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FIRE TESTS OF FLOOR PENETRATION SEALS

TECH-SIL, INC. TEST #TS-TP-0004

G. E. Commerford

Project No. 03-4685-106

Prepared for

TECH-SIL INC.
Houston, Texas 77036

January 1977

Reviewed by: William R. Herrera

William R. Herrera
Manager
Fire Technology Section

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12/23/96

New York Power Authority

FIRE SEAL QUALIFICATION TESTS

INDIAN POINT UNIT # 3

9701030028

SUMMARY

Six cable penetrations installed by Tech-Sil, Inc. were exposed to a 3-hour fire endurance test following the ASTM E-119 time/temperature curve to determine their qualifications for NEL-PIA/MAERP acceptance. The specimens successfully withstood the required exposure.

CH-SIL

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DESCRIPTION OF THE TEST

A representative series of penetrations were installed in an 8 x 10-ft concrete slab 12 inches thick, and exposed for 3-hours on a horizontal furnace to an ASTM E-119 standard time/temperature curve. At the end of this period, the slab was lifted into a vertical position and given the required hose stream test. All temperatures were closely monitored throughout the test.

The results presented apply only to the specimens tested in accordance with NEL-PIA/MEARP fire test standards (including hose stream test requirements) using the same penetration seals fire tested for three hours and reflect performance in the manner tested. The specimens, test procedures, and test results are described in detail in the following paragraphs.

TEST SPECIMEN

(a) Construction of floor slab

A floor section 10 x 8 x 1-ft thick of reinforced concrete with various sized of openings was constructed, cast inside a welded frame built of 12-in. steel channels with 3-in flanges. Number 8 steel reinforcing bars (1-in. diameter) were located 3-in. from each surface as indicated in Figure 1 (represented by dashed lines). One inch diameter anchor bolts were installed in the slab at 2-ft centers along the center line of the channel frames to tie them into the concrete. The design was based upon the anticipated lifting and handling stresses.

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Cable tray and pipe supports were attached to the slab by 1/2-in. diameter by 6-in. long anchor bolts cast into the slab as shown on Figure 1. The slabs were poured on December 2, 1976 and cured for one week at about 400°F.

As shown by Figure 1, the following penetrations were cast into the concrete:

48 in. x 48 in .....(cable tray penetration)

two 6-in. aluminum conduit sleeves .....(cable penetrations)

two 10-in. I. D. steel pipe sleeves.....(for pipes with boot seals)

one 3-in x 36-in. slot.....(simulated seismic gap)

The pipe sleeves extended 3-in. from each surface in the slab. The conduit sleeves were aluminum and mounted flush with both surfaces of the slab.

(b) Cable penetration supports

When the concrete had cured, and the forms stripped away, angle iron cable tray supports were attached using the cast-in-place anchor bolts. The cable trays and pipe penetrations were then welded in place to the supports as follows:

48 x 48-in. penetrations....four 18-in. wide open ladder back cable trays

four 18-in. wide solid back cable trays

two 10-in. I. D. sleeve penetrations....two 6-in. schedule 40 pipes

Each cable tray extended 12-in. below what would later be the exposed surface of the slab during the fire test and 36-in. above the slab

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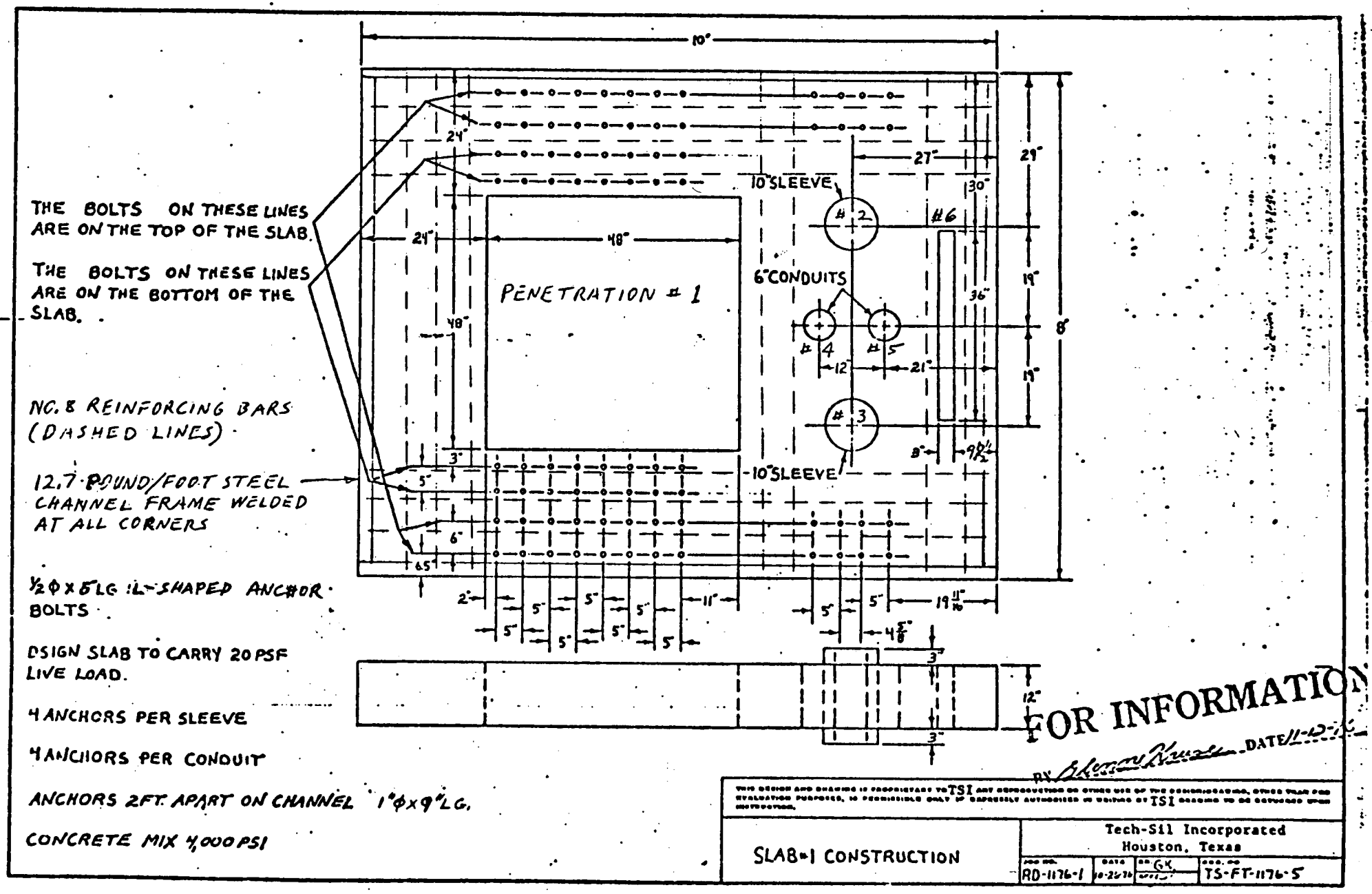

FIGURE 1. DETAILS OF SLAB NO. 1.

on the unexposed surface. The cable trays were anchored to angle iron supports on both the exposed and unexposed surfaces, but welded in place only on the unexposed surface of the slab. Mechanically, it represented part of a longer, continuous assembly.

All pipes extended 18-in. below the exposed surface on both slabs. They were capped at both ends to help stabilize furnace temperatures and to represent a long continuous pipe run. This also avoided any "heat sink" effect from having an open pipe end on the unexposed surface. The pipes were welded to supports on the unexposed surface. Unlike the cable tray penetration, the pipe penetrations were supported only on the unexposed surface, allowing the pipes to deflect. All pipes were slightly off center to simulate typical field-application conditions.

(c) Cable loading

The same cable loading was used for all 8 trays. It consisted of 5 bundles tied together with standard plastic electrical cable ties for the length of the tray. Each bundle consisted of six 250 MCM stranded conductors, nine 12 AWG seven conductor cables and sixteen 14 AWG two conductor wires. All conductor and cable insulation was PVC plastic.

The cable was placed in the trays using adjustable stainless steel hose clamps mounted approximately 6 to 8 inches from the top end at the unexposed surface. A large continuous clamp was placed around the ends at the exposed surface side, representing the bunching of longer cable runs.

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Bundles of cables were also installed through the aluminum conduit sleeves. These extended 6-in. from the exposed surface, 18-in. above the unexposed surface and were clamped to the pipe support brackets on the unexposed surface. Each conduit sleeve held three 250 MCM stranded conductors, nine 12 AWG seven conductor cables and six 14 AWG two conductor wires.

(d) Sealing the penetrations

The 48 in. x 48in. opening and cable tray assemblies were filled using the following materials identified by Tech-Sil, Inc. part numbers.

#TS-MS-009 Silicone foam
#TS-MS-0013 Blanket damming material
#TS-MS-0014 Board damming material
#TS-MS-0016 Loose fiber damming material
#TS-MS-0025 Damming anchors

A one-inch dam consisting of parts 0013, 0014, and 0016 was first installed flush with the exposed surface of each slab. The board material was used to fill large open spaces around the trays, while the blanket and fiber materials were used to pack into spaces, trays, and between pieces of the board material. It should be noted that the loose fiber material varied in thickness from one to two inches in places due to the inaccessibility of the cable trays. It might also be noted that, as a result of this limited access to the trays, there were some areas with less than the minimum of one inch of fiber material providing the dam. When all damming material was in place, "L" shaped anchors were inserted through the dam with one anchor for every 36 square inches

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of material. A 10-inch layer of silicone foam was then formed in place over the damming material and between the cables and cable trays.

Note: All silicone products (i.e., foams, and elastomers) were allowed to cure for 24 hours. However, due to adverse environmental conditions during application and cure (temperatures ranging from 35°F-60°F, high humidity and rain) shrinkage of the silicone foam was evidenced in the large cable tray penetration by gaps around the interface between the concrete and foam, and between foam and cables. The shrinkage varied from a minimum of 1/8-in. to as much as 1/4-in. The shrinkage existed for the depth of the penetration seal.

Repairs were made as best possible by forcing additional foam into the crevices.

For penetration #2 (Slab #1) insulated 6-in. schedule 40 pipe inside a 10-in I.D. sleeve (boot penetration over an insulated pipe), the following materials were used:

#TS-MS-0001 Silicone adhesive
#TS-MS-0016 Loose fiber material
#TS-MS-0024 Silicone sponge rubber
#TS-MS-0032 Insulation cover
#TS-MS-0037 Boot material
#TS-MS-0027 Insulation cement
1/2-in. thick magnesia pipe insulation

First, magnesia pipe insulation was installed on pipe. The portion that passed through the sleeve was removed, made 1/2-in. shorter and replaced using #0027 insulation cement. A 1/4-in. gasket of #0024 silicone sponge rubber was placed in each gap left from shortening the insulation. Next, #0032 insulation covers were mounted and clamped over the replaced insulation. A piece of the pipe insulation was removed near the exposed end of the pipe and a "boot" seal was then attached to

the pipe and sleeve. The lower boot was completed cementing the pipe insulation back into place adjacent to the boot seal. Next, a 10-in. thick fire barrier consisting of #0016 was stuffed into the sleeve approximately centered in the floor slab. The seal was completed by the addition of another boot seal on the unexposed surface.

A similar approach was used on penetration #3 (Slab #1) 6-in. schedule 40 pipe inside a 10-in. I. D. sleeve ("boot"-type penetration seal). The materials used for this penetration seal were as follows:

#TS-MS-001 Silicone adhesive
#TS-MS-0006 Silicone gel
#TS-MS-0013 Blanket damming material
#TS-MS-0016 Loose fiber damming material
#TS-MS-0029 Boot material

A one-inch thick piece of the board damming material was cut to fit in the annular space between the 10-in. sleeve and 6-in. pipe. This was put in place 3-in. inside the exposed end of the sleeve so that it was even with the concrete surface. Loose fiber material was stuffed into spaces between the board and pipes. Damming anchors were inserted through the board. An 8-in. thick layer of silicone foam was then injected into the annular space above the dam.

For the remaining two pipe penetrations (#4 and #5-Slab #1), 6-in. conduits sleeves the materials used to seal were as follows:

#TS-MS-0007 Silicone elastomer
#TS-MS-0009 Silicone foam
#TS-MS-0010 Loose fiber damming material

The loose fiber damming material was used to form a one-inch thick layer at the exposed surface of the slab. The fibers were packed around the cable bundle and between cables within the bundle. Penetration #4 was then filled with 7-in. of silicone foam and penetration #5 was filled with 5-in. of silicone elastomer.

At penetration #6 (Slab #1), the 3-in. x 36-in. simulated seismic gap, the materials used to seal this penetration were as follows:

#TS-MS-0001 Silicone adhesive
#TS-MS-0039 Premolded silicone foam

The foam was molded in sections 4 in x 4 in x 18 in. long. The sections were compressed to a 3-in. width and two pieces were inserted into the slot at both the exposed and unexposed surfaces of the slab. A silicone adhesive was applied to the adjoining ends of the foam. Each foam piece was 4-in. deep and they were installed flush with the concrete surface leaving an unfilled space approximately 4-in. deep at the center of the slab.

In sealing these six penetrations, all necessary Quality Assurance steps were carried out according to Tech-Sil, Inc. Quality Assurance manual, Section #VIII; "Test Control".

TEST FACILITY

The floor penetration seal fire resistance tests were conducted using a horizontal furnace with an open area 9 ft x 6 ft. Flue gas openings were provided on one end. Six Maxon self aspirating burners were mounted in the sides and end. Eight furnace temperature thermocouples were located 1-1/2 ft inside each side wall at 2-ft centers with the first pair of thermocouples 1-1/2 ft from the flue end of the furnace. These thermocouples and six unexposed thermocouples were connected to a multipoint temperature recorder with a range of 0-2,000°F, chart speed of one inch per minute and a print rate of 20 points per minute. Gas flow to the burners was controlled manually as indicated by the average of the furnace temperature thermocouple readings which were monitored at five minute intervals.

Since the tests were conducted out of doors, wind screens were erected around the furnace to meet ASTM E-119 standards. They were adequate to prevent excessive air currents over the unexposed surface of the test slabs. The smoke generated during the fire test moved upward in straight vertical columns until they reached the top of the wind screens, then gradually drifted away. Wind conditions during the tests were calm. The ambient air temperature at the unexposed surface of the slabs was approximately 50°F to 60°F.

TEST PROCEDURES

The prepared floor penetration slab with fire stop materials in

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place was placed in position on top of the furnace. The temperature multipoint recorder was turned on, natural gas was fed to the burners and ignited. The unexposed surface was continually observed for penetration by flame or hot gases and its temperature monitored on the multipoint recorder. At the completion of the 3-hour fire endurance test period, the fuel gas was shut off and, as quickly as possible, the floor panel was lifted from the furnace and into a vertical position. A hose stream from a 2-1/2 inch National Standard Playpipe with 1-1/8 inch tip and 30 psi nozzle pressure was then directed at the floor penetration fire stops from a distance of 20 feet. The required hose stream application time for a 9 x 6 ft exposed area was 82 seconds. The time/temperature record of the test is shown in Figure 2.

TEST RESULTS

Slab #1

All penetration seals remained intact during the three-hour fire test and subsequent hose stream test. Each is commented upon separately below.

(a) Penetration #1 (8 cable trays 48 in. x 48in. penetration

After the hose stream test, this penetration was observed to have all of the damming material in place with the exception of one 18-in. x 6-in. piece which became partially dislodged as a result of the hose stream test. The silicone foam had ablated leaving only 2 inches of resilient foam in the top center half of the penetration seal. Ablation

of the silicone foam was also observed on the unexposed surface around the cables. The ablation ranged from approximately 1 to 2 inches deep on the unexposed surface of the seal. During the fire test, no flame through or ignition of the cable jacketing was observed although during the second half of the test heavy smoke was evolved as a result of the cable jacketing being heated by conduction through the copper cables. A large percentage of the PVC cable jacketing swelled away from the cables for 4 to 6 inches above the unexposed surface of the penetration seal as a result of this heating. Temperatures of 330°F on the unexposed side were observed for 8 minutes before the conclusion of the test and smoldering of the cable insulation continued for several hours after the completion of the test. There was a brief ignition of the cable insulation during the time that the slab was being lifted from the furnace and moved to the hose stream test area. A light breeze was blowing at the time.

(b) Penetration #2 "boot" type seal on an insulated pipe:

The "boot" material on the exposed side was burned away and 2 to3 in. of the loose fiber damming material had fallen out during the test. The boot and the fire barrier were unaffected on the unexposed side.

(c) Penetration #3 "boot" type seal:

The "boot" material on the exposed side was burned away, but the loose fiber damming material inside the boot remained in place around the pipe and in the sleeve. As with Penetration #2, the unexposed "boot" and fire barrier were unaffected by the fire and had successfully passed

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the hose stream test.

(d) Penetration #4 and #5 Electrical Conduits (Sleeves):

The electrical insulation on Penetration #5 ignited on the unexposed surface of the slab 2-hours and 23-minutes into the test. This was quickly extinguished with CO_2, but again ignited at 2-hours and 40-minutes. Ignition was attributed to the heat from the furnace being conducted through the cables and possibly cables lying adjacent to the conduit (sleeve) may have been heated by the aluminum conduit. It should be noted that ignition was not a result of a flame through, but merely a result of heat conduction. All damming material remained in place during the fire and hose stream tests with minimal ablation of the silicone product observed.

(e) Pre-Molded Silicone Foam Strip (simulated seismic gap seal):

The premolded strip on the exposed surface had completely burned (ablated) away. However, the strip on the unexposed surface remained in place. The temperature on the unexposed surface was recorded to be 330°F during the last 10-minutes of the test which was the highest temperature recorded on the unexposed surface. The premolded strip on the unexposed surface remained resilient and under positive pressure after the hose stream test.

In summary, all penetration seals served their initial purpose of preventing fire and smoke from propagating through the penetration. Also, all seals successfully passed the hose stream test after being

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exposed to the ASTM E-119 time/temperature curve for three hours.

Color slides were taken during preparation, fire tests, hose stream tests, and post test observations and were submitted with this report.

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AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President and Chief Executive Officer

PROPERTY ENGINEERING DEPARTMENT
John J Carney, Vice President

January 10, 1984

Mr. Tom Hansen
Manager, Technical Operations
Tech-Sil, Inc.
9990 Richmond
Suite 106
Houston, Texas 77042

Dear Mr. Hansen:

Enclosed are two copies of the ANI/MAERP Cable and Pipe Penetration Fire Stop System Acceptance Form re-issued as requested for an additional two years which will replace acceptance form TS-TP-0004 and 0005 that has expired. This re-issued acceptance form is valid for two (2) years from the date issued and the holder of the acceptance should request that the form be re-issued at the end of the two year period.

The other expired acceptance forms and tests for review will be completed in the near future. If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

David Dalkowski

David Dalkowski
Project Engineer

DD:dm
Encl.

TECH·SIL, INC.
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Log No. 487
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MUTUAL ATOMIC ENERGY REINSURANCE POO

TS-TP-0004
TS-TP-0005

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS

TEST DATE: 12/22/76 & 4/29/77 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	48 x 48	10" Pipe Sleeve
Accepted for Floor	Yes	Yes
Accepted for Wall	Yes	Yes
Material	TS-MS-0009 Silicone Foam(Dow Corning RTV Silicone Foam, No. 3-6548) Density: 15-22 lbs./cu. ft.	Insulated pipe and boot type pipe seals using silicone adhesives, loose fibres, silicone sponge rubber, covers, boots, and silicone gel in various systems. Leaded Foam TS-MS-00-150 & 250 (Density 150 & 250 lbs/cu. ft.
Fire Stop Thickness	Trays: 11" Arrangement (10" foam - 1" damming) Conduit: 10" foam - no damming or 9" Arrangement (8" foam - 1" damming)	Lead Foam Thickness: 12" minimum
Form Material	TS-MS-0013, Blanket Damming: TS-MS-0014, Board Damming; TS-MS-0016, Loose Fiber Damming; and TS-MS-0025, Damming Anchors	

SPECIAL LIMITATIONS

Tray Types: Open Ladder - Solid Bottom Cable Construction: No Limitations
% Cable Loading: 50% Tray, 50% Conduit Max. Conduit Sleeve Size: 6" Aluminum
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 January 10, 1984
Date Issued

John J. Carney

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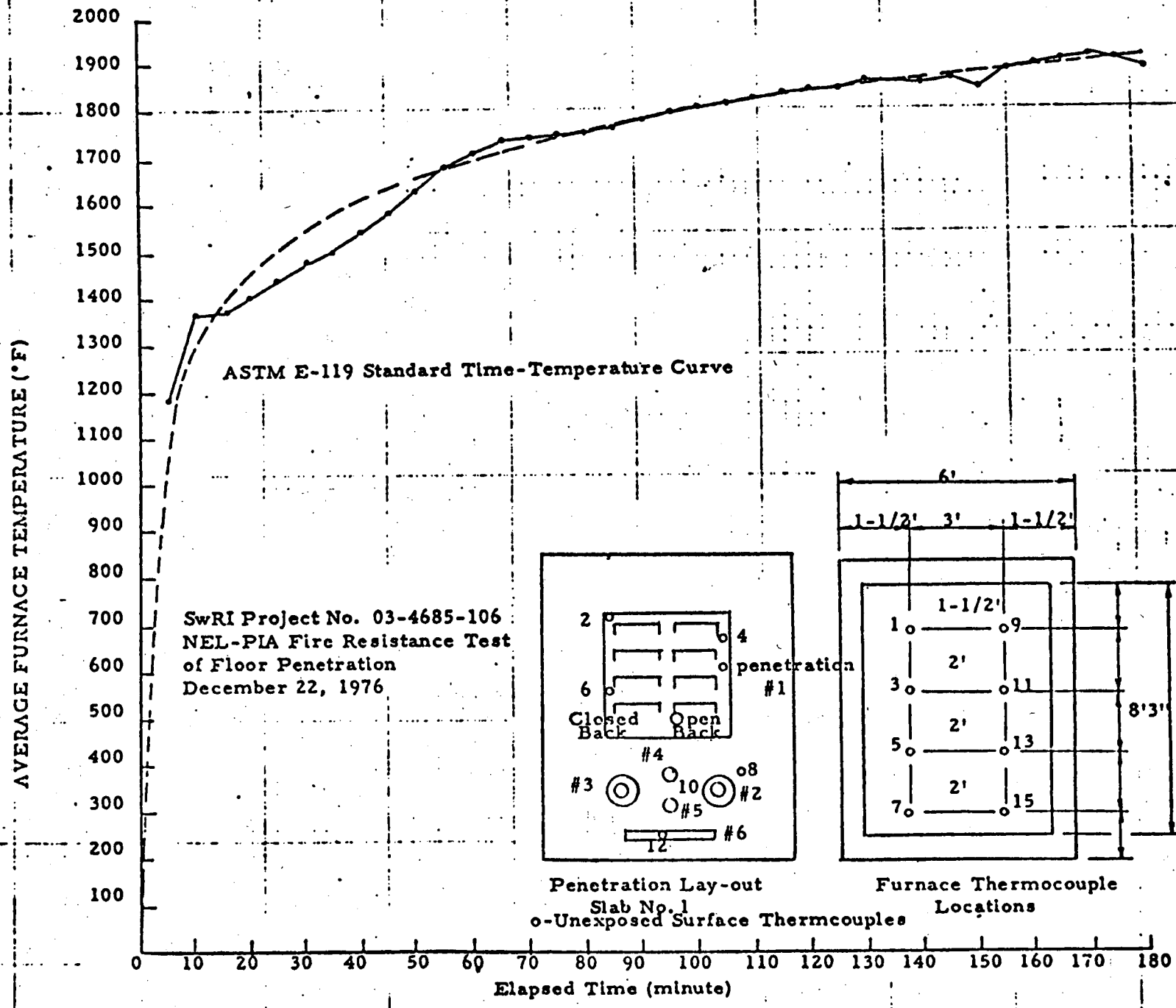
FIGURE 2: AVERA URNACE TEMPERATURE



Mr. Joseph N. Pallucci

-19a-

January 7, 1977

TECH-SIL, INC.

TECHNICAL OPERATIONS	DATE
FIELD OPERATIONS	DATE
QUALITY ASSURANCE	DATE
PRESIDENT	DATE

WITNESSED BY

TEST REPORT TS-TP-0004

Lester A. Eggleston, P.E.
Consultant

Fire Protection Research
Fire Protection Engineering
Hazards Evaluation

230 Montpelier Drive
San Antonio, Texas 78228
(512)734-0698

CERTIFICATION

To Whom It May Concern:

During the month of December, 1976, and particularly on the 20th, 21st, and 22nd, I observed the preparation for and testing of Tech-Sil penetration seals by Southwest Research Institute for NEL-PIA/MAERP qualification, following the basic ASTM E-119 3-hour time/temperature curve and procedures.

The test procedures complied in every respect with those required by NEL-PIA/MAERP, the seals passed without question, and it is my professional opinion that they qualified for acceptance and use.

Lester A. Eggleston

Lester A. Eggleston

LAE:sv

SEAL

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FIRE & HOSE STREAM TEST #TS-TP-0018

OF A SILICONE ELASTOMER SEAL IN AN ELECTRICAL PENETRATION

Conducted by TECH-SIL, Inc.
August 21, 1979 at Portland
Cement Association

BY: Gregory J. Jarosz

construction technology laboratories
a Division of the PORTLAND CEMENT ASSOCIATION

5420 Old Orchard Road, Skokie, Illinois 60077 • Area Code 312/966-6200

September 18, 1979

Mr. Gregory J. Jarosz
Tech-Sil, Inc.
2649 Greenleaf Avenue
Elk Grove Village, Illinois 60007

Dear Mr. Jarosz:

I have reviewed Tech-Sil, Inc., Test Report No. TS-TP-0018 entitled, "Fire and Hose-Stream Test of a Silicone Elastomer Seal in an Electrical Penetration."

The fire and hose-stream test referred to in this report was conducted at the Portland Cement Association's fire test facility on August 21, 1979.

The report describes accurately details of specimen fabrication, test procedures and observations during the test as well as test results.

Sincerely yours,

Melvin S. Abrams

Director
Fire Research Department

Melvin S. Abrams

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construction technology laboratories
a Division of the PORTLAND CEMENT ASSOCIATION
5420 Old Orchard Road, Skokie, Illinois 60077 • Phone 312/966-6200

February 23, 1981

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois 60007

Dear Mr. Jarosz:

I have reviewed Test Report Nos. TS-TP-0018, TS-TP-0024, TS-TP-0043, TS-TP-0048-C, TS-TP-0055-B, and TS-TP-0063. I have also reviewed forms TS-QA-5A attached to each of these reports.

The TS-QA-5A forms show that the silicone elastomer materials identified in the reports as TS-MS-0045, and TS-MS-0045-B are the same since they contain the same percentage of materials used to make up the silicone elastomer.

The percentages are elastomer, 68%, silica flour, 30%, and accelerator, 2%.

Sincerely yours,

Melvin S. Abrams
Director
Fire Research Department

Melvin S. Abrams

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W. G. Corley
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TS-TP-0018 & 0008A
TS-TP-0061

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
PORTLAND CEMENT ASSOCIATION
SKOKIE, ILLINOIS

TEST DATE: 7/19/78 and 8/21/79	HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	32" x 32" (with or without Steel liner)	2" Pipe (Capped) in 12" sleeve
Accepted for Floor	Yes	Yes
Accepted for Wall	Yes	Yes
Material	TS-MS-0045 or TS-MS-0045-B RTV Silicone Elastomer Density: 70-95 lbs./cu. ft.	TS-MS-0009 Silicone Foam (Dow corning RTV 3-6548 Density: 15-23 lbs./cu. ft.
Fire Stop Thickness	6" Silicone Elastomer	9" Arrangement (5" Foam & 2" Damming on both sides)
Form Material	Non-combustible forming material used and removed	Cera Form Board and Cerafiber

SPECIAL LIMITATIONS

Tray Types: solid bottom only Cable Construction: EPR/H Jacketed cable only
% Cable Loading: 50% Tray, 25% Conduit Max. Conduit Sleeve Size: 4"
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 January 11, 1984
Date Issued

J. J. Carney (REM)
John J. Carney

TECH-SIL INC.

I. Forward:

This final report describes the fabrication, test method and test results of a penetration seal specimen which was subjected to a three hour long ASTM E-119 time/temperature curve fire test and two subsequent hose stream tests. The seal specimen was prepared by TECH-SIL, Inc. which utilized cables donated by Cincinnati Gas and Electric Company, so that cable tray loadings seen in the Wm. H. Zimmer Nuclear Power Plant could be duplicated in the test. The test was conducted at Portland Cement Association's Fire Research Laboratory (Skokie, Illinois) on August 21, 1979.

The test fixture consisted of a thirty-two by thirty-two by twelve inch deep simulated penetration located in a forty-eight by forty-eight by twelve inch thick concrete test slab. Two surfaces of the test penetration were lined with quarter inch thick steel plate. The other two surfaces simulated cast concrete surfaces. It was the intent of the test procedure to demonstrate the effects of both types of substrates during the test.

The opening was penetrated by two twenty-four inch wide solid back steel cable trays. One tray (four inches deep) was filled with typical power cables. The other tray (six inches deep) was loaded with typical control cable as used in power generating facilities. Each tray (and cables within) was fifty-four inches long. They were anchored from steel braces located above the unexposed surface of the test slab so that twelve inches of the tray extended below the exposed surface of the test slab.

The opening was also penetrated by one ground cable, a two inch diameter PVC coated flexible conduit, and three-four inch diameter galvanized rigid steel conduits with couplings. The total length of each conduit/coupling assembly was approximately twelve inches long. Two of the conduits were mounted on the openings steel substrates so that the assemblies were flush with both surfaces of the test slab. The remaining conduit was anchored so that it extended six inches below the exposed surface of the test slab.

The penetration was sealed with TECH-SIL, Inc. #TS-MS-0045 RTV Silicone Elastomer. The seal was installed six inches deep and flush with the exposed surface of the test slab. The material was installed flush with the exposed surface to demonstrate a more severe condition of exposure than if the seal was installed farther from the source of the fire.

Each conduit was sealed with the silicone elastomer also. One conduit was sealed so that its seal was above the seal surrounding the conduit. One conduit was sealed so that its seal was flush with the seal surrounding the conduit. The remaining conduit was sealed so that its seal was below the seal surrounding the conduit. Each conduit was sealed with six inches of the silicone elastomer.

