	278.7	188.9
1:07:30	810.3	276.8	301.3	274.1	286.1	173.9
1:10:00	817.1	283.1	310.0	282.2	293.1	200.7
1:12:30	824.7	289.4	317.6	289.5	298.1	206.2
1:15:00	831.6	296.0	325.3	296.5	304.6	197.9
1:17:30	837.0	302.6	332.8	303.6	311.3	225.9
1:20:00	841.8	308.0	340.1	309.2	317.3	220.0
1:22:30	845.3	313.6	347.4	315.4	322.9	198.6
1:25:00	847.7	318.2	353.5	320.2	328.7	192.4
1:27:30	850.0	323.8	359.5	325.2	333.8	227.3
1:30:00	853.3	328.8	365.4	329.4	338.1	218.9
1:32:30	860.8	333.0	370.6	335.1	341.8	217.2
1:35:00	873.5	338.7	375.9	341.1	345.2	162.7
1:37:30	883.7	343.2	380.6	343.8	348.9	186.4
1:40:00	893.0	347.9	385.1	347.9	352.3	205.3
1:42:30	898.8	352.4	389.6	351.1	355.6	184.2
1:45:00	905.2	357.7	394.3	356.1	359.0	168.5
1:47:30	911.3	362.4	398.9	358.6	362.2	154.4
1:50:00	916.5	366.5	403.4	363.3	364.6	157.4
1:52:30	922.2	370.6	407.7	368.3	367.7	168.5
1:55:00	927.3	373.9	412.0	370.4	371.4	155.1
1:57:30	932.1	377.8	415.9	374.6	374.9	189.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
2:00:00	938.4	382.8	420.0	378.4	378.4	168.3
2:02:30	943.5	387.2	424.0	381.0	381.6	185.2
2:05:00	948.2	392.7	428.0	386.4	384.8	169.1
2:07:30	953.7	398.8	431.6	389.7	387.3	191.7
2:10:00	959.6	406.2	435.5	393.5	390.4	196.6
2:12:30	964.8	413.4	439.7	400.6	394.0	207.6
2:15:00	969.6	421.0	443.8	405.5	397.4	180.3
2:17:30	975.2	428.3	448.4	410.3	400.7	204.3
2:20:00	981.6	435.7	452.8	415.1	404.0	213.1
2:22:30	988.2	443.3	457.5	420.3	406.9	244.3
2:25:00	996.2	450.7	462.4	424.9	410.6	261.3
2:27:30	1001.7	457.6	467.4	428.5	414.7	220.5
2:30:00	1009.3	465.5	472.7	434.4	418.6	242.1
2:32:30	1017.4	474.0	479.5	441.4	423.2	305.9
2:35:00	1025.5	482.5	486.3	448.1	427.8	291.3
2:37:30	1033.1	491.7	494.0	454.4	431.8	361.3
2:40:00	1039.9	502.3	502.7	462.3	436.5	403.3
2:42:30	1047.1	514.6	513.3	471.1	442.2	344.2
2:45:00	1055.4	526.7	524.5	480.1	448.2	313.2
2:47:30	1062.5	541.8	537.1	491.4	455.0	298.2
2:50:00	1069.4	558.6	551.0	503.6	461.7	240.8
2:52:30	1076.6	575.7	566.1	517.4	468.7	225.0
2:55:00	1084.4	594.5	582.9	529.7	475.8	192.0
2:57:30	1091.3	615.9	601.7	544.7	484.9	263.7
3:00:00	1099.1	641.4	620.3	557.7	492.2	166.1
3:02:30	1107.1	669.3	640.4	570.2	500.3	223.2
3:05:00	1117.4	700.0	660.6	586.1	510.3	188.9
3:07:30	1124.2	733.1	682.1	602.2	518.0	185.0
3:10:00	1132.5	763.9	705.0	622.7	528.7	159.4
3:12:30	1138.0	791.7	728.9	643.8	540.2	170.0
3:15:00	1143.0	815.2	752.0	664.8	550.6	184.1
3:17:30	1147.9	836.4	776.7	686.7	565.7	177.2
3:20:00	1152.3	858.2	801.7	707.3	586.0	217.2
3:22:30	1158.4	886.6	822.8	727.0	612.8	191.4
3:25:00	1161.4	914.3	839.0	749.4	643.9	212.6
3:27:30	1167.7	945.1	858.7	776.7	676.0	204.5
3:30:00	1170.6	977.1	879.1	800.7	709.4	207.4
3:32:30	1175.5	1008.2	905.9	827.2	746.8	277.7
3:35:00	1179.5	1036.8	923.8	853.7	773.1	257.0
3:37:30	1182.6	1061.9	944.0	875.2	799.3	307.4
3:40:00	1184.1	1087.3	966.5	896.7	824.1	209.2
3:42:30	1187.5	1107.7	986.5	919.8	851.1	333.0
3:45:00	1188.1	1122.7	1005.3	938.2	888.1	248.9
3:47:30	1190.3	1132.4	1021.0	953.7	922.6	245.8
3:50:00	1193.3	1139.8	1034.2	967.1	954.9	288.5
3:52:30	1194.2	1143.0	1051.0	980.4	981.1	275.0
3:55:00	1195.3	1145.0	1066.8	992.6	1008.1	261.5
3:57:30	1199.1	1147.1	1078.9	1003.7	1033.0	291.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
4:00:00	1200.6	1150.0	1089.6	1011.7	1057.7	319.7
4:02:30	1202.1	1153.9	1099.9	1019.3	1080.7	280.3
4:05:00	1204.3	1159.1	1118.4	1026.1	1100.3	319.2
4:07:30	1204.2	1159.9	1129.8	1032.0	1116.4	314.1
4:10:00	1205.2	1162.4	1139.8	1038.2	1129.9	302.4
4:12:30	1206.1	1163.9	1146.5	1043.4	1141.2	311.2
4:15:00	1207.5	1165.5	1152.3	1047.6	1150.1	300.2
4:17:30	1214.9	1158.7	1155.3	1049.4	1154.5	304.4
4:20:00	1218.4	1155.2	1157.1	1050.3	1157.8	281.9
4:22:30	1216.2	1160.6	1160.9	1052.6	1165.3	298.3
4:25:00	1217.0	1159.7	1164.5	1054.4	1167.3	261.7
4:27:30	1219.6	1157.5	1162.6	1056.3	1170.5	350.1
4:30:00	1219.6	1154.9	1162.8	1056.2	1169.5	359.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	73.6	72.8	73.4	73.6	73.7	73.4
0:02:30	73.7	92.9	73.5	73.8	73.7	73.4
0:05:00	76.2	140.0	74.2	74.6	74.4	73.9
0:07:30	81.7	196.8	76.4	77.7	76.7	75.9
0:10:00	89.5	263.9	80.6	83.5	81.5	80.2
0:12:30	98.9	325.2	87.1	92.7	88.9	87.0
0:15:00	109.7	379.1	95.9	104.5	99.3	96.0
0:17:30	121.6	426.5	106.4	118.1	111.3	107.5
0:20:00	134.1	466.8	118.0	133.0	124.8	119.5
0:22:30	147.0	500.5	130.5	148.9	139.1	132.1
0:25:00	160.0	530.3	143.9	164.3	153.7	144.4
0:27:30	172.7	559.8	157.3	180.7	169.1	156.6
0:30:00	185.2	584.9	171.4	196.9	184.2	169.2
0:32:30	195.6	608.0	185.3	212.5	198.2	179.0
0:35:00	207.0	629.1	117.9	225.1	211.0	191.3
0:37:30	205.0	651.5	114.4	245.6	226.7	190.2
0:40:00	197.0	669.6	111.1	260.9	239.2	185.7
0:42:30	196.3	685.4	119.6	274.8	251.8	202.9
0:45:00	194.3	696.6	108.0	289.1	263.3	189.1
0:47:30	197.6	706.6	125.1	298.8	272.6	208.1
0:50:00	202.9	717.3	127.2	308.7	274.6	209.8
0:52:30	204.3	726.8	101.8	318.1	283.2	203.6
0:55:00	202.1	735.2	100.1	325.7	290.2	196.2
0:57:30	216.6	745.0	92.4	333.9	296.9	209.2
1:00:00	225.9	753.2	97.8	343.0	303.2	215.2
1:02:30	232.2	763.2	101.2	348.4	309.0	217.3
1:05:00	231.7	769.1	113.9	356.0	316.1	224.2
1:07:30	234.7	777.0	104.8	362.8	322.2	211.0
1:10:00	251.1	783.5	110.2	369.2	328.1	227.9
1:12:30	259.0	790.1	106.8	375.5	332.7	213.7
1:15:00	263.2	797.7	115.3	381.4	336.0	225.5
1:17:30	273.3	802.0	111.0	388.1	341.7	235.3
1:20:00	272.5	807.9	112.4	394.0	346.3	235.9
1:22:30	275.7	810.8	109.5	400.3	351.2	238.0
1:25:00	279.4	813.2	136.5	405.6	356.0	234.2
1:27:30	298.0	814.6	104.1	411.3	362.0	229.7
1:30:00	302.9	817.4	116.6	417.1	366.0	230.1
1:32:30	309.3	823.3	114.6	421.9	369.5	235.1
1:35:00	311.6	833.2	111.6	426.8	373.4	224.6
1:37:30	304.6	843.0	124.1	432.1	376.6	200.1
1:40:00	313.7	851.0	129.3	436.2	379.8	208.8
1:42:30	307.4	858.6	139.3	439.7	383.1	227.9
1:45:00	327.0	863.9	126.8	442.8	385.9	199.3
1:47:30	324.3	869.8	127.0	446.5	388.9	174.6
1:50:00	329.4	875.2	133.4	450.1	391.8	206.7
1:52:30	333.5	880.0	138.7	453.7	394.5	179.9
1:55:00	331.8	883.3	144.1	457.5	397.4	183.1
1:57:30	342.0	886.9	137.4	461.0	399.9	193.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
2:00:00	366.8	890.9	142.2	464.6	402.7	185.0
2:02:30	382.3	894.2	138.3	467.7	405.1	171.6
2:05:00	400.7	897.8	136.6	470.7	407.8	172.5
2:07:30	410.4	902.4	136.3	473.8	409.7	186.3
2:10:00	407.2	908.7	144.1	477.1	412.4	196.8
2:12:30	413.1	915.7	153.6	480.2	415.0	193.9
2:15:00	410.5	922.6	149.3	483.2	417.9	179.4
2:17:30	402.9	929.1	144.4	486.0	420.3	186.4
2:20:00	395.4	935.8	142.9	489.5	422.8	178.0
2:22:30	396.4	942.2	166.7	492.6	425.9	194.1
2:25:00	399.1	949.8	141.3	495.6	428.2	187.9
2:27:30	398.3	955.7	142.4	498.6	430.1	173.1
2:30:00	405.8	963.9	166.2	501.5	432.6	204.3
2:32:30	413.2	971.1	153.6	504.3	435.1	191.4
2:35:00	408.7	978.8	156.2	506.8	437.2	207.0
2:37:30	432.6	986.5	152.1	509.5	439.4	178.3
2:40:00	435.5	994.6	188.5	512.3	441.3	201.9
2:42:30	438.7	1001.8	164.1	515.0	442.2	211.0
2:45:00	446.6	1010.9	173.3	517.3	444.5	193.9
2:47:30	453.6	1016.2	178.8	519.3	446.8	207.9
2:50:00	429.0	1022.7	175.1	521.5	449.6	182.1
2:52:30	420.4	1030.1	187.6	523.6	451.8	207.6
2:55:00	451.3	1036.8	174.9	526.0	454.0	205.9
2:57:30	452.1	1043.3	175.9	528.7	456.1	211.2
3:00:00	480.4	1050.0	217.7	531.5	457.2	209.1
3:02:30	474.8	1059.7	207.9	534.0	459.1	201.5
3:05:00	488.5	1070.8	172.1	537.0	460.9	230.2
3:07:30	518.5	1080.1	194.3	539.9	462.9	229.4
3:10:00	538.8	1087.3	203.8	543.2	465.4	213.5
3:12:30	551.6	1095.1	203.4	546.0	466.6	221.2
3:15:00	551.6	1102.2	193.2	549.4	468.4	234.0
3:17:30	571.9	1108.3	238.9	553.0	470.9	248.2
3:20:00	584.9	1115.5	217.0	555.6	473.7	245.9
3:22:30	593.8	1123.2	215.0	558.4	475.8	214.6
3:25:00	598.6	1130.7	230.6	561.6	477.8	212.2
3:27:30	611.2	1138.2	234.9	565.0	479.5	233.2
3:30:00	609.4	1143.4	214.3	567.7	482.2	221.4
3:32:30	619.1	1150.7	198.0	570.7	484.8	210.6
3:35:00	634.4	1156.3	226.9	574.0	487.2	210.9
3:37:30	659.2	1161.2	246.3	577.6	490.9	246.9
3:40:00	688.0	1163.3	232.7	582.7	493.9	230.0
3:42:30	696.2	1167.5	214.3	588.0	497.6	243.1
3:45:00	698.5	1170.3	257.0	593.4	501.6	236.7
3:47:30	701.0	1172.9	235.2	598.2	506.1	219.8
3:50:00	720.2	1176.1	221.4	603.5	509.5	237.7
3:52:30	709.8	1178.7	234.8	608.8	513.0	219.1
3:55:00	722.3	1180.8	231.3	614.7	515.8	254.1
3:57:30	703.2	1184.6	211.6	621.2	519.1	259.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
4:00:00	733.7	1187.6	231.3	628.0	523.7	254.8
4:02:30	735.8	1187.9	252.0	634.8	527.1	245.5
4:05:00	729.2	1190.6	259.1	641.7	530.0	235.4
4:07:30	726.6	1191.1	272.6	647.3	533.7	268.4
4:10:00	723.0	1191.4	241.9	653.7	537.2	228.1
4:12:30	724.4	1191.8	249.8	662.3	539.5	229.7
4:15:00	724.9	1193.2	263.9	668.4	540.0	246.3
4:17:30	702.4	1196.8	270.5	673.8	541.6	304.0
4:20:00	711.7	1200.4	259.6	678.9	546.8	296.6
4:22:30	716.7	1197.9	260.8	684.8	551.2	275.4
4:25:00	716.2	1198.0	262.9	690.6	554.1	274.7
4:27:30	685.9	1198.7	214.1	697.6	560.4	259.9
4:30:00	683.2	1199.7	251.3	708.4	566.1	252.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	73.9	74.7	73.4	73.5	73.5	73.8
0:02:30	74.0	75.7	95.4	73.8	73.6	73.8
0:05:00	77.9	82.0	146.2	74.4	74.0	74.1
0:07:30	85.5	92.4	211.0	77.7	76.4	76.8
0:10:00	96.4	105.6	288.5	84.0	81.3	82.1
0:12:30	109.7	120.7	357.5	92.6	88.8	90.5
0:15:00	124.3	136.6	413.3	102.7	97.7	101.5
0:17:30	139.6	153.7	462.6	113.9	107.2	114.2
0:20:00	155.1	171.4	502.2	125.7	118.5	127.7
0:22:30	170.2	188.5	533.8	138.0	128.1	141.3
0:25:00	185.8	204.5	561.5	150.5	138.2	156.4
0:27:30	198.8	220.6	586.3	163.2	147.8	172.0
0:30:00	212.3	236.4	611.4	175.8	156.1	187.3
0:32:30	227.8	251.7	633.5	188.4	166.4	203.5
0:35:00	229.5	266.5	657.6	200.5	173.1	218.0
0:37:30	220.9	281.9	674.3	212.0	184.4	230.7
0:40:00	219.1	296.8	685.6	216.0	193.8	232.9
0:42:30	224.5	300.5	697.2	217.5	197.6	240.9
0:45:00	229.1	307.4	706.7	224.1	180.9	246.8
0:47:30	232.1	304.7	714.0	229.4	193.7	250.5
0:50:00	235.8	310.7	723.4	236.0	209.5	253.9
0:52:30	239.2	322.1	730.6	241.7	235.9	256.6
0:55:00	244.5	334.1	738.3	246.9	235.7	259.8
0:57:30	251.2	346.5	745.1	254.6	265.0	262.6
1:00:00	258.1	356.5	750.8	254.0	259.9	263.9
1:02:30	266.5	367.9	758.1	257.7	268.7	243.2
1:05:00	271.3	377.7	761.1	262.1	265.5	246.7
1:07:30	278.7	381.3	767.5	261.9	250.8	250.8
1:10:00	285.8	390.2	772.0	270.6	257.6	255.0
1:12:30	292.7	400.9	777.9	278.8	264.0	259.4
1:15:00	298.8	404.9	784.4	285.4	258.4	264.6
1:17:30	305.6	414.4	788.1	291.3	271.0	269.5
1:20:00	311.9	420.7	795.5	291.8	285.3	274.2
1:22:30	317.4	432.6	799.8	294.7	271.7	279.1
1:25:00	320.8	442.1	804.2	297.3	277.2	283.7
1:27:30	326.2	393.9	806.8	306.8	286.3	288.1
1:30:00	330.0	399.4	810.8	313.2	279.4	293.4
1:32:30	330.4	397.4	821.1	318.4	262.3	298.5
1:35:00	337.1	370.1	833.9	321.5	228.6	303.2
1:37:30	340.9	346.8	841.5	324.7	244.6	276.0
1:40:00	342.5	324.5	848.4	329.2	232.0	264.5
1:42:30	343.8	367.1	853.4	330.4	233.5	259.7
1:45:00	344.7	321.0	858.0	339.2	257.3	265.8
1:47:30	346.7	306.1	862.7	342.6	253.3	266.2
1:50:00	348.7	279.4	866.6	346.0	231.9	260.9
1:52:30	351.8	240.8	871.7	349.7	223.8	264.8
1:55:00	356.1	234.4	876.0	349.8	266.8	268.8
1:57:30	359.0	252.1	879.5	352.6	265.7	265.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
2:00:00	362.4	238.6	883.5	355.4	269.8	267.3
2:02:30	363.2	268.7	887.2	356.1	257.5	271.4
2:05:00	367.2	246.8	889.7	359.7	254.2	276.8
2:07:30	370.8	243.3	892.1	361.3	258.2	274.9
2:10:00	374.9	255.3	893.9	361.7	262.5	275.7
2:12:30	377.0	261.9	895.4	367.1	263.3	271.5
2:15:00	379.1	246.0	896.6	368.5	262.6	276.0
2:17:30	378.0	274.7	897.3	370.5	267.3	282.0
2:20:00	383.9	238.8	897.7	370.9	264.2	274.5
2:22:30	385.7	258.1	898.0	377.3	260.9	281.5
2:25:00	390.8	252.7	899.6	375.6	262.8	282.7
2:27:30	396.5	265.1	900.6	376.5	269.2	291.7
2:30:00	397.6	278.3	903.1	383.5	266.6	289.2
2:32:30	397.6	276.6	905.2	388.3	282.3	283.6
2:35:00	399.7	283.4	907.4	392.3	270.0	266.4
2:37:30	404.0	296.2	909.9	397.4	278.0	262.1
2:40:00	405.5	289.2	913.0	407.0	281.5	254.7
2:42:30	413.1	286.9	915.2	412.4	288.3	268.4
2:45:00	410.8	287.1	917.0	416.3	287.8	280.2
2:47:30	412.6	298.9	918.7	422.2	285.6	282.5
2:50:00	413.1	317.6	919.3	431.6	276.4	275.9
2:52:30	413.9	284.1	922.8	436.4	263.2	238.5
2:55:00	415.0	293.3	924.6	438.8	267.8	264.0
2:57:30	419.4	301.3	926.8	446.5	275.4	266.0
3:00:00	424.9	285.6	929.4	454.4	273.8	253.5
3:02:30	426.8	302.8	932.7	459.5	249.8	259.5
3:05:00	433.4	299.9	938.9	465.4	249.8	257.8
3:07:30	433.5	317.1	943.4	470.9	283.2	254.7
3:10:00	441.5	310.1	947.1	475.8	271.7	290.2
3:12:30	444.0	330.5	950.9	481.3	276.0	261.8
3:15:00	451.3	336.1	955.0	487.6	252.4	297.3
3:17:30	449.0	317.6	957.0	494.2	253.6	304.6
3:20:00	447.4	313.7	959.5	498.9	264.2	269.2
3:22:30	454.7	336.8	964.0	506.6	270.9	289.4
3:25:00	458.5	308.6	969.6	515.5	272.1	248.4
3:27:30	469.4	317.6	975.3	522.0	254.6	294.5
3:30:00	466.1	318.2	979.8	527.6	244.1	292.0
3:32:30	470.5	313.5	986.4	535.7	264.7	270.4
3:35:00	475.4	340.1	992.2	543.5	250.3	315.2
3:37:30	471.5	316.6	999.8	551.1	271.3	273.3
3:40:00	474.2	343.6	1005.0	559.5	297.8	252.1
3:42:30	479.4	350.0	1009.7	565.3	265.3	304.8
3:45:00	485.2	324.6	1013.7	570.1	312.1	290.6
3:47:30	488.7	349.2	1018.1	578.4	307.9	281.6
3:50:00	498.1	352.1	1022.8	582.5	318.7	297.9
3:52:30	503.2	364.6	1026.7	588.7	266.7	298.1
3:55:00	510.8	399.2	1032.1	593.3	305.2	273.7
3:57:30	525.2	380.0	1036.8	595.1	276.6	268.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
4:00:00	531.8	473.9	1041.2	599.8	283.3	279.3
4:02:30	548.3	425.1	1046.0	604.5	324.3	311.8
4:05:00	555.5	373.1	1048.8	608.8	318.2	301.2
4:07:30	557.4	458.1	1051.8	611.7	318.3	285.4
4:10:00	559.6	469.8	1054.6	613.1	288.3	295.2
4:12:30	554.3	525.4	1056.7	616.1	275.1	313.0
4:15:00	562.6	475.8	1059.3	621.5	334.9	319.6
4:17:30	561.6	530.0	1065.1	624.5	313.5	294.1
4:20:00	564.6	631.5	1071.0	625.8	277.3	307.5
4:22:30	569.2	583.4	1072.2	627.9	322.1	313.6
4:25:00	568.7	589.1	1071.7	630.4	290.2	325.4
4:27:30	573.9	704.3	1075.1	624.5	382.0	281.2
4:30:00	580.7	685.8	1077.6	624.4	387.0	276.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	73.8	74.4	74.6	73.8	74.0
0:02:30	74.1	74.8	75.4	98.9	73.9
0:05:00	74.5	78.0	78.9	152.0	73.7
0:07:30	77.3	84.5	85.4	214.7	73.9
0:10:00	82.3	93.6	94.3	284.8	74.3
0:12:30	90.1	104.7	105.1	347.6	75.7
0:15:00	99.8	117.5	117.1	400.5	78.1
0:17:30	111.3	131.2	130.7	447.1	82.1
0:20:00	123.6	145.6	144.6	486.5	88.3
0:22:30	137.1	159.1	158.4	522.0	96.4
0:25:00	150.7	172.6	172.3	552.0	107.4
0:27:30	164.6	186.1	185.9	578.3	120.1
0:30:00	178.3	198.8	199.1	601.6	134.0
0:32:30	191.4	211.6	211.3	614.4	148.3
0:35:00	203.8	225.0	223.7	634.5	163.1
0:37:30	215.7	239.1	235.1	654.1	176.7
0:40:00	224.4	245.2	234.2	682.9	187.9
0:42:30	219.2	247.3	190.4	690.9	195.6
0:45:00	220.0	257.3	184.0	702.8	200.4
0:47:30	218.3	268.7	185.5	712.6	204.3
0:50:00	216.0	279.6	184.8	723.0	206.9
0:52:30	211.7	287.5	192.4	733.0	209.2
0:55:00	211.8	277.7	191.1	743.1	212.0
0:57:30	207.7	259.6	196.7	754.4	215.2
1:00:00	94.6	253.4	299.9	764.2	219.1
1:02:30	103.9	258.5	311.4	775.4	222.8
1:05:00	109.0	261.8	364.3	787.5	227.4
1:07:30	107.4	273.1	381.8	797.6	229.5
1:10:00	110.2	277.1	411.2	806.2	237.0
1:12:30	112.4	285.2	446.8	813.6	242.8
1:15:00	113.4	293.5	447.1	821.2	249.6
1:17:30	108.6	293.2	491.0	825.4	257.1
1:20:00	114.3	307.8	509.3	830.7	264.7
1:22:30	102.3	311.3	465.3	833.6	272.3
1:25:00	111.9	323.1	498.5	836.0	280.7
1:27:30	112.8	320.4	425.0	838.4	290.8
1:30:00	117.1	325.4	543.2	842.0	299.1
1:32:30	120.3	341.4	474.6	847.8	307.0
1:35:00	114.3	338.4	674.4	858.3	315.7
1:37:30	134.5	336.5	708.3	867.3	323.4
1:40:00	117.4	325.2	612.1	875.4	331.3
1:42:30	124.5	305.3	630.3	881.1	337.4
1:45:00	138.8	323.1	574.3	886.9	345.5
1:47:30	134.9	317.3	592.4	892.7	352.8
1:50:00	130.8	304.3	580.1	897.6	360.2
1:52:30	134.6	290.9	595.2	902.9	367.3
1:55:00	154.9	305.7	578.4	908.0	373.3
1:57:30	145.0	304.7	632.9	913.1	380.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
2:00:00	158.4	317.3	855.6	921.7	387.1
2:02:30	164.4	307.4	945.5	933.1	393.6
2:05:00	193.6	312.8	974.0	947.3	400.8
2:07:30	168.1	303.4	1052.8	962.5	406.2
2:10:00	177.3	307.3	1012.2	974.7	411.3
2:12:30	185.7	325.3	1069.7	986.1	418.3
2:15:00	172.8	319.2	1082.0	993.8	423.8
2:17:30	173.3	321.1	1103.8	1000.7	429.8
2:20:00	163.2	308.6	1126.2	1007.2	434.5
2:22:30	170.5	327.0	1149.2	1013.1	440.3
2:25:00	152.3	310.6	1160.1	1016.6	445.1
2:27:30	180.8	311.9	1166.2	1020.8	448.9
2:30:00	178.7	315.8	1176.4	1026.0	454.9
2:32:30	190.2	342.8	1192.1	1030.9	460.9
2:35:00	184.0	334.7	1203.8	1035.0	464.9
2:37:30	173.3	338.9	1215.3	1038.3	469.8
2:40:00	203.6	337.6	1224.7	1041.7	473.5
2:42:30	188.2	339.1	1234.2	1045.4	478.4
2:45:00	195.4	332.2	1244.7	1049.2	482.6
2:47:30	192.6	327.0	1255.3	1052.2	486.3
2:50:00	196.3	348.0	1263.6	1055.0	491.6
2:52:30	184.0	328.0	1270.2	1059.0	495.9
2:55:00	199.4	347.0	1279.0	1062.4	499.0
2:57:30	208.0	368.8	1289.4	1065.0	502.8
3:00:00	210.8	367.7	1298.5	1068.4	507.8
3:02:30	200.2	361.3	1308.1	1071.7	511.5
3:05:00	217.6	346.5	1312.7	1078.8	515.4
3:07:30	232.1	384.9	1319.8	1081.4	520.1
3:10:00	218.7	394.2	1329.9	1085.5	523.4
3:12:30	230.3	384.2	1335.5	1089.9	525.0
3:15:00	222.6	384.4	1339.6	1092.1	530.1
3:17:30	242.9	377.5	1346.4	1094.3	532.8
3:20:00	207.4	367.6	1345.7	1097.6	535.6
3:22:30	220.1	414.2	1360.2	1101.4	538.0
3:25:00	226.6	391.8	1360.8	1103.4	540.3
3:27:30	231.1	402.1	1362.6	1106.9	543.7
3:30:00	223.8	392.1	1364.0	1108.2	547.2
3:32:30	223.0	410.8	1367.4	1111.7	549.8
3:35:00	249.6	411.4	1359.8	1114.2	553.0
3:37:30	242.5	405.2	1364.2	1117.3	557.4
3:40:00	232.2	435.7	1374.9	1119.6	560.5
3:42:30	214.3	375.4	1382.4	1119.8	561.7
3:45:00	259.2	444.3	1385.4	1119.9	565.3
3:47:30	262.9	445.2	1388.9	1121.3	568.2
3:50:00	238.6	428.6	1392.4	1122.4	569.5
3:52:30	234.8	432.2	1393.3	1122.8	572.8
3:55:00	255.3	441.2	1396.0	1124.4	576.1
3:57:30	203.8	352.8	1398.2	1126.6	577.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 7

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
4:00:00	250.9	422.2	1402.4	1129.2	580.9
4:02:30	256.9	451.0	1403.6	1130.7	581.9
4:05:00	240.6	457.0	1408.0	1131.3	585.1
4:07:30	270.0	463.7	1410.5	1131.5	587.3
4:10:00	238.3	466.1	1411.9	1131.8	589.6
4:12:30	219.5	485.3	1413.4	1132.4	592.0
4:15:00	282.8	495.2	1414.5	1134.9	593.3
4:17:30	269.3	467.7	1416.5	1140.7	595.9
4:20:00	264.1	470.8	1421.2	1145.4	598.2
4:22:30	283.4	492.4	1422.0	1143.7	600.3
4:25:00	262.8	499.2	1424.6	1144.3	602.5
4:27:30	245.6	324.5	1426.7	1147.0	606.8
4:30:00	298.4	340.3	1432.9	1150.0	609.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	70.3	70.3	70.1	70.1	70.4	70.7
0:02:29	70.3	70.3	70.3	70.0	71.2	71.2
0:04:59	70.9	71.3	70.9	70.9	75.2	74.9
0:07:29	72.7	74.3	73.5	73.8	82.3	81.8
0:09:59	76.8	80.1	78.5	78.4	92.1	91.0
0:12:29	83.2	89.2	86.1	85.3	103.8	102.4
0:14:59	91.1	100.4	95.6	93.4	117.1	115.5
0:17:29	100.6	113.3	106.4	104.0	131.8	130.2
0:19:59	111.3	127.4	118.4	115.1	148.1	145.3
0:22:29	122.9	142.1	131.1	127.1	165.4	161.6
0:24:59	135.0	157.1	144.3	139.9	181.4	177.2
0:27:29	147.0	171.9	157.6	149.8	195.7	191.6
0:29:59	160.2	185.5	170.9	163.0	209.5	209.1
0:32:29	173.2	199.2	184.3	172.2	221.3	219.3
0:34:59	186.5	211.8	197.2	181.5	220.6	230.1
0:37:29	183.6	224.0	209.5	125.2	223.5	251.2
0:39:59	158.3	235.5	220.9	137.0	234.5	263.9
0:42:29	123.9	246.6	231.9	139.8	242.8	280.7
0:44:59	158.0	256.7	242.4	153.2	254.9	293.6
0:47:29	157.7	266.0	252.1	135.9	259.2	305.7
0:49:59	184.7	274.8	261.8	154.8	275.0	323.9
0:52:29	174.0	283.4	271.3	141.6	283.0	335.6
0:54:59	174.5	291.8	281.0	136.1	292.9	340.1
0:57:29	178.8	299.6	289.9	147.7	304.7	337.7
0:59:59	185.0	307.6	298.3	142.9	314.6	334.7
1:02:29	188.4	315.0	305.7	148.4	331.9	332.5
1:04:59	209.8	322.4	313.1	137.3	345.9	336.0
1:07:29	199.0	329.5	320.3	134.6	346.8	340.5
1:09:59	201.3	336.4	326.9	145.7	360.8	343.1
1:12:29	206.8	343.3	333.7	138.8	367.6	346.3
1:14:59	215.8	350.2	339.8	142.9	382.4	348.9
1:17:29	221.1	357.0	345.8	159.9	389.7	351.9
1:19:59	218.5	363.3	351.8	144.9	393.0	358.8
1:22:29	226.5	369.0	357.0	147.1	399.9	364.6
1:24:59	223.2	374.4	362.1	146.8	408.3	369.6
1:27:29	217.6	380.5	366.9	144.6	417.0	372.6
1:29:59	220.4	386.7	371.5	157.8	410.5	376.2
1:32:29	236.1	392.3	375.8	160.4	412.8	381.1
1:34:59	227.7	397.2	380.1	167.3	418.2	381.4
1:37:29	214.8	402.2	384.2	150.4	424.7	385.3
1:39:59	223.2	407.3	388.4	155.1	437.0	392.4
1:42:29	217.7	412.3	392.2	171.3	436.8	327.3
1:44:59	227.1	416.1	396.0	170.4	445.4	327.1
1:47:29	214.4	420.3	399.7	165.1	442.3	336.6
1:49:59	210.9	424.0	403.1	163.5	451.4	329.0
1:52:29	224.5	427.4	406.0	184.9	465.3	337.9
1:54:59	227.2	430.9	409.1	178.4	466.9	341.6
1:57:29	221.6	434.7	412.0	185.9	473.0	348.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
1:59:59	225.2	438.3	415.1	181.3	488.9	345.6
2:02:29	235.6	441.5	418.9	207.7	499.2	343.2
2:04:59	245.0	444.6	422.4	205.7	509.2	345.4
2:07:29	281.9	447.7	426.3	221.1	532.8	352.3
2:09:59	262.4	452.5	430.4	201.5	525.0	353.0
2:12:29	284.9	456.8	434.3	214.9	543.7	349.7
2:14:59	307.5	462.1	438.5	238.2	545.9	355.0
2:17:29	315.1	467.0	443.5	205.8	558.3	359.2
2:19:59	311.3	471.8	449.1	219.3	578.2	374.6
2:22:29	309.9	477.4	455.2	222.9	577.1	360.1
2:24:59	299.6	483.6	460.9	203.9	593.4	359.6
2:27:29	313.6	489.9	466.4	202.0	594.3	389.4
2:29:59	312.3	495.9	472.3	187.5	602.2	382.7
2:32:29	395.4	501.8	479.1	212.5	617.8	418.5
2:34:59	325.7	507.9	486.6	203.6	631.3	399.2
2:37:29	333.1	513.9	494.8	193.8	642.3	409.2
2:39:59	343.2	519.8	504.7	193.3	644.7	408.4
2:42:29	375.3	525.6	515.6	211.8	680.6	437.5
2:44:59	370.4	532.4	528.3	217.6	694.4	408.8
2:47:29	383.6	540.1	544.5	248.7	728.7	453.0
2:49:59	375.3	547.9	563.7	200.5	729.7	446.4
2:52:29	404.7	556.1	583.8	224.1	747.1	449.8
2:54:59	415.2	564.0	606.7	227.3	786.9	472.5
2:57:29	448.4	574.3	633.6	217.6	790.9	495.1
2:59:59	473.3	585.9	662.6	274.3	833.3	490.7
3:02:29	483.6	597.9	691.6	214.2	825.9	484.4
3:04:59	454.9	610.8	725.0	203.0	855.4	473.6
3:07:29	461.8	624.1	757.0	241.9	871.9	491.1
3:09:59	493.5	639.5	787.3	238.0	902.0	500.5
3:12:29	492.1	656.0	817.8	230.5	927.4	495.5
3:14:59	498.2	674.0	844.7	225.2	955.8	521.7
3:17:29	485.5	691.6	869.2	202.5	972.0	503.2
3:19:59	484.8	708.2	887.8	215.0	943.9	526.1
3:22:29	506.3	725.1	904.5	212.0	932.2	515.8
3:24:59	556.0	741.6	923.0	241.5	975.9	551.2
3:27:29	539.1	753.7	942.3	242.0	983.8	551.3
3:29:59	549.9	764.7	960.0	231.6	993.4	561.4
3:32:29	572.9	781.9	973.7	237.6	994.3	577.8
3:34:59	578.7	800.3	983.0	233.4	983.8	566.8
3:37:29	574.3	818.8	988.7	210.3	994.7	572.9
3:39:59	607.8	838.0	994.6	245.2	1005.4	602.9
3:42:29	600.3	851.7	1002.4	222.3	1012.8	591.2
3:44:59	633.0	865.9	1009.0	261.2	1010.1	627.9
3:47:29	611.6	878.7	1014.1	252.0	1025.6	628.0
3:49:59	622.6	890.5	1016.0	253.8	1023.2	627.9
3:52:29	617.7	898.8	1017.0	239.9	1043.9	642.1
3:54:59	641.5	907.7	1020.0	239.2	1038.8	648.2
3:57:29	635.3	916.2	1024.4	222.2	1029.8	639.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
3:59:59	624.5	923.2	1025.9	255.1	1034.6	649.3
4:02:29	648.8	929.9	1028.8	281.9	1051.0	662.1
4:04:59	628.5	937.5	1028.4	249.6	1051.4	660.9
4:07:29	647.6	945.7	1027.6	270.2	1061.7	665.2
4:09:59	639.5	952.5	1026.6	244.3	1046.1	654.9
4:12:29	643.7	960.7	1023.5	249.1	1043.5	655.9
4:14:59	642.8	964.8	1020.5	219.6	1040.0	647.4
4:17:29	650.0	967.1	1016.9	286.9	1054.1	656.4
4:19:59	634.5	969.3	1015.0	236.8	1051.6	671.3
4:22:29	633.0	973.0	1013.5	237.4	1060.0	674.9
4:24:59	630.0	975.6	1009.8	225.2	1050.1	675.9
4:27:29	636.5	977.1	1005.7	255.5	1064.0	681.5
4:29:59	852.5	977.0	1003.0	741.8	938.2	791.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	70.3	70.1	70.0	70.7	70.6	70.7
0:02:29	94.7	70.3	70.0	70.7	70.7	72.2
0:04:59	139.1	71.3	71.0	71.1	71.4	79.0
0:07:29	189.9	73.8	74.0	72.9	74.0	88.6
0:09:59	250.2	77.8	79.7	76.8	78.7	101.5
0:12:29	309.9	84.4	87.9	82.6	86.1	116.5
0:14:59	360.1	91.8	98.0	90.5	96.1	132.9
0:17:29	404.5	100.0	109.3	99.7	107.9	150.0
0:19:59	447.4	107.2	121.3	110.4	121.2	167.3
0:22:29	485.7	117.2	133.9	121.9	135.3	184.3
0:24:59	518.8	124.5	147.0	134.0	150.4	200.9
0:27:29	546.2	141.4	159.6	145.5	164.9	216.1
0:29:59	575.8	152.6	172.5	158.1	180.4	230.3
0:32:29	600.7	158.9	185.1	171.1	195.9	240.0
0:34:59	621.1	165.0	197.4	189.0	209.2	253.6
0:37:29	640.4	184.1	209.2	117.1	220.8	251.3
0:39:59	657.2	197.3	221.7	114.1	233.9	263.0
0:42:29	673.5	211.2	234.4	111.7	246.9	270.0
0:44:59	688.4	216.0	247.2	130.1	256.4	274.0
0:47:29	699.9	229.7	260.1	127.2	267.6	287.0
0:49:59	709.6	240.5	272.4	129.2	275.7	290.3
0:52:29	716.1	302.1	277.6	141.3	281.7	300.7
0:54:59	723.0	318.3	285.1	133.1	282.0	290.7
0:57:29	731.4	330.3	289.7	135.2	288.1	294.1
0:59:59	738.6	330.6	299.0	154.4	118.4	299.3
1:02:29	745.6	114.3	306.9	169.2	110.3	310.7
1:04:59	754.6	130.4	313.8	156.0	116.6	321.9
1:07:29	758.9	123.3	317.6	159.4	124.8	326.4
1:09:59	765.9	126.6	323.3	160.1	122.1	340.9
1:12:29	772.5	127.0	328.6	146.7	125.8	344.9
1:14:59	781.9	130.3	333.4	168.9	124.7	356.2
1:17:29	788.6	142.3	338.5	171.2	132.8	364.2
1:19:59	797.2	149.7	342.8	174.1	136.4	364.5
1:22:29	804.5	142.6	346.1	199.8	128.6	368.5
1:24:59	812.5	141.2	350.1	199.4	136.8	369.9
1:27:29	819.0	142.0	353.3	178.9	138.1	374.2
1:29:59	825.0	141.4	357.1	222.0	135.2	376.9
1:32:29	833.4	147.0	359.1	287.7	137.5	381.8
1:34:59	840.8	139.8	361.9	329.3	134.3	386.6
1:37:29	848.3	135.6	365.2	347.9	138.3	393.3
1:39:59	854.8	140.9	369.7	352.1	142.1	392.2
1:42:29	857.9	154.2	373.6	378.7	145.2	394.4
1:44:59	862.6	155.2	379.3	353.1	144.7	377.1
1:47:29	865.8	159.7	381.9	246.0	150.5	378.3
1:49:59	869.6	157.6	385.9	381.8	151.5	373.1
1:52:29	874.7	176.0	391.7	521.3	175.9	368.8
1:54:59	877.5	156.1	394.5	526.0	153.0	374.9
1:57:29	884.2	155.7	397.3	500.1	156.3	383.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
1:59:59	890.6	162.6	400.9	333.5	167.5	393.7
2:02:29	897.5	164.5	405.0	313.2	162.5	399.1
2:04:59	903.8	167.2	408.3	396.6	153.1	401.9
2:07:29	909.7	160.3	413.2	414.1	157.6	410.9
2:09:59	913.7	180.9	416.9	334.7	159.0	415.0
2:12:29	921.2	173.6	422.5	338.5	175.0	419.7
2:14:59	927.1	176.5	425.7	370.3	171.7	427.5
2:17:29	937.5	183.6	432.6	431.3	167.2	439.5
2:19:59	949.1	193.1	439.0	430.7	164.4	448.5
2:22:29	957.2	187.9	445.8	450.1	171.1	459.6
2:24:59	966.3	188.1	454.5	435.8	171.4	465.1
2:27:29	971.6	202.0	462.2	378.0	184.8	474.8
2:29:59	977.9	187.8	470.1	413.1	167.2	494.6
2:32:29	983.9	199.6	479.7	407.1	177.7	507.6
2:34:59	988.4	189.1	489.6	376.5	181.6	533.1
2:37:29	994.4	189.8	499.0	398.4	173.2	565.6
2:39:59	1000.8	174.3	508.5	372.7	173.4	601.5
2:42:29	1006.8	199.5	520.9	394.4	185.9	610.8
2:44:59	1011.4	168.7	535.4	436.0	183.2	609.7
2:47:29	1019.1	188.0	551.1	504.3	187.5	600.2
2:49:59	1022.1	189.1	566.1	447.0	192.2	609.0
2:52:29	1027.3	187.4	583.7	457.2	193.7	612.9
2:54:59	1032.2	175.9	600.8	483.1	195.9	635.9
2:57:29	1035.3	186.9	619.1	486.8	199.1	666.4
2:59:59	1039.9	169.0	635.4	515.3	199.6	692.5
3:02:29	1043.6	181.3	658.5	467.0	201.3	733.2
3:04:59	1047.1	193.0	684.7	472.6	198.3	772.3
3:07:29	1052.1	190.9	713.3	473.4	207.4	781.9
3:09:59	1056.6	197.2	739.0	494.9	207.2	800.5
3:12:29	1057.8	180.4	749.2	530.0	230.1	808.4
3:14:59	1057.9	199.3	763.0	521.7	247.1	831.0
3:17:29	1060.7	201.1	743.8	535.8	219.3	848.0
3:19:59	1062.2	189.3	692.4	564.3	222.1	861.9
3:22:29	1063.9	203.5	749.1	549.3	212.7	877.3
3:24:59	1070.2	202.9	796.6	530.1	236.8	894.3
3:27:29	1073.1	221.0	839.5	544.3	229.4	907.9
3:29:59	1076.7	218.4	860.5	542.2	290.8	912.5
3:32:29	1076.9	230.6	850.9	532.0	221.8	914.5
3:34:59	1074.6	235.3	854.7	528.6	220.8	926.2
3:37:29	1075.0	241.6	859.9	543.6	239.6	925.7
3:39:59	1078.6	230.1	867.8	537.3	243.1	921.0
3:42:29	1080.5	262.7	877.4	548.0	237.9	926.5
3:44:59	1082.4	263.9	870.6	513.0	249.4	932.9
3:47:29	1085.1	246.3	860.7	516.4	248.9	938.7
3:49:59	1085.3	254.7	862.8	532.8	238.2	935.0
3:52:29	1089.0	249.4	866.6	515.2	246.3	939.5
3:54:59	1089.2	244.7	874.1	556.0	257.3	930.3
3:57:29	1089.4	242.9	874.1	562.6	242.4	940.6

APPENDIX C
 DOW CORNING CORP.
 TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
3:59:59	1091.1	251.2	887.8	547.0	248.0	944.0
4:02:29	1091.2	233.1	891.3	576.5	275.2	936.7
4:04:59	1094.6	240.2	904.4	579.8	256.1	943.9
4:07:29	1097.4	268.2	902.1	551.2	259.9	952.5
4:09:59	1097.0	277.6	908.6	542.1	247.4	959.1
4:12:29	1097.3	253.9	908.2	546.6	248.8	958.9
4:14:59	1097.1	251.9	913.3	571.4	245.7	960.4
4:17:29	1101.9	261.6	920.6	569.8	248.7	961.8
4:19:59	1101.0	264.9	921.1	589.7	249.0	963.0
4:22:29	1101.4	261.1	925.4	588.3	247.6	962.8
4:24:59	1101.0	251.4	931.9	559.0	253.3	973.4
4:27:29	1105.3	261.8	937.5	551.0	257.5	975.2
4:29:59	1110.3	244.3	937.3	731.1	719.1	954.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	70.6	69.7	70.9	71.0	70.9	70.4
0:02:29	71.0	94.1	70.7	71.0	70.9	70.6
0:04:59	74.9	140.9	71.3	71.9	71.6	71.4
0:07:29	81.5	195.3	73.3	75.4	73.9	74.5
0:09:59	90.9	260.0	77.8	81.7	78.8	80.7
0:12:29	102.4	321.7	85.0	91.8	86.0	89.3
0:14:59	115.7	373.5	93.8	103.7	94.6	97.9
0:17:29	130.2	417.9	104.4	117.5	105.2	111.3
0:19:59	145.6	459.4	116.2	132.8	116.7	126.4
0:22:29	159.9	494.1	128.8	148.7	128.8	143.6
0:24:59	173.6	524.3	141.6	165.5	141.3	158.4
0:27:29	185.1	551.4	154.8	181.7	153.1	173.4
0:29:59	194.0	579.0	167.8	197.8	165.9	192.7
0:32:29	204.1	604.0	181.2	213.2	178.3	151.0
0:34:59	199.8	625.0	191.6	227.2	190.7	151.6
0:37:29	92.4	639.3	196.4	239.1	200.0	152.7
0:39:59	91.8	655.7	208.3	251.5	211.7	158.7
0:42:29	94.5	671.3	219.7	257.1	223.9	172.0
0:44:59	94.3	684.3	229.4	268.2	235.3	182.8
0:47:29	97.7	697.6	242.2	278.8	246.3	163.5
0:49:59	101.7	707.8	253.8	288.4	257.4	198.6
0:52:29	103.2	716.5	288.5	297.8	267.9	203.1
0:54:59	106.1	726.2	286.2	306.7	278.2	198.1
0:57:29	113.3	735.4	280.9	314.8	288.1	209.0
0:59:59	100.7	743.5	281.2	322.8	297.0	203.5
1:02:29	102.1	750.8	284.5	330.0	305.7	232.4
1:04:59	116.3	758.5	289.2	336.5	314.7	231.3
1:07:29	117.7	765.1	292.3	343.2	323.5	221.8
1:09:59	115.0	771.5	293.2	350.2	329.7	208.2
1:12:29	116.5	779.0	293.4	356.4	336.4	183.2
1:14:59	122.6	784.5	297.9	362.6	342.2	222.6
1:17:29	116.8	789.5	298.5	368.5	348.5	195.1
1:19:59	116.8	794.7	303.1	373.8	354.0	173.7
1:22:29	111.2	797.5	305.2	378.1	358.9	176.8
1:24:59	118.2	802.7	309.9	382.4	363.0	207.4
1:27:29	124.8	807.2	310.9	386.9	365.8	179.3
1:29:59	128.6	811.6	313.8	390.6	369.2	193.8
1:32:29	123.0	817.5	317.9	394.7	373.2	255.1
1:34:59	119.3	826.4	316.1	398.5	377.0	220.5
1:37:29	118.9	838.1	321.2	402.3	380.1	213.4
1:39:59	117.2	848.2	328.1	406.1	381.7	197.1
1:42:29	131.5	854.6	324.0	409.5	384.8	211.3
1:44:59	128.2	860.7	332.5	412.5	387.5	220.7
1:47:29	132.6	865.3	329.9	415.4	389.1	197.7
1:49:59	134.3	871.7	326.1	418.0	392.2	205.8
1:52:29	143.5	879.8	338.9	420.4	394.5	293.7
1:54:59	127.9	883.4	339.4	423.0	397.3	200.2
1:57:29	129.7	893.2	344.2	425.8	399.9	239.0

R8196/95NK3179

Test Date : APRIL 21, 1995

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
1:59:59	155.1	901.7	342.3	428.8	403.5	250.0
2:02:29	218.6	911.3	344.7	431.8	406.9	253.6
2:04:59	200.5	919.4	341.2	435.2	409.6	249.8
2:07:29	208.9	924.1	362.3	438.5	413.4	297.7
2:09:59	216.1	929.1	365.7	442.2	416.5	247.2
2:12:29	215.2	934.2	363.3	445.2	420.3	281.7
2:14:59	221.9	937.2	362.0	448.3	423.8	260.3
2:17:29	228.6	942.8	376.9	451.5	427.3	330.4
2:19:59	236.2	951.0	393.1	454.7	431.5	296.8
2:22:29	252.5	959.4	383.8	458.4	434.9	301.5
2:24:59	271.3	966.1	396.4	462.1	437.4	268.0
2:27:29	281.3	972.8	393.9	465.9	442.0	302.4
2:29:59	285.7	978.3	395.6	469.8	445.5	289.6
2:32:29	284.7	985.2	423.9	473.3	448.5	336.7
2:34:59	282.9	991.4	422.9	477.5	452.3	304.3
2:37:29	295.6	997.4	420.4	481.9	456.9	281.7
2:39:59	285.2	1003.8	420.5	486.1	463.2	298.4
2:42:29	281.1	1010.3	429.0	489.9	469.3	366.9
2:44:59	272.0	1016.5	422.5	495.5	474.4	323.8
2:47:29	283.1	1022.8	431.9	500.6	479.4	397.3
2:49:59	275.4	1027.5	441.3	509.1	483.6	336.1
2:52:29	297.5	1031.0	449.2	517.3	490.7	317.9
2:54:59	288.8	1035.9	469.5	527.5	495.6	314.8
2:57:29	292.6	1040.8	474.9	540.1	500.8	428.5
2:59:59	276.0	1044.5	506.5	554.3	508.2	419.7
3:02:29	290.7	1048.7	523.2	570.2	515.2	380.5
3:04:59	293.2	1051.5	546.1	589.5	523.3	414.6
3:07:29	310.8	1055.6	544.3	610.7	532.3	425.3
3:09:59	299.1	1059.9	565.0	636.7	541.7	407.8
3:12:29	295.3	1060.4	558.1	668.8	552.8	336.5
3:14:59	307.4	1059.9	547.7	703.5	563.9	396.6
3:17:29	309.3	1062.5	551.9	744.3	575.3	346.4
3:19:59	302.6	1064.0	567.4	793.1	589.0	332.8
3:22:29	298.5	1065.8	573.1	848.9	604.0	345.3
3:24:59	305.6	1069.7	588.6	895.4	621.6	437.8
3:27:29	307.0	1073.2	604.1	937.4	639.9	463.7
3:29:59	291.5	1076.7	626.3	975.3	658.2	522.5
3:32:29	308.7	1077.5	628.4	1013.5	676.7	472.2
3:34:59	302.3	1077.7	636.0	1045.3	694.6	459.9
3:37:29	308.3	1079.6	637.6	1068.4	711.9	517.1
3:39:59	314.0	1082.5	646.8	1088.7	736.8	517.4
3:42:29	320.6	1084.6	660.4	1108.0	764.9	496.6
3:44:59	326.8	1087.6	668.8	1119.1	791.2	526.8
3:47:29	321.0	1089.6	685.5	1130.0	814.3	573.3
3:49:59	323.3	1094.0	675.5	1140.2	834.5	556.3
3:52:29	333.8	1096.4	680.0	1147.2	863.7	623.0
3:54:59	333.5	1099.1	689.9	1152.6	895.6	696.8
3:57:29	336.1	1100.1	698.3	1157.2	923.8	664.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
3:59:59	346.7	1103.8	690.8	1155.7	950.8	664.4
4:02:29	334.8	1105.0	682.1	1154.9	979.9	660.0
4:04:59	338.4	1108.4	701.0	1150.4	1011.9	744.1
4:07:29	343.7	1108.5	704.5	1148.5	1045.6	718.5
4:09:59	347.3	1108.4	702.0	1144.5	1079.3	739.5
4:12:29	348.7	1111.0	701.9	1140.9	1106.4	776.1
4:14:59	367.5	1111.0	699.0	1137.3	1129.4	774.6
4:17:29	385.1	1113.8	698.2	1133.1	1148.9	796.6
4:19:59	372.2	1114.4	703.7	1128.8	1165.3	827.3
4:22:29	364.6	1115.9	706.4	1124.7	1179.5	834.9
4:24:59	369.5	1117.9	697.5	1118.7	1188.5	806.8
4:27:29	354.8	1121.6	699.1	1112.8	1192.9	847.8
4:29:59	177.4	1123.1	696.5	1108.5	1197.3	858.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	70.6	70.9	70.4	70.6	70.6	70.4
0:02:29	70.5	71.3	97.6	70.5	70.5	70.4
0:04:59	70.6	75.1	154.1	71.3	71.9	70.9
0:07:29	70.8	81.2	221.0	73.8	75.4	72.5
0:09:59	70.8	90.2	298.4	78.4	81.6	76.1
0:12:29	71.0	100.1	367.8	85.2	89.4	81.4
0:14:59	71.3	110.7	422.4	94.6	97.6	89.3
0:17:29	71.2	123.1	468.8	105.0	109.6	98.8
0:19:59	71.4	135.6	509.1	115.8	121.9	109.6
0:22:29	71.4	148.6	543.5	127.2	132.9	121.2
0:24:59	71.8	158.9	573.0	138.7	147.0	133.0
0:27:29	71.4	155.8	597.2	150.6	156.7	145.5
0:29:59	71.8	166.6	621.9	163.1	169.0	158.0
0:32:29	71.9	193.8	640.4	175.4	181.4	170.8
0:34:59	71.2	205.5	655.5	188.6	194.4	183.6
0:37:29	71.2	216.6	669.8	202.4	200.6	196.9
0:39:59	71.5	228.1	682.0	216.0	204.9	208.3
0:42:29	70.9	242.2	695.1	120.5	209.3	220.4
0:44:59	71.4	252.1	706.5	97.2	214.5	230.7
0:47:29	71.4	265.4	715.2	103.5	221.6	241.1
0:49:59	71.2	277.7	720.8	104.4	228.3	251.2
0:52:29	71.5	291.1	728.1	111.2	236.3	261.5
0:54:59	70.9	298.2	735.0	104.4	245.2	271.3
0:57:29	71.0	308.8	742.9	107.3	244.0	281.0
0:59:59	71.3	314.5	750.0	96.8	247.2	290.1
1:02:29	71.4	325.0	756.5	95.9	249.7	299.2
1:04:59	71.3	353.7	763.9	101.7	252.7	307.7
1:07:29	71.2	353.3	769.9	114.2	266.3	316.3
1:09:59	71.5	355.2	773.8	113.9	262.6	324.5
1:12:29	71.6	361.7	779.8	114.3	281.6	332.3
1:14:59	72.7	365.4	785.0	125.7	283.4	340.2
1:17:29	72.5	366.8	787.1	114.1	294.1	347.3
1:19:59	72.9	369.2	789.8	116.3	299.1	354.2
1:22:29	72.7	371.1	789.5	107.5	305.9	360.9
1:24:59	72.8	376.2	793.7	114.9	315.3	366.3
1:27:29	73.1	383.0	797.6	118.1	330.4	371.2
1:29:59	72.8	388.7	802.5	117.7	342.1	375.9
1:32:29	72.5	399.9	812.1	121.8	348.0	380.7
1:34:59	72.6	407.5	818.8	117.3	350.2	384.7
1:37:29	73.0	417.5	825.4	112.0	352.9	388.4
1:39:59	73.1	419.4	829.3	125.6	360.2	391.8
1:42:29	73.8	422.7	832.3	121.9	364.7	395.5
1:44:59	74.1	431.3	836.5	129.1	369.7	398.8
1:47:29	74.2	432.8	838.8	139.1	378.7	401.8
1:49:59	73.9	431.6	842.6	127.8	378.3	404.9
1:52:29	74.7	439.1	847.7	120.9	364.6	408.1
1:54:59	74.7	443.4	849.5	122.1	382.6	410.6
1:57:29	74.6	451.9	855.0	126.5	382.5	414.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
1:59:59	74.8	459.4	863.1	145.3	386.9	417.0
2:02:29	74.8	462.2	866.9	144.8	387.0	420.1
2:04:59	74.6	463.4	869.7	140.5	371.2	423.7
2:07:29	74.5	428.4	871.0	128.1	375.1	426.8
2:09:59	74.1	421.3	870.9	146.8	385.1	429.2
2:12:29	74.5	432.9	874.0	148.3	386.5	431.8
2:14:59	75.3	448.7	878.1	145.4	407.4	434.6
2:17:29	75.1	475.3	882.7	166.0	389.4	437.7
2:19:59	75.1	499.6	892.5	150.0	413.9	440.9
2:22:29	75.9	530.1	899.5	167.1	415.9	444.1
2:24:59	75.8	518.3	906.4	149.5	436.0	447.5
2:27:29	76.2	534.0	909.7	158.4	459.8	450.7
2:29:59	76.5	524.1	915.8	144.5	495.0	454.4
2:32:29	76.3	520.4	920.7	167.8	513.2	458.1
2:34:59	76.5	527.9	926.7	158.5	528.4	462.2
2:37:29	76.7	526.2	932.4	167.8	570.4	466.0
2:39:59	76.6	527.2	940.1	183.8	579.2	470.3
2:42:29	76.4	507.6	946.9	184.5	614.8	474.1
2:44:59	76.8	524.7	954.0	184.1	659.1	478.1
2:47:29	76.7	502.7	962.5	197.9	748.4	481.9
2:49:59	76.9	532.6	967.6	198.3	781.2	486.2
2:52:29	76.8	541.6	972.3	194.0	810.7	491.2
2:54:59	77.6	537.9	978.3	223.0	864.8	497.1
2:57:29	76.7	527.4	981.7	214.5	859.0	502.9
2:59:59	77.9	556.3	987.6	216.9	859.4	508.3
3:02:29	77.7	554.7	992.5	220.9	852.3	515.0
3:04:59	77.6	574.6	997.3	215.2	876.0	522.6
3:07:29	77.8	585.8	1003.2	213.0	872.9	530.2
3:09:59	77.7	603.8	1008.2	245.8	877.6	539.2
3:12:29	77.7	610.9	1010.5	217.6	888.6	547.1
3:14:59	77.3	611.1	1011.7	250.4	895.2	556.7
3:17:29	77.8	632.1	1014.5	245.0	929.6	567.4
3:19:59	77.7	628.5	1019.3	221.7	962.0	579.5
3:22:29	78.0	628.0	1021.1	233.6	987.3	592.9
3:24:59	78.4	635.0	1026.0	275.3	986.5	607.7
3:27:29	77.0	643.7	1029.7	236.5	987.2	624.8
3:29:59	77.7	649.1	1033.9	235.6	991.4	642.6
3:32:29	77.4	659.0	1036.3	234.8	997.6	661.3
3:34:59	76.8	654.2	1036.3	252.8	1002.0	680.9
3:37:29	76.5	663.4	1039.8	268.4	1018.3	701.7
3:39:59	77.5	672.5	1041.7	269.8	1016.4	720.1
3:42:29	77.9	684.3	1044.2	250.5	1017.4	740.0
3:44:59	78.3	701.8	1049.2	231.2	1031.0	759.8
3:47:29	78.4	719.0	1054.8	270.3	1031.2	774.6
3:49:59	79.1	732.8	1055.1	266.7	1031.5	784.3
3:52:29	78.3	754.3	1059.6	292.5	1038.1	788.2
3:54:59	77.9	768.5	1061.3	287.7	1034.7	797.3
3:57:29	78.3	779.8	1063.9	274.8	1037.0	821.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
3:59:59	79.5	796.9	1065.6	265.2	1043.9	854.3
4:02:29	79.2	806.4	1067.6	280.9	1038.2	881.7
4:04:59	79.2	814.6	1071.9	261.8	1047.0	905.3
4:07:29	80.7	821.3	1073.7	285.3	1052.2	928.0
4:09:59	80.7	827.6	1074.4	268.3	1051.0	953.5
4:12:29	80.1	831.3	1075.5	277.0	1055.4	979.8
4:14:59	81.1	840.6	1076.5	235.6	1059.3	1002.5
4:17:29	81.0	848.1	1079.8	262.5	1060.0	1020.1
4:19:59	81.3	854.4	1080.9	252.9	1065.4	1036.4
4:22:29	81.0	858.5	1081.0	261.9	1065.6	1049.3
4:24:59	81.9	862.3	1080.9	264.1	1067.8	1059.8
4:27:29	81.9	870.3	1084.9	276.6	1071.0	1067.1
4:29:59	82.9	911.7	1088.2	295.8	256.6	1072.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	70.9	71.0	71.2	70.4	70.7
0:02:29	71.1	71.7	71.6	90.9	70.7
0:04:59	72.3	75.8	74.5	132.2	70.6
0:07:29	76.2	82.9	80.0	179.2	70.7
0:09:59	82.7	92.6	87.8	234.9	71.1
0:12:29	91.8	104.6	97.0	287.4	72.0
0:14:59	103.0	116.1	107.8	333.4	74.1
0:17:29	116.3	131.3	119.2	374.2	77.2
0:19:59	129.4	144.3	131.2	410.6	82.3
0:22:29	142.6	158.3	144.2	442.4	89.9
0:24:59	155.3	169.6	156.7	471.1	99.3
0:27:29	168.7	188.9	169.8	495.7	110.9
0:29:59	182.6	202.2	182.7	519.6	123.9
0:32:29	195.6	209.6	196.1	540.6	137.9
0:34:59	208.5	225.6	209.0	562.9	152.7
0:37:29	219.6	233.0	222.7	584.9	167.7
0:39:59	229.4	243.2	235.1	603.4	182.3
0:42:29	139.7	259.4	246.9	623.6	194.6
0:44:59	111.0	277.2	260.5	635.9	203.3
0:47:29	106.0	284.1	274.6	648.7	209.1
0:49:59	104.7	300.1	286.7	658.7	212.6
0:52:29	104.5	317.4	304.0	667.9	215.4
0:54:59	95.4	323.0	309.3	675.4	217.0
0:57:29	96.4	337.1	320.6	681.4	218.9
0:59:59	97.6	325.0	339.1	690.2	220.7
1:02:29	99.5	323.6	349.0	697.5	223.4
1:04:59	104.9	333.6	363.4	706.8	226.0
1:07:29	105.1	329.1	372.3	714.2	229.1
1:09:59	112.0	335.5	386.2	722.3	232.7
1:12:29	111.5	329.0	393.4	730.6	236.5
1:14:59	113.9	334.0	404.5	737.4	240.8
1:17:29	111.4	333.2	417.2	743.0	245.7
1:19:59	115.0	339.0	423.8	747.5	251.0
1:22:29	111.0	338.6	434.5	749.9	257.0
1:24:59	112.4	348.7	441.4	753.6	263.3
1:27:29	121.1	314.9	447.8	758.8	270.6
1:29:59	130.4	314.6	443.5	761.4	278.1
1:32:29	114.5	334.6	449.2	767.2	286.6
1:34:59	131.9	284.2	438.2	775.0	295.1
1:37:29	116.4	275.1	442.0	782.4	303.6
1:39:59	131.3	290.8	434.7	788.5	311.8
1:42:29	119.5	199.3	439.4	793.7	319.9
1:44:59	129.1	195.5	443.0	799.5	327.5
1:47:29	126.3	181.0	444.2	805.0	335.1
1:49:59	136.7	204.6	444.5	811.0	342.4
1:52:29	115.2	253.5	424.7	815.6	349.6
1:54:59	141.7	205.5	448.0	818.6	356.4
1:57:29	128.5	216.8	455.2	824.0	363.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
1:59:59	131.6	209.6	455.4	829.7	369.9
2:02:29	128.7	210.3	462.9	836.4	376.3
2:04:59	160.0	245.0	462.2	842.5	382.8
2:07:29	182.9	249.0	464.1	847.6	389.5
2:09:59	181.8	268.5	453.6	853.1	395.4
2:12:29	169.9	297.6	463.0	858.7	401.2
2:14:59	179.7	342.2	462.9	862.3	407.1
2:17:29	158.1	310.7	464.6	866.6	412.7
2:19:59	188.9	299.8	476.7	874.1	418.4
2:22:29	202.1	332.7	473.7	879.4	423.9
2:24:59	204.0	349.2	478.1	883.8	429.2
2:27:29	188.2	379.9	482.0	888.5	434.3
2:29:59	198.2	446.4	494.5	891.7	439.3
2:32:29	191.0	485.8	497.2	896.5	444.1
2:34:59	189.8	473.1	495.6	901.2	449.4
2:37:29	213.8	496.1	493.2	907.2	454.2
2:39:59	263.3	508.4	500.1	913.4	459.1
2:42:29	248.8	460.3	529.7	920.2	463.6
2:44:59	270.6	568.9	554.9	927.4	467.9
2:47:29	269.6	661.4	564.0	935.0	472.5
2:49:59	309.7	618.3	581.5	942.0	476.8
2:52:29	285.6	690.4	579.3	947.5	480.8
2:54:59	280.5	691.1	610.7	954.2	485.3
2:57:29	258.5	629.0	641.4	960.3	489.2
2:59:59	258.6	752.2	660.3	966.7	493.4
3:02:29	298.8	821.2	604.8	971.8	497.2
3:04:59	273.7	865.1	663.0	978.0	501.2
3:07:29	297.9	817.3	714.4	984.9	504.7
3:09:59	283.7	869.9	718.8	992.0	508.5
3:12:29	301.0	924.8	734.6	997.2	512.2
3:14:59	314.0	878.1	743.1	1002.2	515.4
3:17:29	327.5	908.7	741.8	1006.9	518.4
3:19:59	336.2	977.2	757.6	1012.6	521.3
3:22:29	355.4	973.6	767.1	1016.0	524.3
3:24:59	324.4	916.4	780.6	1021.0	526.8
3:27:29	303.8	878.4	800.7	1024.1	530.3
3:29:59	318.6	992.0	789.9	1028.9	533.6
3:32:29	315.7	903.2	842.8	1031.1	536.7
3:34:59	349.2	1023.4	878.1	1034.2	539.6
3:37:29	368.8	996.7	860.3	1039.2	542.4
3:39:59	381.3	975.3	854.2	1040.9	545.1
3:42:29	374.9	945.8	861.2	1042.4	547.6
3:44:59	395.4	990.0	865.7	1044.9	550.1
3:47:29	390.7	982.7	874.4	1047.6	553.0
3:49:59	401.7	997.6	865.4	1050.8	555.7
3:52:29	403.2	886.0	863.4	1053.1	558.1
3:54:59	341.7	866.1	895.0	1056.3	560.8
3:57:29	357.1	933.5	905.2	1057.3	563.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 8