Locating the conduit seals at three different heights provided three different temperature effects. Naturally, the seal furthest from the source of the fire exhibited the lowest surface temperature during the test. However, these varying temperatures were used to demonstrate their effects on the seal surrounding the conduits. Normally, when conduits as such pass through a fire barrier, TECH-SIL would specify that both ends of the conduit be sealed. The seal surface temperatures shown for the conduits are not then necessarily realistic unless the plant has short sleeves passing through penetrations as demonstrated in the test (if there are two seals in a penetrating conduit and if such an arrangement were used for the test, than the temperature reading thermocouple would have been placed on top of the second seal and consequently be subjected to far less heat).

Permanent forming materials were not used in the test. The seals were installed in the penetration over a smooth board material which was later removed for the test. In essence, a symmetrical seal was produced which demonstrated the effects of a fire and hose stream on either side of a wall or floor penetration.

Since the penetration seal was tested at a point closest to the fire, and a symmetrical seal was used, and solid back trays which conduct more heat through the penetration than ladder back trays were used, the test was performed to qualify the seal configuration for use in either walls or floors, at any point within the wall or floor.

Besides monitoring the furnace atmosphere temperatures during the fire test, the silicone elastomer seal's surface temperatures were also monitored and documented. These thermocouples were laid out in a grid formation so that a cross section of surface temperatures could be obtained.

Thermocouples were also attached to both the metal conductor and jacket of each type of cable used in the test. These thermocouples were installed flush with the surrounding elastomer seal surfaces. The temperature data obtained from these cables was not to be made part of the pass-fail criteria of the test.

The penetration seal specimen was subjected to a three hour long ASTM E-119 time/temperature curve fire test. Immediately after the fire test, the specimen was removed from the test furnace and then subjected to a ASTM E-119 regulation type and period hose stream test. In order to qualify the seal to the IEEE 634-1978 Standard Cable Penetration Fire Stop Qualification Test, the seal specimen was subjected to a second, less severe spray type hose stream test.

Pass-fail criteria used in the test was as follows:

a. The test shall be conducted to the ASTM E-119 time/temperature curve fire test for three hours;

b. That fire shall not penetrate through the penetration seal during the fire test portion of the test;

c. That spontaneous combustion shall not occur on the unexposed surface of the penetration seal during the fire test due to heat conduction;

d. That transmission of heat through the penetration seal specimen shall not exceed 325°F above ambient temperatures during the fire test in order to qualify the seal to ANI's fire test standard for cable and pipe penetrations;

e. That transmission of heat through the penetration seal specimen shall not exceed 400° in order to qualify the seal to the IEEE 634-1978 test standard;

f. That furnace thermocouple location, type and interval of reading conform to the IEEE 634-1978 test standard;

g. That water shall not penetrate through the penetration seal during the regulation period and type ASTM E-119 hose stream test; and,

h. That water shall not penetrate through the penetration seal or dislodge the seal to create an opening during the regulation period and type IEEE 634-1978 hose stream test.

As shown in the results of this test, all of the above pass-fail criteria was successfully addressed.

II. Test Slab:

The test slab was fabricated by Portland Cement Association using the following materials:

Reinforcing Steel: All steel reinforcing bars used were ASTM designation: A615, Grade 60 steel with a minimum yield of 60,000 pounds per square inch.

Concrete: The concrete for this slab was made with sand and gravel from Elgin, Illinois. The aggregate is predominately dolomitic. The sand has a specific gravity of 2.67, an absorption of 1.7% and fineness moculus of 2.80. For the gravel, the specific gravity was 2.67 and absorption was 2%.

The concrete was mixed by Portland Cement Association at their fire research laboratory. Tests for concrete slump and air content were performed by their personnel. The properties of plastic concrete and strength information are given as:

Type: . . . . . Type I Portland Cement

Average Slump, in.:. . . . 3½"

Average Air Content: . . . 4%

Average Fresh Unit
Weight: . . . . . 145 lbs./cu.ft.

Average Compressive
strength at 28 days: . . . 4000 psi

The slab was cast to the following dimensions:

slab: 48" x 48" x 12" (thick)
penetration: 32" x 32" x 12" (deep)

The penetration was cast on center of the slab.

Two sides of the penetration (at a right angle) consisted of quarter inch thick steel plate. The other two surfaces of the penetration consisted of cast concrete. Four reinforcing bar tangs protruded from the side of the slab for the purpose of attaching angle steel braces used for supporting the cable, trays, conduit cables & ground cable used in the test.

III. Penetrating Members:

The thirty-two by thirty-two inch test opening was penetrated by two cable trays, three rigid steel conduits, one-two inch diameter PVC coated flexible conduit and one bare ground cable.

Both cable trays were solid back steel trays manufactured by Huskey Company. Solid back trays were used for the test since they would conduct more heat through the seal specimen creating a more severe condition for the test. Also the solid back trays pose a more severe condition for installing the elastomer sealing material (since the tray is accessible from one side only, it is more difficult to install the elastomer between the cables and tray).

Both trays were cut fifty-four inches long for the test. The trays were bolted to steel braces located above the unexposed surface of the test slab. Each tray hung twelve inches below the exposed surface of the test slab. Thirty inches of tray extended above the unexposed surface of the test slab creating less of a heat sink effect than the allowed thirty-six inch high extension of the tray.

The cable tray used to contain the power cables for the test measured twenty-four inches wide by four inches deep. The large, heavy cables used here were bolted to the tray approximately twenty-four inches above the unexposed surface (the bolts extended through the cable and tray).

The cable tray used to contain the control cables in the test measured twenty-four inches wide by six inches deep. The cables used in this tray were clamped to the tray (with "U" bolts extending through the tray) approximately twenty-four inches above the unexposed surface of the test slab.

The ground cable used in the test was fabricated from a stripped 1/0 cable. This ground cable extended twelve inches below the exposed surface and was bolted to the steel braces used for suspending the cable trays. The simulated ground cable extended eighteen inches above the unexposed surface of the test slab.

Three-four inch diameter galvanized rigid steel conduits were also used as penetrating members. Each conduit (with couplings both end) measured approximately twelve inches long. The conduits were suspended from small pieces of angle steel welded on one of the penetration's steel substrate surfaces. Two of the conduits were mounted so that each conduit end was flush with outside surfaces of the test slab. The remaining conduit was mounted so that it extended six inches below the exposed surface of the test slab.

Besides the three-four inch diameter rigid steel conduits, one piece of PVC jacketed flexible conduit was used as a miscellaneous penetrating member. This two inch diameter flexible conduit extended twelve inches below the exposed surface of the test slab and eighteen inches above the unexposed surface of the slab. Whereas this is not a typical penetrating member, TECH-SIL wished to show its effect as a penetrating member on the surrounding seal.

The cables used in the power cable tray and control cable tray are as follows:

A. Control Cable Tray:

QTY.	TYPE	MAN.	V.	DIA.	JACKET
45	12/C-#12	Okonite & Anaconda	600V	1.0	EPR/H
16	10/C-#12	Okonite	600V	0.9	EPR/H
11	7/C-#12	Okonite	600V	0.7	EPR/H
17	2/C-#12	Okonite & Samuel Morris	600V	0.5	EPR/H
15	4/C-#10	Anaconda, Okonite & Samuel Morris	600V	0.7	EPR/H and EPR/SH
2	3/C-#16	Samuel Morris	600V	0.4	
1	3/C-19/22	Okonite	1 KV	0.7	EPR/H
8	4/C-#12	Okonite & Samuel Morris	600V	0.6	EPR/H

B. Power Cable Tray:

QTY.	TYPE	MAN.	V.	DIA.	JACKET
3	1/C-1/0		1 KV	0.6	EPR/H
3	3/C-500MCM		1 KV	2.6	EPR/H
5	3/C-19/22	Okonite	1 KV	0.7	EPR/H
5	3/C-#4		1 KV	1.3	EPR/H
1	3/C-#6		1 KV	1.0	EPR/H
3	3/C-1/0		1 KV	1.5	EPR/H
1	3/C-2/0		5 KV	2.2	HTK
2	3/C-3/0		1 KV	1.7	EPR/H
3	3/C-4/0		5 KV	2.4	HTK
1	4/C-1/0		1 KV	1.7	EPR/H

C. Conduit Cable Loading:

Each four inch diameter rigid steel conduit:

QTY.	TYPE	MAN.	V.	DIA.	JACKET
1	3/C-19/22	Okonite	1 KV	0.7	EPR/H
1	4/C-#12	Okonite	600V	0.6	EPR/H
1	3/C-#9	Okonite	1 KV	0.7	EPR/H

D. Flexible conduit cable loading:

QTY.	TYPE	MAN.	V.	DIA.	JACKET
1	3/C-19/22	Okonite	1 KV	0.7	EPR/H
1	4/C-#12	Okonite	600V	0.6	EPR/H

IV. Penetration Seal:

TECH-SIL, Inc. Part Number #TS-MS-0045 RTV Silicone Elastomer was used to seal the test penetration and conduits. In the thirty-two by thirty-two inch opening, the elastomer was installed six inches thick (not less than). The cables were only slightly spread to allow the elastomer to flow between the cables and seal the penetration. In some cases, where the cables were placed tightly within the tray, the elastomer did not completely penetrate between the cables.

The elastomer seal was installed so that it was flush with the exposed surface of the slab. By being flush with this surface, the seal was closest to the fire and at its most severe location. In normal installations, floor openings would be sealed flush with the top surface of the floor. However, by performing the test in this manner, the seal would be qualified for use at any position within a wall or floor.

The elastomer seal was tested without the use of permanent damming (forms) attached to either side of the seal. The test penetration seal was formed by using smooth boards and alumina-silica fibers (between the cables) which were later thoroughly removed before the test.

The penetration seal specimen was tested in such a manner to show the effects of the fire and hose stream on either side of the seal as used in a floor or wall type penetration.

The PVC jacketed flexible conduit was sealed with not less than six inches of the silicone elastomer material so that the seal was flush with the elastomer seal surrounding the conduit.

The four inch diameter rigid steel conduits were sealed at different levels to show the effects of the fire not only on the conduit seal, but also the different types of heat conduction emitted from the conduit and its effect on the seal surrounding the conduits.

One of the conduits was sealed with six inches of the elastomer so that its seal was flush with the seal surrounding the conduit. One conduit was sealed with the elastomer so that the conduit seal was located above the seal surrounding the conduit. Its seal's exposed surface was flush with the surrounding seal's unexposed surface. The remaining four inch diameter rigid steel conduit was sealed so that its seal was located below the seal surrounding the conduit. This conduit seal's unexposed surface was flush with the exposed seal surface of the seal surrounding the conduit. As a result, three different temperature effects were shown on these seals.

The seal was installed by TECH-SIL, Inc. personnel. The seal was later inspected by TECH-SIL QA/QC personnel who documented the acceptance of the seal installation.

V. Thermocouples:

Thermocouples were utilized during the test to monitor the furnace atmosphere temperature, seal surface temperature, and cable temperatures.

Three porcelain encapsulated thermocouples are permanently mounted in Portland Cement Association's small fire test furnace so that their exposed length and distance from the test slab is not less than twelve inches. Using the three thermocouples, temperatures of the furnace atmosphere are able to be documented at least once every five minutes.

Seven seal surface thermocouples were utilized for this test. They were installed on the seal's surface in a near perfect grid formation. Part of this grid formation was interrupted in the area where the conduits penetrated the seal. Thermocouples were not installed on this section of the seal (between the conduits and cable tray). Each surface thermocouple's interface contact was covered by a four by four by one eighth inch thick asbestos pad which was cut to fit between the trays, substrate, etc. Each pad was weighted down so that complete contact of the thermocouple with the seal surface was possible.

Surface thermocouples were attached to the four inch diameter steel conduit's seals also. Where the conduit was sealed above the conduit's surrounding seal, the surface thermocouple was mounted in an area approximately one by two inch wide which was not interrupted by cables. This thermocouple/surface interface was covered by an asbestos pad which was cut to fit the seal surface. This pad was weighted to insure a true surface temperature reading. Where the conduit seal was below the seal surrounding the conduit, the thermocouple was placed in a two by two inch free area. Since an asbestos pad could not be fit into the conduit, a flexible mineral wool pad was used to cover the thermocouple/seal surface interface. This pad was also weighted. The same type of thermocouple arrangement was used inside of the conduit where the seal was installed flush with the seal surrounding the conduit.

Although cable temperatures were not made part of this test's pass-fail criteria, thermocouples were installed on both cable conductors and jackets used in the test. One cable of each size in each tray was selected for thermocouple attachment. One thermocouple was attached to the conductor of each of these cables. This was done by slitting the cable jacket, slightly spreading the stranded conductor, attaching the thermocouple between the strands and then closing the jacket. The thermocouple was then held in place with nylon tape from the outside of the jacket. The jacket thermocouple was attached to the cable by simply taping the thermocouple to the jacket. The tip of the thermocouple was covered with three to four layers of Scotch Brand Nylon tape. Additional asbestos insulation was not used over these jacket thermocouples since it was felt that the nylon tape would protect the thermocouple from reading a combined jacket and ambient air temperature and secondly, we believe that a false reading as to the true jacket temperature would be obtained if normal heat dissipation was not allowed. These cable thermocouples were located flush with the seal's surface. Only one cable type from each conduit was selected for thermocouple attachment.

It should be noted that by covering the seal surface with as many asbestos pads as were used in the test, that lower seal surface temperature would most likely occur without the pads. The requirement of these pads evolved from the ASTM E-119 test standard for testing concrete slabs where greater heat dissipation is allowed by the large uninterrupted slab. However, this was a below slab surface penetration seal which was congested by many sources of furnace heat conduction. A large percentage of the free seal surface which would be used for heat dissipation during a fire was insulated, trapping the furnace heat, as a result of using the asbestos pads. This is expecially true in the case of the conduit seals where an area greater than fifty percent was covered with this insulation for the thermocouple/surface interface.

VI. Test Facility:

Portland Cement Association's small slab furnace is located inside of their Fire Research Building. The building is virutally draft free except for the main exhaus system which vents smoke and fumes from the top of the building. The inside ambient air temperatures during the test varied from 77-82°F (87% relative humidity).

The furnace is simply a forty-eight by forty-eight inch wide by forty-eight inch tall steel box with a fire box which measures approximately thirty-two (-thirty-three) by thirty-two (-thirty-three) by thirty-two inches. The furnace utilizes a draft which is located on center at the bottom of the fire chamber. The furnace is heated by four automatic self igniting burners which are located one on each side of the furnace. Inside of the furnace are three porcelain jacketed thermocouples mounted twelve inches below the top of the furnace.

The furnace atmosphere temperatures and drafts are controlled automatically from a central control room. Depending upon the fuel loading of the specimen, temperatures and drafts are sometimes controlled semi-manually to meet the time/temperature curve.

The furnace temperature is automatically documented at least once every five minutes by two separate machines. One instrument which monitors the furnace atmosphere utilizes a continuous circular strip chart while the other instrument prints separate furnace thermocouple readings and supplies this information in the form of a curve.

Separate thermocouples located on the seal's surface and attached to the cables were documented once every three minutes. Each thermocouple's information was printed separately in easy to read curves.

VII. Test Procedure:

The purpose of this test was to subject the seal specimen to the ASTM E-119 time/temperature curve for a three hour duration. After the fire test, the slab would be immediately removed from the furnace, flipped on its side and taken out of doors for two separate hose stream tests. The first hose stream test would be conducted to the ASTM E-119 test standard. The second hose stream test would be performed according to the IEEE 634-1978 test standard.

VIII. Test Record:

The test began at approximately 10:15 am. Thermocouple documenting instruments began to print out ambient temperatures and then began to document the test results. As the fire test began, flaming was observed inside of the furnace (via small windows located on the sides of the furnace). All four burners began to heat the furnace with an even blanket of flame. Since there was so much additional fuel contribution as the result of the heavily loaded cable trays, the furnace atmosphere temperatures had to be controlled manually during the initial minutes of the fire test. Within the first four minutes of the test, smoke appeared coming from the flexible conduit. This smoke persisted during most of the test. After the first fifteen minutes of the test, the furnace draft was stabilized at a.08 inches of water negative pressure differential. Within the first hour of the test, smoke appeared from the conduit where the conduit seal was located below the seal surrounding the conduit. Most of the smoke generation during the test was slight and did not obscure visual contact with any of the components of the test assembly. After two hours, a slight stream of smoke appeared to be coming from the power cable tray. This smoke slowly increased until the fire test was concluded. After the two hour mark, a few of the cable jackets began to expand and snap. It was noted after the test that these cable jackets were mostly contained in the power cable tray and that the snapping only produced several small tears in the cable jackets.

After the regulation period fire test, the slab was lifted from the furnace, placed on its side and wheeled out of doors for the two hose stream tests.

IX. Hose Stream Tests:

The first hose stream test was performed according to the ASTM E-119 test standard. Water was sprayed on the seal specimen for twenty-four seconds using a solid stream of water discharged from a two and half inch diameter hose through a one and an eighth inch diameter National Playpipe Nozzle at thirty psi from a distance of twenty feet.

The second hose stream was performed according to the IEEE 634-1978 test standard. Water was sprayed onto the test specimen for a period of twenty-four seconds using an even spray discharged from a one and a half inch diameter hose through a 30-90° set at 30° high velocity spray nozzle at seventy-five psi from a distance of ten feet.

X. Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the fire test, fire did not occur on the unexposed surface as a result of heat conduction.

D. For the duration of the test, the surface temperatures of the penetration seal did not exceed 240°F.

E. For the duration of the test, the conduit seal surface temperatures performed as follows:

i. Seal above surface: . . . . . 235°F
ii. Seal below surface: . . . . . 945°F
iii. Seal flush with surface: . .470°F

F. That during the fire test, only slight smoke generation was observed caused by the heating of the cable jackets.

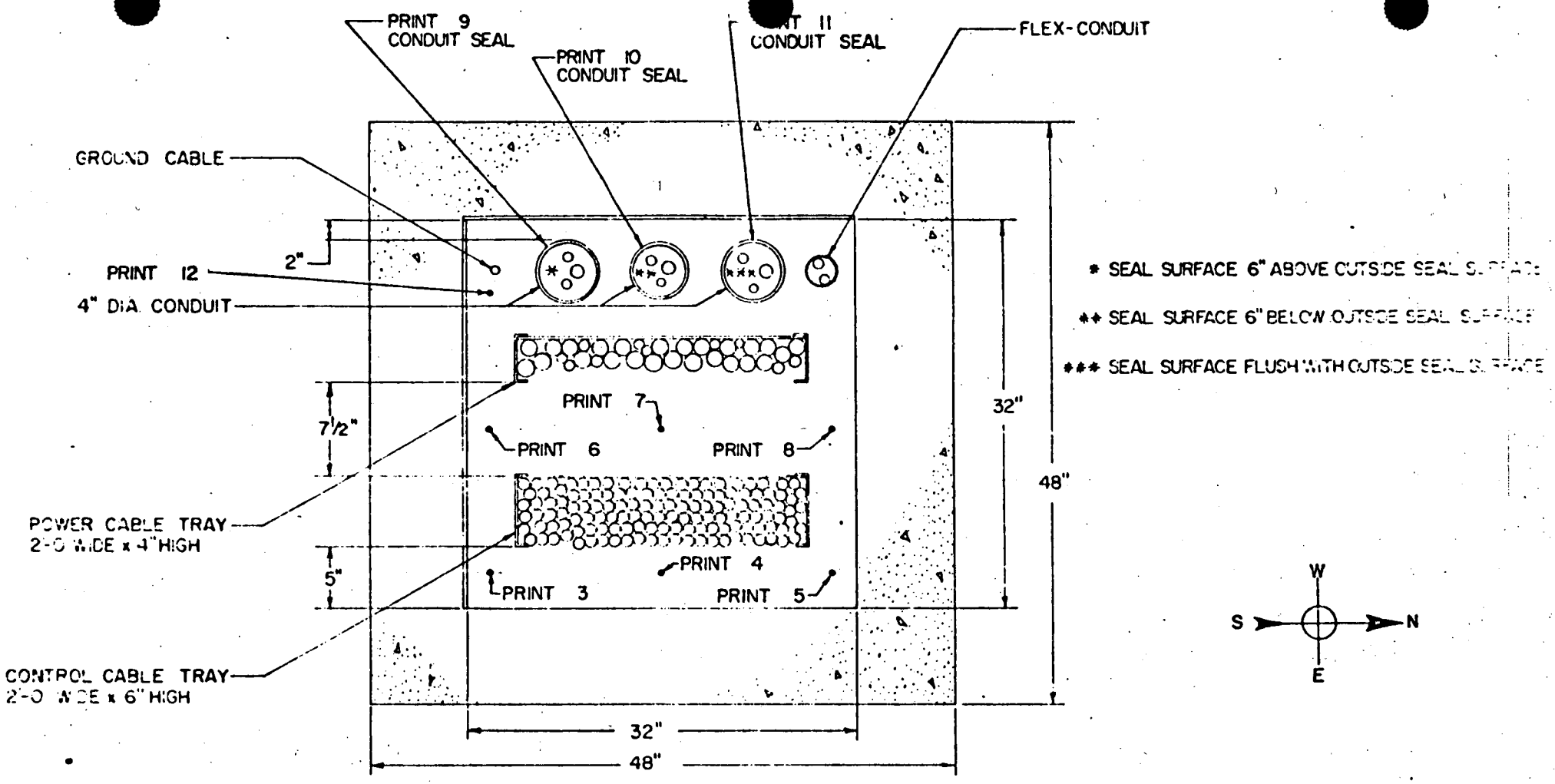
G. That during the ASTM E-119 hose stream test, water did not penetrate through the penetration seal, or cause any portion of the seal (including the exposed char layer) to become dislodged.

H. That during the IEEE 634-1978 hose stream test, water did not penetrate through the penetration seal, or cause any portion of the seal (including the exposed char layer) to become dislodged.

XII. Post Test Observations:

It was noted after the test that a two and a half inch to three inch thick char layer had formed on the exposed surface of the test seal. This char layer was approximately four to four and half inches thick between the cables. The char layer was extremely hard and had to be removed with a hammer/pick. Above the char layer, the material appeared to be useful and still resilient.

The conduit seal below the seal surface surrounding the conduit sustained more dammage. The conduit walls outside of the seal which were subject to direct flame impingment conducted most of the damaging heat into the elastomer seal. It was noted that approximately one inch of useful material remained intact inside of the conduit.



DRAWING RELEASE RECORD				
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			CK	APP
			BY	CK
			CK	CK
			CK	APP
			BY	CK
			CK	CK
			CK	APP

TEST NO. TS-TP-0018

BY DGJ 8/27/79

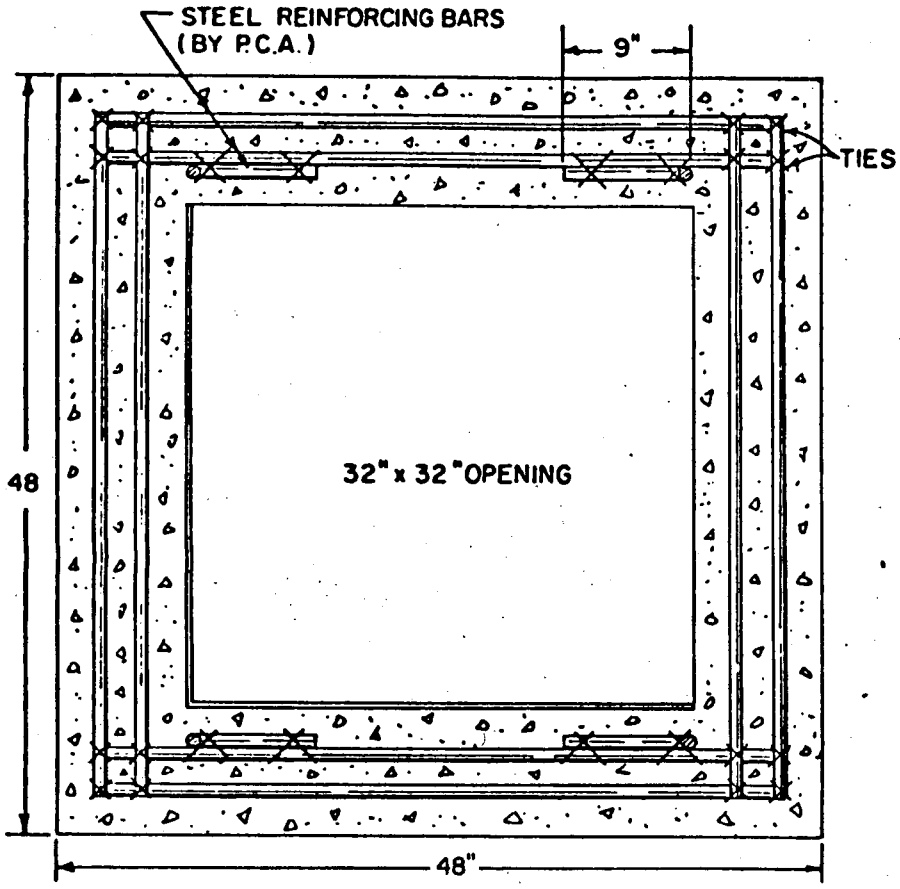
CK'D

APP

Tech-Sil, inc.

DRAWING NO

N/A



SECTION B-B

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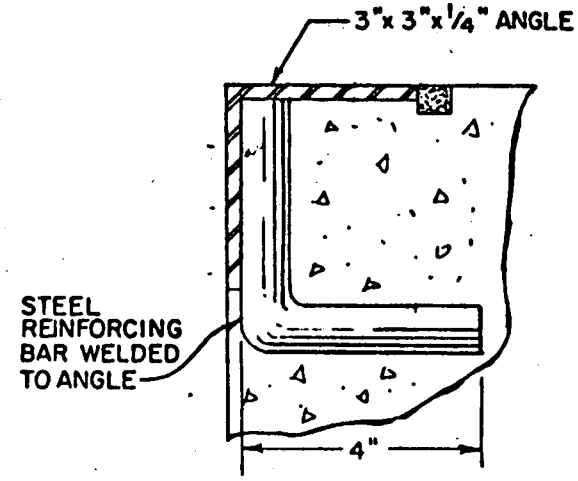

SECTION C-C

SCALE: NONE

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			BY	CK	BY M.K. 3/2/79
			CK	CK	—
			CK	APP.	CK'D
			BY	CK	TH 3/5/79
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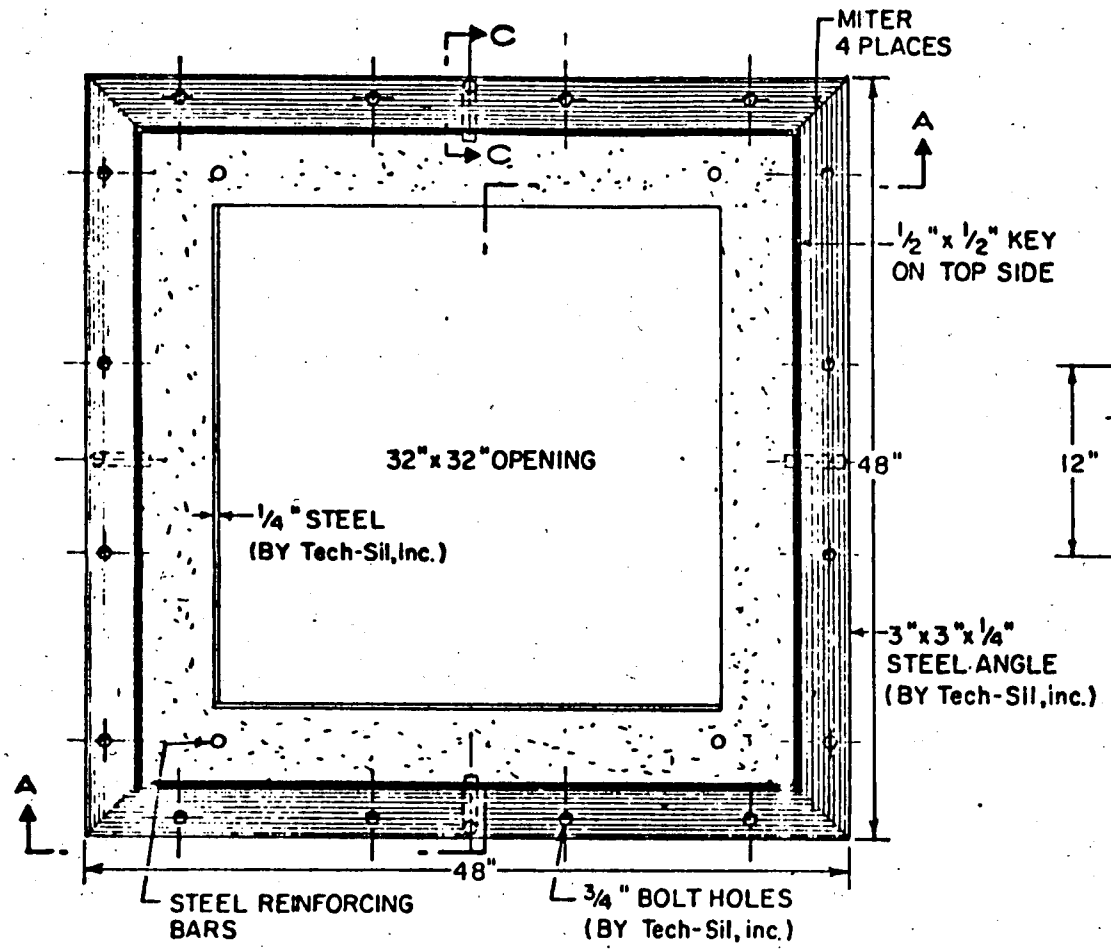
			CK	APP	

Tech-Sil, inc.

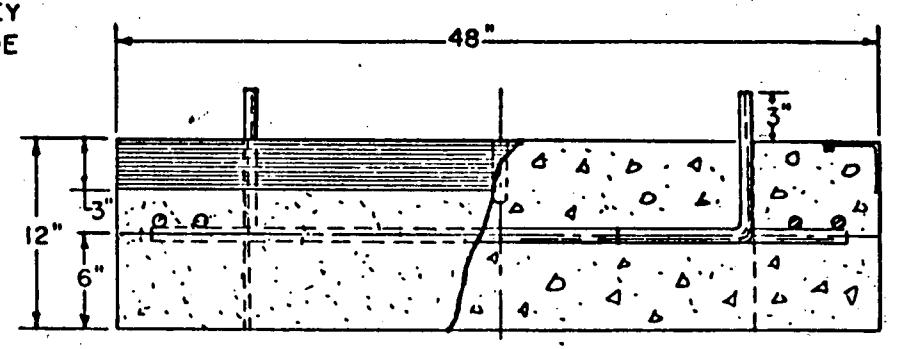
DRAWING NO. TS-TP-0018

SHEET



PLAN

SCALE: 1/8" = 1"



SECTION A-A

SCALE: 1/8" = 1"

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			CK TH	APP. J.P.	
			BY	CK	BY M.K. 3/2/79 — —
			CK	CK	CK'D GT 3/4/79 TH 3/5/79
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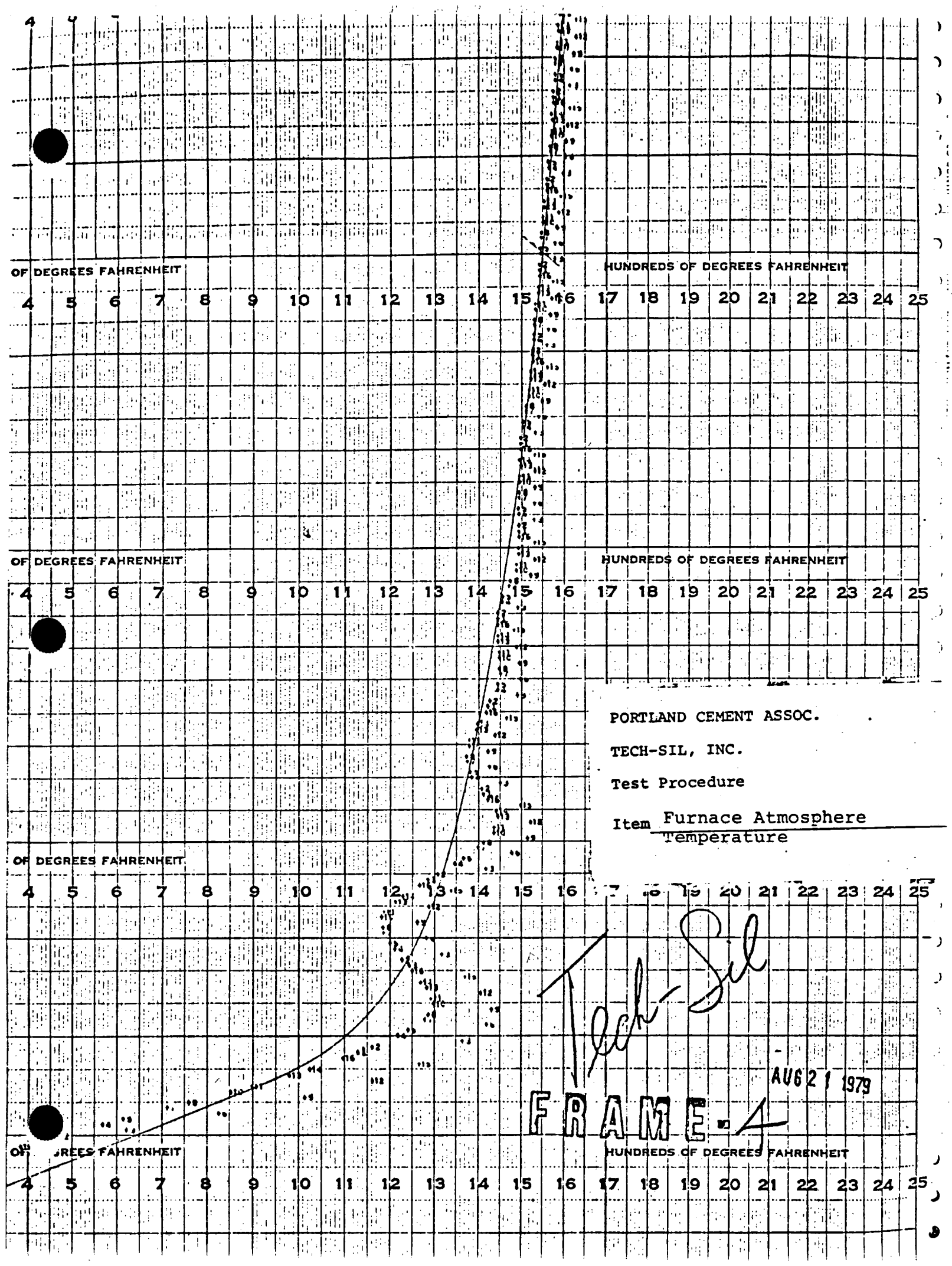
			BY	CK	Tech-Sil, inc.
			CK	CK	DRAWING NO. TS-TP-0018
			CK	APP.	SHEET 1


OF DEGREES FAHRENHEIT
HUNDREDS OF DEGREES FAHRENHEIT
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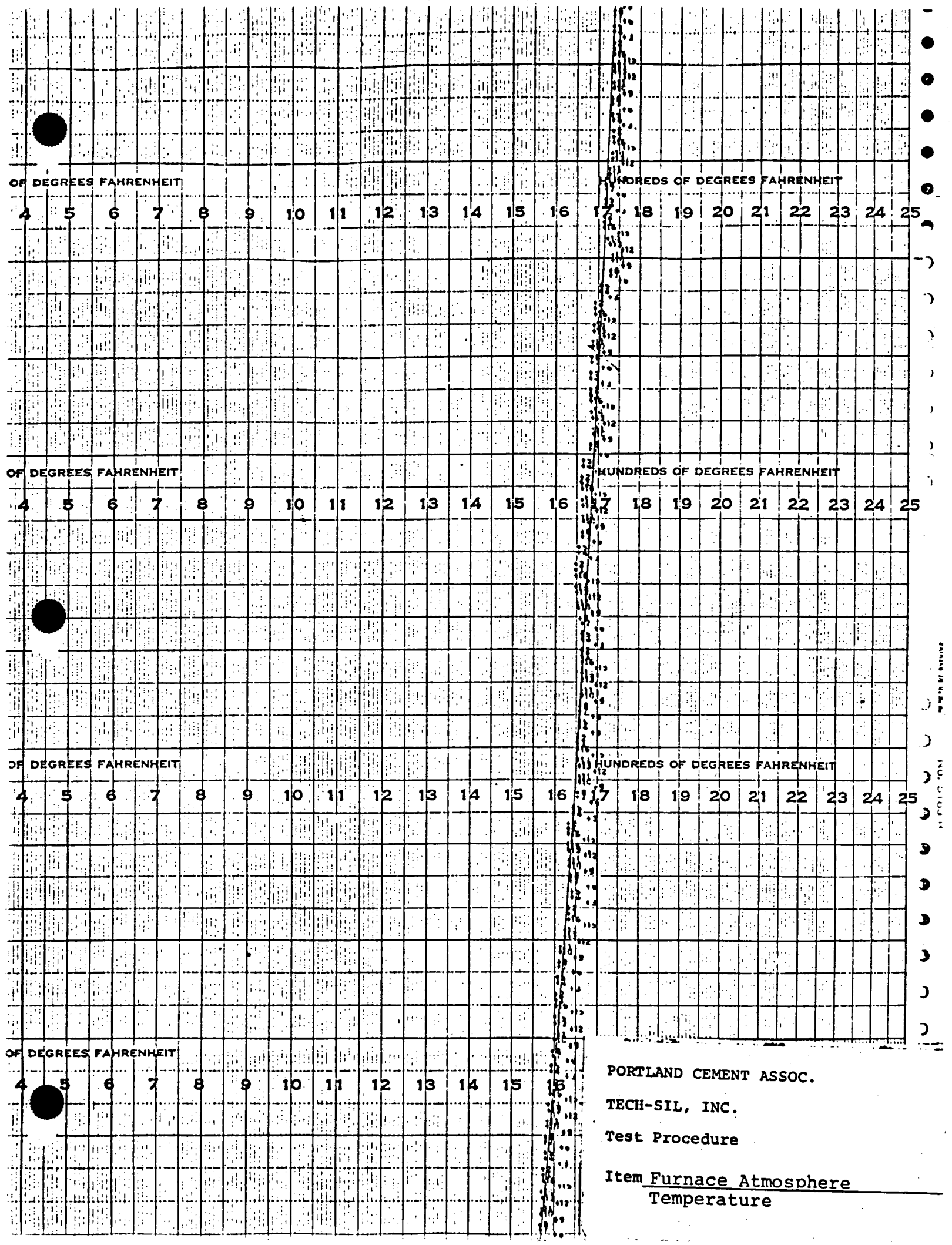
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item Furnace Atmosphere Temperature
Tech-Sil
AUG 21 1979
FRAME 4

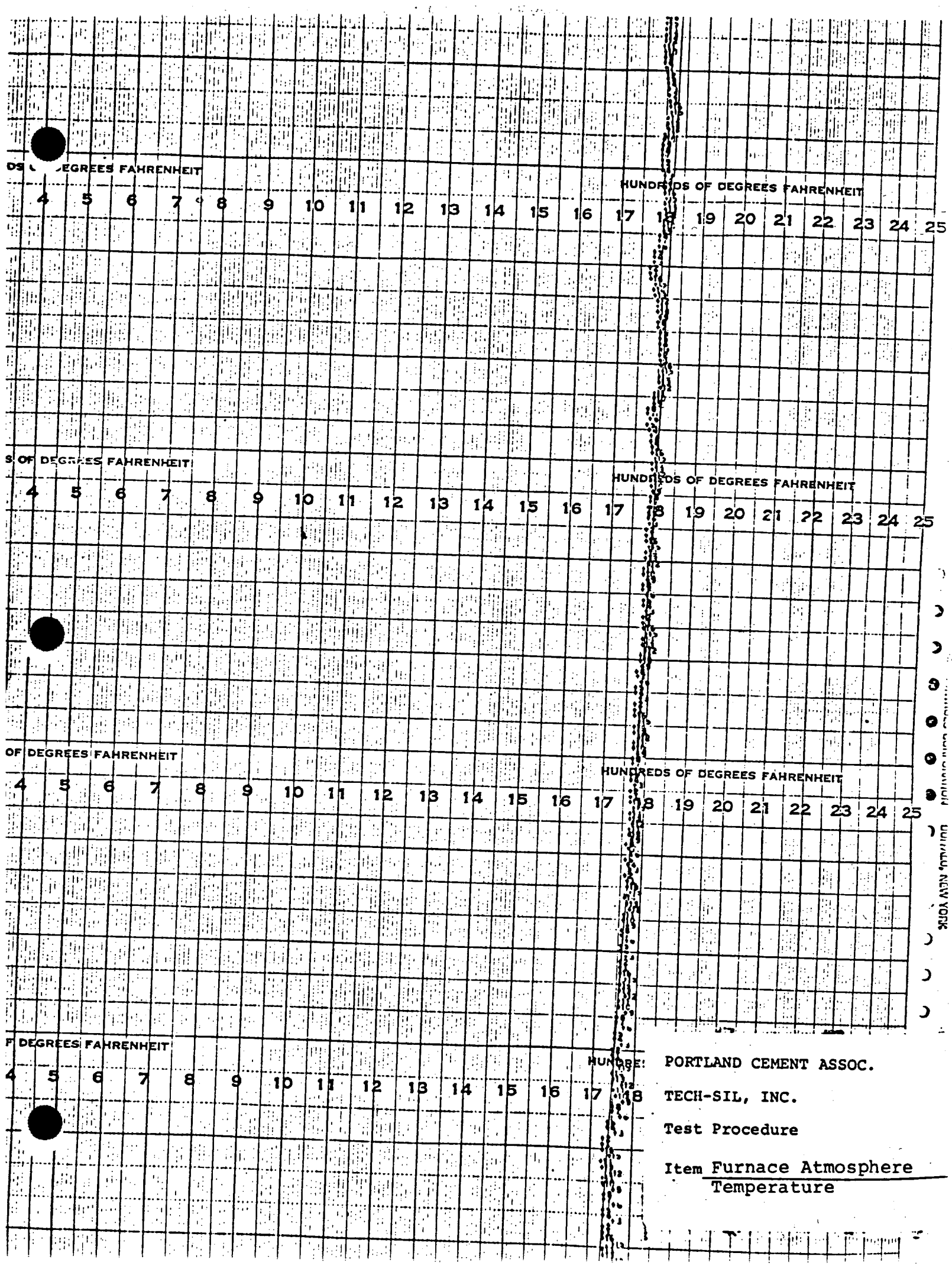


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Furnace Atmosphere Temperature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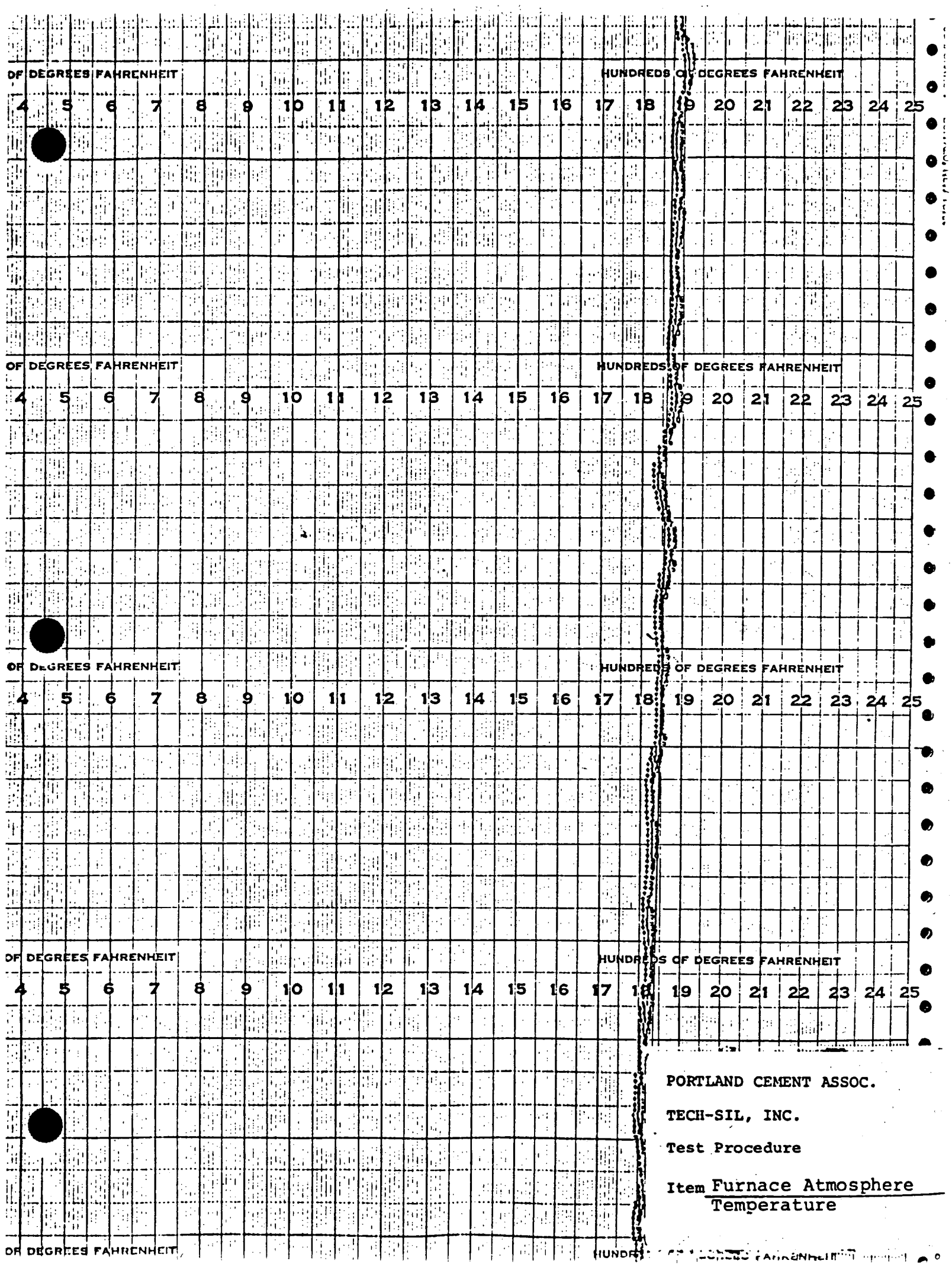
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item Furnace Atmosphere Temperature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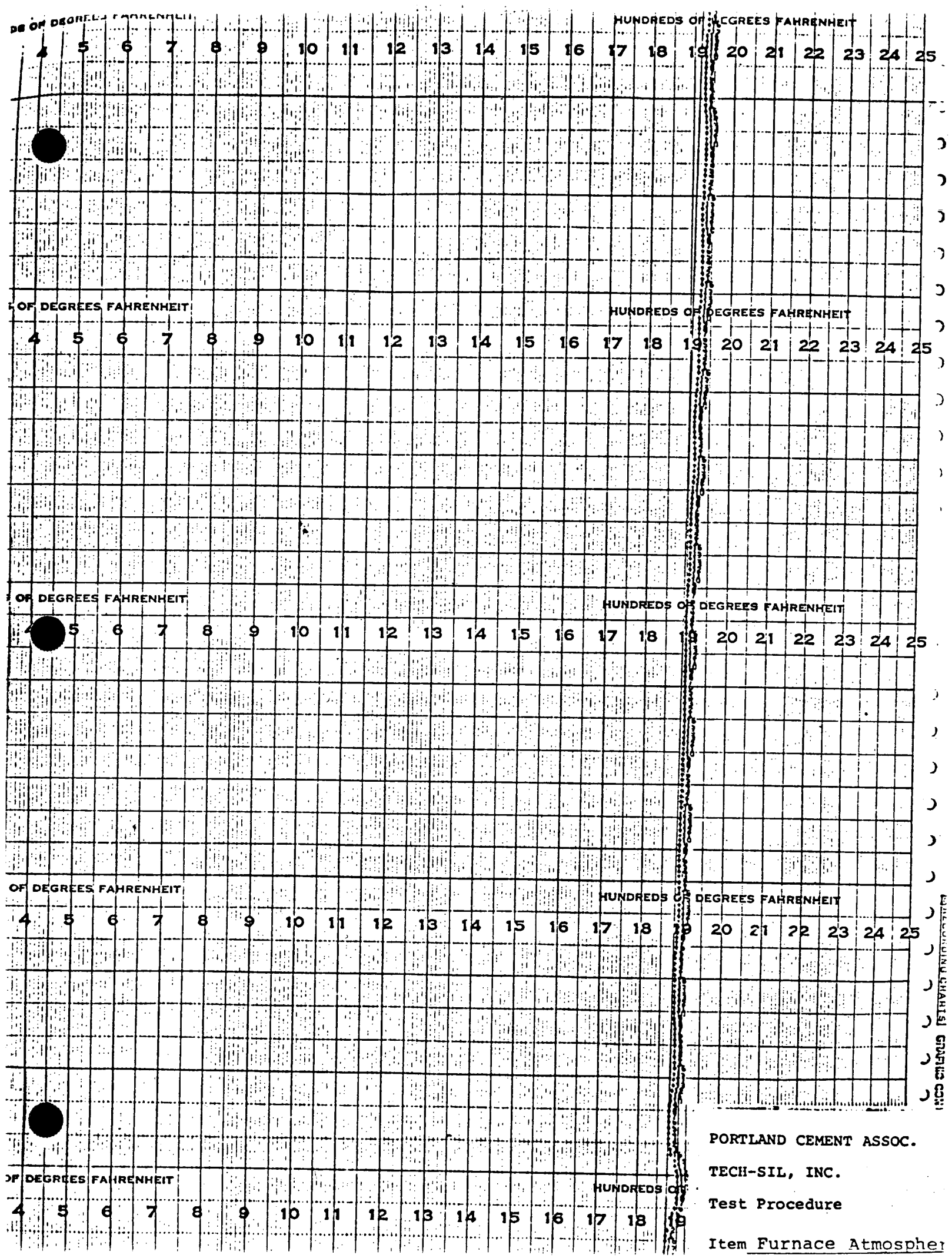
OF DEGREES FAHRENHEIT
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item Furnace Atmosphere Temperature

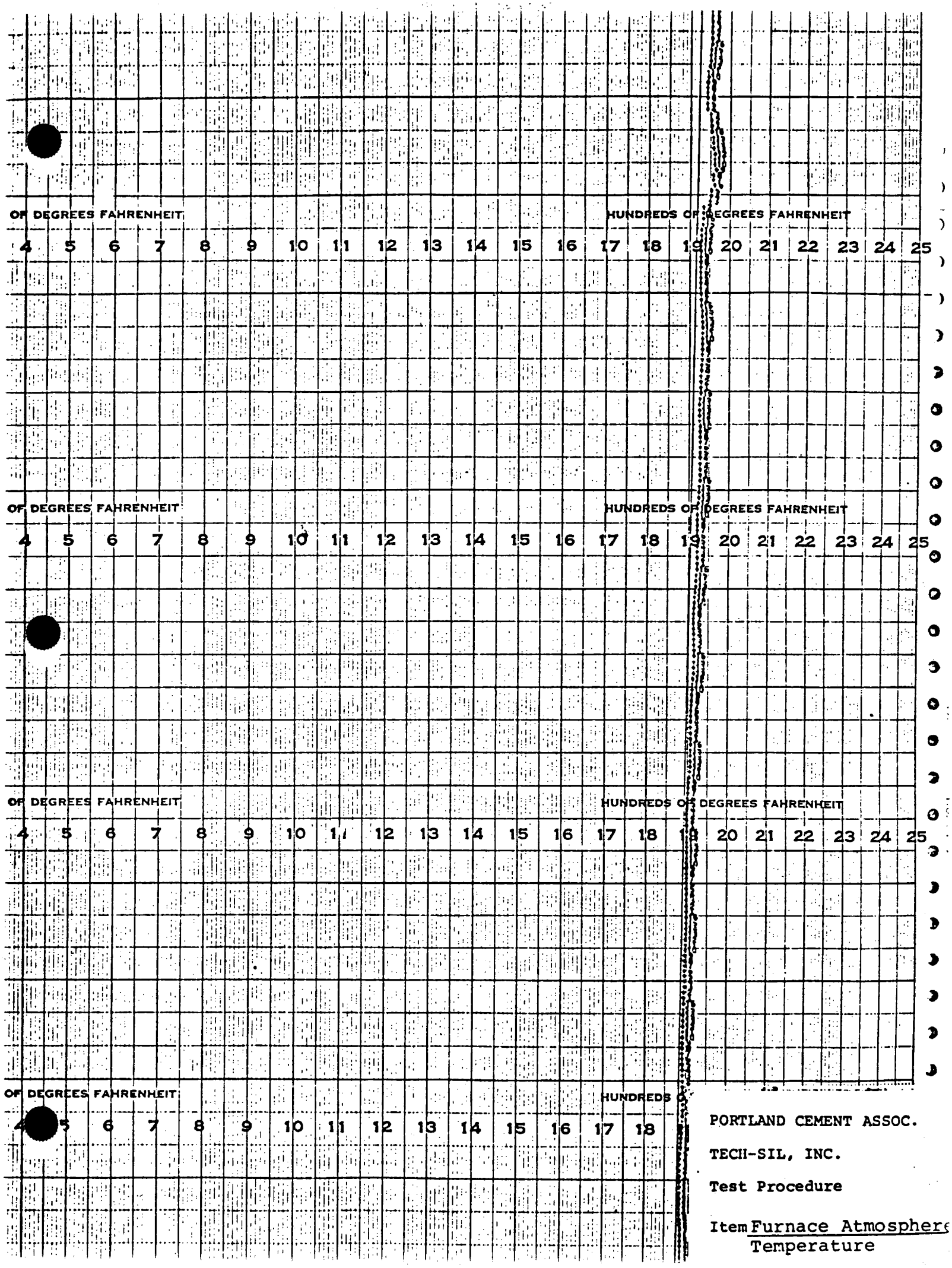


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Furnace Atmosphe

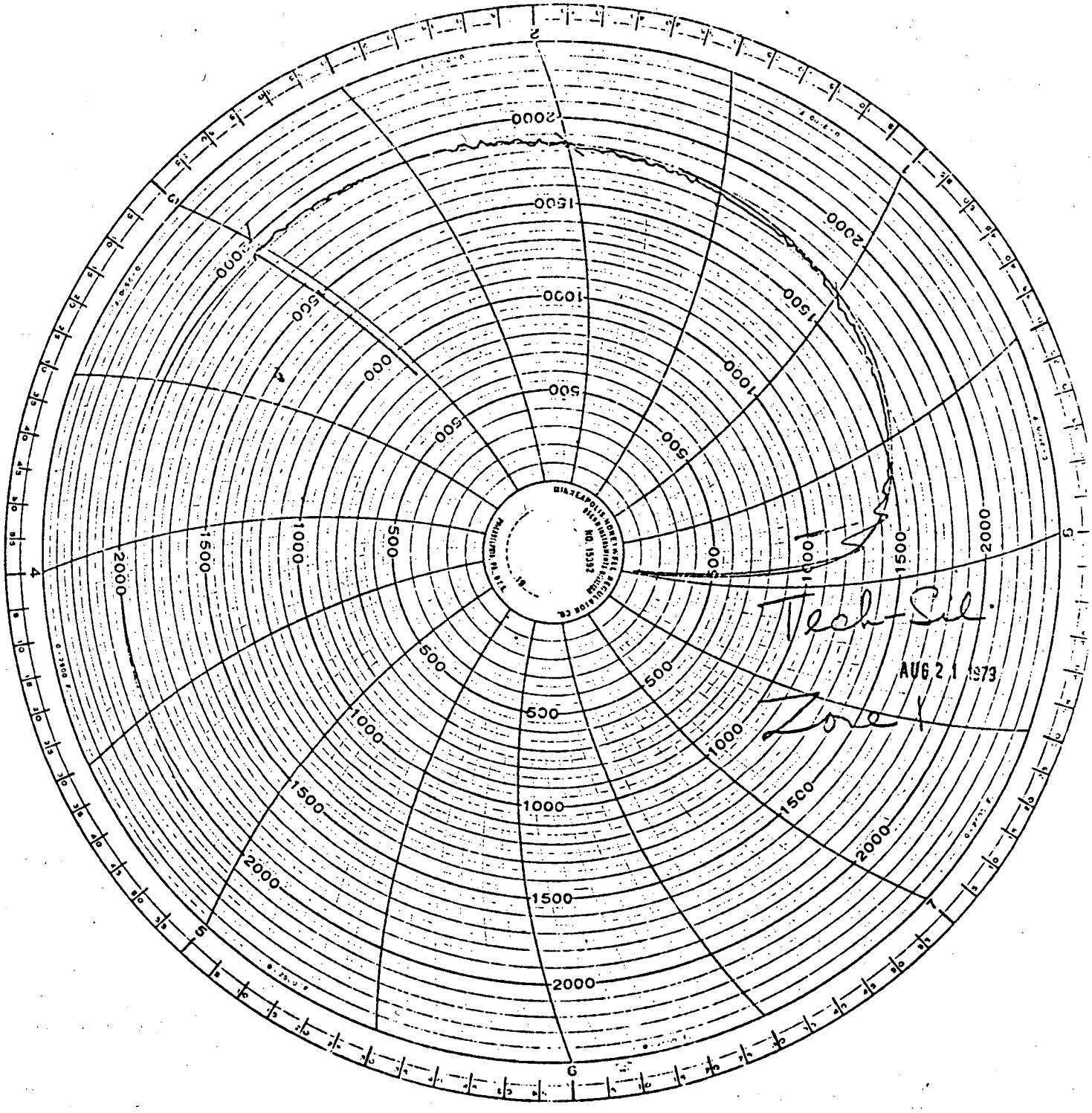


PORTLAND CEMENT ASSOC.

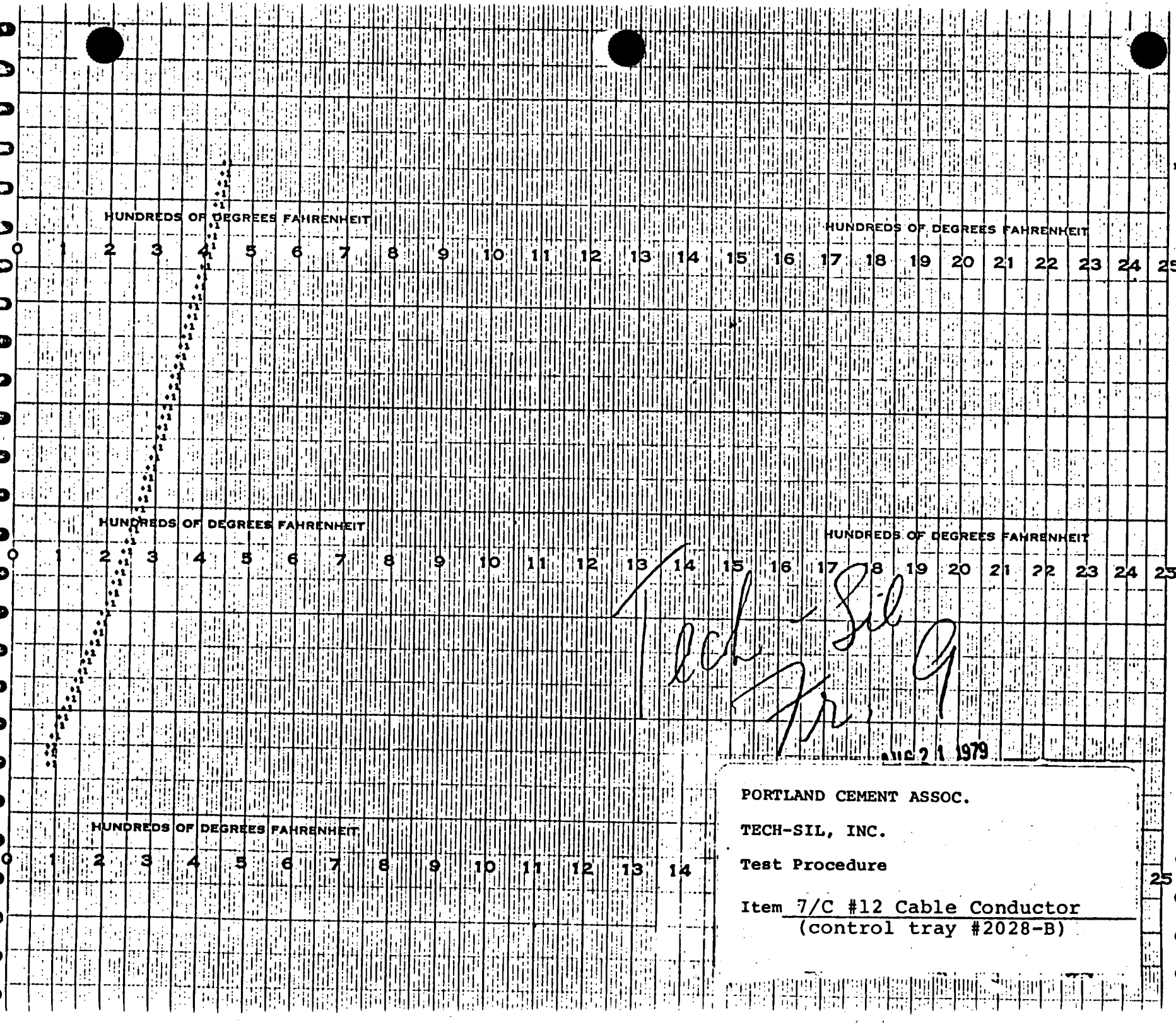
TECH-SIL, INC.