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
3:59:59	380.0	883.2	903.5	1058.3	565.9
4:02:29	359.7	973.8	905.2	1060.5	567.7
4:04:59	321.6	897.8	904.7	1062.6	570.1
4:07:29	393.9	952.0	883.0	1063.2	572.4
4:09:59	371.0	948.4	897.6	1065.5	574.6
4:12:29	391.1	924.4	867.1	1066.2	576.8
4:14:59	394.9	963.0	903.9	1065.6	578.8
4:17:29	366.3	942.1	913.0	1067.8	580.4
4:19:59	391.7	938.1	910.4	1068.2	582.3
4:22:29	367.2	935.2	902.5	1067.5	584.1
4:24:59	404.6	920.6	904.3	1068.7	585.9
4:27:29	380.0	865.6	908.5	1071.9	587.9
4:29:59	388.1	707.7	928.3	1073.7	589.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	73.1	73.3	73.3	73.1	73.3	73.4
0:02:30	73.2	73.2	73.2	73.2	73.5	73.8
0:05:00	73.5	73.8	73.5	73.5	75.7	76.2
0:07:30	75.5	75.7	75.4	74.8	80.5	81.5
0:10:00	79.4	79.3	79.0	78.0	88.2	90.1
0:12:30	86.1	84.8	85.1	82.9	97.9	100.8
0:15:00	94.9	91.6	93.4	89.7	109.3	112.8
0:17:30	105.6	100.8	103.4	97.7	121.7	125.8
0:20:00	117.3	109.8	114.0	106.8	134.8	139.4
0:22:30	129.6	119.3	125.0	116.8	148.4	153.2
0:25:00	142.4	130.3	136.8	127.6	161.9	167.6
0:27:30	154.7	142.0	149.3	138.9	175.4	181.8
0:30:00	167.9	150.9	161.7	150.8	188.6	195.7
0:32:30	181.2	161.8	174.3	163.0	201.5	207.3
0:35:00	194.3	167.9	186.9	175.2	212.9	219.3
0:37:30	207.1	175.1	199.2	186.9	223.0	232.1
0:40:00	219.5	185.4	211.0	198.5	232.5	240.5
0:42:30	231.6	170.6	222.1	209.5	242.5	254.2
0:45:00	241.8	224.4	231.7	220.4	248.5	262.0
0:47:30	248.8	239.0	242.3	232.5	252.1	273.4
0:50:00	255.3	252.1	252.3	241.0	259.6	284.9
0:52:30	262.2	263.5	262.3	249.4	265.9	279.4
0:55:00	267.2	277.9	271.6	200.7	266.8	250.8
0:57:30	252.8	113.9	281.3	113.6	134.1	244.3
1:00:00	254.7	97.4	290.9	114.0	121.3	270.3
1:02:30	256.2	118.4	285.0	113.8	122.4	245.1
1:05:00	259.6	98.0	288.9	109.7	120.2	283.5
1:07:30	261.4	119.5	286.6	99.3	124.8	278.7
1:10:00	264.9	108.2	241.8	101.4	129.5	284.1
1:12:30	268.4	103.0	192.3	105.0	129.3	282.8
1:15:00	271.6	105.0	165.5	102.1	126.9	303.6
1:17:30	275.1	107.8	144.8	106.5	129.5	312.9
1:20:00	279.1	105.4	144.1	102.8	130.0	356.4
1:22:30	282.8	118.7	161.6	108.5	139.4	388.3
1:25:00	287.1	126.7	161.5	107.5	142.8	399.7
1:27:30	290.5	150.6	175.3	108.9	156.1	402.6
1:30:00	294.2	108.8	162.2	116.6	143.3	420.5
1:32:30	298.0	117.4	157.3	111.1	141.9	428.2
1:35:00	301.5	135.8	168.0	105.6	145.7	434.3
1:37:30	304.0	116.5	155.0	123.1	143.9	446.4
1:40:00	307.3	138.5	176.8	113.7	157.7	456.7
1:42:30	310.4	127.7	169.5	122.4	149.7	468.0
1:45:00	313.7	132.7	168.0	115.1	157.4	473.2
1:47:30	316.8	125.2	169.4	118.7	158.8	481.1
1:50:00	319.8	115.9	159.8	125.7	158.3	492.3
1:52:30	322.7	118.6	166.6	134.7	156.9	505.2
1:55:00	326.4	148.9	165.7	122.7	160.3	514.7
1:57:30	330.2	135.7	178.0	134.9	168.5	520.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
2:00:00	333.8	139.1	175.2	119.2	185.8	528.4
2:02:30	336.4	152.0	153.2	117.2	176.6	542.9
2:05:00	339.2	122.7	181.6	140.3	174.5	554.4
2:07:30	342.8	152.6	164.7	124.1	175.6	565.9
2:10:00	345.2	155.1	199.5	122.9	188.7	572.1
2:12:30	348.0	173.9	183.1	123.8	189.6	572.2
2:15:00	350.6	138.6	163.5	134.8	180.0	589.4
2:17:30	353.8	133.5	155.0	135.9	179.4	598.0
2:20:00	356.4	136.9	171.1	125.6	178.6	603.9
2:22:30	359.4	141.4	167.2	129.7	192.4	610.8
2:25:00	362.3	139.2	166.1	135.1	190.4	617.4
2:27:30	364.9	166.7	170.9	131.3	196.1	623.8
2:30:00	367.0	135.1	151.5	129.6	186.1	638.2
2:32:30	369.3	149.4	170.7	132.3	200.8	645.6
2:35:00	372.0	159.7	171.8	136.6	197.3	651.4
2:37:30	374.4	142.6	162.3	142.5	189.4	663.1
2:40:00	377.0	143.0	164.2	134.3	196.1	667.1
2:42:30	379.3	164.0	182.7	129.2	203.1	671.2
2:45:00	381.0	141.4	162.0	139.3	194.3	678.8
2:47:30	382.7	141.8	162.5	134.0	187.8	686.3
2:50:00	385.8	212.0	182.2	115.8	198.4	683.3
2:52:30	389.3	146.5	169.6	131.8	193.5	688.7
2:55:00	392.9	144.2	167.3	142.1	190.4	695.6
2:57:30	398.3	174.4	186.4	130.8	196.9	700.7
3:00:00	404.4	154.8	176.5	143.9	208.7	708.1
3:02:30	410.3	146.0	160.3	135.7	194.9	717.0
3:05:00	416.4	150.5	166.8	147.8	193.3	723.8
3:07:30	423.3	161.6	183.4	152.0	208.3	728.7
3:10:00	427.8	141.6	171.7	135.4	205.3	734.2
3:12:30	431.6	152.6	167.6	141.1	202.2	743.4
3:15:00	434.9	158.3	167.9	147.4	204.0	745.6
3:17:30	437.7	142.8	154.4	144.3	208.5	751.2
3:20:00	439.9	156.5	165.9	148.0	218.4	755.3
3:22:30	441.1	155.2	164.4	144.5	212.9	759.2
3:25:00	442.9	171.8	177.1	141.5	224.4	764.8
3:27:30	444.5	169.3	196.8	143.6	231.8	771.7
3:30:00	446.5	232.2	184.2	143.9	248.0	773.2
3:32:30	448.7	167.2	190.1	177.8	228.0	782.5
3:35:00	451.2	195.6	211.3	151.7	227.2	787.5
3:37:30	454.3	173.6	188.0	162.3	228.9	793.7
3:40:00	458.3	168.8	183.4	158.4	247.0	796.0
3:42:30	462.0	179.9	175.8	155.9	234.7	803.9
3:45:00	465.5	181.3	188.3	150.8	251.9	806.1
3:47:30	470.2	177.2	217.4	170.7	252.4	812.2
3:50:00	474.5	182.9	187.7	157.6	238.2	817.4
3:52:30	479.0	188.1	186.2	154.2	262.0	818.7
3:55:00	483.8	216.0	184.1	149.1	253.5	824.7
3:57:30	488.3	194.0	206.7	153.0	261.2	827.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
4:00:00	492.6	226.4	221.4	165.9	242.7	832.0
4:02:30	497.8	230.4	194.4	146.1	260.6	828.4
4:05:00	503.1	213.8	208.0	156.0	261.9	833.3
4:07:30	508.3	246.0	204.3	132.2	284.5	827.1
4:10:00	512.4	416.5	201.0	144.8	271.0	827.9
4:12:30	516.9	214.6	202.9	148.8	270.7	830.0
4:15:00	521.0	203.8	187.4	150.7	264.9	833.4
4:17:30	525.6	230.6	225.8	143.3	284.9	831.5
4:20:00	529.8	198.5	237.3	165.5	274.2	838.4
4:22:30	533.3	231.9	203.3	152.3	257.6	842.4
4:25:00	536.3	197.8	175.1	154.9	260.5	846.1
4:27:30	538.8	224.5	215.3	141.1	269.2	839.9
4:30:00	541.8	194.3	229.4	155.0	259.2	839.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	72.8	73.0	73.1	73.1	73.1	73.4
0:02:30	92.0	73.1	73.1	73.4	73.2	73.9
0:05:00	126.1	74.0	73.8	73.4	74.0	78.2
0:07:30	173.9	76.7	76.7	73.5	76.6	85.9
0:10:00	235.4	82.2	82.2	73.6	81.5	96.9
0:12:30	297.0	90.7	90.7	73.7	88.9	109.7
0:15:00	352.8	101.9	101.2	73.8	98.8	123.2
0:17:30	402.2	114.8	113.0	74.0	108.8	137.3
0:20:00	445.7	128.5	125.4	73.8	118.5	151.4
0:22:30	483.2	142.6	138.7	73.6	131.5	164.4
0:25:00	515.1	157.4	152.6	73.8	145.5	179.7
0:27:30	545.9	172.3	167.0	74.2	158.2	193.6
0:30:00	574.8	187.0	181.3	73.7	168.2	206.9
0:32:30	600.3	201.2	195.5	74.0	177.9	219.1
0:35:00	619.4	215.2	210.8	74.4	192.5	224.9
0:37:30	636.4	229.2	225.4	74.5	201.3	238.3
0:40:00	654.8	243.0	237.3	74.4	209.7	249.3
0:42:30	671.8	256.3	247.1	232.6	221.0	264.8
0:45:00	689.0	266.1	182.8	236.4	226.6	154.3
0:47:30	702.5	271.2	144.0	239.6	235.1	102.2
0:50:00	714.5	271.6	148.1	244.3	239.4	128.4
0:52:30	726.2	266.9	121.3	247.6	238.2	106.6
0:55:00	734.8	266.4	132.7	252.3	259.0	116.1
0:57:30	743.5	254.6	117.9	257.4	248.7	103.7
1:00:00	751.7	232.4	135.0	263.0	270.0	122.8
1:02:30	758.1	236.5	133.4	269.0	270.0	122.8
1:05:00	762.5	228.7	145.0	275.1	277.9	124.5
1:07:30	768.2	240.9	136.0	280.8	276.3	122.3
1:10:00	771.8	236.5	141.7	287.0	285.8	123.0
1:12:30	775.1	217.4	157.7	292.6	284.6	133.0
1:15:00	779.1	229.6	144.8	298.4	287.0	138.2
1:17:30	790.8	230.0	140.0	304.3	301.4	130.7
1:20:00	794.4	223.1	158.2	310.4	300.8	145.8
1:22:30	798.8	235.4	154.4	316.4	297.5	146.3
1:25:00	805.4	224.7	152.6	322.6	284.9	134.7
1:27:30	809.6	236.7	169.2	328.0	278.1	158.7
1:30:00	816.1	252.5	165.7	333.2	297.8	148.3
1:32:30	825.5	251.0	155.4	337.5	318.1	138.3
1:35:00	830.5	244.0	154.4	341.7	315.1	128.9
1:37:30	833.4	242.3	179.4	345.3	321.0	156.4
1:40:00	837.6	238.8	191.9	348.6	324.3	195.0
1:42:30	844.5	262.2	186.7	352.0	329.6	178.9
1:45:00	853.6	250.6	198.1	354.9	330.5	183.1
1:47:30	859.9	255.1	220.1	357.3	335.2	213.6
1:50:00	865.9	260.6	213.9	359.4	333.5	253.8
1:52:30	874.5	273.4	204.6	361.3	336.8	216.6
1:55:00	882.4	280.1	200.4	363.2	326.9	222.5
1:57:30	888.3	260.5	313.1	365.0	330.7	353.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
2:00:00	893.8	279.2	278.3	366.7	324.6	309.9
2:02:30	898.5	275.9	294.5	368.5	317.2	370.3
2:05:00	902.1	278.2	344.0	371.3	322.7	383.5
2:07:30	906.4	290.1	268.8	373.9	319.9	270.5
2:10:00	911.5	287.2	396.3	376.4	328.2	403.6
2:12:30	915.3	290.9	507.8	378.3	314.3	500.4
2:15:00	918.5	281.4	527.2	379.7	333.3	528.9
2:17:30	922.6	279.6	572.4	381.6	324.6	233.5
2:20:00	926.9	287.1	654.7	383.6	315.1	207.2
2:22:30	930.3	282.3	750.6	385.9	330.1	224.3
2:25:00	933.7	302.8	704.5	388.2	328.2	242.8
2:27:30	935.6	291.7	735.5	390.3	305.5	289.8
2:30:00	937.1	312.1	757.0	392.6	347.5	641.6
2:32:30	940.3	305.1	813.0	395.5	331.8	489.0
2:35:00	941.6	314.7	731.9	398.9	340.0	568.8
2:37:30	944.4	328.9	750.8	402.2	338.5	706.9
2:40:00	944.0	344.7	714.0	406.2	345.3	539.6
2:42:30	945.5	317.3	677.4	410.1	334.3	656.0
2:45:00	945.4	313.2	718.5	414.7	352.2	635.8
2:47:30	945.7	328.2	627.5	420.2	376.9	767.8
2:50:00	947.3	315.4	625.3	425.7	331.2	817.6
2:52:30	948.3	327.0	554.6	430.0	351.6	730.0
2:55:00	951.4	331.8	540.4	434.1	350.6	743.5
2:57:30	955.4	327.1	580.4	439.6	333.1	882.0
3:00:00	958.0	337.9	604.7	445.2	346.9	772.7
3:02:30	961.5	337.6	605.0	451.5	361.7	747.8
3:05:00	965.2	349.8	544.9	458.2	366.2	713.4
3:07:30	968.9	361.8	672.5	465.0	357.1	757.6
3:10:00	972.9	342.2	541.0	470.2	358.2	843.9
3:12:30	975.4	349.2	597.6	475.3	372.2	827.6
3:15:00	980.3	327.2	701.0	480.4	348.8	749.8
3:17:30	985.0	351.9	469.4	485.4	374.0	747.8
3:20:00	989.7	340.8	566.1	488.7	358.0	837.4
3:22:30	993.9	358.4	562.5	491.6	368.5	885.2
3:25:00	999.2	350.8	599.1	494.2	357.5	819.4
3:27:30	1003.6	344.9	613.1	495.9	359.3	821.4
3:30:00	1009.0	360.2	713.6	498.1	350.9	692.5
3:32:30	1014.7	340.8	681.0	499.7	355.2	781.5
3:35:00	1020.0	343.1	713.5	501.9	349.5	731.6
3:37:30	1024.8	347.8	672.2	503.6	350.0	828.2
3:40:00	1029.3	378.7	636.9	505.8	374.2	847.9
3:42:30	1033.3	351.8	669.5	507.1	358.2	902.8
3:45:00	1031.3	374.7	679.3	508.5	360.1	917.8
3:47:30	1032.9	352.9	652.1	510.1	351.7	904.3
3:50:00	1032.5	386.6	596.4	511.4	378.9	869.9
3:52:30	1035.3	357.2	592.8	513.5	378.9	816.5
3:55:00	1036.6	397.9	551.1	515.2	384.1	861.1
3:57:30	1036.5	354.3	646.9	516.6	354.1	900.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
4:00:00	1039.6	391.2	628.6	518.1	369.0	885.1
4:02:30	1040.4	380.9	624.0	518.6	356.6	831.8
4:05:00	1041.9	371.2	651.8	518.9	366.8	894.0
4:07:30	1043.3	378.0	661.2	519.7	355.8	855.1
4:10:00	1044.0	368.3	678.6	519.7	343.6	856.8
4:12:30	1045.0	375.2	684.0	519.6	379.7	868.2
4:15:00	1047.5	413.4	618.2	520.0	374.3	770.8
4:17:30	1047.4	396.0	640.3	521.0	361.4	766.0
4:20:00	1049.7	398.1	710.7	522.2	400.0	820.7
4:22:30	1050.5	399.1	647.9	523.3	378.7	809.3
4:25:00	1053.2	370.4	617.0	524.8	381.5	925.2
4:27:30	1057.4	397.8	702.2	527.1	377.5	829.2
4:30:00	1061.0	519.2	1125.6	528.0	372.0	157.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	73.0	72.8	73.4	73.6	73.4	73.6
0:02:30	73.4	97.9	73.5	73.5	73.6	73.6
0:05:00	73.3	140.7	74.1	74.0	74.6	73.8
0:07:30	73.5	198.5	76.6	76.3	77.9	75.5
0:10:00	73.6	266.8	81.6	80.6	84.1	79.1
0:12:30	73.7	332.1	89.3	88.0	92.8	84.8
0:15:00	73.8	388.6	98.7	97.7	104.6	92.3
0:17:30	74.0	437.8	109.9	109.5	116.8	101.6
0:20:00	74.1	480.4	121.9	121.8	129.1	111.9
0:22:30	73.9	518.6	134.7	134.3	141.5	123.0
0:25:00	74.1	553.4	148.1	147.0	153.6	134.8
0:27:30	74.5	586.2	161.4	159.6	166.1	146.6
0:30:00	74.1	614.1	174.4	172.3	178.5	158.6
0:32:30	74.5	636.9	180.3	184.3	190.2	118.6
0:35:00	74.7	656.6	181.6	196.3	200.9	124.5
0:37:30	74.7	674.2	196.7	149.1	207.0	127.7
0:40:00	75.3	691.9	214.1	141.2	218.9	138.5
0:42:30	272.3	706.9	223.2	191.7	229.6	229.5
0:45:00	269.1	719.7	233.9	229.1	241.7	239.4
0:47:30	274.2	731.5	243.3	230.8	251.2	250.8
0:50:00	281.0	740.7	254.0	242.6	261.3	261.3
0:52:30	291.0	749.9	265.9	268.3	272.6	270.0
0:55:00	290.7	758.0	276.4	290.8	281.5	278.9
0:57:30	298.1	765.8	284.7	275.2	292.4	285.4
1:00:00	307.0	774.0	294.0	303.8	300.2	292.6
1:02:30	314.0	780.9	301.3	299.9	308.6	299.7
1:05:00	320.0	786.0	312.4	304.7	317.1	307.2
1:07:30	323.8	791.3	337.6	310.7	321.9	313.2
1:10:00	330.1	795.9	332.1	314.3	329.9	319.7
1:12:30	337.0	801.8	334.2	320.4	335.9	325.6
1:15:00	342.0	808.5	342.7	313.5	337.8	331.2
1:17:30	343.6	821.3	349.4	324.1	342.6	337.1
1:20:00	352.8	827.1	354.9	326.4	344.9	342.9
1:22:30	360.2	830.7	360.0	334.3	345.5	348.7
1:25:00	367.1	838.1	360.1	336.9	349.5	354.8
1:27:30	371.7	843.4	312.5	347.7	357.1	360.6
1:30:00	372.7	849.3	367.9	350.3	354.1	366.5
1:32:30	374.4	856.6	370.3	361.0	357.4	371.6
1:35:00	381.0	862.1	351.9	353.0	362.8	377.2
1:37:30	385.3	866.1	379.0	363.0	358.2	382.5
1:40:00	383.1	871.4	380.5	375.4	370.9	387.0
1:42:30	388.1	877.6	384.7	375.1	374.1	391.6
1:45:00	391.4	882.7	375.1	383.4	376.7	396.4
1:47:30	395.8	886.5	367.5	381.6	378.5	401.1
1:50:00	395.5	890.0	366.5	388.6	386.7	405.9
1:52:30	395.9	896.1	375.1	390.2	387.5	410.0
1:55:00	399.0	902.5	369.3	387.5	383.0	414.6
1:57:30	407.2	908.7	360.6	403.1	397.4	418.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
2:00:00	407.8	913.3	331.0	403.5	395.5	423.0
2:02:30	408.7	919.3	349.5	410.7	402.9	426.7
2:05:00	408.0	923.8	371.2	410.4	405.6	430.7
2:07:30	398.8	930.4	378.4	415.2	401.1	434.0
2:10:00	399.5	938.7	361.7	420.3	409.1	437.6
2:12:30	396.0	946.2	392.1	427.2	414.1	441.1
2:15:00	399.6	952.6	401.0	434.3	417.7	444.3
2:17:30	406.7	961.4	401.0	443.8	424.1	447.5
2:20:00	411.9	970.2	406.3	447.9	429.2	450.7
2:22:30	416.1	979.4	417.0	452.8	432.1	453.9
2:25:00	416.7	988.0	423.2	459.3	435.1	457.8
2:27:30	422.0	993.8	428.2	465.4	439.2	461.3
2:30:00	424.6	1000.1	475.2	473.3	440.7	465.1
2:32:30	434.6	1007.1	492.4	481.6	449.9	469.1
2:35:00	432.9	1014.0	546.8	487.7	454.9	473.0
2:37:30	436.5	1018.5	537.2	493.8	464.0	476.6
2:40:00	441.5	1022.1	519.1	497.9	466.4	480.6
2:42:30	471.7	1024.6	575.7	505.8	476.7	484.5
2:45:00	476.5	1027.9	518.3	512.7	479.0	488.9
2:47:30	476.4	1029.1	534.8	521.4	480.8	493.5
2:50:00	471.4	1032.0	493.8	533.4	487.8	495.2
2:52:30	466.7	1032.8	587.4	548.2	477.1	500.2
2:55:00	471.8	1035.9	632.2	562.5	488.3	505.9
2:57:30	472.1	1037.8	684.1	577.5	497.0	511.1
3:00:00	465.1	1038.9	714.5	593.7	501.6	516.0
3:02:30	465.8	1042.1	789.8	608.9	501.8	518.8
3:05:00	476.2	1044.8	827.6	630.0	509.4	525.2
3:07:30	451.5	1047.7	830.4	652.9	522.4	530.4
3:10:00	474.3	1051.2	839.2	680.3	523.4	537.8
3:12:30	472.5	1053.3	849.6	702.0	526.9	546.7
3:15:00	449.6	1056.3	823.1	734.3	544.7	556.7
3:17:30	479.8	1057.2	847.7	765.2	553.4	568.0
3:20:00	480.9	1060.2	857.7	797.0	570.4	579.5
3:22:30	463.6	1062.1	870.9	823.3	574.0	591.6
3:25:00	455.1	1064.8	875.8	847.1	578.4	604.4
3:27:30	476.8	1066.6	872.0	870.2	589.7	619.8
3:30:00	447.4	1069.0	744.2	902.5	627.5	636.6
3:32:30	438.3	1071.3	911.0	931.5	654.1	653.3
3:35:00	433.3	1074.0	863.0	949.8	674.3	672.5
3:37:30	458.8	1074.9	914.6	970.3	703.0	692.1
3:40:00	483.7	1079.5	919.9	990.5	746.9	705.5
3:42:30	451.8	1080.8	943.4	1006.7	774.2	722.3
3:45:00	458.6	1078.0	897.7	1023.3	791.9	738.3
3:47:30	456.1	1078.6	965.9	1036.4	810.4	756.8
3:50:00	487.0	1077.7	963.2	1045.5	796.4	775.1
3:52:30	474.5	1080.1	968.2	1055.2	842.7	789.1
3:55:00	491.8	1079.6	984.0	1062.1	854.7	804.1
3:57:30	444.2	1080.5	958.1	1070.2	892.5	817.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
hr:min:sec						
4:00:00	461.2	1082.5	977.5	1073.6	923.3	826.0
4:02:30	444.8	1082.5	884.9	1077.3	971.6	828.0
4:05:00	464.9	1084.7	1017.4	1086.2	1004.6	860.7
4:07:30	424.9	1087.0	862.8	1092.7	1050.7	903.3
4:10:00	438.3	1087.8	863.0	1092.1	1076.6	938.1
4:12:30	453.3	1087.4	1030.0	1090.3	1094.8	972.7
4:15:00	450.8	1090.2	1003.0	1088.9	1105.8	1000.4
4:17:30	424.5	1090.8	889.1	1092.2	1114.6	1024.3
4:20:00	443.5	1093.0	1014.8	1098.4	1119.5	1042.4
4:22:30	438.5	1094.1	998.2	1094.3	1119.2	1064.9
4:25:00	514.8	1097.1	1072.8	1086.1	1105.6	1084.8
4:27:30	437.0	1101.9	973.7	1088.6	1108.1	1103.3
4:30:00	417.0	1104.1	1072.3	1088.4	1109.7	1116.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	73.6	74.3	73.5	73.8	73.7	73.8
0:02:30	74.1	74.8	90.3	73.9	73.8	73.9
0:05:00	77.6	78.6	126.9	74.1	74.3	74.3
0:07:30	84.3	85.3	178.6	75.4	76.1	76.4
0:10:00	94.5	95.1	245.4	78.1	79.6	80.6
0:12:30	106.9	106.6	309.9	82.4	85.2	87.1
0:15:00	120.1	119.6	363.7	88.8	92.8	95.8
0:17:30	134.7	133.1	410.7	96.4	101.5	106.0
0:20:00	149.7	147.0	449.1	104.9	111.1	117.4
0:22:30	164.9	161.3	479.8	114.7	121.4	130.1
0:25:00	180.6	176.4	508.1	124.9	132.3	143.0
0:27:30	196.0	191.4	534.7	135.9	143.4	156.1
0:30:00	211.5	205.1	562.0	147.7	154.7	169.3
0:32:30	227.7	218.8	581.8	159.3	165.9	182.4
0:35:00	240.3	231.4	595.5	170.4	176.9	195.4
0:37:30	200.6	244.7	607.7	181.5	187.9	207.9
0:40:00	195.7	258.2	622.6	193.5	198.4	219.5
0:42:30	250.3	269.3	635.4	205.4	207.8	230.2
0:45:00	273.9	281.3	648.1	210.7	218.6	242.4
0:47:30	281.2	289.9	658.4	215.8	228.1	252.3
0:50:00	293.9	290.4	670.0	224.0	236.2	262.5
0:52:30	304.7	300.1	682.1	230.9	243.9	271.7
0:55:00	333.1	306.0	694.0	240.5	251.3	281.3
0:57:30	322.7	312.2	701.6	246.0	258.0	290.7
1:00:00	344.3	321.9	711.1	258.0	264.8	300.0
1:02:30	355.6	336.4	717.9	270.6	271.6	307.5
1:05:00	346.3	346.2	721.1	276.9	278.1	316.5
1:07:30	351.0	356.7	723.1	276.2	285.0	325.5
1:10:00	355.2	366.6	727.0	273.0	291.8	333.7
1:12:30	360.1	376.5	729.3	268.1	297.8	340.0
1:15:00	346.7	386.6	736.1	273.5	303.8	347.1
1:17:30	357.1	395.9	749.8	278.8	309.7	353.3
1:20:00	358.4	405.5	753.9	284.6	315.3	359.4
1:22:30	365.7	414.4	759.3	283.3	320.7	365.1
1:25:00	371.2	425.2	766.4	290.5	326.3	370.6
1:27:30	368.5	432.9	767.9	286.9	331.5	376.0
1:30:00	374.3	442.8	775.8	279.6	336.4	381.0
1:32:30	371.8	449.7	784.0	280.2	340.8	386.3
1:35:00	363.4	462.3	787.9	281.8	345.4	391.3
1:37:30	365.2	467.5	790.8	282.2	350.1	395.9
1:40:00	363.9	474.9	795.1	274.5	354.7	400.4
1:42:30	372.5	482.7	799.1	281.4	358.9	404.6
1:45:00	361.9	477.6	803.7	276.0	363.9	408.9
1:47:30	359.5	463.7	807.1	269.3	368.2	413.0
1:50:00	356.0	451.7	812.0	261.7	372.5	416.9
1:52:30	355.9	438.4	820.9	255.4	376.3	420.8
1:55:00	335.6	431.9	827.1	258.8	379.9	424.9
1:57:30	355.8	429.7	831.9	284.6	384.5	429.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
2:00:00	355.8	433.3	835.5	276.8	388.2	433.9
2:02:30	368.7	428.0	839.8	285.7	391.9	438.0
2:05:00	365.9	416.7	842.0	279.6	396.2	442.3
2:07:30	370.0	424.3	846.5	287.1	399.8	446.4
2:10:00	378.1	422.6	852.4	264.3	403.7	450.3
2:12:30	370.4	419.6	858.0	257.7	408.2	453.9
2:15:00	394.4	438.7	864.8	242.2	411.8	457.6
2:17:30	372.8	432.0	871.0	253.0	415.4	461.0
2:20:00	415.5	444.4	878.3	247.2	418.8	464.0
2:22:30	402.7	438.7	887.2	247.9	422.2	467.1
2:25:00	403.9	435.1	897.5	236.8	425.8	470.2
2:27:30	430.9	453.3	906.0	256.0	429.1	473.1
2:30:00	427.5	460.3	915.3	250.6	432.8	476.0
2:32:30	478.8	473.3	924.3	246.1	436.1	479.0
2:35:00	519.0	502.5	931.7	235.4	439.8	481.8
2:37:30	588.4	497.5	939.3	244.9	442.8	484.8
2:40:00	689.2	522.9	943.4	212.4	446.5	487.9
2:42:30	749.3	541.8	949.4	220.0	450.2	490.9
2:45:00	723.8	547.1	955.8	215.0	453.5	493.7
2:47:30	792.1	560.9	961.2	218.2	456.7	496.7
2:50:00	1008.3	536.0	971.4	226.6	460.6	499.5
2:52:30	1029.0	529.4	978.2	216.7	463.9	502.2
2:55:00	1018.4	552.2	986.1	201.8	466.9	505.2
2:57:30	1077.4	559.5	994.7	196.3	470.1	508.1
3:00:00	1092.8	586.5	1002.1	186.7	473.6	511.3
3:02:30	1104.0	594.0	1009.5	206.8	476.7	514.7
3:05:00	1129.1	604.4	1017.7	220.3	480.4	519.2
3:07:30	1179.1	631.6	1025.0	200.2	484.8	524.0
3:10:00	1199.1	633.2	1032.3	197.8	489.5	528.3
3:12:30	1224.7	646.4	1037.5	218.2	494.7	534.1
3:15:00	1223.0	688.9	1044.0	196.0	500.4	540.0
3:17:30	1222.1	673.9	1049.3	209.4	506.8	546.9
3:20:00	1226.8	718.3	1053.4	210.5	513.5	553.1
3:22:30	1226.2	778.0	1056.5	196.1	521.2	562.0
3:25:00	1231.9	814.1	1061.9	199.1	529.2	572.6
3:27:30	1254.0	818.2	1064.9	217.5	537.7	585.4
3:30:00	1263.0	850.6	1069.7	200.1	547.4	599.9
3:32:30	1256.1	825.5	1074.3	193.6	557.1	618.8
3:35:00	1266.6	875.1	1078.0	219.1	567.6	640.6
3:37:30	1264.8	905.7	1080.7	204.0	577.6	664.4
3:40:00	1259.1	936.4	1083.3	225.5	588.4	691.9
3:42:30	1258.6	943.2	1086.8	254.3	600.3	723.1
3:45:00	1264.8	956.9	1084.7	234.2	612.5	758.3
3:47:30	1260.4	971.3	1085.5	240.0	626.3	797.6
3:50:00	1259.4	970.7	1085.2	234.3	641.8	829.9
3:52:30	1256.2	967.8	1086.7	273.4	659.9	853.9
3:55:00	1260.5	985.8	1087.7	292.2	679.5	891.2
3:57:30	1259.7	983.9	1087.9	268.0	700.0	924.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
hr:min:sec						
4:00:00	1262.0	966.2	1089.4	266.7	721.1	954.1
4:02:30	1259.4	995.2	1089.3	274.4	741.4	985.1
4:05:00	1258.4	999.2	1090.9	309.8	762.6	1010.2
4:07:30	1269.2	994.5	1092.6	301.4	781.6	1037.2
4:10:00	1267.3	968.9	1091.5	320.6	802.3	1065.9
4:12:30	1252.1	980.9	1092.5	354.2	822.4	1089.1
4:15:00	1258.8	993.4	1093.9	329.6	844.7	1110.0
4:17:30	1268.8	980.5	1095.2	338.2	862.3	1127.8
4:20:00	1256.3	971.4	1095.7	365.5	883.1	1139.1
4:22:30	1262.0	961.0	1097.4	337.8	902.4	1149.7
4:25:00	1250.0	992.4	1099.1	320.6	919.3	1155.3
4:27:30	1257.9	979.2	1101.8	324.5	934.2	1158.3
4:30:00	424.1	945.3	1103.9	205.8	946.4	1158.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	73.8	74.1	74.1	73.5	74.1
0:02:30	73.9	74.2	74.3	95.6	74.0
0:05:00	74.6	76.2	76.0	134.7	74.1
0:07:30	76.9	80.6	79.6	186.5	74.2
0:10:00	81.0	87.7	85.3	247.8	74.5
0:12:30	87.5	96.6	92.5	307.0	75.2
0:15:00	96.6	107.1	101.1	359.6	77.0
0:17:30	106.7	118.3	110.7	404.9	80.0
0:20:00	117.7	130.3	120.8	443.6	84.2
0:22:30	129.4	143.6	131.8	477.4	90.5
0:25:00	141.2	157.7	142.6	508.4	98.1
0:27:30	153.2	172.5	153.5	519.7	107.6
0:30:00	165.0	187.6	163.8	551.4	118.6
0:32:30	176.9	202.1	174.0	570.2	131.0
0:35:00	188.2	215.9	182.4	588.3	144.6
0:37:30	199.3	225.4	191.6	605.7	158.9
0:40:00	210.7	234.8	200.9	626.8	173.3
0:42:30	219.0	243.5	208.5	647.1	185.9
0:45:00	225.3	256.6	225.0	666.5	196.8
0:47:30	232.8	254.5	225.2	681.3	205.2
0:50:00	234.0	249.4	225.9	693.4	211.0
0:52:30	241.0	248.5	227.9	704.7	215.0
0:55:00	248.3	250.8	233.5	714.5	218.5
0:57:30	255.3	253.5	238.5	722.7	222.1
1:00:00	262.7	259.5	245.9	731.8	227.2
1:02:30	269.7	265.5	254.7	738.7	233.1
1:05:00	276.7	269.3	261.7	745.0	239.0
1:07:30	283.5	269.6	268.5	750.2	245.2
1:10:00	290.8	269.5	277.0	754.2	252.2
1:12:30	297.4	272.1	284.4	758.0	259.6
1:15:00	304.1	274.6	291.7	767.7	267.8
1:17:30	310.3	277.8	302.7	781.7	275.8
1:20:00	316.4	285.6	310.9	789.0	284.0
1:22:30	322.8	291.9	318.7	797.1	292.4
1:25:00	328.7	292.8	325.7	806.1	300.5
1:27:30	334.7	297.9	333.6	812.0	308.4
1:30:00	340.4	308.3	338.2	818.7	316.1
1:32:30	345.7	311.5	321.9	827.5	323.8
1:35:00	351.4	317.8	322.3	831.5	331.3
1:37:30	356.2	323.4	325.0	835.5	338.4
1:40:00	361.1	323.0	321.9	839.4	345.6
1:42:30	366.0	333.9	328.3	843.8	352.8
1:45:00	370.5	339.9	328.4	847.8	359.6
1:47:30	375.0	342.3	336.3	850.9	366.3
1:50:00	379.2	348.2	346.2	853.7	373.0
1:52:30	382.9	367.4	343.1	861.4	379.4
1:55:00	386.8	375.4	346.9	865.5	385.6
1:57:30	390.4	378.1	351.6	871.0	391.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
2:00:00	393.7	384.3	361.0	874.8	398.1
2:02:30	397.0	393.2	360.8	879.4	404.0
2:05:00	400.4	388.6	357.2	883.5	409.7
2:07:30	404.1	399.8	367.0	887.4	415.8
2:10:00	407.7	403.9	374.5	892.2	421.6
2:12:30	411.1	348.6	368.9	895.1	427.1
2:15:00	414.3	348.7	376.6	897.6	432.8
2:17:30	417.6	361.0	382.4	901.0	438.3
2:20:00	420.4	365.6	386.4	903.4	443.8
2:22:30	423.5	347.5	392.8	907.5	449.2
2:25:00	426.2	376.0	389.7	910.3	454.4
2:27:30	429.3	347.2	392.8	912.7	459.5
2:30:00	432.2	396.4	385.3	915.4	464.1
2:32:30	435.4	414.5	395.1	920.1	469.0
2:35:00	438.6	435.2	395.7	923.1	473.5
2:37:30	441.2	399.8	403.4	926.5	478.3
2:40:00	444.1	436.1	411.6	927.7	482.6
2:42:30	446.6	402.9	418.2	930.1	487.1
2:45:00	449.3	455.2	425.0	932.3	491.3
2:47:30	451.6	451.9	423.7	935.5	495.4
2:50:00	454.2	399.8	409.1	940.7	499.6
2:52:30	456.7	505.8	419.1	943.9	503.5
2:55:00	459.6	496.9	456.5	949.4	507.5
2:57:30	462.4	506.1	495.8	954.5	511.3
3:00:00	465.3	483.4	532.3	958.9	515.2
3:02:30	468.1	580.0	550.5	965.4	518.7
3:05:00	470.9	563.2	536.6	971.9	522.6
3:07:30	473.8	529.9	523.0	977.9	526.3
3:10:00	476.4	549.2	566.6	984.9	529.6
3:12:30	479.3	572.1	592.3	991.5	533.4
3:15:00	482.6	531.8	625.8	998.4	536.6
3:17:30	486.3	604.3	637.4	1005.1	539.9
3:20:00	489.4	617.5	653.9	1012.4	543.1
3:22:30	493.8	582.3	664.7	1027.6	546.2
3:25:00	498.2	620.3	661.3	1039.4	549.1
3:27:30	502.9	622.4	665.5	1048.2	552.3
3:30:00	508.9	549.5	670.2	1057.0	555.3
3:32:30	515.2	611.5	690.5	1064.4	557.7
3:35:00	522.9	577.1	701.7	1073.3	560.7
3:37:30	530.6	628.8	699.4	1078.8	563.4
3:40:00	539.2	683.3	707.3	1088.1	566.0
3:42:30	549.2	696.7	714.9	1094.8	568.5
3:45:00	560.3	628.7	730.4	1097.0	571.1
3:47:30	570.8	702.5	752.9	1103.0	573.6
3:50:00	583.1	708.3	774.0	1109.2	575.9
3:52:30	596.9	695.3	803.1	1116.3	578.4
3:55:00	612.2	762.6	830.2	1121.4	580.8
3:57:30	626.4	671.5	842.3	1125.6	583.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 9

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
4:00:00	644.2	696.1	859.8	1130.9	585.3
4:02:30	662.7	704.4	869.9	1134.1	587.5
4:05:00	682.0	741.5	870.3	1136.4	589.6
4:07:30	699.4	686.6	876.6	1143.4	592.1
4:10:00	718.5	679.4	874.2	1143.9	593.9
4:12:30	735.8	699.0	875.3	1145.8	595.3
4:15:00	750.3	716.2	871.9	1148.4	597.4
4:17:30	763.1	691.7	873.4	1149.3	599.7
4:20:00	772.4	669.2	872.7	1152.7	601.4
4:22:30	778.0	691.0	870.0	1154.0	603.2
4:25:00	787.1	750.1	875.4	1159.0	605.0
4:27:30	797.0	643.4	871.7	1163.3	607.3
4:30:00	805.3	878.7	879.2	1167.2	607.9



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June 20, 1995



Dow Corning Corporation
Mr. Robert M. Schroeder
2200 W. Salzburg Road
Mail CO43A1
Auburn, MI 48611

Our Reference: R8196, 95NK3179

Subject: UL Classification of Type 96-081 RTV Adhesive/Sealant

Dear Mr. Schroeder:

This is pursuant to our meeting on June 20, 1995 and our previous discussions regarding the above subject.

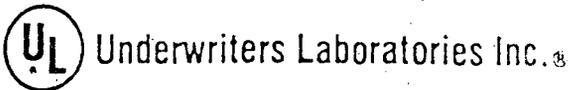
When the Special Services Investigation of Type 96-081 RTV Adhesive/Sealant (Project 95NK3179, File R8196) was initiated, you asked whether UL would also evaluate the products tested to determine whether we noted any differences in terms of fire performance that would preclude the products from being used in Through-Penetration Firestop Systems in which the Type 96-081 RTV Adhesive/Sealant is presently Classified. Based on our review of the data from the investigation, as described in Letter Report R8196 dated May 22, 1995, it was determined that the fire performance of the two lots of Type 96-081 RTV Adhesive/Sealant was similar. No significant deviations or irregularities were noted between the two lots of material which would preclude the products from being used in UL Classified Through-Penetration Firestop Systems.

Very truly yours,

C. J. JOHNSON (Ext. 42649)
Senior Engineering Associate
Engineering Services, 411B

Reviewed by:

RICHARD N. WALKE (Ext. 43084)
Engineering Group Leader
Engineering Services, 411B



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May 22, 1995



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Mr. Robert M. Schroeder
2200 W. Salzburg Road
Mail CO43A1
Auburn, MI 48611

Our Reference: R8196, 95NK3179

Subject: Special Services Investigation of Type 96-081 RTV Adhesive/Sealant

Dear Mr. Schroeder:

The subject of this Letter Report is the fire test investigation of two lots of Dow Corning Corporation Type 96-081 RTV Adhesive/Sealant in through-penetration firestop systems in concrete floors. The sole purpose of the fire test investigation was to develop fire performance data on Type 96-081 RTV Adhesive/Sealant produced using pigmentation of different purities. We understand that the information developed in this investigation is to be submitted only to the United States Nuclear Regulatory Commission and to the Dow Corning Corporation customers which have received shipments of the Type 96-081 RTV Adhesive/Sealant which were produced during the period of May through November, 1994.

In no event shall UL be responsible to anyone for whatever use or nonuse is made of the information contained in this Report and in no event shall UL, its employees, or its agents incur any obligations or liabilities for damages, including, but not limited to, consequential damages, arising out of or in connection with the use or inability to use the information contained in this Letter Report.

The test program consisted of constructing four concrete floor slabs, each of which contained four nominal 6 in. diameter steel sleeved through openings. A nominal 4 in. diameter Type L copper tube was centered in each through opening. Firestop systems incorporating Dow Corning Corporation Type 96-081 RTV Adhesive/Sealant were installed in the through openings of each assembly. The test assemblies were subjected to fire exposure tests conducted in accordance with the Standard, Fire Tests of Through-Penetration Firestops, UL 1479 (ASTM E814).

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committed to quality service

Information conveyed by this Letter Report applies only to the specimens actually involved in these tests.

MATERIALS:

The following materials were used in the construction of the test assemblies:

Normal Weight Concrete - The ready-mixed concrete consisted of Type I Portland cement, sand and siliceous normal weight aggregate mixed with water and an air entraining agent. The average compressive strength and density of the concrete at 28 days, as determined from four standard 6 by 12 in. cylinders, averaged 3413 psi and 143.5 pcf, respectively.

Welded Wire Fabric - The welded wire fabric reinforcement for the concrete floor slabs was a 6 by 6 in. welded wire mesh of No. 10 SWG uncoated steel wire (6 x 6 - W1.4 x W1.4).

Steel Sleeves - The sleeves consisted of 4-1/2 in. lengths of nominal 6 in. diameter Schedule 40 steel pipe. The steel sleeves had an inside diameter of 6.125 in. and a wall thickness of 0.250 in. Four 1/4-20 by 1 in. long hex-head steel bolts, symmetrically located, were welded to the exterior of each steel sleeve at the sleeve midheight to anchor the sleeve in the concrete slab.

Copper Tubes - The nominal 4 in. diameter Type L copper tubes were 52-1/2 in. long with an outside diameter of 4.12 in. and a wall thickness of 0.103 in. Each tube was marked "4" "L" COPPER PIPE MUELLER COPPER TUBE USA STREAMLINE". One end of each tube was sealed by a screw-attached steel cap in conjunction with a ceramic fiber gasket.

Forms - The forms that were used to prevent leakage of the fill material while in its liquid state were nominal 1-1/2 in. diameter foam plastic backer rod. The backer rod was supplied in a plastic bag marked "Compressed Denver Foam - Regular - Open Cell - Non Gassing Polyurethane Foam" and was manufactured by Backer Rod Manufacturing and Supply Co., Inc., Denver, CO.

Fill, Void or Cavity Materials - The fill material was manufactured by Dow Corning Corporation and designated Type 96-081 RTV Adhesive/Sealant. The one component silicone rubber fill material was supplied in standard 10.3 fl oz cartridges for use with caulking guns. Two different lots of the Type 96-081 RTV Adhesive/Sealant were submitted for testing. One lot of material bore the Lot No. ET094458 indicating it was manufactured in Elizabethtown, KY in September of 1994. The second lot of material bore the Lot No. ET025462 indicating it was manufactured in Elizabethtown, KY in February of 1995.

Each cartridge of fill material bore the UL Classification Marking under the Fill, Void or Cavity Materials and Joint Treatment Materials categories. Each lot of fill material conformed with the specifications in Follow-Up Service Procedure, R8196, Volume 1, Section 6. With the exception of the specification for self extinguishing time (Dow Corning Corp. Corporate Test Method

0316A) for Lot No. ET094458, each lot of fill material conformed with the Dow Corning Corp. sales specification for the Type 96-081 RTV Adhesive/Sealant. For Lot No. ET094458, the extinguishing time was 27 sec rather than a maximum of 10 sec.

CONSTRUCTION OF TEST ASSEMBLIES:

The test assemblies were constructed in accordance with the method specified by the submitter. The construction of the test assemblies was observed by members of the technical and engineering staff of Underwriters Laboratories Inc.

The 48 by 48 by 4 1/2 in. thick concrete floor assemblies were constructed in lumber frames and were each reinforced with a nominal 48 by 48 in. piece of welded wire fabric. Prior to concrete placement, steel sleeves were positioned in the lumber frames to create the through openings, as shown in ILL. 1. The concrete was poured into the frames, internally vibrated and was finished to a smooth, flat surface with a trowel and wood float. During the placement of the concrete, the welded wire fabric was lifted to approximately the middepth of the concrete. After the concrete had cured, the lumber frames were removed. Prior to installation of the firestop systems, the steel sleeves were sand-blasted to remove any loose dirt, scale and oil.

A nominal 4 in. diameter copper tube was centered in each of the sixteen steel-sleeved through openings in the concrete floor assemblies. The support racks for the copper tubes were attached to the top surface of the concrete floor assemblies by means of expansion type masonry fasteners. The cross members of the support racks were located approximately 12 in. and 30 in. above the top surface of the concrete floor assembly for support and attachment of the copper tubes. The copper tubes were secured to the support rack cross members with stainless steel band clamps. Each copper tube was positioned such that it projected 12 in. and 36 in. beyond the exposed and unexposed surfaces of the concrete floor assembly, respectively.

Nominal 1-1/2 in. diameter foam plastic backer rod was friction-fitted into the nominal 1 in. annular space between the copper tube and the steel sleeve in each through opening. A nominal 1-1/2 in. depth of Type 96-081 RTV Adhesive/Sealant was applied to fill each through opening flush with the top surface of the floor assembly. For Test Assembly Nos. 1 and 4, Type 96-081 RTV Adhesive/Sealant from Lot No. ET025462 was installed in each through opening. For Test Assembly Nos. 2 and 3, Type 96-081 RTV Adhesive/Sealant from Lot No. ET094458 was installed in each through opening.

FIRE EXPOSURE TESTS:

The fire exposure tests were each conducted in accordance with the Standard, "Fire Tests of Through-Penetration Firestops," UL 1479.

SAMPLES

The fire exposure tests were conducted on Test Assembly Nos. 1, 2, 3 and 4, constructed as described previously in this Letter Report under the section entitled "Construction of Test Assemblies" and as shown in ILL. 1.

Prior to installation of the firestop systems, the floor assemblies were each subjected to low-level fire exposure to drive the free moisture from the concrete. The humidity of each concrete floor assembly, as determined from a moisture-sensitive probe inserted in holes drilled into the concrete, was less than 75 percent at the time of each fire exposure test. The Type 96-081 RTV Adhesive/Sealant was installed in each of the four test assemblies on March 14, 1995.

METHOD

The test assemblies were tested on the horizontal furnace of Underwriters Laboratories Inc. The furnace consists of a steel shell lined with refractory brick with castable refractory ledges. The samples are exposed to radiant flames generated by burning natural gas delivered through four nominal 85,000 Btu/hr capacity multijet pipe burners located in the floor of the furnace. The actual surface of each sample exposed to fire is approximately 40 by 40 in. For each of the four fire tests described herein, the walls of the furnace were additionally lined with ceramic fiber blanket material to allow faster cooling of the furnace between fire tests. The furnace temperatures for each fire test were adjusted to follow the standard time-temperature curve as specified in the Standard, UL 1479 (ASTM E814). The temperatures were measured by three thermocouples symmetrically located 12 in. below the exposed surface of the test assemblies. The four edges of each test assembly were insulated with mineral wool batts.

Temperatures on the fill materials, penetrating items and unexposed surface of each test assembly were measured by 29 thermocouples located as shown in ILL. 2. The thermocouples were covered with nominal 2 by 2 in. dry ceramic fiber pads.

The differential pressure between the furnace chamber and the laboratory was measured with two stainless steel pressure probes connected to pressure transducers. The pressure probes were located approximately 0.78 in. (Channel No. 56) and 12 in. (Channel No. 57) below the exposed surface of each test assembly.

Throughout each fire exposure test, observations were made of the character of the fire and its control, the condition of the unexposed surface, and all developments pertaining to the performance of the firestop systems with special reference to integrity and flame passage through the test assembly. In addition to visual observations, each fire test was videotaped.

RESULTS

Character And Distribution Of Fire - For each fire exposure test, the fire was luminous and well distributed, and the furnace temperatures followed the standard time-temperature curve as outlined in the Standard, UL 1479, and as shown in the graphs and tables listed below:

Test Assembly No.	Graph of Average Furnace Temperature	Table of Average Furnace Temperature
1	ILL. 3	Appendix A, Pages 1, 2 and 3
2	ILL. 8	Appendix A, Pages 4, 5 and 6
3	ILL. 13	Appendix A, Pages 7, 8 and 9
4	ILL. 18	Appendix A, Pages 10, 11 and 12

Pressure Within The Furnace - The differential pressure between the furnace and the laboratory was positive throughout each fire test. The differential pressures between the furnace and the laboratory recorded during each fire exposure test is shown in the tables listed below:

Test Assembly No.	Table of Average Furnace Pressure
1	Appendix B, Pages 1, 2 and 3
2	Appendix B, Pages 4, 5 and 6
3	Appendix B, Pages 7, 8 and 9
4	Appendix B, Pages 10, 11 and 12

Observations During Test - No flaming occurred on the unexposed side of any of the firestop systems during any of the four fire exposure tests. For each test, the furnace fire was extinguished at 270 min.

Temperature Of The Assemblies - The temperatures measured on the unexposed surface of the firestop systems during each fire exposure test are shown in the graphs and tables listed below:

Test Assembly No.	Graphs of Fill Material Temperatures	Tabulated Temperature Data
1	ILLS. 4 - 7	Appendix C, Pages 1 through 15
2	ILLS. 9 - 12	Appendix C, Pages 16 through 30
3	ILLS. 14 - 17	Appendix C, Pages 31 through 45
4	ILLS. 19 - 22	Appendix C, Pages 46 through 60

The Standard, UL 1479, contains a provision whereby T Ratings are established for firestop systems based upon the temperature rise on the unexposed surface. The T Rating is defined as the time at which the hottest point on the unexposed surface of the firestop system rises 325°F above the initial starting temperature. The time at which the limiting temperature was reached on the fill material of each firestop system, disregarding the temperature measured on the copper tube, is shown in the following table:

Test Assembly No.	Opening No.	96-081 RTV Adhesive/Sealant Lot No.	T Rating Time, min (T.C. No.)
1	1	ET025462	28 (2)
	2	ET025462	31 (9)
	3	ET025462	27 (16)
	4	ET025462	31 (25)
2	1	ET094458	27 (2)
	2	ET094458	25 (8)
	3	ET094458	26 (15)
	4	ET094458	25 (23)
3	1	ET094458	28 (1)
	2	ET094458	25 (8)
	3	ET094458	27 (15)
	4	ET094458	29 (25)
4	1	ET025462	30 (4)
	2	ET025462	25 (8)
	3	ET025462	24 (17)
	4	ET025462	22 (22)

S U M M A R Y

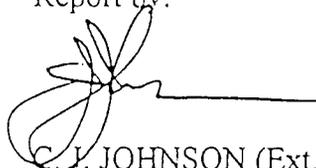
Four nominal 48 by 48 by 4-1/2 in. thick normal concrete floor slabs, each containing four nominal 6 in. diameter Schedule 40 steel pipe sleeves, were constructed. A nominal 4 in. diameter Type L copper tube was centered in each steel sleeved opening such that a nominal 1 in. annular space was present. Forming material consisting of nominal 1-1/2 in. diameter foam plastic backer rod was friction-fitted into the annular space of each opening such that the top (as installed) concave surface of the backer rod was recessed 1-1/2 in. from the top edge of the steel sleeved opening. The annular space of each opening was filled with a nominal 1-1/2 in. depth of Type 96-081 RTV Adhesive/Sealant. For two of the assemblies (Test Assembly Nos. 1 and 4), Type 96-081 RTV Adhesive/Sealant from Lot No. ET025462 was installed in each through

opening. For the two other assemblies (Test Assembly Nos. 2 and 3), Type 96-081 RTV Adhesive/Sealant from Lot No. ET094458 was installed in each through opening.

The test assemblies were each subjected to a 4-1/2 hr long fire exposure test conducted in accordance with the Standard, Fire Tests of Through-Penetration Firestops, UL 1479 (ASTM E814). No flaming occurred on the unexposed surface of any of the firestop systems during the fire exposure tests.

In consideration of the nature of this investigation, the foregoing Report is to be construed as information only and should not be regarded as containing any conclusions or recommendations on the part of Underwriters Laboratories Inc. regarding the acceptability of the fill materials for use in firestop systems as specified in Appendix R to 10CFR50, or for any other purpose.

Report by:



C. J. JOHNSON (Ext. 42649)
Senior Engineering Associate
Engineering Services, 411B

Reviewed by:



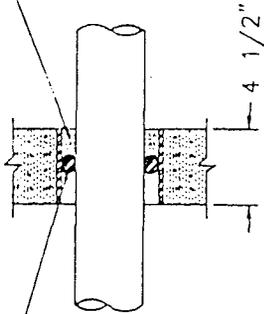
RICHARD N. WALKE (Ext. 43084)
Engineering Group Leader
Engineering Services, 411B

NORTH
↑

NOM 48" x 48" x 4-1/2" THICK
STEEL-REINFORCED NORMAL
WEIGHT CONCRETE SLAB

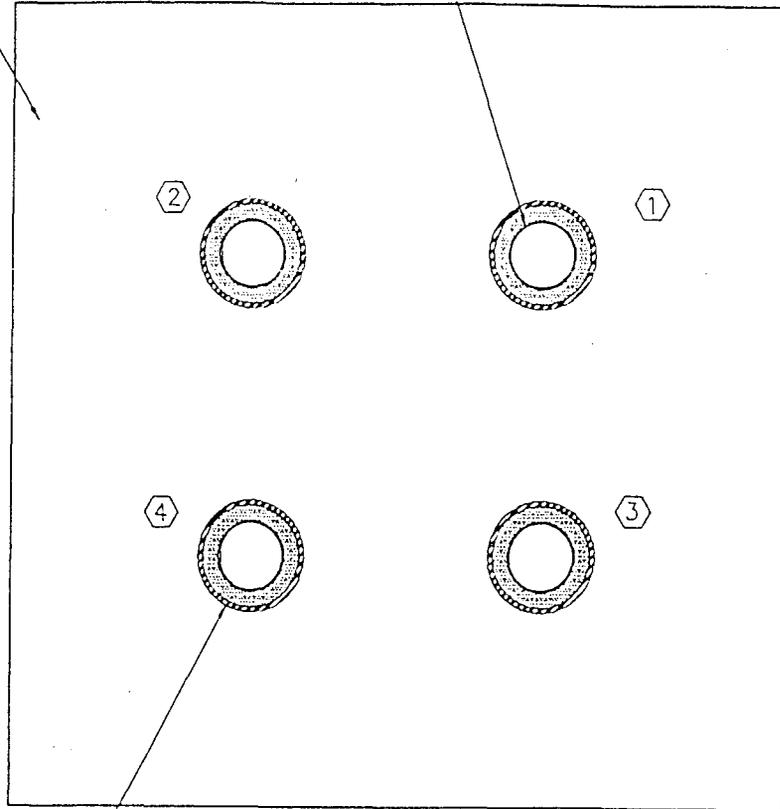
NOM 4" DIAM x 52-1/2" LONG TYPE L
COPPER TUBE CENTERED IN SLEEVED
OPENING (TYP. - 4 PLCS.)

1-1/2" OF 96-081
RTV ADHESIVE/SEALANT



BACKER ROD

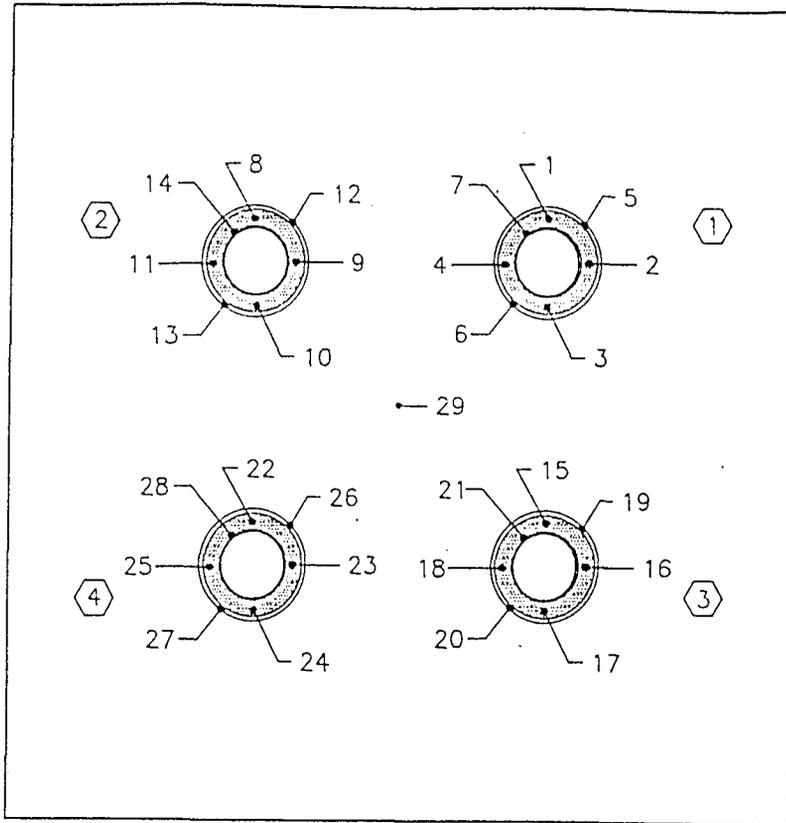
TYPICAL
SECTION



NOM 6" DIAM x 4-1/2" LONG SCH 40 STEEL
PIPE SLEEVE (TYP. - 4 PLCS.)

<u>TEST ASSEMBLY NO.</u>	<u>TEST DATE</u>	<u>96-081 LOT NO.</u>
1	4-18-95	ET025462
2	4-19-95	ET094458
3	4-25-95	ET094458
4	4-28-95	ET025462

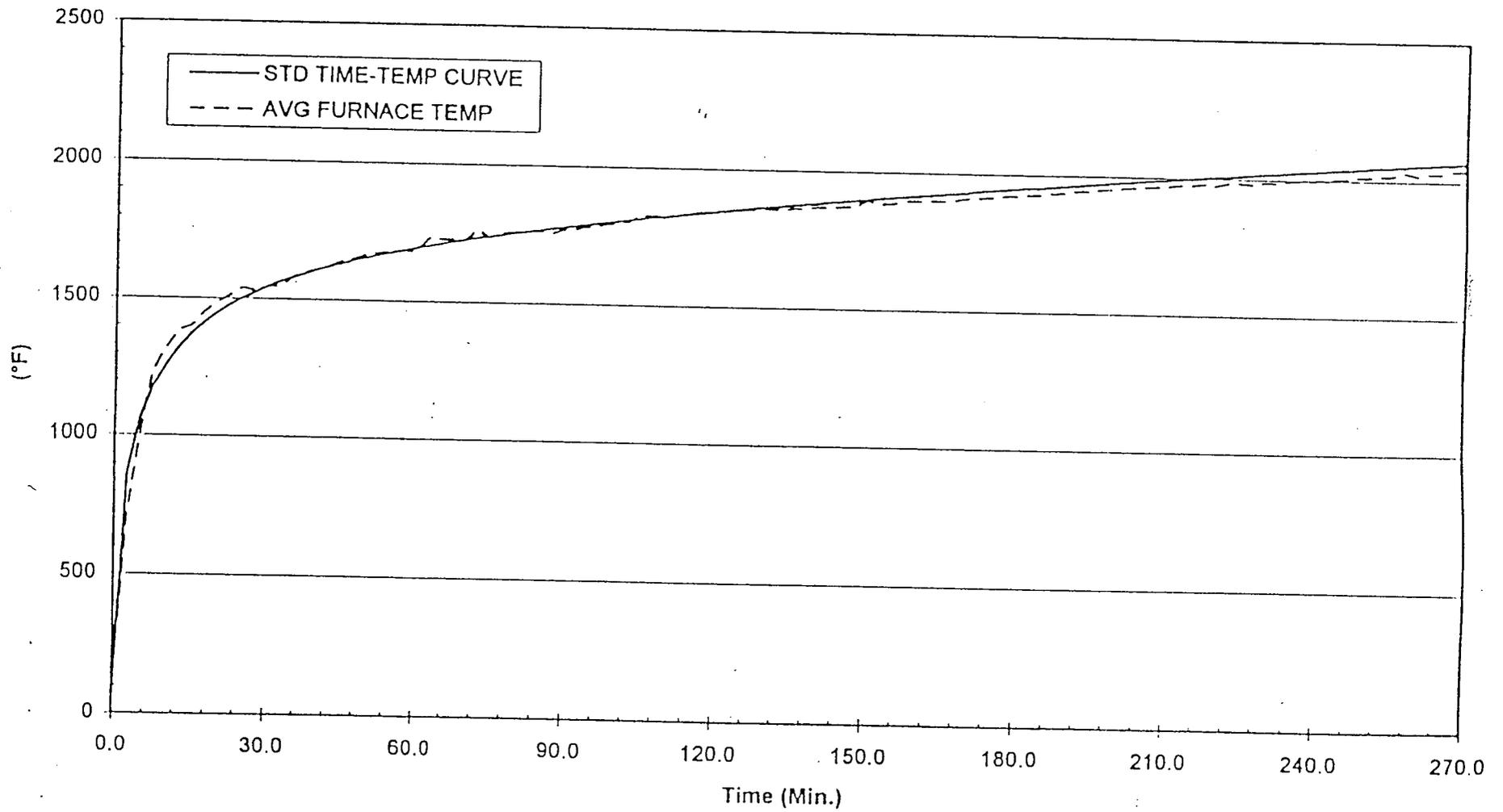
NORTH



T.C. NO.	LOCATION
1,2,3,4,8,9,10,11,15, 16,17,18,22,23,24,25	ON FILL MATERIAL AT CENTER OF ANNULAR SPACE
5,6,12,13,19, 20,26,27	ON EDGE OF STEEL SLEEVE
7,14,21,28	ON COPPER PIPE 1" ABOVE FILL MATERIAL
29	ON CONCRETE AT CENTER OF FLOOR SLAB

THERMOCOUPLE LOCATIONS

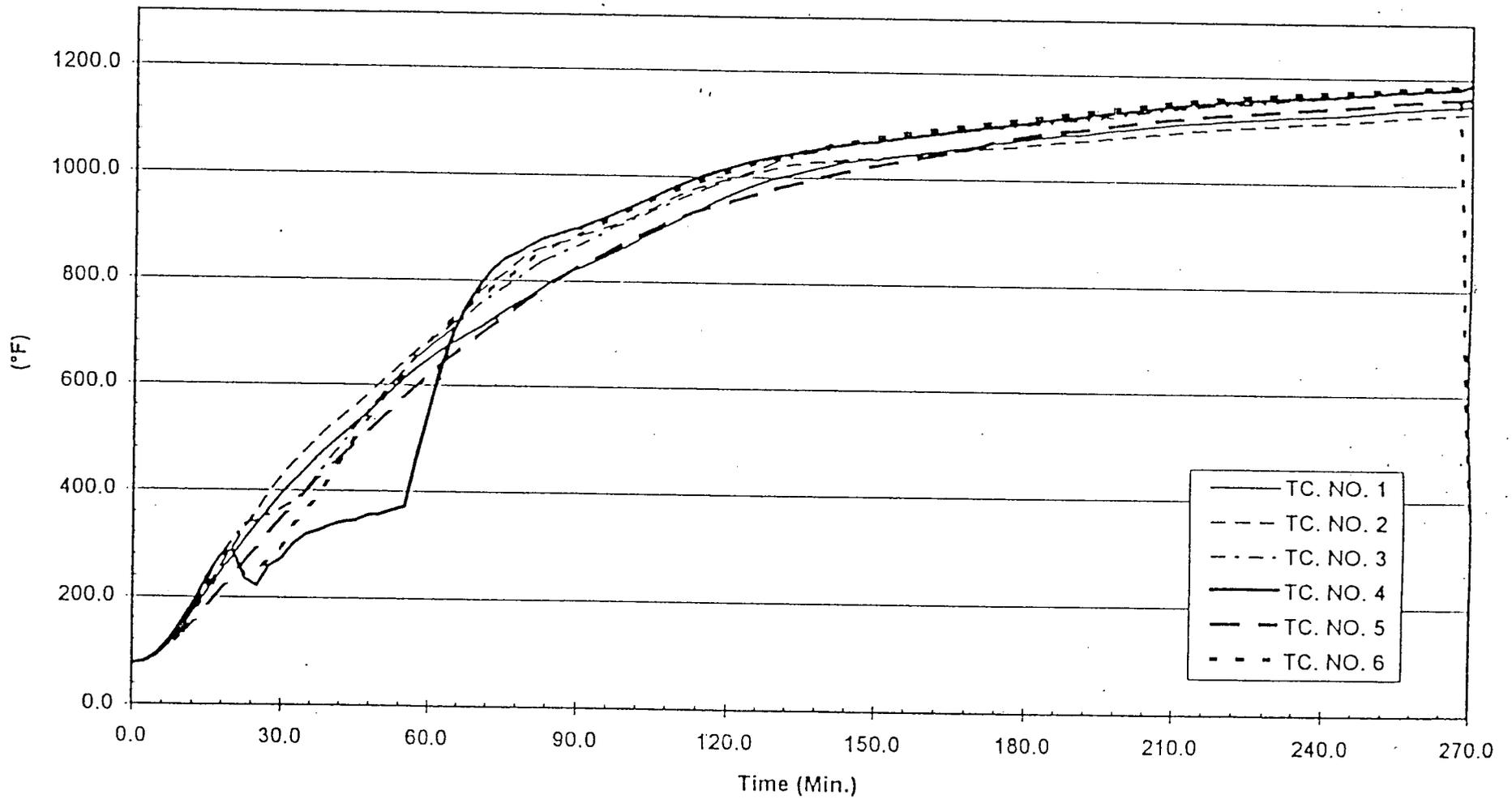
DOW CORNING CORP.
TEST ASSEMBLY NO. 1
FURNACE TEMPERATURES



REV 3

R8196/95NK3179
Test Date : APRIL 18, 1995

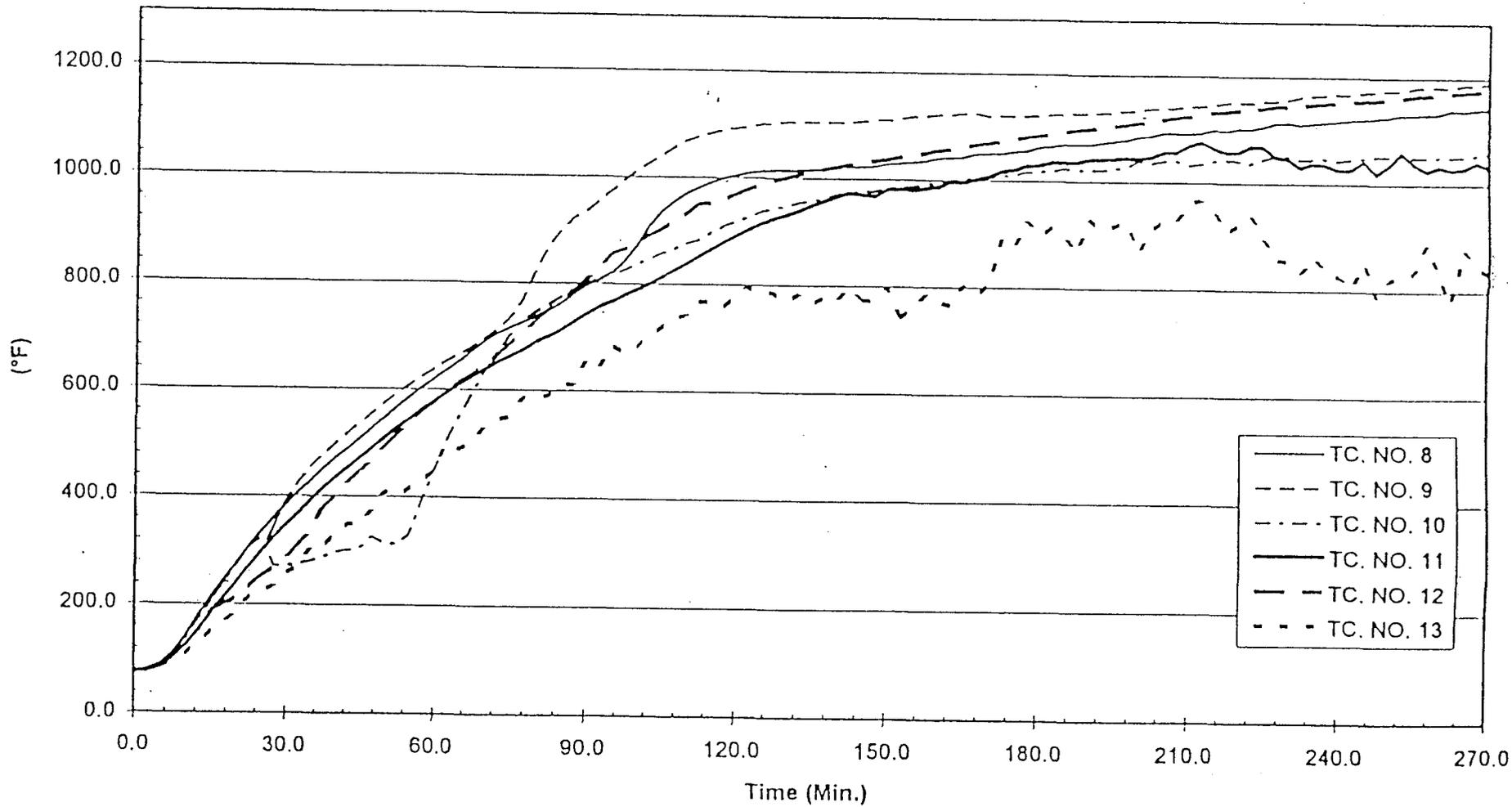
DOW CORNING CORP.
TEST ASSEMBLY NO. 1
OPENING NO. 1



R8196
REV. 4

R8196/95NK3179
Test Date : APRIL 18, 1995

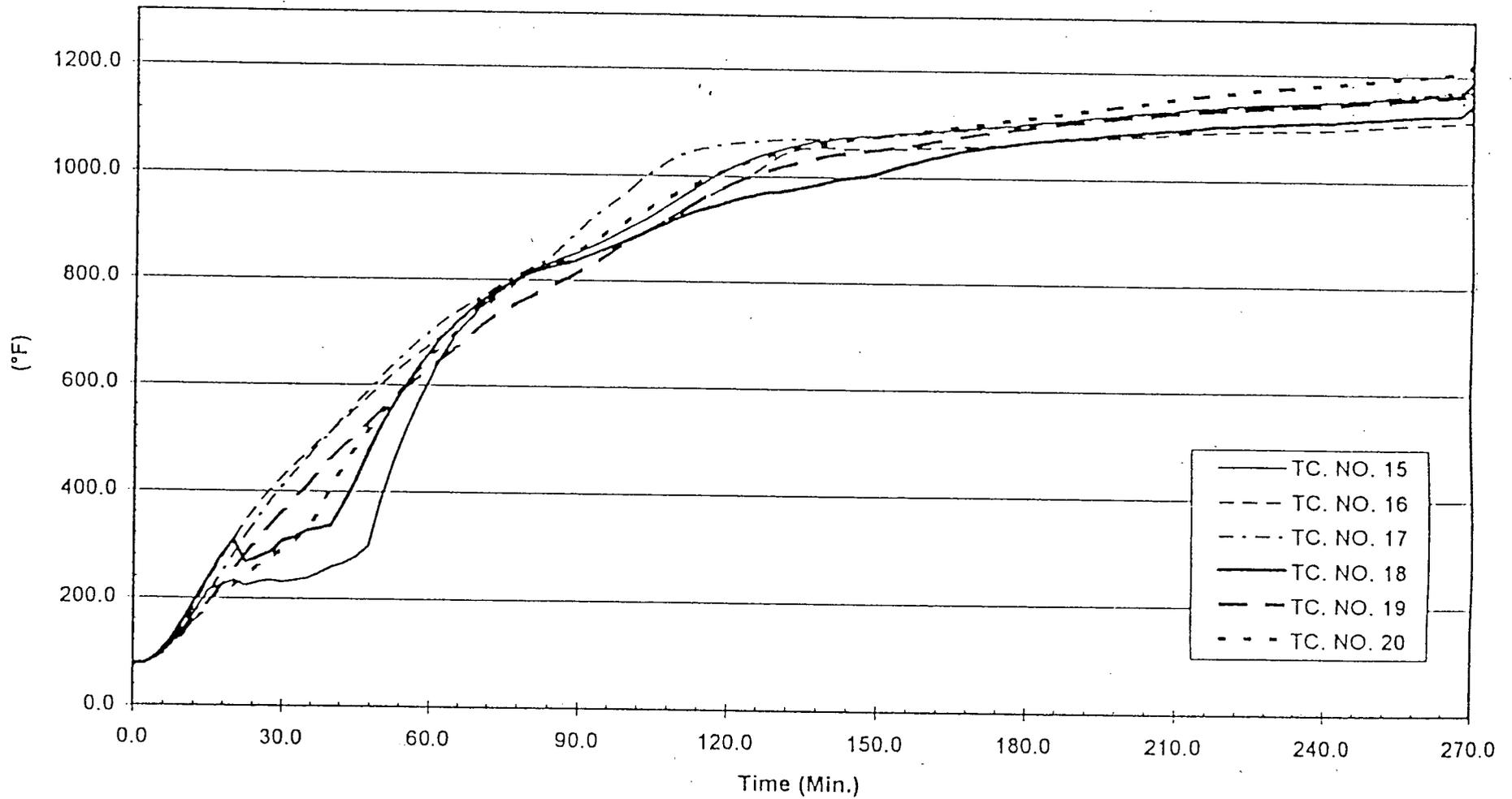
DOW CORNING CORP.
TEST ASSEMBLY NO. 1
OPENING NO. 2



R8196
ILL. 5

R8196/95NK3179
Test Date : APRIL 18, 1995

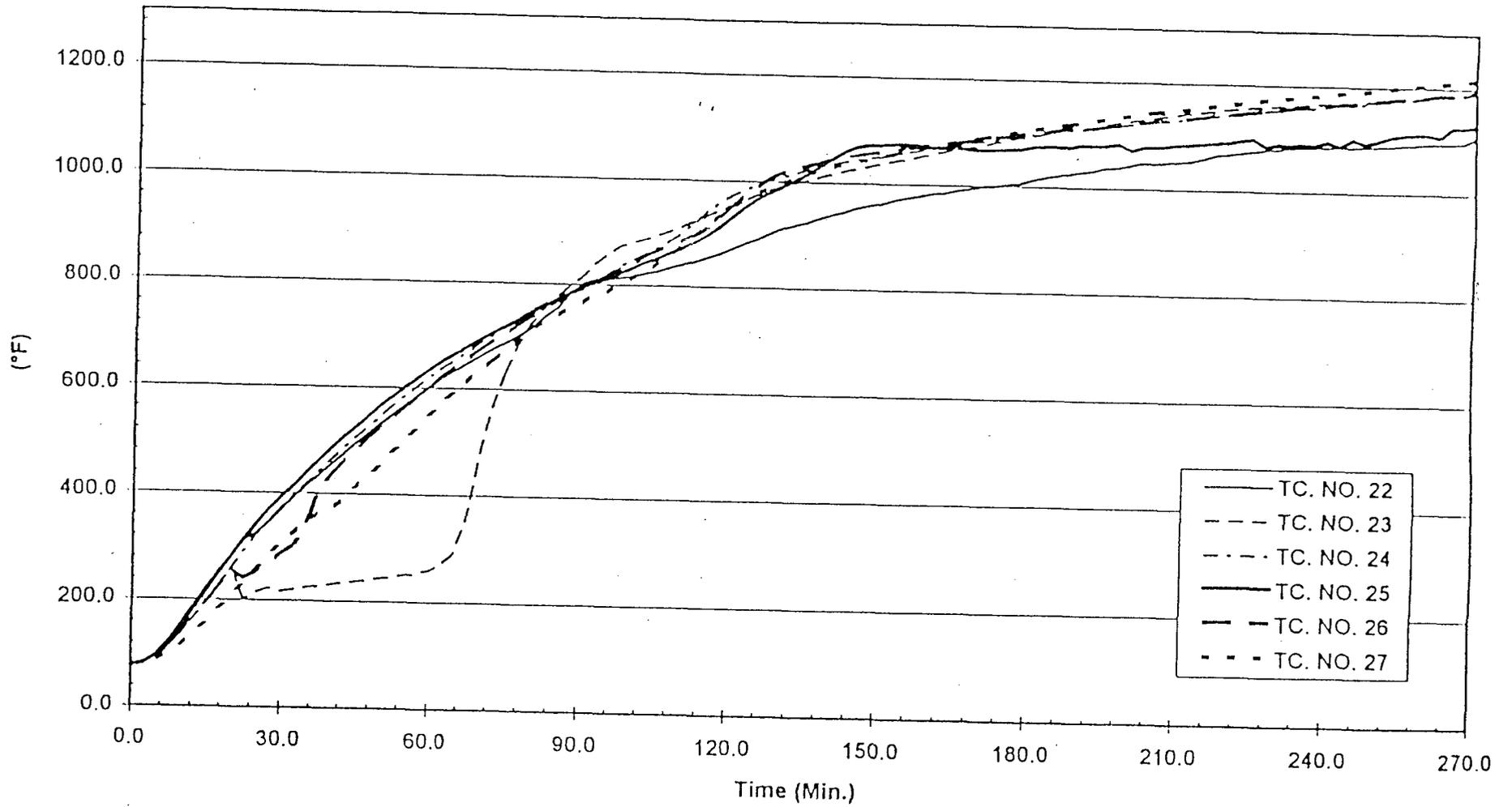
DOW CORNING CORP.
TEST ASSEMBLY NO. 1
OPENING NO. 3