Test Procedure

Item Furnace Atmosphere Temperature



FURNACE ATMOSPHERE TEMPERATURE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HUNDREDS OF DEGREES FAHRENHEIT
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HUNDREDS OF DEGREES FAHRENHEIT
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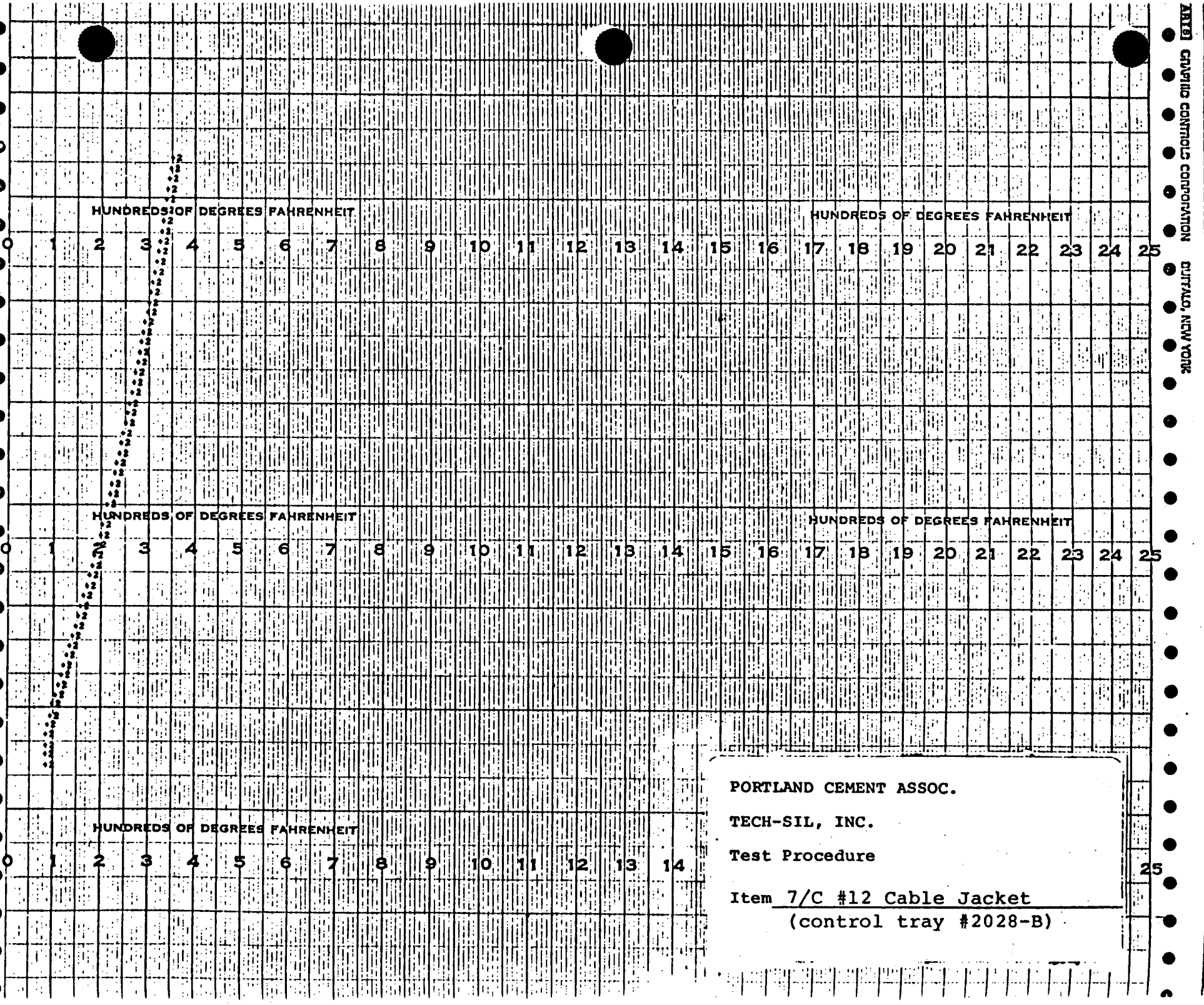
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Tech Sil
AUG 21 1979
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item 7/C #12 Cable Conductor
(control tray #2028-B)
No. 5103 N
THE GORDING CHART
GRAFIC CONTROLS CORPORATION
BUFFALO, NEW YORK

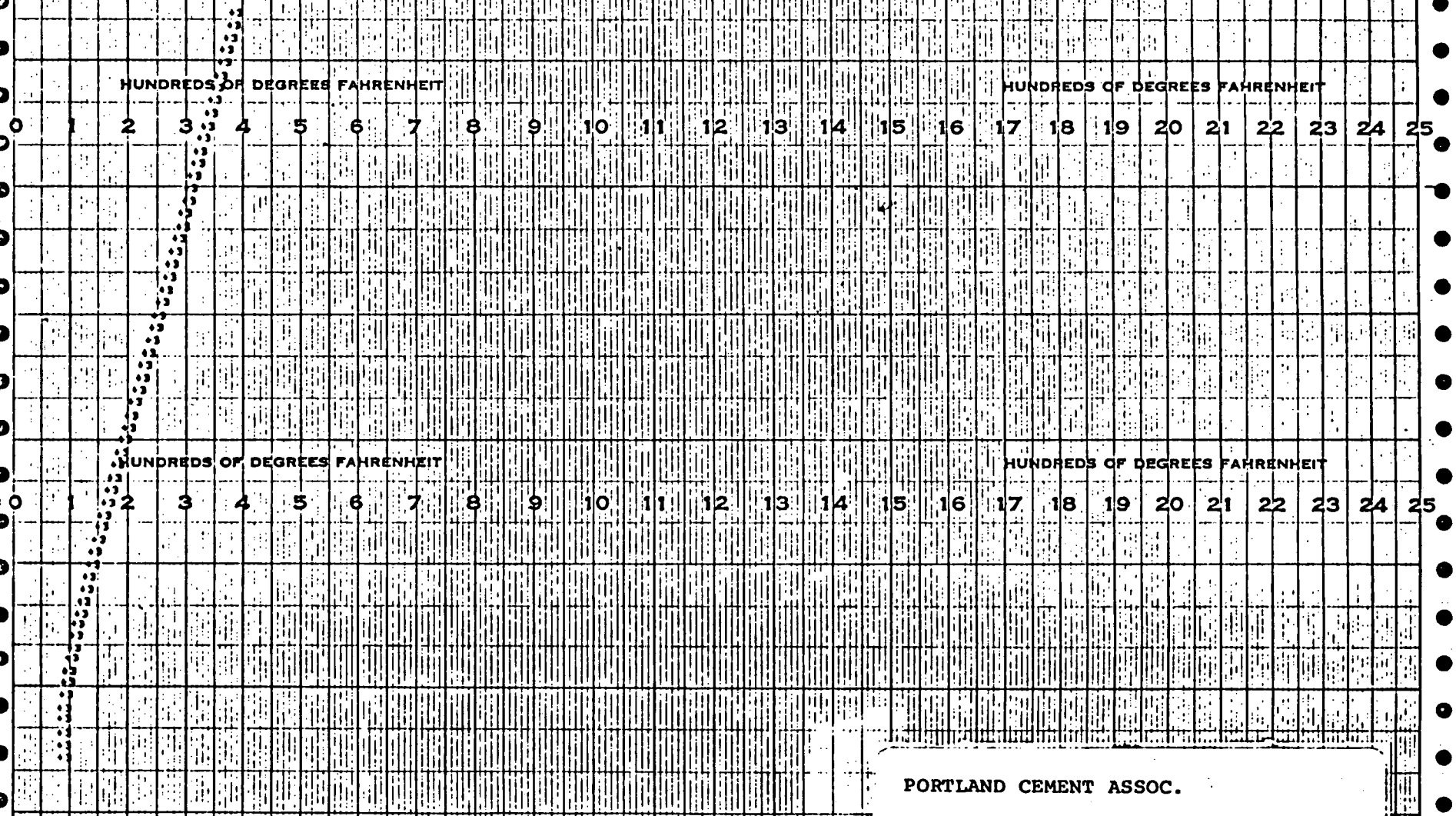


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 7/C #12 Cable Jacket
(control tray #2028-B)



PORTLAND CEMENT ASSOC.

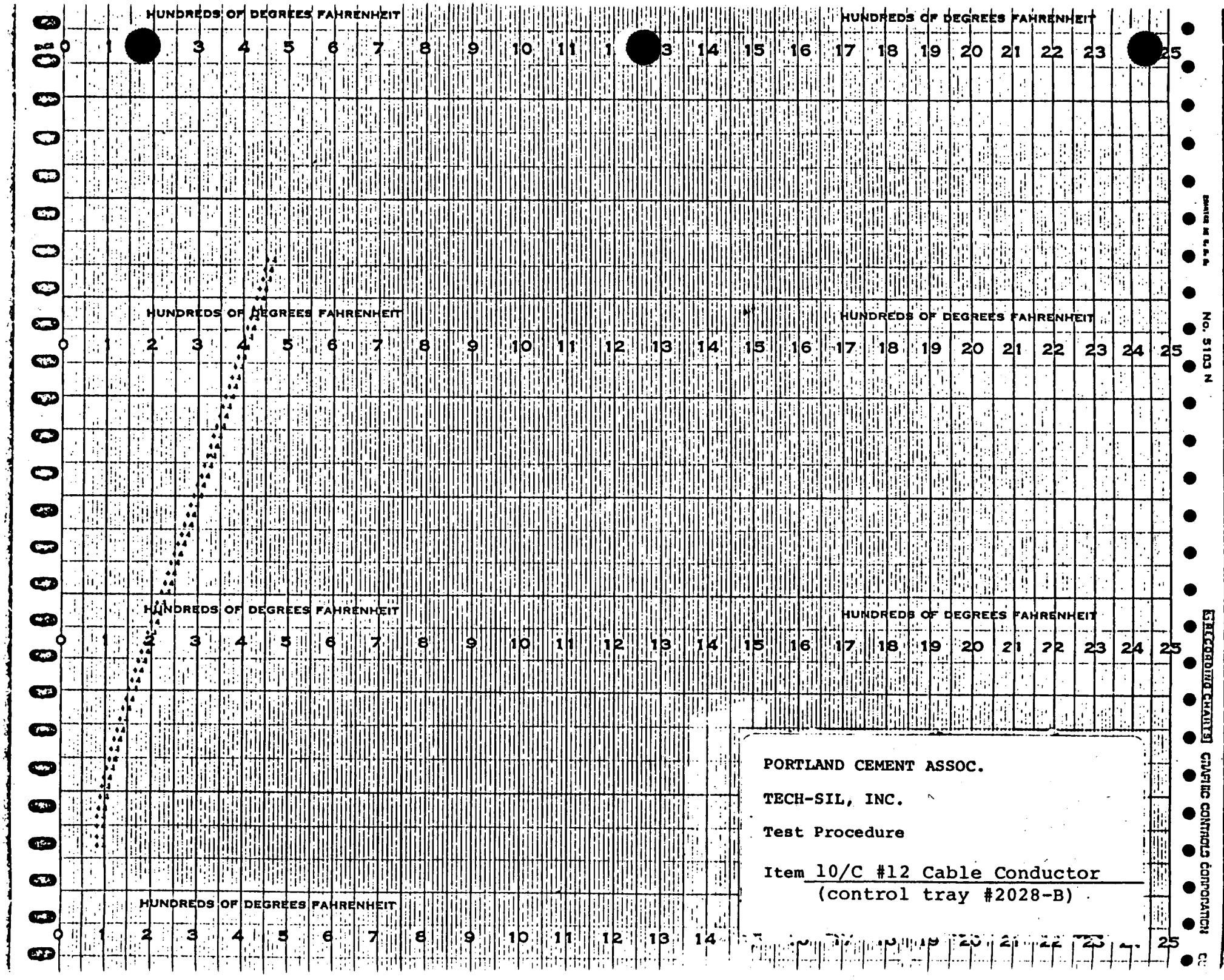
TECH-SIL, INC.

Test Procedure

Item 10/C #12 Cable Jacket

(control tray #2028-B)

NO. 5183 N

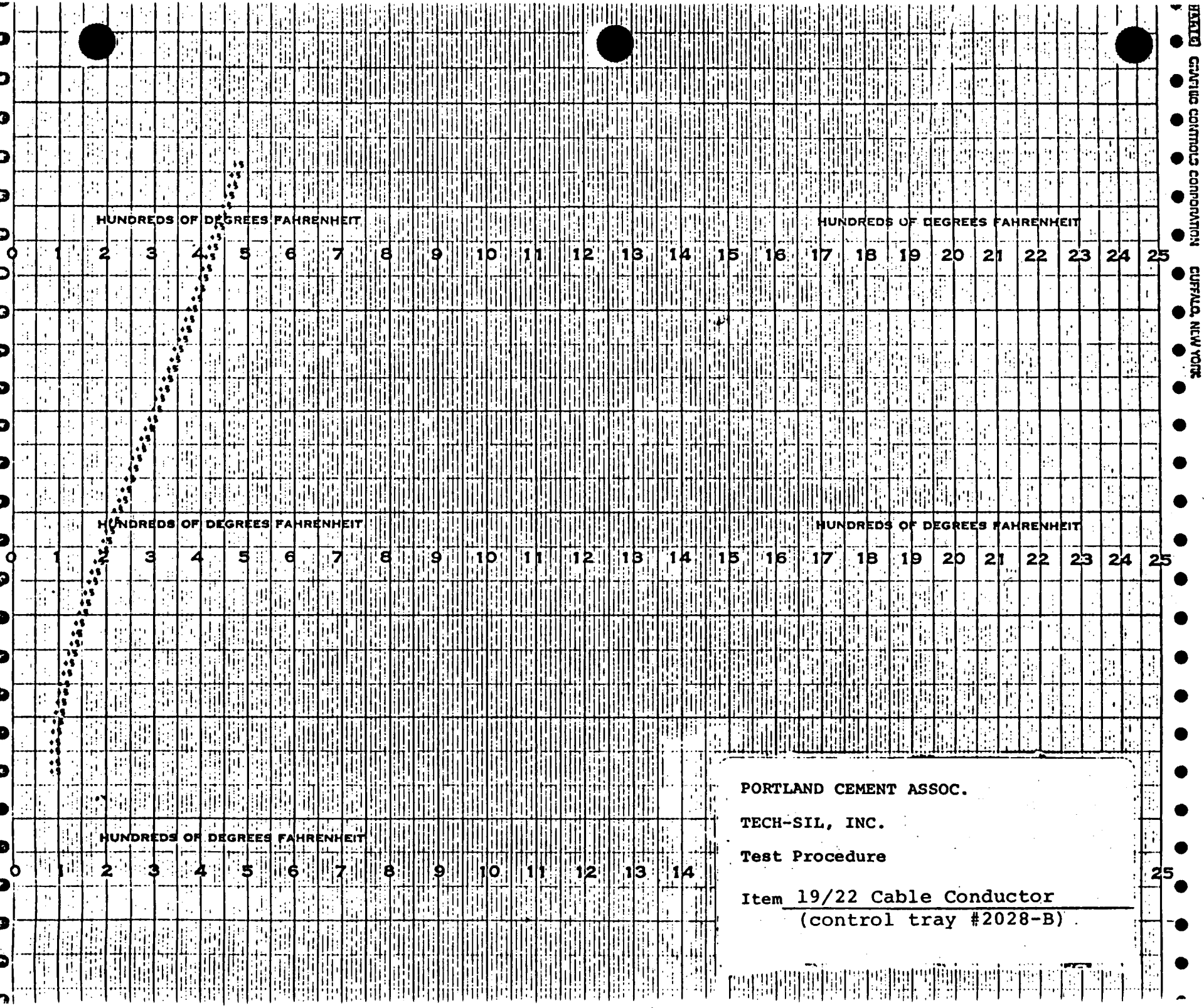


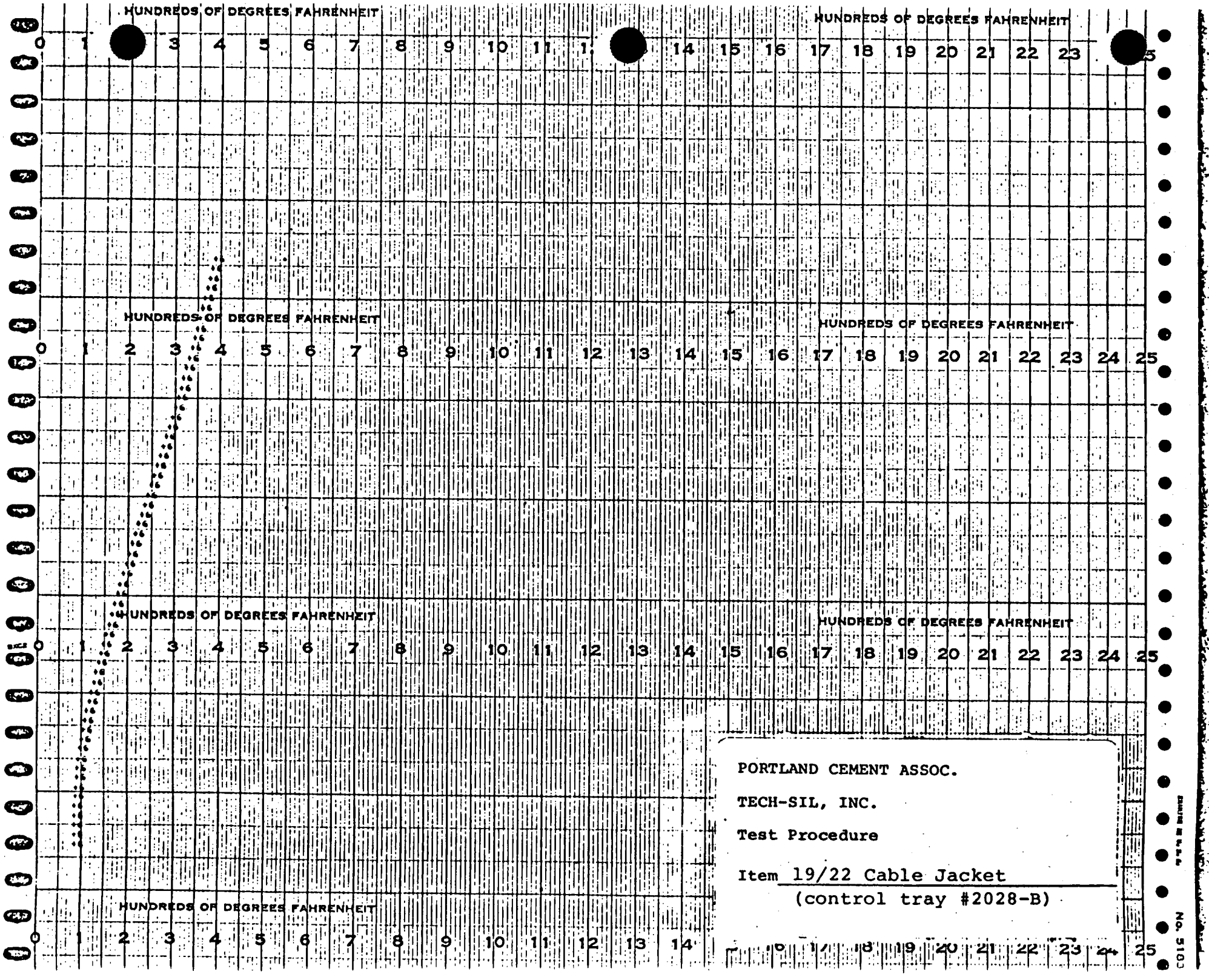
PORTLAND CEMENT ASSOC.

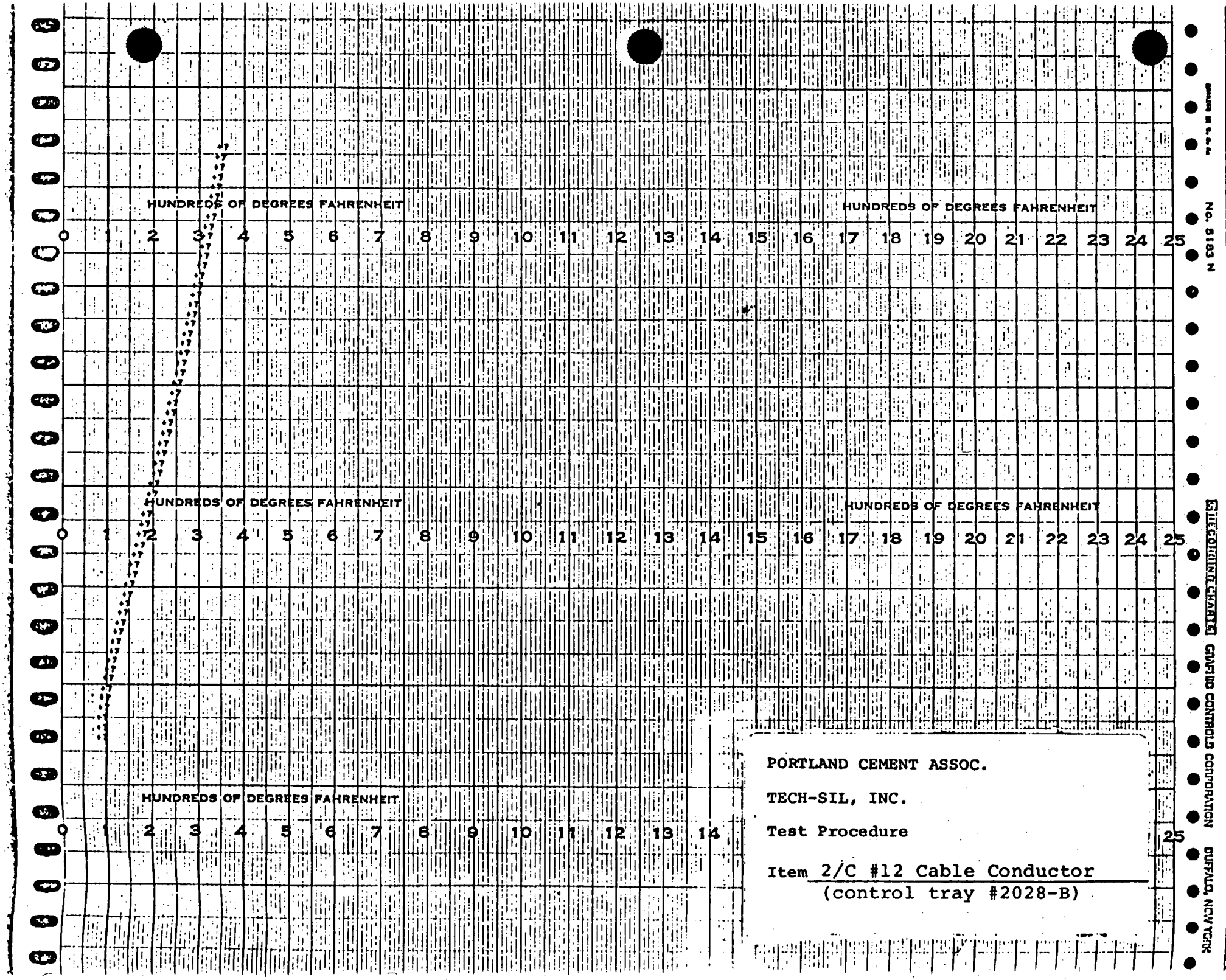
TECH-SIL, INC.

Test Procedure

Item 10/C #12 Cable Conductor
(control tray #2028-B)


HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 25
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item 19/22 Cable Conductor
(control tray #2028-B)
HAMMOND GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK


HUNDREDS OF DEGREES FAHRENHEIT
0 1 3 4 5 6 7 8 9 10 11 14 15 16 17 18 19 20 21 22 23 5
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item 19/22 Cable Jacket
(control tray #2028-B)
No. 510

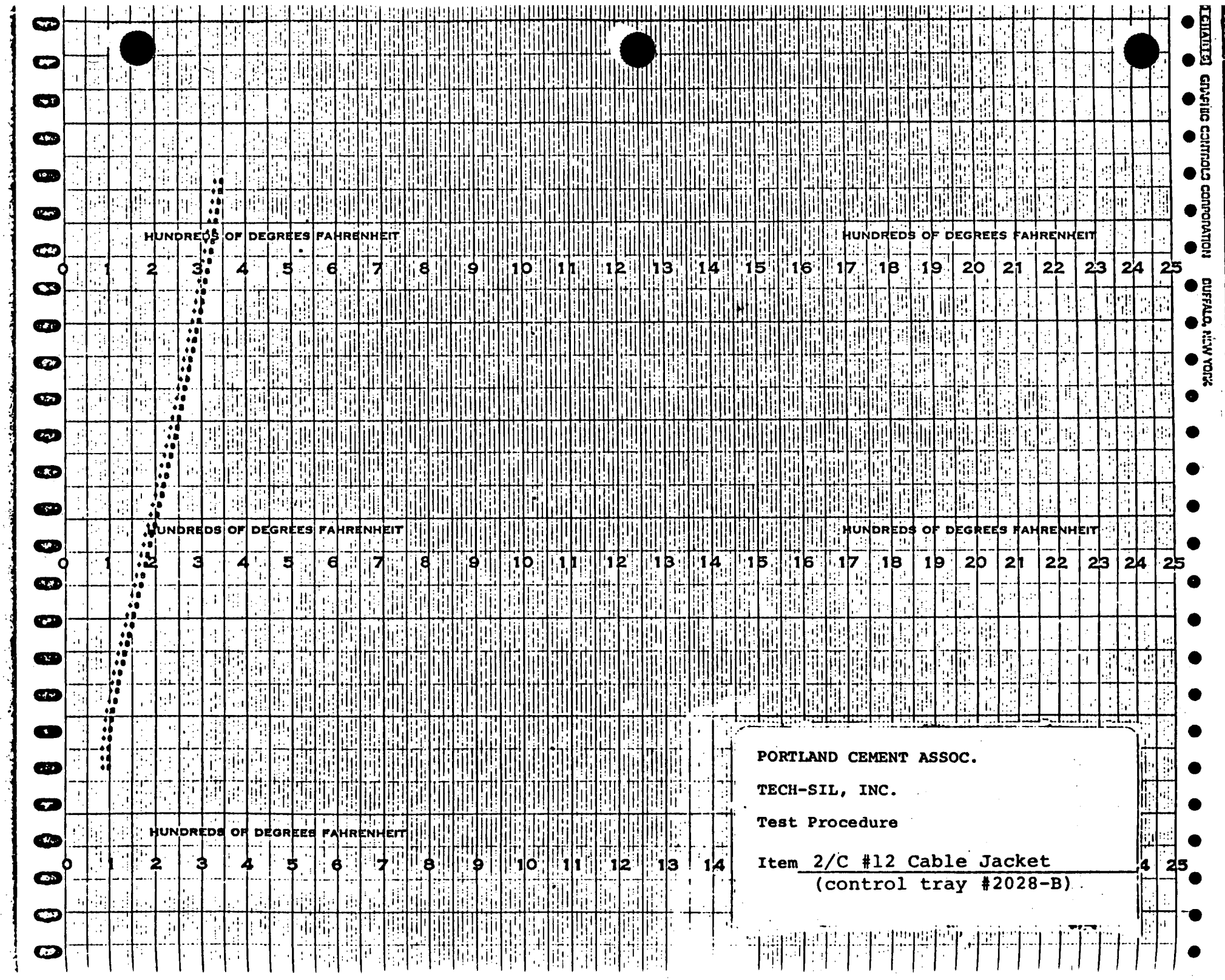


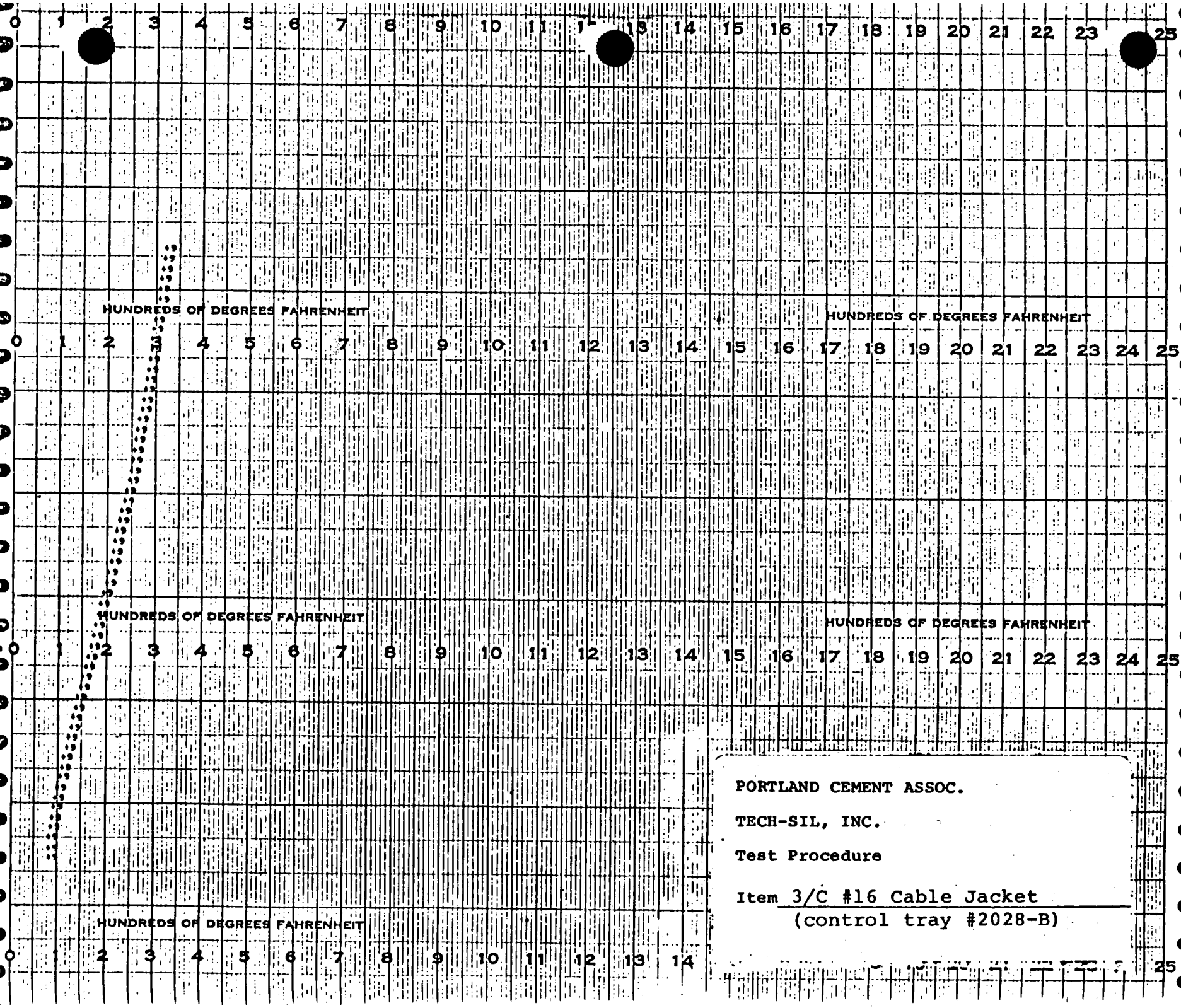
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 2/C #12 Cable Conductor
(control tray #2028-B)


HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item 2/C #12 Cable Jacket
(control tray #2028-B)
GRAFTIC CONTROLS CORPORATION
BUFFALO, NEW YORK

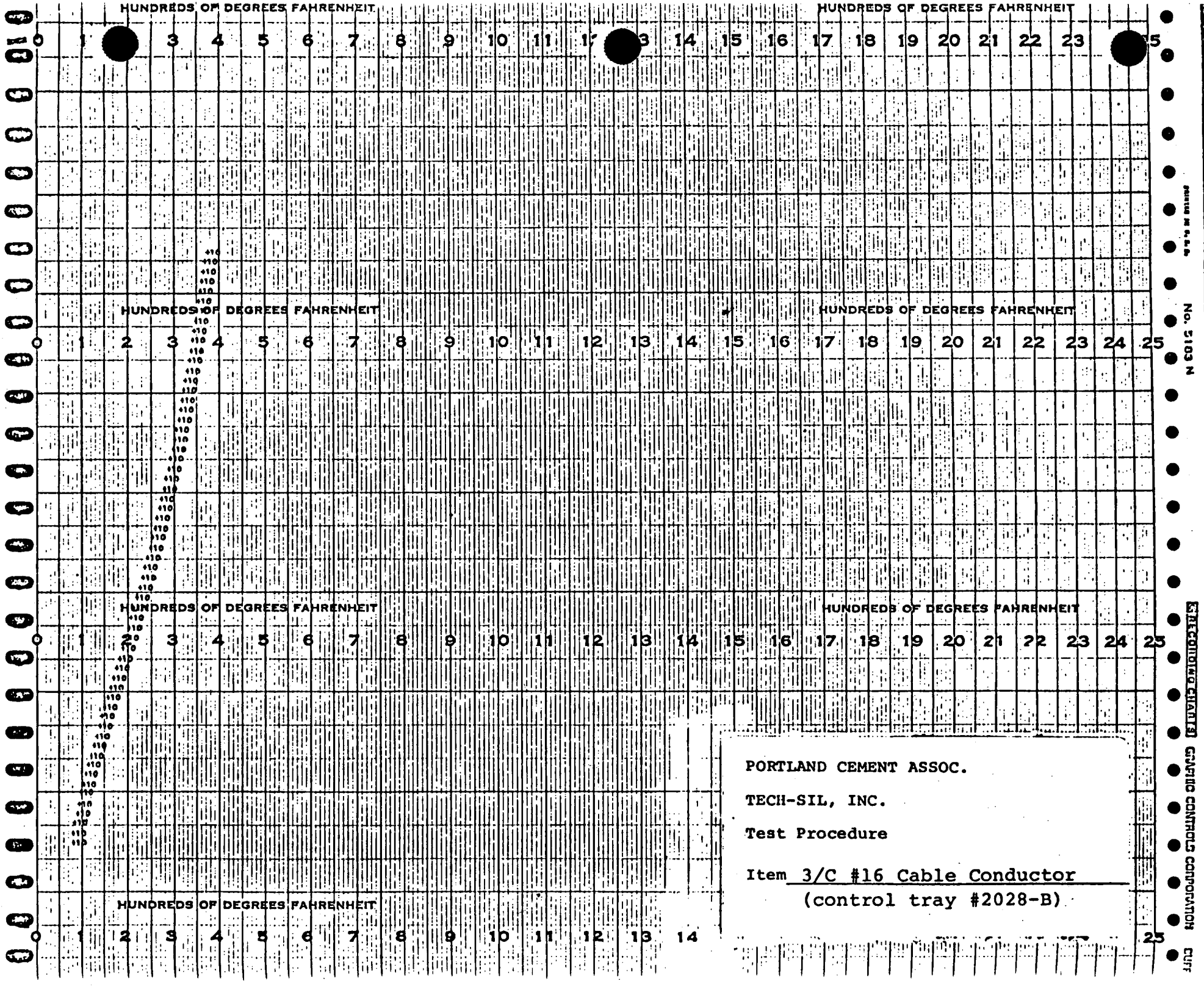


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C #16 Cable Jacket
(control tray #2028-B)

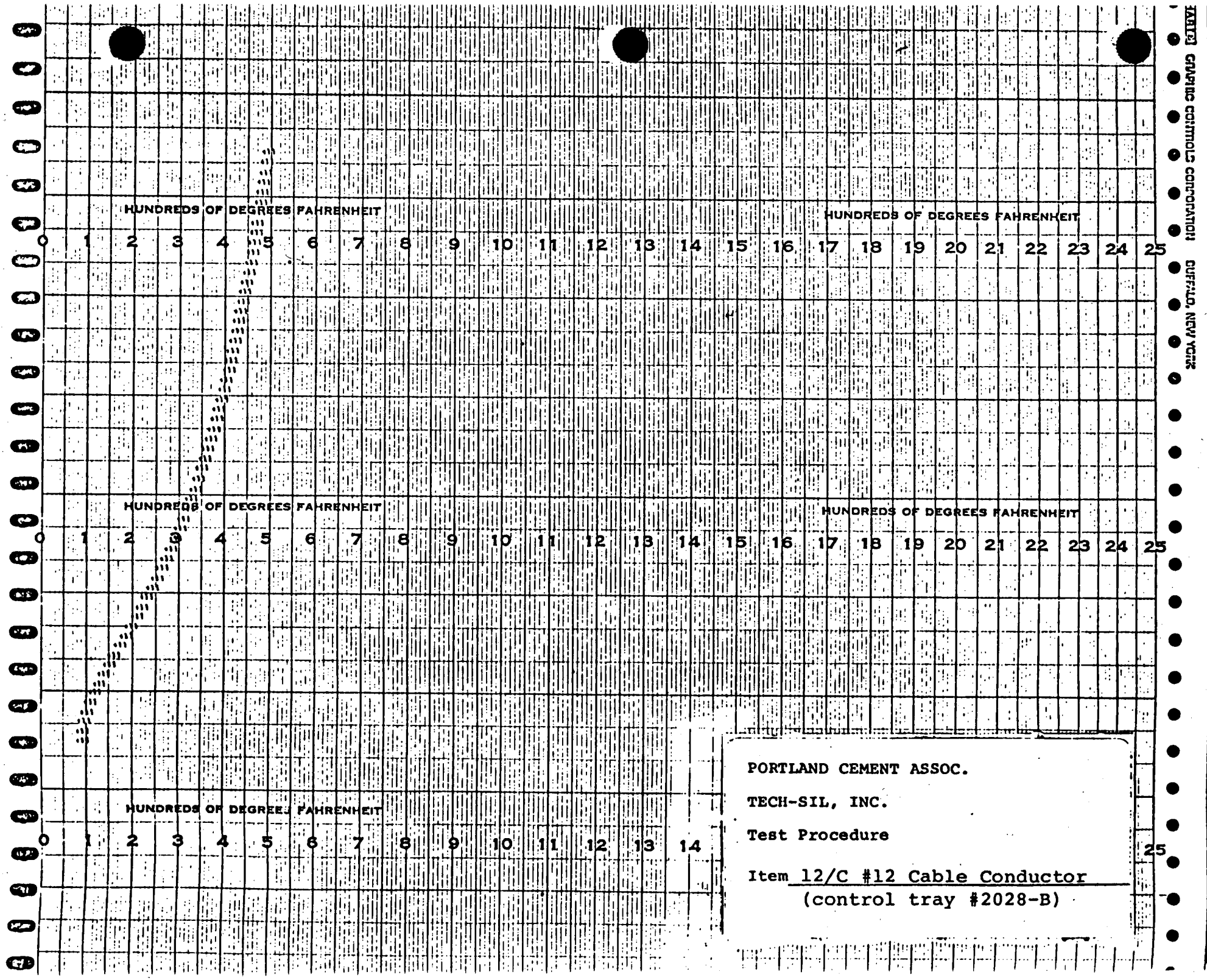


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C #16 Cable Conductor
(control tray #2028-B)

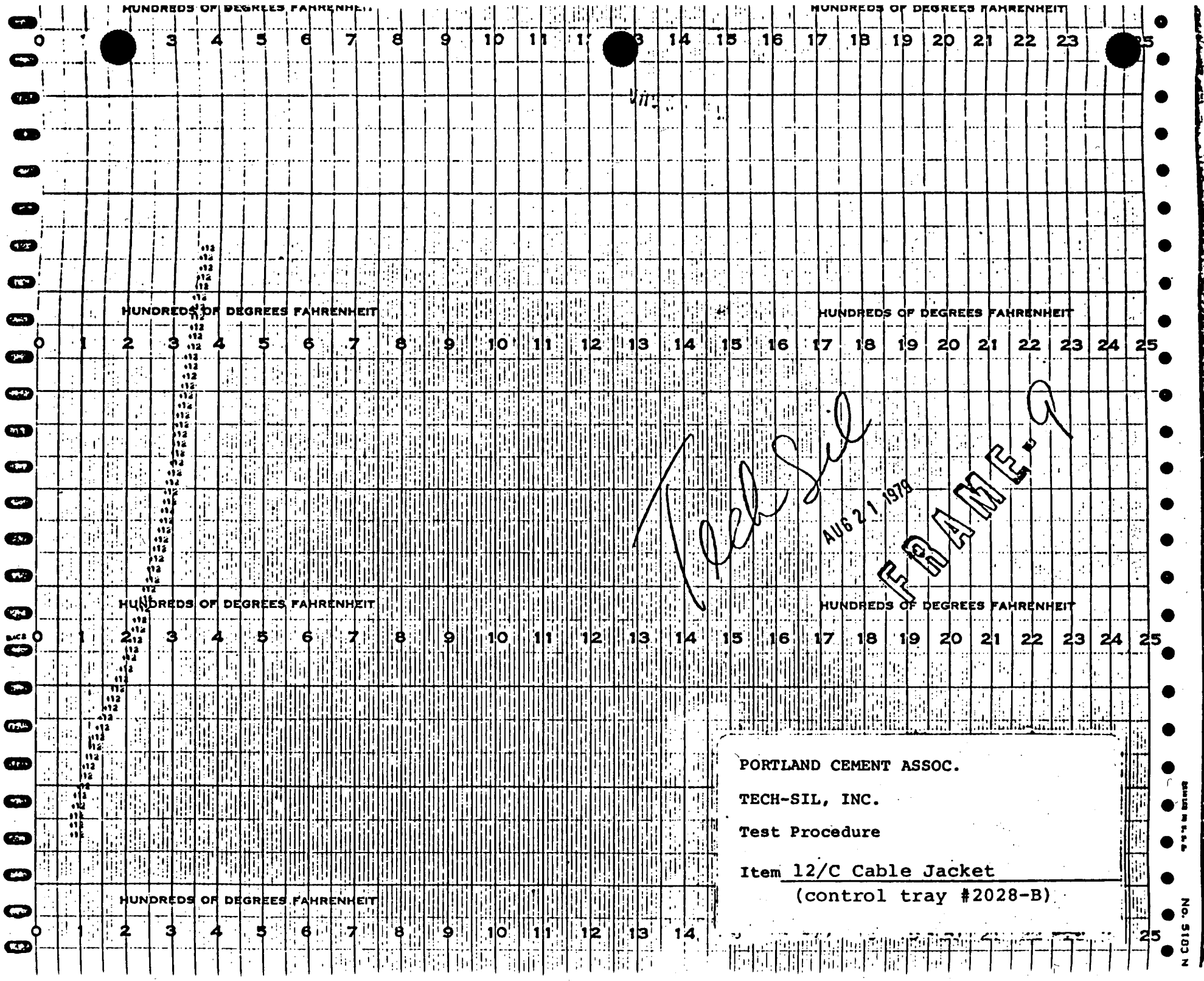


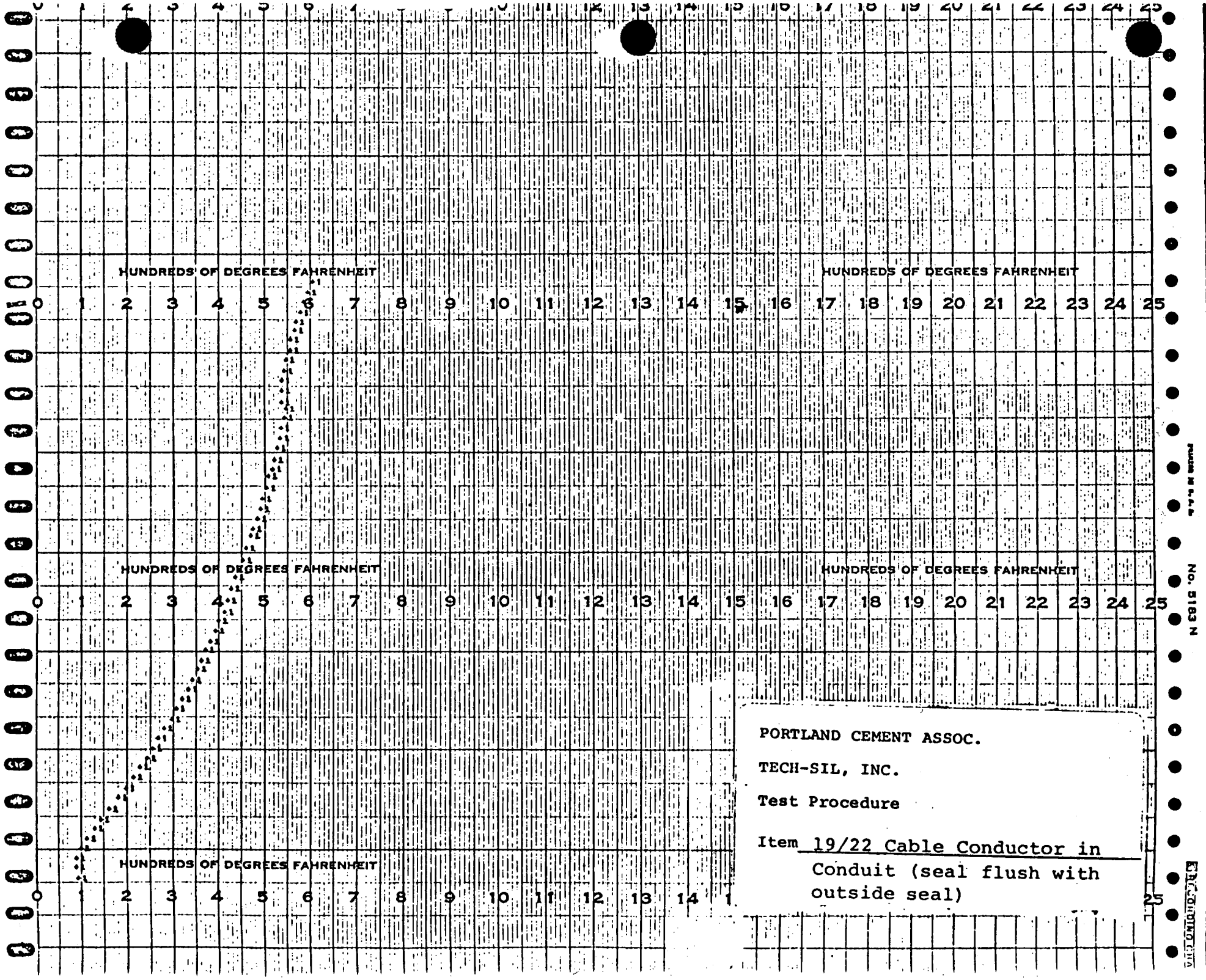
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 12/C #12 Cable Conductor
(control tray #2028-B)


HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Tech Sil
AUG 21 1978
FRAME 9
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item 12/C Cable Jacket
(control tray #2028-B)

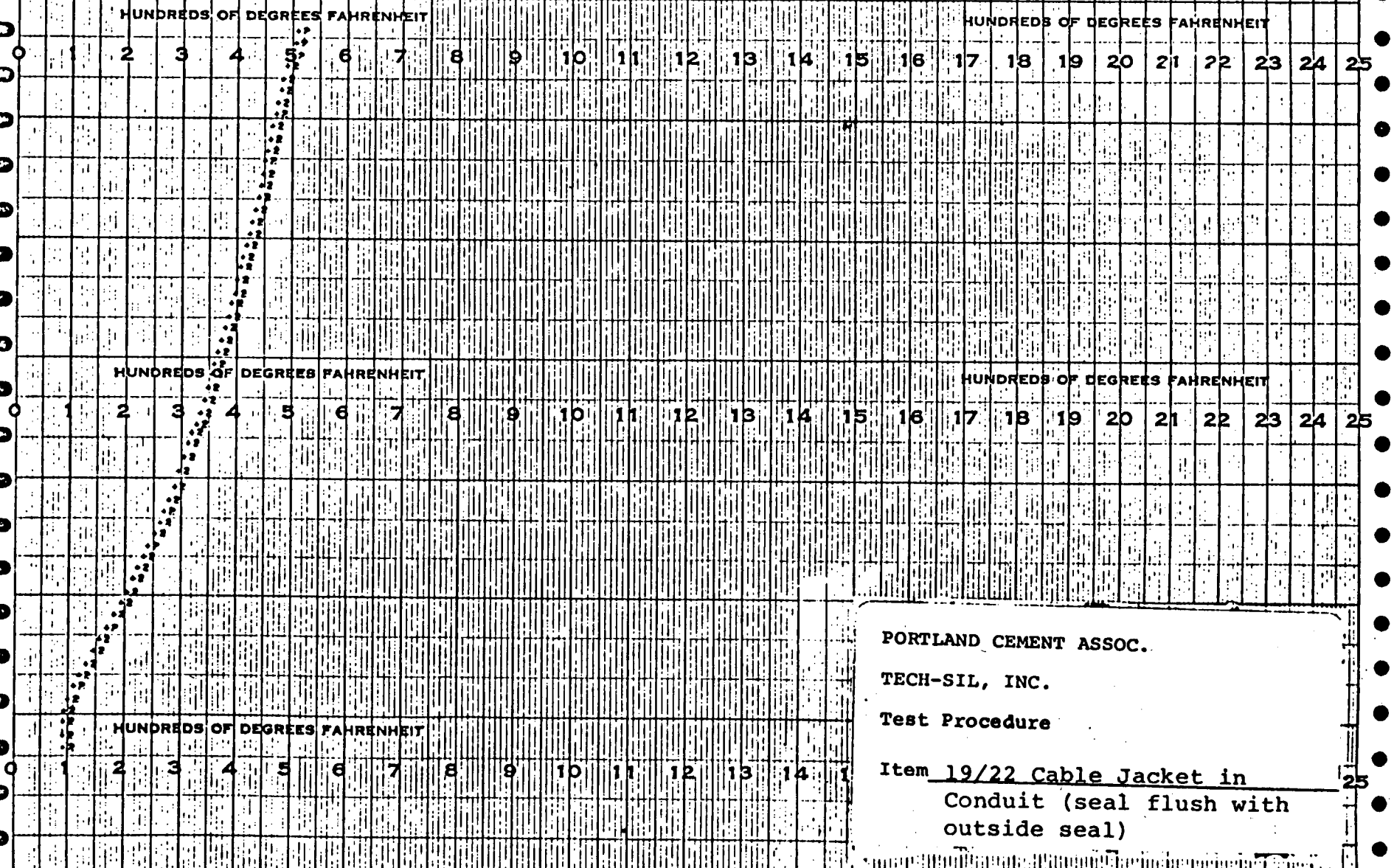


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Conductor in Conduit (seal flush with outside seal)



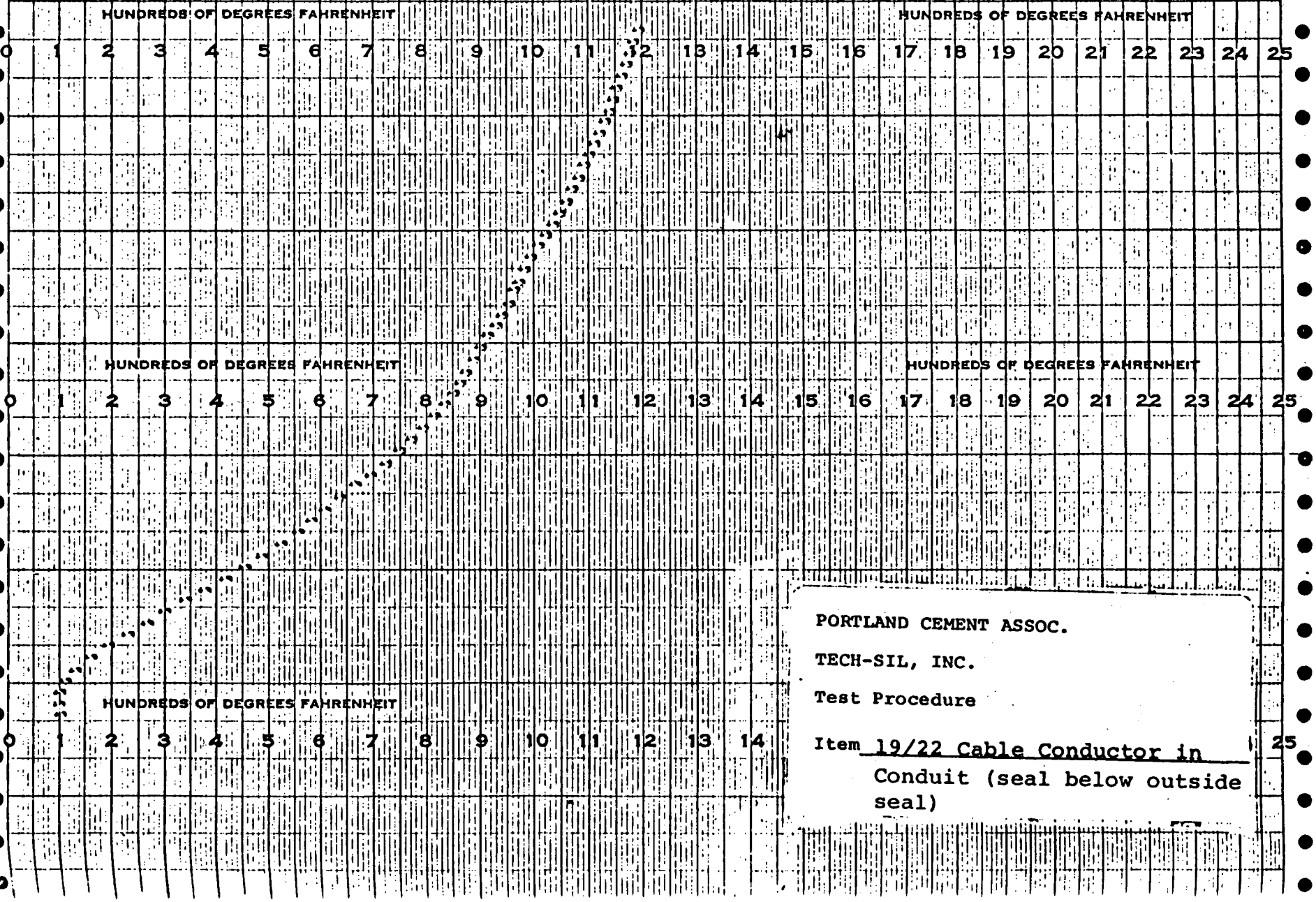
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Jacket in Conduit (seal flush with outside seal)

HIGGINS CHART GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

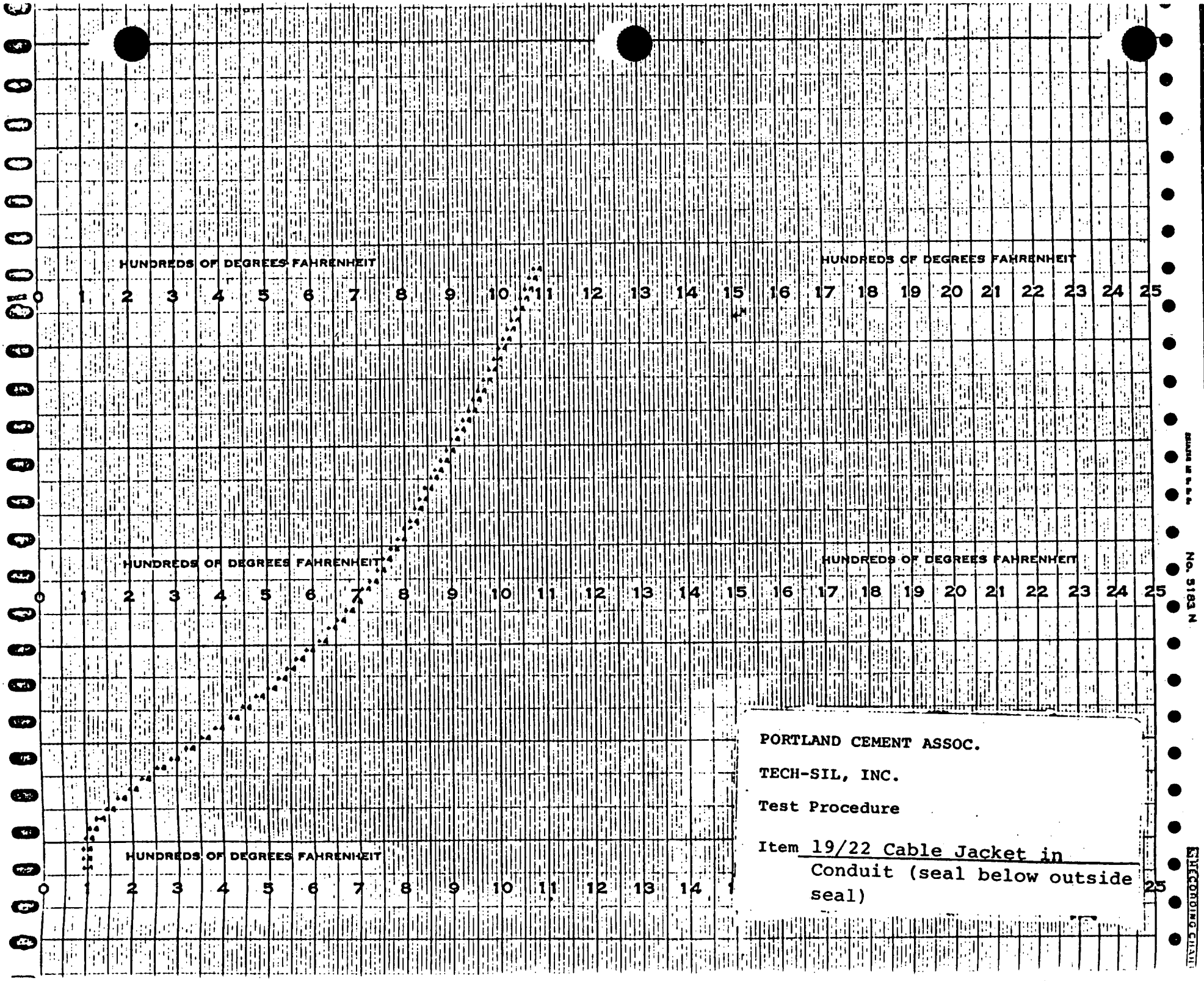


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Conductor in Conduit (seal below outside seal)