R8196
11.1.5

R8196/95NK3179
Test Date : APRIL 18, 1995

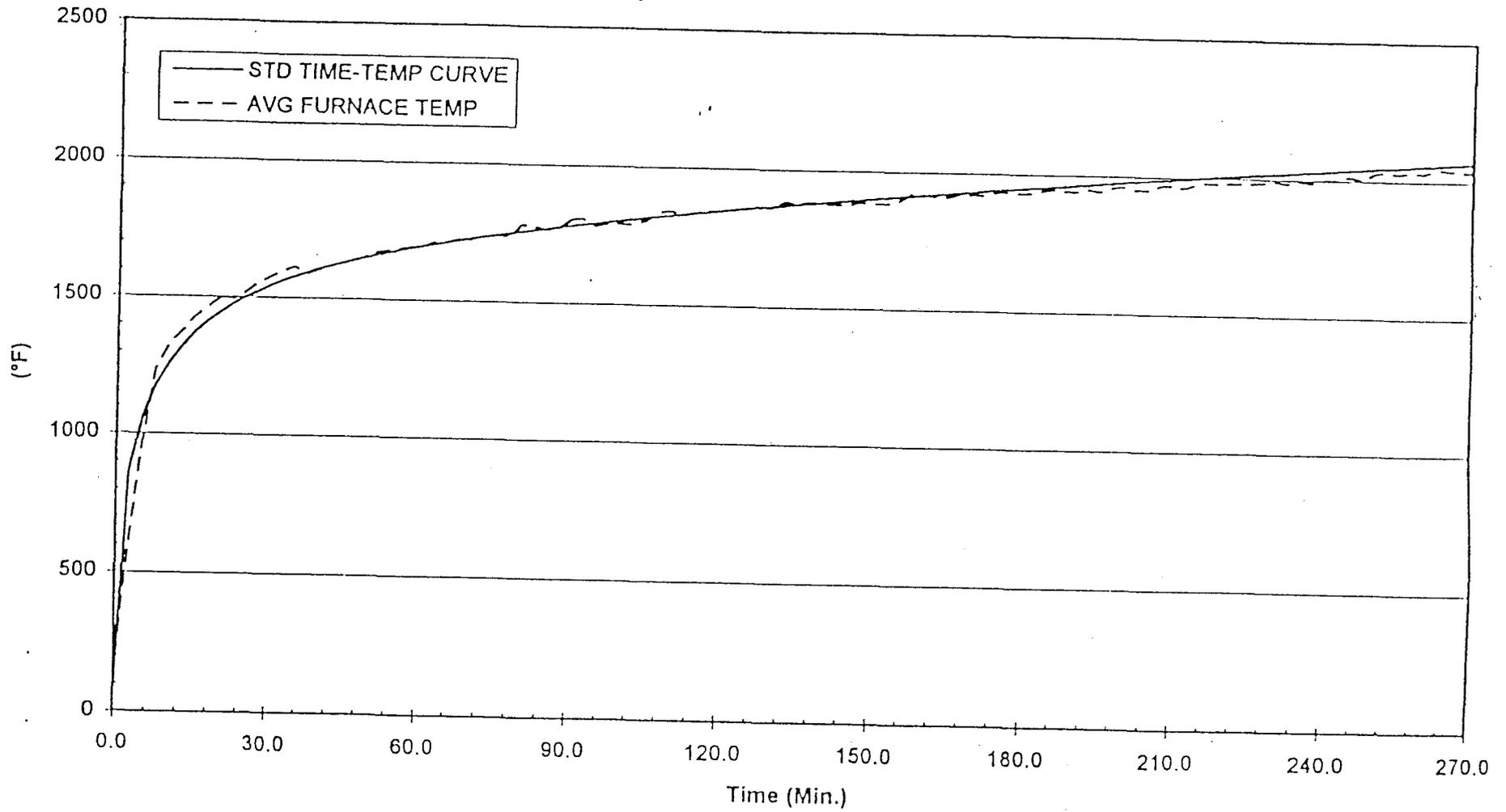
DOW CORNING CORP.
TEST ASSEMBLY NO. 1
OPENING NO. 4



R8196
ILL. 7

R8196/95NK3179
Test Date : APRIL 18, 1995

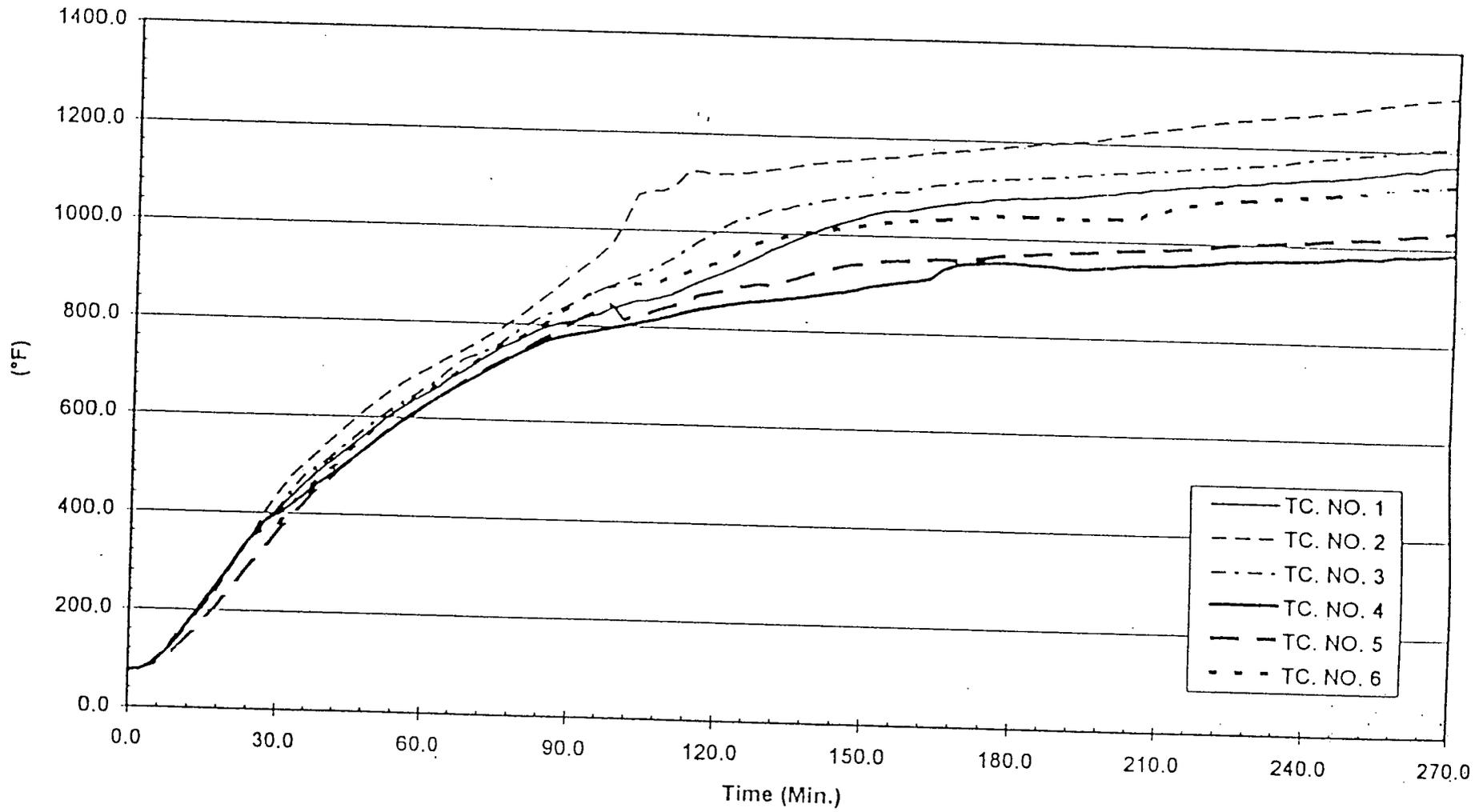
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
FURNACE TEMPERATURES



R8196
ILL. 8

R8196/95NK3179
Test Date : APRIL 19, 1995

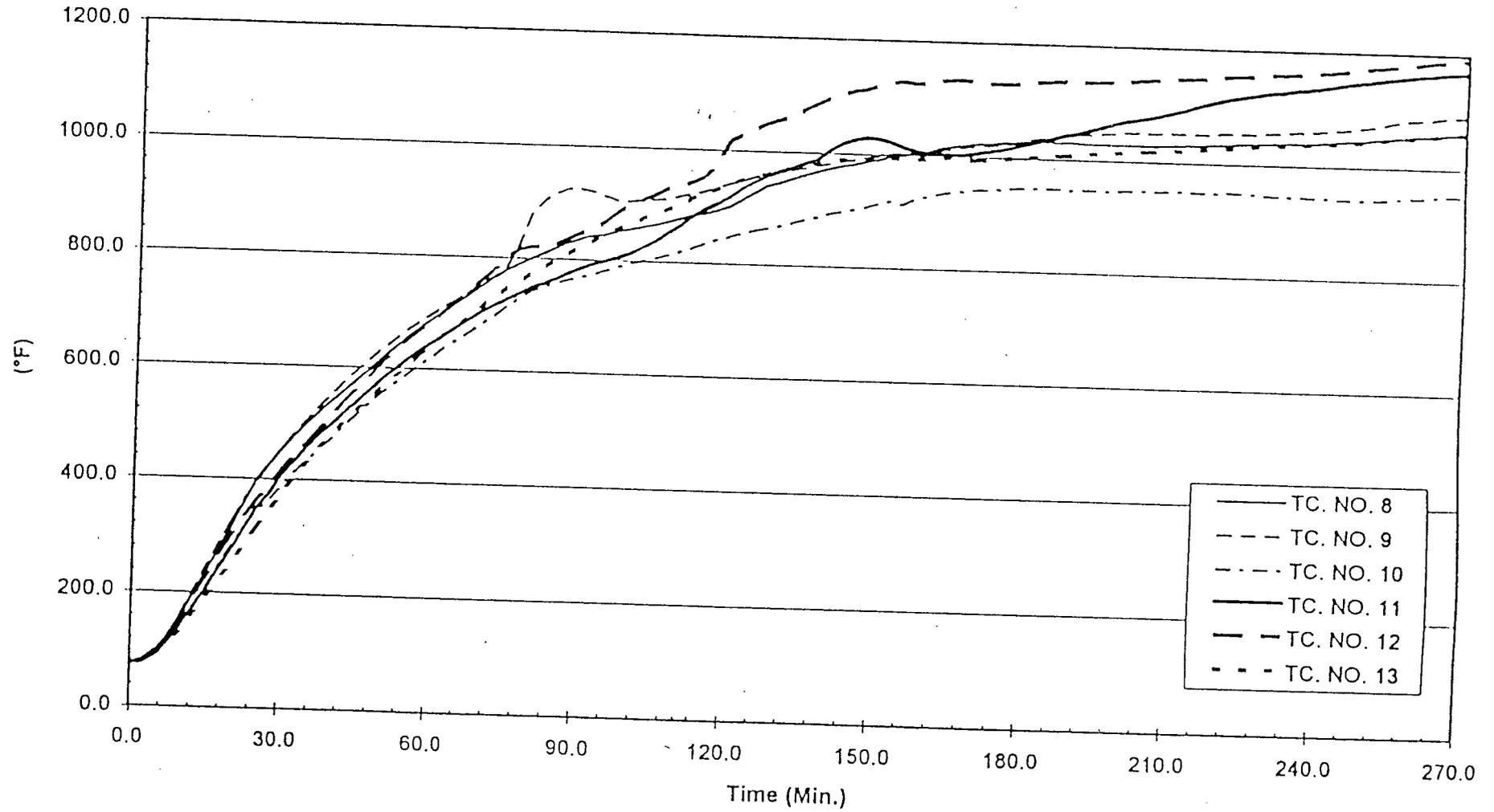
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
OPENING NO. 1



R8196
ILL. 9

R8196/95NK3179
Test Date : APRIL 19, 1995

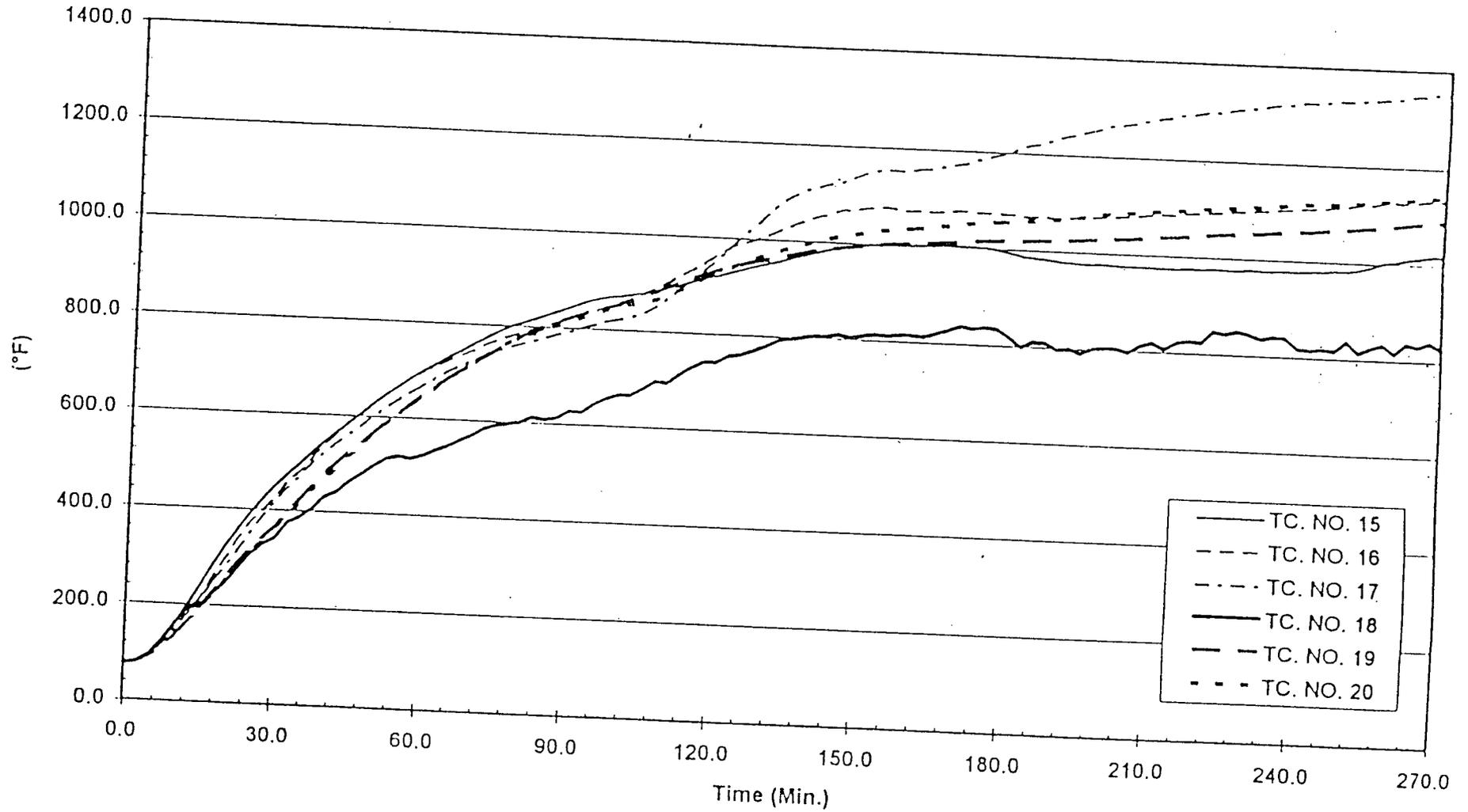
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
OPENING NO. 2



R8196
FIL. 10

R8196/95NK3179
Test Date : APRIL 19, 1995

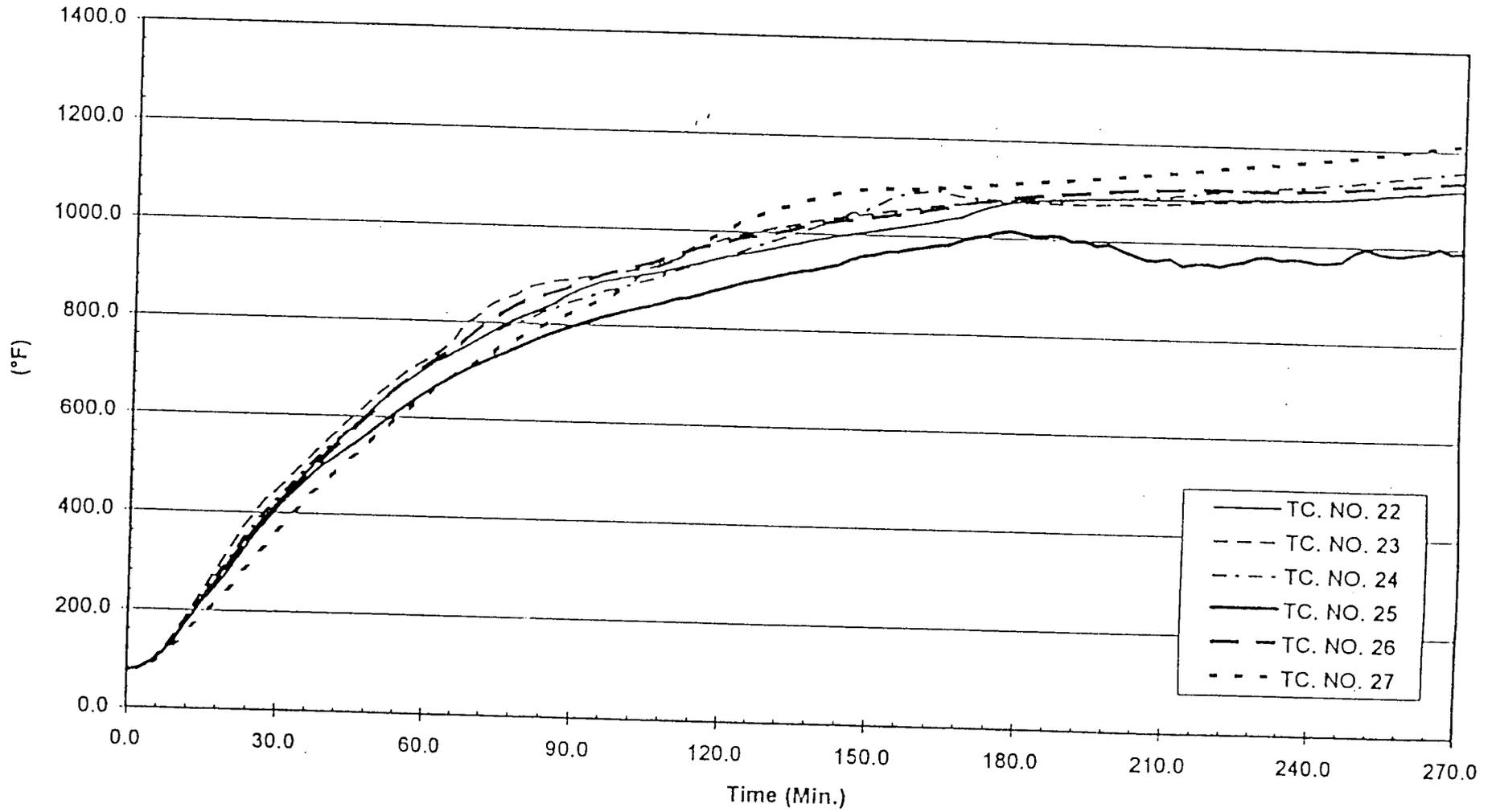
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
OPENING NO. 3



R8196
ILL. 11

R8196/95NK3179
Test Date : APRIL 19, 1995

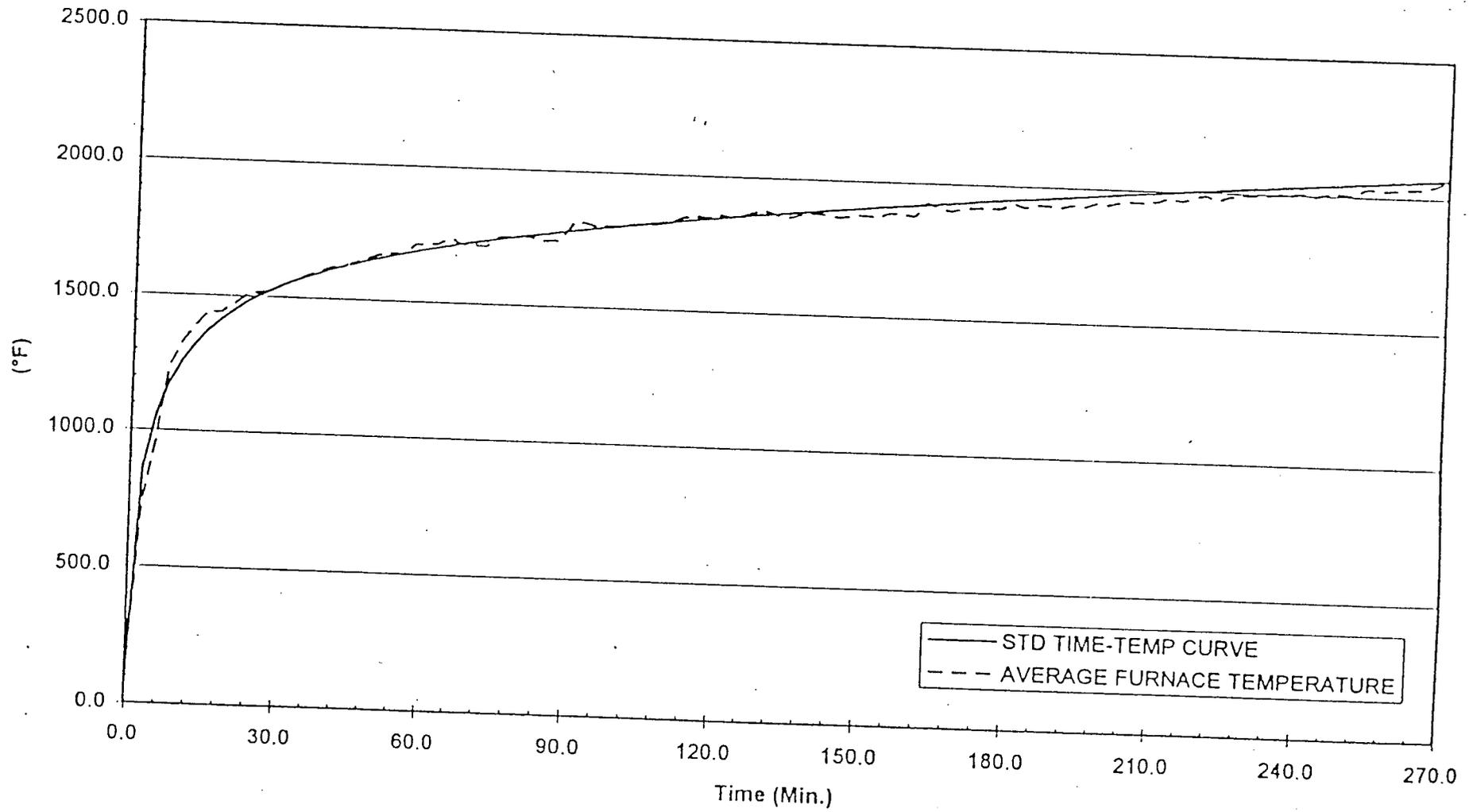
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
OPENING NO. 4



R8196
ILL. 12

R8196/95NK3179
Test Date : APRIL 19, 1995

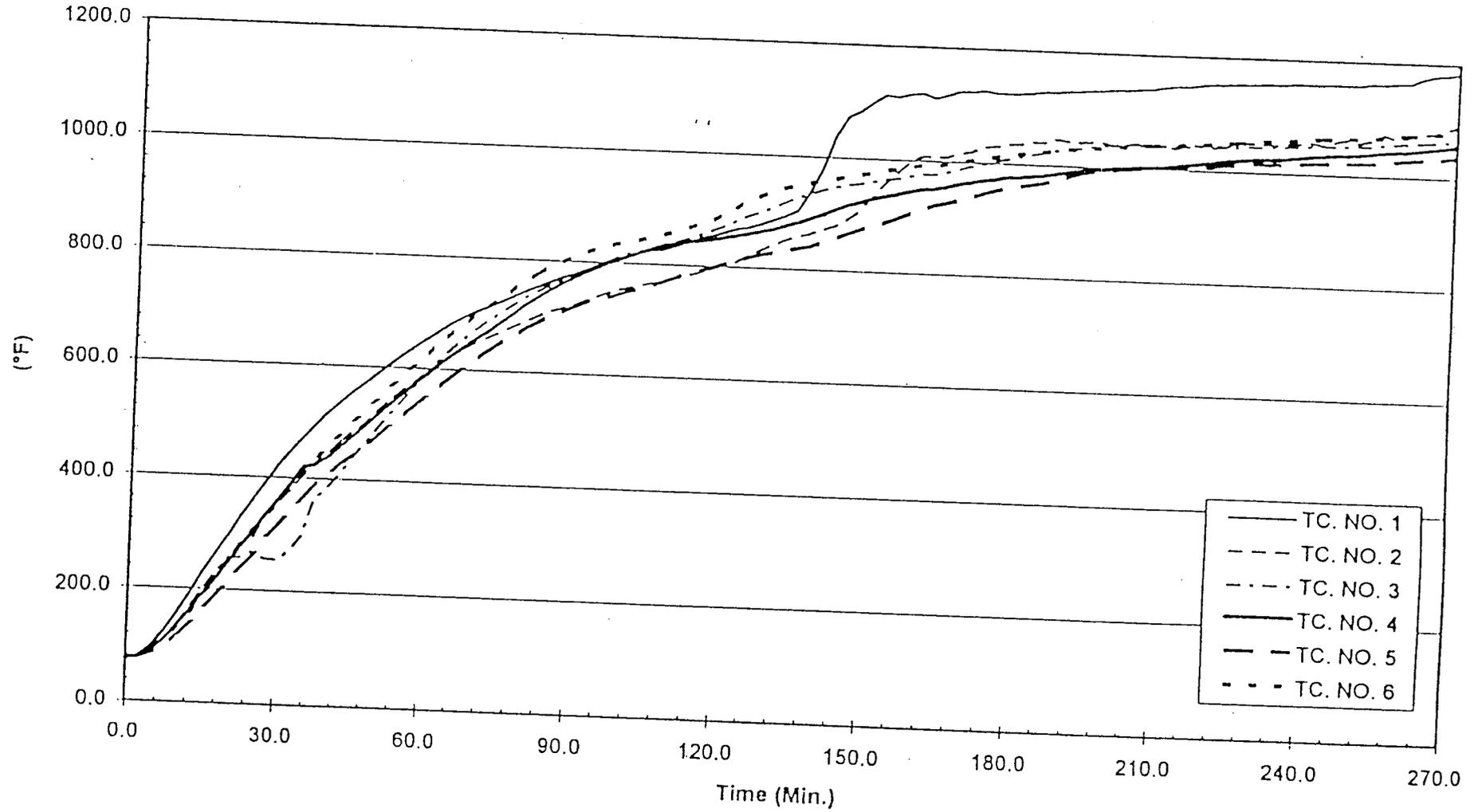
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
FURNACE TEMPERATURES



R8196
ILL. 13

R8196/95NK3179
Test Date : APRIL 25, 1995

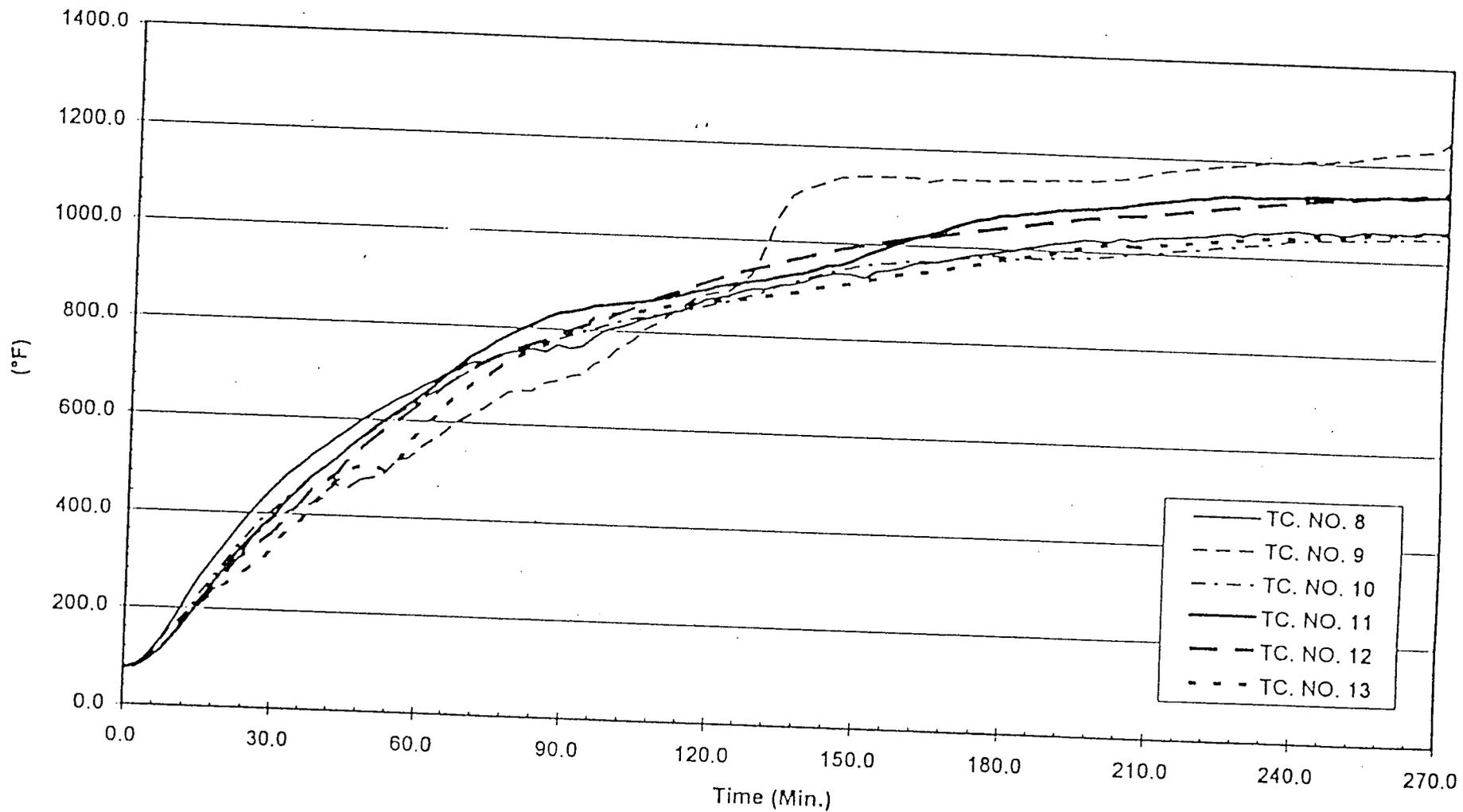
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
OPENING NO. 1



R8195
ILL. 14

R8196/95NK3179
Test Date : APRIL 25, 1995

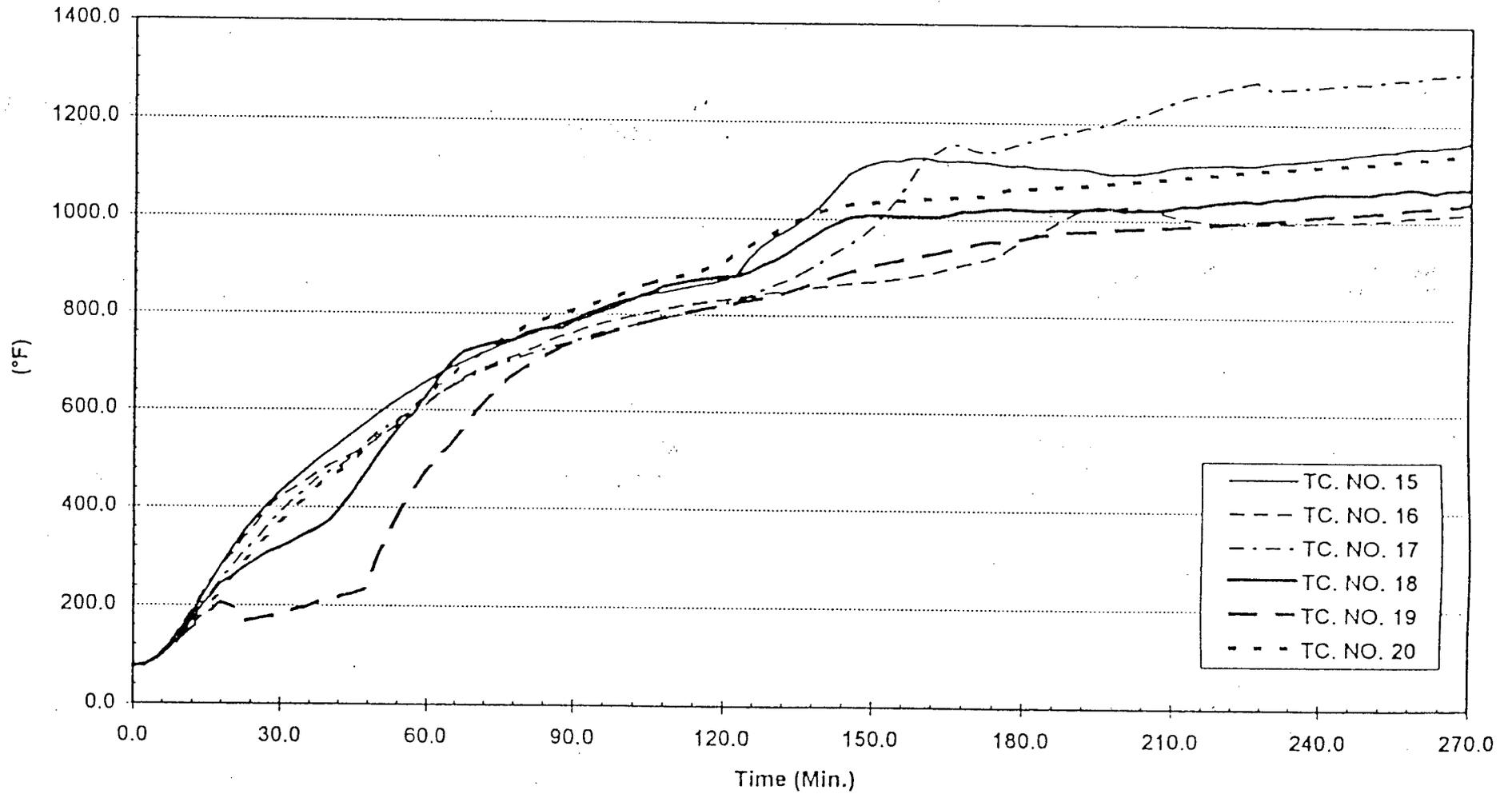
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
OPENING NO. 2



R8196
REV. 15

R8196/95NK3179
Test Date : APRIL 25, 1995

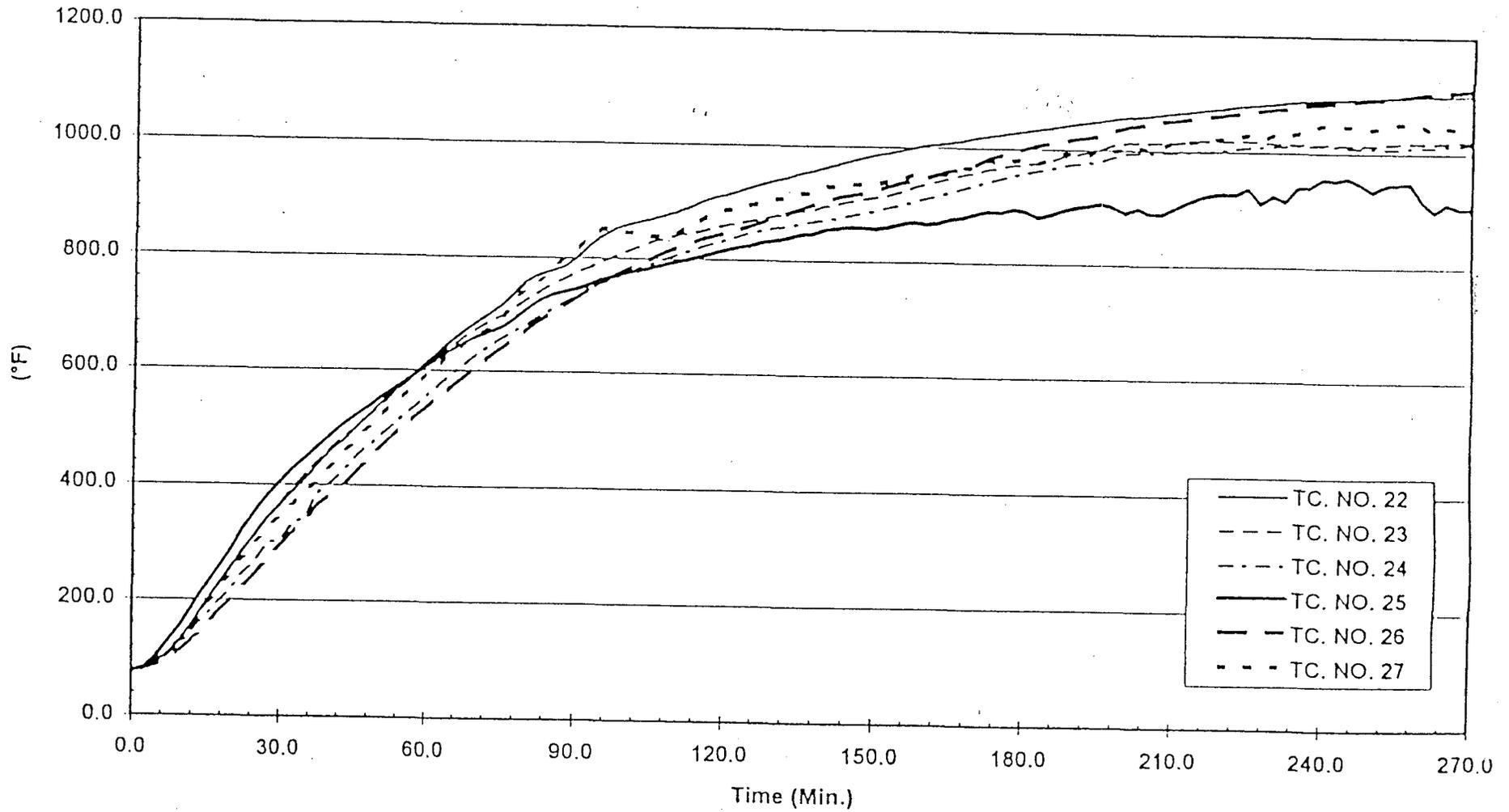
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
OPENING NO. 3



R8196
ILL. 16

R8196/95NK3179
Test Date : APRIL 25, 1995

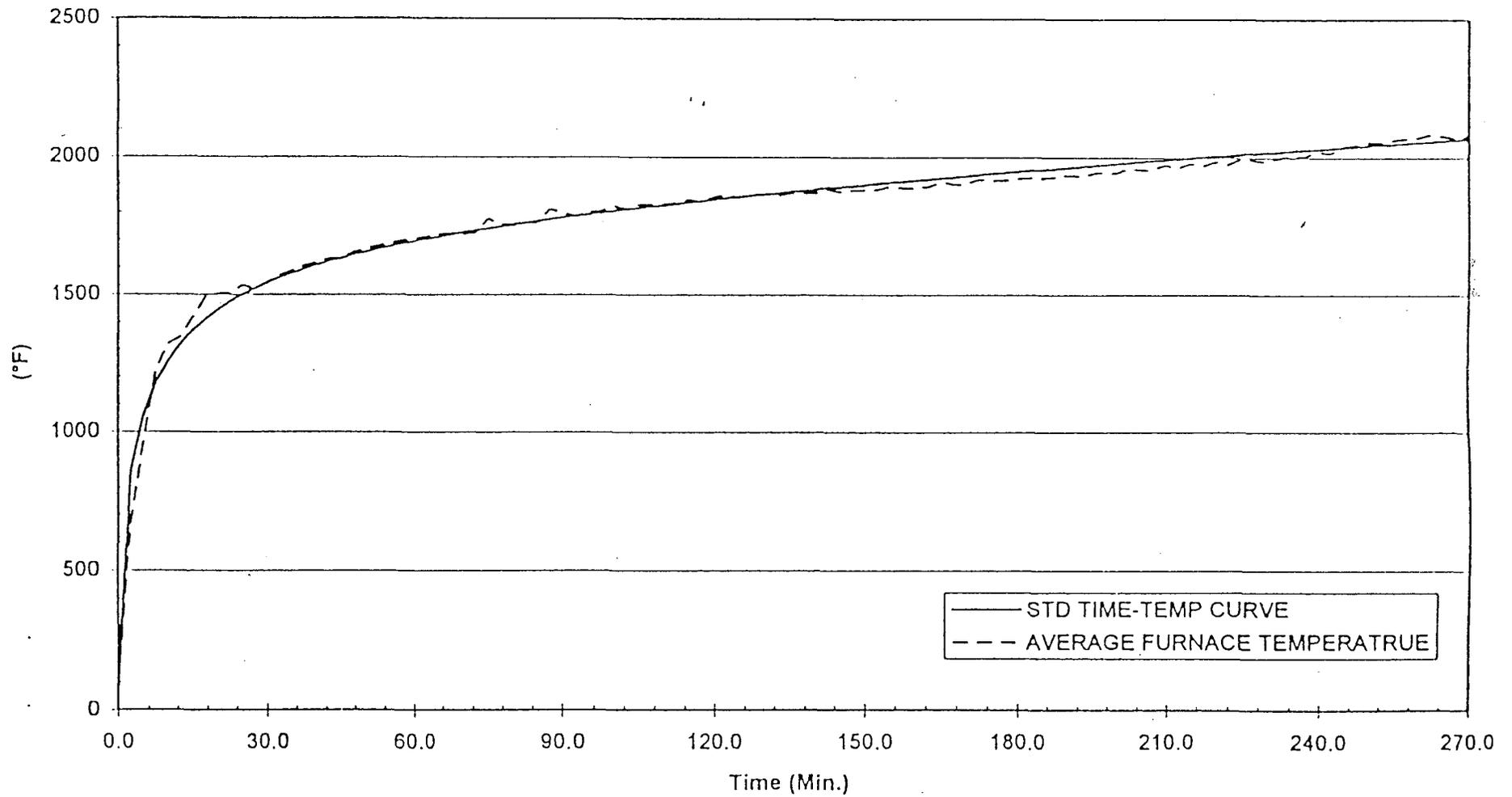
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
OPENING NO. 4



R8195
REV. 17

R8196/95NK3179
Test Date : APRIL 25, 1995

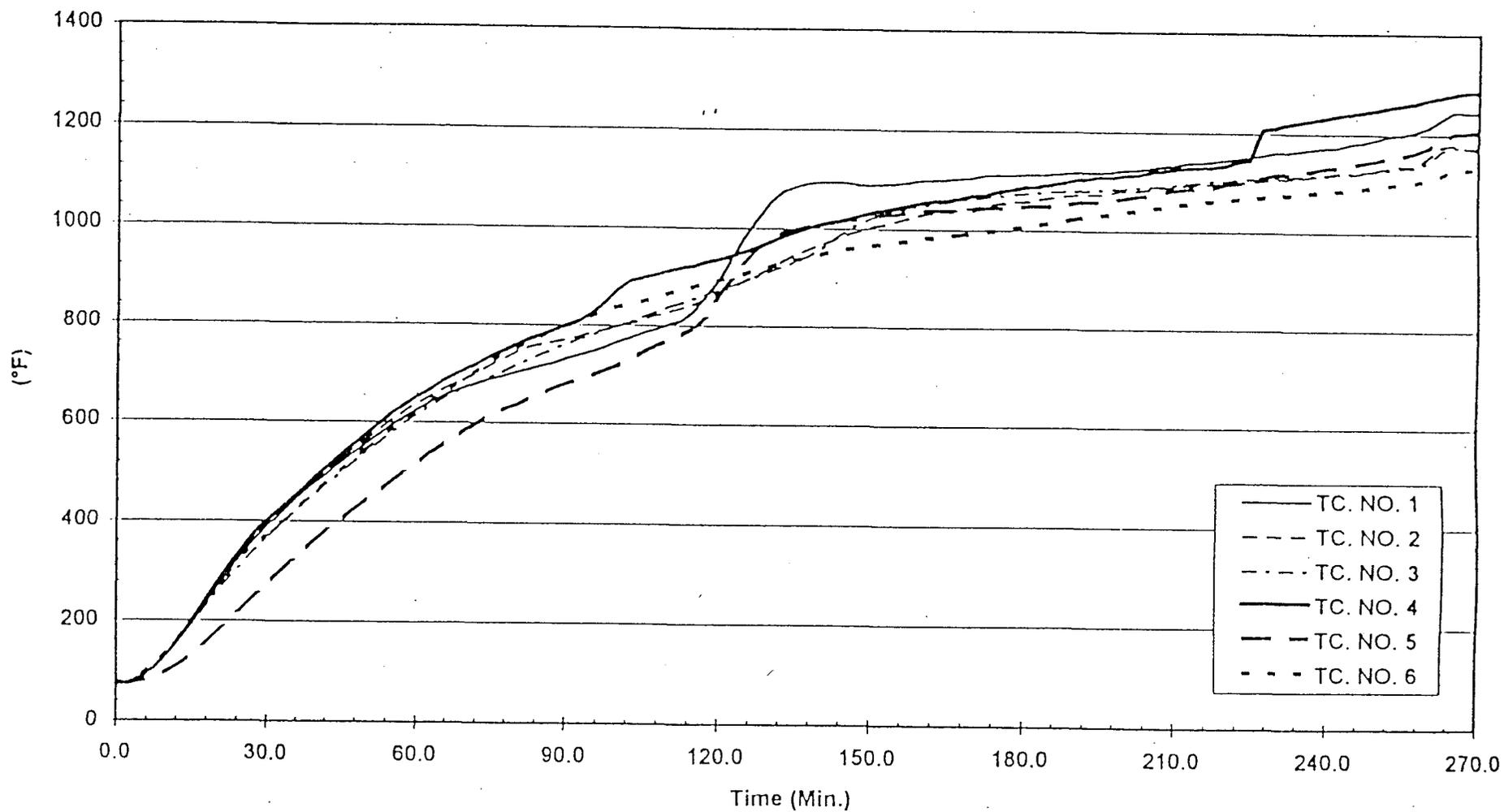
DOW CORNING CORP.
TEST ASSEMBLY NO. 4
FURNACE TEMPERATURES



R8196
ILL. 18

R8196/95NK3179
Test Date : APRIL 28, 1995

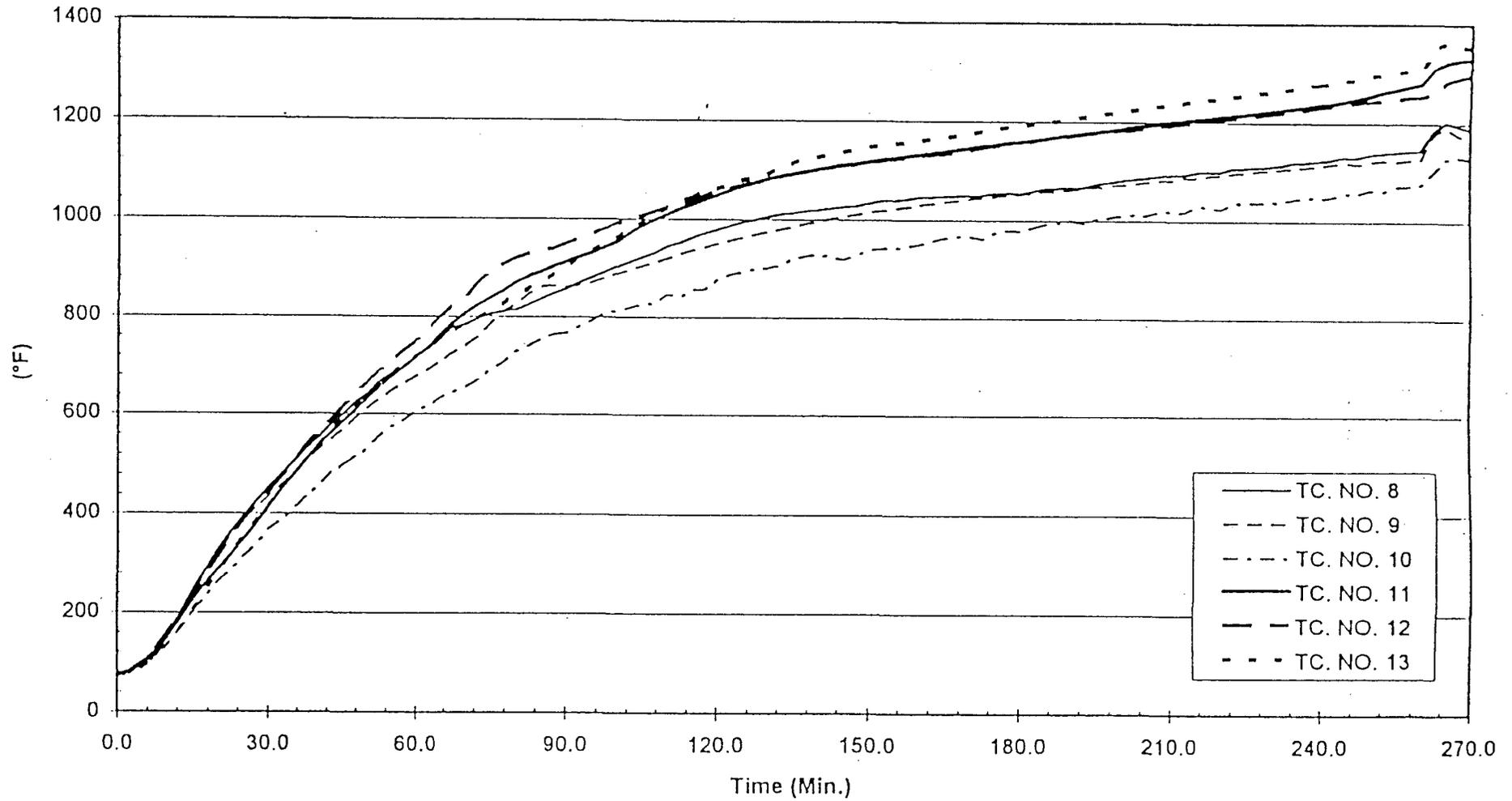
DOW CORNING CORP.
TEST ASSEMBLY NO. 4
OPENING NO. 1



R8195
REV. 19

R8196/95NK3179
Test Date : APRIL 28, 1995

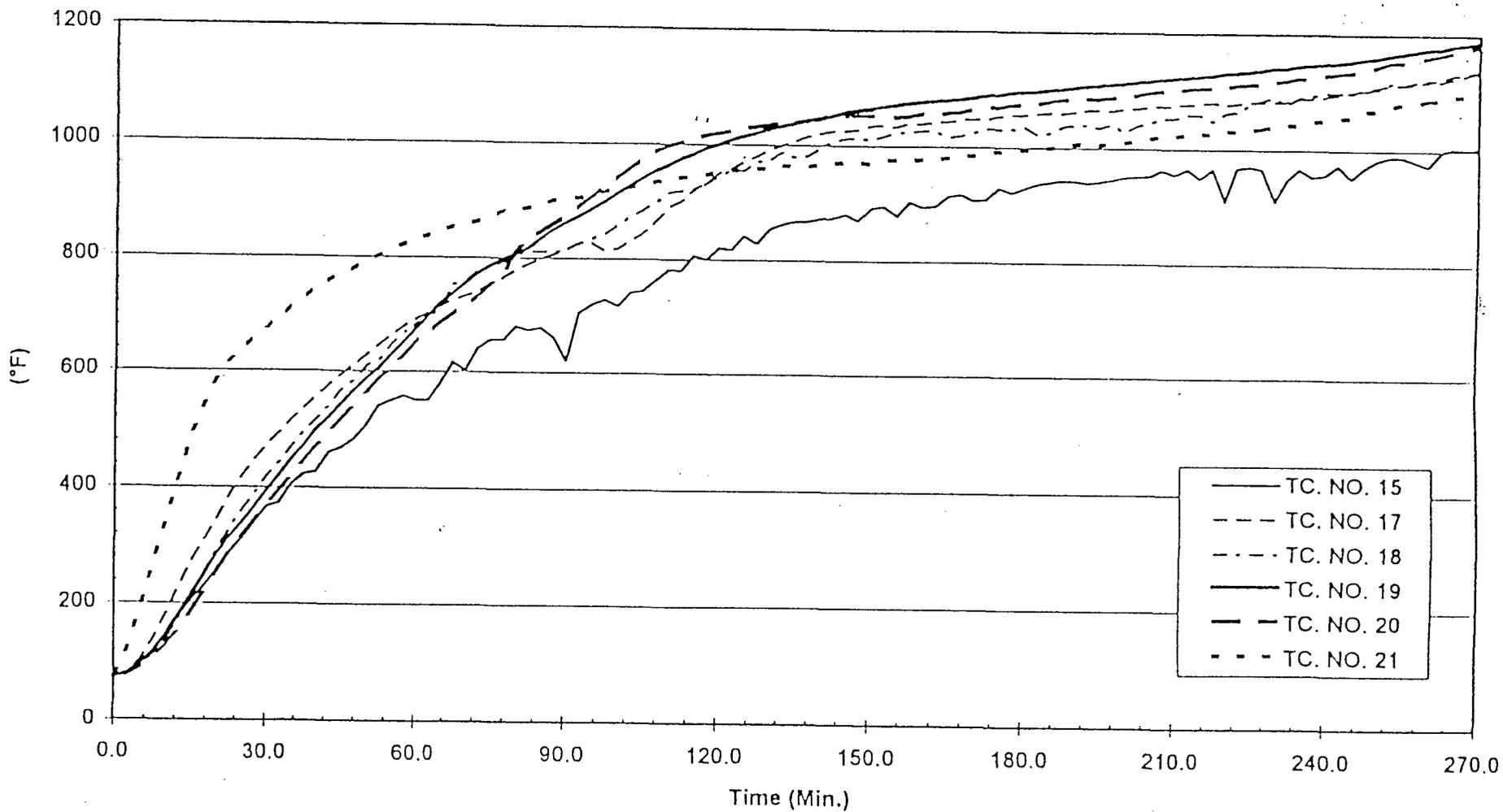
DOW CORNING CORP.
TEST ASSEMBLY NO. 4
OPENING NO. 2



R8195
ILL. 20

R8196/95NK3179
Test Date : APRIL 28, 1995

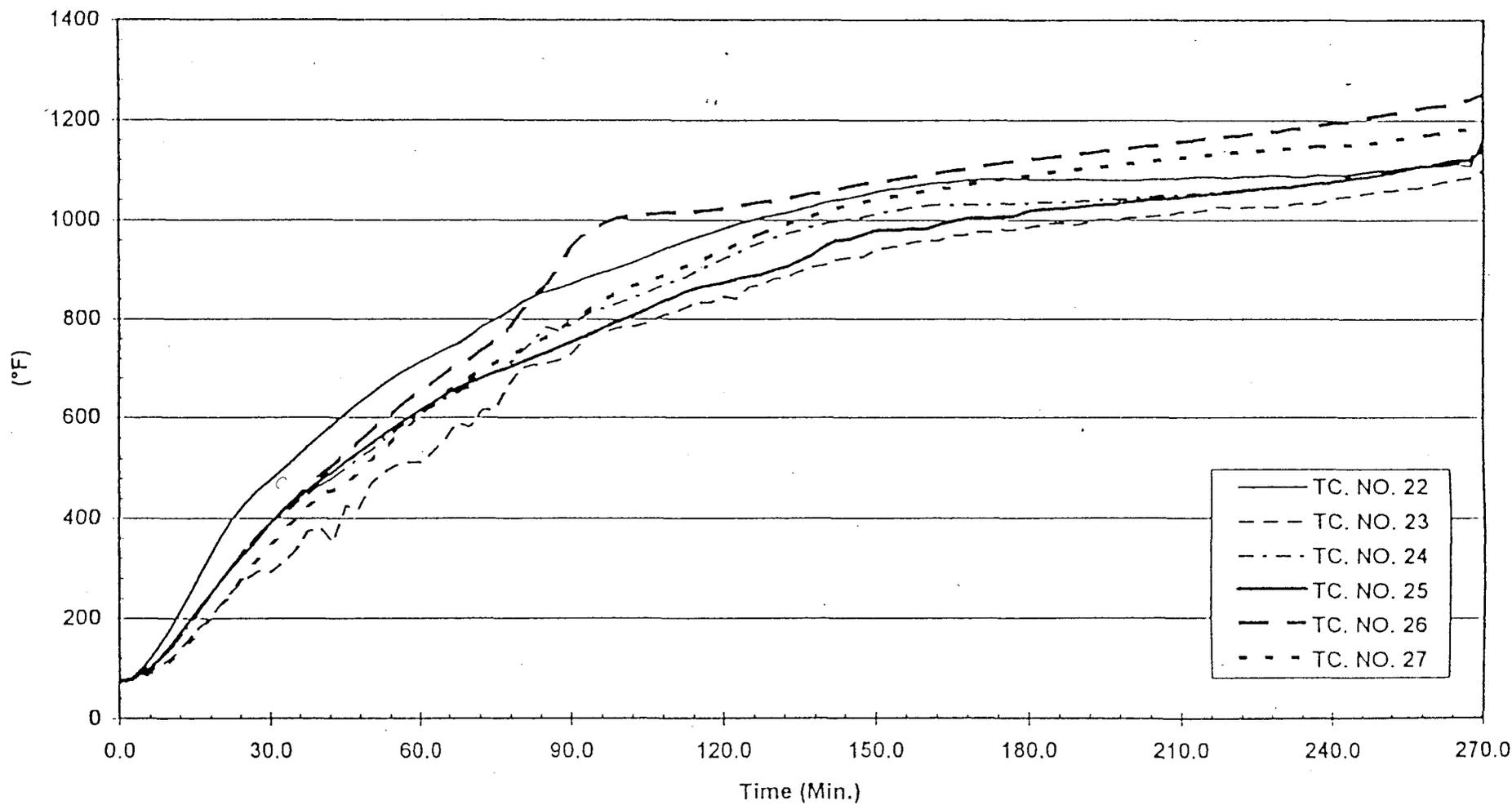
DOW CORNING CORP.
TEST ASSEMBLY NO. 4
OPENING NO. 3



R8196
ILL. 21

R8196/95NK3179
Test Date : APRIL 28, 1995

DOW CORNING CORP.
TEST ASSEMBLY NO. 4
OPENING NO. 4



R8196
ILL. 22

R8196/95NK3179
Test Date : APRIL 28, 1995

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

AVERAGE FURNACE TEMPERATURE, °F

TIME hr:min:sec	
0:00:00	80.8
0:02:30	702.6
0:05:00	990.3
0:07:30	1235.2
0:10:00	1319.1
0:12:30	1380.6
0:15:00	1398.2
0:17:30	1449.0
0:20:00	1481.3
0:22:30	1511.1
0:25:00	1538.8
0:27:30	1530.4
0:30:00	1542.4
0:32:30	1545.2
0:35:00	1579.8
0:37:30	1596.7
0:40:00	1608.7
0:42:30	1623.6
0:45:00	1642.6
0:47:30	1652.2
0:50:00	1668.2
0:52:30	1673.4
0:55:00	1680.1
0:57:30	1682.7
1:00:00	1685.2
1:02:30	1732.0
1:05:00	1728.9
1:07:30	1730.2
1:10:00	1725.4
1:12:30	1765.1
1:15:00	1739.7
1:17:30	1754.4
1:20:00	1759.0
1:22:30	1761.2
1:25:00	1761.7
1:27:30	1757.7
1:30:00	1770.6
1:32:30	1775.9
1:35:00	1783.1
1:37:30	1790.4
1:40:00	1797.5
1:42:30	1802.9
1:45:00	1828.4
1:47:30	1826.1
1:50:00	1826.1
1:52:30	1830.5
1:55:00	1838.8
1:57:30	1843.6

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

AVERAGE FURNACE TEMPERATURE, °F

TIME hr:min:sec	
2:00:00	1845.5
2:02:30	1849.5
2:05:00	1854.7
2:07:30	1854.3
2:10:00	1858.2
2:12:30	1857.8
2:15:00	1861.2
2:17:30	1863.7
2:20:00	1867.5
2:22:30	1868.5
2:25:00	1872.3
2:27:30	1875.0
2:30:00	1897.7
2:32:30	1888.1
2:35:00	1886.0
2:37:30	1896.4
2:40:00	1896.0
2:42:30	1898.1
2:45:00	1898.9
2:47:30	1902.8
2:50:00	1910.5
2:52:30	1912.0
2:55:00	1916.7
2:57:30	1920.8
3:00:00	1922.8
3:02:30	1924.7
3:05:00	1931.4
3:07:30	1932.2
3:10:00	1941.0
3:12:30	1944.6
3:15:00	1945.8
3:17:30	1952.2
3:20:00	1956.2
3:22:30	1960.0
3:25:00	1964.1
3:27:30	1966.2
3:30:00	1967.3
3:32:30	1973.2
3:35:00	1972.3
3:37:30	1978.2
3:40:00	1973.4
3:42:30	1983.8
3:45:00	1984.1
3:47:30	1980.0
3:50:00	1989.3
3:52:30	1986.6
3:55:00	1995.5
3:57:30	1996.4

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

AVERAGE FURNACE TEMPERATURE, °F

TIME hr:min:sec	
4:00:00	1999.1
4:02:30	2001.6
4:05:00	2003.7
4:07:30	2010.9
4:10:00	2013.3
4:12:30	2019.0
4:15:00	2016.4
4:17:30	2032.3
4:20:00	2021.4
4:22:30	2030.5
4:25:00	2028.6
4:27:30	2039.7
4:30:00	2041.7

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	AVGERAGE FURNACE TEMPERATURE °F
0:00:00	108.3
0:02:30	594.7
0:05:00	957.2
0:07:30	1234.8
0:10:00	1327.6
0:12:30	1372.8
0:15:00	1426.2
0:17:30	1463.8
0:20:00	1496.9
0:22:30	1493.6
0:25:00	1520.2
0:27:30	1552.9
0:30:00	1575.2
0:32:30	1596.5
0:35:00	1614.1
0:37:30	1586.5
0:40:00	1603.5
0:42:30	1619.0
0:45:00	1632.8
0:47:30	1641.9
0:50:00	1662.8
0:52:30	1677.0
0:55:00	1681.6
0:57:30	1692.3
1:00:00	1693.8
1:02:30	1710.7
1:05:00	1710.2
1:07:30	1723.4
1:10:00	1721.8
1:12:30	1737.8
1:15:00	1742.0
1:17:30	1737.7
1:20:00	1781.9
1:22:30	1775.7
1:25:00	1766.0
1:27:30	1772.5
1:30:00	1803.3
1:32:30	1809.9
1:35:00	1780.8
1:37:30	1792.1
1:40:00	1789.9
1:42:30	1792.0
1:45:00	1803.2
1:47:30	1835.7
1:50:00	1844.5
1:52:30	1829.1
1:55:00	1837.7
1:57:30	1843.4

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	AVGERAGE FURNACE TEMPERATURE °F
2:00:00	1846.0
2:02:30	1848.2
2:05:00	1859.3
2:07:30	1865.2
2:10:00	1858.7
2:12:30	1883.6
2:15:00	1876.9
2:17:30	1883.6
2:20:00	1879.8
2:22:30	1875.3
2:25:00	1876.4
2:27:30	1886.1
2:30:00	1882.2
2:32:30	1882.8
2:35:00	1891.3
2:37:30	1919.3
2:40:00	1917.8
2:42:30	1912.4
2:45:00	1909.3
2:47:30	1922.8
2:50:00	1919.0
2:52:30	1923.1
2:55:00	1933.1
2:57:30	1930.8
3:00:00	1929.3
3:02:30	1936.6
3:05:00	1944.3
3:07:30	1943.4
3:10:00	1939.3
3:12:30	1949.8
3:15:00	1941.4
3:17:30	1955.2
3:20:00	1961.6
3:22:30	1950.9
3:25:00	1951.7
3:27:30	1966.5
3:30:00	1966.6
3:32:30	1961.4
3:35:00	1978.5
3:37:30	1978.3
3:40:00	1978.1
3:42:30	1982.9
3:45:00	1981.1
3:47:30	1983.6
3:50:00	1992.5
3:52:30	1983.7
3:55:00	1996.2
3:57:30	1988.8

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	AVGERAGE FURNACE TEMPERATURE °F
4:00:00	1998.9
4:02:30	2000.1
4:05:00	2014.4
4:07:30	2004.3
4:10:00	2025.4
4:12:30	2033.1
4:15:00	2025.5
4:17:30	2034.8
4:20:00	2027.8
4:22:30	2045.2
4:25:00	2041.2
4:27:30	2035.4
4:30:00	2037.3

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE °F
0:00:00	78.2
0:02:30	728.0
0:05:00	956.7
0:07:30	1235.2
0:10:00	1327.3
0:12:30	1384.2
0:15:00	1440.2
0:17:30	1438.5
0:20:00	1471.6
0:22:30	1500.8
0:25:00	1514.3
0:27:30	1520.0
0:30:00	1544.2
0:32:30	1560.7
0:35:00	1582.3
0:37:30	1598.1
0:40:00	1614.7
0:42:30	1622.6
0:45:00	1638.6
0:47:30	1655.4
0:50:00	1670.2
0:52:30	1678.8
0:55:00	1672.3
0:57:30	1714.0
1:00:00	1712.2
1:02:30	1717.2
1:05:00	1738.4
1:07:30	1718.0
1:10:00	1713.8
1:12:30	1715.7
1:15:00	1750.8
1:17:30	1753.2
1:20:00	1755.2
1:22:30	1746.0
1:25:00	1740.5
1:27:30	1746.4
1:30:00	1811.8
1:32:30	1811.8
1:35:00	1798.8
1:37:30	1803.5
1:40:00	1802.5
1:42:30	1814.1
1:45:00	1807.9
1:47:30	1816.5
1:50:00	1824.8
1:52:30	1843.8
1:55:00	1852.2
1:57:30	1846.2

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE °F
2:00:00	1858.9
2:02:30	1848.8
2:05:00	1856.1
2:07:30	1872.2
2:10:00	1875.9
2:12:30	1860.1
2:15:00	1857.4
2:17:30	1870.3
2:20:00	1874.3
2:22:30	1870.2
2:25:00	1862.2
2:27:30	1870.1
2:30:00	1873.6
2:32:30	1867.4
2:35:00	1886.0
2:37:30	1882.9
2:40:00	1875.9
2:42:30	1928.2
2:45:00	1911.9
2:47:30	1898.0
2:50:00	1911.6
2:52:30	1911.7
2:55:00	1918.0
2:57:30	1914.6
3:00:00	1937.7
3:02:30	1920.9
3:05:00	1932.1
3:07:30	1931.0
3:10:00	1924.8
3:12:30	1937.7
3:15:00	1930.4
3:17:30	1946.0
3:20:00	1941.0
3:22:30	1953.7
3:25:00	1953.4
3:27:30	1956.1
3:30:00	1958.2
3:32:30	1975.8
3:35:00	1963.1
3:37:30	1975.9
3:40:00	1988.5
3:42:30	1970.7
3:45:00	1985.2
3:47:30	1991.5
3:50:00	1994.0
3:52:30	1993.7
3:55:00	2000.4
3:57:30	1997.2

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hr:min:sec	AVERAGE FURNACE TEMPERATURE °F
4:00:00	2004.6
4:02:30	1996.3
4:05:00	2004.8
4:07:30	2007.5
4:10:00	2002.9
4:12:30	2026.3
4:15:00	2031.0
4:17:30	2024.8
4:20:00	2028.1
4:22:30	2031.5
4:25:00	2034.1
4:27:30	2047.0
4:30:00	2061.6

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	AVERAGE FURNACE TEMPERATRUE °F
0:00:00	77.9
0:02:30	668.2
0:05:00	961.2
0:07:30	1219.2
0:10:00	1319.6
0:12:30	1345.5
0:15:00	1419.2
0:17:30	1489.1
0:20:00	1501.9
0:22:30	1505.0
0:25:00	1533.8
0:27:30	1520.0
0:30:00	1545.6
0:32:30	1569.6
0:35:00	1587.6
0:37:30	1605.3
0:40:00	1617.8
0:42:30	1632.0
0:45:00	1634.9
0:47:30	1655.6
0:50:00	1667.9
0:52:30	1678.1
0:55:00	1688.3
0:57:30	1696.7
1:00:00	1705.4
1:02:30	1712.4
1:05:00	1719.5
1:07:30	1723.0
1:10:00	1719.3
1:12:30	1726.0
1:15:00	1776.6
1:17:30	1757.6
1:20:00	1752.7
1:22:30	1761.2
1:25:00	1761.1
1:27:30	1811.1
1:30:00	1797.7
1:32:30	1786.2
1:35:00	1800.6
1:37:30	1805.0
1:40:00	1819.9
1:42:30	1810.6
1:45:00	1828.3
1:47:30	1828.3
1:50:00	1827.5
1:52:30	1834.4
1:55:00	1844.6
1:57:30	1836.5

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	AVERAGE FURNACE TEMPERATRUE °F
2:00:00	1855.3
2:02:30	1863.1
2:05:00	1852.9
2:07:30	1863.3
2:10:00	1865.5
2:12:30	1859.0
2:15:00	1867.4
2:17:30	1869.5
2:20:00	1869.2
2:22:30	1880.8
2:25:00	1873.8
2:27:30	1879.3
2:30:00	1881.9
2:32:30	1881.2
2:35:00	1894.5
2:37:30	1889.4
2:40:00	1888.1
2:42:30	1893.8
2:45:00	1912.0
2:47:30	1901.0
2:50:00	1904.9
2:52:30	1919.3
2:55:00	1913.4
2:57:30	1918.6
3:00:00	1922.3
3:02:30	1925.4
3:05:00	1923.0
3:07:30	1928.1
3:10:00	1935.6
3:12:30	1931.4
3:15:00	1940.0
3:17:30	1947.4
3:20:00	1942.1
3:22:30	1960.8
3:25:00	1954.4
3:27:30	1956.2
3:30:00	1972.5
3:32:30	1962.0
3:35:00	1978.3
3:37:30	1968.5
3:40:00	1984.9
3:42:30	1974.4
3:45:00	1994.3
3:47:30	1989.4
3:50:00	1984.9
3:52:30	1998.4
3:55:00	2006.2
3:57:30	2003.5

APPENDIX A
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	AVERAGE FURNACE TEMPERATRUE °F
4:00:00	2021.7
4:02:30	2015.1
4:05:00	2039.3
4:07:30	2044.4
4:10:00	2054.3
4:12:30	2054.7
4:15:00	2064.4
4:17:30	2070.7
4:20:00	2073.9
4:22:30	2086.0
4:25:00	2079.0
4:27:30	2070.3
4:30:00	2080.6

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.035	0.021
4:02:30	0.035	0.021
4:05:00	0.036	0.022
4:07:30	0.036	0.022
4:10:00	0.035	0.021
4:12:30	0.035	0.021
4:15:00	0.036	0.021
4:17:30	0.036	0.022
4:20:00	0.037	0.022
4:22:30	0.036	0.022
4:25:00	0.036	0.022
4:27:30	0.036	0.022
4:30:00	0.036	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.164	0.146
0:02:30	0.027	0.015
0:05:00	0.028	0.015
0:07:30	0.030	0.017
0:10:00	0.030	0.017
0:12:30	0.031	0.017
0:15:00	0.031	0.018
0:17:30	0.032	0.019
0:20:00	0.032	0.019
0:22:30	0.032	0.019
0:25:00	0.032	0.018
0:27:30	0.032	0.019
0:30:00	0.032	0.019
0:32:30	0.033	0.019
0:35:00	0.032	0.019
0:37:30	0.033	0.019
0:40:00	0.033	0.019
0:42:30	0.033	0.020
0:45:00	0.034	0.019
0:47:30	0.034	0.020
0:50:00	0.034	0.020
0:52:30	0.034	0.020
0:55:00	0.034	0.019
0:57:30	0.034	0.020
1:00:00	0.034	0.021
1:02:30	0.035	0.021
1:05:00	0.034	0.021
1:07:30	0.035	0.021
1:10:00	0.035	0.021
1:12:30	0.035	0.021
1:15:00	0.035	0.020
1:17:30	0.035	0.021
1:20:00	0.036	0.021
1:22:30	0.035	0.021
1:25:00	0.035	0.021
1:27:30	0.035	0.021
1:30:00	0.035	0.021
1:32:30	0.036	0.021
1:35:00	0.035	0.021
1:37:30	0.035	0.022
1:40:00	0.036	0.021
1:42:30	0.035	0.022
1:45:00	0.036	0.021
1:47:30	0.036	0.022
1:50:00	0.035	0.022
1:52:30	0.036	0.022
1:55:00	0.036	0.021
1:57:30	0.036	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.036	0.022
2:02:30	0.036	0.022
2:05:00	0.036	0.022
2:07:30	0.036	0.022
2:10:00	0.036	0.023
2:12:30	0.036	0.022
2:15:00	0.037	0.022
2:17:30	0.036	0.022
2:20:00	0.036	0.022
2:22:30	0.036	0.023
2:25:00	0.036	0.022
2:27:30	0.037	0.022
2:30:00	0.037	0.022
2:32:30	0.036	0.022
2:35:00	0.036	0.022
2:37:30	0.036	0.022
2:40:00	0.037	0.023
2:42:30	0.037	0.022
2:45:00	0.036	0.022
2:47:30	0.037	0.023
2:50:00	0.037	0.023
2:52:30	0.037	0.023
2:55:00	0.037	0.023
2:57:30	0.037	0.023
3:00:00	0.037	0.022
3:02:30	0.037	0.023
3:05:00	0.037	0.023
3:07:30	0.038	0.023
3:10:00	0.037	0.023
3:12:30	0.037	0.023
3:15:00	0.037	0.022
3:17:30	0.037	0.022
3:20:00	0.037	0.023
3:22:30	0.037	0.023
3:25:00	0.037	0.022
3:27:30	0.037	0.023
3:30:00	0.037	0.023
3:32:30	0.038	0.022
3:35:00	0.037	0.022
3:37:30	0.037	0.023
3:40:00	0.038	0.023
3:42:30	0.037	0.022
3:45:00	0.037	0.023
3:47:30	0.037	0.023
3:50:00	0.037	0.023
3:52:30	0.038	0.023
3:55:00	0.038	0.023
3:57:30	0.038	0.023

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 2

FURNACE PRESSURES, INCHES OF WATER
TC. NO. 56 TC. NO. 57

0.037	0.023
0.037	0.023
0.038	0.023
0.038	0.023
0.038	0.024
0.038	0.023
0.038	0.023
0.038	0.023
0.038	0.023
0.038	0.023
0.038	0.023
0.038	0.023
0.037	0.023
0.038	0.023

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hh:mm:ss	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.019	0.009
0:02:30	0.025	0.007
0:05:00	0.027	0.007
0:07:30	0.028	0.007
0:10:00	0.029	0.007
0:12:30	0.031	0.007
0:15:00	0.030	0.007
0:17:30	0.030	0.007
0:20:00	0.031	0.006
0:22:30	0.031	0.007
0:25:00	0.029	0.007
0:27:30	0.030	0.007
0:30:00	0.031	0.007
0:32:30	0.032	0.008
0:35:00	0.031	0.009
0:37:30	0.032	0.010
0:40:00	0.032	0.012
0:42:30	0.032	0.014
0:45:00	0.032	0.016
0:47:30	0.032	0.018
0:50:00	0.032	0.019
0:52:30	0.033	0.018
0:55:00	0.032	0.019
0:57:30	0.033	0.019
1:00:00	0.033	0.019
1:02:30	0.033	0.019
1:05:00	0.033	0.019
1:07:30	0.033	0.019
1:10:00	0.033	0.019
1:12:30	0.033	0.019
1:15:00	0.033	0.019
1:17:30	0.033	0.019
1:20:00	0.033	0.020
1:22:30	0.034	0.020
1:25:00	0.033	0.020
1:27:30	0.033	0.020
1:30:00	0.034	0.020
1:32:30	0.034	0.020
1:35:00	0.034	0.021
1:37:30	0.033	0.020
1:40:00	0.034	0.020
1:42:30	0.034	0.021
1:45:00	0.034	0.021
1:47:30	0.034	0.020
1:50:00	0.035	0.020
1:52:30	0.034	0.020
1:55:00	0.034	0.021
1:57:30	0.034	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hh:mm:ss	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.034	0.020
2:02:30	0.034	0.021
2:05:00	0.035	0.020
2:07:30	0.035	0.021
2:10:00	0.035	0.020
2:12:30	0.034	0.020
2:15:00	0.035	0.020
2:17:30	0.034	0.020
2:20:00	0.035	0.020
2:22:30	0.034	0.020
2:25:00	0.035	0.020
2:27:30	0.034	0.020
2:30:00	0.035	0.021
2:32:30	0.035	0.021
2:35:00	0.035	0.021
2:37:30	0.035	0.020
2:40:00	0.035	0.021
2:42:30	0.035	0.020
2:45:00	0.035	0.020
2:47:30	0.035	0.021
2:50:00	0.035	0.020
2:52:30	0.034	0.020
2:55:00	0.035	0.021
2:57:30	0.035	0.021
3:00:00	0.035	0.020
3:02:30	0.035	0.021
3:05:00	0.035	0.021
3:07:30	0.035	0.020
3:10:00	0.035	0.021
3:12:30	0.036	0.020
3:15:00	0.035	0.020
3:17:30	0.035	0.020
3:20:00	0.035	0.021
3:22:30	0.035	0.021
3:25:00	0.035	0.021
3:27:30	0.036	0.021
3:30:00	0.035	0.020
3:32:30	0.035	0.020
3:35:00	0.035	0.021
3:37:30	0.035	0.020
3:40:00	0.036	0.020
3:42:30	0.036	0.021
3:45:00	0.036	0.021
3:47:30	0.036	0.020
3:50:00	0.036	0.021
3:52:30	0.036	0.021
3:55:00	0.036	0.021
3:57:30	0.036	0.020

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 3

TIME hh:mm:ss	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.036	0.021
4:02:30	0.036	0.021
4:05:00	0.036	0.021
4:07:30	0.036	0.021
4:10:00	0.036	0.020
4:12:30	0.036	0.021
4:15:00	0.036	0.021
4:17:30	0.036	0.021
4:20:00	0.036	0.021
4:22:30	0.036	0.021
4:25:00	0.036	0.021
4:27:30	0.036	0.020
4:30:00	0.037	0.021

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
0:00:00	0.028	0.017
0:02:30	0.025	0.014
0:05:00	0.026	0.014
0:07:30	0.028	0.016
0:10:00	0.029	0.017
0:12:30	0.031	0.017
0:15:00	0.028	0.017
0:17:30	0.030	0.018
0:20:00	0.030	0.017
0:22:30	0.031	0.019
0:25:00	0.032	0.019
0:27:30	0.031	0.019
0:30:00	0.031	0.019
0:32:30	0.031	0.019
0:35:00	0.032	0.020
0:37:30	0.033	0.020
0:40:00	0.032	0.020
0:42:30	0.032	0.020
0:45:00	0.032	0.020
0:47:30	0.032	0.020
0:50:00	0.033	0.020
0:52:30	0.033	0.021
0:55:00	0.033	0.020
0:57:30	0.032	0.021
1:00:00	0.033	0.020
1:02:30	0.033	0.021
1:05:00	0.033	0.021
1:07:30	0.033	0.021
1:10:00	0.033	0.020
1:12:30	0.034	0.021
1:15:00	0.034	0.021
1:17:30	0.034	0.022
1:20:00	0.033	0.021
1:22:30	0.034	0.022
1:25:00	0.035	0.021
1:27:30	0.035	0.022
1:30:00	0.035	0.022
1:32:30	0.035	0.022
1:35:00	0.035	0.022
1:37:30	0.036	0.022
1:40:00	0.034	0.021
1:42:30	0.035	0.022
1:45:00	0.035	0.022
1:47:30	0.035	0.022
1:50:00	0.035	0.022
1:52:30	0.035	0.022
1:55:00	0.036	0.022
1:57:30	0.035	0.022

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.035	0.022
2:02:30	0.036	0.023
2:05:00	0.036	0.023
2:07:30	0.036	0.023
2:10:00	0.036	0.023
2:12:30	0.036	0.022
2:15:00	0.035	0.022
2:17:30	0.036	0.022
2:20:00	0.036	0.023
2:22:30	0.036	0.022
2:25:00	0.036	0.022
2:27:30	0.036	0.022
2:30:00	0.036	0.023
2:32:30	0.036	0.023
2:35:00	0.036	0.022
2:37:30	0.037	0.023
2:40:00	0.036	0.022
2:42:30	0.036	0.023
2:45:00	0.037	0.022
2:47:30	0.036	0.022
2:50:00	0.036	0.023
2:52:30	0.036	0.022
2:55:00	0.036	0.023
2:57:30	0.036	0.023
3:00:00	0.037	0.023
3:02:30	0.036	0.023
3:05:00	0.036	0.023
3:07:30	0.036	0.023
3:10:00	0.036	0.022
3:12:30	0.037	0.023
3:15:00	0.037	0.023
3:17:30	0.037	0.023
3:20:00	0.037	0.023
3:22:30	0.037	0.023
3:25:00	0.037	0.023
3:27:30	0.037	0.023
3:30:00	0.037	0.023
3:32:30	0.037	0.024
3:35:00	0.037	0.023
3:37:30	0.037	0.023
3:40:00	0.038	0.023
3:42:30	0.037	0.023
3:45:00	0.037	0.024
3:47:30	0.037	0.023
3:50:00	0.037	0.023
3:52:30	0.037	0.023
3:55:00	0.037	0.023
3:57:30	0.038	0.023

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
4:00:00	0.037	0.023
4:02:30	0.037	0.023
4:05:00	0.038	0.024
4:07:30	0.038	0.024
4:10:00	0.038	0.025
4:12:30	0.038	0.024
4:15:00	0.038	0.023
4:17:30	0.038	0.024
4:20:00	0.039	0.024
4:22:30	0.038	0.023
4:25:00	0.038	0.023
4:27:30	0.038	0.024
4:30:00	0.038	0.024

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	74.7	74.6	74.9	74.9	75.2	75.2
0:02:30	77.2	79.1	78.0	79.3	79.9	79.3
0:05:00	90.3	94.5	92.5	95.3	92.5	92.1
0:07:30	111.2	116.5	116.1	119.6	107.4	109.8
0:10:00	140.5	146.0	149.4	153.9	128.7	136.2
0:12:30	174.6	180.2	187.1	192.5	154.9	170.6
0:15:00	211.0	218.1	230.8	236.8	182.9	205.9
0:17:30	243.9	256.0	273.7	276.1	211.3	241.5
0:20:00	276.7	293.1	307.8	287.5	239.3	275.1
0:22:30	307.9	328.8	337.0	235.2	266.4	242.4
0:25:00	337.3	363.0	342.6	221.1	294.0	245.5
0:27:30	366.1	397.2	354.4	257.6	321.8	273.5
0:30:00	394.1	429.3	366.5	272.8	348.6	292.4
0:32:30	419.3	455.4	379.2	301.8	374.2	337.3
0:35:00	443.3	478.9	404.1	318.5	399.8	363.5
0:37:30	466.7	502.0	433.0	325.2	425.2	390.0
0:40:00	488.3	523.5	465.0	334.7	446.7	428.4
0:42:30	507.7	543.1	493.8	342.0	469.1	467.6
0:45:00	528.5	562.7	523.4	344.9	491.0	503.4
0:47:30	548.9	583.6	551.7	354.7	512.8	536.6
0:50:00	571.0	604.6	577.9	356.7	535.1	567.5
0:52:30	592.8	626.1	606.6	364.3	557.6	599.6
0:55:00	614.5	647.9	631.9	372.1	580.0	630.1
0:57:30	634.2	667.9	655.0	472.7	601.5	659.4
1:00:00	651.8	685.8	675.2	557.4	621.7	686.4
1:02:30	667.8	701.9	692.2	638.8	640.9	709.6
1:05:00	682.6	720.5	713.0	704.6	659.9	729.7
1:07:30	696.6	744.9	733.6	753.7	678.2	748.6
1:10:00	711.2	778.3	756.2	791.3	696.7	767.5
1:12:30	726.8	799.0	772.5	820.5	715.1	786.3
1:15:00	742.8	813.6	787.9	840.8	732.7	801.7
1:17:30	757.3	833.9	802.7	851.9	749.4	817.1
1:20:00	769.1	853.0	821.0	866.5	766.6	838.0
1:22:30	785.2	861.9	836.2	878.9	784.1	854.9
1:25:00	801.3	870.4	847.7	886.8	799.1	867.2
1:27:30	814.2	876.1	858.8	894.2	813.3	878.6
1:30:00	824.7	884.5	869.2	901.9	828.9	889.7
1:32:30	835.1	893.5	880.5	911.0	839.4	900.6
1:35:00	845.6	901.8	893.8	920.5	852.6	912.4
1:37:30	857.6	910.5	905.4	930.9	866.5	924.2
1:40:00	870.2	919.7	915.9	941.0	879.2	935.5
1:42:30	882.5	931.3	926.4	951.9	890.4	946.7
1:45:00	894.6	942.5	936.5	962.4	901.6	956.9
1:47:30	907.0	954.8	946.9	973.3	912.4	966.7
1:50:00	919.6	966.2	957.6	983.5	922.5	976.2
1:52:30	931.6	975.6	967.5	993.4	932.2	985.2
1:55:00	943.4	983.4	976.8	1002.1	939.8	993.6
1:57:30	955.5	990.6	986.3	1010.2	947.6	1002.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
2:00:00	966.7	996.7	995.9	1017.4	954.4	1010.1
2:02:30	976.5	1001.9	1004.6	1024.2	961.3	1017.6
2:05:00	985.5	1007.3	1012.9	1029.7	968.1	1024.8
2:07:30	993.3	1013.0	1022.5	1035.5	974.7	1031.8
2:10:00	1000.5	1019.7	1030.9	1040.4	981.3	1038.3
2:12:30	1005.4	1023.7	1037.3	1044.2	986.7	1043.7
2:15:00	1011.4	1026.8	1042.9	1048.1	992.6	1049.6
2:17:30	1017.5	1029.7	1048.1	1052.9	999.3	1054.7
2:20:00	1022.3	1031.7	1053.0	1057.5	1004.3	1060.5
2:22:30	1028.4	1034.3	1058.4	1061.9	1010.0	1065.0
2:25:00	1032.4	1036.6	1062.4	1065.4	1015.3	1069.4
2:27:30	1034.9	1038.0	1065.4	1067.9	1020.5	1073.9
2:30:00	1036.5	1037.8	1067.0	1069.9	1024.3	1078.1
2:32:30	1040.4	1040.9	1071.4	1073.4	1028.8	1081.9
2:35:00	1044.2	1043.6	1075.4	1077.9	1033.5	1086.2
2:37:30	1046.1	1045.7	1078.8	1080.3	1037.6	1089.1
2:40:00	1050.7	1048.1	1082.7	1083.9	1042.3	1093.1
2:42:30	1052.7	1049.4	1084.7	1086.1	1046.3	1096.0
2:45:00	1057.0	1051.9	1088.2	1090.0	1050.5	1099.0
2:47:30	1059.9	1053.9	1090.9	1093.1	1054.5	1102.0
2:50:00	1063.3	1055.8	1093.4	1096.2	1061.9	1105.2
2:52:30	1068.4	1059.6	1097.6	1100.2	1070.1	1108.3
2:55:00	1070.5	1061.2	1098.7	1102.3	1075.0	1111.2
2:57:30	1074.1	1063.2	1101.7	1105.6	1079.6	1114.0
3:00:00	1077.0	1065.4	1103.5	1108.4	1083.1	1117.2
3:02:30	1080.4	1068.2	1106.3	1111.9	1087.0	1120.1
3:05:00	1083.5	1070.3	1109.2	1115.1	1090.5	1123.0
3:07:30	1086.1	1073.2	1112.8	1118.6	1094.0	1126.1
3:10:00	1086.9	1074.5	1113.7	1120.1	1095.8	1128.9
3:12:30	1089.7	1076.8	1116.5	1123.2	1098.8	1131.7
3:15:00	1093.0	1079.6	1119.5	1126.7	1101.9	1134.6
3:17:30	1096.1	1081.9	1122.5	1129.6	1105.4	1137.7
3:20:00	1098.0	1084.3	1125.7	1131.9	1107.9	1140.2
3:22:30	1101.2	1086.7	1128.4	1134.9	1111.0	1143.2
3:25:00	1104.4	1089.7	1132.3	1137.9	1114.0	1146.0
3:27:30	1106.7	1091.7	1134.6	1140.4	1117.1	1148.7
3:30:00	1109.4	1093.3	1136.7	1143.4	1119.2	1150.9
3:32:30	1110.7	1096.5	1139.2	1145.6	1121.5	1153.3
3:35:00	1112.7	1098.5	1141.9	1147.7	1124.3	1155.7
3:37:30	1114.3	1100.6	1144.4	1149.8	1126.1	1157.7
3:40:00	1117.1	1102.6	1146.3	1152.6	1128.1	1159.8
3:42:30	1118.2	1104.1	1147.4	1153.8	1129.7	1161.5
3:45:00	1119.6	1104.8	1148.8	1155.4	1131.3	1163.6
3:47:30	1121.5	1107.1	1150.5	1157.5	1133.4	1165.0
3:50:00	1123.0	1108.5	1153.0	1158.8	1135.3	1166.7
3:52:30	1124.9	1110.6	1155.5	1160.5	1137.2	1168.5
3:55:00	1125.5	1111.7	1157.3	1161.1	1138.4	1169.7
3:57:30	1127.0	1113.2	1159.1	1162.3	1140.3	1171.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
hr:min:sec						
4:00:00	1127.5	1114.6	1160.8	1163.2	1141.4	1171.3
4:02:30	1129.4	1116.0	1162.6	1164.6	1143.1	1172.8
4:05:00	1131.2	1117.6	1165.0	1166.3	1145.0	1174.5
4:07:30	1133.3	1119.5	1167.3	1168.1	1147.2	1176.1
4:10:00	1135.5	1121.4	1169.6	1169.8	1149.1	1177.4
4:12:30	1138.0	1123.3	1172.0	1172.1	1151.6	1178.8
4:15:00	1141.0	1125.9	1175.1	1175.0	1154.3	1181.0
4:17:30	1141.3	1127.4	1176.8	1174.9	1155.9	1182.4
4:20:00	1144.2	1128.8	1178.5	1177.2	1157.9	1183.6
4:22:30	1145.4	1129.8	1180.1	1178.0	1159.2	1184.7
4:25:00	1146.8	1131.6	1182.0	1179.4	1161.3	1186.1
4:27:30	1148.1	1132.5	1184.0	1180.3	1160.6	1187.4
4:30:00	1150.6	1135.5	1188.5	1189.3	1163.6	376.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	73.9	75.0	75.2	75.2	75.0	75.2
0:02:30	121.2	76.8	76.9	77.1	76.5	78.1
0:05:00	184.3	88.1	88.7	88.1	84.8	88.3
0:07:30	252.9	107.6	108.5	106.9	99.2	102.4
0:10:00	325.5	137.5	136.8	134.4	121.4	123.0
0:12:30	391.9	174.9	170.2	167.8	149.6	147.7
0:15:00	449.6	211.1	206.0	202.2	180.7	186.4
0:17:30	500.3	244.1	240.2	237.8	211.3	199.8
0:20:00	543.5	275.9	241.4	273.3	240.7	212.0
0:22:30	584.4	305.8	267.7	303.8	269.2	231.9
0:25:00	619.6	333.0	298.5	322.2	296.8	251.6
0:27:30	646.1	358.5	341.0	270.8	322.0	267.0
0:30:00	668.2	383.9	390.5	271.5	345.8	284.4
0:32:30	686.5	407.2	426.1	275.3	367.4	309.8
0:35:00	705.3	429.1	455.3	280.3	392.3	336.1
0:37:30	723.1	450.8	477.2	287.4	414.1	377.2
0:40:00	738.0	471.5	498.2	296.0	435.2	399.7
0:42:30	751.2	489.5	518.2	300.4	453.3	427.0
0:45:00	762.8	508.4	537.0	303.4	472.1	446.7
0:47:30	776.4	527.6	556.0	326.2	491.4	470.6
0:50:00	786.9	547.1	574.2	315.1	509.7	493.3
0:52:30	797.1	566.7	591.9	312.8	527.7	516.2
0:55:00	807.3	586.3	609.1	330.4	545.0	539.4
0:57:30	813.8	604.3	625.0	392.5	562.3	560.2
1:00:00	820.1	620.9	639.8	451.3	578.6	577.2
1:02:30	827.9	635.8	653.5	500.8	593.2	593.2
1:05:00	838.1	652.6	666.8	548.8	608.6	612.5
1:07:30	846.7	671.9	680.6	593.6	623.4	627.8
1:10:00	854.0	691.4	695.9	634.3	637.7	645.9
1:12:30	861.7	704.9	712.9	671.4	651.0	665.5
1:15:00	869.1	716.4	734.5	704.2	663.8	687.4
1:17:30	879.0	726.4	768.6	729.7	675.6	707.1
1:20:00	885.8	737.2	822.4	746.3	689.6	729.1
1:22:30	887.5	748.5	868.5	760.2	700.6	749.8
1:25:00	889.1	761.9	899.7	773.7	712.6	768.5
1:27:30	891.3	778.7	924.6	789.1	728.1	785.5
1:30:00	898.2	795.0	937.5	799.7	743.8	808.4
1:32:30	902.0	806.6	955.8	808.6	755.9	828.4
1:35:00	907.6	821.0	974.7	817.0	766.5	857.3
1:37:30	911.8	843.7	994.1	825.3	778.4	864.9
1:40:00	919.1	871.8	1011.1	836.3	787.5	877.3
1:42:30	924.8	909.2	1026.0	847.0	799.1	892.0
1:45:00	930.2	936.3	1039.6	857.6	811.6	903.2
1:47:30	937.6	954.4	1054.5	866.3	824.3	918.8
1:50:00	941.3	969.8	1067.5	875.4	837.7	932.6
1:52:30	946.2	980.4	1075.8	882.9	850.8	950.4
1:55:00	950.0	990.6	1082.8	897.2	864.8	953.1
1:57:30	953.7	998.7	1089.7	909.5	878.7	959.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
2:00:00	958.6	1004.6	1092.7	918.8	891.5	969.7
2:02:30	962.4	1009.5	1096.4	927.4	903.8	979.1
2:05:00	965.3	1012.7	1100.0	937.0	914.8	987.4
2:07:30	969.0	1014.4	1103.3	944.4	924.3	995.1
2:10:00	967.8	1014.3	1105.4	948.8	931.1	1000.9
2:12:30	969.5	1015.5	1106.1	955.0	940.6	1007.1
2:15:00	973.4	1016.2	1105.2	959.9	950.0	1012.6
2:17:30	975.3	1017.2	1106.1	963.2	957.9	1017.3
2:20:00	979.8	1021.3	1105.4	970.7	967.0	1021.7
2:22:30	984.2	1023.1	1106.5	974.4	973.5	1026.6
2:25:00	984.5	1022.1	1108.3	976.9	970.5	1030.8
2:27:30	986.2	1024.0	1111.1	978.8	968.6	1033.9
2:30:00	990.4	1028.6	1110.8	984.3	981.3	1037.0
2:32:30	995.0	1030.5	1114.5	986.5	982.5	1042.1
2:35:00	998.4	1032.5	1117.7	988.0	979.8	1046.2
2:37:30	1000.8	1034.9	1118.8	993.0	984.2	1049.8
2:40:00	1003.1	1039.6	1121.7	995.2	987.7	1054.6
2:42:30	1006.0	1041.6	1122.4	1000.9	997.5	1058.0
2:45:00	1010.0	1043.3	1124.6	1001.9	996.2	1062.2
2:47:30	1013.8	1048.7	1125.0	1005.9	1001.9	1066.2
2:50:00	1017.7	1049.6	1120.0	1006.8	1007.3	1069.9
2:52:30	1018.6	1049.8	1121.5	1007.9	1017.1	1074.0
2:55:00	1021.8	1054.1	1121.2	1011.4	1020.7	1077.4
2:57:30	1024.3	1055.8	1121.2	1016.1	1028.4	1081.3
3:00:00	1027.5	1062.4	1122.6	1019.1	1029.4	1084.8
3:02:30	1030.9	1065.2	1124.3	1018.7	1034.8	1088.9
3:05:00	1033.4	1068.4	1126.3	1024.0	1034.6	1092.9
3:07:30	1036.0	1068.8	1127.7	1020.8	1034.7	1096.1
3:10:00	1040.0	1068.9	1126.9	1021.3	1041.0	1098.1
3:12:30	1043.1	1073.1	1128.7	1021.6	1041.5	1101.2
3:15:00	1047.0	1075.9	1130.9	1025.5	1042.6	1104.2
3:17:30	1049.0	1078.6	1132.8	1028.4	1045.4	1107.6
3:20:00	1052.3	1084.8	1134.6	1038.6	1043.0	1111.2
3:22:30	1055.8	1086.5	1138.0	1035.2	1046.5	1113.6
3:25:00	1058.4	1092.2	1138.6	1040.1	1055.9	1117.7
3:27:30	1058.3	1092.4	1140.1	1041.3	1055.6	1121.3
3:30:00	1061.4	1091.4	1142.6	1032.3	1068.9	1124.4
3:32:30	1063.0	1093.6	1143.6	1034.7	1075.9	1128.1
3:35:00	1065.6	1099.2	1145.8	1041.0	1064.0	1131.8
3:37:30	1066.4	1097.5	1150.9	1043.2	1056.5	1133.8
3:40:00	1068.9	1102.0	1151.2	1041.1	1058.2	1136.4
3:42:30	1071.5	1101.2	1151.2	1036.9	1068.5	1137.9
3:45:00	1072.9	1106.2	1154.1	1044.6	1067.2	1141.1
3:47:30	1075.3	1112.7	1154.6	1050.0	1049.8	1144.6
3:50:00	1076.3	1114.4	1156.7	1051.0	1045.8	1146.0
3:52:30	1076.0	1110.6	1162.9	1045.0	1030.6	1147.9
3:55:00	1079.2	1112.9	1164.4	1045.5	1036.9	1149.2
3:57:30	1078.1	1115.0	1166.6	1047.2	1034.7	1151.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
hr:min:sec						
4:00:00	1080.9	1116.8	1168.4	1042.7	1025.7	1152.5
4:02:30	1083.4	1120.5	1167.4	1045.6	1026.5	1154.3
4:05:00	1084.6	1121.3	1171.6	1049.3	1041.9	1155.9
4:07:30	1087.3	1123.9	1174.4	1051.7	1019.0	1158.1
4:10:00	1089.5	1126.2	1176.5	1051.7	1035.0	1160.3
4:12:30	1092.7	1130.7	1175.0	1056.5	1058.8	1162.8
4:15:00	1095.7	1129.5	1181.7	1050.8	1037.8	1165.5
4:17:30	1095.9	1131.9	1183.4	1050.1	1025.6	1167.8
4:20:00	1094.2	1133.2	1183.7	1051.6	1032.8	1169.9
4:22:30	1099.1	1139.5	1182.1	1051.3	1026.9	1171.4
4:25:00	1098.3	1137.4	1187.5	1053.0	1030.1	1173.9
4:27:30	1102.1	1140.4	1187.1	1056.2	1041.4	1175.6
4:30:00	1104.0	1142.5	1190.1	1058.8	1032.4	1178.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	75.2	74.3	74.9	74.9	75.2	75.0
0:02:30	76.8	121.2	77.8	77.7	77.2	78.5
0:05:00	83.6	186.6	90.6	92.4	88.9	95.2
0:07:30	93.0	258.6	111.0	116.7	108.9	121.8
0:10:00	107.4	333.2	140.6	150.6	138.2	157.7
0:12:30	127.4	402.2	175.8	190.4	172.4	198.0
0:15:00	148.5	460.8	214.1	232.7	209.7	239.1
0:17:30	163.8	505.4	222.9	271.7	246.2	277.7
0:20:00	186.0	547.7	233.3	308.5	281.5	307.7
0:22:30	211.9	587.2	223.1	343.4	316.0	266.3
0:25:00	223.9	620.9	230.0	374.7	349.7	275.9
0:27:30	233.6	645.8	233.8	403.5	382.2	285.0
0:30:00	258.1	664.4	230.1	427.9	410.8	306.0
0:32:30	268.7	680.9	234.5	451.0	438.1	313.3
0:35:00	305.1	697.9	238.5	473.1	464.1	325.8
0:37:30	307.8	712.4	247.3	494.8	488.5	329.8
0:40:00	328.3	726.5	258.5	513.6	513.8	335.7
0:42:30	348.1	739.6	266.2	534.3	540.2	376.3
0:45:00	347.3	751.7	277.8	556.7	565.4	423.1
0:47:30	375.5	762.9	297.3	579.0	590.9	477.2
0:50:00	409.5	774.2	382.3	600.8	616.1	522.4
0:52:30	401.5	784.0	454.8	622.1	640.6	562.0
0:55:00	416.1	794.9	515.3	642.4	663.3	599.8
0:57:30	431.1	801.8	568.4	660.9	684.2	635.5
1:00:00	448.8	808.4	616.4	678.4	703.9	666.5
1:02:30	499.0	814.7	659.6	696.2	722.5	693.1
1:05:00	490.1	824.4	695.9	716.8	738.4	716.8
1:07:30	499.8	835.1	722.5	734.2	752.3	738.5
1:10:00	531.3	842.4	744.8	751.1	766.4	758.4
1:12:30	544.3	848.3	765.3	766.6	781.5	773.9
1:15:00	550.9	853.5	785.2	782.1	796.1	788.3
1:17:30	585.2	861.2	802.7	797.5	809.5	801.9
1:20:00	584.8	868.0	815.9	810.8	821.9	812.0
1:22:30	589.7	872.6	828.0	821.2	833.8	819.5
1:25:00	611.1	875.7	836.5	830.0	852.9	826.4
1:27:30	610.8	880.4	846.2	837.6	877.4	832.1
1:30:00	659.6	888.2	855.9	842.1	898.9	841.4
1:32:30	643.6	894.3	866.1	852.2	921.3	850.3
1:35:00	685.5	902.0	877.6	862.0	938.5	860.9
1:37:30	673.4	906.8	889.9	872.5	954.8	869.8
1:40:00	683.0	913.7	902.8	882.9	973.8	879.2
1:42:30	705.2	920.2	914.5	893.4	994.7	890.0
1:45:00	719.2	926.5	928.3	905.4	1010.2	901.4
1:47:30	736.3	934.7	943.0	918.4	1025.6	911.0
1:50:00	741.5	939.4	958.0	932.4	1038.4	921.7
1:52:30	767.4	945.5	973.3	946.3	1045.8	931.4
1:55:00	767.3	947.8	988.0	959.3	1052.4	938.1
1:57:30	758.4	953.7	1002.2	970.6	1056.6	944.7

DOW CORNING CORP.
TEST ASSEMBLY NO. 1

FURNACE PRESSURES, INCHES OF WATER

TIME hr:min:sec	TC. NO. 56	TC. NO. 57
0:00:00	0.018	0.009
0:02:30	0.026	0.014
0:05:00	0.026	0.014
0:07:30	0.028	0.016
0:10:00	0.028	0.016
0:12:30	0.029	0.016
0:15:00	0.030	0.017
0:17:30	0.030	0.017
0:20:00	0.030	0.017
0:22:30	0.030	0.017
0:25:00	0.030	0.017
0:27:30	0.030	0.017
0:30:00	0.030	0.017
0:32:30	0.031	0.018
0:35:00	0.031	0.018
0:37:30	0.031	0.018
0:40:00	0.031	0.018
0:42:30	0.031	0.018
0:45:00	0.032	0.018
0:47:30	0.031	0.018
0:50:00	0.031	0.018
0:52:30	0.032	0.018
0:55:00	0.032	0.018
0:57:30	0.032	0.018
1:00:00	0.033	0.019
1:02:30	0.032	0.019
1:05:00	0.033	0.019
1:07:30	0.033	0.019
1:10:00	0.032	0.019
1:12:30	0.033	0.019
1:15:00	0.033	0.019
1:17:30	0.033	0.019
1:20:00	0.033	0.019
1:22:30	0.034	0.019
1:25:00	0.033	0.020
1:27:30	0.033	0.019
1:30:00	0.034	0.020
1:32:30	0.033	0.019
1:35:00	0.033	0.019
1:37:30	0.034	0.020
1:40:00	0.034	0.019
1:42:30	0.033	0.019
1:45:00	0.033	0.019
1:47:30	0.033	0.019
1:50:00	0.033	0.019
1:52:30	0.034	0.020
1:55:00	0.033	0.020
1:57:30	0.034	0.020

R8196/95NK3179

Test Date : APRIL 18, 1995

APPENDIX B
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	FURNACE PRESSURES, INCHES OF WATER	
	TC. NO. 56	TC. NO. 57
2:00:00	0.034	0.020
2:02:30	0.033	0.019
2:05:00	0.034	0.020
2:07:30	0.034	0.021
2:10:00	0.034	0.020
2:12:30	0.034	0.020
2:15:00	0.034	0.020
2:17:30	0.034	0.021
2:20:00	0.034	0.020
2:22:30	0.034	0.020
2:25:00	0.034	0.020
2:27:30	0.034	0.020
2:30:00	0.034	0.020
2:32:30	0.035	0.021
2:35:00	0.035	0.021
2:37:30	0.035	0.021
2:40:00	0.035	0.021
2:42:30	0.034	0.021
2:45:00	0.034	0.021
2:47:30	0.035	0.021
2:50:00	0.034	0.021
2:52:30	0.034	0.021
2:55:00	0.035	0.021
2:57:30	0.035	0.021
3:00:00	0.035	0.021
3:02:30	0.034	0.021
3:05:00	0.035	0.021
3:07:30	0.035	0.021
3:10:00	0.035	0.021
3:12:30	0.035	0.020
3:15:00	0.035	0.021
3:17:30	0.035	0.021
3:20:00	0.035	0.020
3:22:30	0.035	0.021
3:25:00	0.036	0.022
3:27:30	0.035	0.021
3:30:00	0.035	0.021
3:32:30	0.035	0.021
3:35:00	0.035	0.021
3:37:30	0.036	0.021
3:40:00	0.035	0.021
3:42:30	0.035	0.022
3:45:00	0.035	0.022
3:47:30	0.035	0.021
3:50:00	0.035	0.021
3:52:30	0.035	0.021
3:55:00	0.036	0.022
3:57:30	0.035	0.022

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
2:00:00	777.4	958.1	1014.9	981.6	1060.4	952.5
2:02:30	796.4	962.2	1024.7	993.1	1062.9	959.6
2:05:00	784.1	964.4	1034.5	1006.4	1065.2	964.1
2:07:30	785.1	967.4	1041.8	1022.2	1066.5	969.6
2:10:00	770.0	966.8	1049.4	1038.3	1069.1	970.7
2:12:30	782.8	968.2	1055.9	1048.5	1069.7	974.7
2:15:00	765.9	971.7	1061.8	1052.7	1070.4	979.5
2:17:30	776.2	976.4	1066.2	1053.9	1070.5	984.2
2:20:00	768.7	980.1	1069.0	1053.8	1073.1	990.9
2:22:30	798.4	983.9	1073.3	1053.2	1073.9	995.4
2:25:00	772.8	984.2	1076.2	1052.5	1074.0	999.0
2:27:30	774.4	985.8	1078.1	1052.0	1074.7	1001.7
2:30:00	797.3	990.6	1079.2	1051.1	1074.9	1008.0
2:32:30	743.3	995.1	1081.8	1052.8	1077.6	1015.4
2:35:00	757.9	998.7	1083.3	1053.5	1079.6	1022.0
2:37:30	786.4	999.9	1085.1	1054.4	1081.0	1028.4
2:40:00	771.0	1003.6	1087.2	1055.7	1083.5	1035.6
2:42:30	765.9	1006.8	1088.4	1056.4	1085.3	1040.5
2:45:00	802.9	1010.0	1090.8	1057.5	1087.3	1046.3
2:47:30	786.6	1013.0	1093.4	1058.9	1089.4	1050.9
2:50:00	803.8	1016.9	1094.7	1059.9	1091.5	1054.3
2:52:30	891.3	1020.1	1097.0	1062.0	1094.6	1058.5
2:55:00	876.3	1021.8	1099.8	1063.1	1097.2	1061.3
2:57:30	926.5	1026.2	1100.8	1065.1	1100.2	1064.4
3:00:00	899.3	1029.7	1104.6	1067.2	1102.8	1067.9
3:02:30	913.8	1032.6	1107.3	1068.9	1104.9	1070.7
3:05:00	897.5	1035.1	1108.5	1070.3	1107.3	1072.9
3:07:30	866.9	1037.6	1111.2	1072.4	1109.8	1076.1
3:10:00	929.3	1041.5	1113.7	1073.3	1111.8	1077.1
3:12:30	912.6	1043.2	1116.0	1074.5	1113.6	1079.0
3:15:00	917.2	1047.4	1118.3	1076.3	1115.8	1081.5
3:17:30	925.7	1049.8	1120.3	1078.0	1118.6	1084.2
3:20:00	868.5	1051.3	1123.4	1079.3	1120.8	1086.5
3:22:30	913.0	1056.1	1126.1	1080.6	1122.8	1088.2
3:25:00	927.0	1058.6	1127.8	1082.6	1125.3	1090.3
3:27:30	926.7	1059.7	1129.9	1084.5	1127.9	1093.1
3:30:00	961.5	1062.7	1131.5	1086.4	1130.3	1094.0
3:32:30	968.0	1063.9	1134.7	1088.6	1132.5	1096.3
3:35:00	949.5	1065.9	1136.6	1090.0	1134.4	1098.8
3:37:30	908.5	1067.2	1137.2	1090.9	1136.2	1102.5
3:40:00	922.5	1068.1	1139.7	1091.9	1137.4	1102.3
3:42:30	940.5	1073.0	1141.9	1092.9	1139.0	1103.2
3:45:00	895.4	1073.9	1142.5	1093.9	1140.7	1105.0
3:47:30	858.5	1074.8	1144.7	1094.3	1141.6	1106.4
3:50:00	853.2	1075.8	1146.0	1094.4	1142.6	1106.9
3:52:30	833.2	1076.8	1145.9	1095.0	1144.4	1109.4
3:55:00	864.0	1079.1	1147.8	1095.4	1145.8	1109.8
3:57:30	834.2	1079.8	1148.2	1096.1	1147.4	1111.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

	TEMPERATURES, °F					
TIME	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
hr:min:sec						
4:00:00	826.2	1081.6	1150.2	1096.8	1148.7	1111.5
4:02:30	805.2	1082.0	1151.1	1098.0	1150.5	1112.1
4:05:00	852.9	1084.2	1151.3	1099.7	1152.8	1114.9
4:07:30	787.7	1086.6	1153.1	1101.3	1154.7	1116.2
4:10:00	820.4	1089.9	1154.4	1102.9	1157.0	1118.4
4:12:30	827.5	1093.1	1157.6	1105.0	1159.4	1119.0
4:15:00	834.4	1095.8	1158.8	1107.0	1162.0	1122.5
4:17:30	888.8	1095.1	1160.2	1108.2	1164.2	1122.9
4:20:00	828.1	1095.1	1160.9	1109.5	1165.9	1124.7
4:22:30	778.0	1099.2	1162.6	1110.7	1168.0	1124.8
4:25:00	877.6	1099.2	1164.8	1112.4	1170.5	1126.5
4:27:30	846.6	1103.9	1166.5	1113.9	1172.6	1127.6
4:30:00	832.9	1104.3	1189.3	1115.7	1170.2	1146.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	75.3	75.9	74.9	75.9	76.0	76.0
0:02:30	78.7	79.7	126.0	78.6	78.4	78.4
0:05:00	91.1	91.3	197.1	92.2	90.0	90.3
0:07:30	108.6	107.0	276.1	114.5	107.7	108.8
0:10:00	132.6	129.9	355.3	144.4	132.9	134.7
0:12:30	161.3	157.4	425.0	178.6	163.1	164.6
0:15:00	191.6	186.7	482.5	213.7	195.3	196.6
0:17:30	221.4	218.8	532.0	248.2	228.1	228.6
0:20:00	251.9	221.7	575.8	280.7	258.0	260.4
0:22:30	281.2	245.6	615.2	309.5	200.1	291.2
0:25:00	309.1	259.9	646.4	323.2	213.9	319.7
0:27:30	336.1	275.4	668.8	344.3	221.9	347.2
0:30:00	361.2	289.9	686.0	369.5	216.8	373.4
0:32:30	386.6	306.2	701.2	394.3	220.5	397.7
0:35:00	411.3	327.3	718.7	415.6	224.5	419.8
0:37:30	440.0	361.5	733.8	435.1	227.6	442.7
0:40:00	463.0	406.6	746.7	455.4	230.6	465.2
0:42:30	486.1	450.4	759.5	475.6	233.7	486.2
0:45:00	508.4	485.2	770.8	494.7	236.5	506.6
0:47:30	530.5	516.3	782.7	512.5	239.8	525.6
0:50:00	552.5	546.3	792.8	530.7	242.7	546.6
0:52:30	572.9	572.9	803.6	549.6	245.8	567.0
0:55:00	594.2	601.9	813.1	567.5	249.5	586.8
0:57:30	614.1	629.0	819.9	585.5	252.9	605.4
1:00:00	633.2	653.9	827.3	603.1	258.4	623.1
1:02:30	651.6	677.8	837.5	619.3	270.2	639.6
1:05:00	670.6	700.2	849.4	634.0	289.8	654.5
1:07:30	690.9	721.5	857.3	648.3	351.2	669.7
1:10:00	712.2	741.6	864.6	662.3	474.6	687.4
1:12:30	729.5	760.8	875.4	675.2	566.4	702.6
1:15:00	743.6	778.7	883.3	687.8	631.3	716.9
1:17:30	756.2	796.6	892.3	700.6	684.1	733.7
1:20:00	767.8	812.3	895.7	715.4	725.1	749.0
1:22:30	781.3	825.5	895.8	735.7	752.1	761.9
1:25:00	793.7	835.3	896.7	753.9	775.8	771.7
1:27:30	805.5	847.0	899.6	778.1	795.9	779.9
1:30:00	818.5	859.9	907.8	799.7	814.2	788.1
1:32:30	832.1	875.2	909.3	807.9	838.5	799.6
1:35:00	846.3	890.7	914.3	809.5	858.8	820.2
1:37:30	861.9	904.6	917.2	812.7	872.9	834.6
1:40:00	876.9	919.0	922.0	816.4	880.5	847.4
1:42:30	891.1	932.4	926.0	821.5	886.9	859.8
1:45:00	903.2	945.3	932.6	827.3	894.5	871.3
1:47:30	917.0	957.5	937.8	833.7	902.8	884.8
1:50:00	931.7	969.9	940.9	840.2	912.3	900.2
1:52:30	946.4	981.8	945.8	846.9	922.8	920.4
1:55:00	960.2	993.2	949.6	854.0	933.6	941.1
1:57:30	971.9	1003.7	953.9	862.4	944.0	958.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
2:00:00	982.7	1013.3	957.7	872.0	954.3	972.0
2:02:30	992.3	1021.9	962.6	882.5	964.4	982.6
2:05:00	1001.6	1029.9	964.3	891.3	973.9	992.0
2:07:30	1009.2	1037.0	968.3	901.9	982.7	1000.3
2:10:00	1016.1	1043.7	967.3	911.7	989.9	1008.8
2:12:30	1022.1	1049.3	969.9	918.9	996.7	1015.7
2:15:00	1028.1	1054.4	972.8	924.3	1003.0	1022.3
2:17:30	1033.9	1058.9	974.8	932.8	1009.5	1028.5
2:20:00	1039.0	1062.8	977.5	939.3	1015.7	1034.3
2:22:30	1043.3	1066.8	979.6	945.5	1021.8	1039.3
2:25:00	1046.6	1070.5	980.7	953.6	1027.0	1043.7
2:27:30	1049.0	1073.7	980.1	958.5	1031.8	1047.2
2:30:00	1051.0	1076.0	985.7	961.8	1036.9	1050.4
2:32:30	1054.7	1079.5	989.4	969.1	1042.1	1055.1
2:35:00	1057.6	1083.0	990.9	974.5	1047.5	1059.7
2:37:30	1061.0	1085.8	993.0	977.9	1052.4	1063.1
2:40:00	1066.3	1089.0	996.5	983.0	1057.5	1067.8
2:42:30	1070.4	1092.1	997.6	985.2	1062.2	1071.8
2:45:00	1075.1	1095.3	1001.6	989.6	1066.9	1075.6
2:47:30	1079.1	1098.5	1004.9	993.0	1071.8	1079.4
2:50:00	1082.4	1101.4	1008.7	998.5	1076.2	1083.1
2:52:30	1086.5	1104.9	1010.5	998.6	1081.2	1086.7
2:55:00	1089.0	1108.0	1013.6	1002.8	1085.4	1089.3
2:57:30	1092.2	1111.0	1016.7	1004.4	1090.1	1093.4
3:00:00	1095.0	1114.3	1019.4	1011.7	1094.4	1097.0
3:02:30	1098.1	1117.5	1022.5	1016.4	1099.0	1100.5
3:05:00	1100.9	1120.9	1025.1	1020.4	1103.5	1103.9
3:07:30	1104.6	1124.2	1027.3	1023.9	1107.9	1106.4
3:10:00	1106.7	1127.2	1030.8	1028.0	1111.2	1108.8
3:12:30	1109.4	1130.1	1032.8	1031.3	1115.7	1112.1
3:15:00	1111.9	1133.2	1036.1	1036.8	1119.8	1115.4
3:17:30	1114.7	1136.8	1038.6	1038.6	1123.9	1118.3
3:20:00	1116.8	1140.2	1039.2	1042.7	1127.9	1121.0
3:22:30	1118.7	1143.2	1043.0	1048.1	1131.3	1123.9
3:25:00	1121.3	1146.3	1046.2	1046.5	1134.9	1126.6
3:27:30	1123.8	1149.6	1046.9	1049.6	1138.6	1128.9
3:30:00	1125.7	1152.7	1051.4	1051.3	1142.2	1132.0
3:32:30	1127.9	1156.3	1052.3	1053.4	1145.1	1134.5
3:35:00	1129.7	1158.7	1054.5	1059.2	1147.9	1137.8
3:37:30	1131.3	1161.7	1053.6	1065.9	1150.4	1140.7
3:40:00	1132.9	1164.1	1055.7	1068.3	1153.5	1144.2
3:42:30	1134.5	1166.8	1059.4	1070.8	1155.7	1146.5
3:45:00	1136.2	1169.2	1059.2	1073.9	1158.4	1148.9
3:47:30	1137.3	1171.5	1059.7	1077.3	1160.9	1152.2
3:50:00	1138.6	1173.5	1059.7	1078.7	1161.8	1153.8
3:52:30	1139.9	1175.5	1058.8	1081.8	1164.1	1155.8
3:55:00	1140.8	1177.5	1063.1	1082.4	1164.7	1157.7
3:57:30	1142.1	1179.5	1061.8	1083.7	1166.9	1159.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
4:00:00	1143.1	1181.0	1063.0	1084.4	1168.0	1161.9
4:02:30	1144.4	1183.3	1065.7	1083.6	1169.3	1164.9
4:05:00	1146.5	1185.3	1066.8	1085.3	1170.8	1167.1
4:07:30	1148.4	1187.2	1070.1	1086.1	1172.4	1169.0
4:10:00	1149.8	1189.3	1072.9	1087.5	1173.8	1171.2
4:12:30	1151.7	1192.0	1074.4	1087.6	1176.0	1173.8
4:15:00	1154.2	1194.7	1076.5	1090.9	1178.0	1176.8
4:17:30	1155.7	1196.7	1078.5	1091.7	1179.4	1178.7
4:20:00	1157.4	1198.7	1077.3	1093.2	1181.7	1180.9
4:22:30	1158.8	1201.0	1082.5	1093.5	1183.6	1183.0
4:25:00	1160.8	1203.4	1081.8	1095.4	1185.9	1185.5
4:27:30	1162.2	1205.5	1085.0	1096.5	1187.2	1187.1
4:30:00	1164.1	1219.6	1085.5	1106.5	1191.1	1189.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	75.9	76.5	76.3	75.3	75.4
0:02:30	79.6	80.9	78.6	118.1	75.5
0:05:00	95.4	93.7	86.5	181.4	75.6
0:07:30	120.0	111.1	97.7	247.3	75.7
0:10:00	151.6	136.4	114.1	314.9	76.0
0:12:30	186.0	165.1	134.4	376.4	76.9
0:15:00	220.2	195.0	157.5	430.0	78.7
0:17:30	252.3	225.1	182.8	472.9	81.8
0:20:00	281.1	255.0	207.5	510.9	86.9
0:22:30	311.8	240.6	233.2	544.7	93.9
0:25:00	341.2	253.2	258.2	576.7	102.6
0:27:30	369.0	271.8	283.6	601.6	112.1
0:30:00	394.0	287.1	308.5	619.0	122.1
0:32:30	416.3	301.5	325.8	633.8	131.7
0:35:00	440.1	341.9	343.3	651.0	140.8
0:37:30	462.4	407.3	362.6	666.6	149.7
0:40:00	484.7	436.8	373.5	681.2	157.9
0:42:30	505.5	461.0	387.7	693.7	165.5
0:45:00	524.9	482.3	415.0	706.0	172.3
0:47:30	546.2	504.5	433.5	717.6	178.8
0:50:00	565.9	524.5	457.3	730.3	184.8
0:52:30	584.0	544.9	481.0	740.9	189.9
0:55:00	602.6	565.4	503.4	750.3	194.7
0:57:30	620.2	585.3	527.8	757.8	198.8
1:00:00	635.8	605.0	551.8	764.3	202.3
1:02:30	652.1	623.1	574.3	772.5	205.0
1:05:00	666.1	641.4	595.7	782.0	207.8
1:07:30	679.7	658.8	616.0	792.4	209.8
1:10:00	693.5	675.9	636.2	799.5	212.5
1:12:30	706.3	691.8	655.2	806.9	214.9
1:15:00	719.0	707.7	674.1	814.2	217.7
1:17:30	731.9	722.4	693.9	823.4	220.4
1:20:00	745.4	738.1	713.4	828.6	223.6
1:22:30	756.9	753.2	728.8	833.1	226.1
1:25:00	770.2	767.1	741.9	836.8	229.1
1:27:30	782.1	780.0	754.5	840.7	232.5
1:30:00	793.6	791.4	767.0	848.3	237.0
1:32:30	802.1	804.8	779.4	852.4	241.0
1:35:00	810.6	816.8	787.7	859.5	245.7
1:37:30	821.5	829.8	801.1	862.5	249.9
1:40:00	831.7	842.5	813.6	868.1	255.1
1:42:30	842.3	855.1	826.8	873.8	260.2
1:45:00	851.4	866.0	841.2	880.1	265.9
1:47:30	861.2	877.3	856.1	884.8	272.0
1:50:00	871.0	886.1	876.0	890.1	279.2
1:52:30	883.6	896.5	896.6	893.7	286.7
1:55:00	896.8	910.9	916.4	897.0	295.1
1:57:30	912.4	931.4	934.8	902.6	302.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

TEMPERATURES, °F

TIME	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
hr:min:sec					
2:00:00	931.3	952.5	950.7	907.5	311.0
2:02:30	949.8	972.4	964.8	913.9	319.0
2:05:00	965.1	990.0	976.5	916.8	326.4
2:07:30	977.7	1005.1	987.3	920.9	333.7
2:10:00	989.1	1015.5	996.6	922.0	340.3
2:12:30	1001.8	1023.4	1005.6	923.9	347.0
2:15:00	1014.1	1030.6	1013.8	926.3	354.0
2:17:30	1028.8	1036.1	1021.8	931.7	360.9
2:20:00	1043.2	1043.2	1028.4	934.8	367.8
2:22:30	1057.5	1048.2	1034.8	937.4	374.5
2:25:00	1067.4	1052.3	1039.9	939.8	380.5
2:27:30	1071.9	1055.9	1045.0	941.8	386.1
2:30:00	1073.2	1058.5	1049.6	945.3	392.0
2:32:30	1074.9	1062.8	1055.7	950.0	398.0
2:35:00	1075.2	1067.9	1061.7	954.7	403.7
2:37:30	1072.4	1071.3	1066.4	956.2	409.4
2:40:00	1069.3	1075.4	1072.0	959.6	414.9
2:42:30	1070.4	1077.5	1077.0	961.8	420.4
2:45:00	1069.4	1080.2	1081.9	965.6	425.9
2:47:30	1067.2	1084.1	1086.7	968.0	431.6
2:50:00	1067.3	1086.1	1090.9	973.0	437.0
2:52:30	1067.6	1092.0	1095.3	972.5	442.4
2:55:00	1069.3	1093.3	1099.1	975.8	447.2
2:57:30	1069.3	1098.3	1103.6	979.9	452.2
3:00:00	1074.0	1100.3	1107.6	983.4	457.1
3:02:30	1075.7	1102.7	1111.6	986.5	462.0
3:05:00	1076.1	1107.4	1115.6	989.2	466.6
3:07:30	1074.5	1111.4	1119.4	989.6	470.9
3:10:00	1079.5	1108.8	1122.2	996.4	475.3
3:12:30	1079.1	1112.5	1126.4	998.3	479.5
3:15:00	1079.9	1115.8	1130.6	1002.7	483.5
3:17:30	1083.0	1118.8	1133.8	1004.8	487.8
3:20:00	1071.0	1123.9	1138.0	1006.7	491.8
3:22:30	1077.8	1124.1	1141.7	1011.2	495.1
3:25:00	1078.1	1127.9	1144.9	1012.6	498.6
3:27:30	1081.1	1130.0	1148.0	1013.5	501.7
3:30:00	1083.8	1133.4	1150.9	1016.9	505.3
3:32:30	1084.9	1134.9	1153.4	1017.8	508.7
3:35:00	1086.3	1138.2	1156.7	1022.0	512.2
3:37:30	1088.7	1142.5	1159.6	1025.1	515.9
3:40:00	1090.3	1143.7	1163.2	1026.5	519.3
3:42:30	1094.5	1145.8	1165.8	1028.9	522.4
3:45:00	1097.3	1149.3	1169.2	1030.6	525.4
3:47:30	1083.6	1153.5	1172.1	1032.3	528.7
3:50:00	1088.4	1154.0	1175.0	1033.8	531.2
3:52:30	1087.0	1158.0	1177.3	1036.1	533.5
3:55:00	1089.7	1159.5	1180.1	1037.5	535.6
3:57:30	1087.8	1162.0	1181.9	1038.2	538.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 1

	TEMPERATURES, °F				
TIME	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
hr:min:sec					
4:00:00	1094.6	1162.3	1184.3	1041.1	540.2
4:02:30	1087.0	1167.1	1187.0	1042.1	542.1
4:05:00	1100.7	1167.2	1189.3	1045.2	544.0
4:07:30	1092.9	1171.5	1191.7	1046.3	546.2
4:10:00	1097.0	1173.1	1194.2	1049.9	548.2
4:12:30	1105.6	1176.1	1197.3	1052.5	550.6
4:15:00	1109.8	1178.3	1199.9	1057.3	552.8
4:17:30	1111.1	1179.8	1202.5	1057.2	554.7
4:20:00	1111.3	1182.2	1205.2	1057.9	556.2
4:22:30	1106.3	1186.3	1207.7	1061.5	558.0
4:25:00	1125.5	1186.7	1210.4	1062.5	560.0
4:27:30	1125.3	1188.4	1212.5	1067.0	561.6
4:30:00	1127.7	1193.6	1214.6	1068.2	563.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
0:00:00	75.2	75.3	75.2	75.0	74.6	74.9
0:02:30	78.9	79.6	78.6	77.8	77.8	79.6
0:05:00	92.5	94.3	91.8	90.8	87.6	93.2
0:07:30	113.3	118.2	112.7	112.4	102.0	112.8
0:10:00	143.2	152.9	142.6	144.6	124.1	141.2
0:12:30	177.6	177.6	177.6	181.4	150.9	174.4
0:15:00	212.4	204.1	214.5	215.6	178.5	210.7
0:17:30	245.3	238.2	252.6	252.4	207.5	248.5
0:20:00	286.0	279.9	286.7	286.8	241.4	285.1
0:22:30	319.5	322.7	319.9	325.8	272.2	320.4
0:25:00	355.3	358.4	352.8	354.0	303.1	353.0
0:27:30	386.0	406.3	384.6	384.4	331.6	364.9
0:30:00	407.3	442.2	411.3	397.7	363.7	376.0
0:32:30	433.3	476.1	446.3	416.6	392.8	414.9
0:35:00	458.9	501.3	475.9	436.5	418.1	448.4
0:37:30	480.8	520.7	492.8	456.5	446.6	463.7
0:40:00	501.4	545.4	512.5	474.6	468.3	486.0
0:42:30	522.0	568.9	533.1	493.6	490.6	510.3
0:45:00	542.4	590.8	554.1	512.8	512.2	534.0
0:47:30	562.6	613.1	575.7	533.0	533.3	557.1
0:50:00	581.6	633.2	594.2	552.8	553.7	578.6
0:52:30	602.5	652.5	612.7	572.0	574.0	600.0
0:55:00	619.5	670.4	629.9	591.5	591.0	619.2
0:57:30	635.6	686.5	646.4	609.8	608.2	637.5
1:00:00	650.0	700.9	663.3	627.2	625.5	654.2
1:02:30	664.8	714.6	681.4	643.0	642.5	669.7
1:05:00	683.2	728.4	702.6	657.8	657.1	686.9
1:07:30	698.3	742.4	723.1	672.5	676.4	703.1
1:10:00	715.6	757.5	733.3	687.7	690.9	719.7
1:12:30	732.5	772.9	744.1	702.8	707.2	735.2
1:15:00	748.9	788.8	757.7	717.0	719.2	750.1
1:17:30	760.2	805.4	778.1	731.0	732.8	763.8
1:20:00	771.9	823.4	795.5	743.9	745.8	775.8
1:22:30	786.7	844.4	810.0	755.9	763.5	786.2
1:25:00	795.2	863.5	822.2	767.1	774.7	810.3
1:27:30	803.6	885.5	832.3	774.8	790.8	826.8
1:30:00	808.5	905.5	844.9	780.0	807.0	840.5
1:32:30	816.0	924.9	859.3	785.1	818.2	860.7
1:35:00	823.2	946.2	872.1	790.3	827.9	872.3
1:37:30	834.3	971.3	883.0	795.8	843.8	880.1
1:40:00	843.6	1015.4	893.7	800.7	812.6	884.9
1:42:30	851.4	1069.7	904.3	806.3	820.9	886.4
1:45:00	854.3	1080.6	916.1	811.1	827.7	889.0
1:47:30	860.0	1079.5	928.2	817.1	835.9	893.7
1:50:00	867.9	1090.0	942.5	823.2	843.5	904.4
1:52:30	880.4	1118.5	960.9	830.0	853.2	912.0
1:55:00	892.8	1121.6	978.0	836.8	865.3	922.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, *F