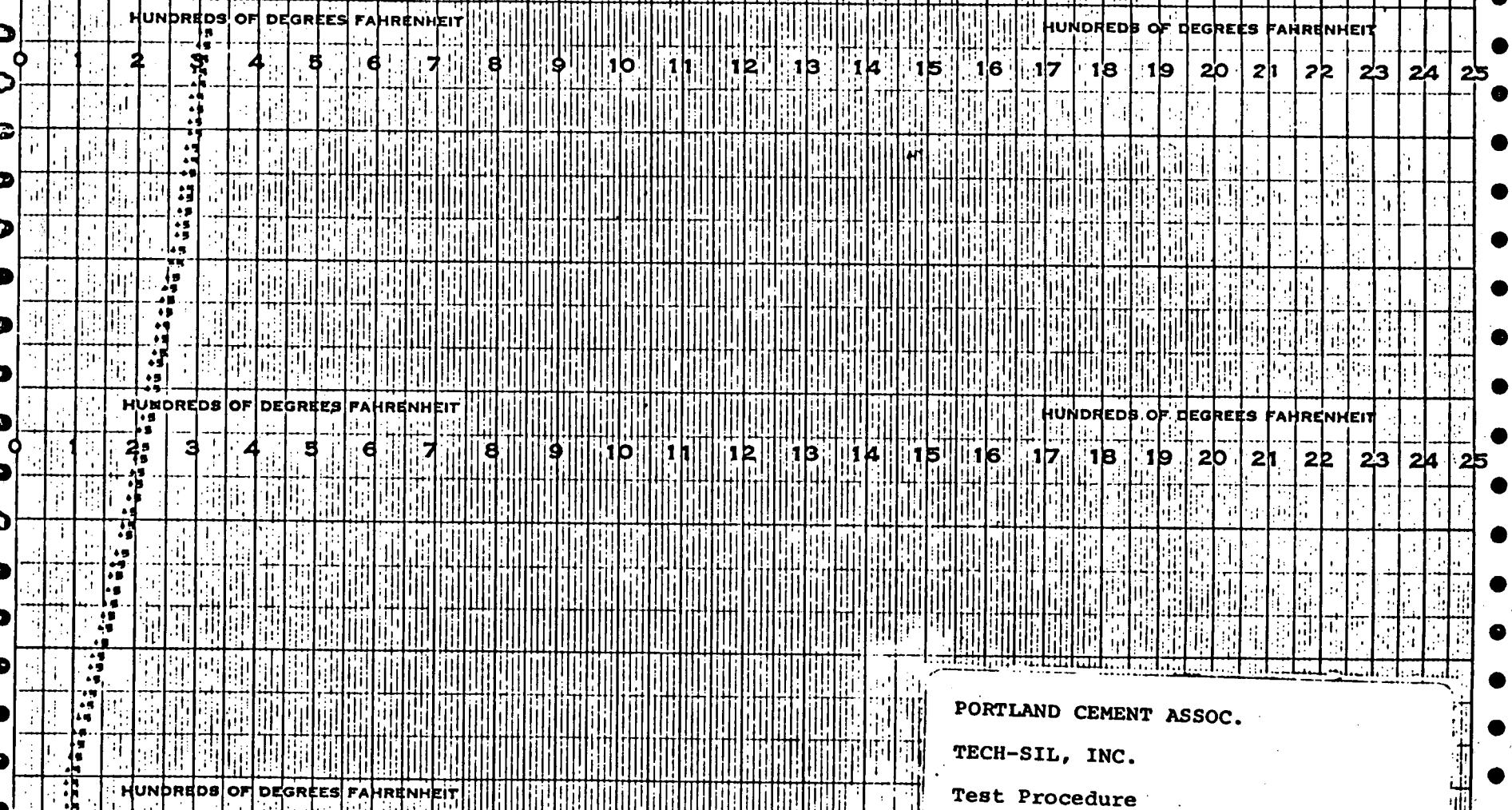


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Jacket in Conduit (seal below outside seal)



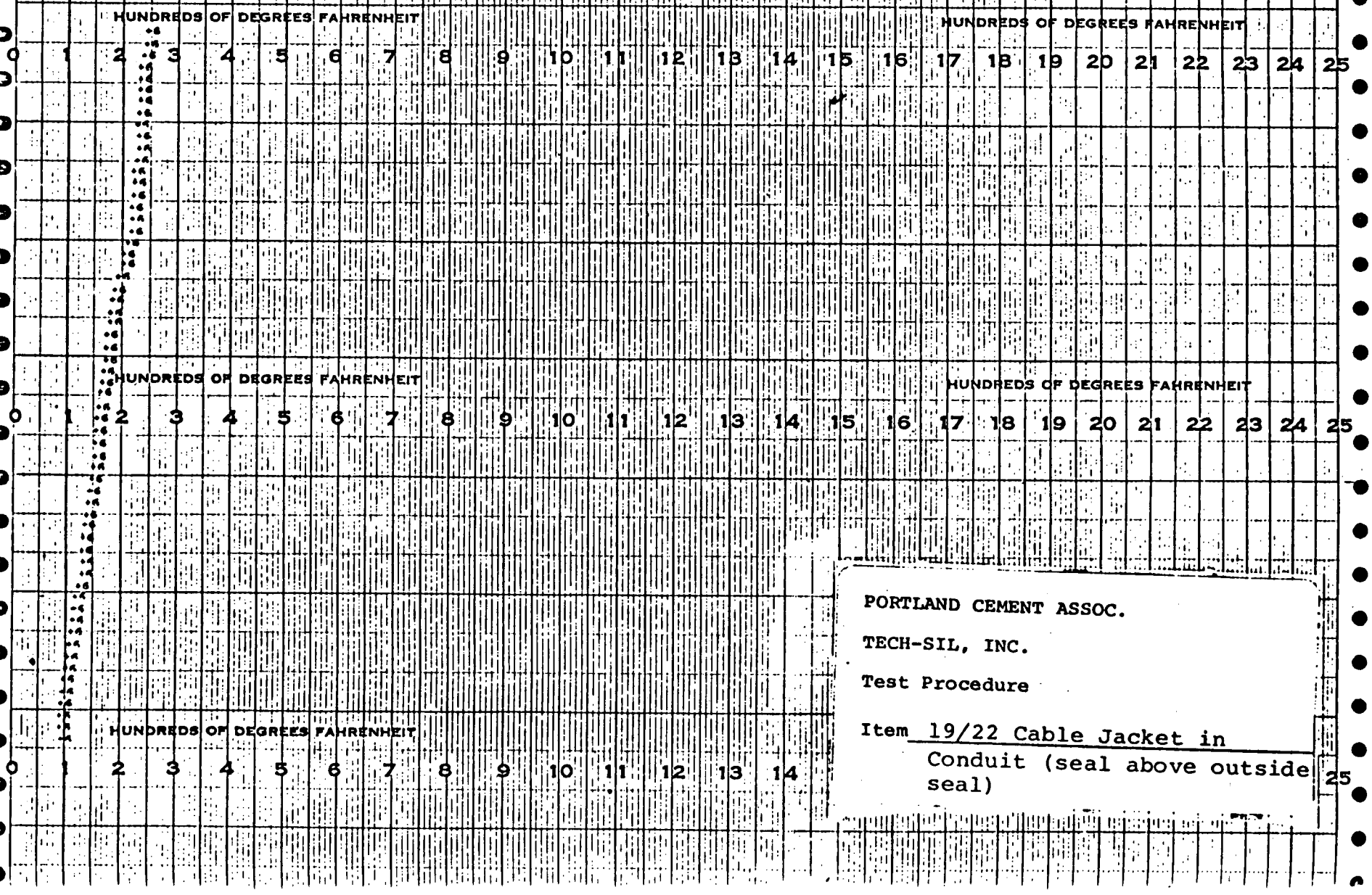
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Conductor in Conduit (seal above outside seal)

GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK



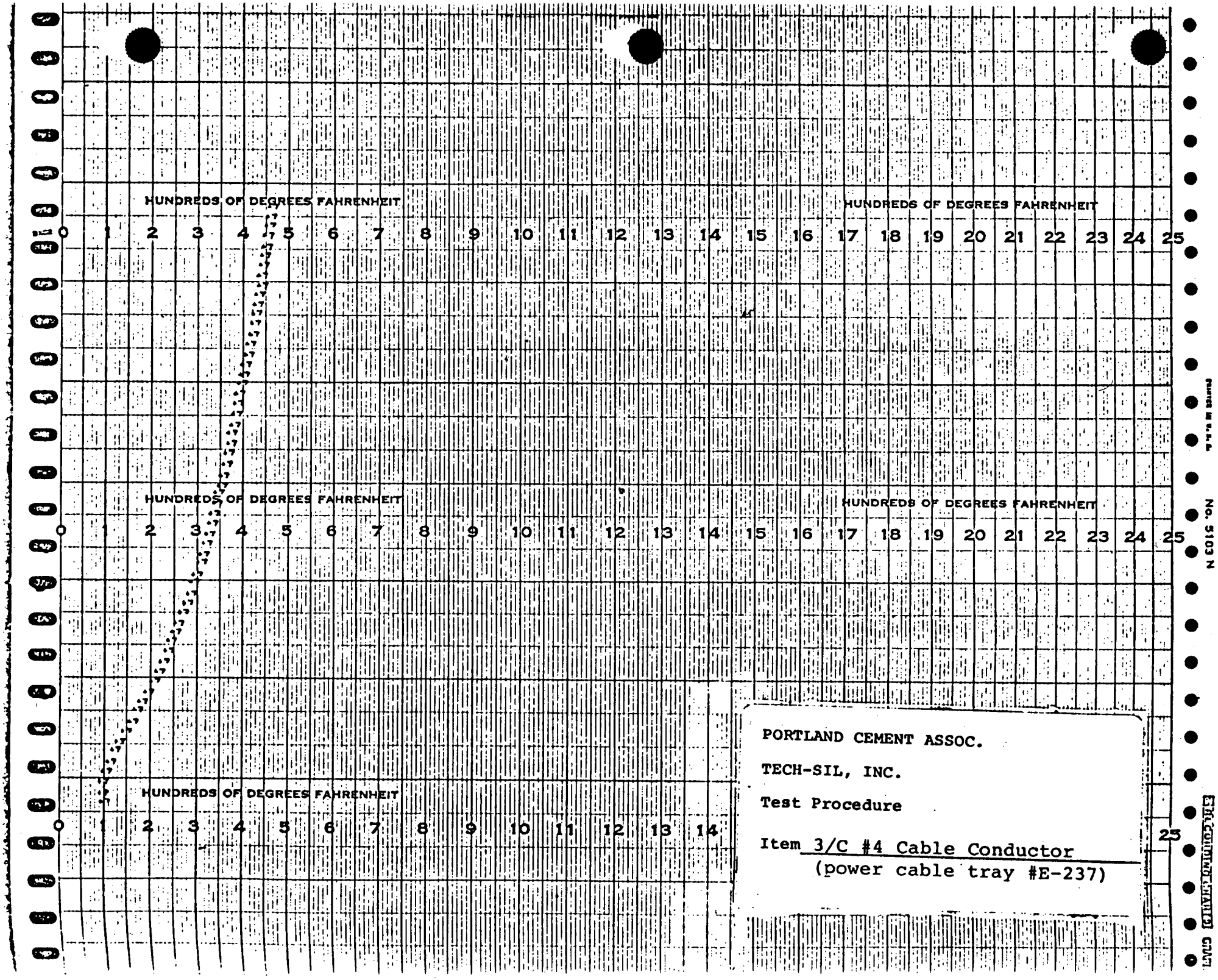
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Jacket in Conduit (seal above outside seal)

FRALO, NEW YORK

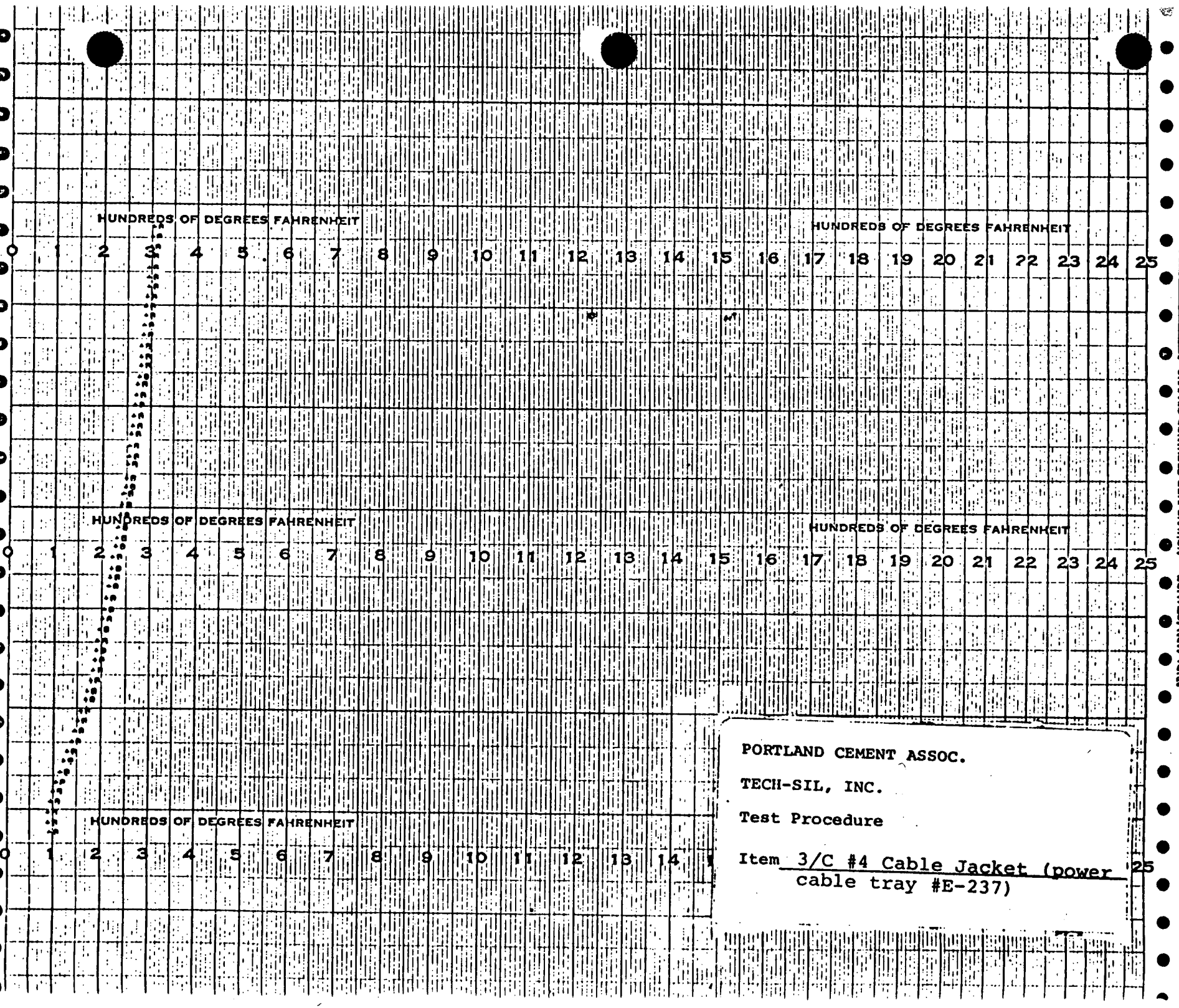


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C #4 Cable Conductor
(power cable tray #E-237)

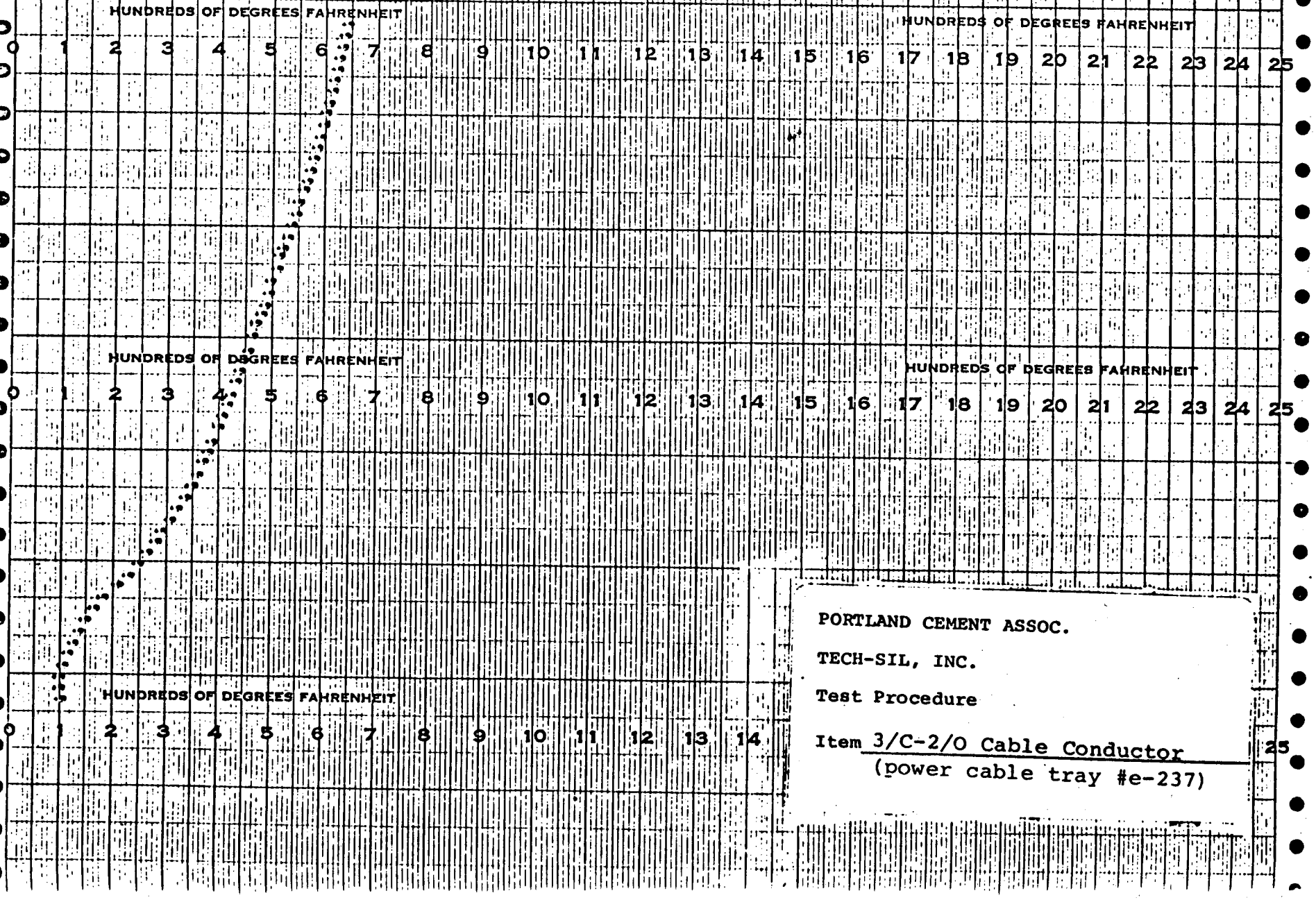


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C #4 Cable Jacket (power cable tray #E-237)

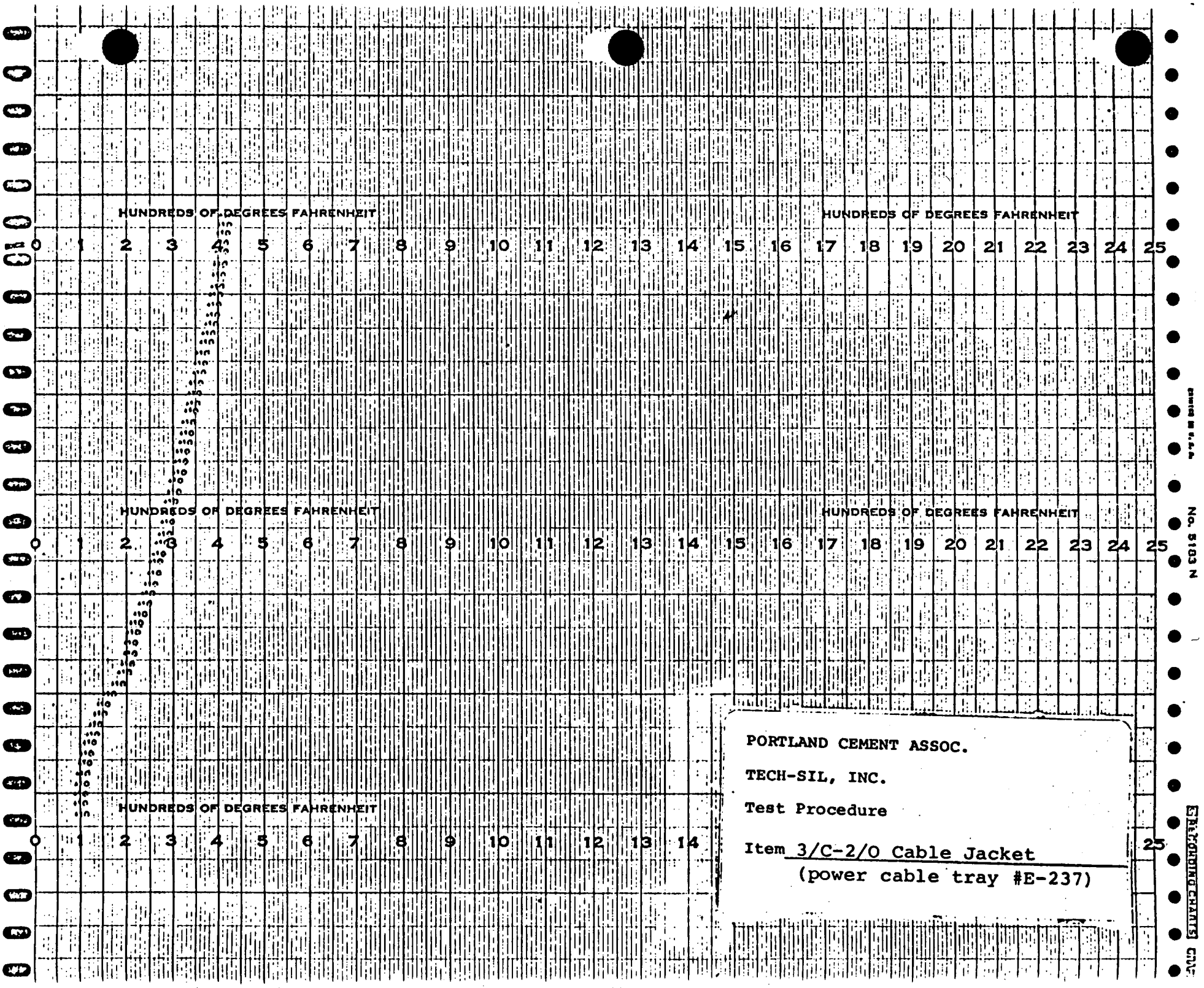


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C-2/0 Cable Conductor
(power cable tray #e-237)

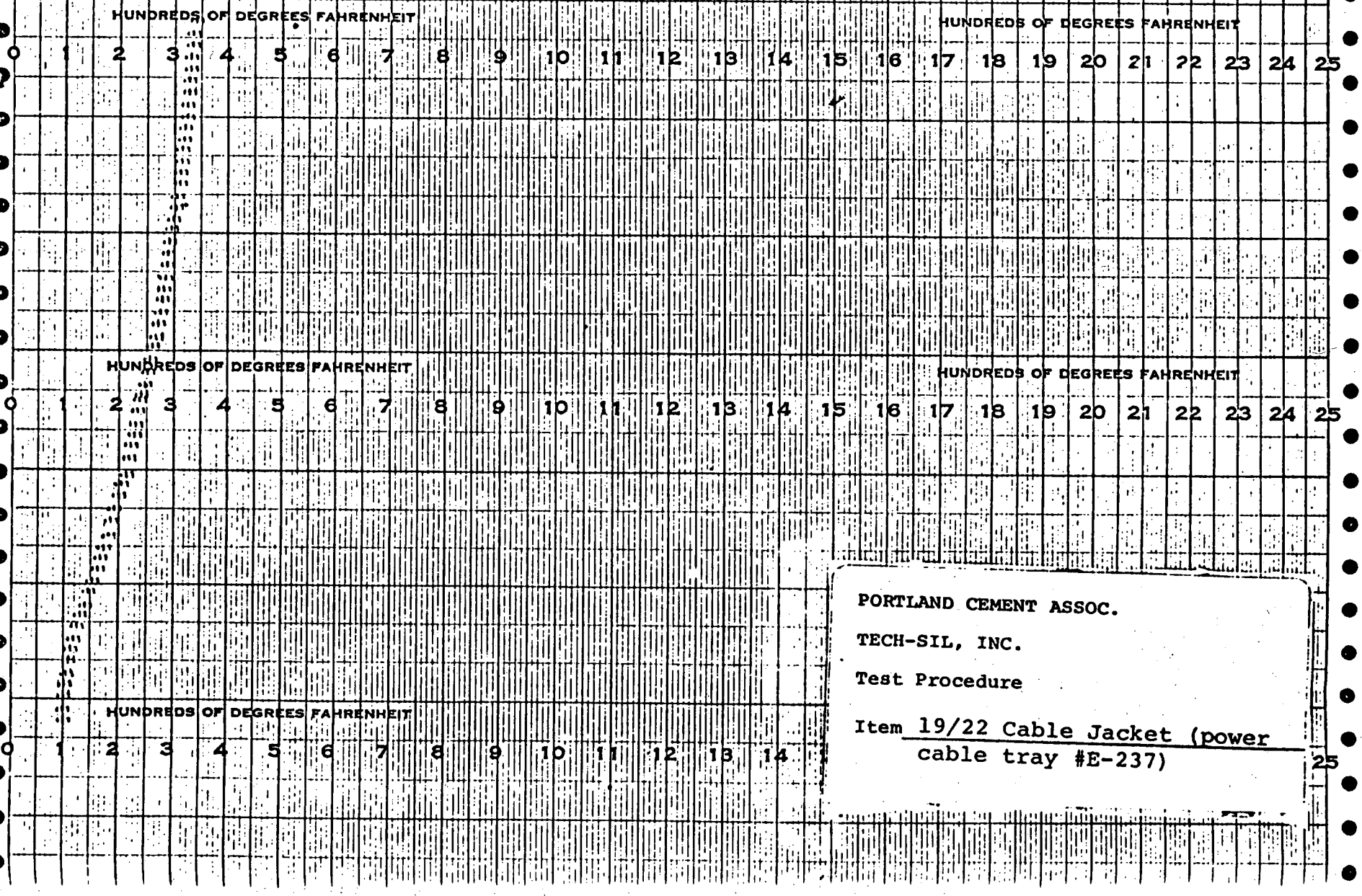


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C-2/0 Cable Jacket
(power cable tray #E-237)



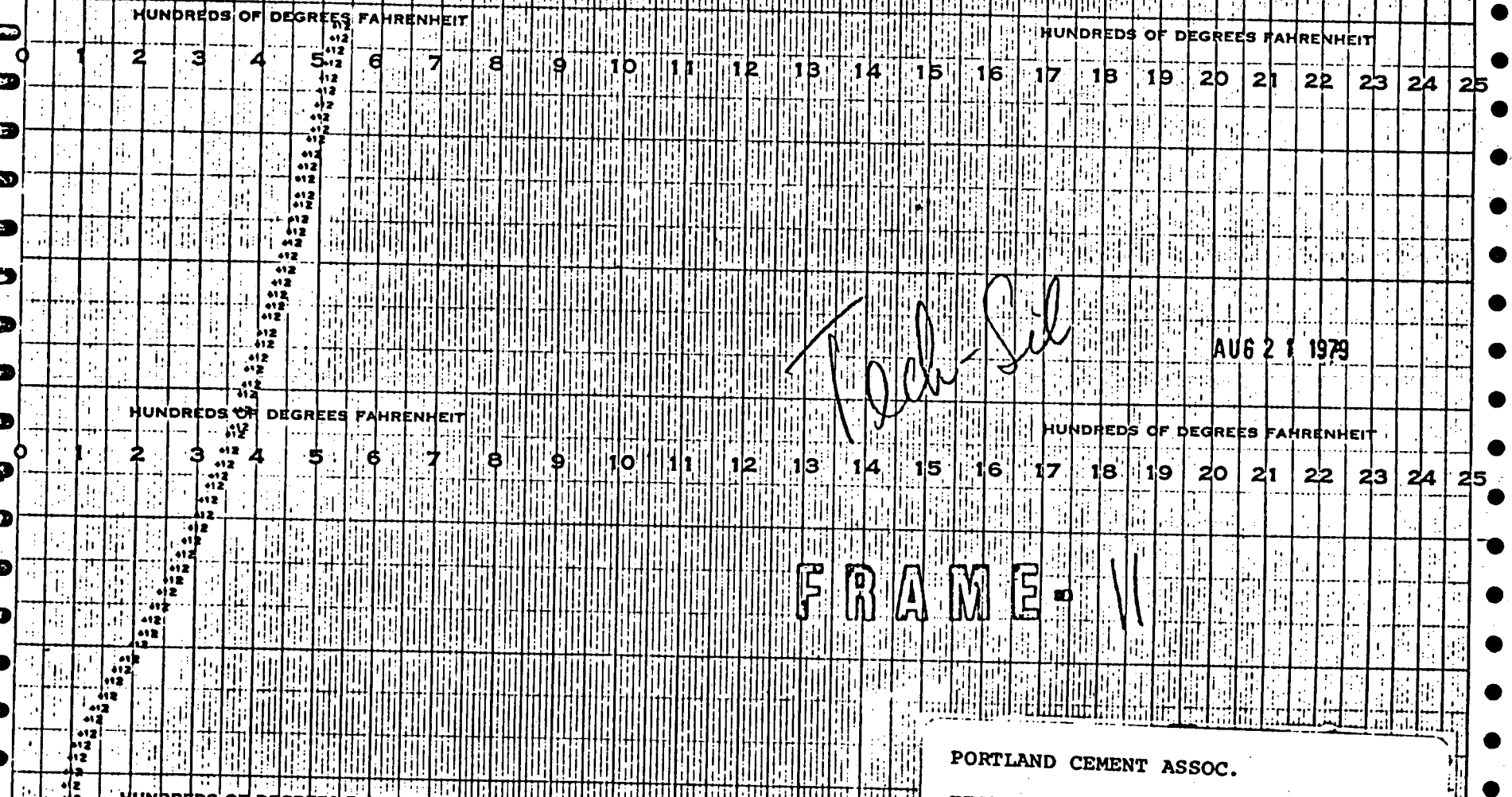
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Jacket (power cable tray #E-237)

RECORDING CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK



Tech-Sil

AUG 2 1 1979

FRAME-11

PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 19/22 Cable Conductor
(power cable tray #E-237)