TIME hr:min:sec	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
1:57:30	904.2	1117.2	993.7	842.3	870.9	931.0
2:00:00	914.5	1118.0	1009.4	846.5	876.3	938.9
2:02:30	925.5	1119.9	1022.0	850.7	885.6	951.5
2:05:00	938.2	1121.3	1029.8	854.5	887.7	972.3
2:07:30	951.2	1125.5	1038.1	857.2	893.0	979.8
2:10:00	965.5	1129.9	1047.5	859.7	890.7	986.9
2:12:30	975.3	1132.5	1048.8	862.9	898.4	992.0
2:15:00	988.0	1138.2	1057.1	866.9	906.3	997.5
2:17:30	997.5	1142.4	1060.9	870.2	914.1	1002.5
2:20:00	1009.1	1146.0	1067.0	873.9	922.8	1006.3
2:22:30	1019.1	1149.7	1072.2	877.9	929.4	1010.5
2:25:00	1026.6	1152.3	1075.9	881.4	935.4	1014.5
2:27:30	1033.3	1155.5	1078.9	886.9	939.7	1018.1
2:30:00	1042.3	1158.1	1082.7	892.9	943.3	1022.4
2:32:30	1048.6	1159.8	1086.6	897.7	946.9	1026.0
2:35:00	1051.6	1161.8	1088.7	901.5	948.5	1028.7
2:37:30	1050.9	1164.9	1090.0	905.0	949.5	1030.6
2:40:00	1056.5	1168.7	1097.3	908.3	950.3	1032.2
2:42:30	1061.7	1171.9	1103.7	913.3	952.6	1035.0
2:45:00	1066.2	1173.9	1107.1	932.2	955.0	1035.9
2:47:30	1068.6	1177.0	1111.4	942.1	952.7	1039.2
2:50:00	1072.9	1179.6	1115.6	946.1	955.7	1041.4
2:52:30	1074.6	1183.2	1117.6	947.9	957.4	1042.7
2:55:00	1079.1	1185.5	1119.2	949.4	962.4	1045.3
2:57:30	1080.4	1188.4	1121.7	949.7	965.8	1046.8
3:00:00	1083.8	1191.1	1123.4	949.8	967.4	1045.9
3:02:30	1083.2	1193.3	1124.8	947.2	968.2	1046.2
3:05:00	1084.9	1196.0	1126.4	946.2	970.8	1045.3
3:07:30	1087.1	1199.0	1128.3	945.8	972.4	1044.8
3:10:00	1087.2	1201.6	1130.0	941.4	973.0	1043.3
3:12:30	1089.5	1202.8	1132.3	941.5	975.1	1043.8
3:15:00	1092.1	1205.2	1134.5	942.2	976.6	1044.1
3:17:30	1095.9	1209.0	1137.6	944.2	979.5	1045.3
3:20:00	1097.1	1215.3	1140.0	946.2	980.3	1045.3
3:22:30	1102.0	1218.5	1141.7	949.7	981.2	1047.1
3:25:00	1102.2	1223.0	1143.2	952.3	983.1	1049.1
3:27:30	1107.5	1227.7	1145.2	952.2	983.9	1061.0
3:30:00	1108.1	1230.8	1146.6	951.6	985.0	1061.6
3:32:30	1111.9	1235.2	1148.4	953.0	986.1	1071.8
3:35:00	1114.9	1238.9	1151.5	955.8	988.4	1076.4
3:37:30	1116.0	1243.5	1154.0	957.1	991.6	1079.9
3:40:00	1118.5	1246.2	1155.2	959.7	992.3	1082.9
3:42:30	1118.3	1249.5	1157.6	962.6	996.9	1086.5
3:45:00	1122.7	1252.7	1159.4	964.4	998.3	1088.7
3:47:30	1123.7	1255.0	1161.2	964.4	999.2	1090.4
3:50:00	1125.0	1259.3	1163.8	966.9	1001.9	1092.7
3:52:30	1130.3	1260.4	1165.9	968.1	1002.8	1094.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
3:55:00	1129.6	1263.2	1167.6	967.6	1005.1	1096.4
3:57:30	1132.6	1265.5	1173.3	968.5	1005.9	1098.5
4:00:00	1135.9	1268.0	1177.3	970.3	1007.3	1100.2
4:02:30	1136.7	1270.8	1179.1	970.8	1010.0	1101.9
4:05:00	1138.0	1274.4	1181.6	973.4	1012.2	1104.2
4:07:30	1141.7	1276.7	1184.5	976.5	1013.6	1107.3
4:10:00	1143.0	1281.5	1187.8	976.5	1015.4	1109.2
4:12:30	1148.0	1286.1	1190.4	976.2	1015.3	1110.4
4:15:00	1149.9	1290.3	1192.2	976.7	1016.7	1113.7
4:17:30	1153.9	1293.9	1196.6	981.2	1021.0	1116.8
4:20:00	1158.2	1296.2	1198.7	982.6	1022.9	1119.0
4:22:30	1155.9	1300.8	1200.9	982.1	1026.2	1123.7
4:25:00	1164.8	1302.6	1203.3	983.7	1027.9	1123.6
4:27:30	1167.8	1304.8	1205.7	985.2	1030.6	1125.5
4:30:00	1169.3	1307.5	1207.5	988.0	1034.0	1127.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
0:00:00	78.1	75.2	75.0	75.0	74.7	74.9
0:02:30	114.4	78.9	79.0	77.4	77.1	80.5
0:05:00	175.7	94.5	94.9	90.2	88.7	96.3
0:07:30	244.9	119.8	121.2	112.3	109.3	119.6
0:10:00	321.2	154.4	157.6	140.9	138.3	152.4
0:12:30	386.6	194.4	201.4	173.2	171.7	189.9
0:15:00	443.9	234.5	244.1	208.8	204.6	226.3
0:17:30	496.2	274.9	285.8	249.0	242.0	264.4
0:20:00	540.9	316.7	325.3	282.9	274.7	299.8
0:22:30	577.5	356.2	361.3	313.4	311.2	332.3
0:25:00	609.7	397.1	394.4	340.8	346.4	361.9
0:27:30	639.4	425.7	423.6	361.6	373.2	386.5
0:30:00	664.0	451.6	452.4	385.7	405.1	416.1
0:32:30	686.3	476.1	479.6	411.5	430.6	441.8
0:35:00	706.4	498.5	503.5	434.2	457.0	463.9
0:37:30	721.4	518.4	528.2	452.7	478.1	487.9
0:40:00	731.2	539.1	552.5	473.4	498.5	514.5
0:42:30	743.7	558.8	574.8	496.2	519.3	539.2
0:45:00	755.7	578.8	596.1	516.6	539.4	562.8
0:47:30	767.4	598.9	616.1	538.0	559.9	586.2
0:50:00	779.8	618.2	634.5	555.7	580.0	609.3
0:52:30	790.3	636.9	652.0	572.7	599.0	630.9
0:55:00	800.5	655.0	668.9	589.7	616.4	650.8
0:57:30	808.9	672.2	684.3	606.9	632.7	669.2
1:00:00	817.5	687.7	698.4	622.7	647.0	685.5
1:02:30	824.4	702.0	711.0	637.6	660.2	701.7
1:05:00	835.3	717.0	722.9	651.6	674.1	719.7
1:07:30	839.9	732.3	737.0	665.8	689.3	738.1
1:10:00	845.7	747.6	751.6	680.6	702.8	758.1
1:12:30	854.5	763.3	765.5	696.2	714.3	777.2
1:15:00	859.9	777.1	781.5	712.6	725.6	801.1
1:17:30	864.0	789.2	823.7	728.1	736.8	814.5
1:20:00	870.1	799.4	878.1	739.7	747.1	820.1
1:22:30	878.0	809.0	901.3	749.0	755.1	820.6
1:25:00	881.9	819.5	915.7	756.2	763.9	826.2
1:27:30	884.0	828.9	923.7	762.8	774.5	836.7
1:30:00	891.4	836.6	923.2	768.4	783.6	846.6
1:32:30	898.3	843.0	920.0	774.2	792.1	854.8
1:35:00	899.8	845.3	912.8	780.7	798.3	867.5
1:37:30	903.0	851.0	905.6	788.1	804.5	884.9
1:40:00	903.0	855.9	904.2	794.6	812.7	897.9
1:42:30	904.2	860.5	906.9	800.4	823.7	907.6
1:45:00	909.5	864.9	908.9	805.8	835.7	918.0
1:47:30	919.0	870.3	910.4	811.9	850.4	929.2
1:50:00	928.4	877.0	916.1	818.3	864.2	934.0
1:52:30	927.6	883.0	920.6	825.9	881.9	941.4
1:55:00	932.2	887.3	925.9	834.5	895.0	951.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
1:57:30	936.2	893.1	933.2	841.9	905.0	979.2
2:00:00	938.5	900.7	941.2	848.0	918.2	1017.9
2:02:30	943.4	912.6	946.4	854.3	933.0	1027.9
2:05:00	947.0	925.6	953.5	859.6	944.1	1039.5
2:07:30	947.6	937.8	959.7	864.6	955.0	1048.5
2:10:00	949.9	944.4	963.2	869.2	964.7	1055.9
2:12:30	955.9	951.8	966.7	874.5	970.5	1063.2
2:15:00	958.8	959.3	971.8	880.3	980.0	1075.2
2:17:30	960.6	965.5	976.6	886.1	986.4	1084.9
2:20:00	961.4	971.8	981.3	892.1	1003.7	1095.4
2:22:30	964.9	977.2	986.0	896.8	1016.5	1103.2
2:25:00	966.7	981.3	989.5	901.4	1024.7	1109.4
2:27:30	965.0	986.9	993.9	906.5	1028.9	1113.7
2:30:00	967.0	990.4	997.1	912.3	1027.1	1120.6
2:32:30	967.8	997.0	1001.2	917.6	1021.8	1125.6
2:35:00	969.8	1000.6	1003.1	912.2	1013.4	1128.4
2:37:30	973.1	1003.9	1004.9	922.6	1007.3	1125.4
2:40:00	978.8	1006.5	1007.0	928.2	1002.6	1128.8
2:42:30	979.7	1013.8	1010.9	932.3	1003.5	1131.4
2:45:00	985.2	1017.8	1013.8	936.1	1002.6	1133.4
2:47:30	986.9	1020.4	1016.6	938.8	1004.1	1134.2
2:50:00	989.9	1023.6	1019.9	941.3	1007.0	1130.3
2:52:30	993.2	1024.3	1021.2	942.9	1010.9	1129.2
2:55:00	996.9	1026.8	1024.3	944.8	1015.0	1128.8
2:57:30	999.0	1027.8	1027.4	946.2	1019.7	1129.3
3:00:00	997.2	1030.0	1031.0	947.2	1024.5	1132.7
3:02:30	998.3	1029.2	1035.3	946.8	1030.1	1134.4
3:05:00	999.2	1029.3	1038.6	947.6	1035.3	1135.3
3:07:30	1000.7	1030.3	1041.9	947.5	1041.9	1136.6
3:10:00	1001.8	1030.1	1043.6	945.5	1045.7	1134.9
3:12:30	1002.9	1028.8	1045.2	945.9	1051.5	1136.0
3:15:00	1005.2	1028.7	1047.1	945.9	1057.4	1136.8
3:17:30	1008.7	1028.4	1048.7	945.7	1064.3	1138.1
3:20:00	1008.9	1028.8	1050.3	947.6	1069.2	1139.7
3:22:30	1011.3	1029.1	1050.9	948.5	1073.2	1140.9
3:25:00	1014.4	1028.8	1050.3	947.9	1077.2	1142.2
3:27:30	1015.7	1029.3	1051.0	947.6	1081.8	1144.2
3:30:00	1014.7	1030.5	1051.9	949.6	1087.2	1145.9
3:32:30	1017.5	1031.0	1051.6	949.1	1092.6	1146.7
3:35:00	1020.8	1031.5	1051.4	947.8	1099.2	1148.0
3:37:30	1023.7	1032.9	1052.5	946.1	1104.8	1150.1
3:40:00	1024.1	1034.1	1053.8	948.1	1110.2	1151.7
3:42:30	1027.5	1035.1	1053.8	948.7	1115.3	1153.3
3:45:00	1027.9	1036.4	1054.3	947.4	1118.7	1154.6
3:47:30	1028.1	1037.5	1055.2	946.8	1122.2	1156.5
3:50:00	1031.4	1037.8	1056.0	945.1	1126.1	1157.9
3:52:30	1031.8	1039.6	1057.8	944.8	1128.3	1158.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
3:55:00	1034.3	1039.2	1059.2	945.3	1131.4	1159.7
3:57:30	1034.0	1040.6	1060.6	944.4	1133.8	1161.5
4:00:00	1036.8	1041.4	1061.5	943.6	1136.5	1162.7
4:02:30	1038.8	1042.9	1063.7	944.0	1139.4	1164.5
4:05:00	1042.0	1044.5	1064.9	941.4	1143.5	1166.8
4:07:30	1044.3	1046.6	1067.6	942.8	1146.7	1168.9
4:10:00	1046.5	1047.6	1070.0	942.1	1149.3	1172.2
4:12:30	1049.2	1050.0	1074.0	942.5	1152.7	1174.0
4:15:00	1052.1	1052.3	1079.4	944.9	1155.4	1177.1
4:17:30	1057.1	1054.3	1083.1	946.3	1158.4	1180.0
4:20:00	1055.8	1056.3	1085.1	946.6	1160.7	1181.6
4:22:30	1058.3	1057.3	1086.1	949.4	1162.6	1185.3
4:25:00	1058.8	1059.9	1089.2	950.7	1165.1	1187.4
4:27:30	1061.4	1061.4	1090.7	951.1	1167.6	1189.5
4:30:00	1063.1	1062.8	1092.2	952.3	1168.5	1191.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
0:00:00	74.6	78.2	75.3	75.5	75.3	75.3
0:02:30	77.8	119.4	78.7	79.2	77.8	78.9
0:05:00	88.7	190.4	93.8	94.3	90.6	95.1
0:07:30	104.8	271.7	119.5	117.5	111.9	121.2
0:10:00	129.6	355.2	154.5	156.2	142.2	156.1
0:12:30	160.8	428.5	196.2	189.2	176.9	190.9
0:15:00	189.9	487.7	238.9	209.9	209.0	197.1
0:17:30	221.6	540.6	282.1	258.9	247.0	221.2
0:20:00	251.0	587.8	322.9	295.6	280.4	245.9
0:22:30	282.0	622.1	360.1	339.9	315.1	276.3
0:25:00	313.1	650.7	394.0	374.8	352.0	306.9
0:27:30	342.5	679.0	424.9	400.1	388.5	328.3
0:30:00	371.5	703.8	452.6	427.8	419.5	341.3
0:32:30	402.5	726.5	477.4	463.3	448.2	374.3
0:35:00	430.1	746.7	500.5	483.3	475.9	388.0
0:37:30	456.0	760.3	523.8	512.1	501.6	404.7
0:40:00	479.3	771.0	546.0	539.6	524.2	429.6
0:42:30	503.3	782.4	567.7	564.0	545.1	441.5
0:45:00	525.2	796.0	588.6	587.9	564.5	463.9
0:47:30	546.4	805.9	609.4	610.5	583.8	481.0
0:50:00	565.5	815.7	630.1	630.1	603.3	498.1
0:52:30	585.0	824.1	649.8	649.5	621.4	514.4
0:55:00	605.2	833.7	668.0	668.2	639.4	520.2
0:57:30	624.4	842.6	685.8	684.7	656.2	516.5
1:00:00	643.5	850.5	701.3	699.1	672.3	523.7
1:02:30	661.1	858.9	715.5	711.5	687.8	535.6
1:05:00	675.1	868.0	730.1	722.6	701.6	544.1
1:07:30	694.4	873.4	744.5	735.0	714.4	557.2
1:10:00	711.6	879.1	759.1	745.7	725.1	568.6
1:12:30	729.2	886.6	772.9	759.0	736.2	583.7
1:15:00	744.8	892.0	787.3	769.1	747.8	591.8
1:17:30	758.6	895.5	798.5	778.1	756.2	595.9
1:20:00	771.6	901.6	807.4	786.5	763.6	600.5
1:22:30	784.3	907.9	815.8	795.2	770.7	612.6
1:25:00	797.7	913.0	825.3	804.2	778.5	608.0
1:27:30	810.5	914.4	835.1	812.2	786.8	613.7
1:30:00	822.5	920.6	844.5	819.4	793.4	628.4
1:32:30	834.5	929.3	853.4	829.1	801.9	625.8
1:35:00	845.7	929.9	860.8	837.9	809.3	644.6
1:37:30	856.3	930.1	866.3	847.3	816.4	657.4
1:40:00	865.3	930.8	870.3	856.6	822.2	665.8
1:42:30	875.6	932.5	873.7	866.3	828.2	666.6
1:45:00	884.6	934.6	877.4	878.9	838.2	680.1
1:47:30	892.5	943.3	883.7	891.1	852.3	696.3
1:50:00	900.9	953.6	890.9	905.1	871.8	694.1
1:52:30	914.6	951.3	898.4	920.6	893.5	713.3
1:55:00	923.1	956.3	906.8	934.1	913.2	729.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
1:57:30	930.4	959.1	914.0	950.4	935.8	741.0
2:00:00	939.7	963.1	921.4	967.2	959.2	742.0
2:02:30	947.8	966.4	928.5	981.1	983.1	754.6
2:05:00	953.7	971.2	936.0	990.2	1009.7	759.3
2:07:30	959.5	973.5	942.8	999.1	1029.0	768.4
2:10:00	967.8	976.7	949.6	1009.6	1057.1	778.5
2:12:30	970.5	984.1	956.0	1021.5	1078.0	790.5
2:15:00	976.9	986.0	963.2	1032.2	1093.0	795.6
2:17:30	980.8	987.4	970.1	1040.9	1105.6	799.5
2:20:00	985.8	988.1	977.6	1050.6	1112.1	803.4
2:22:30	988.8	990.8	983.6	1057.7	1119.5	804.2
2:25:00	990.7	991.9	987.7	1066.4	1124.9	809.0
2:27:30	991.7	991.0	992.1	1068.2	1135.6	803.8
2:30:00	992.8	992.8	995.2	1072.1	1145.9	807.9
2:32:30	994.3	993.7	998.2	1076.1	1152.4	812.3
2:35:00	993.8	995.7	997.4	1074.9	1153.6	809.9
2:37:30	993.2	1000.3	997.9	1069.6	1151.9	813.1
2:40:00	994.4	1004.7	999.2	1071.1	1156.0	813.6
2:42:30	996.4	1006.6	1000.1	1069.9	1158.9	811.3
2:45:00	998.5	1009.6	1001.1	1070.8	1163.2	818.5
2:47:30	992.9	1011.1	1001.5	1073.0	1169.4	825.7
2:50:00	994.6	1014.0	1002.2	1075.6	1173.7	835.9
2:52:30	996.3	1016.8	1001.3	1072.8	1183.0	831.6
2:55:00	998.2	1017.9	1000.5	1072.4	1189.5	836.0
2:57:30	1000.5	1021.9	996.0	1072.4	1195.4	833.0
3:00:00	1002.0	1019.8	991.4	1070.7	1205.0	817.7
3:02:30	1003.5	1021.4	985.7	1068.3	1214.3	798.2
3:05:00	1005.5	1021.8	983.2	1068.9	1219.6	810.5
3:07:30	1007.8	1023.3	981.3	1069.3	1227.5	809.6
3:10:00	1009.1	1024.5	978.9	1067.2	1235.7	795.5
3:12:30	1010.8	1025.7	977.4	1070.4	1241.9	798.1
3:15:00	1012.6	1028.1	975.3	1070.9	1247.7	790.4
3:17:30	1014.2	1032.0	976.8	1072.8	1254.5	800.4
3:20:00	1016.0	1032.5	976.0	1073.5	1262.7	802.5
3:22:30	1017.2	1033.3	974.8	1076.8	1264.9	802.9
3:25:00	1018.1	1035.4	974.2	1077.4	1269.3	796.5
3:27:30	1020.1	1037.5	974.1	1080.1	1275.4	809.8
3:30:00	1021.3	1037.2	973.8	1083.5	1279.2	817.6
3:32:30	1022.4	1039.6	973.2	1084.1	1284.0	805.9
3:35:00	1024.0	1042.9	973.2	1086.4	1289.9	820.0
3:37:30	1025.3	1045.7	974.7	1088.9	1292.7	824.2
3:40:00	1027.3	1046.0	974.1	1089.8	1297.5	821.4
3:42:30	1028.8	1047.5	976.0	1092.4	1299.0	845.0
3:45:00	1030.8	1048.7	975.3	1094.7	1302.9	840.7
3:47:30	1032.7	1049.9	974.3	1096.4	1307.1	847.1
3:50:00	1034.0	1051.8	977.4	1097.9	1310.8	842.4
3:52:30	1035.2	1052.3	975.2	1100.3	1314.8	833.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 13	TC. NO. 14	TC. NO. 15	TC. NO. 16	TC. NO. 17	TC. NO. 18
3:55:00	1036.9	1054.4	976.5	1101.9	1319.1	839.3
3:57:30	1038.4	1054.7	977.3	1103.8	1320.3	836.4
4:00:00	1039.0	1057.5	975.8	1106.4	1325.3	816.2
4:02:30	1040.4	1058.2	978.2	1108.5	1325.3	814.8
4:05:00	1041.9	1060.3	978.9	1109.0	1328.7	817.3
4:07:30	1043.8	1063.6	981.6	1112.7	1330.8	814.5
4:10:00	1046.1	1065.2	980.9	1116.2	1330.6	834.6
4:12:30	1048.3	1068.8	984.7	1118.5	1334.3	812.2
4:15:00	1051.3	1073.4	991.6	1119.9	1335.3	822.6
4:17:30	1052.8	1075.3	1000.4	1125.2	1337.8	830.7
4:20:00	1054.3	1074.9	1003.5	1126.3	1340.7	813.7
4:22:30	1056.3	1077.4	1009.8	1125.5	1345.3	833.4
4:25:00	1059.0	1078.0	1012.3	1129.9	1347.4	828.0
4:27:30	1060.9	1080.6	1016.8	1131.5	1351.7	837.0
4:30:00	1062.4	1081.8	1016.5	1132.2	1351.4	824.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
0:00:00	75.0	75.9	78.5	75.9	76.0	75.7
0:02:30	78.9	79.0	117.3	78.9	80.2	78.9
0:05:00	91.2	90.4	185.6	92.6	96.7	92.9
0:07:30	108.5	107.0	262.4	114.3	121.8	114.9
0:10:00	133.2	131.5	343.6	145.2	156.4	146.6
0:12:30	160.7	160.5	414.4	183.0	197.0	184.0
0:15:00	191.0	188.6	465.6	221.0	239.5	224.2
0:17:30	225.7	218.8	511.3	259.0	281.4	268.2
0:20:00	258.5	250.1	553.9	297.5	324.0	304.9
0:22:30	288.1	280.8	588.4	332.5	362.8	341.8
0:25:00	316.6	309.7	619.4	364.5	398.1	376.1
0:27:30	342.7	336.0	649.0	395.0	429.7	406.6
0:30:00	365.4	362.9	675.0	423.3	450.9	433.9
0:32:30	398.0	390.3	697.7	451.3	479.5	461.6
0:35:00	425.1	417.3	717.1	479.3	504.9	488.9
0:37:30	452.7	443.9	728.6	504.9	529.0	515.2
0:40:00	480.0	465.8	739.4	530.9	554.6	538.2
0:42:30	503.7	492.1	749.2	555.8	579.3	560.8
0:45:00	525.8	518.6	760.9	580.1	602.7	583.5
0:47:30	547.4	542.5	770.5	604.2	626.0	606.3
0:50:00	568.6	565.5	782.4	627.7	649.5	629.1
0:52:30	589.8	587.3	791.4	649.0	670.9	650.5
0:55:00	609.6	608.9	801.4	669.6	690.6	670.5
0:57:30	630.8	629.4	809.6	688.7	708.3	688.2
1:00:00	650.9	649.5	817.1	705.9	724.4	704.4
1:02:30	669.2	668.0	823.1	720.8	738.6	718.9
1:05:00	686.9	685.6	833.9	734.4	758.3	732.7
1:07:30	703.4	702.2	838.5	747.4	794.9	748.2
1:10:00	719.2	718.6	844.9	762.1	811.4	762.5
1:12:30	734.7	736.0	853.4	777.4	835.2	775.2
1:15:00	750.0	752.3	859.4	792.6	847.9	786.7
1:17:30	766.2	766.7	861.1	805.9	856.0	796.8
1:20:00	778.8	779.0	865.8	816.9	872.6	807.0
1:22:30	788.7	784.8	872.7	827.3	880.3	818.9
1:25:00	801.2	795.0	875.5	838.5	886.4	830.8
1:27:30	812.2	805.5	877.6	856.3	890.8	840.9
1:30:00	822.3	813.6	886.7	869.9	894.2	849.1
1:32:30	830.6	822.8	889.6	879.6	899.8	858.4
1:35:00	837.7	832.3	889.4	889.0	904.8	867.2
1:37:30	844.9	841.5	887.8	894.8	908.5	874.2
1:40:00	852.2	848.6	887.0	899.7	912.2	881.9
1:42:30	861.1	853.1	888.3	903.9	915.9	889.2
1:45:00	871.5	858.1	895.8	908.1	921.1	896.7
1:47:30	883.1	865.6	908.6	913.5	928.9	905.5
1:50:00	893.9	877.0	911.3	920.7	940.5	915.5
1:52:30	904.9	890.1	910.8	927.5	954.2	923.8
1:55:00	915.8	903.9	915.2	934.2	967.5	932.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
1:57:30	924.0	916.6	918.5	940.9	976.1	941.1
2:00:00	932.4	927.8	919.0	947.1	984.6	949.1
2:02:30	941.4	939.4	924.0	952.2	992.5	957.6
2:05:00	947.9	950.9	927.2	957.2	998.0	966.5
2:07:30	953.5	960.8	930.0	962.6	1002.9	975.1
2:10:00	959.5	970.0	934.1	968.2	1009.3	983.7
2:12:30	965.0	978.0	940.0	973.9	1013.6	992.3
2:15:00	971.3	986.0	942.2	979.9	1019.3	1001.9
2:17:30	976.4	993.2	945.4	985.5	1024.0	1010.7
2:20:00	981.6	1000.6	946.3	990.6	1028.9	1020.5
2:22:30	985.7	1007.5	948.9	995.5	1033.1	1030.8
2:25:00	989.3	1013.5	951.1	999.8	1036.5	1043.1
2:27:30	992.6	1018.2	949.9	1004.4	1040.1	1047.6
2:30:00	995.9	1022.0	953.8	1008.5	1044.1	1059.7
2:32:30	998.6	1026.5	954.6	1012.8	1048.4	1072.5
2:35:00	1000.6	1029.3	956.5	1016.6	1051.5	1082.7
2:37:30	1001.9	1031.5	960.7	1020.5	1054.2	1086.4
2:40:00	1004.0	1034.6	966.2	1025.3	1058.0	1090.4
2:42:30	1005.1	1038.5	965.7	1030.2	1062.3	1091.2
2:45:00	1007.1	1041.7	971.0	1035.4	1065.2	1087.0
2:47:30	1008.9	1044.4	973.9	1040.2	1066.9	1082.1
2:50:00	1011.1	1048.1	978.4	1050.6	1069.4	1079.9
2:52:30	1013.4	1051.0	980.1	1060.7	1070.9	1078.0
2:55:00	1015.3	1052.8	983.1	1066.9	1071.8	1076.4
2:57:30	1016.4	1054.7	985.5	1071.4	1073.2	1076.6
3:00:00	1017.6	1056.9	982.7	1075.5	1073.3	1077.0
3:02:30	1018.0	1058.5	982.9	1077.4	1072.4	1077.0
3:05:00	1019.6	1060.8	984.5	1079.3	1072.2	1077.8
3:07:30	1021.0	1063.0	986.6	1081.6	1072.3	1078.7
3:10:00	1021.6	1066.0	986.0	1082.7	1072.0	1080.1
3:12:30	1023.6	1068.9	988.4	1083.7	1072.1	1081.2
3:15:00	1024.9	1072.4	989.8	1084.5	1072.5	1083.2
3:17:30	1027.0	1076.7	993.6	1085.0	1073.9	1084.7
3:20:00	1028.9	1080.2	994.1	1086.2	1074.6	1086.7
3:22:30	1030.5	1083.1	996.1	1086.3	1075.5	1088.6
3:25:00	1032.0	1085.0	999.1	1085.7	1076.1	1090.1
3:27:30	1034.0	1087.5	1000.2	1086.3	1076.7	1091.8
3:30:00	1036.0	1089.7	1000.8	1086.8	1077.8	1093.6
3:32:30	1037.6	1091.8	1003.2	1087.0	1079.2	1096.3
3:35:00	1039.6	1093.8	1007.4	1087.2	1080.2	1098.9
3:37:30	1041.7	1096.1	1009.9	1088.0	1082.3	1101.7
3:40:00	1043.8	1098.6	1011.1	1089.0	1083.6	1104.5
3:42:30	1046.2	1100.7	1013.2	1089.6	1084.7	1107.0
3:45:00	1048.3	1103.1	1012.5	1090.4	1085.9	1109.2
3:47:30	1049.7	1104.9	1013.3	1091.2	1086.3	1110.5
3:50:00	1051.9	1107.3	1014.7	1091.4	1087.9	1113.3
3:52:30	1053.4	1109.4	1015.6	1091.6	1089.0	1115.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
3:55:00	1055.6	1112.0	1020.1	1092.3	1090.5	1117.9
3:57:30	1057.3	1113.7	1019.7	1093.3	1091.6	1119.8
4:00:00	1059.0	1115.7	1021.6	1093.2	1093.1	1122.2
4:02:30	1060.8	1117.6	1023.7	1094.3	1094.7	1124.9
4:05:00	1063.1	1119.4	1027.3	1096.0	1096.7	1127.2
4:07:30	1065.0	1119.5	1028.5	1097.8	1098.6	1130.1
4:10:00	1067.3	1120.9	1031.3	1099.8	1100.6	1132.4
4:12:30	1070.0	1122.9	1034.1	1102.3	1103.3	1136.1
4:15:00	1072.5	1125.3	1038.3	1105.0	1105.7	1139.5
4:17:30	1075.8	1128.1	1041.6	1107.2	1108.3	1142.6
4:20:00	1077.7	1130.2	1041.5	1109.4	1110.8	1146.1
4:22:30	1080.9	1132.7	1044.2	1110.9	1112.3	1148.6
4:25:00	1083.3	1135.9	1044.7	1113.6	1114.8	1152.0
4:27:30	1086.4	1138.3	1047.4	1115.9	1116.8	1154.6
4:30:00	1087.6	1141.0	1047.4	1117.5	1118.3	1157.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
0:00:00	75.9	75.9	75.7	78.2	74.7
0:02:30	79.0	80.5	79.2	112.0	74.7
0:05:00	93.4	95.3	90.6	171.2	74.8
0:07:30	116.3	116.7	107.3	237.2	75.1
0:10:00	146.8	147.2	131.5	308.7	75.4
0:12:30	182.3	184.3	161.0	374.2	76.6
0:15:00	218.3	220.7	191.4	430.6	78.9
0:17:30	246.3	257.8	213.0	483.9	82.1
0:20:00	279.8	294.0	241.7	529.0	87.6
0:22:30	314.6	327.0	275.0	565.1	95.1
0:25:00	352.0	358.4	304.1	598.1	104.9
0:27:30	381.3	388.4	333.7	626.7	117.2
0:30:00	413.9	416.7	365.8	653.7	132.0
0:32:30	439.2	444.4	394.8	675.8	147.9
0:35:00	464.1	472.9	424.3	697.2	164.5
0:37:30	488.7	497.1	450.8	711.2	180.4
0:40:00	507.5	522.6	473.3	720.1	193.4
0:42:30	525.7	547.7	497.4	731.8	202.8
0:45:00	544.4	572.4	520.3	744.3	209.3
0:47:30	563.2	597.1	544.2	757.8	213.6
0:50:00	582.6	621.1	566.8	770.9	216.8
0:52:30	601.8	653.6	587.8	781.7	219.5
0:55:00	621.1	673.1	608.4	792.0	223.1
0:57:30	638.9	693.8	629.5	801.5	226.6
1:00:00	655.5	712.4	649.9	807.7	231.0
1:02:30	670.9	726.8	668.8	815.2	235.5
1:05:00	685.9	742.2	686.2	826.8	240.5
1:07:30	700.0	762.3	702.4	832.9	246.4
1:10:00	712.6	783.6	718.9	838.2	252.8
1:12:30	723.7	802.4	736.1	845.7	260.0
1:15:00	734.7	818.7	751.2	852.0	267.8
1:17:30	746.6	834.2	764.6	855.0	275.9
1:20:00	758.0	846.3	778.1	859.1	284.4
1:22:30	770.2	854.6	791.8	866.4	293.3
1:25:00	780.8	863.6	804.7	870.8	302.2
1:27:30	790.2	872.4	817.1	872.8	310.8
1:30:00	798.6	883.8	829.8	882.2	319.5
1:32:30	806.9	893.6	840.2	888.5	327.8
1:35:00	815.4	902.4	851.1	888.7	336.0
1:37:30	822.3	910.0	862.9	888.5	343.9
1:40:00	829.2	917.2	883.7	890.0	351.8
1:42:30	835.4	923.8	902.9	890.7	359.3
1:45:00	841.4	930.4	919.0	896.4	366.4
1:47:30	848.8	940.0	928.7	908.5	373.8
1:50:00	857.3	948.6	940.2	913.8	380.9
1:52:30	860.7	957.2	959.4	912.2	387.8
1:55:00	867.6	965.1	974.2	916.4	394.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
1:57:30	875.8	971.8	988.1	919.2	401.5
2:00:00	883.0	977.8	1002.9	921.6	408.0
2:02:30	890.9	984.4	1017.0	924.9	414.4
2:05:00	897.3	989.0	1027.3	927.3	420.6
2:07:30	903.3	993.6	1037.1	930.3	426.8
2:10:00	909.2	998.6	1047.1	934.5	432.6
2:12:30	916.0	1003.9	1053.3	940.9	438.6
2:15:00	920.4	1010.1	1062.9	943.7	444.1
2:17:30	924.3	1015.4	1069.3	945.5	449.6
2:20:00	930.9	1020.5	1076.8	945.6	455.1
2:22:30	935.9	1024.9	1082.7	949.3	460.3
2:25:00	947.8	1028.7	1088.4	949.3	465.3
2:27:30	955.9	1032.4	1091.5	950.3	470.2
2:30:00	959.5	1035.8	1093.4	951.3	475.1
2:32:30	966.4	1039.0	1094.7	953.9	479.8
2:35:00	967.8	1042.2	1094.9	954.1	484.5
2:37:30	973.1	1045.7	1094.5	957.8	489.0
2:40:00	975.9	1050.4	1096.4	964.1	493.4
2:42:30	981.8	1055.0	1098.3	967.0	497.7
2:45:00	984.2	1059.3	1099.5	969.7	501.7
2:47:30	992.5	1064.8	1101.7	970.7	506.0
2:50:00	999.8	1069.5	1103.5	975.7	510.0
2:52:30	1004.2	1073.6	1106.9	978.4	514.2
2:55:00	1011.0	1077.4	1108.8	979.8	517.8
2:57:30	1014.1	1081.0	1111.4	986.5	522.0
3:00:00	1009.0	1084.0	1113.6	983.4	525.6
3:02:30	1004.6	1087.4	1115.2	984.4	529.0
3:05:00	1007.3	1090.1	1117.6	986.6	532.6
3:07:30	1006.7	1092.1	1119.4	987.8	535.9
3:10:00	996.3	1093.6	1121.7	989.8	539.1
3:12:30	998.5	1095.5	1124.5	991.5	542.1
3:15:00	988.6	1097.4	1126.3	994.0	545.2
3:17:30	992.4	1099.5	1128.9	997.2	548.2
3:20:00	981.6	1101.7	1131.3	996.7	551.3
3:22:30	972.5	1103.7	1134.0	997.8	554.3
3:25:00	963.3	1104.6	1136.4	999.2	556.9
3:27:30	962.8	1106.0	1138.9	1001.5	559.7
3:30:00	966.2	1107.2	1141.5	1003.2	562.0
3:32:30	952.0	1108.5	1143.4	1004.0	564.7
3:35:00	956.7	1109.0	1146.5	1007.1	567.4
3:37:30	958.0	1109.0	1149.9	1009.9	569.8
3:40:00	952.6	1109.4	1152.7	1010.3	572.1
3:42:30	959.4	1108.9	1155.2	1011.3	574.5
3:45:00	963.2	1108.2	1158.1	1013.4	576.9
3:47:30	973.3	1107.8	1160.2	1014.4	579.1
3:50:00	974.7	1108.4	1162.9	1016.6	581.3
3:52:30	968.8	1108.9	1165.1	1017.1	583.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 2
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
3:55:00	972.5	1110.1	1168.3	1020.5	585.5
3:57:30	970.1	1111.1	1171.0	1020.3	587.6
4:00:00	964.6	1112.2	1173.9	1022.1	589.3
4:02:30	966.0	1113.6	1176.3	1024.6	591.2
4:05:00	969.2	1115.3	1179.5	1025.8	593.2
4:07:30	986.6	1116.8	1182.0	1029.8	594.9
4:10:00	995.9	1118.6	1185.7	1033.5	596.8
4:12:30	987.4	1120.7	1188.9	1036.7	598.5
4:15:00	983.0	1122.9	1192.5	1039.4	600.2
4:17:30	982.6	1125.2	1196.4	1043.0	602.3
4:20:00	987.0	1127.3	1199.5	1043.0	604.0
4:22:30	990.1	1128.7	1203.2	1044.9	605.5
4:25:00	999.5	1131.2	1207.2	1046.9	607.1
4:27:30	988.9	1133.4	1209.2	1048.6	608.9
4:30:00	991.2	1135.2	1212.1	1049.4	610.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 1 °F	TC. NO. 2 °F	TC. NO. 3 °F	TC. NO. 4 °F	TC. NO. 5 °F	TC. NO. 6 °F
0:00:00	74.2	74.4	74.8	74.5	74.7	74.8
0:02:30	79.0	76.8	77.9	77.3	77.1	79.0
0:05:00	97.3	89.2	89.9	89.6	85.3	90.6
0:07:30	123.0	108.8	107.9	107.8	97.6	106.5
0:10:00	155.1	134.8	132.5	132.8	115.0	128.9
0:12:30	191.7	166.0	161.3	159.6	137.1	155.5
0:15:00	229.1	199.2	191.9	189.1	163.8	185.1
0:17:30	262.6	229.2	223.8	215.5	187.1	215.9
0:20:00	294.6	250.7	255.3	245.6	211.6	246.3
0:22:30	328.1	281.1	256.2	274.8	237.1	276.5
0:25:00	360.9	288.9	266.5	302.3	259.1	306.1
0:27:30	391.1	332.6	255.1	332.4	291.8	329.3
0:30:00	422.8	352.2	253.8	359.5	313.7	352.1
0:32:30	447.9	377.9	269.3	387.5	339.8	379.1
0:35:00	471.7	402.3	296.4	418.9	363.3	408.4
0:37:30	494.6	427.1	362.2	423.0	387.8	432.0
0:40:00	516.6	444.6	381.1	437.4	404.1	456.8
0:42:30	535.7	465.5	409.0	455.0	425.9	478.6
0:45:00	554.4	483.6	436.9	474.4	440.8	500.1
0:47:30	571.5	498.7	464.6	494.0	457.0	520.9
0:50:00	588.8	521.0	489.9	513.6	476.5	542.4
0:52:30	605.7	541.0	515.2	532.8	495.5	563.8
0:55:00	622.6	558.5	540.4	552.0	513.8	585.1
0:57:30	638.1	574.9	565.8	570.7	531.6	605.9
1:00:00	652.3	592.7	591.0	588.5	549.3	625.7
1:02:30	666.5	608.6	613.9	606.1	567.2	644.3
1:05:00	680.6	622.7	634.7	622.9	585.0	662.3
1:07:30	692.7	636.6	654.1	639.2	602.6	680.1
1:10:00	703.3	648.4	672.5	655.1	619.6	697.0
1:12:30	712.8	659.3	689.4	670.2	635.4	713.2
1:15:00	723.1	669.1	704.4	685.9	650.2	729.9
1:17:30	733.4	679.4	718.7	702.5	663.6	747.0
1:20:00	743.6	689.7	732.4	719.5	677.1	762.8
1:22:30	753.3	699.5	744.3	734.1	689.4	776.6
1:25:00	762.4	709.4	755.9	747.6	700.4	789.0
1:27:30	771.0	715.2	766.7	759.8	709.4	799.4
1:30:00	778.2	722.8	776.6	771.8	718.9	810.0
1:32:30	786.9	732.0	785.8	782.9	728.5	818.6
1:35:00	796.6	740.2	796.1	793.0	735.9	826.2
1:37:30	805.5	748.2	806.6	802.3	739.4	832.4
1:40:00	811.3	755.0	816.3	810.3	746.6	837.1
1:42:30	817.3	760.4	821.1	818.2	753.4	841.7
1:45:00	823.5	764.4	824.7	826.1	759.9	846.7
1:47:30	824.9	769.2	832.1	833.2	767.4	852.5
1:50:00	832.3	774.1	840.1	836.9	775.5	858.8
1:52:30	840.4	780.8	847.3	841.2	783.6	865.8
1:55:00	848.5	787.7	855.2	843.7	790.4	873.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 1 °F	TC. NO. 2 °F	TC. NO. 3 °F	TC. NO. 4 °F	TC. NO. 5 °F	TC. NO. 6 °F
1:57:30	853.8	793.5	863.4	846.5	796.5	881.1
2:00:00	860.9	801.7	871.8	851.3	804.1	891.8
2:02:30	866.6	808.9	881.7	855.4	810.1	904.6
2:05:00	870.9	820.0	890.4	859.6	816.6	916.1
2:07:30	877.4	831.6	898.4	864.2	822.9	925.9
2:10:00	885.3	841.8	907.5	868.3	827.7	934.9
2:12:30	893.7	850.9	916.8	875.6	832.8	942.9
2:15:00	903.3	857.8	926.0	882.5	836.7	948.5
2:17:30	935.2	863.6	933.7	889.8	840.6	952.3
2:20:00	979.6	871.8	940.6	898.1	848.6	956.5
2:22:30	1038.2	878.8	947.0	907.0	857.1	961.6
2:25:00	1072.0	890.6	950.8	915.0	865.1	966.2
2:27:30	1083.6	907.2	954.5	922.0	873.3	970.2
2:30:00	1098.9	929.5	959.0	927.9	880.5	974.9
2:32:30	1112.4	954.9	962.7	933.4	887.2	979.7
2:35:00	1109.5	975.7	966.4	937.9	895.2	982.5
2:37:30	1115.0	995.6	971.4	943.8	904.3	986.7
2:40:00	1117.8	1007.7	975.3	947.7	913.1	990.6
2:42:30	1109.3	1007.1	976.6	949.7	920.7	989.2
2:45:00	1115.9	1007.6	980.2	953.9	925.1	994.4
2:47:30	1123.7	1015.2	986.8	959.9	931.0	1000.5
2:50:00	1123.4	1018.6	992.6	963.9	937.9	1004.0
2:52:30	1126.5	1027.9	997.9	968.0	944.2	1008.1
2:55:00	1122.7	1029.9	1002.8	971.3	950.6	1011.5
2:57:30	1122.7	1034.3	1008.5	975.1	956.4	1015.8
3:00:00	1123.3	1035.7	1012.1	976.2	960.1	1017.5
3:02:30	1125.1	1039.6	1017.1	979.1	963.2	1021.2
3:05:00	1127.5	1040.5	1020.8	981.1	967.7	1023.3
3:07:30	1128.3	1046.6	1026.2	984.8	974.0	1026.7
3:10:00	1131.0	1043.0	1030.0	988.5	980.2	1029.8
3:12:30	1131.9	1042.4	1032.3	991.9	986.2	1030.7
3:15:00	1133.4	1044.1	1036.0	995.3	990.8	1033.1
3:17:30	1134.4	1042.6	1038.0	996.6	993.0	1034.1
3:20:00	1136.4	1037.4	1040.7	998.8	996.5	1036.5
3:22:30	1136.1	1041.5	1041.2	1000.3	998.2	1037.3
3:25:00	1138.7	1044.5	1040.9	1002.0	1000.1	1039.4
3:27:30	1140.0	1041.5	1041.9	1002.8	1002.1	1041.2
3:30:00	1143.3	1041.7	1041.0	1003.9	1002.6	1042.3
3:32:30	1146.0	1038.0	1041.0	1006.2	1004.0	1043.3
3:35:00	1146.6	1043.8	1042.0	1009.7	1006.1	1045.2
3:37:30	1149.8	1043.5	1041.8	1012.2	1006.4	1046.0
3:40:00	1151.6	1047.1	1041.2	1014.4	1007.0	1047.8
3:42:30	1153.0	1043.3	1043.2	1018.0	1010.9	1049.9
3:45:00	1153.4	1052.0	1043.3	1020.0	1012.4	1051.1
3:47:30	1153.2	1051.1	1044.5	1021.8	1014.4	1053.4
3:50:00	1155.1	1051.2	1045.3	1023.8	1014.9	1055.1
3:52:30	1155.2	1049.6	1046.2	1024.7	1015.9	1056.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 1 °F	TC. NO. 2 °F	TC. NO. 3 °F	TC. NO. 4 °F	TC. NO. 5 °F	TC. NO. 6 °F
3:55:00	1156.5	1052.5	1046.6	1026.0	1016.5	1057.6
3:57:30	1157.6	1053.0	1048.0	1028.6	1017.8	1059.8
4:00:00	1157.3	1056.0	1049.6	1030.9	1019.3	1061.6
4:02:30	1158.0	1052.3	1050.5	1032.7	1020.1	1063.0
4:05:00	1157.6	1058.2	1050.9	1034.6	1020.9	1063.7
4:07:30	1158.3	1063.0	1051.3	1035.3	1020.9	1064.5
4:10:00	1158.0	1058.0	1052.4	1037.1	1022.0	1065.4
4:12:30	1161.6	1063.0	1053.3	1039.3	1022.8	1067.0
4:15:00	1161.1	1073.3	1055.5	1041.9	1024.8	1069.0
4:17:30	1163.6	1066.1	1057.9	1043.9	1027.0	1071.4
4:20:00	1163.8	1069.9	1059.3	1045.1	1029.1	1072.9
4:22:30	1172.4	1077.9	1060.6	1047.6	1030.8	1074.3
4:25:00	1177.8	1076.6	1062.1	1050.3	1032.1	1075.6
4:27:30	1180.0	1083.8	1064.0	1053.2	1034.2	1078.1
4:30:00	1183.5	1090.4	1066.1	1057.1	1036.8	1080.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 7 °F	TC. NO. 8 °F	TC. NO. 9 °F	TC. NO. 10 °F	TC. NO. 11 °F	TC. NO. 12 °F
0:00:00	73.5	74.4	74.4	74.7	74.5	75.1
0:02:30	114.0	81.5	81.2	77.7	78.2	82.4
0:05:00	168.6	104.0	102.1	93.0	92.7	97.3
0:07:30	230.9	136.2	131.6	116.0	113.8	117.2
0:10:00	297.5	175.2	163.7	148.1	141.4	142.3
0:12:30	361.5	221.6	191.8	187.7	174.6	177.5
0:15:00	420.3	265.1	217.6	229.8	210.7	205.7
0:17:30	468.3	300.4	249.8	265.3	250.4	237.0
0:20:00	508.4	334.9	276.3	299.8	285.1	271.2
0:22:30	547.9	369.0	300.6	332.8	318.7	302.4
0:25:00	583.0	400.8	340.4	360.2	345.6	321.4
0:27:30	608.6	430.0	364.9	389.5	373.4	343.6
0:30:00	628.7	456.2	389.8	408.7	394.8	360.9
0:32:30	650.3	481.1	402.8	434.1	427.1	395.7
0:35:00	671.3	500.7	414.9	455.4	450.7	418.4
0:37:30	688.8	522.7	420.8	479.3	477.8	449.9
0:40:00	703.4	540.5	444.0	497.5	496.5	467.0
0:42:30	718.2	560.5	463.2	516.4	516.4	483.2
0:45:00	732.1	578.5	457.8	537.9	541.7	518.9
0:47:30	744.2	597.8	475.6	557.8	561.9	539.9
0:50:00	756.3	614.0	480.4	577.1	581.4	561.0
0:52:30	767.1	628.4	490.2	595.5	599.9	580.8
0:55:00	776.8	644.5	516.6	612.8	617.8	600.3
0:57:30	784.7	656.4	522.7	629.8	636.4	617.9
1:00:00	798.1	672.4	546.5	645.6	654.7	637.7
1:02:30	808.6	685.6	564.0	661.6	674.2	656.7
1:05:00	817.0	699.4	578.7	678.1	695.4	675.8
1:07:30	822.6	708.7	601.2	694.0	716.9	693.7
1:10:00	828.5	724.1	615.5	709.1	738.1	710.5
1:12:30	832.5	727.7	628.4	722.7	752.6	725.0
1:15:00	839.4	740.5	648.2	735.2	770.3	738.3
1:17:30	846.8	748.4	666.1	746.6	784.6	749.0
1:20:00	850.8	752.6	669.8	757.3	796.7	758.8
1:22:30	853.6	757.2	670.8	765.7	808.9	768.1
1:25:00	857.8	752.7	688.1	772.2	823.0	776.0
1:27:30	858.9	767.4	693.5	778.8	831.7	787.8
1:30:00	864.5	761.2	704.3	786.7	836.8	798.3
1:32:30	876.9	765.8	708.2	794.8	841.3	807.5
1:35:00	884.9	786.4	731.1	803.3	849.8	816.8
1:37:30	888.7	802.3	741.7	812.2	852.5	825.2
1:40:00	891.9	808.8	766.6	820.3	856.8	836.4
1:42:30	891.9	817.1	780.3	826.5	859.6	847.2
1:45:00	893.1	827.0	805.7	831.4	863.5	859.0
1:47:30	897.2	833.4	817.3	836.3	867.5	870.2
1:50:00	903.3	841.9	835.8	841.2	872.4	879.9
1:52:30	908.9	845.7	852.4	846.4	877.8	887.9
1:55:00	912.4	857.1	870.0	851.0	887.0	898.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 7 °F	TC. NO. 8 °F	TC. NO. 9 °F	TC. NO. 10 °F	TC. NO. 11 °F	TC. NO. 12 °F
1:57:30	916.0	871.4	882.0	857.4	891.9	907.7
2:00:00	917.1	877.3	887.4	863.6	900.0	916.7
2:02:30	918.7	881.1	892.2	870.7	904.4	925.8
2:05:00	923.4	891.5	907.5	877.4	910.1	933.1
2:07:30	925.5	898.0	932.8	884.3	914.3	939.3
2:10:00	927.9	898.7	991.3	893.1	917.2	946.0
2:12:30	931.6	907.4	1051.4	903.1	925.2	953.9
2:15:00	931.2	910.3	1093.9	913.4	930.4	961.7
2:17:30	934.2	915.7	1109.1	922.2	934.5	967.5
2:20:00	939.9	925.8	1116.7	930.0	943.3	974.4
2:22:30	941.1	933.0	1127.5	938.8	952.0	981.5
2:25:00	945.6	937.7	1135.4	945.5	954.8	987.8
2:27:30	947.1	935.2	1138.9	950.9	964.6	992.4
2:30:00	948.0	929.1	1140.0	956.5	977.3	996.9
2:32:30	954.4	944.3	1141.0	959.5	986.4	1001.9
2:35:00	958.1	947.2	1139.7	962.3	996.6	1006.6
2:37:30	960.8	953.6	1140.2	965.9	1007.0	1011.5
2:40:00	966.5	963.5	1140.4	968.4	1016.9	1016.1
2:42:30	971.9	965.3	1132.7	968.9	1021.5	1017.9
2:45:00	979.9	968.0	1137.8	971.0	1029.6	1022.1
2:47:30	982.4	974.0	1139.0	975.1	1040.3	1026.2
2:50:00	985.4	981.3	1139.0	976.9	1048.9	1030.7
2:52:30	988.6	985.8	1139.1	979.7	1056.2	1034.3
2:55:00	990.6	988.4	1139.4	982.1	1060.5	1038.1
2:57:30	989.4	993.7	1141.0	985.5	1067.6	1042.4
3:00:00	995.6	995.7	1141.9	980.2	1067.4	1045.0
3:02:30	999.7	1003.4	1142.2	982.0	1072.4	1048.8
3:05:00	1005.0	1007.1	1143.7	982.6	1074.9	1052.3
3:07:30	1004.4	1012.9	1145.2	984.4	1079.3	1056.6
3:10:00	1006.8	1016.9	1146.2	986.1	1083.6	1060.5
3:12:30	1007.6	1019.5	1147.1	986.7	1084.8	1063.7
3:15:00	1010.3	1025.3	1145.0	988.2	1088.3	1067.5
3:17:30	1012.0	1023.7	1147.6	989.4	1088.4	1070.2
3:20:00	1011.8	1021.3	1151.4	992.2	1091.7	1072.9
3:22:30	1015.4	1030.8	1153.1	995.9	1093.7	1076.4
3:25:00	1019.7	1025.7	1157.2	998.2	1099.5	1076.7
3:27:30	1018.4	1030.3	1162.0	1001.4	1103.3	1078.6
3:30:00	1025.0	1034.5	1168.3	1003.8	1107.0	1082.1
3:32:30	1029.2	1035.1	1173.6	1006.5	1110.0	1084.7
3:35:00	1028.0	1036.8	1176.2	1010.2	1113.9	1087.5
3:37:30	1034.0	1040.0	1180.6	1012.2	1117.2	1090.6
3:40:00	1040.4	1041.1	1182.6	1014.5	1119.2	1093.8
3:42:30	1040.3	1044.8	1186.7	1018.3	1123.1	1097.0
3:45:00	1043.9	1048.3	1187.5	1020.9	1125.3	1100.3
3:47:30	1042.6	1044.4	1191.6	1024.2	1124.9	1103.0
3:50:00	1048.8	1051.4	1193.2	1025.8	1123.1	1105.7
3:52:30	1048.1	1051.0	1198.8	1028.6	1125.5	1108.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 7 °F	TC. NO. 8 °F	TC. NO. 9 °F	TC. NO. 10 °F	TC. NO. 11 °F	TC. NO. 12 °F
3:55:00	1052.5	1053.7	1198.8	1031.6	1126.7	1111.9
3:57:30	1055.6	1056.8	1199.2	1035.2	1127.3	1114.7
4:00:00	1054.6	1057.2	1202.9	1037.9	1128.2	1117.6
4:02:30	1056.8	1053.9	1205.1	1040.4	1130.5	1120.1
4:05:00	1057.2	1056.4	1203.1	1041.2	1129.3	1122.0
4:07:30	1060.2	1051.4	1209.3	1042.3	1130.6	1123.8
4:10:00	1060.1	1053.8	1207.6	1043.2	1129.4	1125.1
4:12:30	1069.6	1060.6	1213.1	1042.9	1131.9	1128.1
4:15:00	1069.2	1059.9	1217.3	1044.8	1132.7	1130.4
4:17:30	1073.5	1058.8	1222.4	1045.9	1134.4	1132.6
4:20:00	1073.6	1059.1	1225.2	1047.4	1133.4	1134.8
4:22:30	1073.4	1058.5	1227.6	1047.9	1130.8	1136.0
4:25:00	1077.7	1064.4	1229.1	1048.7	1135.2	1139.3
4:27:30	1082.0	1063.2	1233.8	1049.0	1136.6	1142.1
4:30:00	1084.6	1065.1	1249.3	1051.1	1136.5	1142.7

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 13 °F	TC. NO. 14 °F	TC. NO. 15 °F	TC. NO. 16 °F	TC. NO. 17 °F	TC. NO. 18 °F
0:00:00	75.1	73.7	75.0	74.8	75.0	75.1
0:02:30	81.5	122.4	77.9	79.3	78.9	78.0
0:05:00	95.6	185.9	94.2	96.3	94.5	91.1
0:07:30	115.4	259.8	119.8	122.2	118.1	111.7
0:10:00	143.1	338.3	153.6	157.5	150.0	141.9
0:12:30	176.7	409.9	192.1	198.0	184.9	178.1
0:15:00	203.1	470.9	233.5	238.0	214.1	209.7
0:17:30	228.8	518.2	275.5	274.2	248.7	242.7
0:20:00	251.0	557.5	313.9	302.1	277.4	257.8
0:22:30	264.6	594.6	349.1	335.3	308.5	275.7
0:25:00	287.9	626.0	379.4	365.0	332.1	291.2
0:27:30	299.6	647.1	406.2	398.5	364.4	307.5
0:30:00	333.0	665.2	432.7	422.8	389.5	317.2
0:32:30	363.9	684.2	455.0	437.7	415.1	330.0
0:35:00	380.0	702.0	477.4	454.5	436.5	345.0
0:37:30	411.8	717.9	497.7	471.9	459.9	355.1
0:40:00	439.2	731.9	516.0	487.8	475.1	372.7
0:42:30	471.2	747.5	535.2	499.1	488.1	401.1
0:45:00	494.0	760.6	555.2	512.1	508.2	435.6
0:47:30	503.1	773.1	574.2	525.6	535.3	473.5
0:50:00	504.8	785.9	592.9	542.2	555.6	509.7
0:52:30	495.5	796.1	610.9	560.7	572.2	544.1
0:55:00	511.4	805.9	628.2	579.1	588.0	573.9
0:57:30	555.0	814.1	644.5	596.7	603.1	597.2
1:00:00	584.1	825.4	659.8	614.2	618.7	634.4
1:02:30	607.1	836.4	674.2	632.3	633.4	667.7
1:05:00	633.6	845.7	687.3	649.8	647.8	698.2
1:07:30	655.0	851.3	699.4	666.1	661.9	720.3
1:10:00	677.9	856.9	711.9	680.0	674.1	729.0
1:12:30	693.9	859.9	722.9	690.9	684.5	736.7
1:15:00	712.2	863.9	733.5	701.5	694.2	741.6
1:17:30	730.6	870.0	742.7	711.5	704.1	745.7
1:20:00	742.4	873.5	752.4	721.4	713.7	759.5
1:22:30	756.1	876.5	762.0	732.2	722.2	766.5
1:25:00	766.7	879.3	771.6	744.9	730.2	770.4
1:27:30	779.1	880.1	780.2	754.8	737.6	769.4
1:30:00	790.9	882.4	789.6	762.7	744.5	784.5
1:32:30	806.4	891.4	801.3	772.3	753.5	792.7
1:35:00	827.1	900.1	811.7	779.7	762.5	803.3
1:37:30	833.5	902.7	820.9	786.2	767.2	812.5
1:40:00	836.7	907.0	829.1	792.0	773.4	824.0
1:42:30	839.3	907.8	834.1	798.1	779.7	834.4
1:45:00	844.1	911.4	839.2	803.4	785.7	844.6
1:47:30	849.5	917.2	844.3	808.9	791.3	856.3
1:50:00	855.5	922.2	849.3	814.8	796.7	862.8
1:52:30	857.9	928.1	854.9	820.0	802.3	867.4
1:55:00	862.4	931.2	859.7	822.9	809.1	871.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 13 °F	TC. NO. 14 °F	TC. NO. 15 °F	TC. NO. 16 °F	TC. NO. 17 °F	TC. NO. 18 °F
1:57:30	864.9	935.5	864.7	826.9	815.6	875.5
2:00:00	869.6	937.8	870.6	830.8	821.4	878.0
2:02:30	872.8	940.8	882.9	835.2	829.6	879.6
2:05:00	874.5	944.7	917.1	838.2	839.1	888.3
2:07:30	878.0	946.9	942.1	842.5	850.8	901.5
2:10:00	883.3	948.9	960.6	845.9	861.8	912.4
2:12:30	888.3	953.1	975.4	849.5	871.2	927.4
2:15:00	891.5	952.3	990.7	853.3	883.9	945.2
2:17:30	895.9	954.5	1009.9	856.1	897.2	961.1
2:20:00	903.3	958.8	1033.3	859.5	914.4	978.9
2:22:30	909.3	958.8	1063.6	862.5	931.6	991.2
2:25:00	912.4	960.3	1091.2	865.7	947.3	1002.5
2:27:30	916.4	961.2	1105.2	867.9	963.4	1006.6
2:30:00	922.8	960.8	1114.0	869.7	987.0	1007.9
2:32:30	927.8	963.8	1120.3	872.2	1014.9	1006.7
2:35:00	933.8	967.7	1118.1	876.0	1046.1	1005.5
2:37:30	939.2	968.8	1125.7	880.9	1083.7	1006.0
2:40:00	940.8	971.6	1126.0	885.0	1123.8	1005.5
2:42:30	945.8	977.3	1120.0	890.0	1137.3	1005.3
2:45:00	950.5	984.2	1118.4	897.1	1153.0	1008.0
2:47:30	956.1	985.8	1119.6	903.6	1154.1	1015.7
2:50:00	962.2	989.6	1117.9	909.9	1141.8	1015.9
2:52:30	965.7	991.6	1117.3	916.1	1136.6	1020.3
2:55:00	970.0	992.5	1112.2	925.4	1142.4	1021.8
2:57:30	976.8	992.6	1109.2	943.2	1151.0	1022.2
3:00:00	979.4	997.1	1111.0	958.4	1158.5	1020.7
3:02:30	984.2	1000.8	1105.9	971.4	1165.9	1018.6
3:05:00	987.9	1005.5	1106.1	983.8	1173.1	1019.7
3:07:30	993.4	1003.4	1103.5	999.2	1177.2	1020.4
3:10:00	999.4	1007.1	1105.3	1013.0	1182.4	1020.8
3:12:30	1003.9	1007.1	1103.5	1020.3	1190.0	1021.7
3:15:00	1009.2	1010.5	1097.4	1020.1	1193.1	1024.9
3:17:30	1011.9	1010.8	1093.9	1022.2	1197.6	1024.1
3:20:00	1015.5	1013.6	1095.6	1027.3	1208.1	1018.7
3:22:30	1017.0	1015.4	1094.8	1026.7	1215.1	1021.0
3:25:00	1014.1	1020.4	1097.8	1021.5	1221.4	1020.9
3:27:30	1016.2	1018.9	1102.2	1016.0	1231.8	1021.1
3:30:00	1019.8	1025.0	1107.9	1008.9	1242.2	1025.6
3:32:30	1021.0	1026.2	1111.3	1004.0	1251.3	1030.7
3:35:00	1023.1	1027.2	1112.3	1000.2	1257.6	1030.0
3:37:30	1025.5	1032.7	1113.1	997.1	1260.1	1035.2
3:40:00	1029.0	1038.2	1115.2	995.8	1268.7	1037.8
3:42:30	1031.7	1038.9	1114.7	995.9	1274.0	1039.8
3:45:00	1033.9	1041.1	1113.2	993.8	1280.5	1042.2
3:47:30	1036.1	1041.8	1115.0	993.7	1286.3	1039.2
3:50:00	1036.4	1044.7	1119.0	994.5	1271.0	1044.6
3:52:30	1040.7	1046.4	1121.8	995.0	1271.1	1046.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 13 °F	TC. NO. 14 °F	TC. NO. 15 °F	TC. NO. 16 °F	TC. NO. 17 °F	TC. NO. 18 °F
3:55:00	1041.3	1049.8	1123.3	995.7	1273.1	1048.7
3:57:30	1042.0	1051.3	1125.7	997.7	1275.9	1052.4
4:00:00	1046.7	1050.8	1128.6	998.6	1276.9	1055.6
4:02:30	1047.8	1052.5	1131.3	999.4	1279.3	1055.7
4:05:00	1049.1	1052.4	1133.4	999.6	1281.6	1055.6
4:07:30	1049.3	1056.1	1137.6	1000.4	1283.3	1055.8
4:10:00	1051.3	1055.3	1140.7	1001.6	1284.2	1056.1
4:12:30	1052.2	1063.2	1144.1	1003.6	1288.4	1061.8
4:15:00	1054.1	1064.4	1145.9	1006.4	1291.4	1063.4
4:17:30	1055.3	1066.9	1150.6	1009.9	1292.6	1067.7
4:20:00	1055.8	1066.2	1152.7	1011.4	1295.5	1065.8
4:22:30	1057.8	1066.5	1152.3	1012.2	1299.6	1059.4
4:25:00	1060.4	1070.7	1156.0	1013.3	1300.6	1065.5
4:27:30	1060.3	1074.7	1157.3	1015.8	1304.4	1066.6
4:30:00	1060.5	1075.5	1164.6	1022.5	1304.1	1067.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME	TC. NO. 19	TC. NO. 20	TC. NO. 21	TC. NO. 22	TC. NO. 23	TC. NO. 24
hr:min:sec	°F	°F	°F	°F	°F	°F
0:00:00	75.4	76.1	74.3	75.8	75.6	75.6
0:02:30	79.6	80.9	132.7	78.4	78.2	77.9
0:05:00	92.1	93.2	203.1	90.0	89.5	87.9
0:07:30	109.0	109.6	283.4	106.5	105.8	102.7
0:10:00	133.0	133.3	365.1	130.8	128.8	122.8
0:12:30	157.1	161.7	436.0	160.4	157.6	147.6
0:15:00	179.2	193.6	493.6	194.1	190.7	172.6
0:17:30	206.4	226.1	539.1	227.2	224.8	196.6
0:20:00	198.0	256.5	574.1	258.1	256.4	221.2
0:22:30	167.5	286.3	608.5	288.0	287.3	248.6
0:25:00	171.4	315.5	637.6	315.8	317.0	270.4
0:27:30	176.2	343.1	657.2	344.1	341.9	300.5
0:30:00	181.0	369.4	676.9	365.6	366.8	304.1
0:32:30	190.5	395.0	698.2	388.6	394.4	334.5
0:35:00	195.7	419.3	718.4	409.5	418.6	342.3
0:37:30	205.3	442.1	736.9	433.6	439.2	385.2
0:40:00	210.8	462.8	751.3	457.1	461.4	401.5
0:42:30	218.8	477.4	764.5	473.9	480.6	421.0
0:45:00	224.3	498.7	777.8	495.5	496.6	446.9
0:47:30	234.5	522.2	788.2	516.9	515.9	465.3
0:50:00	300.0	544.9	797.5	537.6	534.6	481.9
0:52:30	354.2	567.2	808.1	557.4	554.5	501.2
0:55:00	403.5	588.7	816.4	575.9	573.5	520.2
0:57:30	443.4	609.8	822.4	595.4	590.9	537.9
1:00:00	480.3	630.3	834.1	613.5	608.6	556.7
1:02:30	506.8	651.1	843.2	632.2	625.8	574.4
1:05:00	530.4	671.4	851.1	650.8	641.5	592.6
1:07:30	562.1	690.9	854.9	668.2	658.2	610.5
1:10:00	597.7	709.3	858.1	684.0	672.1	627.2
1:12:30	625.0	727.1	861.4	698.4	685.4	642.7
1:15:00	653.1	743.7	867.3	714.6	696.3	656.6
1:17:30	672.9	759.0	872.6	735.3	709.8	669.3
1:20:00	688.4	773.1	874.8	757.3	724.7	682.4
1:22:30	703.2	783.5	877.7	768.7	738.0	695.3
1:25:00	718.9	792.5	880.6	775.9	751.8	708.0
1:27:30	731.9	800.4	881.3	783.9	762.6	720.3
1:30:00	743.2	808.3	890.6	800.1	775.3	731.8
1:32:30	749.2	816.2	908.4	819.9	783.0	743.1
1:35:00	754.7	824.6	910.7	837.0	794.0	754.6
1:37:30	763.1	832.9	912.4	850.0	802.4	763.9
1:40:00	772.0	842.7	914.5	857.2	811.5	773.6
1:42:30	779.7	855.3	914.5	862.8	820.2	782.9
1:45:00	786.2	863.8	915.0	867.6	829.0	790.5
1:47:30	792.1	870.4	919.9	873.7	834.6	798.2
1:50:00	797.7	876.2	924.2	880.4	839.9	806.3
1:52:30	803.3	881.9	928.4	888.8	844.6	814.1
1:55:00	808.9	889.1	930.0	898.5	848.5	821.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 19 °F	TC. NO. 20 °F	TC. NO. 21 °F	TC. NO. 22 °F	TC. NO. 23 °F	TC. NO. 24 °F
1:57:30	814.1	898.6	933.0	906.7	854.4	827.5
2:00:00	818.6	909.8	935.4	911.0	859.2	833.4
2:02:30	823.6	926.5	937.5	917.7	863.5	840.1
2:05:00	827.8	943.0	942.3	924.9	867.5	846.2
2:07:30	833.8	958.0	946.5	931.1	872.0	851.9
2:10:00	840.1	971.2	947.1	937.5	876.3	855.6
2:12:30	846.8	985.3	951.8	943.7	880.4	859.2
2:15:00	854.8	997.8	952.7	950.3	884.7	863.6
2:17:30	863.3	1006.7	954.7	955.6	888.0	867.6
2:20:00	872.0	1016.2	959.1	961.6	894.8	871.1
2:22:30	881.4	1024.0	959.9	968.4	899.0	875.3
2:25:00	889.2	1029.2	963.1	974.4	904.1	879.7
2:27:30	896.8	1030.9	963.8	979.5	908.2	884.1
2:30:00	902.7	1033.9	962.7	985.2	911.1	888.9
2:32:30	908.1	1035.9	966.5	989.2	915.5	893.8
2:35:00	913.2	1037.4	968.8	993.7	921.7	899.0
2:37:30	919.7	1039.2	970.2	998.5	929.5	905.3
2:40:00	924.6	1041.1	973.7	1003.3	935.9	910.8
2:42:30	928.5	1041.9	977.9	1005.1	940.7	916.2
2:45:00	934.6	1043.5	984.2	1008.4	946.7	922.4
2:47:30	941.4	1045.4	986.7	1013.1	952.8	929.2
2:50:00	947.0	1046.1	989.0	1016.9	956.9	935.0
2:52:30	953.2	1047.4	990.9	1020.9	962.5	941.3
2:55:00	952.6	1057.6	992.0	1023.8	965.8	947.3
2:57:30	955.3	1062.0	991.4	1027.6	970.5	953.6
3:00:00	960.5	1062.8	995.6	1030.1	972.5	957.4
3:02:30	965.8	1064.3	999.7	1033.4	974.9	961.8
3:05:00	969.7	1065.9	1003.5	1036.1	979.6	965.5
3:07:30	973.0	1067.8	1002.7	1040.1	987.1	970.6
3:10:00	974.9	1069.0	1005.9	1043.5	990.9	974.1
3:12:30	976.5	1070.7	1005.9	1046.5	995.0	977.4
3:15:00	977.1	1073.3	1009.6	1048.9	999.8	980.0
3:17:30	979.3	1074.9	1011.1	1052.9	1008.9	987.4
3:20:00	981.7	1077.0	1012.2	1055.6	1011.5	992.5
3:22:30	982.2	1079.3	1014.6	1057.9	1013.7	995.5
3:25:00	982.7	1081.8	1018.4	1059.8	1013.0	995.8
3:27:30	984.5	1083.8	1017.8	1062.2	1014.3	997.3
3:30:00	986.1	1085.9	1022.9	1064.6	1014.1	997.5
3:32:30	988.2	1088.7	1025.7	1067.0	1016.8	998.4
3:35:00	989.8	1091.1	1026.9	1069.8	1018.3	999.2
3:37:30	991.6	1093.3	1030.2	1071.9	1018.7	1000.3
3:40:00	993.6	1095.5	1035.5	1074.0	1018.1	1002.3
3:42:30	995.9	1098.2	1036.9	1077.2	1019.2	1005.4
3:45:00	996.5	1101.1	1039.9	1079.3	1018.8	1007.9
3:47:30	998.5	1103.6	1039.6	1081.4	1017.8	1009.5
3:50:00	1000.8	1105.1	1042.9	1083.2	1016.4	1010.5
3:52:30	1003.2	1106.4	1043.4	1085.8	1014.9	1012.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 19 °F	TC. NO. 20 °F	TC. NO. 21 °F	TC. NO. 22 °F	TC. NO. 23 °F	TC. NO. 24 °F
3:55:00	1005.3	1108.6	1045.0	1087.6	1014.5	1012.7
3:57:30	1007.7	1110.8	1048.2	1089.6	1014.7	1013.0
4:00:00	1010.3	1112.4	1047.6	1091.0	1014.9	1013.0
4:02:30	1012.0	1114.7	1049.4	1091.7	1014.2	1011.6
4:05:00	1013.4	1115.7	1048.6	1092.5	1014.1	1009.7
4:07:30	1015.3	1117.5	1052.5	1093.7	1014.4	1008.4
4:10:00	1017.8	1119.1	1051.4	1095.0	1013.7	1007.8
4:12:30	1020.2	1121.9	1059.9	1094.7	1015.6	1007.2
4:15:00	1023.0	1125.0	1059.8	1096.8	1017.6	1008.4
4:17:30	1026.6	1127.2	1063.8	1098.0	1019.4	1009.7
4:20:00	1028.7	1129.6	1062.8	1098.4	1018.6	1011.2
4:22:30	1029.8	1131.8	1062.1	1098.8	1018.6	1012.1
4:25:00	1031.7	1133.9	1065.7	1098.8	1020.1	1013.4
4:27:30	1033.8	1136.6	1068.8	1099.5	1021.0	1014.8
4:30:00	1039.4	1127.8	1075.8	1100.4	1022.2	1016.5

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 25 °F	TC. NO. 26 °F	TC. NO. 27 °F	TC. NO. 28 °F	TC. NO. 29 °F
0:00:00	75.2	75.8	75.8	74.5	75.8
0:02:30	81.6	78.1	80.1	116.8	75.8
0:05:00	101.8	86.0	91.7	171.2	75.9
0:07:30	128.4	96.8	107.4	233.7	75.8
0:10:00	155.5	112.4	130.1	302.9	76.2
0:12:30	190.8	132.0	157.3	367.1	77.2
0:15:00	225.4	154.7	187.6	426.5	79.0
0:17:30	256.7	180.3	217.9	476.1	82.2
0:20:00	289.9	200.4	246.9	517.8	87.6
0:22:30	325.0	224.4	274.7	556.6	95.2
0:25:00	355.8	247.9	300.8	591.8	104.8
0:27:30	382.6	273.6	326.1	616.3	115.9
0:30:00	405.9	296.0	346.7	635.9	127.9
0:32:30	428.3	318.6	367.2	656.7	140.2
0:35:00	446.5	335.8	383.4	675.9	151.9
0:37:30	464.8	364.2	407.6	693.5	162.8
0:40:00	483.9	380.4	430.3	708.1	172.5
0:42:30	501.9	395.9	452.5	722.9	180.0
0:45:00	518.3	418.8	474.1	737.4	186.3
0:47:30	534.5	442.4	496.5	750.0	192.2
0:50:00	549.9	462.3	517.7	760.7	197.3
0:52:30	564.7	483.3	537.9	770.9	201.3
0:55:00	579.0	501.3	556.0	781.4	204.7
0:57:30	592.4	519.4	573.1	789.4	206.8
1:00:00	607.0	537.3	593.5	801.8	208.3
1:02:30	621.2	554.8	610.9	813.6	209.9
1:05:00	634.6	571.2	628.5	822.6	210.9
1:07:30	647.5	588.3	644.5	827.6	212.4
1:10:00	658.4	604.5	659.5	833.0	213.7
1:12:30	666.9	623.3	673.4	837.7	215.6
1:15:00	675.8	639.7	690.2	845.2	217.6
1:17:30	690.2	655.6	722.5	853.1	220.4
1:20:00	708.1	671.7	745.1	858.7	223.5
1:22:30	722.1	686.7	754.8	861.9	226.8
1:25:00	732.9	701.5	775.9	865.4	230.6
1:27:30	739.9	716.0	799.8	866.8	234.7
1:30:00	745.6	729.6	816.7	871.4	239.6
1:32:30	752.8	743.0	832.9	884.5	244.8
1:35:00	761.9	756.7	849.9	890.6	250.7
1:37:30	768.2	768.8	850.6	895.0	256.8
1:40:00	774.6	780.2	845.2	898.7	263.5
1:42:30	778.5	790.1	842.1	899.6	270.9
1:45:00	783.5	800.3	838.7	901.3	278.5
1:47:30	789.3	809.9	838.0	907.8	286.6
1:50:00	794.3	818.4	843.6	912.9	294.8
1:52:30	799.2	826.8	856.0	918.5	303.1
1:55:00	804.4	834.3	868.9	921.1	311.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 25 °F	TC. NO. 26 °F	TC. NO. 27 °F	TC. NO. 28 °F	TC. NO. 29 °F
1:57:30	810.9	840.6	879.3	926.0	319.8
2:00:00	816.4	846.0	886.2	930.4	328.0
2:02:30	820.8	852.2	888.0	933.1	336.0
2:05:00	825.1	858.6	895.0	938.0	344.1
2:07:30	830.7	865.3	899.8	941.9	351.8
2:10:00	833.8	875.1	904.9	943.0	359.4
2:12:30	839.1	881.5	909.7	946.3	366.6
2:15:00	845.1	888.7	915.7	946.9	374.0
2:17:30	846.8	897.0	917.7	947.8	380.7
2:20:00	853.9	901.9	928.4	951.6	387.7
2:22:30	856.9	910.6	930.7	952.2	394.3
2:25:00	859.1	913.8	933.8	953.9	401.2
2:27:30	858.2	917.9	933.2	954.2	407.3
2:30:00	857.0	924.5	934.1	952.9	413.3
2:32:30	860.1	931.0	940.7	956.5	419.3
2:35:00	865.7	936.6	944.3	958.3	425.1
2:37:30	869.4	941.0	951.6	960.3	430.7
2:40:00	866.1	946.2	946.7	963.7	436.6
2:42:30	868.6	952.5	953.6	967.9	442.2
2:45:00	875.2	958.7	951.5	974.1	447.8
2:47:30	878.6	963.0	965.6	975.7	452.9
2:50:00	885.3	970.4	964.3	978.4	458.2
2:52:30	889.1	981.8	978.7	980.0	463.1
2:55:00	887.6	988.3	972.3	981.4	468.1
2:57:30	894.0	994.6	979.6	980.9	472.9
3:00:00	890.2	999.7	980.1	984.5	477.6
3:02:30	880.4	1006.1	975.7	987.4	482.1
3:05:00	886.1	1010.3	981.2	990.6	486.7
3:07:30	893.3	1014.9	992.3	990.4	490.9
3:10:00	898.4	1018.3	993.3	993.3	495.1
3:12:30	901.6	1021.4	990.3	993.5	499.3
3:15:00	906.0	1025.0	1002.6	997.0	503.4
3:17:30	900.5	1032.9	999.6	996.9	507.2
3:20:00	889.3	1038.2	998.8	998.1	511.1
3:22:30	897.7	1042.7	1004.8	999.8	515.2
3:25:00	888.9	1045.5	999.7	1003.8	518.6
3:27:30	889.0	1049.9	1006.7	1003.3	522.0
3:30:00	898.4	1052.2	1015.5	1007.8	525.4
3:32:30	908.7	1055.0	1014.6	1009.9	528.8
3:35:00	917.8	1058.4	1018.0	1012.0	532.1
3:37:30	923.6	1060.6	1019.8	1015.2	535.5
3:40:00	925.8	1062.6	1023.2	1020.6	538.7
3:42:30	925.0	1065.8	1025.5	1020.9	541.8
3:45:00	935.3	1068.7	1030.3	1023.9	545.0
3:47:30	909.9	1071.5	1023.0	1023.6	547.9
3:50:00	923.3	1073.8	1029.8	1026.9	550.4
3:52:30	913.8	1076.2	1029.8	1028.2	553.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 3
TEMPERATURES, °F

TIME hr:min:sec	TC. NO. 25 °F	TC. NO. 26 °F	TC. NO. 27 °F	TC. NO. 28 °F	TC. NO. 29 °F
3:55:00	937.0	1079.7	1033.5	1030.7	556.0
3:57:30	939.5	1081.8	1041.1	1033.3	558.5
4:00:00	953.4	1083.9	1048.0	1032.6	561.0
4:02:30	950.6	1085.8	1045.2	1034.3	563.6
4:05:00	954.8	1087.0	1047.7	1034.0	565.7
4:07:30	945.4	1090.0	1042.0	1037.4	568.1
4:10:00	932.1	1091.9	1041.9	1035.7	570.3
4:12:30	942.4	1092.9	1046.6	1043.4	572.3
4:15:00	945.4	1095.9	1050.9	1044.7	574.7
4:17:30	947.4	1098.4	1052.0	1048.3	576.7
4:20:00	916.1	1102.0	1047.1	1046.2	578.8
4:22:30	897.5	1104.6	1038.8	1046.5	580.9
4:25:00	911.3	1105.8	1045.5	1049.9	582.4
4:27:30	903.2	1108.2	1042.4	1054.3	584.5
4:30:00	904.1	1109.6	1048.5	1056.6	586.3

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1 °F	TC. NO. 2 °F	TC. NO. 3 °F	TC. NO. 4 °F	TC. NO. 5 °F	TC. NO. 6 °F
0:00:00	72.5	72.3	72.5	72.5	72.1	72.5
0:02:30	74.1	74.7	74.1	74.4	72.8	77.3
0:05:00	84.8	86.9	84.4	85.1	77.7	90.9
0:07:30	103.6	106.8	101.6	103.2	85.9	108.8
0:10:00	130.4	133.8	126.7	128.9	97.4	134.8
0:12:30	159.1	165.2	157.4	160.8	111.4	164.9
0:15:00	190.6	199.1	189.5	196.8	129.5	196.4
0:17:30	227.3	232.0	221.9	234.8	150.7	229.3
0:20:00	264.5	266.4	254.3	273.3	175.5	263.1
0:22:30	299.2	302.4	285.1	309.6	200.4	296.3
0:25:00	331.4	335.2	313.6	344.0	224.9	327.0
0:27:30	362.0	366.2	341.5	376.2	250.2	354.3
0:30:00	389.3	394.1	367.4	402.1	274.3	369.0
0:32:30	412.2	417.6	390.3	423.7	298.6	390.7
0:35:00	436.8	439.6	413.8	445.4	319.9	415.2
0:37:30	459.6	462.5	437.2	467.6	342.2	438.8
0:40:00	479.6	485.2	458.9	491.4	364.6	461.2
0:42:30	499.7	506.8	479.2	513.4	385.4	483.2
0:45:00	519.5	527.6	499.8	535.4	405.3	505.1
0:47:30	538.8	548.2	521.1	555.3	425.0	525.9
0:50:00	557.7	566.6	540.6	576.5	444.2	546.3
0:52:30	576.5	586.3	559.6	597.7	463.5	566.1
0:55:00	594.3	605.0	579.2	617.6	482.1	585.3
0:57:30	609.3	622.1	597.9	634.2	501.3	604.4
1:00:00	625.1	637.4	615.2	651.3	519.7	622.3
1:02:30	638.8	651.5	631.7	665.3	538.2	640.2
1:05:00	651.3	665.1	646.2	682.3	553.9	657.5
1:07:30	662.4	677.2	658.7	695.2	570.0	674.4
1:10:00	671.9	689.1	670.8	707.7	585.6	690.9
1:12:30	680.1	702.0	681.1	720.8	600.5	707.4
1:15:00	688.4	717.1	692.9	734.2	614.7	724.0
1:17:30	695.7	730.1	704.6	746.7	626.9	739.8
1:20:00	702.4	743.1	716.4	758.0	635.5	752.0
1:22:30	708.7	753.4	728.4	770.2	649.0	763.6
1:25:00	716.7	759.9	740.1	778.5	658.6	774.9
1:27:30	722.2	764.2	750.0	787.5	670.4	786.0
1:30:00	731.1	770.0	760.2	798.1	680.4	796.8
1:32:30	739.2	775.9	769.8	808.5	688.4	807.1
1:35:00	746.4	783.2	779.4	823.9	698.8	818.1
1:37:30	755.3	790.3	788.2	845.1	708.5	828.1
1:40:00	765.3	798.0	797.5	872.3	717.9	836.7
1:42:30	773.7	804.8	806.4	889.9	732.6	842.9
1:45:00	784.0	810.9	816.3	896.3	745.2	848.7
1:47:30	791.3	818.4	826.5	903.1	758.2	855.8
1:50:00	800.2	826.0	836.5	910.4	769.0	864.2
1:52:30	809.2	834.7	845.5	917.7	781.9	872.4
1:55:00	828.0	843.6	855.0	922.3	794.0	879.5
1:57:30	861.1	855.1	863.0	930.8	818.4	886.4

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 1 °F	TC. NO. 2 °F	TC. NO. 3 °F	TC. NO. 4 °F	TC. NO. 5 °F	TC. NO. 6 °F
2:00:00	892.6	866.7	872.4	935.8	862.7	892.7
2:02:30	936.9	878.3	881.8	943.8	896.0	898.7
2:05:00	980.8	891.8	891.5	951.9	930.5	907.4
2:07:30	1017.0	905.1	901.5	961.6	957.8	915.1
2:10:00	1049.5	919.1	911.7	972.4	976.6	922.3
2:12:30	1072.5	933.3	922.1	982.8	991.4	929.5
2:15:00	1081.5	946.1	932.2	991.4	996.7	935.5
2:17:30	1088.9	957.6	943.0	999.5	1002.5	941.4
2:20:00	1092.4	968.1	958.8	1007.5	1006.6	947.5
2:22:30	1092.5	976.4	977.3	1012.1	1011.7	953.7
2:25:00	1092.5	987.6	995.0	1016.6	1017.6	959.5
2:27:30	1088.5	994.3	1009.1	1023.7	1018.4	962.5
2:30:00	1086.0	1001.4	1020.4	1031.1	1021.4	965.4
2:32:30	1088.6	1008.3	1028.6	1035.9	1026.3	969.5
2:35:00	1090.5	1014.6	1035.4	1041.5	1028.7	973.5
2:37:30	1093.8	1021.8	1042.8	1046.2	1033.7	977.2
2:40:00	1097.2	1028.0	1047.0	1052.0	1036.2	981.3
2:42:30	1099.2	1031.8	1050.7	1056.2	1038.5	984.0
2:45:00	1099.3	1035.6	1053.5	1057.5	1036.6	987.0
2:47:30	1102.1	1040.5	1058.0	1061.3	1037.7	989.7
2:50:00	1104.3	1043.1	1061.2	1067.9	1039.3	993.0
2:52:30	1108.9	1047.8	1063.6	1068.4	1043.7	996.6
2:55:00	1110.0	1053.4	1067.9	1076.5	1043.6	999.8
2:57:30	1109.0	1054.7	1070.6	1081.0	1044.9	1003.3
3:00:00	1111.5	1057.0	1072.7	1085.7	1047.8	1007.0
3:02:30	1111.3	1059.9	1074.9	1087.3	1047.1	1010.1
3:05:00	1112.5	1064.9	1077.1	1090.8	1048.0	1014.3
3:07:30	1115.1	1069.0	1078.1	1095.1	1051.2	1018.3
3:10:00	1117.0	1070.7	1079.0	1101.2	1055.5	1022.9
3:12:30	1117.4	1071.8	1080.6	1103.7	1058.1	1027.5
3:15:00	1117.0	1072.0	1081.7	1107.9	1057.6	1031.0
3:17:30	1118.5	1076.4	1083.5	1106.9	1061.2	1034.2
3:20:00	1121.9	1079.7	1084.9	1111.1	1064.5	1036.9
3:22:30	1122.8	1079.8	1086.5	1112.5	1068.5	1040.7
3:25:00	1126.7	1083.6	1088.1	1118.4	1072.4	1043.9
3:27:30	1130.3	1087.7	1090.7	1120.7	1077.6	1047.3
3:30:00	1133.2	1087.8	1093.0	1123.8	1081.5	1051.7
3:32:30	1137.7	1094.1	1095.5	1127.4	1084.4	1055.2
3:35:00	1138.1	1093.7	1098.9	1128.5	1086.9	1058.2
3:37:30	1141.1	1095.5	1101.5	1129.3	1088.3	1060.5
3:40:00	1144.9	1096.1	1100.9	1132.5	1094.9	1062.7
3:42:30	1148.2	1099.9	1104.8	1141.4	1097.5	1065.4
3:45:00	1150.6	1100.4	1106.1	1145.7	1102.3	1067.9
3:47:30	1155.0	1103.4	1107.3	1207.4	1109.1	1070.1
3:50:00	1160.2	1105.9	1108.9	1210.5	1115.6	1072.3
3:52:30	1161.1	1107.6	1110.9	1217.8	1115.9	1074.3
3:55:00	1164.6	1109.3	1112.3	1222.5	1121.1	1076.7
3:57:30	1167.9	1112.6	1114.3	1226.8	1124.6	1079.1

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME	TEMPERATURES, °F					
	TC. NO. 1	TC. NO. 2	TC. NO. 3	TC. NO. 4	TC. NO. 5	TC. NO. 6
hr:min:sec	°F	°F	°F	°F	°F	°F
4:00:00	1170.6	1113.2	1115.9	1230.2	1129.5	1081.7
4:02:30	1172.4	1118.1	1120.9	1235.6	1131.5	1084.1
4:05:00	1179.6	1117.1	1120.3	1238.8	1137.5	1086.7
4:07:30	1183.1	1120.6	1122.6	1244.0	1141.7	1089.3
4:10:00	1188.8	1126.6	1125.6	1247.5	1145.1	1092.9
4:12:30	1197.0	1131.8	1127.3	1253.1	1153.6	1095.8
4:15:00	1198.8	1135.9	1131.8	1257.5	1156.0	1098.9
4:17:30	1205.5	1133.6	1133.1	1261.6	1162.5	1102.1
4:20:00	1214.1	1152.5	1142.6	1269.5	1172.2	1106.6
4:22:30	1231.1	1175.7	1167.1	1274.2	1188.7	1116.7
4:25:00	1245.5	1179.2	1173.8	1279.4	1202.0	1127.3
4:27:30	1243.0	1172.8	1174.0	1283.8	1203.5	1129.0
4:30:00	1243.0	1167.5	1172.4	1285.0	1205.9	1129.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7 °F	TC. NO. 8 °F	TC. NO. 9 °F	TC. NO. 10 °F	TC. NO. 11 °F	TC. NO. 12 °F
0:00:00	71.9	72.6	72.5	72.5	72.5	72.5
0:02:30	38.9	76.3	76.7	75.3	81.1	81.1
0:05:00	-16.6	92.8	93.0	87.7	97.5	99.2
0:07:30	215.0	118.1	117.6	107.7	118.7	123.6
0:10:00	278.6	153.4	153.9	136.5	150.3	158.1
0:12:30	337.4	195.5	194.8	166.6	186.8	195.3
0:15:00	393.6	242.0	239.9	200.5	223.6	235.4
0:17:30	448.7	285.2	281.5	231.4	258.0	274.3
0:20:00	498.9	326.0	320.4	261.6	286.6	311.2
0:22:30	534.7	361.6	355.3	285.4	315.3	350.5
0:25:00	563.9	393.3	386.1	313.5	346.6	385.6
0:27:30	590.5	423.5	411.6	336.8	378.0	413.9
0:30:00	608.8	452.8	434.4	368.2	413.8	440.5
0:32:30	630.2	476.7	456.8	385.0	446.0	472.1
0:35:00	648.7	502.3	479.5	406.6	476.1	498.0
0:37:30	667.1	528.0	503.0	433.3	505.9	536.7
0:40:00	682.8	550.7	525.5	452.5	533.6	562.6
0:42:30	698.7	576.6	547.0	481.5	559.6	586.4
0:45:00	713.1	598.8	568.8	498.0	583.8	614.0
0:47:30	725.1	622.6	590.8	514.1	606.9	641.6
0:50:00	737.3	641.2	611.7	530.0	631.3	665.2
0:52:30	747.7	666.4	630.1	557.0	654.6	688.3
0:55:00	756.5	682.5	648.1	575.2	676.5	710.2
0:57:30	765.9	696.4	664.3	588.2	696.5	730.2
1:00:00	775.0	718.3	678.0	606.7	716.1	750.0
1:02:30	784.0	733.5	692.1	617.8	736.9	776.0
1:05:00	789.7	752.2	708.3	633.6	760.7	798.5
1:07:30	797.0	776.4	724.7	645.4	785.0	820.6
1:10:00	801.4	782.8	740.2	654.3	805.9	838.4
1:12:30	807.0	794.2	756.5	670.0	823.2	869.1
1:15:00	813.2	805.0	783.2	691.2	837.6	891.7
1:17:30	821.0	809.9	810.6	705.5	853.2	907.2
1:20:00	821.6	813.9	826.2	727.9	869.9	918.7
1:22:30	827.4	824.3	846.1	739.7	882.2	928.7
1:25:00	831.5	837.0	860.9	753.5	892.4	933.8
1:27:30	835.1	847.9	865.0	762.9	902.8	939.5
1:30:00	841.5	857.3	861.4	767.0	912.2	950.1
1:32:30	843.8	870.3	864.0	779.8	921.5	958.5
1:35:00	847.0	881.6	871.4	792.0	931.7	970.3
1:37:30	854.1	891.8	879.0	806.7	942.3	979.4
1:40:00	857.9	902.3	887.4	812.5	953.2	989.9
1:42:30	863.9	912.1	895.0	818.3	972.1	997.3
1:45:00	867.3	921.8	903.4	825.3	985.7	1005.7
1:47:30	869.6	930.9	911.6	828.6	997.9	1014.5
1:50:00	875.5	944.4	920.0	846.5	1009.0	1022.4
1:52:30	878.4	952.2	928.1	840.7	1019.5	1030.3
1:55:00	881.3	962.8	935.5	856.4	1028.8	1037.7
1:57:30	884.5	970.5	941.8	857.0	1038.1	1046.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 7 °F	TC. NO. 8 °F	TC. NO. 9 °F	TC. NO. 10 °F	TC. NO. 11 °F	TC. NO. 12 °F
2:00:00	890.8	978.4	949.4	876.1	1047.6	1056.7
2:02:30	894.1	985.4	955.6	886.4	1057.0	1061.8
2:05:00	897.4	993.4	962.9	893.4	1066.0	1067.7
2:07:30	902.5	998.7	968.8	898.7	1073.2	1073.0
2:10:00	905.6	1004.9	974.7	901.2	1080.3	1078.7
2:12:30	913.4	1010.0	979.6	907.2	1087.0	1084.4
2:15:00	914.7	1013.0	985.2	920.1	1091.3	1091.1
2:17:30	916.9	1016.6	991.1	924.8	1095.9	1096.8
2:20:00	921.4	1018.9	995.9	929.5	1100.5	1101.0
2:22:30	925.2	1022.5	1001.0	925.7	1104.8	1105.5
2:25:00	929.0	1025.5	1005.1	918.8	1109.0	1110.8
2:27:30	930.2	1027.9	1009.9	927.2	1112.8	1111.9
2:30:00	928.4	1033.2	1014.1	939.1	1116.4	1115.6
2:32:30	934.1	1038.2	1018.3	941.1	1121.0	1119.3
2:35:00	937.0	1038.3	1021.5	941.0	1124.6	1121.8
2:37:30	939.5	1041.5	1025.5	945.0	1128.1	1126.7
2:40:00	941.6	1045.4	1029.4	949.9	1132.1	1129.9
2:42:30	942.9	1046.2	1032.9	956.9	1134.6	1132.2
2:45:00	946.9	1047.9	1036.2	963.0	1138.6	1133.9
2:47:30	950.2	1048.5	1039.1	966.7	1142.1	1137.5
2:50:00	952.5	1049.0	1041.4	966.3	1145.6	1140.8
2:52:30	956.1	1050.0	1044.1	961.0	1150.1	1146.1
2:55:00	958.0	1053.6	1046.9	974.5	1152.2	1149.8
2:57:30	960.5	1054.6	1049.3	979.4	1155.7	1153.6
3:00:00	962.6	1053.2	1051.6	977.1	1158.5	1157.8
3:02:30	964.6	1058.0	1054.6	984.3	1161.7	1160.9
3:05:00	966.0	1063.1	1057.2	992.7	1164.8	1164.8
3:07:30	970.1	1064.2	1059.1	993.9	1168.9	1166.9
3:10:00	974.3	1066.4	1060.9	999.2	1172.1	1171.2
3:12:30	974.9	1066.2	1064.7	994.0	1175.2	1174.5
3:15:00	974.8	1073.4	1066.9	1003.1	1178.2	1177.4
3:17:30	979.4	1076.6	1068.8	1005.8	1182.1	1179.8
3:20:00	980.6	1080.5	1071.9	1010.4	1185.3	1182.7
3:22:30	986.1	1083.6	1073.7	1012.4	1188.8	1184.4
3:25:00	986.6	1086.3	1077.2	1010.7	1191.9	1188.1
3:27:30	993.0	1089.0	1079.6	1017.9	1195.8	1189.9
3:30:00	993.2	1092.3	1082.2	1020.3	1198.8	1193.4
3:32:30	996.8	1092.1	1085.5	1016.2	1201.8	1197.0
3:35:00	996.3	1098.0	1087.3	1027.3	1204.8	1199.8
3:37:30	998.8	1100.2	1089.8	1029.5	1207.3	1202.6
3:40:00	1003.3	1098.2	1092.6	1023.0	1210.4	1205.6
3:42:30	1004.0	1106.4	1095.1	1035.1	1212.7	1208.6
3:45:00	1006.1	1107.3	1097.3	1037.2	1215.7	1211.3
3:47:30	1010.1	1109.8	1100.4	1036.7	1219.3	1214.2
3:50:00	1013.7	1110.2	1103.1	1038.2	1221.7	1217.3
3:52:30	1015.0	1113.9	1104.7	1039.8	1225.3	1220.3
3:55:00	1017.0	1118.5	1107.9	1044.2	1228.4	1223.9
3:57:30	1021.6	1119.8	1109.3	1050.1	1231.6	1226.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME	TEMPERATURES, °F					
	TC. NO. 7	TC. NO. 8	TC. NO. 9	TC. NO. 10	TC. NO. 11	TC. NO. 12
hr:min:sec	°F	°F	°F	°F	°F	°F
4:00:00	1025.0	1122.1	1112.6	1046.4	1235.9	1230.8
4:02:30	1026.7	1124.8	1115.9	1049.1	1238.6	1233.8
4:05:00	1028.9	1131.1	1120.0	1055.6	1243.2	1238.8
4:07:30	1040.1	1129.4	1115.7	1055.2	1248.7	1239.9
4:10:00	1040.0	1136.0	1120.6	1063.5	1255.4	1243.9
4:12:30	1047.1	1138.7	1123.8	1060.5	1262.3	1246.9
4:15:00	1049.9	1141.4	1121.7	1069.8	1268.5	1247.7
4:17:30	1053.5	1143.5	1125.7	1072.4	1274.1	1253.0
4:20:00	1147.7	1144.4	1125.1	1074.7	1280.0	1253.2
4:22:30	1192.9	1183.6	1175.5	1099.5	1310.8	1261.2
4:25:00	1122.1	1201.7	1192.0	1127.3	1321.9	1283.9
4:27:30	1092.0	1194.3	1176.3	1131.8	1327.6	1291.3
4:30:00	1087.0	1187.2	1166.8	1125.9	1329.5	1296.8

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13 °F	TC. NO. 14 °F	TC. NO. 15 °F	TC. NO. 16 °F	TC. NO. 17 °F	TC. NO. 18 °F
0:00:00	72.6	73.1	72.6	72.5	72.6	72.6
0:02:30	76.1	128.1	77.4	75.7	78.3	76.0
0:05:00	88.6	196.5	92.3	86.1	100.2	89.1
0:07:30	106.8	271.5	112.8	100.8	134.2	108.5
0:10:00	134.5	354.5	141.9	121.9	178.9	136.5
0:12:30	167.6	426.7	175.2	147.2	225.0	170.5
0:15:00	203.6	486.7	203.9	176.4	268.4	209.7
0:17:30	241.5	533.1	227.5	215.7	306.2	249.0
0:20:00	279.6	578.6	253.5	243.5	342.0	288.3
0:22:30	317.8	614.9	283.7	264.9	382.5	326.1
0:25:00	353.6	641.0	309.3	284.1	415.7	358.1
0:27:30	385.7	663.5	337.8	306.0	445.0	387.9
0:30:00	416.6	680.4	365.7	330.5	470.4	417.5
0:32:30	447.7	697.2	372.7	329.6	492.2	441.9
0:35:00	476.4	713.9	404.7	373.1	514.3	468.4
0:37:30	506.8	731.0	422.7	376.7	536.0	494.8
0:40:00	535.8	744.8	426.3	417.0	554.9	515.1
0:42:30	563.1	758.7	458.6	437.1	575.7	540.2
0:45:00	590.1	769.7	467.2	458.1	594.2	567.4
0:47:30	616.6	780.7	482.2	481.3	611.0	583.3
0:50:00	640.3	790.3	506.9	505.4	629.9	610.4
0:52:30	662.0	801.4	540.0	521.6	647.3	619.2
0:55:00	682.7	810.6	548.9	551.1	664.2	648.0
0:57:30	701.5	817.6	557.7	565.6	679.4	667.7
1:00:00	718.9	828.4	549.9	577.3	692.8	683.9
1:02:30	736.1	837.7	550.6	606.8	702.7	692.5
1:05:00	752.7	846.7	578.2	625.9	713.9	711.2
1:07:30	769.0	852.6	617.3	639.7	725.1	752.7
1:10:00	784.2	857.3	602.4	660.5	732.4	758.7
1:12:30	796.8	861.4	640.7	671.6	741.6	778.1
1:15:00	810.4	865.3	656.1	684.6	753.4	782.4
1:17:30	827.1	867.7	656.5	675.6	766.8	792.3
1:20:00	843.7	876.8	679.5	694.1	779.1	802.6
1:22:30	858.0	882.0	673.6	716.4	789.3	811.1
1:25:00	870.9	885.6	678.0	731.0	799.3	811.9
1:27:30	885.7	888.0	661.4	744.4	806.5	810.9
1:30:00	902.3	893.8	620.8	757.1	816.1	814.8
1:32:30	920.0	900.7	704.7	763.5	827.0	824.9
1:35:00	936.2	908.0	719.7	773.1	826.8	834.7
1:37:30	950.1	915.9	728.5	797.6	813.9	842.8
1:40:00	962.5	922.0	717.6	821.4	817.6	857.8
1:42:30	982.8	924.2	740.6	839.1	832.1	873.1
1:45:00	993.3	930.8	744.4	858.1	844.3	883.9
1:47:30	1007.9	934.4	761.9	870.8	863.4	897.3
1:50:00	1023.9	941.7	782.5	884.3	889.6	914.4
1:52:30	1034.7	944.8	780.1	894.9	899.5	918.2
1:55:00	1043.3	948.8	807.0	905.7	922.0	919.1
1:57:30	1056.8	953.0	799.9	919.7	931.8	931.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13 °F	TC. NO. 14 °F	TC. NO. 15 °F	TC. NO. 16 °F	TC. NO. 17 °F	TC. NO. 18 °F
2:00:00	1061.1	958.6	820.0	929.1	949.7	944.7
2:02:30	1068.8	962.7	817.9	941.2	958.2	956.1
2:05:00	1079.8	964.8	841.6	950.7	970.1	954.2
2:07:30	1084.1	971.8	828.7	958.5	980.5	970.8
2:10:00	1092.2	973.1	852.8	964.7	992.0	974.0
2:12:30	1104.1	977.4	861.8	972.2	999.3	987.0
2:15:00	1113.9	979.6	866.9	976.2	1006.4	978.8
2:17:30	1123.3	980.0	866.6	982.3	1014.5	981.0
2:20:00	1126.0	984.5	871.3	987.0	1019.7	994.1
2:22:30	1132.1	988.2	873.4	992.0	1025.1	1006.2
2:25:00	1136.6	987.7	879.7	997.2	1024.8	1012.0
2:27:30	1141.4	992.1	869.6	999.4	1027.3	1014.8
2:30:00	1147.4	993.3	890.3	1002.5	1033.6	1009.9
2:32:30	1151.3	998.5	894.4	1005.7	1035.5	1016.6
2:35:00	1152.8	1000.7	877.7	1008.3	1033.0	1024.1
2:37:30	1157.0	1000.1	902.7	1009.8	1039.2	1023.6
2:40:00	1159.9	1004.0	893.5	1011.4	1038.8	1027.9
2:42:30	1163.2	1006.3	895.9	1012.6	1042.2	1026.7
2:45:00	1166.7	1010.7	913.2	1013.7	1043.3	1016.6
2:47:30	1171.0	1014.6	916.1	1015.5	1046.8	1019.1
2:50:00	1173.9	1017.1	906.1	1017.3	1048.3	1024.5
2:52:30	1179.4	1020.2	908.4	1021.1	1047.0	1032.2
2:55:00	1184.0	1021.9	927.9	1022.1	1053.4	1030.3
2:57:30	1188.0	1025.4	919.9	1024.3	1055.0	1031.3
3:00:00	1191.5	1024.9	928.0	1026.7	1055.8	1035.6
3:02:30	1195.0	1029.1	935.7	1028.0	1057.3	1023.0
3:05:00	1198.8	1032.0	938.6	1030.1	1059.9	1025.7
3:07:30	1201.4	1033.6	942.9	1033.2	1058.8	1035.6
3:10:00	1206.5	1038.2	941.7	1035.6	1061.5	1039.3
3:12:30	1209.4	1037.9	938.0	1038.0	1065.0	1039.5
3:15:00	1213.3	1040.2	941.2	1039.1	1065.3	1034.7
3:17:30	1216.5	1046.0	944.2	1039.8	1063.9	1042.1
3:20:00	1220.6	1047.0	949.5	1042.8	1068.9	1028.1
3:22:30	1224.1	1050.9	951.2	1045.4	1068.5	1039.6
3:25:00	1228.0	1053.1	951.9	1049.2	1072.4	1044.6
3:27:30	1231.1	1057.5	961.5	1051.8	1073.6	1051.8
3:30:00	1234.2	1059.3	954.3	1054.1	1074.8	1051.8
3:32:30	1238.1	1062.1	964.7	1057.8	1076.5	1058.1
3:35:00	1243.0	1062.8	948.4	1059.1	1078.1	1059.1
3:37:30	1245.5	1066.6	965.0	1060.2	1080.3	1048.3
3:40:00	1247.8	1067.6	909.3	1063.9	1076.3	1061.5
3:42:30	1251.5	1070.2	966.8	1066.3	1078.9	1064.5
3:45:00	1255.5	1073.7	970.3	1068.7	1082.3	1078.0
3:47:30	1259.5	1075.0	965.3	1071.7	1081.2	1084.5
3:50:00	1261.2	1077.8	909.5	1073.8	1082.3	1090.4
3:52:30	1264.9	1081.6	947.1	1076.1	1083.2	1078.7
3:55:00	1269.4	1082.4	966.0	1078.7	1088.7	1090.4
3:57:30	1274.5	1089.0	952.3	1080.8	1088.7	1094.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 13 °F	TC. NO. 14 °F	TC. NO. 15 °F	TC. NO. 16 °F	TC. NO. 17 °F	TC. NO. 18 °F
4:00:00	1276.3	1092.0	955.4	1083.5	1091.3	1099.5
4:02:30	1280.9	1095.6	972.6	1085.6	1095.6	1098.8
4:05:00	1287.2	1097.2	949.6	1088.3	1099.6	1098.2
4:07:30	1286.6	1077.6	968.4	1091.5	1105.2	1102.3
4:10:00	1295.4	1095.0	982.2	1095.2	1108.6	1105.8
4:12:30	1299.2	1094.9	988.2	1100.5	1113.6	1117.2
4:15:00	1301.8	1078.7	988.7	1102.4	1113.7	1113.5
4:17:30	1307.9	1091.6	980.3	1105.3	1116.5	1119.1
4:20:00	1307.3	1081.0	972.0	1109.4	1119.6	1122.4
4:22:30	1352.7	1374.7	998.1	1110.2	1125.2	1119.4
4:25:00	1362.8	1195.3	1003.5	1116.0	1132.0	1125.6
4:27:30	1356.2	1131.3	1002.1	1121.1	1134.7	1132.0
4:30:00	1351.8	1107.9	1004.4	1122.5	1137.5	1136.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19 °F	TC. NO. 20 °F	TC. NO. 21 °F	TC. NO. 22 °F	TC. NO. 23 °F	TC. NO. 24 °F
0:00:00	72.5	73.1	73.4	73.5	73.1	73.4
0:02:30	78.2	77.0	117.6	81.7	76.0	76.0
0:05:00	93.4	88.5	185.3	105.8	86.4	89.6
0:07:30	114.5	103.7	259.7	138.5	102.2	109.5
0:10:00	144.0	126.2	341.2	179.2	118.9	136.8
0:12:30	177.6	153.5	413.9	224.0	143.3	168.3
0:15:00	211.4	183.6	485.0	269.0	175.8	203.5
0:17:30	245.6	217.1	538.8	315.5	194.9	239.8
0:20:00	281.3	251.8	584.8	359.5	228.3	274.8
0:22:30	310.8	284.4	616.9	400.0	256.5	307.5
0:25:00	336.9	314.1	638.5	430.6	276.4	339.1
0:27:30	363.7	341.7	657.1	456.5	293.7	364.0
0:30:00	393.3	367.7	675.5	477.3	292.0	387.3
0:32:30	418.6	393.2	693.2	498.6	310.1	406.8
0:35:00	447.4	419.7	712.6	521.0	333.7	426.4
0:37:30	470.7	445.3	729.7	543.8	373.4	446.9
0:40:00	497.0	469.5	745.3	564.7	381.0	464.8
0:42:30	519.2	493.7	759.8	586.3	350.6	482.4
0:45:00	543.0	516.8	770.0	607.5	425.6	501.1
0:47:30	565.8	540.0	780.8	628.0	417.1	520.5
0:50:00	587.9	563.0	793.1	647.5	470.4	537.1
0:52:30	606.9	586.5	803.4	666.4	492.1	556.1
0:55:00	630.1	608.3	814.2	683.1	506.8	572.9
0:57:30	652.3	629.0	822.2	698.5	512.4	590.7
1:00:00	676.3	653.4	831.2	712.5	512.5	606.9
1:02:30	697.9	669.3	837.7	725.5	533.3	620.8
1:05:00	719.7	685.8	845.9	737.3	555.9	635.1
1:07:30	737.4	702.1	852.3	748.9	589.8	647.9
1:10:00	755.9	717.4	857.2	765.6	581.2	660.9
1:12:30	773.1	732.1	862.1	784.7	615.1	679.1
1:15:00	786.5	753.5	870.4	797.5	616.7	690.8
1:17:30	798.0	772.6	881.0	814.0	664.2	707.6
1:20:00	805.7	812.2	881.9	831.0	699.2	731.8
1:22:30	817.2	835.6	887.4	844.0	707.3	757.6
1:25:00	834.4	845.6	891.3	853.6	708.6	783.8
1:27:30	849.0	859.7	900.2	861.1	715.2	776.5
1:30:00	861.3	872.4	904.0	870.3	728.3	787.3
1:32:30	872.8	890.2	904.5	880.6	757.1	804.6
1:35:00	885.7	908.3	909.8	889.6	777.8	818.1
1:37:30	898.9	925.9	916.2	898.0	776.0	824.6
1:40:00	913.4	942.1	922.1	906.5	783.6	833.5
1:42:30	927.6	957.9	923.4	915.8	784.6	844.6
1:45:00	939.9	973.1	929.4	925.4	790.9	852.8
1:47:30	952.7	986.5	932.8	936.5	803.5	864.5
1:50:00	964.0	996.2	939.4	947.2	812.3	875.0
1:52:30	974.4	1002.9	941.9	956.8	821.8	884.0
1:55:00	982.5	1009.4	944.9	965.5	833.7	898.3
1:57:30	993.4	1015.3	946.7	972.8	832.6	909.2

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F					
	TC. NO. 19 °F	TC. NO. 20 °F	TC. NO. 21 °F	TC. NO. 22 °F	TC. NO. 23 °F	TC. NO. 24 °F
2:00:00	999.8	1019.5	952.7	981.8	845.0	921.2
2:02:30	1008.4	1022.7	955.1	990.1	840.1	931.8
2:05:00	1014.6	1028.5	954.1	997.0	862.2	944.7
2:07:30	1020.5	1031.3	959.2	1004.2	868.7	954.0
2:10:00	1026.2	1034.3	958.4	1009.5	880.2	965.0
2:12:30	1032.5	1037.9	964.3	1014.0	884.6	972.2
2:15:00	1036.3	1038.5	963.2	1019.5	895.5	978.8
2:17:30	1041.1	1041.9	963.0	1026.4	904.8	986.5
2:20:00	1045.9	1043.9	966.2	1034.2	908.9	992.0
2:22:30	1050.7	1049.2	968.5	1039.3	920.3	996.8
2:25:00	1056.6	1050.4	970.5	1043.7	923.7	1001.6
2:27:30	1060.2	1051.4	971.9	1048.8	925.5	1005.4
2:30:00	1063.0	1052.0	968.3	1054.7	939.4	1011.5
2:32:30	1066.8	1050.2	975.3	1059.9	944.5	1016.2
2:35:00	1070.1	1049.5	975.8	1062.7	948.9	1020.1
2:37:30	1073.0	1051.3	975.6	1067.1	954.9	1025.0
2:40:00	1075.8	1056.2	977.0	1070.8	959.2	1028.9
2:42:30	1077.4	1055.3	978.1	1073.7	958.3	1030.7
2:45:00	1079.2	1057.8	981.2	1075.6	969.2	1029.9
2:47:30	1081.8	1059.4	983.6	1078.7	969.5	1031.0
2:50:00	1084.4	1063.7	985.7	1080.6	977.2	1030.7
2:52:30	1088.2	1067.6	991.2	1081.1	976.7	1030.8
2:55:00	1089.8	1067.9	992.3	1081.7	979.1	1031.9
2:57:30	1092.8	1072.0	996.1	1081.8	980.5	1032.8
3:00:00	1095.2	1072.4	995.5	1080.2	985.2	1033.1
3:02:30	1096.1	1075.4	998.0	1079.8	989.1	1034.3
3:05:00	1098.4	1078.3	999.5	1080.4	993.8	1035.8
3:07:30	1100.7	1082.7	1002.6	1079.8	992.8	1036.0
3:10:00	1103.5	1082.4	1006.8	1082.2	990.5	1036.9
3:12:30	1105.9	1083.9	1006.2	1079.3	996.2	1039.2
3:15:00	1107.5	1083.8	1006.0	1079.6	1001.6	1040.6
3:17:30	1109.5	1086.4	1010.3	1078.9	999.2	1041.2
3:20:00	1111.2	1088.0	1010.5	1078.9	1004.5	1043.8
3:22:30	1113.9	1091.4	1015.1	1079.1	1005.4	1045.1
3:25:00	1116.5	1096.2	1017.1	1081.2	1008.7	1048.0
3:27:30	1118.7	1099.0	1021.5	1080.4	1008.3	1049.6
3:30:00	1121.4	1099.3	1022.1	1082.6	1016.0	1050.1
3:32:30	1123.4	1103.4	1025.6	1084.6	1014.8	1052.8
3:35:00	1125.5	1104.9	1026.4	1084.5	1018.5	1054.4
3:37:30	1127.0	1104.8	1027.3	1084.5	1026.5	1056.5
3:40:00	1130.2	1107.2	1030.8	1083.1	1023.9	1057.9
3:42:30	1132.3	1110.7	1032.1	1086.0	1024.5	1060.4
3:45:00	1133.9	1112.5	1034.3	1085.6	1026.8	1061.9
3:47:30	1137.1	1114.3	1036.7	1088.3	1024.9	1064.0
3:50:00	1140.4	1117.1	1040.4	1087.8	1025.1	1066.0
3:52:30	1142.0	1119.9	1042.6	1085.4	1032.0	1067.8
3:55:00	1145.0	1124.6	1044.4	1084.5	1034.1	1069.6
3:57:30	1146.7	1123.8	1048.9	1090.5	1031.5	1072.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME	TEMPERATURES, °F					
	TC. NO. 19 °F	TC. NO. 20 °F	TC. NO. 21 °F	TC. NO. 22 °F	TC. NO. 23 °F	TC. NO. 24 °F
4:00:00	1149.1	1128.5	1051.8	1088.1	1040.3	1075.1
4:02:30	1150.9	1132.1	1054.1	1088.3	1045.7	1078.5
4:05:00	1153.1	1134.1	1056.7	1092.4	1048.4	1080.9
4:07:30	1156.7	1139.0	1067.8	1095.2	1053.3	1085.7
4:10:00	1159.7	1144.0	1068.7	1098.3	1057.5	1090.6
4:12:30	1164.7	1152.7	1075.9	1099.7	1058.4	1096.6
4:15:00	1167.7	1153.7	1080.9	1104.4	1062.4	1100.6
4:17:30	1172.0	1158.4	1081.7	1104.5	1063.9	1105.1
4:20:00	1175.1	1161.8	1086.7	1106.2	1070.0	1109.9
4:22:30	1176.9	1166.2	1088.0	1105.4	1076.6	1118.2
4:25:00	1181.3	1171.5	1093.2	1110.0	1080.5	1121.3
4:27:30	1184.7	1176.7	1096.3	1106.5	1083.7	1125.9
4:30:00	1187.7	1180.7	1098.8	1159.5	1099.2	1146.0

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25 °F	TC. NO. 26 °F	TC. NO. 27 °F	TC. NO. 28 °F	TC. NO. 29 °F
0:00:00	73.4	73.4	73.2	73.8	72.8
0:02:30	76.5	80.2	76.0	105.6	72.7
0:05:00	91.2	94.9	85.0	159.6	72.9
0:07:30	113.7	113.7	97.1	218.1	72.9
0:10:00	144.6	138.8	114.6	282.9	73.4
0:12:30	176.6	170.7	137.8	345.4	74.6
0:15:00	210.9	205.6	165.1	404.5	76.9
0:17:30	241.2	241.1	194.5	459.4	80.5
0:20:00	273.1	273.8	225.4	507.0	86.5
0:22:30	303.1	305.3	256.8	540.5	95.9
0:25:00	329.4	334.9	287.6	566.7	121.5
0:27:30	356.7	365.3	317.9	588.3	174.6
0:30:00	390.1	389.9	345.3	605.4	195.7
0:32:30	415.1	416.1	372.2	623.2	205.0
0:35:00	435.0	438.9	397.1	641.3	208.1
0:37:30	455.9	464.1	423.1	658.5	209.9
0:40:00	475.8	487.5	448.0	673.1	210.1
0:42:30	494.3	507.8	455.5	687.8	210.7
0:45:00	513.9	531.7	467.6	698.5	210.7
0:47:30	531.6	552.4	493.3	710.8	210.6
0:50:00	549.0	573.9	517.0	720.9	210.6
0:52:30	565.9	595.6	539.0	731.5	210.4
0:55:00	582.4	614.5	560.5	741.7	210.2
0:57:30	598.6	635.3	581.6	750.4	210.1
1:00:00	614.6	652.1	606.5	759.3	209.7
1:02:30	629.2	670.7	627.8	767.3	210.0
1:05:00	643.7	687.7	646.9	776.3	211.0
1:07:30	657.5	706.8	665.2	782.7	213.1
1:10:00	669.4	718.1	681.4	788.3	215.0
1:12:30	680.5	737.8	695.9	794.3	219.6
1:15:00	691.2	755.1	709.9	802.5	225.4
1:17:30	700.6	778.9	723.1	812.2	232.8
1:20:00	711.4	813.1	736.2	821.2	240.9
1:22:30	721.3	847.6	749.4	825.5	248.9
1:25:00	731.9	866.8	762.4	832.0	256.8
1:27:30	742.0	902.3	776.1	838.3	265.5
1:30:00	752.4	945.1	796.2	845.4	273.9
1:32:30	763.2	970.1	808.9	850.5	282.7
1:35:00	775.4	986.1	830.8	854.2	291.9
1:37:30	787.5	997.6	843.1	861.6	300.9
1:40:00	797.4	1004.8	857.9	866.5	310.2
1:42:30	808.3	1008.0	866.9	869.9	318.9
1:45:00	818.9	1009.9	874.8	875.9	328.0
1:47:30	831.0	1012.3	883.9	880.8	337.0
1:50:00	841.8	1014.4	894.5	887.4	345.6
1:52:30	853.4	1014.7	905.6	892.6	354.9
1:55:00	862.1	1017.2	915.8	896.3	363.7
1:57:30	867.7	1018.7	927.2	900.3	371.9

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME hr:min:sec	TEMPERATURES, °F				
	TC. NO. 25 °F	TC. NO. 26 °F	TC. NO. 27 °F	TC. NO. 28 °F	TC. NO. 29 °F
2:00:00	871.6	1021.7	938.2	909.0	381.2
2:02:30	879.9	1026.8	949.9	912.1	390.0
2:05:00	884.2	1030.1	961.0	915.0	384.6
2:07:30	888.6	1034.9	971.6	921.6	394.6
2:10:00	898.2	1036.7	981.8	923.6	406.5
2:12:30	904.8	1042.3	991.1	926.9	415.0
2:15:00	917.0	1046.1	999.0	931.5	421.5
2:17:30	928.5	1052.4	1006.9	934.8	427.3
2:20:00	946.6	1054.4	1015.7	939.5	432.5
2:22:30	958.4	1059.2	1023.4	940.6	438.0
2:25:00	961.6	1065.3	1029.7	940.3	442.8
2:27:30	970.2	1070.8	1034.9	945.7	448.0
2:30:00	978.3	1074.0	1040.4	947.8	452.9
2:32:30	980.1	1077.3	1045.3	950.4	457.8
2:35:00	979.1	1081.5	1049.0	953.4	462.4
2:37:30	982.7	1085.7	1053.1	954.5	467.0
2:40:00	981.5	1088.8	1057.0	957.4	472.1
2:42:30	989.9	1093.3	1061.0	958.4	476.8
2:45:00	996.5	1097.6	1064.1	963.4	481.4
2:47:30	1001.4	1100.7	1068.9	966.2	485.7
2:50:00	1004.7	1104.7	1073.0	970.3	489.9
2:52:30	1002.6	1109.4	1076.4	972.2	493.7
2:55:00	1006.0	1112.5	1080.2	974.1	498.0
2:57:30	1007.7	1116.5	1084.1	978.0	501.8
3:00:00	1017.0	1119.7	1088.2	977.7	505.5
3:02:30	1020.6	1122.1	1091.9	982.0	509.4
3:05:00	1022.1	1125.8	1095.1	983.9	512.9
3:07:30	1022.9	1128.7	1098.5	985.9	516.2
3:10:00	1025.7	1131.8	1100.9	988.0	519.4
3:12:30	1028.5	1133.4	1104.3	990.6	523.1
3:15:00	1030.3	1137.7	1106.6	992.7	526.4
3:17:30	1031.3	1140.5	1108.9	996.0	529.7
3:20:00	1035.7	1142.4	1112.1	997.4	532.7
3:22:30	1038.0	1146.2	1114.8	1002.2	535.7
3:25:00	1042.3	1149.1	1118.4	1002.4	538.6
3:27:30	1041.5	1152.2	1121.6	1005.9	541.2
3:30:00	1044.4	1156.4	1123.4	1008.4	544.1
3:32:30	1047.2	1158.8	1126.7	1011.3	546.8
3:35:00	1050.1	1162.1	1128.6	1012.5	549.5
3:37:30	1052.1	1163.7	1131.5	1015.7	552.0
3:40:00	1053.5	1168.4	1133.6	1015.3	554.5
3:42:30	1057.9	1169.3	1136.0	1018.2	556.5
3:45:00	1060.5	1173.3	1137.5	1020.2	558.9
3:47:30	1062.1	1175.4	1139.4	1021.6	560.7
3:50:00	1064.6	1178.0	1141.6	1024.5	562.4
3:52:30	1065.9	1183.0	1143.6	1028.4	565.0
3:55:00	1069.0	1184.3	1145.0	1027.8	566.8
3:57:30	1073.4	1187.9	1147.5	1033.0	568.6

APPENDIX C
DOW CORNING CORP.
TEST ASSEMBLY NO. 4

TIME	TEMPERATURES, °F				
	TC. NO. 25	TC. NO. 26	TC. NO. 27	TC. NO. 28	TC. NO. 29
hr:min:sec	°F	°F	°F	°F	°F
4:00:00	1074.7	1192.1	1148.7	1036.2	570.7
4:02:30	1078.0	1194.6	1149.5	1039.4	572.8
4:05:00	1082.3	1199.1	1150.4	1044.0	574.7
4:07:30	1085.0	1205.3	1152.5	1052.8	576.6
4:10:00	1089.0	1209.8	1156.2	1058.3	578.5
4:12:30	1093.7	1214.2	1160.3	1061.7	580.5
4:15:00	1099.9	1218.2	1163.3	1069.8	582.2
4:17:30	1105.8	1222.1	1167.6	1069.4	583.8
4:20:00	1107.7	1226.9	1171.3	1077.1	585.5
4:22:30	1114.3	1229.1	1176.3	1079.2	587.9
4:25:00	1117.6	1236.5	1179.2	1086.1	590.3
4:27:30	1120.0	1240.1	1182.4	1087.1	592.8
4:30:00	1140.4	1252.5	1188.6	1227.3	594.5



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June 20, 1995



Dow Corning Corporation
Mr. Robert M. Schroeder
2200 W. Salzburg Road
Mail CO43A1
Auburn, MI 48611

Our Reference: R8196, 95NK3179

Subject: UL Classification of Type Sylgard 170 F.C. Silicone Elastomer

Dear Mr. Schroeder:

This is pursuant to our meeting on June 20, 1995 and our previous discussions regarding the above subject.

When the Special Services Investigation of Type Sylgard 170 F.C. Silicone Elastomer (Project 95NK3179, File R8196) was initiated, you asked whether UL would also evaluate the products tested to determine whether we noted any differences in terms of fire performance that would preclude the products from being used in Through-Penetration Firestop Systems in which the Type Sylgard 170 F.C. Silicone Elastomer is presently Classified. Based on our review of the data from the investigation, as described in Letter Report R8196 dated May 26, 1995, it was determined that the fire performance of the various lots of Type Sylgard 170 F.C. Silicone Elastomer was similar. No significant deviations or irregularities were noted between the various lots of material which would preclude the products from being used in UL Classified Through-Penetration Firestop Systems.

Very truly yours,

C. J. JOHNSON, (Ext. 42649)
Senior Engineering Associate
Engineering Services, 411B

Reviewed by:

RICHARD N. WALKER (Ext. 43084)
Engineering Group Leader
Engineering Services, 411B

APPENDIX F
ENGINEERING EVALUATIONS

G.L. 86-10

APPENDIX F- ENGINEERING EVALUATIONS

This appendix includes both generic and installation specific Engineering Evaluations in support of WBN penetration seal typical details and installations. Engineering evaluations included were performed in accordance with the guidance of Generic Letter 86-10 and VECTRA Project Instruction PI-006-00922.000-002, "Performance of WBN Penetration Seal Engineering Evaluations".

EVALUATION CATEGORIES

The following evaluations address typical installation designs at WBN are in support of typical details for these designs:

1. CATEGORY A- Two layer boot seals with penetrants larger than 2" diameter.
2. CATEGORY B- Foam seals with fluid filled large bore pipe.
3. CATEGORY C- Elastomer seals with fluid filled large bore pipe.
4. CATEGORY D- Single sided boot seals with fluid filled large bore pipe
- HDSE seals with fluid filled large bore pipe.
5. CATEGORY E- Installation specific seal evaluations.
6. CATEGORY F- Large annulus where max. annulus may exceed allowed.

GENERIC LETTER 86-10

In Enclosure 2 to Generic Letter 86-10 (Appendix R Questions & Answers, Section 3.2.2, Deviations from Tested Configurations), the NRC stated that where exact replication of a tested configuration cannot be achieved, the field installation should meet all of the following criteria:

1. The continuity of the fire barrier material is maintained.
 2. The thickness of the fire barrier material is maintained.
 3. The nature of the support assembly is unchanged from the tested configuration.
-

4. The application or "end use" of the fire barrier is unchanged from the tested configuration. For example, the use of a cable tray barrier to protect a cable tray which differs in configuration from those that were tested is acceptable. However, the use of the structural steel fire proofing to protect a cable tray assembly may not be acceptable.
5. The configuration has been reviewed by a qualified fire protection engineer and found to provide an equivalent level of protection.

CATEGORY A EVALUATION

Two Layer Boot Seals
with Penetrants Larger Than 2"

WBN Typical Detail
L, LXIV, XLVIII

Applicable Supporting Fire Test
1. ICMS Test ICC0186015

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The penetration assemblies identified in Attachment A require further engineering justification because one or more critical attributes lies outside the parameters of the applicable fire tests or typical detail. The identified installed penetration assemblies have penetrating item (pipe) sizes, sleeve diameters and/or penetration annulus larger than those qualified by Engineering Report No. 0006-00922-02 for the subject penetrations.

B. PERTINENT PENETRATION SEAL ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472-48; Typical Detail XLVIII, Drawing 47A472-50; Typical Detail L and Drawing 47A472-64; Typical Detail LXIV.

The following describes the installed penetration seal assemblies' general attributes:

- Barrier construction: All penetrations are assembled in 2 or 3 hours rated concrete barriers having a thickness of 12" or greater.
- Penetration Opening Size: The piping penetrants are sealed in sleeves which range from 6" to 66" diameter.
- Penetration Orientation: The penetration assembly may have either through wall or ceiling/floor orientation.
- Penetrating Items: Single pipe with a diameter ranging from 3" to 52". The pipe may be insulated or uninsulated.
- Penetration Annulus: The penetration assemblies identified in Attachment A could potentially have an installed annulus of up to 14".

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Date: _____

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- Penetration Seal Assembly: The penetration assemblies identified in Attachment A utilize a dual (inner/outer) fabric wrapped configuration attaching to both the penetrating item and an existing embedded sleeve or Sleeve Extension Insert (S.E.I.). The inner layer consists of a Carborundum Fibersil Cloth 36-400U and the outer layer of Arlon (KCF) Grade 56493F031 boot fabric. Both attachment surfaces are bonded using Dow Corning 732 silicone adhesive and secured using ½" x .020 stainless steel banding. The dual boot configurations are required to be installed typical to both sides of the protective barrier. Where required by the service temperature of the piping, Detail LXIV requires addition of a thermal insulation collar to be installed on the pipe on both sides of the penetration and a single layer of ceramic fiber blanket between the boots.

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS

The following describes the critical attributes of the fire test assembly which will be used to evaluate the identified penetration seal assemblies:

ICMS Test ICC0186015 (Penetrations 1 and 2)	Penetrant Size:	Single 2" diameter pipe with and without calcium silicate insulation
	Opening Size:	12" diameter sleeve
	Free Area:	5" annular space
	Seal Material:	Double layer of boot on each side of the barrier, consisting of inner layer of Carborundum 36-400U Fibersil Cloth and outer layer of Silicone Boot Arlon (KCF) grade 56493F031
	Barrier Const.:	12" thick poured concrete (horizontal)
	Test Results:	3 hour F and T rating for up to 2" diameter pipe size

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS

Basis for Qualification

The general WBN criteria applicable to piping penetrations through fire rated barriers is based on the size of piping penetrant(s). Specifically, for pipe sizes less than 8" diameter, F and T ratings commensurate with the fire rating of the barrier in which they are installed will be provided. For 8" through 12" pipe sizes, an F rating only (commensurate with the rating of the barrier) is required. Piping penetrations for pipe sizes larger than 12" necessitate evaluation to demonstrate acceptability of the installed penetration seal assembly.

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[Signature]

Date:

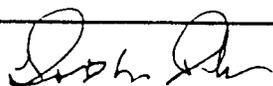
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Fire Test ICC0186015 demonstrated that piping penetrations sealed in accordance with WBN Typical Details L, LXIV and XLVIII and containing individual pipes up to 2" diameter are capable of achieving a 3 hour F and T rating. However, since the penetration seal assemblies listed in Attachment A, which utilize the subject seal details involve 3" through 52" pipe sizes, their acceptability will only be based on providing an F rating commensurate with that of the barrier.

On this basis, the penetration seal assemblies identified in Attachment A are qualified based on a comparison with the tested configurations described in Section C as described below:

1. The installed penetration assemblies are all contained within barriers having a minimum concrete thickness of 12" and are therefore bounded by Test ICC0186015.
2. The penetration opening size associated with the installed configurations (i.e., up to 66" diameter sleeves) will not adversely affect the performance of the dual boot seal assemblies. This is due to the subject boot seal assemblies being specifically designed to accommodate pipe movement, and therefore are mechanically fastened to both the pipe and sleeve on both sides of the barrier. Therefore, larger opening sizes for installed boot seal assemblies than those specifically tested will not affect the ability of the seal to provide up to a 3 hour F rating.
3. The orientation of the tested penetration seal assemblies (floor/ceiling) results in a more severe fire exposure than through wall orientations and will therefore bound both floor/ceiling and through wall configurations. All other pertinent elements of the tested and installed assemblies are equivalent and symmetrical.
4. The increase in piping penetrant size for installed configurations (up to 52" diameter piping) compared to the tested 2" diameter piping penetrants will not adversely affect the performance of the subject seal assemblies. In addition to the inner and outer boot fabric on the exposed side of the barrier, the presence of the same dual layer boot seal on the unexposed side, ensures that the assembly will survive a 3 hour ASTM E-119 fire exposure and subsequent hose stream effects, without passage of flame, hot gasses or water projection through the seal. In particular, the Carborundum Fibersil 36-400U cloth is manufactured to withstand temperatures in excess of 1800°F without degradation which exceeds credible unexposed side temperatures. Therefore, due to the nature and specialized materials comprising the dual layer boot seal design, large piping penetrant sizes will not adversely affect the ability of the seal to provide up to a 3 hour F rating.
5. As with increasing size of piping penetrants, greater sizes in annular gaps between installed and tested configurations will not affect the performance of the subject boot seal assemblies. Since the boot seal is mechanically attached to both the pipe and sleeve assembly on both sides of the barrier and designed to accommodate significant pipe movement, the maximum potential annular gap of approximately 14" will not adversely affect the ability of the seal to provide up to a 3 hour F rating.

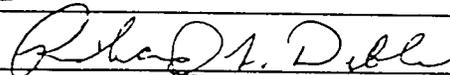
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Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames and hot gasses through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (i.e., pipes 8" in diameter and larger) are only required to satisfy an F rating. However, as described above, for the subject typical boot seal details, an F rating commensurate with that of the barrier in which they are installed also applies for piping penetrants larger than 2" diameter. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating Failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configurations referenced in Section C satisfy this criteria and are qualified as 3 hour F rated assemblies.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for a 3 hour duration. Since 3 hour fire rated wall and floor/ceiling configurations are the most stringent application for the subject penetration seal assemblies, the installed boot seal assemblies provide an F rating equivalent to the 3 hour rated barriers in which they are installed.

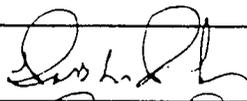
E. CONCLUSION

Based on the evaluation detailed in Section D above, the subject seal assemblies installed in the penetration Mark Numbers listed in Attachment A provide protection equivalent to the most stringent rated barrier configuration (3 hours) in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified in Attachment A due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the subject penetration seals is not required. The evaluation contained in Section D above concluded that the installed configurations provide a level of protection equivalent to the barrier in which they are installed.

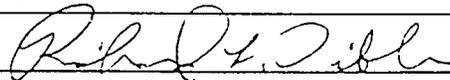
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G. SUMMARY

Based on the evaluation detailed in Section D above, the seal assemblies installed in the Mark Numbers listed in Attachment A provide protection equivalent to the fire rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to those penetrations, the fire would not propagate between rooms via the penetrations identified in Attachment A due to the protection provided by the installed penetration seal assemblies.

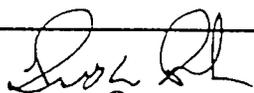
H. REFERENCES

1. ICMS Test ICC0186015, " Fire and Hose Stream Tests for Penetration Seal Systems," (NMP2-PSS6), dated March 1986
2. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment," Revision 0

I. ATTACHMENTS

1. Attachment A

Preparer:



Date:

10/4/95

Verifier:



Date:

10/4/95

Attachment A
Category A

MARK NO	PIPE	SLEEVE	DETAIL	SYSTEM	FLUID	INSUL	DWG NO	LOCATION
A0001AM	8	14	XLVIII	074	YES	YES	47W472-1, 47W471-1	20'8"N/U, /A5
A0001BM	8	12	XLVIII	074	YES	YES	47W472-1, 47W471-1	11'N/V AT A5
A0001CM	8	14	XLVIII	074	YES	YES	47W472-1, 47W471-1	11'N/V, /A11
A0001DM	8	14	XLVIII	074	YES	YES	472472-1, 47W471-1	20'8" N/U, /A11
A0003AM	14	20	XLVIII	074	YES	YES	47W472-1, 47W471-1	14'3" N/U, /A5
A0003BM	14	20	XLVIII	074	YES	YES	472472-1, 47W471-1	3'5" N/V, /A5
A0003CM	14	20	XLVIII	074	YES	YES	47W472-1, 47W471-1	14'3" N/U, /A11
A0003DM	14	20	XLVIII	074	YES	YES	47W472-1, 47W471-1	3'7" N/V, /A11
A0095AM	6	14	XXXIII	072	YES	NO	47W472-1, 47W471-2	/U, 20"E/A13
A0095BM	6	14	XXXIII	072	YES	NO	47W472-1, 47W471-3	/U, 4"E/A3
A0142AM	24	30	XLVIII	063	YES	NO	47W472-1, 47W471-3	/U, 12"W/A3
A0218CM	6	16	LVII	063	YES	NO	47W472-1, 47W471-5	7'7"N/U, /A5
A0341AM	4	12	LVII	062	YES	NO	47W471-2, 47W472-2	2'9"N/Q, /A10
A0400AM	10	14	LVII	003	YES	YES	47W471-7, 47W472-2	3'N/S, 3'6"W/A2
A0429AM	8	18	L	012	NO	YES	47W471-6, 47W472-2	10"N/S, 3"W/A15
A0444DM	3	12	XLVIII	074	YES	YES	47W471-9, 47W472-2	9'4"S/W, /A5
A0447BM	8	18	XLVIII	074	YES	YES	47W471-9, 47W472-2	6'5"S/W, /A5
A0454BM	4	12	XXXII	062	YES	NO	47W471-9, 47W472-2	6'4"N/U, 11'6"E/A4
A0461AM	8	18	XLVIII	074	YES	YES	47W471-8, 47W472-2	3'N/V, 13'7"E/A9
A0461BM	8	18	XLVIII	074	YES	YES	47W471-9, 47W472-2	5'2"N/V, 14"W/A7
A0470BM	8	18	XLVIII	074	YES	YES	47W471-9, 47W472-2	4" N/V, /A5
A0472BM	18	24	L	067	YES	NO	47W471-8, 47W472-2	5'6"N/U, 11'5"W/A14
A0658AM	4	6	L	062	YES	NO	47W471-8, 47W472-3	6'N/U, 3'4" E/A12
A0658BM	4	6	L	062	YES	NO	47W471-9, 47W472-3	5'10" N/U, 3'6" W/A4
A0706AM	8	16	XLVIII	012	NO	YES	47W471-6, 47W472-3	6'6"N/Q, 3"W/A15
A0759AM	10	14	XLVIII	078	YES	NO	47W471-14, 47W472-3	38'4"N/CLRB, /A11
A0780AM	4	8	L	03B	YES	YES	47W471-11, 47W472-3	7'11"S/U, /A3
A0782BM	4	8	XXXIII	03B	YES	YES	47W471-11, 47W472-3	/U, 9'5" E/A2
A0783CM	4	8	XLVIII	003	YES	YES	47W471-11, 47W472-3	/U, 12'5" E/A2
A0784AM	4	8	XLVIII	03B	YES	YES	47W471-10, 47W472-3	8'S/U, /A13
A0798AM	3	6	XXXII	070	YES	NO	47W471-12, 47W472-3	22"S/W, 2'9 1/2"W/A12
A0798BM	3	6	XXXII	070	YES	NO	47W471-13, 47W472-3	1'10"S/W, 2'9"E/A4
A0850AM	3	6	XXXII	070	YES	NO	47W471-12, 47W472-4	9'S/V, /A9
A0871AM	4	8	XLVIII	078	YES	NO	47W471-13, 47W472-4	5'6"S/CLRB, /A5
A0942CM	4	8	L	070	YES	NO	47W471-15, 47W472-4	7'3"N/T, 9"E/A6
A0974AM	6	10	XLVIII	040	NO	NO	47W471-17, 47W472-4	9'8"S/WA, 26'9"W/A5
A1082AM	12	14	XLVIII	067	YES	NO	47W471-7, 47W472-5	1'8"N/T, 2'6"E/A1
A1157BM	8	18	XLVIII	074	YES	YES	47W471-9, 47W472-5	5'2"N/V, 12'3"W/A7
A1304AM	12	16	LVII	067	YES	NO	47W471-6, 47W472-6	1'7"N/T, 2'5"W/A15
A1465AM	3	10	L	012	NO	YES	47W471-2, 47W472-6	8'N/S, 2'3"E/A10
A1544AM	4	8	L	041	YES	NO	47W471-13, 47W472-9	16'7"N/U, 6"W/A2
A1545AM	4	6	L	041	YES	NO	47W471-13, 47W472-9	16'7"N/U, 7"W/A2
A1704AM	4	6	L	067	YES	NO	47W471-11, 47W472-9	2'6"S/T, 2'6"E/A4
A2013AM	4	8	L	041	YES	NO	47W471-12, 47W472-10	10'6"S/V, 8'8"E/A14
A2014AM	4	8	L	041	YES	NO	47W471-12, 47W472-10	10'6"S/V, 7'8"E/A14
CO175A	4	12	XLVIII	059	YES	NO	47W469-2	/Q, 9'6"W/C12
R1S001	8	12	L	074	YES	YES	47W470-2	AZ 308 DEG, RAD 65'6"
R1S002	8	12	L	074	YES	YES	47W470-2	AZ 306 DEG, RAD 65'6"
R1S003	10	16	L	072	YES	NO	47W470-2	AZ 304 DEG, RAD 65'6"
R1S004	10	16	L	072	YES	NO	47W470-2	AZ 301 DEG, RAD 65'6"
R1S009	4	10	L	03B	YES	YES	47W470-2	AZ 301 DEG, RAD 65'6"
R1S011	4	10	L	03B	YES	YES	47W470-2	AZ 301 DEG, RAD 65'6"
R1S012	3	8	L	033	NO	NO	47W470-2	AZ 299 DEG, RAD 65'6"
R1S016	3	6	L	070	YES	NO	47W470-2	AZ 300 DEG, RAD 65'6"
R1S017	3	6	L	070	YES	NO	47W470-2	AZ 299 DEG, RAD 65'6"
R1S019	3	6	L	062	YES	NO	47W470-2	AZ 299 DEG, RAD 65'6"
R1S037	4	12	L	062	YES	NO	47W470-2	AZ 281 DEG, RAD 65'6"

Attachment A
Category A

MARK NO	PIPE	SLEEVE	DETAIL	SYSTEM	FLUID	INSUL	DWG NO	LOCATION
1S039	3	6	L	081	YES	NO	47W470-2	AZ 301 DEG, RAD 65'6"
1S040	6	10	L	070	YES	NO	47W470-2	AZ 299 DEG, RAD 65'6"
1S041	6	10	L	070	YES	NO	47W470-2	AZ 301 DEG, RAD 65'6"
1S042	6	10	L	070	YES	NO	47W470-2	AZ 301 DEG, RAD 65'6"
1S049	4	10	L	026	YES	NO	47W470-2	AZ 289 DEG, RAD 65'6"
1S050	6	10	L	070	YES	NO	47W470-2	AZ 288 DEG, RAD 65'6"
1S063	52	66	LXIV	001	NO	YES	47W470-2	AZ // TO 0 DEG, 4'2"E
1S064	52	66	LXIV	001	NO	YES	47W470-2	AZ // TO 180 DEG, 4'4"E
1S065	52	66	LXIV	001	NO	YES	47W470-2	AZ // TO 180 DEG, 4'3"W
1S066	52	66	LXIV	001	NO	YES	47W470-2	AZ // TO 0 DEG, 4'7"W
1S067	30	40	LXIV	003	YES	YES	47W470-2	AZ // TO 0 DEG, 7'8"E
1S068	30	40	LXIV	003	YES	YES	47W470-2	AZ // TO 180 DEG, 7'8"E
1S069	30	40	LXIV	003	YES	YES	47W470-2	AZ // TO 180 DEG, 7'8"W
1S070	30	40	LXIV	003	YES	YES	47W470-2	AZ // TO 0 DEG, 7'8"W
1S094	6	10	L	078	YES	NO	47W470-2	AZ 292 DEG, RAD 65'6"
1S098	4	6	L	026	YES	NO	47W470-2	AZ 301 DEG, RAD 65'6"
1S112	20	30	LXIV	003	YES	YES	47W470-2	AZ // TO 0 DEG, 8'7"W
1S113	20	30	LXIV	003	YES	YES	47W470-2	AZ // TO 180 DEG, 8'7"W
1S114	20	30	LXIV	003	YES	YES	47W470-2	AZ // TO 180 DEG, 8'9"E
1S115	20	30	LXIV	003	YES	YES	47W470-2	AZ//TO 0 DEG, 8'7" EAST

CATEGORY B EVALUATION

**Foam Seals with Fluid Filled Large
Bore Pipe**

WBN Typical Detail
I, V, VIII, XL

Applicable Supporting Fire Test

1. ICMS ICO1091035
2. ICMS ICC0286016
3. Promatec CTP-1076
4. Promatec CTP-1124
5. BISCO 748-49
6. GSU 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The penetration seal assemblies listed in Attachment "A" require further engineering justification because one or more critical attributes lies outside the parameters of the applicable fire tests or typical detail. The identified penetrations have installed piping larger than qualified by Engineering Report No. 0006-00922-02 for the subject penetrations.

B. PERTINENT PENETRATION SEAL ASSEMBLY CONSTRUCTION ELEMENTS:

The identified penetration seal assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472:

Sheet 1	Detail I
Sheet 5	Detail V
Sheet 8	Detail VIII
Sheet 40	Detail XL

The following describes common attributes of all the penetration seal assemblies listed in attachment A.

- Barrier construction: All penetrations are through 2 or 3 hour concrete walls with thicknesses equal to or greater than 12".
- Penetration Orientation: The installed seal assemblies are installed in either wall or floor/ceiling orientations.
- Penetrating Items: The subject penetrations are all single piping penetrant penetrations.
- Seal Assembly: All of the typical seal details listed above require a 12" minimum depth of Dow Corning 3-6548 RTV Silicone Foam installed within the plane of the barrier, permanent damming material is not required, and will therefore (conservatively) not be credited in this evaluation.

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Each penetration seal assembly's specific attributes as identified below are delineated in Attachment A.

- Penetration: Opening Size and Type
- Penetrating Items: Penetrant Size and Type

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS

- Barrier construction: Fire Tests ICO1091035, ICC026016, CTP-1076, 748-49 and 93-H-72449 were all performed with 12" thick concrete slabs and exposed to 3 hour fire endurance tests. The subject seal assemblies are installed in concrete barriers greater than or equal to 12" thick.
- Penetration Opening and Penetrant Size: Fire Test 748-49 was performed utilizing a 12" diameter sleeve penetrated by a 8" diameter capped pipe. Fire Test 93-H-72449 was performed utilizing a 20" diameter sleeve penetrated by a 16" diameter capped pipe. Based on the results of 93-H-72449, Pen.11 (complete seal material activation which allowed water to pass to the unexposed side during the hose stream test) the limiting parameter for piping size to be directly bounded by fire test is 12" diameter, which is conservative (Reference Engineering Report No. 0006-00922-02). Therefore, the installed configurations identified in Attachment A exceed WBN typical detail parameters for penetrating commodity size.
- Penetration Orientation: Fire Tests ICO1091035, ICC026016, CTP-1076, 748-49 and 93-H-72449 were all performed in a floor (horizontal) orientation. The installed seal assemblies are installed in wall or floor/ceiling orientations.
- Seal Assembly: Fire Tests ICO1091035, ICC026016, CTP-1076, 748-49 and 93-H-72449 were all performed with an installed seal depth of 12" (min.) of Dow Corning 3-6548 RTV Silicone Foam without permanent damming material. The installed configurations are all sealed with a 12" minimum of Dow Corning 3-6548 RTV Silicone Foam. Since permanent damming is not required, it will not be credited.

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS

Basis for Qualification

The subject penetration seal assemblies are qualified based on a comparison of the items discussed in section C above as documented by the following.

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1. The subject WBN seal assemblies are installed in 2 or 3 hour concrete barriers with thicknesses equal to or greater than 12". Those assemblies installed in barriers greater than 12" thick will benefit from the additional heat dissipation capacity along the penetration sleeve/seal interface which will serve to reduce the unexposed seal surface temperatures.
2. The tested penetration seal assemblies were installed in a floor/ceiling orientation which due to more severe fire exposure is worst case and bounds through wall orientations. Additionally, all pertinent elements of the tested and installed seal assemblies are equivalent and symmetrical.
3. The tested penetration seal assemblies were sealed with a 12" depth of Silicone Foam without permanent damming material as were the penetrations identified in Attachment A and are therefore equivalent. Fire Test ICO1091035 (Pen. 3) serves as a qualification basis for annular spaces up to 14" for a 12" thickness of Silicone Foam without damming material. Therefore, the worst case installed configuration for potential annular gap (16" diameter piping through a 30" diameter sleeve) is bounded by test.
4. 3 hour fire endurance testing of (dry) large bore piping penetration sealed with a 12" depth of Silicone Foam without permanent damming (Reference GSU Fire Test 93-H-72449) demonstrated that an F rating in accordance with ASTM E-814-83 can be achieved with up to a 16" diameter pipe prior to the application of the hose stream test. This test shows that with large bore pipe, the seal material will become fully charred along the entire seal/pipe interface. This degree of charring is not typically found in testing where small bore pipe (which represent a significant body of successfully tested penetrating items) were used as penetrants. The increased charring is due to the increased thermal capacity of large bore pipe over small bore pipe. However, test observations from Fire Test 93-H-72449 provide conclusive evidence that although the seal material was charred through the entire penetration the charred seal material was still in place at the end of the fire exposure and therefore prevented passage of flame to the unexposed surface. Following application of the solid hose stream test method, it was noted that the seal assembly allowed water to pass to the unexposed surface. The solid hose stream applied to the test assembly is the most severe test method by which seal assemblies are tested due to the force imparted on the seal material. However neither the test observations or conclusions indicate that the seal material had been dislodged from the penetration.

Based on review of Fire Test 93-H-72449, it is concluded that had the hose stream test been applied to a duplicate penetration seal assembly after 1 hour of fire exposure as permitted by ASTM E-814, the assembly would have clearly passed the hose stream criterion.

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Additionally, since the 16" diameter piping penetrant tested in 93-H-72449 was not subjected to fire in a fluid filled condition, the presence of fluid in the piping associated with the installed WBN seal assemblies will significantly reduce transmission of heat into the seal, thus resulting in superior performance (i.e., reduce rate of char formation) to that of the tested configuration. This is demonstrated by evaluation of test CTP-1124.

a. Pertinent Construction Elements of Promatec Fire Test CTP-1124

Fire tests CTP-1124.1b & CTP-1124.1c provide thermocouple temperature reference points for like sized penetrating items in seal assemblies using the same type of seal and damming materials. The variable of interest in this evaluation is that Pen. 1b used a dry pipe and Pen. 1c used a fluid filled pipe.

Fire Test CTP-1124.1b tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, insulated with 1" of Alumina Silica blanket and metal jacketing through the penetration. The penetration was sealed with 6" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

Fire Test CTP-1124.1c tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, filled with fluid. The penetration was sealed with 10" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

b. Fire Test CTP-1124 Review

This review examines the maximum temperatures recorded on both 10" pipe penetrants at similar locations to identify differences in temperature increase on the unexposed side of the penetration seals.

Pen. 1b penetrating item thermocouple readings shows that the temperature at the insulation jacket/seal material surface interface was 686°F (T/C I-5), the temperature on the pipe itself, 13" from the exposed surface of the seal was 548°F (T/C E-7) and the temperature of the pipe 48" from the exposed surface of the seal was 154°F (T/C E-8). Based on the thermal properties of Alumina Silica material, a portion of the heat conducted by the pipe was not transferred to the seal material as it would had the pipe been uninsulated (i.e., the insulation effectively resulted in higher piping surface temperatures than that of an uninsulated pipe).

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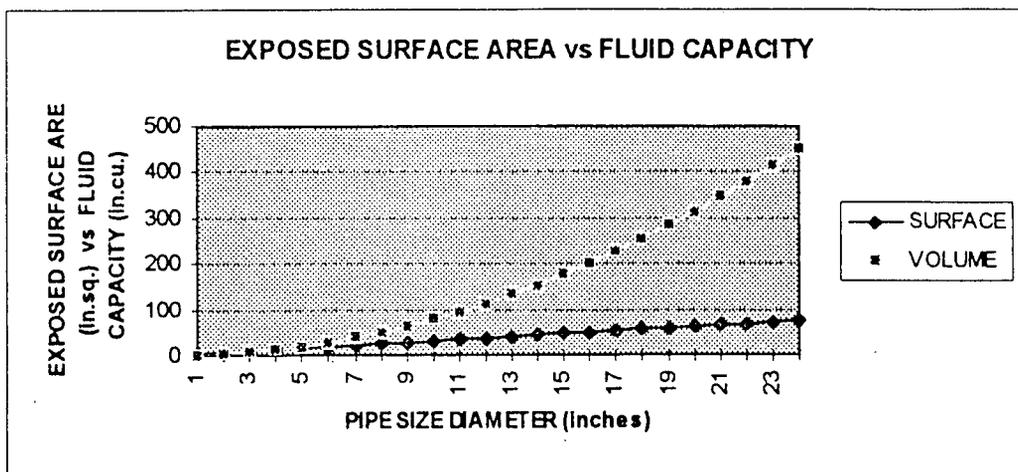
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Pen. 1c penetrating item thermocouple readings shows that the temperature at the pipe/seal material surface interface was 200°F (T/C I-5), the temperature on the pipe 13" from the exposed surface of the seal was 186°F (T/C P-6) and the temperature of the pipe 48" from the exposed surface of the seal was 178°F (T/C E-12). Although Pen. 1c had 4" of additional seal depth over that used in Pen. 1b (i.e., 10" vs. 6"), the drastic differences in seal interface and pipe surface temperatures 13" from the exposed surface of the seal clearly demonstrate the effects of fluid in the piping. Specifically, the unexposed pipe surface temperatures (three times higher for Pen. 1b than for Pen. 1c) is attributed moreover to the fluid's capacity to absorb heat than the difference in seal depth. This effect is demonstrated below by comparing the exposed surface area of a given pipe size to its fluid carrying capacity per unit length.



Therefore, with increasing size of a fluid filled pipe, its capacity to absorb heat (and hence reduce heat transmission into the penetration seal material) increases at a much greater rate than its exposed surface area. Therefore, in absence of specific fire tests which directly bound the largest WBN fluid filled pipe penetration (36" diameter), reasonable assurance exists to conclude that a seal assembly consisting of 12" of Dow Corning 3-6548 RTV Silicone Foam is sufficient to achieve an F rating commensurate with the barrier in which it is installed.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames and hot gasses through the opening. The other alternative uses a T rating to ensure that in addition to preventing the passage of flame, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

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The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configuration referenced in Section C satisfy this criteria, except the 16" diameter pipe penetration associated with Test 93-H-72449 which enabled passage of the hose stream. However, as described above, had the option been exercised for subjecting a duplicate seal assembly to the hose stream test after 1 hour of fire exposure in accordance with ASTM E-814, this assembly would have certainly received a 3 hour F rating.

E. CONCLUSION

Based on the evaluation detailed in Section D above, a technical basis exists to conclude that the installed WBN penetration seal assemblies listed in Attachment A will provide an F rating equivalent to the fire rated barrier in which they are installed.

F. FEATURES ANALYSIS

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in Section D above concluded that the installed configurations provide a level of protection equivalent to the 2 or 3 hour rating of the barriers in which they are installed.

G. SUMMARY

Based on the evaluation detailed in Section D above, the seal assemblies installed in the penetrations itemized in Attachment A provide protection equivalent to the fire rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to those penetrations, the fire would not propagate between rooms via the penetrations itemized in Attachment A due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES

1. ICMS Test ICO1091035, "3 Hour Fire Resistance Evaluation of Ten Different Fire Penetration Seal Designs," dated November 11, 1991
2. ICMS Test ICC0286016, "Fire and Hose Stream Tests for Penetration Seal Systems," (NMP2-PSS7), dated March 1986
3. Promatec Test CTP-1076, "Three Hour Qualification Test, HDSE, HDSE/HDLE Comparison, Radflex/Foam Composite Seal, Adhesive Sealant Conduit Seal, Nine Inch Silicone Foam W/O Damming and Radflex B Comparison for Electrical and Mechanical Penetration Seals," dated March 28, 1985

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4. Promatec Test CTP-1124.1c, "Ten (10) Inch Depth Promaflex w/Dams, 36 Inch Diameter Sleeve / 10 Inch Diameter Pipe Fluid Filled Pipe Penetrant for Movable Mechanical Penetration Seals," dated February 19, 1988
5. Promatec Test CTP-1124.1b, "Six (6) Inch Depth Promaflex w/Dams, 36 Inch Diameter Sleeve / 10 Inch Diameter Pipe for Movable Mechanical Penetration Seals," dated February 19, 1988
6. BISCO Test 748-49, "Fire Test Configuration for a Three Hour Rated Fire Seal Utilizing BISCO SF-20 Where a Steel Sleeve Condition With Pipe Penetrant Exists," dated July 9, 1981
7. GSU P.O. No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs," dated November 22, 1993
8. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", Rev. 0

I. ATTACHMENTS

1. Attachment A

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ATTACHMENT A

CAT. B

MARK NO	PIPE	SLEEVE	DETAIL	SYSTEM	FLUID	INSUL	DWG NO	ROOM A	ROOM B	LOCATION
A0002BM	14	20	XL	063	YES	NO	47W472-1, 47W471-1	A211	A216	3'5" N/V, /A5
A0002CM	14	20	XL	063	YES	NO	47W472-1, 47W471-1	A213	A217	14'3" N/U, /A11
A0002DM	14	20	XL	063	YES	NO	47W472-1, 472471-1	A212	A217	3'7" N/V, /A11
A0010AM	20	26	I	063	YES	NO	47W472-1, 47W471-1	A214	A217	6'3" S/U, /A11
A0010BM	20	26	I	063	YES	NO	47W472-1, 47W471-1	A209	A216	6'3" S/U, /A5
A0094AM	16	30	I	063	YES	NO	47W472-1, 47W471-2	A301	A325	/U, 20"E/A13
A0094BM	16	30	I	063	YES	NO	47W472-1, 47W471-3	A301	A307	/U, 14"W/A3
A0142BM	24	30	I	063	YES	NO	47W472-1, 47W471-2	A301	A325	/U, 12'6"E/A13
A0205AM	15	20	I	063	YES	NO	47W472-1, 47W471-4	A324	A325	3'N/U, 12'W/A13
A0205BM	16	20	I	063	YES	NO	47W472-1, 47W471-5	A307	A308	3'N/U, 12'9"E/A3
A0208AM	20	24	I	063	YES	NO	47W472-1, 47W471-4	A324	A325	5'3"N/U, 12'W/A13
A0208BM	20	24	XL	063	YES	NO	47W472-1, 47W471-5	A307	A308	5'3"N/U, 12'9"E/A3
A0395AM	18	24	I	070	YES	NO	47W471-8, 47W472-2	A415	A416	2'11"N/V, 2'11"E/A9
A0395BM	18	24	I	070	YES	NO	47W471-9, 47W472-2	A411	A412	5'2"N/V, 3'11"W/A7
A0473AM	18	24	I	067	YES	NO	47W471-8, 47W472-2	A416	A429	3'4"S/V, /A11
A0473BM	18	24	I	067	YES	NO	47W471-8, 47W472-2	A415	A429	19'1"S/W, /A11
A0473CM	18	24	VIII	067	YES	NO	47W471-9, 47W472-2	A411	A428	3'4"S/V, /A5
A0473DM	18	24	I	067	YES	NO	47W471-9, 47W472-2	A412	A428	19'S/W, /A5
A0474AM	18	24	I	067	YES	NO	47W471-8, 47W472-2	A419	A429	3'4"S/V, 11'6"W/A12
A0474BM	18	24	I	067	YES	NO	47W471-9, 47W472-2	A406	A428	3'4"S/V, 11'6" E/A4
A0474CM	18	24	I	067	YES	NO	47W471-8, 47W472-2	A419	A429	14" N/V, 11'6"W/A12
A0474DM	18	24	V	067	YES	NO	47W471-9, 47W472-2	A406	A428	14"N/V, 11'6"E/A4
A0430BM	20	26	I	067	YES	NO	47W471-6, 47W472-2	A401	A406	/U, 3'0"E/A3
A0483AM	18	24	I	070	YES	NO	47W471-8, 47W472-2	A416	A401	/U, 2'11"E/A9
A0483BM	18	24	I	070	YES	NO	47W471-9, 47W472-2	A411	A401	15'5"N/U, 3'W/A7
A0484AM	18	24	I	070	YES	NO	47W471-6, 47W472-2	A401	A417	/U, 3'E/A9
A0484BM	18	24	V	070	YES	NO	47W471-7, 47W472-2	A401	A411	/U, 2'11" W/A7
A0485AM	16	20	VIII	070	YES	NO	47W471-6, 47W472-2	A401	A301	/U, 2'8" W/A9
A0623AM	20	26	I	072	YES	NO	47W471-1, 47W472-3	A208	A216	24'5"S/U, /A5
A0623BM	20	26	I	072	YES	NO	47W471-1, 47W472-3	A215	A217	24'5"S/U, /A11
A0753AM	24	30	VIII	067	YES	NO	47W471-10, 47W472-3	A701	A709	/U, 11'7" W/A13
A0753BM	24	30	VIII	067	YES	NO	47W471-10, 47W472-3	A701	A709	/U, 15'8"W/A13
A0753CM	24	30	I	067	YES	NO	47W471-11, 47W472-3	A701	A705	/U, 14'10"W/A4
A0753DM	24	30	I	067	YES	NO	47W471-11, 47W472-3	A701	A705	/U, 10'10" W/A4
A0758BM	18	24	I	070	YES	NO	47W471-12, 47W472-3	A415	A416	4'N/V, 2'11"E/A9
A0758CM	18	24	I	070	YES	NO	47W471-13, 47W472-3	A411	A412	4'N/V, 2'11"W/A7
A0758DM	18	24	I	070	YES	NO	47W471-13, 47W472-3	A701	A411	13'4"N/U, 2'11"W/A7
A0765AM	18	24	I	070	YES	NO	47W471-12, 47W472-3	A708	A416	10'N/U, 2'11"E/A9
A0765BM	18	24	I	070	YES	NO	47W471-13, 47W472-3	A701	A411	10'N/U, 5'1"E/A6
A0807BM	18	24	I	067	YES	NO	47W471-11, 47W472-4	A701	A428	/U, 4'W/A5
A0808AM	18	24	I	067	YES	NO	47W471-10, 47W472-4	A701	A429	/U, 4'E/A11
A0808BM	18	24	I	067	YES	NO	47W471-11, 47W472-4	A701	A428	/U, 8'W/A5
A0816AM	18	24	I	067	YES	NO	47W471-12, 47W472-4	A429	A415	7'3"N/V, /A11
A0816BM	18	24	I	067	YES	NO	47W471-13, 47W472-4	A411	A428	1'S/V, /A5
A0817AM	18	24	I	067	YES	NO	47W471-12, 47W472-4	A416	A429	1'S/V, /A11
A0817BM	18	24	I	067	YES	NO	47W471-13, 47W472-4	A412	A428	7'3"N/V, /A5
A2140AM	36	42	I	067	YES	NO	47W471-6, 47W472-10	A401	A301	4'2"S/U, 12'3"W/A2
A2220AM	36	42	I	067	YES	NO		A350	OUTS	128'N/U, 88'3"W/A1
A2222BM	30	36	I	067	YES	NO		A360	OUTS	128'N/U, 83'3" E/A15

CATEGORY C EVALUATION

**Elastomer Seals with Fluid Filled
Large Bore Pipe**

WBN Typical Detail
LX, LXI, XLII, XLIV, XLVI

Applicable Supporting Fire Test
1. Promatec Test CTP-1142
2. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The penetration seal assemblies listed in Attachment "A" require further engineering justification because one or more critical attributes lies outside the parameters of the applicable fire tests or typical detail. The identified penetrations have installed piping larger than qualified by Engineering Report No. 0006-00922-02 for the subject penetrations.