HUNDREDS OF DEGREES FAHRENHEIT

0 1 4 5 6 7 8 9 10 11 12 14 15 16 17 18 19 20 21 22 23 24 25

HUNDREDS OF DEGREES FAHRENHEIT

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

HUNDREDS OF DEGREES FAHRENHEIT

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

HUNDREDS OF DEGREES FAHRENHEIT

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

HUNDREDS OF DEGREES FAHRENHEIT

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

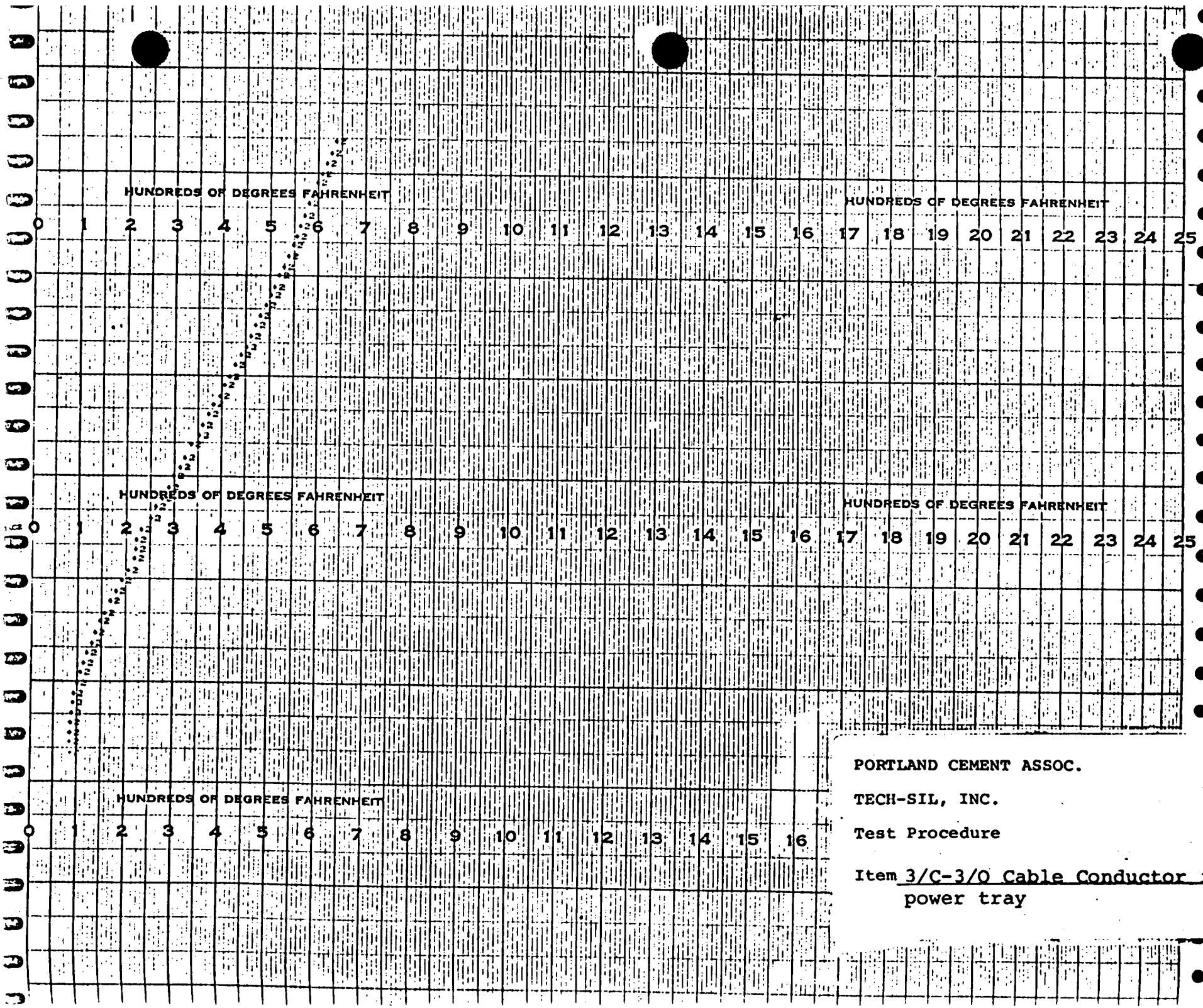
Test Procedure

Item 3/C-3/0 Cable Jacket in power tray #E-237

Tech-Sil

AUG 21 1979

FRAME 12

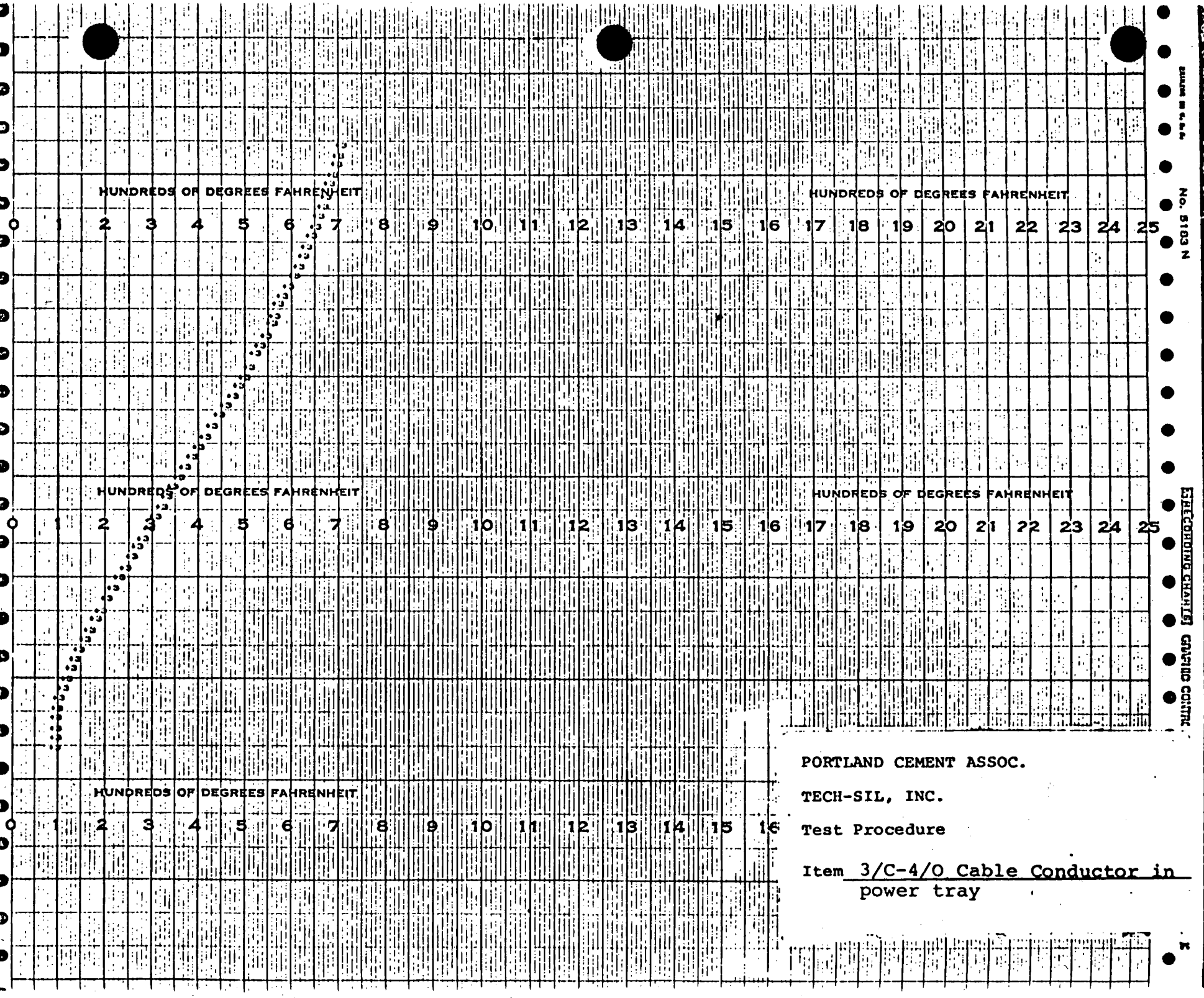


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C-3/0 Cable Conductor in power tray

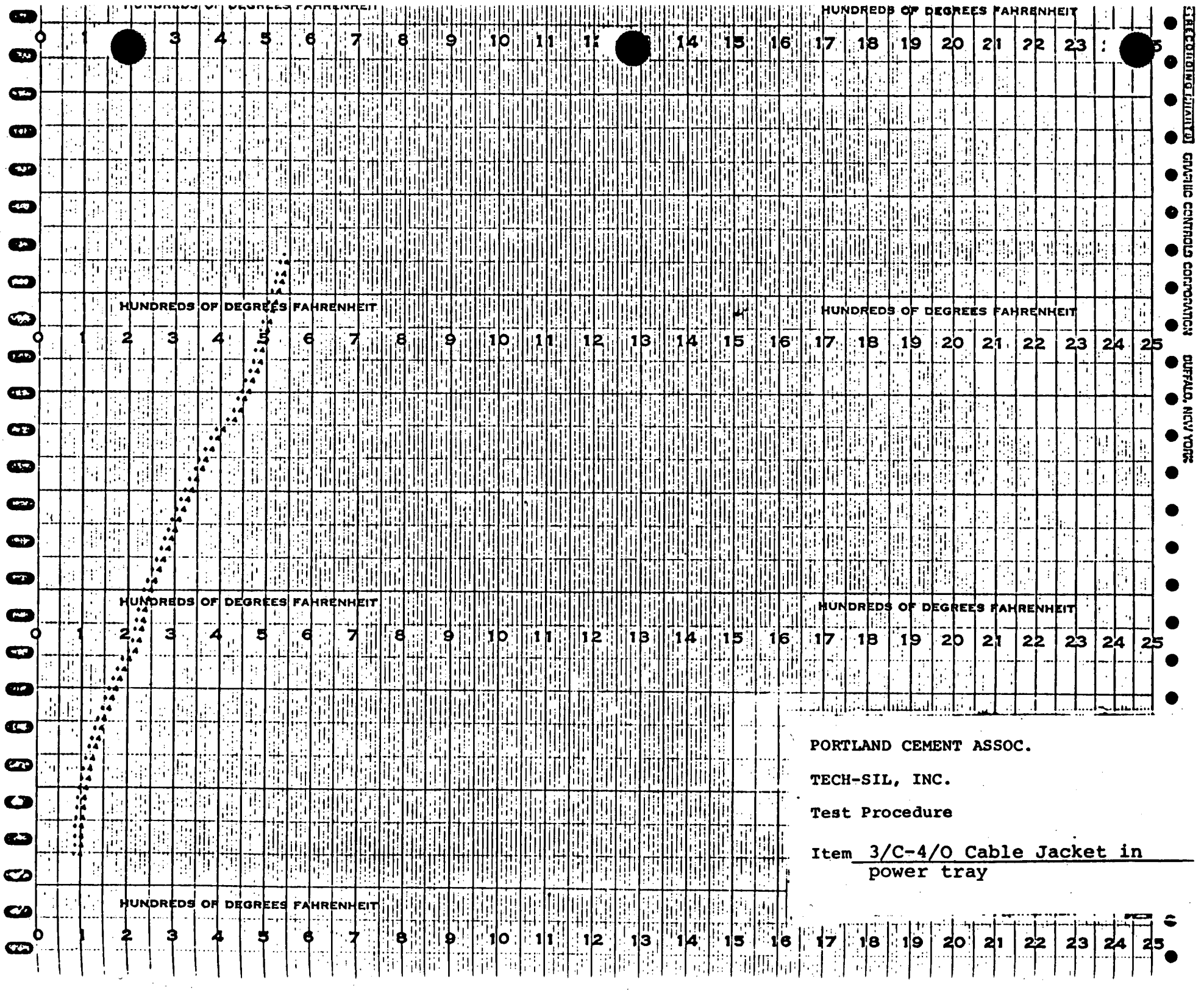


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C-4/0 Cable Conductor in power tray

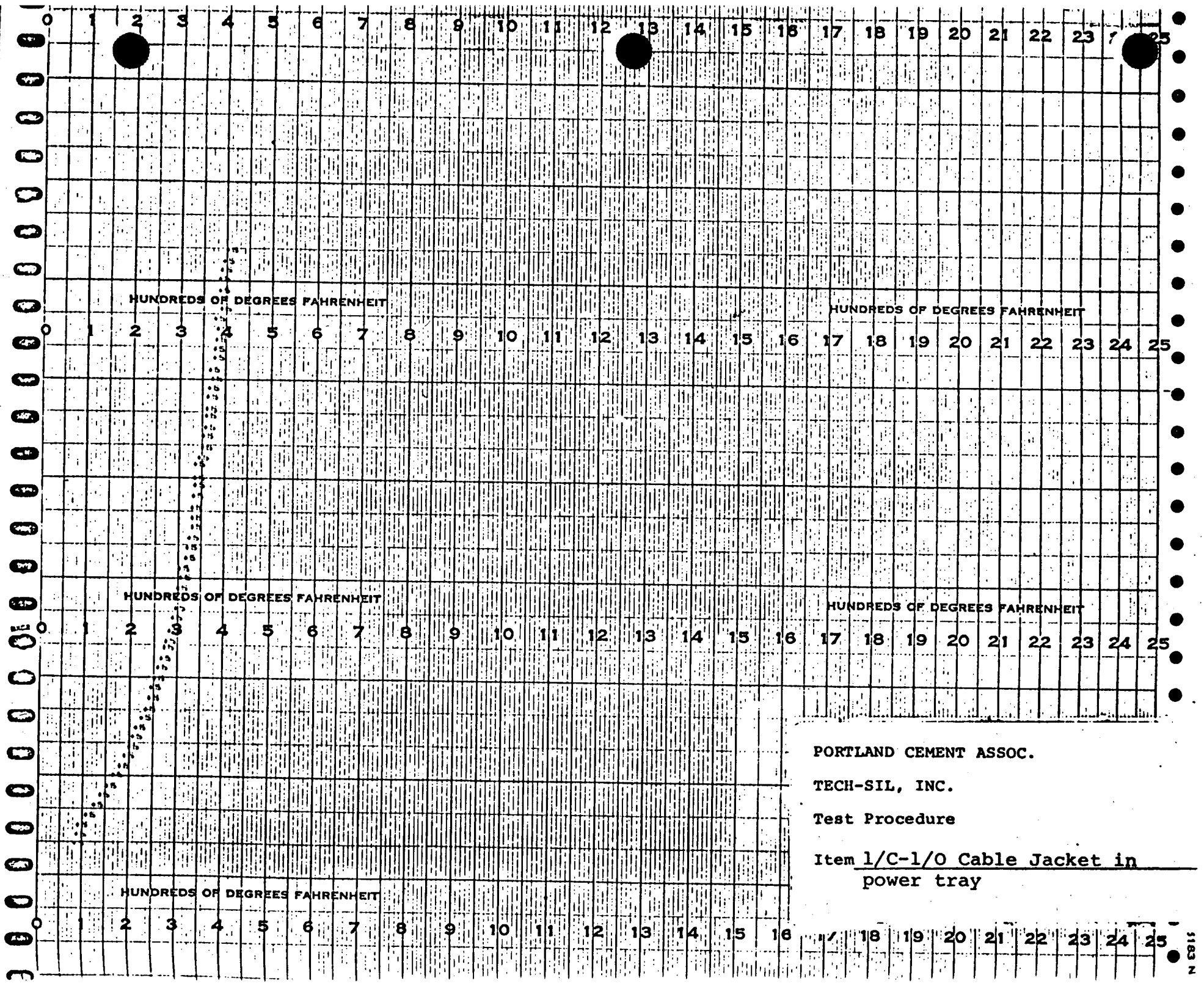


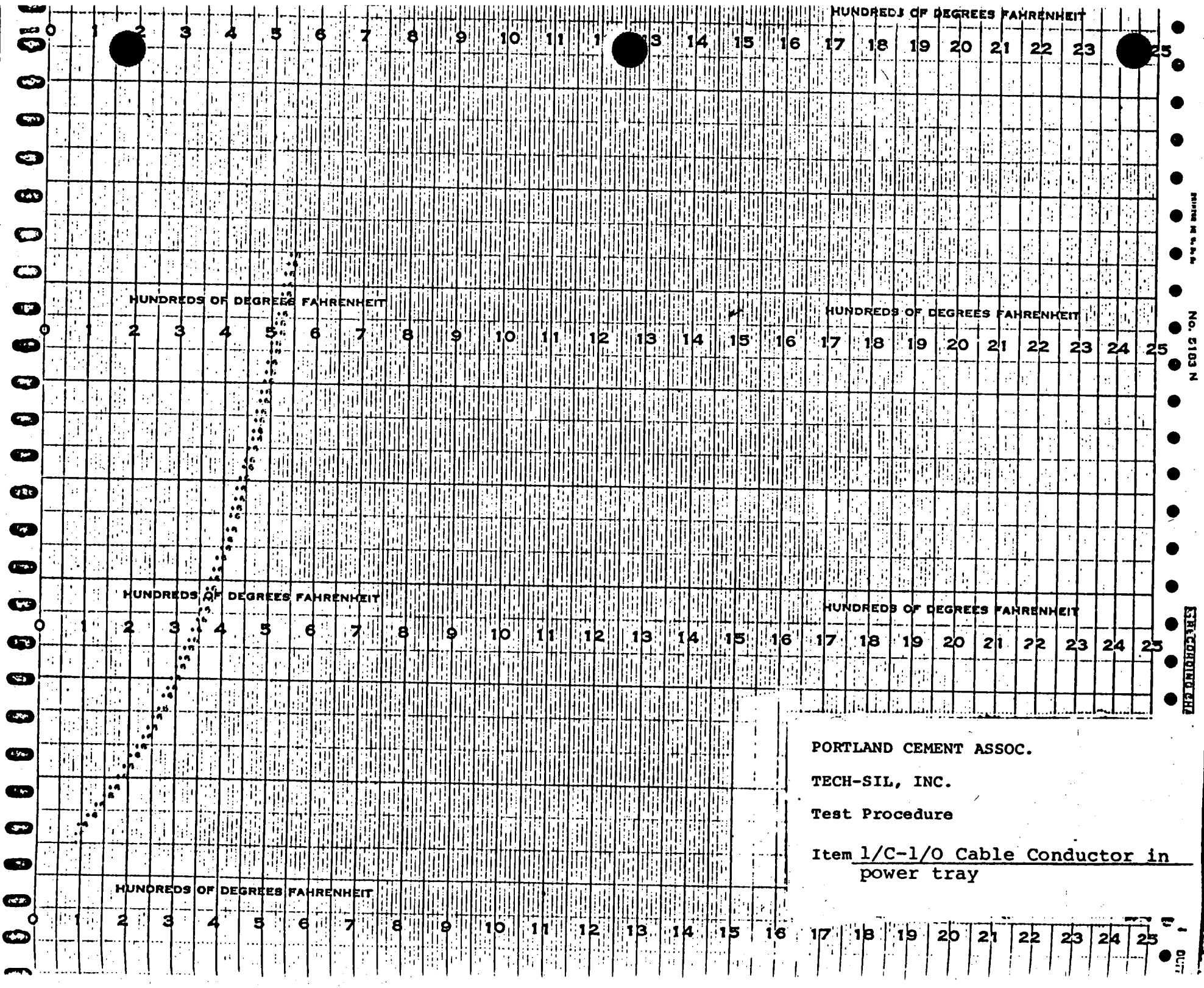
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 3/C-4/O Cable Jacket in power tray


HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item 1/C-1/0 Cable Jacket in power tray

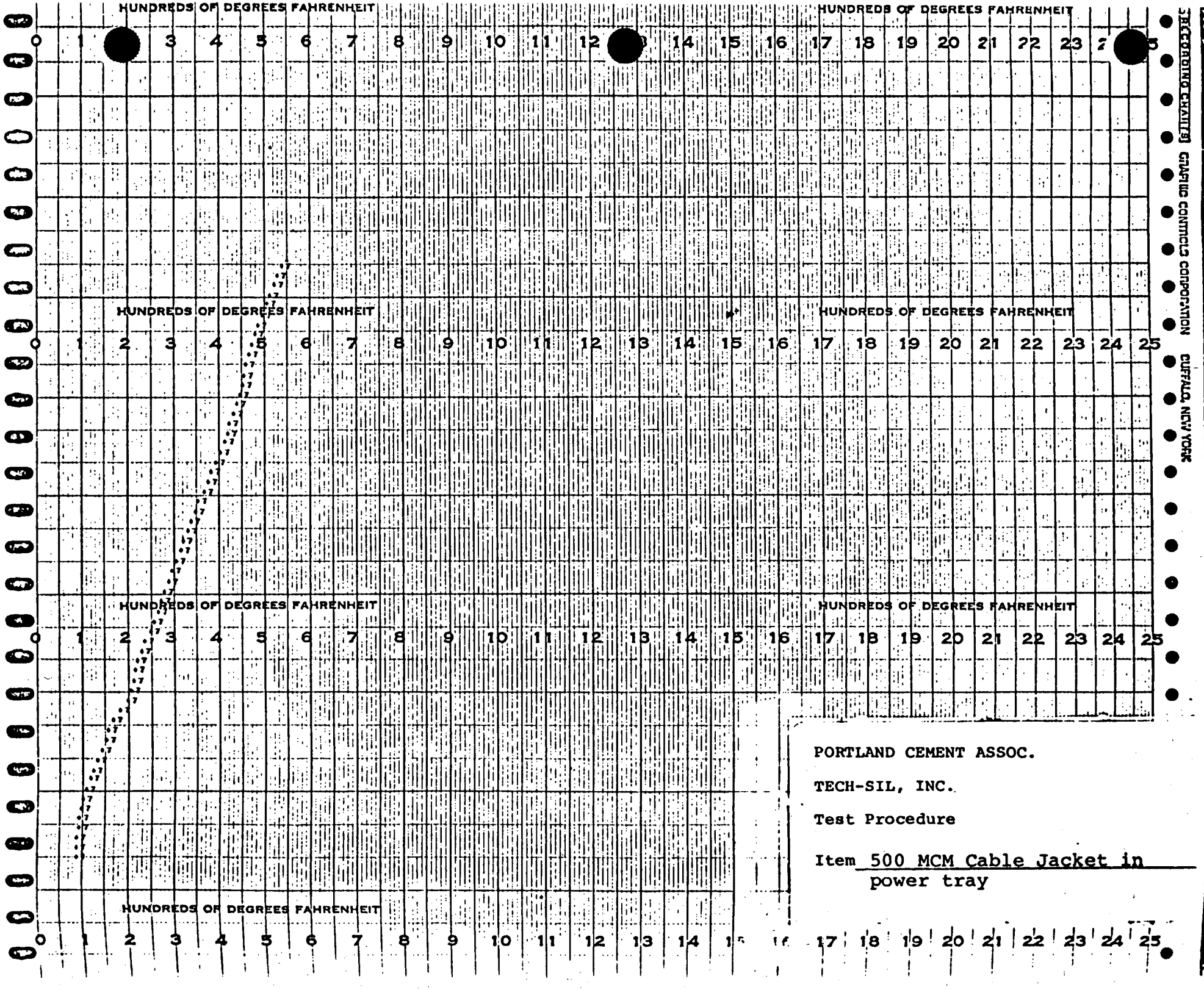


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 1/C-1/0 Cable Conductor in power tray

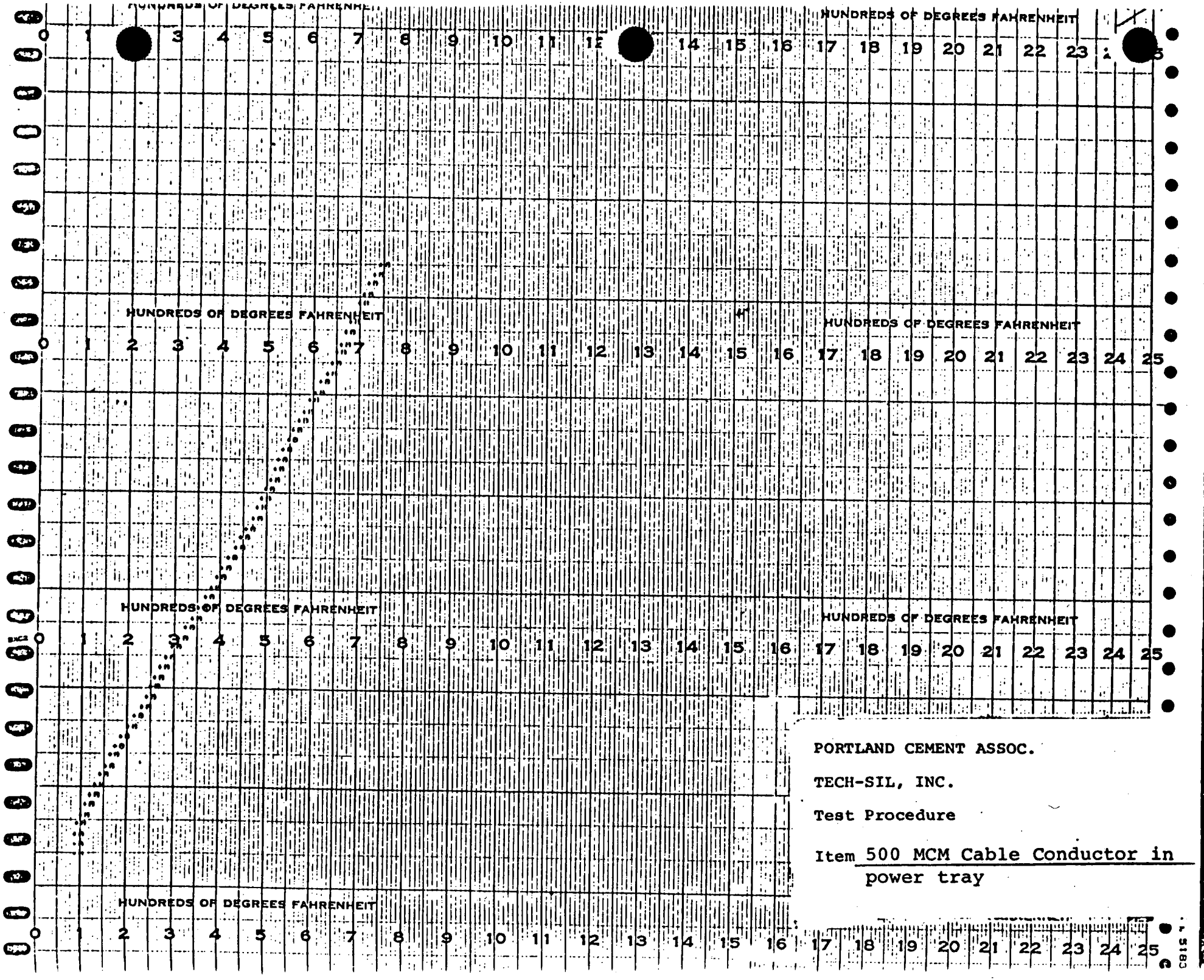


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 500 MCM Cable Jacket in power tray

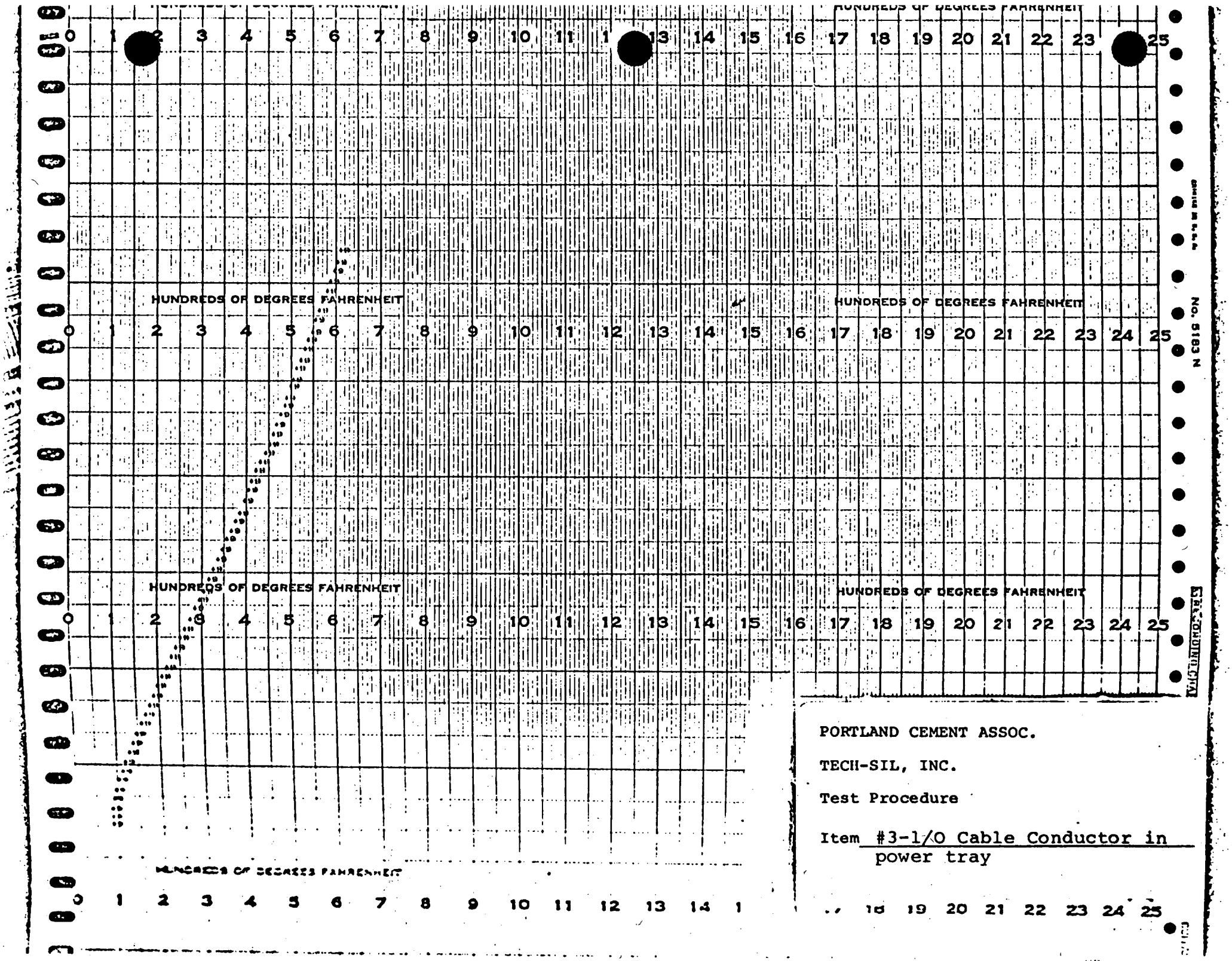


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 500 MCM Cable Conductor in power tray