B. PERTINENT PENETRATION SEAL ASSEMBLY CONSTRUCTION ELEMENTS:

The identified penetration seal assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472: Sht. 60, Detail LX, Sht. 61, Detail LXI, Sht. 42, Detail XLII, Sht. 44, Detail XLIV, Sht. 46, Detail XLVI.

The following describes common attributes of all the penetration seal assemblies listed in attachment A.

- Barrier construction: All penetrations are through 2 or 3 hour concrete walls with thicknesses equal to or greater than 12".
- Penetration Orientation: The installed seal assemblies are installed in either wall or floor/ceiling orientations.
- Penetrating Items: The subject penetrations are all single piping penetrant penetrations.
- Seal Assembly: All of the typical seal details listed above require a 6" minimum depth of Dow Corning Sylgard 170 or GE 6428 RTV Silicone Elastomer installed within the plane of the barrier, permanent damming material is not required, and will therefore (conservatively) not be credited in this evaluation.

Each penetration seal assembly's specific attributes as identified below are delineated in Attachment A.

- Penetration: Opening Size and Type
- Penetrating Items: Penetrant Size and Type

Preparer: _____

Chris Johnson

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10/4/95

Verifier: _____

Joshua

Date: _____

10/4/95

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

Promatec Test CTP-1142 Penetrant Size: 6" diameter conduit one of various (Penetration 11) penetrations within the blackout tested)
 Opening Size: 48" x 48" blackout
 Seal Material: 6" (min.) Promatec LDSE
 Barrier Const.: 12" thick poured concrete (horizontal)
 Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures below 325°F plus initial temperature

GSU Test 93-H-72449 Penetrant Size: 8" diameter pipe
 (Penetration 7) Opening Size: 12" diameter sleeve
 Seal Material: 6" (min.) silicone elastomer w/ 1" damming
 Barrier Const.: 12" thick poured concrete (horizontal)
 Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 343°F above initial temperature

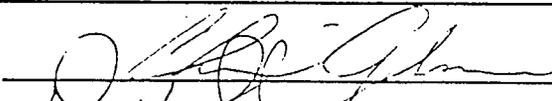
GSU Test 93-H-72449 Penetrant Size: 16" diameter pipe
 (Penetration 12) Opening Size: 20" diameter sleeve
 Seal Material: 12" (min.) silicone elastomer
 Barrier Const.: 12" thick poured concrete (horizontal)
 Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 330°F above initial temperature

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

As established in the qualification of WBN typical details LX, LXI, XLII, XLIV, XLVI, silicone elastomer performs better than LDSE with respect to the passage of flame, hose stream and transmission of heat to the unexposed side of a test assembly (Refer to Reference 3 for an additional discussion of this determination). Based on this, a review of the tested configurations in section C establishes the following:

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1. A penetration seal comprised of a 6" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 12" in diameter and smaller which contain pipes less than or equal to 6" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 272°F above initial temperature at two hours into the three hour fire endurance test.
2. A penetration seal comprised of a 6" depth of silicone elastomer with 1" of non-combustible damming material provides a 3 hour F rated assembly when sealing openings 12" in diameter and smaller which contain pipes less than or equal to 8" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 277°F above initial temperature at two hours into the three hour fire endurance test.
3. A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 250°F above initial temperature at two hours into the three hour fire endurance test.
4. The subject WBN seal assemblies are installed in 2 or 3 hour concrete barriers with thicknesses equal to or greater than 12". Those assemblies installed in barriers greater than 12" thick will benefit from the additional heat dissipation capacity along the penetration sleeve/seal interface which will serve to reduce the unexposed seal surface temperatures.
5. The tested penetration seal assemblies were installed in a floor/ceiling orientation which due to more severe fire exposure is worst case and bounds through wall orientations. Additionally, all pertinent elements of the tested and installed seal assemblies are equivalent and symmetrical.
6. The tested penetration seal assemblies were sealed with a 6" minimum depth of Silicone Elastomer without permanent damming material as were the penetrations identified in Attachment A and are therefore equivalent. Fire Test ICC1185020 serves as a qualification basis for annular spaces up to 17" for a 6" thickness of Silicone Elastomer without damming material. Therefore, the worst case installed configuration for potential annular gap (6" diameter piping through a 40" diameter sleeve) is bounded by test.

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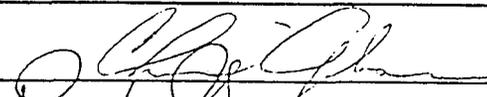
7. Additionally, since the 16" diameter piping penetrant tested in 93-H-72449 was not subjected to fire in a fluid filled condition, the presence of fluid in the piping associated with the installed WBN seal assemblies will significantly reduce transmission of heat into the seal, thus resulting in superior performance (i.e., reduce rate of char formation) to that of the tested configuration. This is demonstrated by evaluation of test CTP-1124.

a. Pertinent Construction Elements of Promatec Fire Test CTP-1124

Fire tests CTP-1124.1b & CTP-1124.1c provide thermocouple temperature reference points for like sized penetrating items in seal assemblies using the same type of seal and damming materials. The variable of interest in this evaluation is that Pen. 1b used a dry pipe and Pen. 1c used a fluid filled pipe.

Fire Test CTP-1124.1b tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, insulated with 1" of Alumina Silica blanket and metal jacketing through the penetration. The penetration was sealed with 6" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

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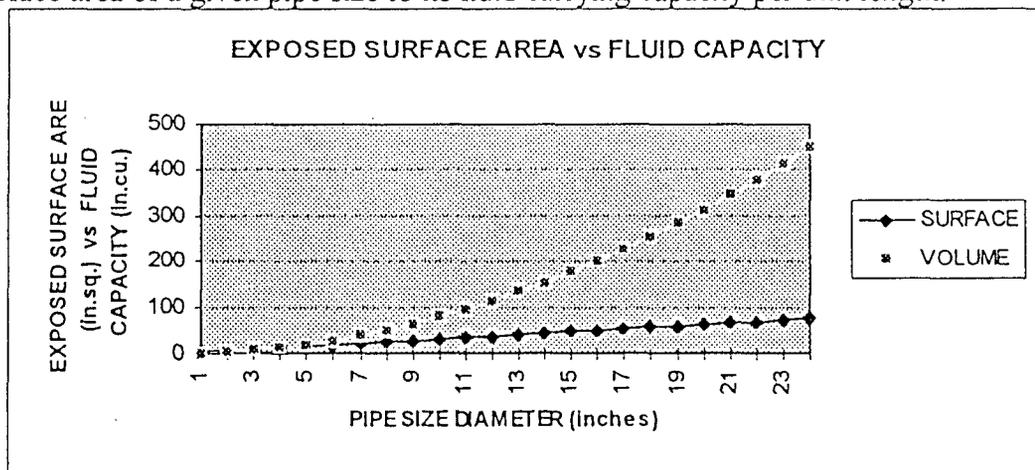
Fire Test CTP-1124.1c tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, filled with fluid. The penetration was sealed with 10" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

b. Fire Test CTP-1124 Review

This review examines the maximum temperatures recorded on both 10" pipe penetrants at similar locations to identify differences in temperature increase on the unexposed side of the penetration seals.

Pen. 1b penetrating item thermocouple readings shows that the temperature at the insulation jacket/seal material surface interface was 686°F (T/C I-5), the temperature on the pipe itself, 13" from the exposed surface of the seal was 548°F (T/C E-7) and the temperature of the pipe 48" from the exposed surface of the seal was 154°F (T/C E-8). Based on the thermal properties of Alumina Silica material, a portion of the heat conducted by the pipe was not transferred to the seal material as it would had the pipe been uninsulated (i.e., the insulation effectively resulted in higher piping surface temperatures than that of an uninsulated pipe).

Pen. 1c penetrating item thermocouple readings shows that the temperature at the pipe/seal material surface interface was 200°F (T/C I-5), the temperature on the pipe 13" from the exposed surface of the seal was 186°F (T/C P-6) and the temperature of the pipe 48" from the exposed surface of the seal was 178°F (T/C E-12). Although Pen. 1c had 4" of additional seal depth over that used in Pen. 1b (i.e., 10" vs. 6"), the drastic differences in seal interface and pipe surface temperatures 13" from the exposed surface of the seal clearly demonstrate the effects of fluid in the piping. Specifically, the unexposed pipe surface temperatures three times higher for Pen. 1b than for Pen. 1c is attributed moreover to the fluid's capacity to absorb heat than the difference in seal depth. This effect is demonstrated below by comparing the exposed surface area of a given pipe size to its fluid carrying capacity per unit length.



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 Verifier: *[Signature]*

Date: 10/9/95
 Date: 10/11/95

Therefore, with increasing size of a fluid filled pipe, its capacity to absorb heat (and hence reduce heat transmission into the penetration seal material) increases at a much greater rate than its exposed surface area. Therefore, in absence of specific fire tests which directly bound the largest WBN fluid filled pipe penetration (36" diameter), reasonable assurance exists to conclude that a seal assembly consisting of 6" of Dow Corning Sylgard 170 or GE 6428 RTV Silicone Elastomer is sufficient to achieve an F rating commensurate with the barrier in which it is installed.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames and hot gasses through the opening. The other alternative uses a T rating to ensure that in addition to preventing the passage of flame, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configurations referenced in Section C satisfy this criteria.

E. CONCLUSION

Based on the evaluation detailed in Section D above, a technical basis exists to conclude that the installed WBN penetration seal assemblies listed in Attachment A will provide an F rating equivalent to the fire rated barrier in which they are installed.

F. FEATURES ANALYSIS

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in Section D above concluded that the installed configurations provide a level of protection equivalent to the 2 or 3 hour rating of the barriers in which they are installed.

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G. SUMMARY

Based on the evaluation detailed in Section D above, the seal assemblies installed in the penetrations itemized in Attachment A provide protection equivalent to the fire rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to those penetrations, the fire would not propagate between rooms via the penetrations itemized in Attachment A due to the protection provided by the installed penetration seal assemblies.

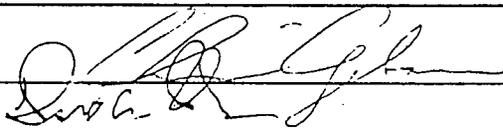
H. REFERENCES

1. Promatec Fire Test CTP-1142, "Three Hour Fire Qualification Test, Six (6) Inch Depth LDSE w/ Aluminum & Steel Penetrants, XLPE/PVC Cable", dated November 23, 1987.
2. GSU P.O. No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs," dated November 22, 1993
3. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", Rev. 0

I. ATTACHMENTS

1. Attachment A

Preparer:



Date:

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Verifier:



Date:

10/4/95

ATTACHMENT A

CAT. C

MARK NO	PIPE	SLEEVE	DETAIL	SYSTEM	FLUID	INSUL	DWG NO	ROOM A	ROOM B	LOCATION
A0002AM	14	20	XLII	063	YES	NO	472472-1, 47W471-1	A210	A216	14'3" N/U, /A5
A0263DM	12	16	XLVI	067	YES	NO	47W472-1, 47W471-3	A306	A301	20"N/T, 2'6"E/A1
A0438AM	8	16	XLVI	003	YES	YES	47W471-8, 47W472-2	A419	A325	2'4"N/U, 11'10"W/A15
A0472AM	24	30	XLVI	067	YES	NO	47W471-8, 47W472-2	A419	A325	5'6"N/U, 5'5"W/A14
A0472CM	24	30	XLVI	067	YES	NO	47W471-9, 47W472-2	A406	A307	5'6"N/U, 6'6" E/A2
A0472DM	24	30	XLVI	067	YES	NO	47W471-9, 47W472-2	A406	A307	5'6"N/U, 12'9"E/A2
A0485BM	16	20	XLVI	070	YES	NO	47W471-7, 47W472-2	A401	A301	/U, 2'8" E/A7
A0486AM	18	24	XLVI	070	YES	NO	47W471-6, 47W472-2	A401	A301	2'6"S/T, 5'W/A10
A0486BM	18	24	XLVI	070	YES	NO	47W471-6, 47W472-2	A401	A301	2'9"N/T, 5'W/A10
A0486CM	18	24	XLVI	070	YES	NO	47W471-7, 47W472-2	A401	A301	4'4"S/T, 5'E/A6
A0486DM	18	24	XLVI	070	YES	NO	47W471-7, 47W472-2	A401	A301	2'8"N/T, 5'1"E/A6
A0486EM	18	24	XLVI	070	YES	NO	47W471-7, 47W472-2	A401	A301	3'6" N/T, 19'5"E/A2
A0486GM	18	24	XLVI	070	YES	NO	47W471-7, 47W472-2	A401	A301	3'6"N/T, 6'7"E/A2
A0486IM	18	24	XLVI	070	YES	NO	47W471-7, 47W472-2	A401	A301	3'6" N/T, 10'3"W/A2
A0525AM	8	12	XLVI	067	YES	NO	47W471-7, 47W472-2	A401	A301	2'9"S/T, 2'9"E/A4
A0536AM	10	16	XLVI	070	YES	NO	47W471-6, 47W472-2	A401	A301	2'6"S/T, 2'9"W/A10
A0536BM	10	16	XLVI	070	YES	NO	47W471-7, 47W472-2	A401	A301	2'7"S/T, 2'9"E/A6
A0657EM	8	10	XLVI	067	YES	NO	47W471-9, 47W472-3	A406	A307	4'7" S/V, 6'6" W/A3
A0657FM	8	10	XLVI	067	YES	NO	47W471-9, 47W472-3	A406	A307	8'2"S/V, 6'11"E/A2
A0657GM	8	10	XLVI	067	YES	NO	47W471-9, 47W472-3	A406	A307	8'9"S/V, 9'4"W/A2
A0657HM	8	10	XLVI	067	YES	NO	47W471-9, 47W472-3	A406	A307	8'2"S/V, 14'1"W/A2
A0707AM	12	20	XLVI	03B	YES	YES	47W471-6, 47W472-3	A401	A401	5'N/Q, 3'W/A15
A0752BM	24	30	XLVI	067	YES	NO	47W471-12, 47W472-3	A709	A419	11'6"N/U, 3'6"E/A13
A0752DM	24	30	XLVI	067	YES	NO	47W471-13, 47W472-3	A705	A406	11'6"N/U, 3'6"W/A3
A0758AM	18	24	XLVI	070	YES	NO	47W471-12, 47W472-3	A708	A416	12'3"N/U, 2'11"E/A9
A0760CM	16	20	XLVI	070	YES	NO	47W471-10, 47W472-3	A701	A401	/U, 2'8"W/A9
A0760DM	16	20	XLVI	070	YES	NO	47W471-11, 47W472-3	A701	A401	/U, 2'8"E/A7
A0766AM	24	40	XLVI	070	YES	NO	47W471-10, 47W472-3	A701	A401	8'S/S, 14"W/A10
A0766BM	24	40	XLII	070	YES	NO	47W471-10, 47W472-3	A701	A401	8'N/S, 14"W/A10
A0766CM	24	40	XLII	070	YES	NO	47W471-10, 47W472-3	A701	A401	16'10"N/S, 14"W/A10
A0799AM	8	12	XLVI	024	YES	NO	47W471-10, 47W472-3	A701	A423	6'N/Q, 9'E/A14
A0801AM	24	30	XLVI	067	YES	NO	47W471-10, 47W472-3	A701	A401	3'7"S/S, 3'8"W/A11
A0801BM	24	30	XLVI	067	YES	NO	47W471-10, 47W472-3	A701	A401	4'10"S/T, 3'7"W/A11
A0802AM	8	12	XLVI	025	YES	NO	47W471-10, 47W472-3	A701	A401	/S, 2'6" W/A11
A0806AM	8	12	XLVI	070	YES	NO	47W471-10, 47W472-4	A701	A401	3'S/U, 4'6"E/A10
A0806BM	8	12	XLVI	070	YES	NO	47W471-11, 47W472-4	A701	A401	2'11" S/U, 4'6" W/A6
A0814AM	12	18	XLVI	070	YES	NO	47W471-11, 47W472-4	A701	A401	2'N/T, 7'6"W/A8
A0814BM	12	18	XLVI	070	YES	NO	47W471-11, 47W472-4	A701	A401	5'N/T, 7'6" W/A8
A0993AM	10	14	XLVI	078	YES	NO	47W471-13, 47W472-4	A701	A428	2'S/CLRB, 2'6"E/A5
A0994AM	8	12	XLVI	078	YES	NO	47W471-13, 47W472-4	A701	A428	12'3"S/CLRB, 2'W/A7
A1106AM	8	12	XLVI	067	YES	NO	47W471-11, 47W472-5	A701	A401	12"N/R, 8'11"E/A3
A1144AM	8	12	XLVI	025	YES	NO	47W471-16, 47W472-5	A911	A813	3'9"S/U, /A10
A1304BM	12	16	XLII	067	YES	NO	47W471-7, 47W472-6	A401	A301	3'8"N/S, 2'8"W/A5
DG0001	10	14	XLVI	067	YES	NO	17W585-1	D109	D104	3'E/W, FUEL TRNS BLDG
DG0002	10	14	XLVI	067	YES	NO	17W585-1	D109	D105	SWA/1B-
DG0003	10	14	XLVI	067	YES	NO	17W585-1	D109	D106	SWA/2A-A, 3'1"W/EWA
DG0004	10	14	XLVI	067	YES	NO	17W585-1	D109	D107	SWA/1A-A, 3'1"W/EWA

CATEGORY D EVALUATIONS

**Single Sided Boot Seals with Fluid
Filled Large Bore Pipe**

**HDSE Seals with Fluid Filled
Large Bore Pipe**

WBN Typical Detail
LIX

Applicable Supporting Fire Test
1. ICC1088024

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The penetration seal assembly identified as MARK NO.:RIS062 requires further engineering justification because one or more critical attributes lies outside the parameters of the applicable fire tests or typical detail. The identified penetration has installed piping larger than qualified by Engineering Report No. 0006-00922-02 for the subject penetration.

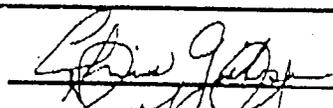
B. PERTINENT PENETRATION SEAL ASSEMBLY CONSTRUCTION ELEMENTS:

The identified penetration seal assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472: Sht.59, Detail LIX.

The following describes the penetration seal assembly's' general attributes:

Mark No.: RIS062	Penetrate Size: 12" diameter pipe
	Opening Size: 16" diameter sleeve
	Seal Material: INNER boots (1) layer of Silicone Boot Arlon (KCF) grade 56493F031 & Carborundum 36-400U Fibersil Cloth, (3) layers of Carborundum Durablanket, OUTER boots (1) layer of Carborundum 36-400U Fibersil Cloth, & Silicone Boot Arlon (KCF) grade 56493F031. Assembled using Dow Corning-795 adhesive/sealant, S.S. tie wire & bands
	Barrier Const.: 12" thick poured concrete with a 3" curb
	Barrier Rating: 3 hour

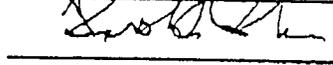
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C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS

The following describes the critical attributes of the fire test assembly which will be used to evaluate the identified penetration seal assembly:

ICMS Test ICC1088024 (Penetration 2)	Penetrant Size: 12" diameter pipe Opening Size: 16" diameter sleeve Seal Material: INNER boots (1) layer of Silicone Boot Arlon (KCF) grade 56493F031 & Carborundum 36-400U Fibersil Cloth, (3) layers of Carborundum Durablanket, OUTER boots (1) layer of Carborundum 36-400U Fibersil Cloth, & Silicone Boot Arlon (KCF) grade 56493F031. Assembled using Dow Corning-795 adhesive/sealant, S.S. tie wire & bands
	Barrier Const.: 12" thick poured concrete with a 3" curb
	Test Results: 3 hour rating per WBN criteria with no flame through or hose stream to the unexposed side of the seal

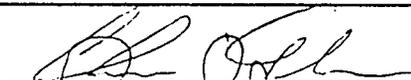
D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assembly is qualified based on a comparison with tested configuration described in section C above as documented by the following:

1. The installed penetration seal assembly is constructed using the essential elements of the tested configuration, which qualifies providing a 3 hour F rated assembly when sealing openings 16" in diameter and smaller which contain pipes less than or equal to 12" in diameter through wall or floor/ceiling barriers.
2. The subject WBN seal assembly is installed in 3 hour concrete barrier equal to or greater than 12" thick.
3. The tested penetration seal assembly was installed in a floor/ceiling orientation which bounds wall installations also when the seal is constructed symmetrically.
4. The installed piping is significantly longer than that tested and will thereby provide for heat dispersion along the pipes length and not directly into the seal as seen by the tested seal assembly.

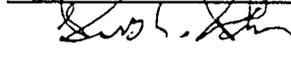
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5. Additionally, since the 12" diameter piping penetrant tested in ICC1088024 was not subjected to fire in a fluid filled condition, the presence of fluid in the piping associated with the installed WBN seal assemblies will significantly reduce transmission of heat into the seal, thus resulting in superior performance (i.e., reduce rate of char formation) to that of the tested configuration. This is demonstrated by evaluation of test CTP-1124.

a. Pertinent Construction Elements of Promatec Fire Test CTP-1124

Fire tests CTP-1124.1b & CTP-1124.1c provide thermocouple temperature reference points for like sized penetrating items in seal assemblies using the same type of seal and damming materials. The variable of interest in this evaluation is that Pen. 1b used a dry pipe and Pen. 1c used a fluid filled pipe.

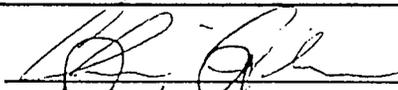
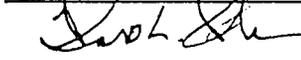
Fire Test CTP-1124.1b tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, insulated with 1" of Alumina Silica blanket and metal jacketing through the penetration. The penetration was sealed with 6" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

Fire Test CTP-1124.1c tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, filled with fluid. The penetration was sealed with 10" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

b. Fire Test CTP-1124 Review

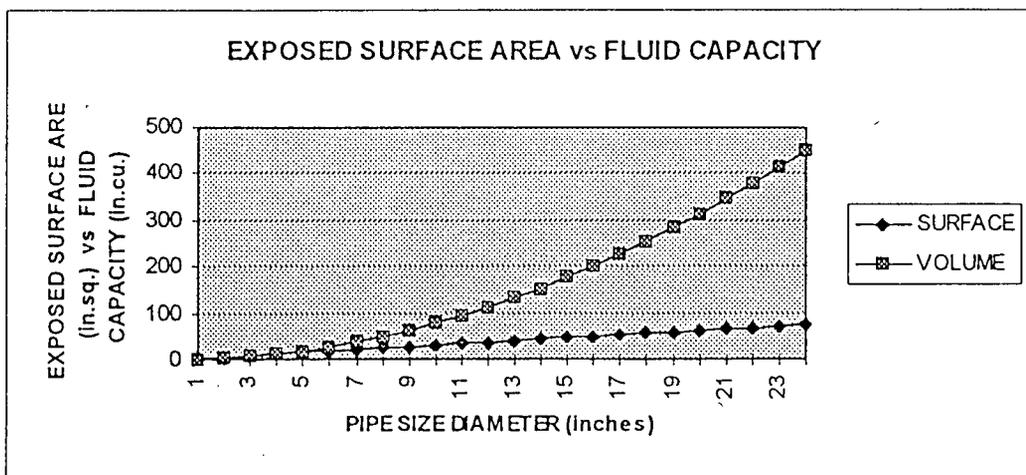
This review examines the maximum temperatures recorded on both 10" pipe penetrants at similar locations to identify differences in temperature increase on the unexposed side of the penetration seals.

Pen. 1b penetrating item thermocouple readings shows that the temperature at the insulation jacket/seal material surface interface was 686°F (T/C I-5), the temperature on the pipe itself, 13" from the exposed surface of the seal was 548°F (T/C E-7) and the temperature of the pipe 48" from the exposed surface of the seal was 154°F (T/C E-8). Based on the thermal properties of Alumina Silica material, a portion of the heat conducted by the pipe was not transferred to the seal material as it would had the pipe been uninsulated (i.e., the insulation effectively resulted in higher piping surface temperatures than that of an uninsulated pipe).

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Date: 10/4/95
Date: 10/4/95

Pen. 1c penetrating item thermocouple readings shows that the temperature at the pipe/seal material surface interface was 200°F (T/C I-5), the temperature on the pipe 13" from the exposed surface of the seal was 186°F (T/C P-6) and the temperature of the pipe 48" from the exposed surface of the seal was 178°F (T/C E-12). Although Pen. 1c had 4" of additional seal depth over that used in Pen. 1b (i.e., 10" vs. 6"), the drastic differences in seal interface and pipe surface temperatures 13" from the exposed surface of the seal clearly demonstrate the effects of fluid in the piping. Specifically, the unexposed pipe surface temperatures three times higher for Pen. 1b than for Pen. 1c is attributed moreover to the fluid's capacity to absorb heat than the difference in seal depth. This effect is demonstrated below by comparing the exposed surface area of a given pipe size to its fluid carrying capacity per unit length.



Therefore, with increasing size of a fluid filled pipe, its capacity to absorb heat (and hence reduce heat transmission into the penetration seal material) increases at a much greater rate than its exposed surface area. Therefore, in absence of specific fire tests which directly bound the largest WBN fluid filled pipe penetration (36" diameter), reasonable assurance exists to conclude that a seal assembly consisting of Two(2) Fire Boot Assemblies with Three (3) 1" thick layers of Ceramic Blanket is sufficient to achieve an F rating commensurate with the barrier in which it is installed.

Preparer:

[Signature]

Date:

10/4/95

Verifier:

[Signature]

Date:

10/9/95

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames and hot gasses through the opening. The other alternative uses a T rating to ensure that in addition to preventing the passage of flame, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configurations referenced in Section C satisfy this criteria.

E. CONCLUSION

Based on the evaluation detailed in Section D above, a technical basis exists to conclude that the installed WBN penetration seal assembly MARK NO.: R1S062 will provide an F rating equivalent to the fire rated barrier in which it is installed.

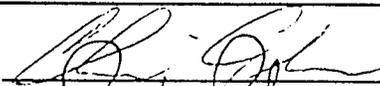
F. FEATURES ANALYSIS

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seal being evaluated is not required. The evaluation contained in Section D above concluded that the installed configuration provide a level of protection equivalent to the 3 hour rating of the barrier in which it is installed.

G. SUMMARY

Based on the evaluation detailed in Section D above, the seal assembly installed in the penetration identified as MARK NO.: R1S062 will provide protection equivalent to the fire rated barrier in which it is installed. In the unlikely event that a fire originated in either of the rooms adjacent to the penetration, the fire would not propagate between rooms via the penetration identified as MARK NO.: R1S062 due to the protection provided by the installed penetration seal assembly.

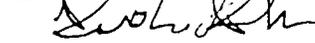
Preparer: _____



Date: _____

10/4/95

Verifier: _____



Date: _____

10/4/95

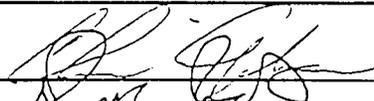
H. REFERENCES

1. Construction Technology Laboratories Fire Test ICC1088024, "Fire and Hose Stream Tests of Four Mechanical Penetration Seal Systems," dated November 1988.
2. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", Rev. 0

I. ATTACHMENTS

None

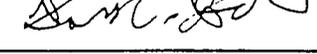
Preparer:



Date:

12/4/95

Verifier:



Date:

12/15/95

WBN Typical Detail
XLVII

Applicable Supporting Fire Test
1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The penetration seal assembly identified as MARK NO.:A2186AM requires further engineering justification because one or more critical attributes lies outside the parameters of the applicable fire tests or typical detail. The identified penetration has installed piping larger than qualified by Engineering Report No. 0006-00922-02 for the subject penetration.

B. PERTINENT PENETRATION SEAL ASSEMBLY CONSTRUCTION ELEMENTS:

The identified penetration seal assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472: Sht.47, Detail XLVII.

The following describes the penetration seal assemblies' general attributes:

Mark No.: A2186AM	Penetrant Size: 36" diameter pipe
	Opening Size: 42" diameter sleeve
	Seal Material: 15" (min.) high density silicone elastomer (P-90) within the barrier
	Barrier Const.: 12" thick poured concrete with a 3" curb
	Barrier Rating: 3 hour

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS

The following describes the critical attributes of the fire test assembly which will be used to evaluate the identified penetration seal assembly:

Preparer: _____

Brian J. [Signature]

Date: _____

10/4/95

Verifier: _____

[Signature]

Date: _____

10/4/95

GSU Test 93-H-72449
(Penetration 8)

Penetrant Size: 18" diameter pipe
 Opening Size: 26" diameter sleeve
 Seal Material: 12" (min.) HDSE (high density silicone elastomer)
 Barrier Const.: 12" thick poured concrete (horizontal)
 Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures less than 325°F above initial temperature

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assembly is qualified based on a comparison with tested configuration described in section C above as documented by the following:

1. A penetration seal comprised of a 12" depth of HDSE high density silicone elastomer provides a 3 hour F rated assembly when sealing openings 26" in diameter and smaller which contain pipes less than or equal to 18" in diameter through floor/ceiling barriers.
2. The subject WBN seal assembly is installed in 3 hour 12" thick concrete with a 3" concrete curbing.
3. The tested penetration seal assembly was installed in a floor/ceiling orientation which is the same as the installed seal assembly.
4. The tested penetration seal assembly was sealed with a 12" minimum depth of HDSE High Density Silicone Elastomer without permanent damming material, which is evaluated against the installed ICMS P-90 material in Section 3 of Engineering Report 0006-00922-02 and found to equivalent. The installed penetration seal assembly is sealed with 15" minimum of P-90 material.
5. Additionally, since the 18" diameter piping penetrant tested in 93-H-72449 was not subjected to fire in a fluid filled condition, the presence of fluid in the piping associated with the installed WBN seal assemblies will significantly reduce transmission of heat into the seal, thus resulting in superior performance (i.e., reduce rate of char formation) to that of the tested configuration. This is demonstrated by evaluation of test CTP-1124.

Preparer: _____

Date: 10/19/95

Verifier: _____

Date: 10/4/95

a. Pertinent Construction Elements of Promatec Fire Test CTP-1124

Fire tests CTP-1124.1b & CTP-1124.1c provide thermocouple temperature reference points for like sized penetrating items in seal assemblies using the same type of seal and damming materials. The variable of interest in this evaluation is that Pen. 1b used a dry pipe and Pen. 1c used a fluid filled pipe.

Fire Test CTP-1124.1b tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, insulated with 1" of Alumina Silica blanket and metal jacketing through the penetration. The penetration was sealed with 6" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

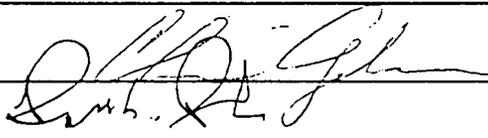
Fire Test CTP-1124.1c tested a 36" diameter by 14" long steel sleeve in a 12" thick concrete slab penetrated by a 10" diameter by 60" long steel pipe, filled with fluid. The penetration was sealed with 10" of Promatec PROMAFLEX and 1" of Alumina Silica damming board on both exposed and unexposed sides supported by a seal support framework.

b. Fire Test CTP-1124 Review

This review examines the maximum temperatures recorded on both 10" pipe penetrants at similar locations to identify differences in temperature increase on the unexposed side of the penetration seals.

Pen. 1b penetrating item thermocouple readings shows that the temperature at the insulation jacket/seal material surface interface was 686°F (T/C I-5), the temperature on the pipe itself, 13" from the exposed surface of the seal was 548°F (T/C E-7) and the temperature of the pipe 48" from the exposed surface of the seal was 154°F (T/C E-8). Based on the thermal properties of Alumina Silica material, a portion of the heat conducted by the pipe was not transferred to the seal material as it would had the pipe been uninsulated (i.e., the insulation effectively resulted in higher piping surface temperatures than that of an uninsulated pipe).

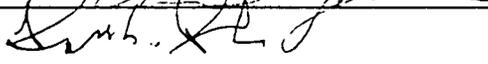
Preparer:



Date:

10/19/95

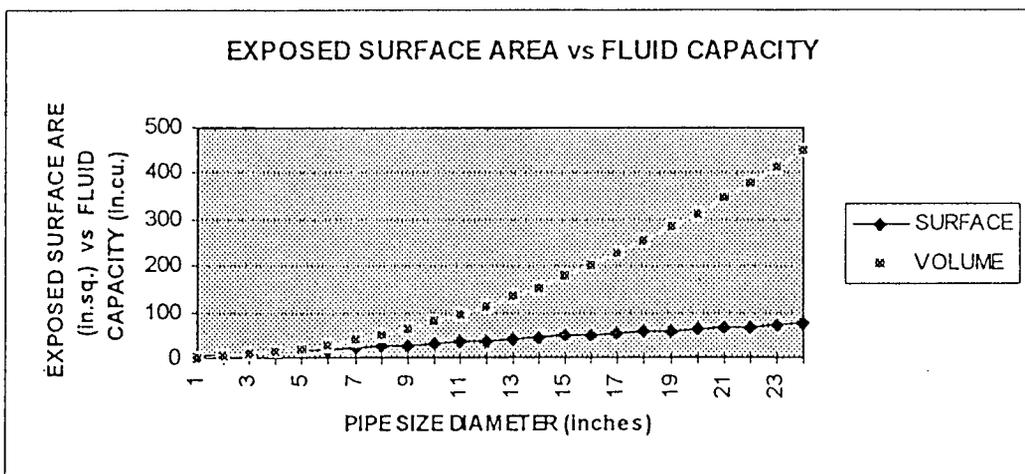
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Pen. 1c penetrating item thermocouple readings shows that the temperature at the pipe/seal material surface interface was 200°F (T/C I-5), the temperature on the pipe 13" from the exposed surface of the seal was 186°F (T/C P-6) and the temperature of the pipe 48" from the exposed surface of the seal was 178°F (T/C E-12). Although Pen. 1c had 4" of additional seal depth over that used in Pen. 1b (i.e., 10" vs. 6"), the drastic differences in seal interface and pipe surface temperatures 13" from the exposed surface of the seal clearly demonstrate the effects of fluid in the piping. Specifically, the unexposed pipe surface temperatures three times higher for Pen. 1b than for Pen. 1c is attributed moreover to the fluid's capacity to absorb heat than the difference in seal depth. This effect is demonstrated below by comparing the exposed surface area of a given pipe size to its fluid carrying capacity per unit length.



Therefore, with increasing size of a fluid filled pipe, its capacity to absorb heat (and hence reduce heat transmission into the penetration seal material) increases at a much greater rate than its exposed surface area. Therefore, in absence of specific fire tests which directly bound the largest WBN fluid filled pipe penetration (36" diameter), reasonable assurance exists to conclude that a seal assembly consisting of 12" of CMS P-90 is sufficient to achieve an F rating commensurate with the barrier in which it is installed.

Preparer: *[Signature]*
 Verifier: *[Signature]*

Date: 10/18/95
 Date: 10/4/95

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames and hot gasses through the opening. The other alternative uses a T rating to ensure that in addition to preventing the passage of flame, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configurations referenced in Section C satisfy this criteria.

E. CONCLUSION

Based on the evaluation detailed in Section D above, a technical basis exists to conclude that the installed WBN penetration seal assembly MARK NO.: A2186AM will provide an F rating equivalent to the fire rated barrier in which it is installed.

F. FEATURES ANALYSIS

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seal being evaluated is not required. The evaluation contained in Section D above concluded that the installed configuration provide a level of protection equivalent to the 3 hour rating of the barrier in which it is installed.

G. SUMMARY

Based on the evaluation detailed in Section D above, the seal assembly installed in the penetration identified as MARK NO.: A2186AM will provide protection equivalent to the fire rated barrier in which it is installed. In the unlikely event that a fire originated in either of the rooms adjacent to the penetration, the fire would not propagate between rooms via the penetration identified as MARK NO.: A2186AM due to the protection provided by the installed penetration seal assembly.

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Verifier: _____

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10/4/95

10/4/95

H. REFERENCES

1. GSU P.O. No. 93-H-72449, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs," dated November 22, 1993
2. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", Rev. 0

I. ATTACHMENTS

None

Preparer:

[Signature]

Date:

10/22/95

Verifier:

[Signature]

Date:

10/21/95

CATEGORY E EVALUATIONS

Installation Specific Seal Evaluations

Mark Nos. A0956CM

A0956DM

WBN Typical Detail
XLVI

Applicable Supporting Fire Test

1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail XLVI. The installed Upper Head Injection (UHI) lines are larger than the penetrating pipe size allowed by typical detail XLVI. The maximum size pipe allowed by typical detail XLVI is 6" in diameter. This limit is based on largest size pipe tested to support WBN typical detail XLVI. The installed UHI lines are 12" in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472-46 (Typical Detail XLVI). The following describes the penetration seal assemblies general attributes:

Mark Nos.: A0956CM and A0956DM	Penetrant Size: 12" diameter pipe
	Opening Size: 18" diameter sleeve w/ 6" extension on the room E101 side
	Seal Material: 13" (min.) silicone elastomer (7" within the barrier; 6" in sleeve extension)
	Barrier Const.: 36" thick poured concrete
	Barrier Rating: 3 hour

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Date: 10/9/95

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assembly which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 (Penetration 12)	Penetrant Size: 16" diameter pipe
	Opening Size: 20" diameter sleeve
	Seal Material: 12" (min.) silicone elastomer
	Barrier Const.: 12" thick poured concrete (horizontal)
	Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 330°F above initial temperature

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with the tested configuration described in section C above as documented by the following:

A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were less than 325°F above initial temperature approximately 2 hours 55 minutes into the three hour fire endurance test.

The installed configurations being evaluated are 12" pipes in 18" sleeves sealed with a minimum of 13" of silicone elastomer (7" within the barrier; 6" in the sleeve extension) in 3 hour rated walls. Comparing the tested configuration to the installed configurations, it can be concluded that the installed configurations will provide at least a 3 hour F rating based on the following:

- The installed configurations will be subjected to a less severe fire exposure than the tested configurations due to wall orientation of the installed configurations compared to the floor/ceiling orientation of the tested assembly.

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Verifier: _____

Date: _____

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- Post-test observations of the tested assembly showed that 4" to 4-1/2" of seal material were still intact (with 3" depth uncharred) within the penetration, indicating that a 7" to 7-1/2" depth of seal material was consumed during the fire exposure. The installed configurations, if exposed to a fire from the room E101 (sleeve extension) side, would be expected to heat up more quickly and experience greater material degradation than that tested, due to the absence of surrounding concrete for the first 6" of seal material depth. However, the additional 1" seal depth and the additional 24" concrete barrier thickness of the installed provide reasonable assurance that significant seal material would still remain intact within the penetrations. In a fire from the room R150 (non-sleeve extension) side, the seal would be expected to have even better performance because the challenged portion of the seal is within the barrier, and flame would have to propagate through 29" of unsealed sleeve depth before reaching the seal material.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. All of the tested configurations referenced in section C satisfy this criteria and are qualified as 3 hour F rated assemblies. The installed configurations are in 3 hour rated fire barriers.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configurations provide an F rating equivalent to the 3 hour rated barrier in which they are installed.

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/4/95

E. CONCLUSION:

Based on the evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0956CM and A0956DM provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0956CM and A0956DM due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 3 hour rating of the barriers in which they are installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0956CM and A0956DM provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0956CM and A0956DM due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96

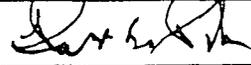
Preparer: _____



Date: _____

10-4-95

Verifier: _____



Date: _____

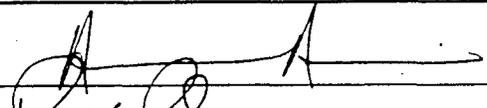
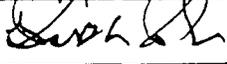
10/7/95

3. WBN Drawing 47A472-46

4. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", revision 0.

I. ATTACHMENTS:

None.

Preparer: 
Verifier: 

Date: 10-4-95
Date: 10/4/95

WBN Typical Detail
VIII

Applicable Supporting Fire Test
1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail VIII. The installed Main Steam line is larger than the penetrating pipe size allowed by typical detail VIII. The maximum size pipe allowed by typical detail VIII is 12" in diameter. This limit is based on a conservative application of the largest size pipe tested to support WBN typical detail VIII. The installed Main Steam line is 16" in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assembly is constructed in accordance with TVA Specification G-96 and Drawings 47A472-8 (Typical Detail VIII). The following describes the penetration seal assembly's general attributes:

Mark No.: A1469AM	Penetrant Size: 16" diameter pipe
	Opening Size: 18" diameter sleeve
	Seal Material: 1 1/8" (min.) silicone foam within the barrier
	Barrier Const.: 12" thick poured concrete
	Barrier Rating: 3 hour

Preparer: John G. [Signature]

Date: 10/4/95

Verifier: [Signature]

Date: 10/4/95

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assembly which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 (Penetration 11)	Penetrant Size: 16" diameter pipe
	Opening Size: 20" diameter sleeve
	Seal Material: 12" (min.) silicone foam
	Barrier Const.: 12" thick poured concrete (horizontal)
	Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 576°F above initial temperature.

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assembly is qualified based on a comparison with tested configurations described in section C above as documented by the following as established in GSU test, penetration 11:

1. A penetration seal comprised of a 12" depth of silicone foam provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 576°F above initial temperature at three hours.

Although this penetration successfully withstood the three (3) hour fire endurance portion of the test, when subjected to the hose stream test the penetration failed. However, as allowed by ASTM E-814-83, if a duplicate specimen was to be subjected to a one (1) hour fire endurance test and then the hose stream applied, it is certain that the assembly would pass the hose stream test. In this scenario, the configuration tested in penetration 11 would be rated for three (3) hours with respect to an F rating only.

Preparer: John G. Grawtzer

Date: 10/4/95

Verifier: Josh. L. L.

Date: 10/4/95

The installed configuration being evaluated is a 16" pipe in an 18" sleeve sealed with a minimum of 12" of silicone foam in 3 hour rated floor/ceiling. Comparing the tested configuration to the installed configuration, it can be concluded that the installed configuration will provide at least a 3 hour F rating based on the following:

- The installed configuration has a minimum of 11 5/8" of material installed in the barrier. Typical detail VIII has a sleeve extension on one side of the barrier (top side in this case). The sleeve is 15 7/8" long, the floor is 12" thick so the extension is 3 7/8". Since a field walkdown confirmed that the seal was installed flush with the top of the sleeve extension, the total thickness of the seal is 15 1/2" (11 5/8" in the barrier plus 3 7/8" in the extension)
- The installed configuration in a floor/ceiling orientation is equivalent to the tested configuration.
- The 16" pipe size of the tested configuration is the same as the installed.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configuration referenced in section C satisfies this criteria and is qualified as a 3 hour F rated assembly.

As discussed in the Basis for Qualification section above, the installed configuration will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configuration provides an F rating equivalent to the 3 hour rated barrier in which it is installed.

Preparer: John A. Grovther
Verifier: [Signature]

Date: 10/4/95
Date: 10/4/95

E. CONCLUSION:

Based on evaluation detailed in section D above, the seal assembly installed in penetration identified as Mark No.: A1469AM provides protection equivalent to the 3 hour rated barrier in which it is installed. In the unlikely event that a fire originated in either of the rooms adjacent to this penetration, the fire would not propagate between rooms via this penetration identified as Mark No.: A1469AM due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seal being evaluated is not required. The evaluation contained in section D above concluded that the installed configuration provide a level of protection equivalent to the 3 hour rating of the barrier in which it is installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assembly installed in the penetration identified as Mark No.: A1469AM provides protection equivalent to the 3 hour rated barrier in which it is installed. In the unlikely event that a fire originated in either of the rooms adjacent to this penetration, the fire would not propagate between rooms via the penetration identified as Mark No.: A1469AM due to the protection provided by the installed penetration seal assembly.

Preparer: John G. Grotzke
Verifier: Sub. Sam

Date: 10/4/95
Date: 10/4/95

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96
3. WBN Drawing 47A472-8

I. ATTACHMENTS:

None.

Preparer:

John G. Gantzer

Date:

10/4/95

Verifier:

John G. Gantzer

Date:

10/4/95

WBN Typical Detail
LXXXIII

Applicable Supporting Fire Test
1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail LXXXIII. The installed Ventilating System line is larger than the penetrating pipe size allowed by typical detail LXXXIII. The maximum size pipe allowed by typical detail LXXXIII is 12" in diameter. This limit is based on a conservative application of the largest size pipe tested to support WBN typical detail LXXXIII. The installed Ventilating System line is 16" in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawings 47A472-83- (Typical Detail LXXXIII). The following describes the penetration seal assemblies general attributes:

Mark No.: A1880AM	Penetrant Size:	16" diameter pipe
	Opening Size:	18" diameter sleeve
	Seal Material:	13" (min.) silicone foam within the barrier with a boot (for pressure) on one side (Room E101 side). The seal material is flush with the sleeve on the other side of the penetration.
	Barrier Const.:	24" thick poured concrete
	Barrier Rating:	3 hour

Preparer: John J. Coulter

Date: 10/4/95

Verifier: [Signature]

Date: 10/5/95

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assembly which will be used to evaluate the identified penetration seal assembly:

GSU Test 93-H-72449 (Penetration 11)	Penetrant Size: 16" diameter pipe
	Opening Size: 20" diameter sleeve
	Seal Material: 12" (min.) silicone foam
	Barrier Const.: 12" thick poured concrete (horizontal)
	Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 576°F above initial temperature

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assembly is qualified based on a comparison with tested configurations described in section C above as documented by the following as established by GSU test penetration 11:

1. A penetration seal comprised of a 12" depth of silicone foam provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 576°F above initial temperatures at three hours.

Although this penetration successfully withstood the three (3) hour fire endurance portion of the test, when subjected to the hose stream test the penetration failed. However, as allowed by ASTM E-814-83, if a duplicate specimen was to be subjected to a one (1) hour fire endurance test, and then the hose stream applied, it is certain that the assembly would pass the hose stream test. In this scenario, the configuration tested in penetration 11 would be rated for three (3) hours with respect to an F rating only.

Preparer: _____

John J. Powell

Date: _____

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Verifier: _____

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Date: _____

10/4/95

The installed configuration being evaluated is a 16" pipe in a 18" sleeve sealed with a minimum of 13" of silicone foam in 3 hour rated wall. Comparing the tested configuration above to the installed configuration, it can be concluded that the installed configuration will provide at least a 3 hour F rating based on the following:

- The installed configuration has a minimum of 1" more material installed than the tested configuration.
- The installed configuration will be subjected to a less severe fire exposure than the tested configurations due to wall orientation and 24" thick barrier of the installed configuration compared to the floor/ceiling orientation and the 12" thick barrier of the tested assembly.
- The installed 16" pipe size is the same as the pipe qualified by test.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned a F rating. The tested configuration referenced in section C satisfies this criteria and is qualified as a 3 hour F rated assembly. The installed configuration is in a 3 hour rated fire barrier.

As discussed in the Basis for Qualification section above, the installed configuration will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configuration provides a F rating equivalent to the 3 hour rated barrier in which it is installed.

Preparer:

John A. Rosenthal

Date:

10/4/95

Verifier:

[Signature]

Date:

10/4/95

E. CONCLUSION:

Based on evaluation detailed in section D above, the seal assembly installed in the penetration identified as Mark No.: A1880AM provides protection equivalent to the 3 hour rated barrier in which it is installed. In the unlikely event that a fire originated in either of the rooms adjacent to this penetration, the fire would not propagate between rooms via the penetration identified as Mark No.: A1880AM due to the protection provided by the installed penetration seal assembly.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seal being evaluated is not required. The evaluation contained in section D above concluded that the installed configuration provides a level of protection equivalent to the 3 hour rating of the barrier in which it is installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assembly installed in the penetration identified as Mark No. A1880AM provides protection equivalent to the 3 hour rated barrier in which it is installed. In the unlikely event that a fire originated in either of the rooms adjacent to this penetration, the fire would not propagate between rooms via the penetration identified as Mark No.: A1880AM due to the protection provided by the installed penetration seal assembly

Preparer: _____

John J. Gower

Date: _____

10/4/95

Verifier: _____

[Signature]

Date: _____

10/4/95

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96
3. WBN Drawing 47A472-83

I. ATTACHMENTS:

None.

Preparer: JOHN Q. GROWTHER

Date: 10/4/95

Verifier: [Signature]

Date: 10/4/95

Mark Nos. A1109AM

A1110AM

WBN Typical Detail
XLVI

Applicable Supporting Fire Test
1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail XLVI. The installed Station Drainage lines are larger than the penetrating pipe size allowed by typical detail XLVI. The maximum size pipe allowed by typical detail XLVI is 6" in diameter. This limit is based on largest size pipe tested to support WBN typical detail XLVI. The installed Station Drainage lines are 8" in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472-46 (Typical Detail XLVI) for penetrations A1109AM and A1110AM. The following describes the penetration seal assemblies general attributes:

Mark No.: A1109AM	Penetrant Size: 8" diameter pipe
	Opening Size: 12" diameter sleeve by 14" long
	Seal Material: 8" (min.) silicone elastomer within the barrier, 14" overall seal depth
	Barrier Const.: 8" thick poured concrete
	Barrier Rating: 3 hour

Mark No.: A1110AM	Pipe Size: 8" diameter pipe
	Sleeve Size: 12" diameter sleeve by 14" long
	Seal Material: 8" (min.) silicone elastomer within the barrier, 14" overall seal depth
	Barrier Const.: 8" thick poured concrete
	Barrier Rating: 3 hour

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Date: 10/9/95

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assembly which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 (Penetration 12)	Penetrant Size: 16" diameter pipe
	Opening Size: 20" diameter sleeve
	Seal Material: 12" (min.) silicone elastomer
	Barrier Const.: 12" thick poured concrete (horizontal)
	Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 330°F above initial temperature

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configuration described in section C above as documented by the following as established in GSU Test , Penetration 12:

1. A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers.

The installed configurations being evaluated are 8" pipes in 12" sleeves sealed with a minimum of 14" of silicone elastomer in 8" thick 3 hour rated wall. Comparing tested configuration to the installed configurations, it can be concluded that the installed configurations will provide at least a 3 hour F rating based on the following:

- The installed configurations have a minimum of 2" more material installed than the tested configuration. Eventhough 3" of material is installed outside the plane of the barrier on each side the overall depth of the seal assembly is sufficient to prevent the propagation of fire. Regardless of which side of the assembly is exposed to fire, the amount within the barrier (8") plus the additional seal material in the sleeve extension

Preparer: _____

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Date: 10/4/95

on the opposite side of the barrier (3"), ensures a sufficient depth of seal material exists to prevent the propagation of fire through the penetration.

- The installed configurations will be subjected to a less severe fire exposure than the tested configurations due to wall orientation of the installed configurations compared to the floor/ceiling orientation of the tested assembly.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configuration referenced in section C satisfies this criteria and is qualified as 3 hour F rated assembly.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configurations provide an F rating equivalent to the 3 hour rated barrier in which they are installed.

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E. CONCLUSION:

Based on the evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A1109AM and A1110AM provide protection equivalent to the 3 hour rated barrier in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A1109AM and A1110AM due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 3 hour rating of the barrier in which they are installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A1109AM and A1110AM provide protection equivalent to the 3 hour rated barrier in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A1109AM and A1110AM due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96

Preparer: _____

Verifier: _____

Date: _____

Date: _____

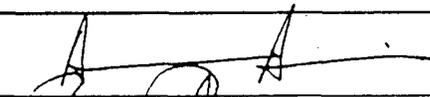
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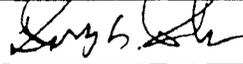
3. WBN Drawing 47A472-46

I. ATTACHMENTS:

None.

Preparer: 

Date: 10-4-95

Verifier: 

Date: 10/4/95

Mark Nos. A0920BM

A0920DM

WBN Typical Detail
XLVI

Applicable Supporting Fire Test
1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail XLVI. The installed Ventilating System lines are larger than the penetrating pipe size allowed by typical detail XLVI. The maximum size pipe allowed by typical detail XLVI is 6 inches in diameter. This limit is based on largest size pipe tested to support WBN typical detail XLVI. The installed Ventilating System lines are between 16 inches in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47W472-46 for penetrations A0920BM and A0920DM (Typical Detail XLVI). The following describes the penetration seal assemblies general attributes:

Mark No.: A0920BM	Penetrant Size: 22" diameter pipe
	Opening Size: 24" diameter sleeve
	Seal Material: 11" (min.) silicone elastomer within the barrier
	Barrier Const.: 27" thick poured concrete
	Barrier Rating: 2 hour (regulatory)

Mark No.: A0920DM	Pipe Size: 22" diameter pipe
	Sleeve Size: 24" diameter sleeve
	Seal Material: 27" (min.) silicone elastomer within the barrier
	Barrier Const.: 27" thick poured concrete
	Barrier Rating: 2 hour (regulatory)

Preparer: [Signature]

Date: 10-4-95

Verifier: [Signature]

Date: 10/9/95

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 (Penetration 12)	Penetrant Size: 16" diameter pipe
	Opening Size: 20" diameter sleeve
	Seal Material: 12" (min.) silicone elastomer
	Barrier Const.: 12" thick poured concrete (horizontal)
	Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 330°F above initial temperature.

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

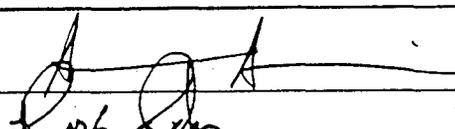
As established in GSU Test penetration No. 12:

1. A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed surface temperatures were approximately 255°F above initial temperature at two hours into the fire endurance test.

The installed configurations being evaluated are 22" pipes in 24" sleeves sealed with a minimum of 11" of silicone elastomer in 3 hour rated barriers. Comparing tested configuration above to the installed configurations, it can be concluded that the installed configurations will provide at least a 2 hour F rating based on the following:

- The installed configurations have a minimum of 3 inches of seal material in excess of the tested configuration installed in a sleeve extension on the top side of the floor/ceiling configuration.

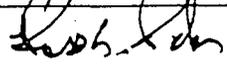
Preparer: _____



Date: _____

10-4-95

Verifier: _____



Date: _____

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- The increase in pipe size from the 16" qualified by test to the 22" installed is more than compensated for by the increased material installed in the sleeve extensions and by the small (approximately 1") annulus resulting from the pipe and sleeve combination, and finally by the reduction in the required rating of the installed assemblies (2 hour) compared to the successfully tested 3 hour rated configuration.

The installed configurations have a minimum of 11" of material installed within the barrier with a minimum of 3 inches of elastomer installed in the sleeve extension which is comparable to the tested configuration.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN (FPR), large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configuration referenced in section C satisfies this criteria and is qualified as a 3 hour F rated assembly. The installed configurations are in 2 hour rated fire barriers.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configuration provides an F rating equivalent to the 2 hour rated barriers in which they are installed.

E. CONCLUSION:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0920BM and A0920DM provide protection equivalent to the 2 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0920BM and A0920DM due to the protection provided by the installed penetration seal assemblies.

Preparer: _____

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Verifier: _____

Date: 10/4/95

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 2 hour rating of the barrier in which they are installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0920BM and A0920DM provide protection equivalent to the 2 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0920BM and A0920DM due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96
3. WBN Drawing 47W472-46

I. ATTACHMENTS:

None.

Preparer: _____

Date: _____

Verifier: _____

Date: _____

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Mark Nos.: A0929AM
A0929BM
A0967AM
A0967BM
A1035BM
C0012A

WBN Typical Detail
XLVI

Applicable Supporting Fire Test
CTL Test ICC0286015
CTL Test ICC0286018
OPL Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals are not directly bounded by existing WBN typical details because one of the critical attributes lies outside the parameters of typical detail XLVI. The installed Station Drainage and Ventilating System lines are larger than the penetrating pipe size allowed by typical detail XLVI. The maximum size pipe allowed by typical detail XLVI is 6" in diameter. This limit is based on largest size pipe tested to support WBN typical detail XLVI. The installed Station Drainage and Ventilating System lines are 8" in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

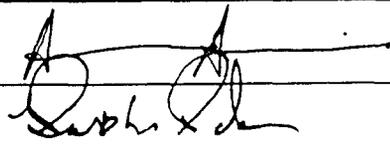
B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47W472-46 for penetrations A0929AM, A0929BM, A0967AM, A0967BM, A1035BM and C0012A (Typical Detail XLVI). The following describes the penetration seal assemblies general attributes:

Mark No.: A0929AM Penetrant Size: 8" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 6" (min.) silicone elastomer within the barrier
Barrier Const.: 12" thick poured concrete
Barrier Rating: 3 hour

Mark No.: A0929BM Pipe Size: 8" diameter pipe
Sleeve Size: 12" diameter sleeve
Seal Material: 6" (min.) silicone elastomer within the barrier
Barrier Const.: 12" thick poured concrete
Barrier Rating: 3 hour

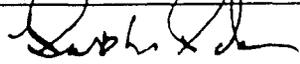
Preparer: _____



Date: _____

10-4-95

Verifier: _____



Date: _____

10/4/95

Penetration Identification

Mark Nos.: A0929AM
A0929BM
A0967AM
A0967BM
A1035BM
C0012A

Mark No.: A0967AM Penetrant Size: 8" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 7" (min.) silicone elastomer within the barrier
Barrier Const.: 12" thick poured concrete
Barrier Rating: 3 hour

Mark No.: A0967BM Penetrant Size: 8" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 7" (min.) silicone elastomer within the barrier
Barrier Const.: 12" thick poured concrete
Barrier Rating: 3 hour

Mark No.: A1035BM Penetrant Size: 8" diameter pipe
Opening Size: 14" diameter sleeve
Seal Material: 6" (min.) silicone elastomer within the barrier
Barrier Const.: 12" thick poured concrete
Barrier Rating: 3 hour

Mark No.: C0012A Penetrant Size: 8" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 8" (min.) silicone elastomer within the barrier
Barrier Const.: 18" thick poured concrete
Barrier Rating: 3 hour

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 Penetrant Size: 16" diameter pipe
(Penetration 12) Opening Size: 20" diameter sleeve
Seal Material: 12" (min.) silicone elastomer
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with
unexposed side surface temperatures of 330°F
above initial temperature.

Preparer: [Signature]

Date: 10-4-95

Verifier: [Signature]

Date: 10/4/95

Penetration Identification
Mark Nos.: A0929AM
A0929BM
A0967AM
A0967BM
A1035BM
C0012A

CTL Test ICC0286018
(Penetration 1)

Penetrant Size: No Penetrant Existed
Opening Size: 6" diameter sleeve
Seal Material: 6" (min.) silicone elastomer
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with
unexposed side surface temperatures of 179°F
above initial temperature

CTL Test ICC0286015
(Penetration 3)

Penetrant Size: 2" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 6" (min.) silicone elastomer
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with
unexposed side surface temperatures of 105°F
above initial temperature.

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

Based on this, a review of the tested configurations in section C, the following can be established:

1. A penetration seal comprised of a 6" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 12" in diameter and smaller which contain pipes less than or equal to 2" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 105°F above initial temperature at three hours into the fire endurance test.

Preparer: _____

Date: 10-4-95

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Date: 10/4/95

Penetration Identification
Mark Nos.: A0929AM
A0929BM
A0967AM
A0967BM
A1035BM
C0012A

2. A penetration seal comprised of a 6" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 12" in diameter and smaller which contain no penetrants through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 179°F above initial temperature at three hours into the fire endurance test.

A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 330°F above initial temperature at three hours into the fire endurance test.

The installed configurations being evaluated are 8" pipes in 12" sleeves sealed with a minimum of 6" of silicone elastomer in 3 hour rated walls. Comparing the tested 3 configurations above to the installed configurations, it can be concluded that the installed configurations will provide a 3 hour F rating based on the following:

- The installed configurations have 2.75" to 4" of additional installed in the existing steel sleeve extensions on top of the 6" minimum in the barrier seal depth as required per Typical Detail XLVI.
- Upon comparison with test 3 above, the decrease in pipe size from the 16" qualified by test to the 8" installed more than compensates for the reduction in the 12" material thickness in the installed assemblies.
- Conversely, comparison with tests 1 and 2 above, indicates that the increase in pipe size from the 6" qualified by test to the 8" installed is more than compensated for by the addition of silicone material thickness in the installed assemblies.

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/4/95

Penetration Identification
Mark Nos.: A0929AM
A0929BM
A0967AM
A0967BM
A1035BM
C0012A

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. All of the tested configurations referenced in section C satisfy this criteria and are qualified as 3 hour F rated assemblies.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configurations provide an F rating equivalent to the 3 hour rated barrier in which they are installed.

E. CONCLUSION:

Based on the evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos. A0929AM, A0929BM, A0967AM, A0967BM, A1035BM and C0012A provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos's A0929AM, A0929BM, A0967AM, A0967BM, A1035BM and C0012A due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 3 hour rating of the barriers in which they are installed.

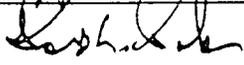
Preparer: _____



Date: _____

10-4-95

Verifier: _____



Date: _____

10/4/95

Penetration Identification
Mark Nos.: A0929AM
A0929BM
A0967AM
A0967BM
A1035BM
C0012A

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.'s A0929AM, A0929BM, A0967AM, A0967BM, A1035BM and C0012A provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos. A0929AM, A0929BM, A0967AM, A0967BM, A1035BM and C0012A due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. Construction Technology Laboratories Fire Test ICC0186015, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS6)," dated March 1986.
3. Construction Technology Laboratories Fire Test ICC0286018, "Fire and Hose Stream Tests for Penetration Seal Systems (NMP2-PSS9)", dated April 1986.
4. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", revision 0.
5. TVA Specification G-96
6. WBN Drawing 47W472-46

I. ATTACHMENTS:

None.

Preparer: _____

Date: 10-7-95

Verifier: _____

Date: 10/4/95

Penetration Identification
Mark Nos. A0970AM
A0970BM
A0971AM
A0971BM

WBN Typical Detail
I

Applicable Supporting Fire Test
1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail I. The installed Ventilating System lines are larger than the penetrating pipe size allowed by typical detail I. The maximum size pipe allowed by typical detail I is 12 inches in diameter. This limit is based on a conservative application of the largest size pipe tested to support WBN typical detail I (16 inch pipe in GSU Test 93-H-72449). The installed Ventilating System lines are 20 inches in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47W472-1 for penetrations A0970AM, A0970BM, A0971AM and A0971BM (Typical Detail I). The following describes the penetration seal assemblies general attributes:

Mark No.: A0970AM Penetrant Size: 20" diameter pipe
Opening Size: 22" diameter sleeve
Seal Material: 18" (min.) silicone foam within the barrier
Barrier Const.: 18" thick poured concrete
Barrier Rating: 2 hour (Regulatory)

Mark No.: A0970BM Penetrant Size: 20" diameter pipe
Opening Size: 22" diameter sleeve
Seal Material: 17" (min.) silicone foam within the barrier
Barrier Const.: 18" thick poured concrete
Barrier Rating: 2 hour (Regulatory)

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/5/95

Penetration Identification

Mark Nos. A0970AM
A0970BM
A0971AM
A0971BM

Mark No.: A0971AM Penetrant Size: 20" diameter pipe
Opening Size: 22" diameter sleeve
Seal Material: 18" (min.) silicone foam within the barrier
Barrier Const.: 18" thick poured concrete
Barrier Rating: 2 hour (Regulatory)

Mark No.: A0971BM Penetrant Size: 20" diameter pipe
Opening Size: 22" diameter sleeve
Seal Material: 17" (min.) silicone foam within the barrier
Barrier Const.: 18" thick poured concrete
Barrier Rating: 2 hour (Regulatory)

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 Penetrant Size: 16" diameter pipe
(Penetration 11) Opening Size: 20" diameter sleeve
Seal Material: 12" (min.) silicone foam
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 576°F plus initial temperature.

Preparer:

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Date:

10-4-95

Verifier:

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Date:

10/5/95

Mark Nos. A0970AM

A0970BM

A0971AM

A0971BM

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

A review of the tested configuration in section C establishes the following:

1. A penetration seal comprised of a 12" depth of silicone foam provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed surface temperatures were approximately 319°F above initial temperature at 2 hours into the fire endurance test.
2. This penetration successfully withstood the three (3) hour fire endurance portion of the test. When subjected to the hose stream test the penetration failed. However, as allowed by ASTM E814-83, if a duplicate specimen was to be subjected to a one (1) hour fire endurance test, and then the hose stream applied, it is certain that the assembly would pass the hose stream test.

The installed configurations being evaluated are 20" pipes in 22" sleeves sealed with a minimum of 17" of silicone foam in 2 hour rated barriers. Comparing the tested configuration above to the installed configurations, it can be concluded that the installed configurations will provide a rating commensurate with the barriers in which they are installed based on the following:

- The installed configurations have a minimum of 5 inches more material installed than the tested configuration.
- The installed configurations will be subjected to a less severe fire exposure than the tested configurations due to wall orientation of the installed configurations compared to the floor/ceiling orientation of the tested assembly.
- The increase in pipe size from the 16" qualified by test to the 20" installed is more than compensated for by the increased material installed and by the reduction in the required rating of the installed assemblies (2 hour) compared to the successfully tested 3 hour rated configuration.

Preparer: _____



Date: _____

10-4-95

Verifier: _____

Date: _____

10/5/95

Penetration Identification

Mark Nos.: A0970AM
A0970BM
A0971AM
A0971BM

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN (FPR), large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configuration referenced in section C satisfies this criteria and is qualified as 2 hour F rated assembly. The installed configurations are in 2 hour rated fire barriers.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 2 hours in 2 hour rated barriers. Therefore, the installed configurations provide an F rating equivalent to the barrier in which they are installed.

E. CONCLUSION:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0970AM, A0970BM, A0971AM and A0971BM provide protection equivalent to the barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0970AM, A0970BM, A0971AM or A0971BM due to the protection provided by the installed penetration seal assemblies.

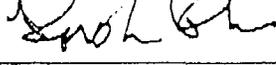
Preparer: _____



Date: _____

10-4-95

Verifier: _____



Date: _____

10 5 95

Mark Nos. A0970AM
A0970BM
A0971AM
A0971BM

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the rating of the barrier in which they are installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0970AM, A0970BM, A0971AM and A0971BM provide protection equivalent to the barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0970AM, A0970BM, A0971AM or A0971BM due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96
3. WBN Drawing 47W472-1

I. ATTACHMENTS:

None.

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/5/95

Mark Nos.: A0968AM

A1035CM

A1806AM

A1807AM

WBN Typical Detail

XLVI

Applicable Supporting Fire Test

1. GSU Test 93-II-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:**A. DISCUSSION**

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail XLVI. The installed Station Drainage and Ventilating System lines are larger than the penetrating pipe size allowed by typical detail XLVI. The maximum size pipe allowed by typical detail XLVI is 6 inches in diameter. This limit is based on largest size pipe tested to support WBN typical detail XLVI. The installed Station Drainage and Ventilating System lines are between 8 inches and 12 inches in diameter.

The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47W472-46 for penetrations A0968AM, A1035CM, A1806A and A1807AM (Typical Detail XLVI). The following describes the penetration seal assemblies general attributes:

Mark No.: A0968AM	Penetrant Size:	8" diameter pipe
	Opening Size:	12" diameter sleeve
	Seal Material:	12" (min.) silicone elastomer within the barrier
	Barrier Const.:	12" thick poured concrete
	Barrier Rating:	3 hour

Mark No.: A1035CM	Pipe Size:	8" diameter pipe
	Sleeve Size:	14" diameter sleeve
	Seal Material:	11" (min.) silicone elastomer within the barrier
	Barrier Const.:	12" thick poured concrete
	Barrier Rating:	3 hour

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/2/95

Penetration Identification

Mark Nos.: A0968AM
A1035CM
A1806AM
A1807AM

Mark No.: A1806AM Penetrant Size: 12" diameter pipe
Opening Size: 16" diameter sleeve
Seal Material: 12" (min.) silicone elastomer within the barrier
Barrier Const.: 12" thick poured concrete
Barrier Rating: 3 hour

Mark No.: A1807AM Penetrant Size: 8" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 12" (min.) silicone elastomer within the barrier
Barrier Const.: 12" thick poured concrete
Barrier Rating: 3 hour

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 Penetrant Size: 16" diameter pipe
(Penetration 12) Opening Size: 20" diameter sleeve
Seal Material: 12" (min.) silicone elastomer
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with
unexposed side surface temperatures of 330°F
above initial temperature.

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/4/95

Mark Nos.: A0968AM
A1035CM
A1806AM
A1807AM

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

As established in GSU Test penetration No. 12:

1. A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed surface temperatures were approximately 330°F above initial temperature at the end of the three hour fire endurance test.

The installed configurations being evaluated are 8" pipes in 12" and 14" sleeves and 12" pipes in 16" sleeves sealed with a minimum of 11" of silicone elastomer in 3 hour rated barriers. Comparing tested configuration above to the installed configurations, it can be concluded that the installed configurations will provide at least a 3 hour F rating based on the following:

- The decrease in pipe size from the 16" qualified by test to the 8" installed more than compensates for the reduction in the required thickness of the installed assembly at penetration A1035CM.
- The remaining installed configurations have a minimum of 12" of material installed which is consistent with the tested configuration.

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Date: 10-4-95

Verif: _____

Date: 10/4/95

Mark Nos.: A0968AM

A1035CM

A1806AM

A1807AM

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN (FPR), large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

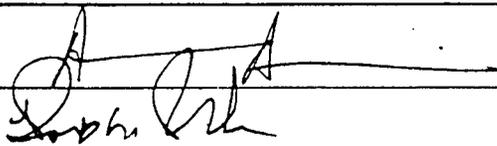
The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configuration referenced in section C satisfies this criteria and is qualified as a 3 hour-F rated assembly. The installed configurations are in 3 hour rated fire barriers.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configuration provides an F rating equivalent to the 3 hour rated barriers in which they are installed.

E. CONCLUSION:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0968AM, A1035CM, A1806AM and A1807AM provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0968AM, A1035CM, A1806AM or A1807AM due to the protection provided by the installed penetration seal assemblies.

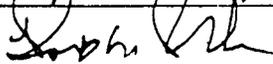
Preparer: _____



Date: _____

10-4-95

Verif: _____



Date: _____

10/4/95

Mark Nos.: A0968AM

A1035CM

A1806AM

A1807AM

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 3 hour rating of the barrier in which they are installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A0968AM, A1035CM, A1806AM and A1807AM provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A0968AM, A1035CM, A1806AM and A1807AM due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96
3. WBN Drawing 47W472-46

I. ATTACHMENTS:

None.

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/4/95

Mark Nos. A1893AM

A1901AM

WBN Typical Detail
XLVI

Applicable Supporting Fire Test
1. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail XLVI. The installed Ventilating System lines are larger than the penetrating pipe size allowed by typical detail XLVI. The maximum size pipe allowed by typical detail XLVI is 6 inches in diameter. This limit is based on largest size pipe tested to support WBN typical detail XLVI. The installed Ventilating System lines are between 16 inches in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47W472-46 for penetrations A1893AM and A1901AM (Typical Detail XLVI). The following describes the penetration seal assemblies general attributes:

Mark No.: A1893AM	Penetrant Size:	16" diameter pipe
	Opening Size:	18" diameter sleeve
	Seal Material:	12" (min.) silicone elastomer within the barrier
	Barrier Const.:	12" thick poured concrete
	Barrier Rating:	3 hour

Mark No.: A1901AM	Pipe Size:	16" diameter pipe
	Sleeve Size:	18" diameter sleeve
	Seal Material:	12" (min.) silicone elastomer within the barrier
	Barrier Const.:	12" thick poured concrete
	Barrier Rating:	3 hour

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Date: 10-4-95

Verifier: [Signature]

Date: _____

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

GSU Test 93-H-72449 (Penetration 12)	Penetrant Size: 16" diameter pipe
	Opening Size: 20" diameter sleeve
	Seal Material: 12" (min.) silicone elastomer
	Barrier Const.: 12" thick poured concrete (horizontal)
	Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 330°F above initial temperature.

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

As established in GSU Test penetration No. 12:

1. A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed surface temperatures were approximately 330°F above initial temperature at the end of the three hour fire endurance test.

The installed configurations being evaluated are 16" pipes in 18" sleeves sealed with a minimum of 12" of silicone elastomer in 3 hour rated barriers. Comparing tested configuration above to the installed configurations, it can be concluded that the installed configurations will provide at least a 3 hour F rating based on the following:

- The installed pipe size is 16" which is the same as the tested configuration.
- The installed configurations have a minimum of 12" of material installed which is consistent with the tested configuration.

Preparer: _____

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Date: _____

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Verifier: _____

Date: _____

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Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN (FPR), large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. The tested configuration referenced in section C satisfies this criteria and is qualified as a 3 hour F rated assembly. The installed configurations are in 3 hour rated fire barriers.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 3 hours. Therefore, the installed configuration provides an F rating equivalent to the 3 hour rated barriers in which they are installed.

E. CONCLUSION:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A1893AM and A1901AM provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A1893AM and A1901AM due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 3 hour rating of the barrier in which they are installed.

Preparer: _____

Date: 10-4-95

Verifier: _____

Date: 10/4/95

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A1893AM and A1901AM provide protection equivalent to the 3 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: A1893AM and A1901AM due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.
2. TVA Specification G-96
3. WBN Drawing 47W472-46

I. ATTACHMENTS:

None.

Preparer: _____

JA

Date: _____

10-4-95

Verifier: _____

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Date: _____

10/4/95

Mark Nos.: C0067A
 C0068A
 A1109BM

WBN Typical Detail
 XLVI

Applicable Supporting Fire Test

1. Promatec Test CTP-1142
2. GSU Test 93-H-72449

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified seals require further justification because one of the critical attributes lies outside the parameters of the applicable fire test or typical detail XLVI. The installed Station Drainage lines are larger than the penetrating pipe size allowed by typical detail XLVI. The maximum size pipe allowed by typical detail XLVI is 6" in diameter. This limit is based on largest size pipe tested to support WBN typical detail XLVI. The installed Station Drainage lines are 8" in diameter. The WBN Fire Protection Report (FPR) states that large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472-46 for penetrations C0067A, C0068A A1109BM (Typical Detail XLVI). The following describes the penetration seal assemblies general attributes:

Mark No.: C0067A	Penetrant Size: 8" diameter pipe Opening Size: 12" diameter sleeve Seal Material: 7" (min.) silicone elastomer within the barrier Barrier Const.: 8" thick poured concrete Barrier Rating: 2 hour (non-regulatory)
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Mark No.: C0068A	Pipe Size: 8" diameter pipe Sleeve Size: 12" diameter sleeve Seal Material: 8" (min.) silicone elastomer within the barrier Barrier Const.: 8" thick poured concrete Barrier Rating: 2 hour (non-regulatory)
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Preparer: _____

Date: 10-4-95

Verifier: [Signature]

Date: 10/5/95

Penetration Identification

Mark Nos.: C0067A
C0068A
A1109BM

Mark No.: A1109BM

Penetrant Size: 8" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 7" (min.) silicone elastomer within the barrier
Barrier Const.: 8" thick poured concrete
Barrier Rating: 2 hour (regulatory)

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

Promatec Test CTP-1142
(Penetration 11)

Penetrant Size: 6" diameter conduit (one of various penetrations within the blockout tested)
Opening Size: 48" x 48" blockout
Seal Material: 6" (min.) Promatec LDSE
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures below 325°F plus initial temperature

GSU Test 93-H-72449
(Penetration 7)

Penetrant Size: 8" diameter pipe
Opening Size: 12" diameter sleeve
Seal Material: 6" (min.) silicone elastomer w/ 1" damming
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 343°F above initial temperature

GSU Test 93-H-72449
(Penetration 12)

Penetrant Size: 16" diameter pipe
Opening Size: 20" diameter sleeve
Seal Material: 12" (min.) silicone elastomer
Barrier Const.: 12" thick poured concrete (horizontal)
Test Results: 3 hour F rating per WBN criteria with unexposed side surface temperatures of 310°F above initial temperature

Preparer:

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Date:

10-4-95

Verifier:

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Date:

10/4/95

Mark Nos.: C0067A

C0068A

A1109BM

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

As established in the qualification of WBN typical detail XLVI, silicone elastomer performs better than LDSE with respect to the passage of flame, hose stream and transmission of heat to the unexposed side of a test assembly (Refer to Reference 7 for an additional discussion of this determination). Based on this, a review of the tested configurations in section C establishes the following:

1. A penetration seal comprised of a 6" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 12" in diameter and smaller which contain pipes less than or equal to 6" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 272°F above initial temperature at two hours into the three hour fire endurance test.
2. A penetration seal comprised of a 6" depth of silicone elastomer with 1" of non-combustible damming material provides a 3 hour F rated assembly when sealing openings 12" in diameter and smaller which contain pipes less than or equal to 8" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 277°F above initial temperature at two hours into the three hour fire endurance test.
3. A penetration seal comprised of a 12" depth of silicone elastomer provides a 3 hour F rated assembly when sealing openings 20" in diameter and smaller which contain pipes less than or equal to 16" in diameter through floor/ceiling barriers. In addition to the F rating, unexposed side surface temperatures were approximately 250°F above initial temperature at two hours into the three hour fire endurance test.

The installed configurations being evaluated are 8" pipes in 12" sleeves sealed with a minimum of 7" of silicone elastomer in 2 hour rated walls. Therefore, tested configuration 1 above most closely resembles the installed configurations. Comparing tested configuration 1 to the installed configurations, it can be concluded that the installed configurations will provide at least a 2 hour F rating based on the following:

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Verifier: _____

Date: _____

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Mark Nos.: C0067A
C0068A
A1109BM

- The installed configurations have a minimum of 1" more material installed than the tested configuration.
- The installed configurations will be subjected to a less severe fire exposure than the tested configurations due to wall orientation of the installed configurations compared to the floor/ceiling orientation of the tested assembly.
- The increase in pipe size from the 6" qualified by test to the 8" installed is more that compensated by the reduction in the required rating of the installed assemblies (2 hour) compared to the successfully tested 3 hour rated configuration.

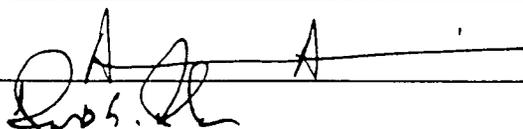
Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames, hot gasses and hose stream through the opening. The other alternative uses a T rating to ensure that in addition to satisfying F rating requirements, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present. As stated in the WBN FPR, large bore piping penetrations (e.g., pipes 8" in diameter and larger) are required to be F rated. Therefore, the only failure mode to be addressed for the installed penetration seals is the F rating requirement.

The F rating failure mode addresses burn through of the seal. Tested configurations which do not result in actual burn through or passage of hose stream are assigned an F rating. All of the tested configurations referenced in section C satisfy this criteria and are qualified as 3 hour F rated assemblies. The installed configurations are in 2 hour rated fire barriers.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 2 hours. Therefore, the installed configurations provide an F rating equivalent to the 2 hour rated barrier in which they are installed.

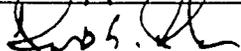
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10/4/95

Mark Nos.: C0067A
C0068A
A1109BM

E. CONCLUSION:

Based on the evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: C0067A, C0068A and A1109BM provide protection equivalent to the 2 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: C0067A, C0068A or A1109BM due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 2 hour rating of the barriers in which they are installed.

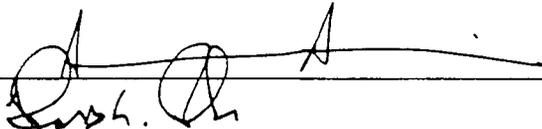
G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: C0067A, C0068A and A1109BM provide protection equivalent to the 2 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via the penetrations identified as Mark Nos.: C0067A, C0068A or A1109BM due to the protection provided by the installed penetration seal assemblies.

H. REFERENCES:

1. Promatec Test CTP-1142, "Three Hour Fire Qualification Test, Six (6) Inch Depth LDSE w/ Aluminum & Steel Penetrants, XLPE/PVC Cable", dated November 23, 1987.
2. GSU P.O. No. 93-H-72449 Test, "Three Hour Fire Resistance Evaluation of Twelve Different Fire Penetration Seal Designs Contained Within Two Different Test Slabs", dated November 22, 1993.

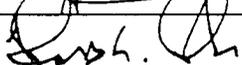
Preparer: _____



Date: _____

10-4-95

Verifier: _____



Date: _____

10/4/95

Penetration Identification

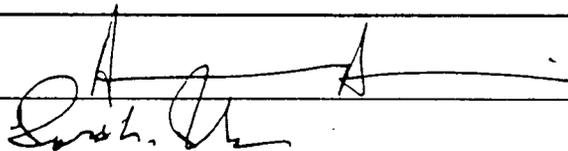
Mark Nos.: C0067A
C0068A
A1109BM

3. TVA Specification G-96
4. WBN Drawing 47W469-2
5. WBN Drawing 47W471-16
6. WBN Drawing 47W472-5
7. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", revision 0.

I. ATTACHMENTS:

None.

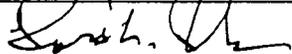
Preparer: _____



Date: _____

10-4-95

Verifier: _____



Date: _____

10/4/95

CATEGORY F EVALUATIONS

Large Annulus Penetrations

Oversized Spare Sleeves

WBN Typical Detail
III, XXXVIII

Applicable Supporting Fire Test

1. ICMS ICO1091035
2. ICMS ICC1185020

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified Silicone Foam seals require further engineering justification because the penetration opening size lies outside the parameter of the applicable fire tests or typical detail.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration seal assemblies are constructed in accordance with TVA Specification G-96 and Drawing 47A472, Sheets 3 and 38. The following describes the penetrations general attributes.

The penetration seal assemblies installed per typical detail III:

- are installed in 2 or 3 hour rated concrete walls of varying thickness.
- are 18" to 26" diameter sleeves. The typical detail allows a 14" maximum sleeve size.
- are sealed with a 12" minimum thickness of Dow Corning 3-6548 RTV Silicone Foam installed within the plane of the barrier; permanent damming material is not required, but where used/left in place shall be non-combustible (e.g. ceramic fiber/board) material.

The penetration seal assemblies installed per typical detail XXXVIII:

- are installed in 2 or 3 hour rated concrete walls and floors of varying thickness.
- are 18" diameter sleeves. The typical detail allows a 17" maximum sleeve size.
- are sealed with a 6" minimum thickness of either Dow Corning Sylgard 170 or G.E. 6428 RTV Silicone Elastomer installed within the plane of the barrier; permanent damming material is not required, but where used/left in place shall be non-combustible (e.g. ceramic fiber/board) material. Floor sleeves 6" in diameter and larger are supported in accordance with drawing 47W472-7.

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C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS

Fire Test ICO1091035 (penetration 3) was performed:

- using a 12" thick concrete test slab. The installed seal assemblies are installed in concrete walls of varying thickness.
- using a 14" diameter spare sleeve tested in a floor (horizontal) orientation. The installed seal assemblies are 18" to 26" diameter sleeves installed in a wall (vertical) orientation.
- using a 12" minimum depth of Dow Corning 3-6548 RTV Silicone Foam without permanent damming. The installed seal assemblies require 12" minimum depth of Silicone Foam, which is consistent with the tested configuration.

Fire Test ICC1185020 was performed:

- using a 12" thick concrete test slab. The installed seal assemblies are installed in concrete walls of varying thickness.
- using a 30"x 30" blockout tested in a floor orientation with the penetrants arranged such that a free area of 17"x 30" was provided. The installed seal assemblies are 18" sleeves which are of smaller area than that tested and therefore bounded.
- using a 6" minimum depth of Dow Corning Sylgard 170 RTV Silicone Elastomer without permanent damming. The installed seal assemblies require 6" minimum depth of Silicone Elastomer, which is consistent with the tested configuration.

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS

Basis for Qualification

The penetration seal assemblies are qualified based on a comparison of the items discussed in section C above as documented by the following:

1. The installed penetration seal assemblies (both Detail III and XXXVIII) are installed in 2 or 3 hour fire rated concrete barriers of varying thickness. Since the typical details require that the seal be installed within the plane of the barrier, as were the tested configurations, the installed are expected to perform the same as the tested configurations.

Preparer: _____

Date: 12/7/95

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Date: 10/4/95

2. The installed Silicone Foam (Detail III) seal assemblies are 18" to 26" diameter sleeves installed in a wall orientation. The tested configuration used a 14" diameter sleeve which was installed in a floor orientation, and bounds the wall orientation since the seal elements are symmetrical. The seal assemblies are installed in a wall orientation, which will not experience as severe a fire exposure as a floor orientation. Also, a seal assembly installed in a wall orientation will experience significantly less stress from the effects of gravity exerted along its sleeve interface surfaces than would a ceiling/floor installation. The above, coupled with the fact that the sleeves have no penetrants to conduct heat through the seal material, supports the assertion that the performance of the installed seal assemblies will be similar to that of the tested configuration even though the opening sizes are significantly larger.
3. The installed Silicone Foam (Detail III) seal assemblies are sealed utilizing a 12" minimum depth of Dow Corning 3-6548 RTV Silicone Foam with no permanent damming required. These construction elements are consistent with the testing and are therefore bounded by the tested configuration.
4. The installed Silicone Elastomer (Detail XXXVIII) seal assemblies are 18" diameter spare sleeves installed in both wall and floor orientation. Fire Test ICC1185020 was performed in a floor orientation which bounds the installed as the seal assembly design is symmetrical. The subject sleeves have an area of 254in², which is smaller than the free area of 510 in² in fire test ICC1185020; therefore, although the Typical Detail conservatively limited opening size to 17" diameter (the smallest dimension of the 17" x 30" free area) the size of the subject seal assemblies is actually bounded by the tested configuration.
5. The installed Silicone Elastomer (Detail XXXVIII) seal assemblies are sealed utilizing a 6" minimum depth of either Dow Corning Sylgard 170 or G.E. 6428 RTV Silicone Elastomer with no permanent damming required. These construction elements are consistent with the testing and therefore bounded by the tested configuration.

Failure Mode Analysis

ASTM E-814 for mechanical penetrations provides two alternatives for rating penetration seals. One alternative uses an F rating to ensure the penetration seal prevents the passage of flames and hot gasses through the opening. The other alternative uses a T rating to ensure that in addition to preventing the passage of flame, the unexposed side temperature is sufficiently low to preclude ignition where combustible construction, interiors, etc. are present.

The first failure mode addressed is burn through of the seal. Tested configurations which do not result in actual burn through, but whose temperatures are above the T rating failure threshold are assigned an F rating. For purposes of this evaluation, test assemblies which allowed flames and hot gasses to pass through the penetration seal material are not used for comparison.

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The second failure mode addressed is temperature failure as recorded on the unexposed surface of the penetration seal. Tested configurations which maintain "cold side" seal surface temperatures below the failure threshold of 325°F above the initial temperature are assigned a T rating. This failure mode generally results from the installation of an insufficient depth of penetration seal material or from the penetrant being a large, thermally conductive member, such as large bore piping. Based on the WBN licensing basis for penetration seal qualification, achievement of a T rating for mechanical penetration assemblies is not required.

E. CONCLUSION:

Based on the evaluation detailed in section D above, the seal assemblies installed in the penetrations identified in Attachment A provide protection equivalent to the 2 and 3 hour barriers in which they are installed. In the unlikely event that a fire originated in the room on either side of these penetrations, the fire would not propagate between rooms via the penetrations themselves due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals addressed by this evaluation is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 2 and 3 hour ratings of the barriers in which they are installed.

G. SUMMARY:

Based on evaluation detailed in section D above, the seal assemblies installed in the penetration identified in Attachment A provide protection equivalent to the fire rated barriers in which they are installed. In the unlikely event that a fire originated in the room on either side of these penetrations, the fire would not propagate between rooms via the penetrations themselves due to the protection provided by the installed penetration seal assemblies.

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Date: _____

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Date: _____

10/4/96

H. REFERENCES

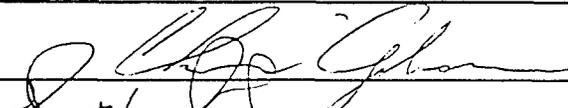
ICMS Test ICO1091035, "3 Hour Fire Resistance Evaluation of Ten Different Fire Penetration Seal Designs," dated November 11, 1991

ICMS Test ICC1185020, "Fire and Hose Stream Tests For Penetration Seal Systems (NMP2-PSS11)," dated January 1986.

WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", Rev. 0

I. ATTACHMENTS

1. Attachment A

Preparer: 
Verifier: 

Date: 12/7/95
Date: 10/4/74

ATTACHMENT A

MARK NO	SLE	PIPE	DETAIL	SYSTEM	FLUID	INSUL	DWG NO	ROOM A	ROOM B	LOCATION
A0007AM	26	0	III	SPR			47W472-1, 47W471-1	A215	A217	24'5" S/U, /A11
A0007BM	26	0	III	SPR			47W472-1, 47W471-1	A214	A217	6'3" S/U, /A11
A0090AM	20	0	III	SPR			47W472-1, 47W471-2	A325	A326	/U, 14'3" W/A15
A0463AM	18	0	III	SPR			47W471-8, 47W472-2	A415	A416	3'N/V, 12'E/A9
A0463BM	18	0	XXXVIII	SPR			47W471-9, 47W472-2	A411	A412	5'2"N/V, 12'1"W/A7
A0777AM	18	0	XXXVIII	SPR			47W471-10, 47W472-3	A712	A401	3'2"S/T, 3'W/A15
C0001A	18	0	XXXVIII	SPR			47W469-1	T201	A401	/Q, 10'6"E/C11

Penetration Identification

Mark Nos.: A8158	A8163
A8159	A8164
A8160	A13809
A8162	

WBN Typical Detail
H1

Applicable Supporting Fire Test

1. OPL Test IC01091035
2. CTL Test ICC1182009
3. CTL Test ICC0483010

ENGINEERING JUSTIFICATION FOR APPROVAL:

A. DISCUSSION

The identified penetration seals require further engineering justification because one of the critical attributes lies outside the parameters of the fire tested configurations. Each of these cable slot penetration seals are installed in 2 hour rated 8" thick poured concrete walls. Mark numbers A8158, A8159, A8160, A8162, A8163 and A8164 are in the wall separating rooms A805 and A802. Mark number A13809 is in the wall separating rooms A866 and A865. Each of these cable slots has been sealed with an 8" depth of Dow Corning 3-6548 Silicone RTV Foam with a 1" non-combustible ceramic fiber damming board on each side of the barrier. The 8" depth of silicone foam installed in these penetrations is less than the 9" (minimum) depth tested in each of the referenced fire tests.

B. PERTINENT PENETRATION ASSEMBLY CONSTRUCTION ELEMENTS

The identified penetration assemblies are constructed in accordance with TVA Specification G-96 and Drawing 45W883-1 (Typical Detail H1). The following describes general attributes common to each of the penetration seals being evaluated:

Mark Nos.: A8158 A8159 A8160 A8162 A8163 A8164	Penetrant Size:	Less than 25% actual cable fill
	Opening Size:	5" x 20" unlined cable slots
	Seal Material:	8" (min.) silicone foam within the barrier with 1" non-combustible ceramic fiber damming board on each side of the barrier
	Barrier Const.:	8" thick poured concrete wall
	Barrier Rating:	2 hour (regulatory)

Mark No.: A13809	Penetrant Size:	Less than 35% actual cable fill
	Opening Size:	5" x 20" unlined cable slots
	Seal Material:	8" (min.) silicone foam within the barrier with 1" non-combustible ceramic fiber damming board on each side of the barrier
	Barrier Const.:	8" thick poured concrete wall
	Barrier Rating:	2 hour (regulatory)

Preparer: <u>LS Gurbuck</u>	Date: <u>10/5/95</u>
Verifier: <u>Richard L. Dill</u>	Date: <u>10/5/95</u>

Penetration Identification

Mark Nos.: A8158	A8163
A8159	A8164
A8160	A13809
A8162	

C. FIRE TEST PERTINENT CONSTRUCTION ELEMENTS:

The following describes the critical attributes of the fire test assemblies which will be used to evaluate the identified penetration seal assemblies:

OPL Test IC01091035
(Penetration PSS1)

Penetrant Size: (1) 18" x 4" Cable Tray (Solid Bottom)
 (1) 18" x 4" Cable Tray (Ladder Back)
 each filled with 68.5% actual fill of
 PE/PVC jacketed cabling

Opening Size: 24" x 24" blackout lined with 1/4" steel
 Seal Material: 8-3/4" (min.) silicone foam with 1" non-
 combustible ceramic fiber damming board on
 each side of the silicone foam

Barrier Const.: 12" thick poured concrete (horizontal)
 Test Results: Approximate 3 hour rating per WBN criteria
 with highest unexposed side temperature of
 549°F at 2 hours into the 3 hour test
 (measured on 250 MCM cable)

CTL Test ICC1182009
(Penetration 2)

Penetrant Size: (1) 24" x 6" Cable Tray (Ladder Back)
 filled with 100% visual fill of cabling
 Opening Size: 8" x 28" cable slot lined with 1/4" steel
 Seal Material: 9" (min.) silicone foam with 1" non-
 combustible ceramic fiber damming board on
 exposed side of penetration

Barrier Const.: 12" thick poured concrete (horizontal)
 Test Results: Approximate 3 hour rating per WBN criteria
 with highest unexposed side temperature of
 496°F at 2 hours into the 3 hour test
 (measured on 350 MCM cable)

Preparer: LS Gussbeck

Date: 10/5/95

Verifier: Richard H. Telle

Date: 10/5/95

Penetration Identification

Mark Nos.:	A8158	A8163
	A8159	A8164
	A8160	A13809
	A8162	

CTL Test ICC0483010
(Penetration A)

Penetrant Size: (1) 4" dia. cable bundle w/Kellem grip
(1) 3" dia. cable bundle

Opening Size: 8" x 28" unlined cable slot

Seal Material: 9" (min.) silicone foam with 1" non-combustible ceramic fiber damming board on exposed side of penetration

Barrier Const.: 12" thick poured concrete (horizontal)

Test Results: 3 hour rating per WBN criteria with highest unexposed side temperature of 294°F at 2 hours into the 3 hour test (measured on 3" dia. cable bundle)

D. BASIS FOR QUALIFICATION AND FAILURE MODE ANALYSIS:

Basis for Qualification

The installed penetration seal assemblies are qualified based on a comparison with tested configurations described in section C above as documented by the following:

As established in the qualification of WBN typical detail H1, 9" of silicone foam with 1" of non-combustible ceramic fiber damming material on each side provides a 3 hour rated configuration for sealing cable slot penetrations at WBN. Considering the 3 hour qualified H1 configuration, which used the same testing referenced above, the Mark numbers identified in this evaluation will provide a rating which is at least equivalent to the 2 hour rating of the barriers in which these penetrations are installed.

This position is supported by a comparison of the referenced tested configurations to the installed configurations. After performing such a comparison, it can be concluded that the installed configurations will provide at least a 2 hour rating based on the following:

- The tested configurations essentially achieved a 3 hour rating with approximately 9" of silicone foam and 1" of damming for cable bundles and single tray configurations. A second layer of damming board was installed in the configuration which tested multiple penetrating cable trays. The installed configurations have a minimum of 8" of silicone foam and a 1" non-combustible ceramic fiber damming board on each side of the penetration. The installed configurations have a single cable tray which does not

Preparer: LS Gustack

Date: 10/5/95

Verifier: Robert H. Dible

Date: 10/5/95

Penetration Identification

Mark Nos.:	A8158	A8163
	A8159	A8164
	A8160	A13809
	A8162	

penetrate completely through the barrier and therefore, will easily achieve a 2 hour rating.

- The installed configurations will be subjected to a less severe fire exposure than the tested configurations due to wall orientation of the installed configurations compared to the floor/ceiling orientation of the tested assemblies.

Failure Mode Analysis

IEEE 634-1978 for electrical penetrations provides a standard method for rating electrical penetration seals. Acceptance of a tested assembly is based on two distinct criteria. The first criteria is burn through. A penetration seal assembly is considered to have failed if during the fire endurance test, the penetration seal allows the passage of flame to the unexposed side. Also associated with the burn through failure mode is the hose stream test requirements. The test specimen is considered to have failed if during the hose stream test performed on the specimen after the fire endurance test, the test assembly allows the passage of water to the unexposed side.

The second criteria invokes unexposed side temperature limitations. The test assembly is considered to have failed if temperatures on the unexposed side of the penetration exceeded 700°F during the fire endurance test.

As discussed in the Basis for Qualification section above, the installed configurations will prevent the passage of flame and hose stream for at least 2 hours.

As for the unexposed side temperature criteria, temperatures on the unexposed side of the tested assemblies were well below the 700°F limit at 2 hours into 3 hour fire endurance tests (294°F for ICC0483010, 496°F for ICC1182009, and 549°F for IC01091035). While the installed configurations have 1" less silicone foam than two of the tested configurations, the installed configurations have non-combustible ceramic fiber damming boards installed on each side of the penetration (unlike tests ICC0483010 and ICC1182009). The 1" of additional damming material will perform better than the 1" of silicone foam which it replaces. Therefore, the installed configurations will prevent unexposed side temperatures from reaching the 700°F limit for at least 2 hours.

Preparer:

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Date:

10/5/95

Verifier:

Richard J. Zible

Date:

10/5/95

Penetration Identification

Mark Nos.: A8158 A8163
 A8159 A8164
 A8160 A13809
 A8162

While the installed configurations have the same amount of damming material and 1" less foam than the tested configuration in IC01091035, the IC01091035 configuration had multiple penetrating cables, each of which was overfilled. The installed configurations are of a smaller size and contain a single cable tray with loading well below that of the tested configuration. Therefore, the installed configurations will maintain unexposed side temperatures below the 700°F limit for at least 2 hours.

E. CONCLUSION:

Based on the evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A8158, A8159, A8160, A8162, A816, A8164 and A13809 will provide protection equivalent to the 2 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via these penetrations due to the protection provided by the installed penetration seal assemblies.

F. FEATURES ANALYSIS:

Analysis to determine the additional benefits of the fire protection features (e.g., suppression, detection, combustible loading, etc.) in the rooms adjacent to the penetration seals being evaluated is not required. The evaluation contained in section D above concluded that the installed configurations provide a level of protection equivalent to the 2 hour rating of the barriers in which they are installed.

G. SUMMARY:

Based on the evaluation detailed in section D above, the seal assemblies installed in the penetrations identified as Mark Nos.: A8158, A8159, A8160, A8162, A816, A8164 and A13809 will provide protection equivalent to the 2 hour rated barriers in which they are installed. In the unlikely event that a fire originated in either of the rooms adjacent to these penetrations, the fire would not propagate between rooms via these penetrations due to the protection provided by the installed penetration seal assemblies.

Preparer: _____

L.S. Gurbuch

Date: _____

10/5/95

Verifier: _____

D. J. Tible

Date: _____

10/5/95

Penetration Identification	
Mark Nos.: A8158	A8163
A8159	A8164
A8160	A13809
A8162	

Page 6 of 6

H. REFERENCES:

1. Construction Technology Laboratories Fire Test IC01091035, "Fire and Hose Stream Tests For Penetration Seal Systems," dated October 1990
2. Construction Technology Laboratories Fire Test ICC1182009, "Fire and Hose Stream Tests for Penetration Seal Systems and Seismic Gap," dated December 1982
3. Construction Technology Laboratories Fire Test ICC0483010, "Fire and Hose Stream Tests for Penetration Seal Systems," dated May 1983
4. TVA Specification G-96
5. WBN Drawing 45W883-1
6. WBN Engineering Report No.: 0006-00922-02, "Engineering Report for Penetration Seal Program Assessment", revision 0 (Section 3.3.b.7 for typical detail H1).

I. ATTACHMENTS:

None.

Preparer: LS GuebeckDate: 10/5/95Verifier: R. H. DillDate: 10/5/95

APPENDIX G

TVA's POSITION ON CABLE TRAY / SEAL INTERFACE

Appendix G- TVA's Position on Cable Tray / Seal Interface

A number of the test configurations used to support the design of the WBN penetration seals had continuous cable trays that passed through the penetration. At WBN, the cable trays do not pass through the penetration seals. Questions have been raised on whether the presence of a metallic cable tray passing through a penetration seal improves or degrades the performance of the seal during a fire. Configurations that have a cables in a cable tray passing completely through the penetration seal will have equal or higher cold side temperatures and will have equal or greater amounts of foam charring than the same configurations with only cables passing through the seal. The conclusion that penetrations without a cable tray passing through the penetration seal provide a higher level of protection was made considering combustion and heat transfer principles and is supported by the existing test data.

For a given cable loading, the question is what effect does the presence of a cable tray have on the combustion of either the cable or the foam? There are three effects to consider. The first is the ability to support and sustain active combustion in the penetration, the second is the effect of the cable tray on combustion of the cables within a sealed penetration and the third is the depth and rate at which temperatures needed to support combustion in the penetration occur. In configurations where there is a continuous tray, the foam forms a seal on the outside of the cable tray and across the top of the cables. Some foam will enter the tray at the entrances to the penetration, however there is little foam between the individual cables. In penetrations where no cable tray is present, the foam forms a seal on all sides of the cable bundle. More foam will make it into the cable bundle for this configuration than is the case where a cable tray is present. This is the result of the cables tending to separate as they are suspended across the width of the penetration. In either configuration, the interior of the penetration is essentially full of material and there is a limited amount of oxygen present. As temperatures rise in the cable bundle and in the foam, the foam will begins to expand which helps to seal any gaps. As the heating continues the foam will char. A similar change will occur in the cable jacketing and insulation. The combustible material will change form but a significant combustion will not occur due to the limited amount of oxygen available inside the penetration. As the foam chars, it continues to insulate all surfaces it is in contact with. The charred foam becomes brittle and may crack. Where damming boards are present, as is the case in all of the WBN cable tray configurations and was the case in a number of fire tests, the char will remain in the penetration. Even if the char material cracks, only a limited amount of oxygen will be able to make it into the interior of the penetration and only at areas where there are cracks. As a result, active and sustained combustion will only occur along the face of the foam facing the heat source (fire or furnace) where there is an adequate supply of oxygen. Cables inside the penetration do not actively burn because there is a limited supply of oxygen due to the presence of the foam and char material not because of shielding of the cable by the cable tray walls. On the basis of this alone, it can be concluded that the cable tray walls have a negligible effect on burning of the cable

insulation in the penetration seals. How rapidly the foam chars is a function of how rapidly heat is conducted into the penetration. Since the foam and the char are very good insulators, the char front proceeds very slowly where only foam is present. However, along metal paths such as the cable trays or principally along the copper in the cables, the temperatures are much higher at a given position and point in time than in areas where there is no metal. To develop this observation, it is important to note that the seal serves two functions. The first is to insulate the unexposed side of the seal from the flame temperature. The second is to act as a heat sink to conduct heat being transferred along the cables and trays into the seal material thus reducing the cable temperature on the unexposed side of the seal. The seal material is not a very good choice for a heat sink. It has a low thermal conductivity and because of its low density, a correspondingly low heat capacity. Increasing the amount of metal in the seal requires that a greater depth of seal material be present to dissipate the heat being transferred into a seal through conduction along the metal in the cables or cable trays. Theoretically, the presence of cable trays result in higher temperatures deeper into the seal thus increasing the depth of charring. In actuality, the amount of copper is more important due to its higher thermal conductivity and the fact that in penetrations with a substantial number of power cables the heat transfer area through the copper is much greater than through the tray. Table 1 compares the thermal conductivity of the penetration material. As can be seen, copper dominates the process.

Material	Thermal Conductivity BTU/hr-ft-°F	Density lb/ft ³
Silicon Foam	0.04	~20
Damming Board	0.03	~14
Concrete	1.0	140
Steel	27	489
Copper	227	556

Table 1

Tests clearly demonstrate that the points discussed thus far are true. The test results of 1001A show that for a given cable loading the amount of foam charring is essentially the same whether the cable tray has a solid bottom or a ladder bottom. Table 2 summarizes the tests of interest.

Test	1001A Slot 1.1	1001A Slot 1.5	1001A Slot 2.1	1001A Slot 2.2
Tray width	18	18	36	36
Tray type	solid	ladder	ladder	solid
Total conductor cross sectional area (in ²)	6.1	6.1	12.3	12.3
Power cable	4.4	4.4	9.4	9.4

conductor cross sectional area (in ²)				
Cable tray steel cross sectional area (in ²)	1.3	0.5	0.5	2.2
Initial Foam Depth (in)	10	10	10	10
Char Depth (in)	2 to 6	3 to 7	5 to 9 ⁵ / ₈	5 to 9 ⁵ / ₈
Max. temperature (°F)	384	280	495	580

Table 2

If combustion effects were significant, much more foam would be charred in tests with ladder bottom trays than was seen in the case of solid bottom trays. This was not the case. The basic behavior between solid trays and ladder back trays was the same whether the trays were 18 inches wide or 36 inches wide. Also for a given location within a block out the amount of charring was essentially the same for a given amount of fill. Most importantly, a 36 inch tray that was fully filled with cable showed that the char/foam interface went much deeper into the penetration than was seen in an 18 inch wide tray. This is exactly what would be expected due to heat conduction through the copper. A fully filled 36 inch wide tray has substantially more copper in it than an 18 inch wide tray does. In the case of test 1001A, the fully filled 18 inch trays had a cross section of 6.1 in² of copper, 4.4 in² of which was from large power cable. The 36 inch wide trays had 12.3 in² of copper, 9.4 in² of which was from large conductor power cable. The depth of charring in the 18 inch trays was about 3 to 4 inches with 5 to 6 inches of uncharred foam remaining. In the 36 inch trays the depth of charring was over 9 inches with 3/8 inch of uncharred foam remaining. The depth of charring seen in this test was due to the ability of the large copper conductors to transfer large amounts of energy deep into the penetration. This resulted in high temperatures through the seal with the resultant charring as the entire seal depth was required to dissipate energy being transferred into the penetration. The difference in the depth of charring was due to the increased surface area needed by the char and foam to dissipate the heat being conducted down the greater mass of copper in the 36 inch wide trays. It is also clear from the temperatures seen by the thermocouples that energy was being conducted out of the copper into the char and remaining foam. For the 36 inch wide trays, the temperature at the copper/foam interface at the end of the test was less than 600 °F. If the foam and cables had been actively burning only 3/8 of an inch from the unexposed side of the penetration, the temperature at the copper/foam interface would have been well over a 1000 °F. It would be impossible for 3/8 inch of foam, with a thermal conductivity of 0.04 BTU/hr-ft -°F, to dissipate the heat being transferred through copper conductors, with a thermal conductivity of 227 BTU/hr-ft -°F, and drop the temperature by over 400 °F. The figures associated with test 1001A show the char/foam interface. They incorrectly label the char as foam consumed implying the destruction and elimination of material which was not the case. Both the physics of the

situation and the testing indicate the importance of damming board as a physical restraint to retain the char in place in penetrations.

It is concluded that tests performed using a continuous cable tray going through the penetration can be used without extrapolation of the results to determine the acceptability of WBN cable penetrations. WBN cable penetrations do not have trays that extend completely through the penetration seals. The tests show that the principle mechanism for seal degradation is the transfer of heat through the cable conductors. Active and sustained combustion does not occur in the penetration except at the face of the seal due to a limited oxygen supply necessary to support such combustion. Thus the presence of a cable tray is not important in limiting or preventing the cables from burning within the penetration. Tests with fully penetrating trays will therefore bound corresponding tests or in plant configurations with partial or no penetration of cable tray based on the preceding discussion.

ENCLOSURE 2

TEST PLAN
FOR
THREE HOUR FIRE ENDURANCE TESTS
OF PENETRATION SEAL CONFIGURATIONS

THREE HOUR FIRE ENDURANCE TESTS
OF PENETRATION SEAL CONFIGURATIONS

PREPARED BY J.J. PIERCE

CHECKED BY MARK, H. SALLEY

SIGNATURE J.J. Pierce

SIGNATURE Mark H. Salley

DATE 10/4/95

DATE 10/4/95

APPROVED BY W.L. Elliott

SIGNATURE W.L. Elliott

DATE 10/4/95

THREE HOUR FIRE ENDURANCE TESTS OF PENETRATION SEALS

1.0 SCOPE

This test plan describes the methods and guidelines for a three hour fire endurance test. This test plan includes the preparation of the test slab and specimens, installation of the penetration seal (PS) assemblies, performance of fire endurance and hose stream tests, temperature monitoring, and applicable documentation of these tasks and test results.

2.0 OBJECTIVE

Successful results of this test program will provide additional evidence that the cable tray penetration seals in fire barrier will satisfactorily withstand an ASTM E-119-88 fire exposure for a period of three hours, followed by a hose stream test. These tests shall satisfy the requirements for fire testing the seals as detailed in IEEE 634-1978, "Standard Cable Penetration Fire Stop Qualification Test", except where clarified and, in the absence of other standards for these specific types of tests, standard practice shall be invoked.

3.0 ACCEPTANCE CRITERIA

The test can be considered acceptable and the PS suitable for use in accordance with the fire rating, provided the following are met:

- 3.1 The PS shall have withstood the fire endurance test as specified without passage of flame or gases hot enough to ignite the cable or other fire stop material on the unexposed side for a period equal to the required fire rating.
- 3.2 Transmission of heat through the PS shall not raise the temperature on its unexposed surface above 700° F (388° C).
- 3.3 A hose stream test as described in Section 8.2 will be performed at the end of the fire endurance test. If the hose stream test does not cause any openings through the PS, the PS shall be acceptable.

4.0 REFERENCES

- 4.1 10CFR50, Appendix R - Fire Protection Program for Operating Nuclear Power Plants.
- 4.2 American Society for Testing and Materials (ASTM) E119-88 "Standard Test Methods for Fire Tests of Building Construction and Materials".
- 4.3 IEEE 634-1978, "Standard Cable Penetration Fire Stop Qualification Test"

5.0 RESPONSIBILITIES

5.1 TENNESSEE VALLEY AUTHORITY (TVA)

- 5.1.1 Establish the criteria, guidelines, drawings (draft quality), recommendations, etc. to govern the configuration of the test items.
- 5.1.2 Establish the criteria, guidelines, drawings (draft quality), recommendations, etc. to govern the installation of the fire penetration seal systems.
- 5.1.3 Supply personnel to witness assembly and test article configurations installation at TVA's discretion.

5.2 OMEGA POINT LABORATORIES, INC. (OPL)

- 5.2.1 Prepare the test furnace, slab, penetration assemblies and provide all required test instrumentation in accordance with its Appendix B Quality Assurance and Quality Control Program and other applicable procedures.
- 5.2.2 Provide thermocouple calibration and instrumentation, storage temperature records, and relative humidity instrumentation.
- 5.2.3 Assemble, install and document the installation of the electrical raceways (i.e., trays, cables) and penetration seals. Provide computer generated drawings of the PSs which clearly indicate critical dimensions, thermocouple locations, etc.
- 5.2.4 Coordinate all phases of the fire test preparation.
- 5.2.5 Supply QC personnel to witness and document assembly and test article raceway configurations.

- 5.2.6 Provide all applicable quality control documentation for the PS materials to the test articles and attendant instrumentation on each test article.
- 5.2.7 Observe and document the installation of the PS and attendant instrumentation on each test article.
- 5.2.8 Conduct the fire endurance and water hose stream tests.
- 5.2.9 Document the test parameters and provide a formal, detailed written report of the test program and test results.
- 5.2.10 Notify TVA within three (3) working days of completion of the test specimen.

5.3 OPL QUALITY ASSURANCE/QUALITY CONTROL

- 5.3.1 Maintain the quality control documentation of the materials used in the test program. TVA procured materials and their documentation will be maintained by TVA or OPL at TVA's discretion.
- 5.3.2 Witness and document monitoring activities of the PS installation.
- 5.3.3 Inspect and document the construction and instrumentation of the test articles.
- 5.3.4 Provide written calibration documentation of thermo-couples, measurement devices and data acquisition systems used in this test program.

6.0 SPECIAL PRECAUTION

6.1 PRECAUTIONS FOR INSTALLATION OF THE PS

- 6.1.1 Observe specific precautions recommended by manufacturers' material safety data sheets.

6.2 PRECAUTIONS FOR CONDUCTING THE FIRE ENDURANCE TEST

- 6.2.1 Proper safety precautions shall be exercised to preclude personnel from direct exposure to the flame environment, hot object, hazardous gases, and other related hazards.

7.5.2 Cable Tray Slots

The frame around the cable tray slot shall be constructed as shown on test detail 5 in Appendix A. The method of anchoring the frame to the concrete is shown for information only and is not intended to limit Omega Point Lab in the anchoring the frame to the concrete. The anchoring of the frame to the concrete is the responsibility of Omega Point Lab.

7.5.3 Cable Trays

The slab will consist of twelve (12) 18" wide, standard weight steel cable trays with 4" side rails and rungs spaced on 6" centers. Cable tray configurations for this program will consist of assemblies which do not penetrate the concrete slab. The cable trays shall be installed as follows.

On the exposed side, the cable tray shall penetrate the slot a nominal 3-inch ($\pm \frac{1}{8}$ -inch) and extend down a minimum of 12-inches (approximately 15-inches total length). On the unexposed side the cable tray shall penetrate the slot a nominal 3-inch ($\pm \frac{1}{8}$ -inch) and extend up a minimum of 36-inches (approximately 39-inches total length). See test detail 5 in Appendix A.

7.5.4 Supports

On the exposed side, the cable tray section may be attached directly to angle steel embedded in the concrete. No other external supports are necessary, provided the tray segment is rigid mounted and will remain in position for the duration of the test. On the unexposed side, the cable tray section will require supports in addition to the angle steel connection. The design and construction of the supports on the unexposed side shall be the responsibility of Omega Point Lab.

7.6 CABLE LOADING REQUIREMENTS

- 7.6.1 The twelve cable trays identified in 7.5.2 will be used to bound cable fill attributes of the PS.

Penetration Seal Assembly A1 will contain a single layer of 4/C-#16 conductors.

Penetration Seal Assembly A2 will contain 100% visual fill of 4/C-#16 conductors.

Penetration Seal Assembly A3 will contain 100% visual fill of 4/C-#16 conductors.

Penetration Seal Assembly A4 will contain 50% visual fill of 4/C-#16 conductors.

Penetration Seal Assembly A5 will contain 50% visual fill of 4/C-#16 conductors.

Penetration Seal Assembly A6 will contain a single layer of 4/C-#16 conductors.

Penetration Seal Assembly A7 will be a spare penetration.

Penetration Seal Assembly A8 will be a spare penetration.

Penetration Seal Assembly B1 will contain 20-3/C#10, 4-#6, 2-#2, 12-2/0, 4-4/0 and 20-300 MCM conductors.

Penetration Seal Assembly B2 will contain 9-300 MCM conductors.

Penetration Seal Assembly B3 will contain 10-3/C#10, 2-#6, 1-#2, 6,-2/0, 2-4/0 and 10-300 MCM conductors.

Penetration Seal Assembly B4 will contain 20-3/C#10, 4-#6, 2-#2, 12-2/0, 4-4/0 and 20-300 MCM conductors.

Penetration Seal Assembly B5 will contain 9-300 MCM conductors.

Penetration Seal Assembly B6 will contain 10-3/C#10, 2-#6, 1-#2, 6,-2/0, 2-4/0 and 10-300 MCM conductors.

7.6.2 Cable Length and Installation

The cables are to be installed continuous through the penetration. On the exposed side, the cables shall be approximately flush with the end of the tray. On the unexposed side, the cables may extend up to 6-inches past the end of the tray.

7.7 THERMOCOUPLE INSTALLATION

7.7.1 General

All thermocouples used in this test program shall be provided and installed by OPL, with QC surveillance by OPL personnel. The thermocouple wires shall be calibrated (by Lot Number) prior to installation and/or use, and applicable quality control documentation records

generated. All thermocouples will consist of 24 GA, type K, Chromel-Alumel, braided fiberglass insulation (Special Limits of Error $\pm 1.1^{\circ}$ C) electrically welded thermo-junctions. Calibration will consist of manufacturer supplied (and audited) certifications of calibrations at fire temperatures of thermocouples taken from both ends of each purchased lot number.

The thermocouples shall be covered with a 2"x2"x0.4" (nominal) felted mineral fiber pads held in position with glass fiber adhesive tape, stainless steel hose clamps or stainless steel wire, depending upon the application.

7.7.2 Required Thermocouples

There shall be a minimum of three thermocouples located on the unexposed surface of the damming board; three at the interface of the penetrants (one for each of the following cable types: 3/C-#10, 2/0 and 300 MCM) and the seal; three on the penetrants (one for each of the following cable types: 3/C-#10, 2/0 and 300 MCM) located between 1-inch and 3-inches above the unexposed surface of the seal; and three on the unexposed surface of the slab.

7.7.3 Engineering Thermocouples

These thermocouples are for information and are not to be used in determining the pass/fail qualifications of the seal assembly.

Two sets of engineering thermocouples shall be placed inside the seal of penetrations A6 and B6 every 2-inches beginning at the interface of the exposed board. One set shall be located on the jacket of the 4/C-#16 in penetration A6 and the other set located in the seal material midway between the cables and the concrete slot. One set shall be located on the jacket of the 300 MCM and the other set located in the seal material midway between the conductors and the concrete slot.

One set of thermocouples shall be placed on each cable tray side rail at the interface of the damming board and the tray.

One thermocouple on each side of the metal frame around each cable tray slot.

A thermocouple placed midway between each cable tray slot and beside each cable tray slot on the perimeter (see test detail 6, Appendix A).

Two thermocouples placed at the interface of the foam seal and the damming board for each penetration.

7.8 INSTALLATION OF THE PENETRATION SEAL ASSEMBLIES

Upon completion of the fabrication and installation of the cables and raceways to the test slab, all openings in the test slab shall be sealed by OPL or by a penetration seal contractor under the direction of OPL. The penetration seal assemblies will consist of Dow Corning 3-6548 room temperature vulcanizing (RTV) foam with ceramic fiber damming material (e.g., Carborundum Board).

- 7.8.1 Penetrations A1 through A6 are to be sealed with a seal assembly as follows. Beginning on the exposed (fire) side, the seal has a damming board on the surface of the slab, 12-inches of foam flush with the surface of the concrete, and a damming board on the unexposed surface of the slab (see test detail 2, Attachment A).
- 7.8.2 Penetrations A7 and A8 are spare penetrations and are to be sealed as follows. Beginning on the exposed (fire) side, the seal has a damming board on the surface of the slab, 11-inches ($\pm \frac{1}{8}$ ") of foam, and a damming board on the unexposed surface of the slab (see test detail 3, Appendix A).
- 7.8.3 Penetrations B1 through B6 are to be sealed with a seal assembly as follows. Beginning on the exposed (fire) side, the seal has a damming board on the surface of the slab, 11-inches ($\pm \frac{1}{4}$ ") of foam, ceramic fiber material inside the penetration, and a damming board on the unexposed surface of the slab (see test detail 4, Attachment A).

7.9 PREBURN INSPECTION

- 7.9.1 Prior to the commencement of the fire endurance test, a thorough check of the test assembly and associated equipment (including data recording equipment) shall be performed and documented by OPL.
- 7.9.2 TVA shall inspect the PS for workmanship, surface defects, etc. prior to test.

- 7.9.3 Written approval of the construction, assembly, installation and instrumentation will be supplied by OPL prior to performance of each fire exposure test (a sign-off sheet for this purpose will be supplied by OPL and included in the final report).

8.0 PROCEDURE

8.1 FIRE ENDURANCE TEST

- 8.1.1 The penetration seal test assemblies shall be exposed to the standard time/temperature curve found in ASTM E119-88 for three hours. TVA personnel may request that the test be stopped at any time.
- 8.1.2 OPL shall adapt their testing procedures to assure the fire test complies with the requirements established in all referenced standards. Any changes, revisions, or deviations required to comply with this requirement shall be documented and properly justified and included as a part of the final test report.

8.2 WATER HOSE STREAM TEST

Immediately (within 10 minutes) following the fire endurance test, accessible surfaces on the exposed side of the test article shall be subjected to the cooling, impact and erosion effects of a hose stream delivered through a 1½-inch fog nozzle set at a discharge angle of 30° with a nozzle pressure of 75 psig and a minimum discharge of 75 gpm. The nozzle orifice is to be a maximum of 5 feet from the edge of the tested assembly.

9.0 DATA SYSTEMS

During the fire exposure period, the thermocouples will be scanned at one minute intervals or less. Data storage for reporting purposes will be at one minute intervals (minimum); however, the furnace thermocouples should be scanned at 15 second intervals to allow close control of the furnace. A printer output of all thermocouple data should be done every 60 seconds.

10.0 FIRE TEST REPORT

- 10.1 OPL shall submit a report on the results of the test and thermocouple data. The test report shall be prepared and submitted in accordance with the requirements of sections 10.2 and 10.3 following.
- 10.2 OPL will assemble the final test report, containing the collected data, disposition of test anomalies and required quality control documentation.
- 10.3 The test report shall be prepared in sufficient detail to summarize the total testing activity. The report shall include as a minimum:
- a. Date of the test
 - b. Location of the test
 - c. Description of the test furnace and test article
 - d. Calibration documentation of all thermocouples
 - e. Qualification and certification for QA personnel
 - f. Test procedures used
 - g. Acceptance criteria
 - h. Provide quality control records for:
 - (1) Test article construction
 - (2) Identification and installation of penetration seal assemblies
 - (3) Thermocouple locations
 - (4) Cables, sizes, type and location
 - (5) Actual raceway fill densities (mass per linear foot)
 - i. Computer printout and graphic results of the fire endurance test
 - j. All raw data
 - k. 35mm photographic coverage of the test project
 - l. Written visual observations of the penetrations conditions prior and subsequent to the hose stream test
 - m. Video tape documentation of each typical seal installation and the fire and hose stream test
 - n. Provide a chronological log (Event Log) of all activities from receipt of materials through final test report
 - o. A copy of the test plan and fire barrier installation procedures provided by TVA
 - p. Temperature/Time data provided to TVA in ASCII format
- 10.4 OPL shall provide six copies of the test report to TVA.

APPENDIX A
TEST DETAILS

SUBJECT PENETRATION SEAL TEST - Detail 1- PROJECT WBN

COMPUTED BY J. J. PIERCE

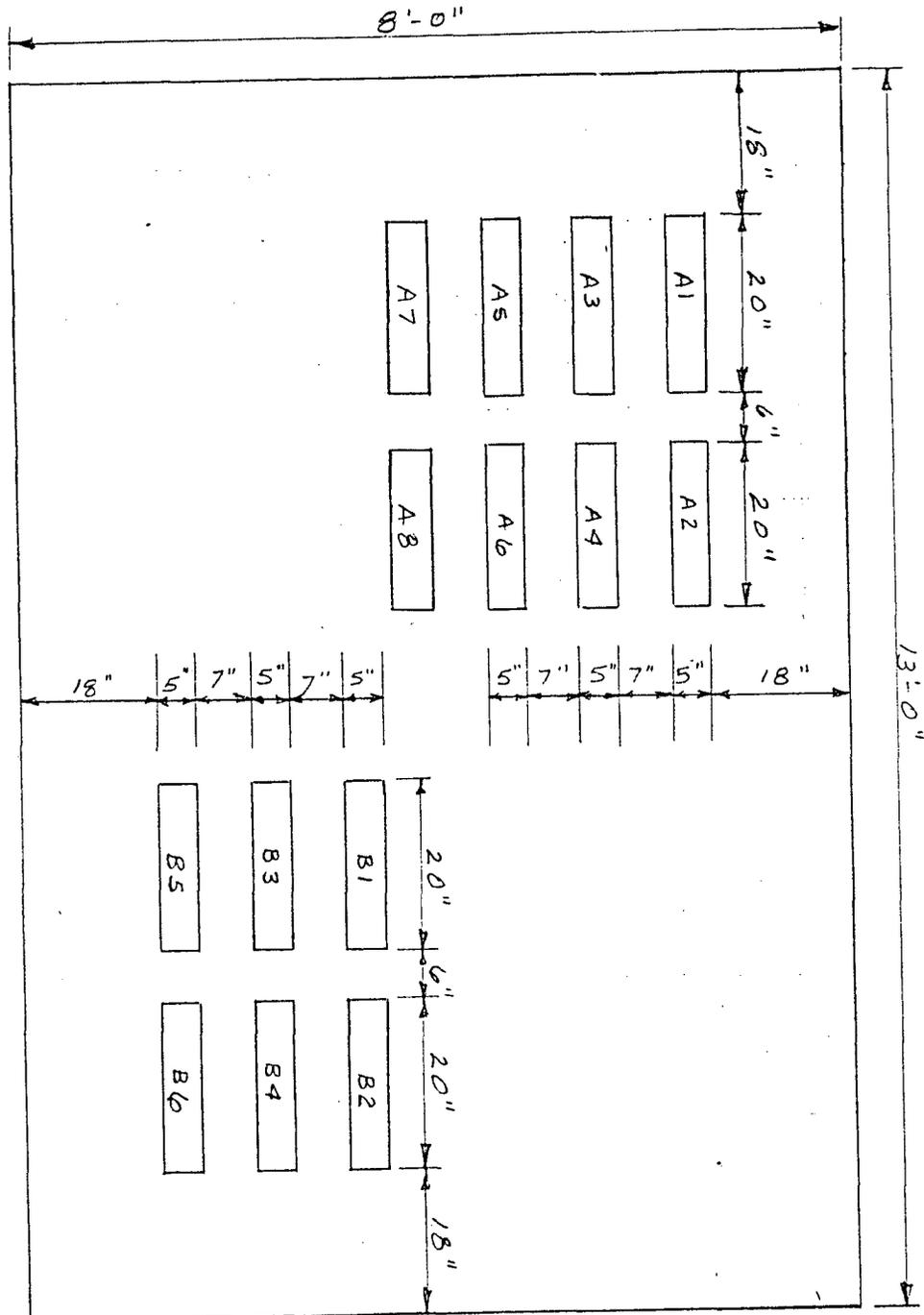
DATE 10/2/95

CHECKED BY M. H. Salley

DATE 10/2/95

Detail 1
Tray Slot Location

PLAN VIEW



SUBJECT PENETRATION SEAL TEST

PROJECT WBN

COMPUTED BY JJ PIERCE

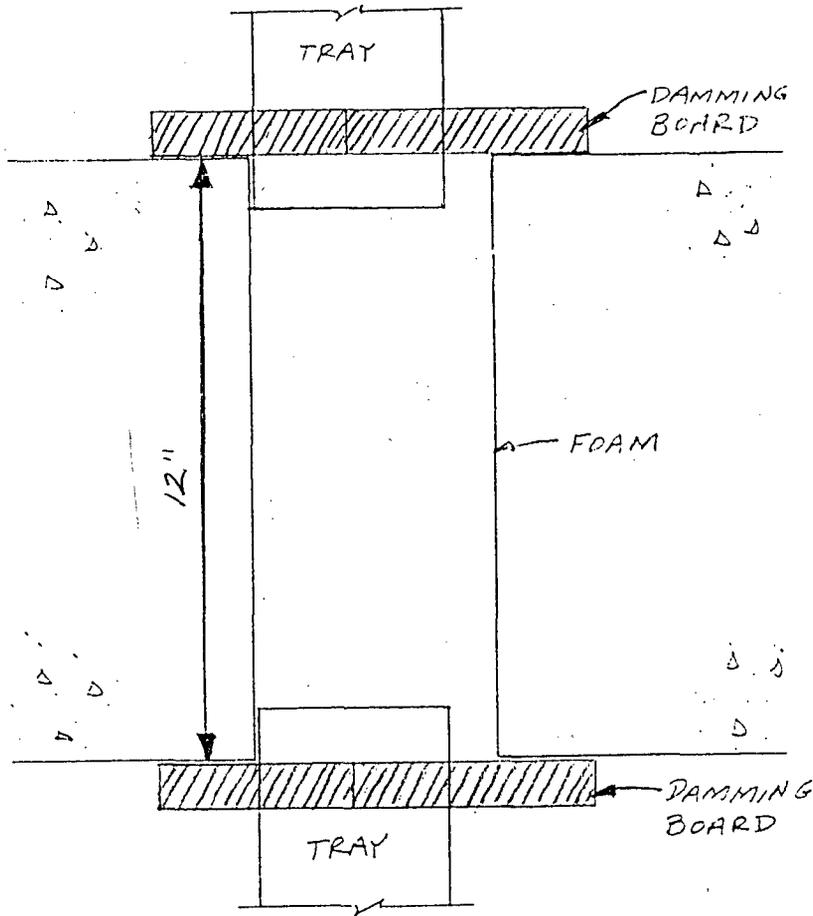
DATE 10/2/95

CHECKED BY

M/Sally

DATE 10/2/95

Detail 2



TYPICAL DETAIL A1-A6
(SCALE 1/4" = 1")

SUBJECT PENETRATION SEAL TEST

PROJECT W3N

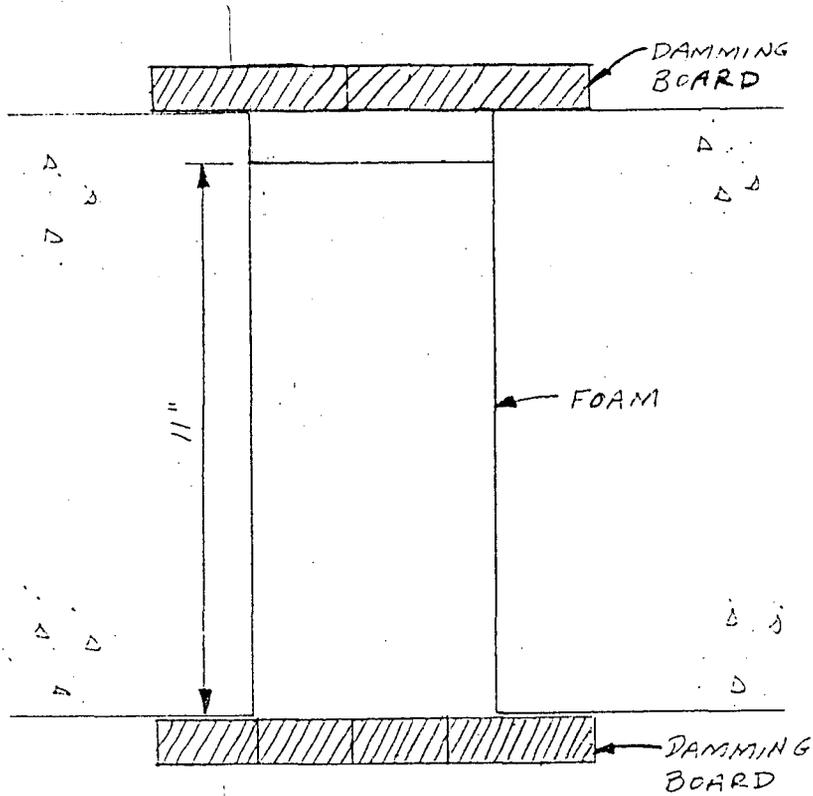
COMPUTED BY JJ PIERCE

DATE 10/2/95

CHECKED BY M.H. Salley

DATE 10/2/95

Detail 3



TYPICAL DETAIL A7#A8
(SCALE 1/4" = 1")

A7 - FIRE SIDE ON BOTTOM
A8 - FIRE SIDE ON TOP

SUBJECT PENETRATION SEAL TEST

PROJECT WBN

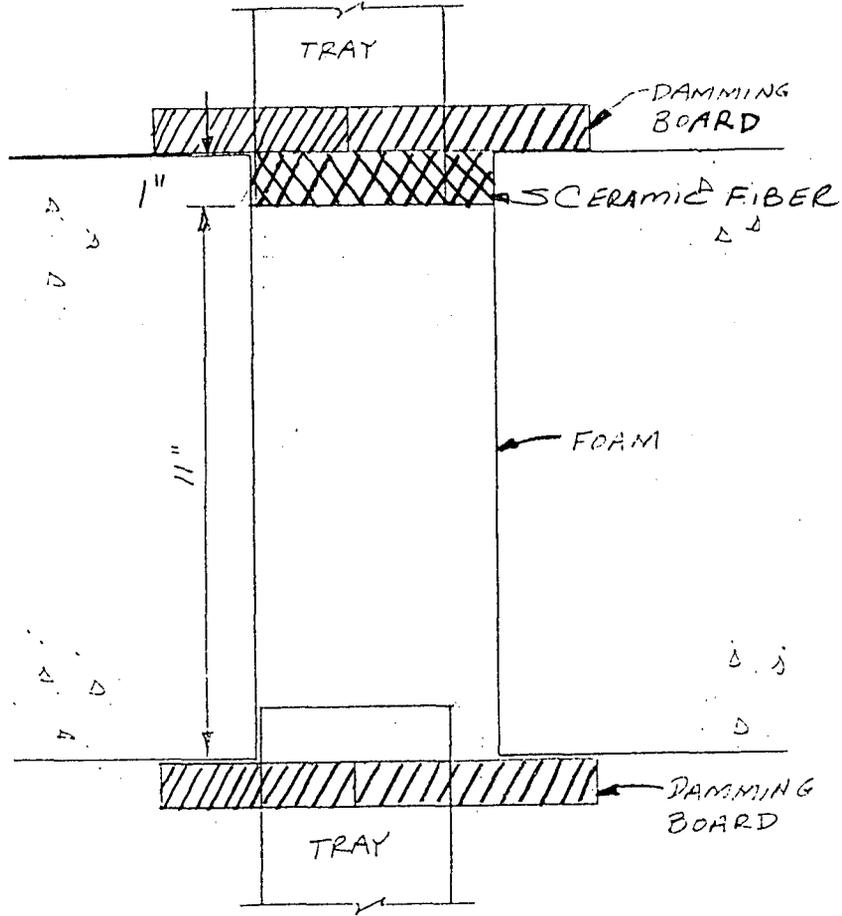
COMPUTED BY JJ PIERCE

DATE 10/2/95

CHECKED BY M.H. Selby

DATE 10/2/95

Detail 4



TYPICAL DETAIL "B"
(SCALE 1/4" = 1")

SUBJECT Cable Tray Frame & Tray Connection PROJECT

Pierce 10/2/95

M/Sally

10/2/95

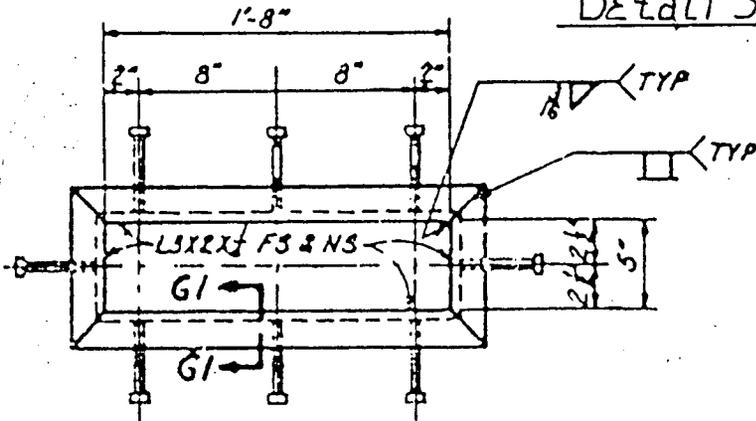
COMPUTED BY

DATE

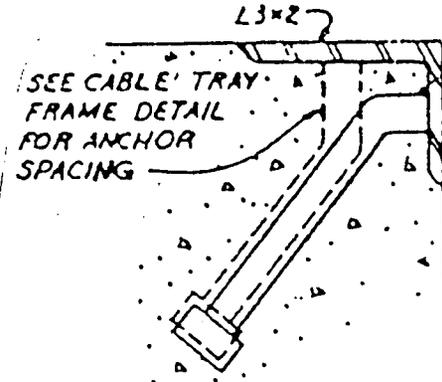
CHECKED BY

DATE

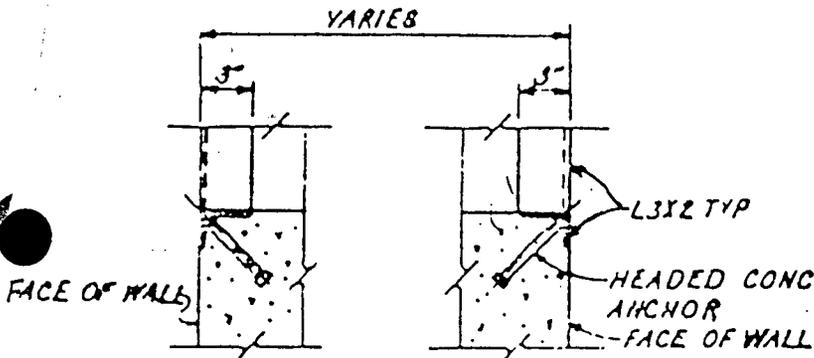
Detail 5



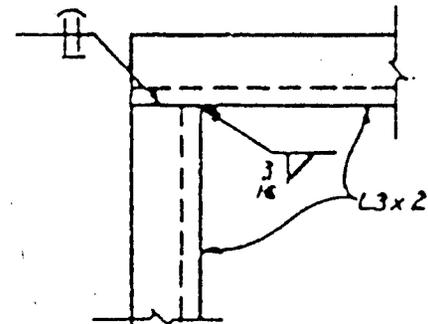
CABLE TRAY FRAME ELEVATION SCALE: 1 1/2" = 1'-0"



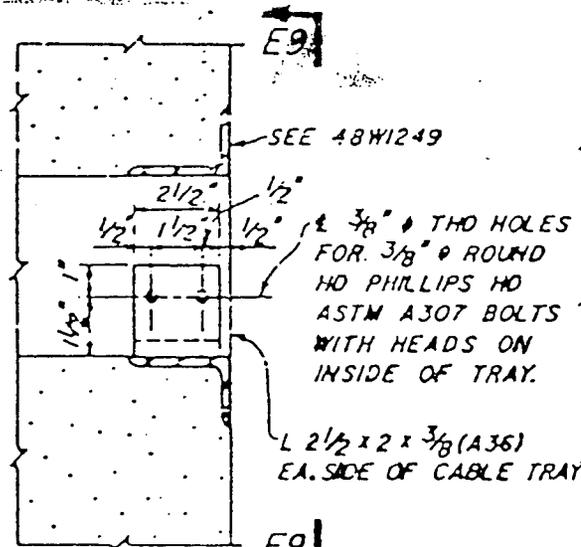
ALTERNATE CONCRETE ANCHOR DETAIL SCALE: 6" = 1'-0"



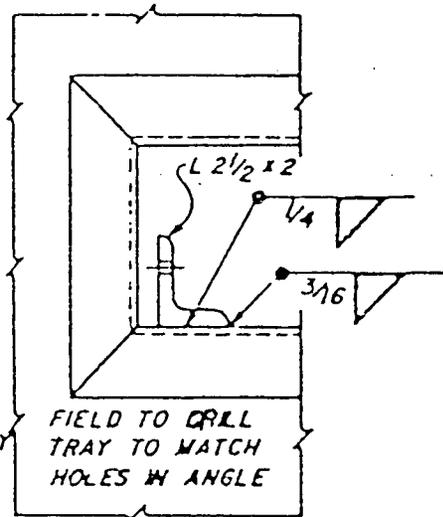
GI-GI SCALE: 1 1/2" = 1'-0"



ALTERNATE CORNER DETAIL SCALE: 3" = 1'-0"



ELEVATION



E9-E9

TYP HOLD DOWN CLIP DETAIL FOR WALL FRAME CONNECTIONS

SUBJECT PENETRATION SEAL TEST

PROJECT WBN

COMPUTED BY J. J. PIERCE

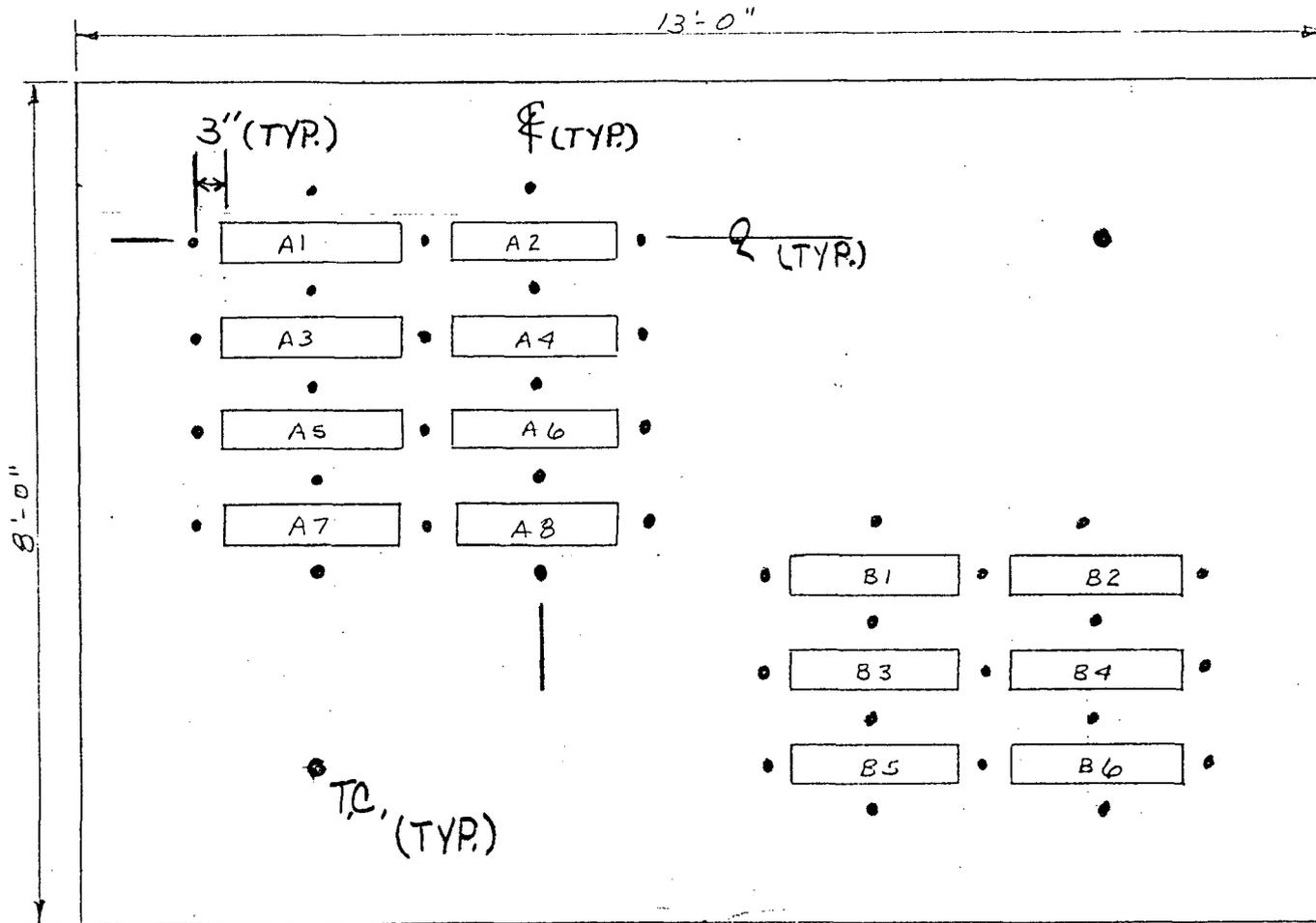
DATE 10/2/95

CHECKED BY [Signature]

DATE 10/2/95

Detail 6

ENGINEERING Thermocouples - Slab



PLAN VIEW

ENCLOSURE 3

COMMITMENT

1. TVA has agreed to perform additional penetration seal fire testing. The testing is being conducted to provide additional evidence that cable tray penetration seals will perform satisfactorily.

ENCLOSURE 1

Engineering Report
for
Penetration Seal Program Assessment