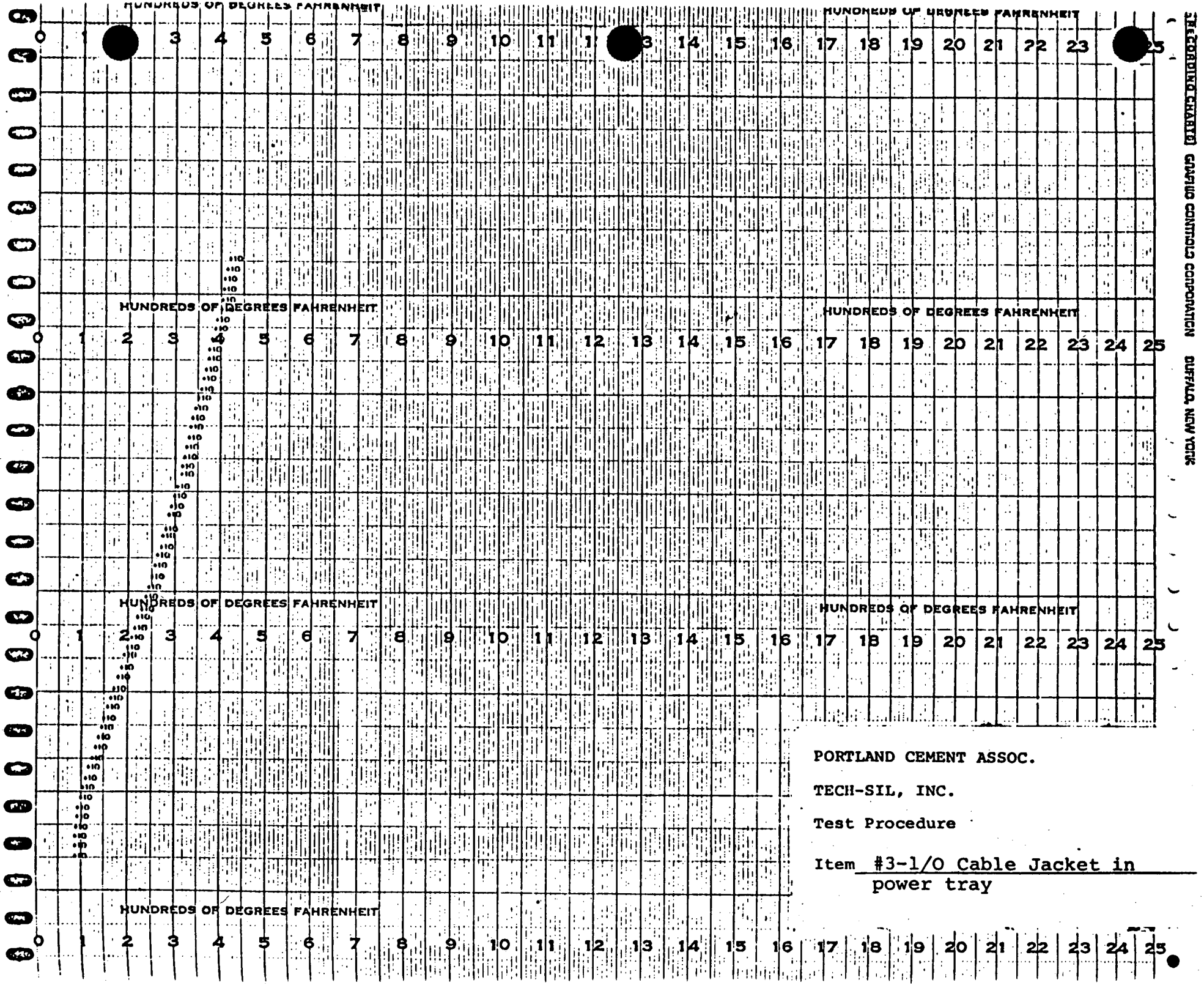


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item #3-1/0 Cable Conductor in power tray

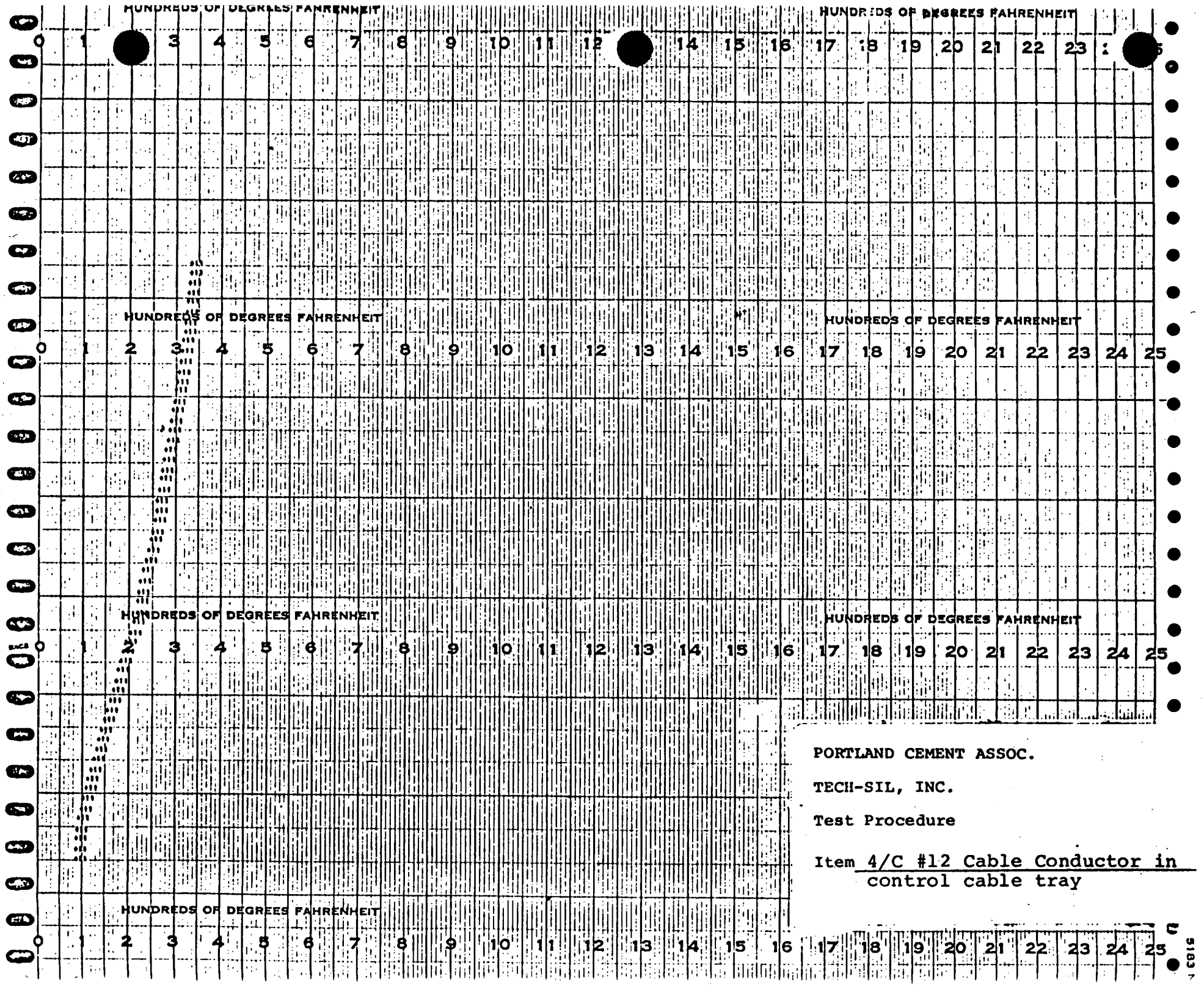


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item #3-1/0 Cable Jacket in power tray

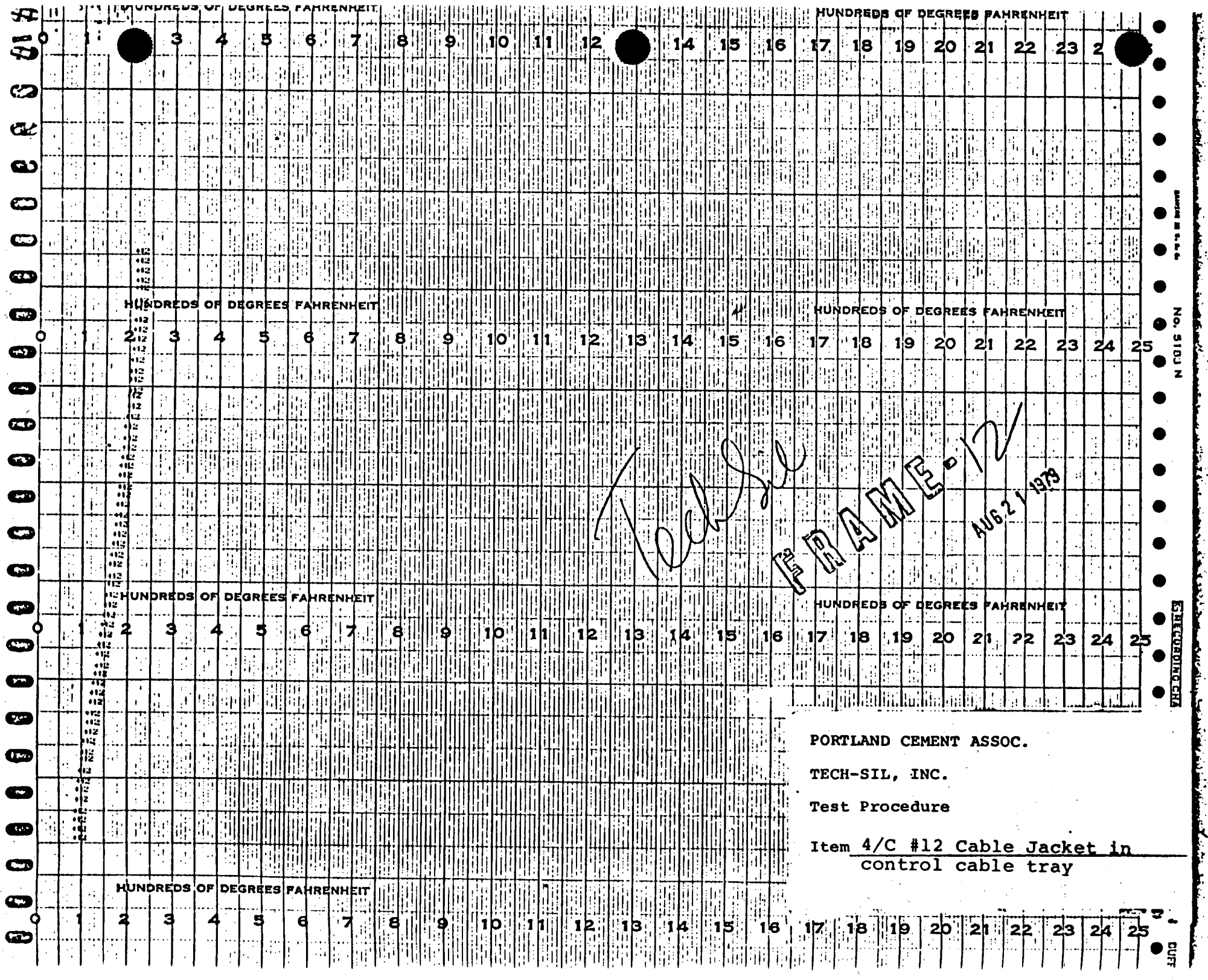


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 4/C #12 Cable Conductor in control cable tray

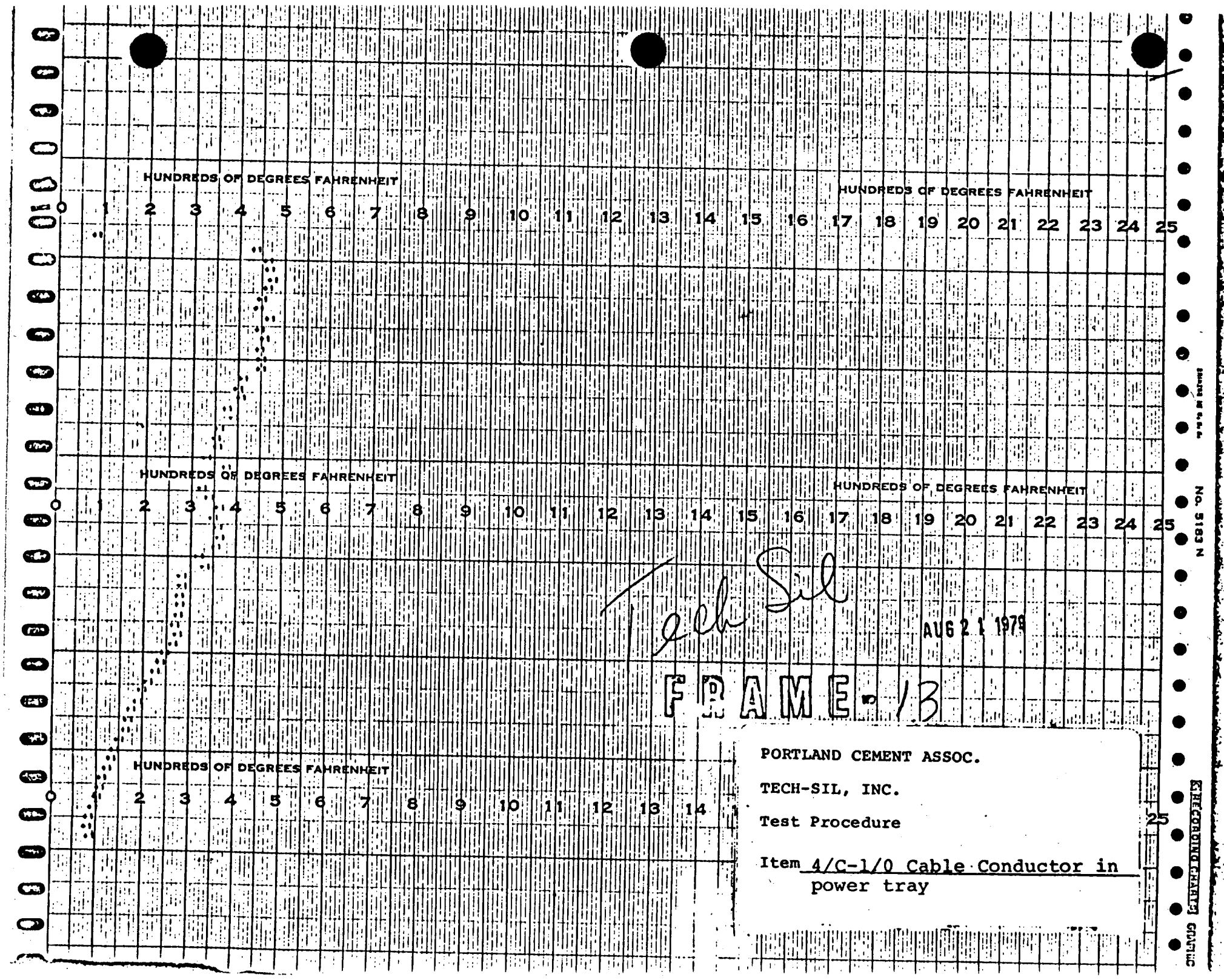


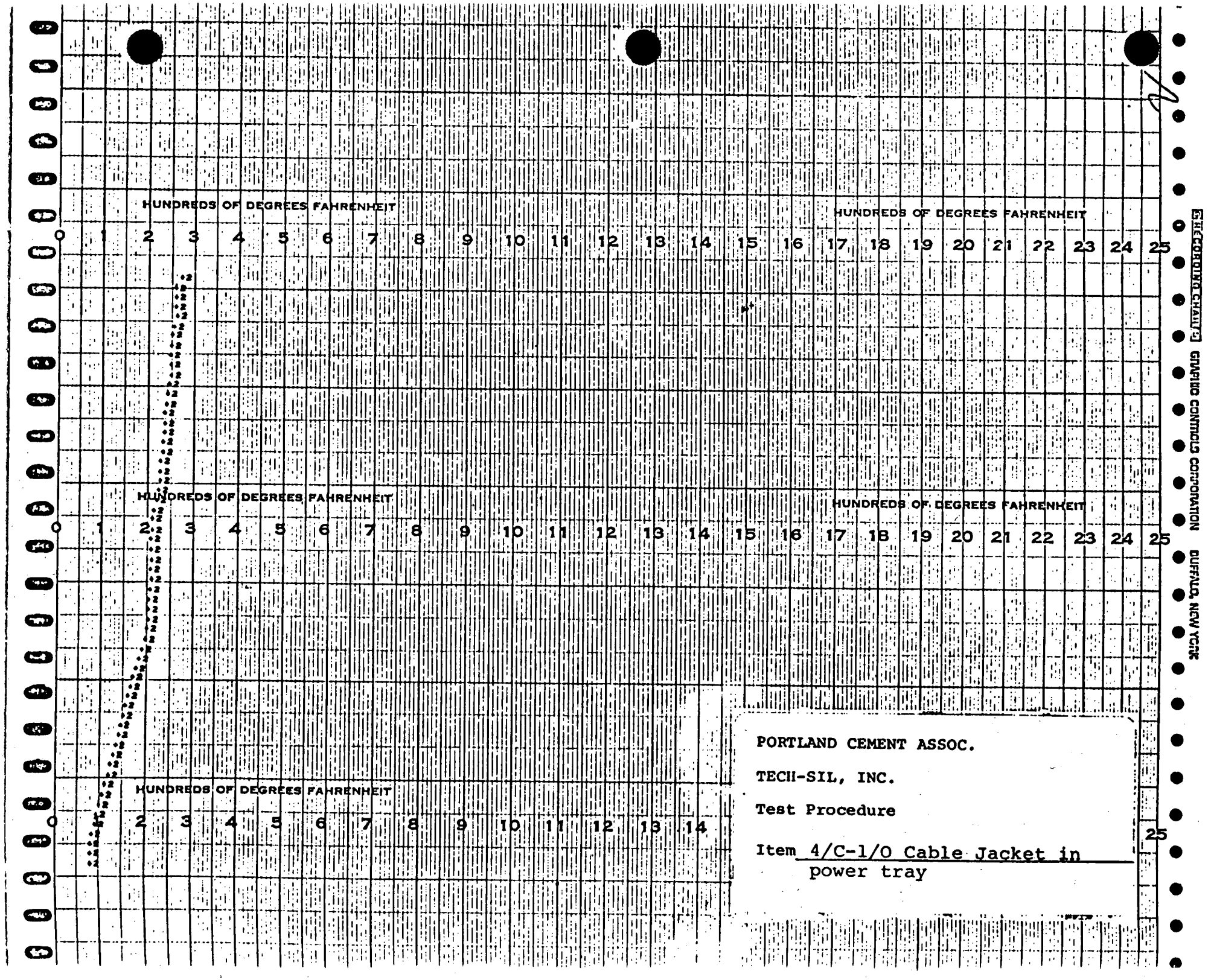
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 4/C #12 Cable Jacket in control cable tray


HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 25
Tech Sil
AUG 2 1 1979
FRAME-13
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item 4/C-1/0 Cable Conductor in power tray
No. 5183 N
THE FORMING CHARTS CO. INC.

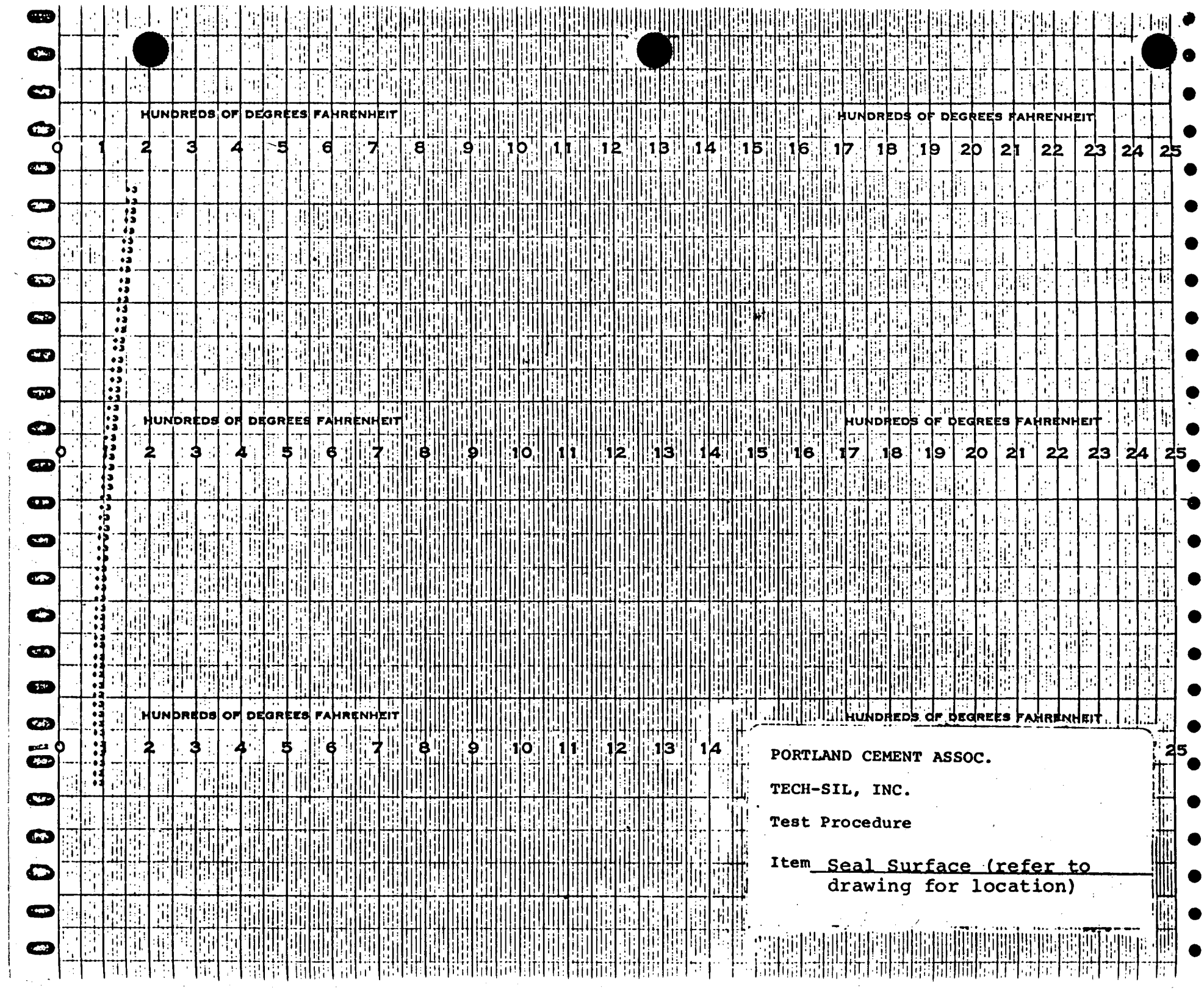


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item 4/C-1/0 Cable Jacket in power tray

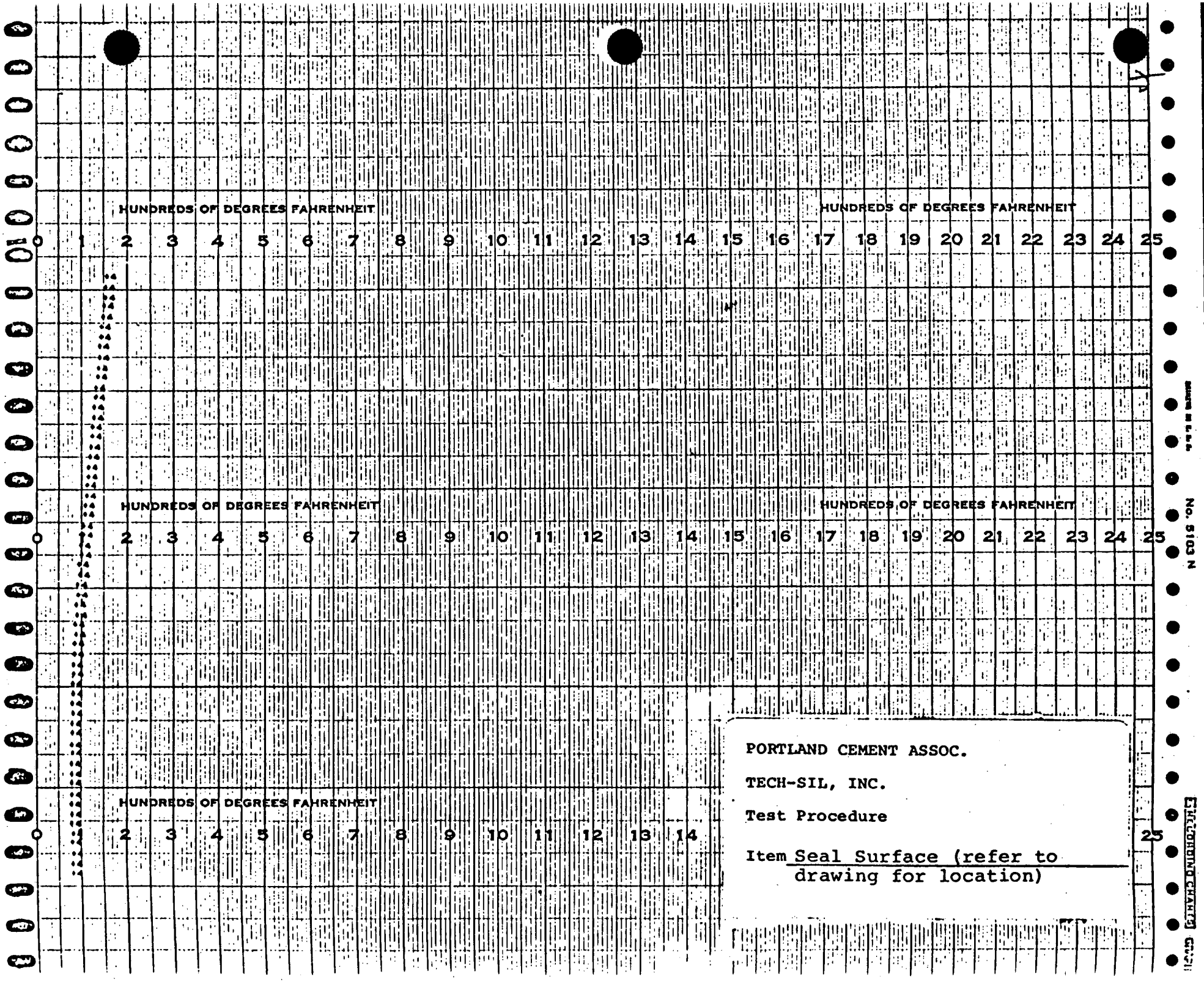


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)

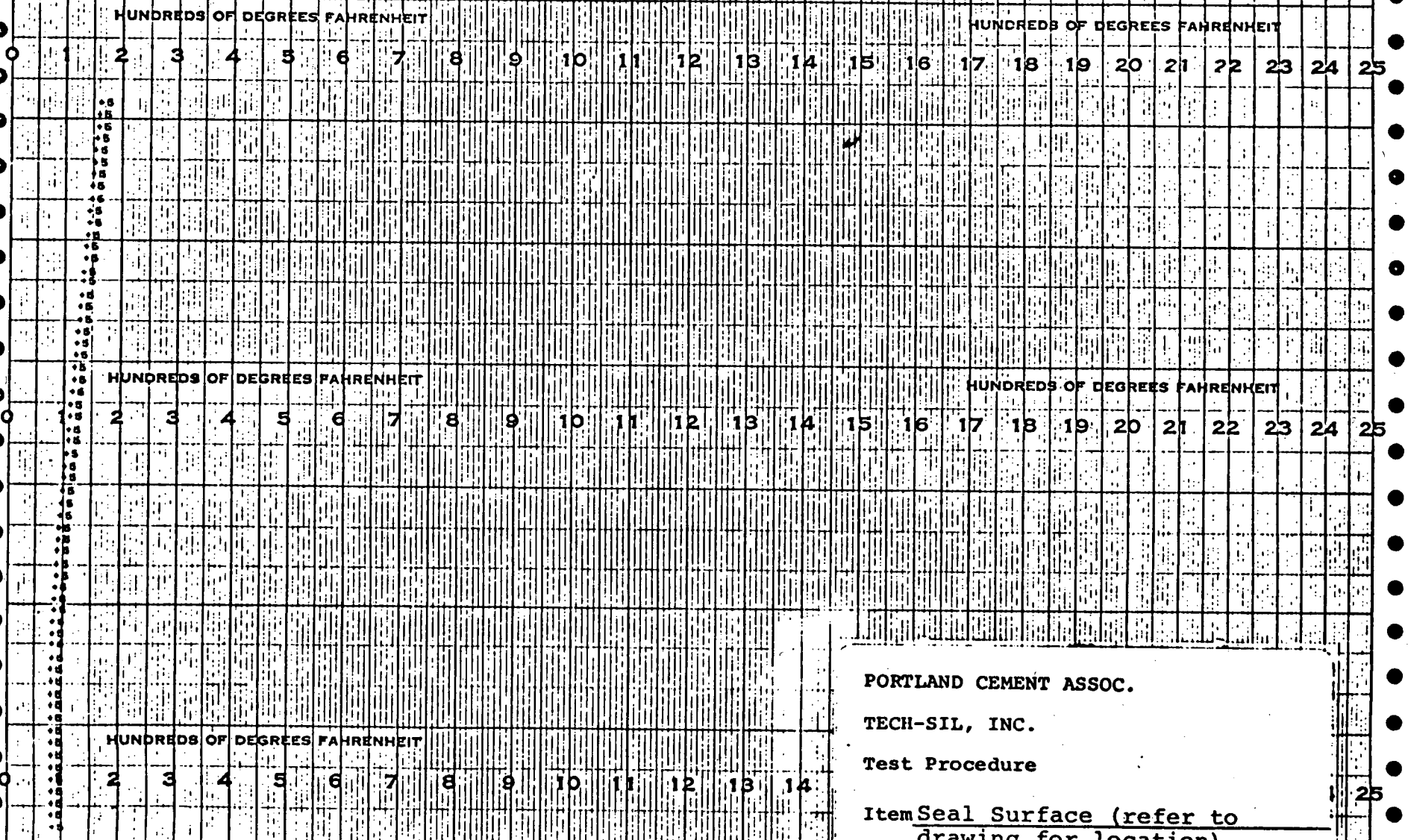


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)



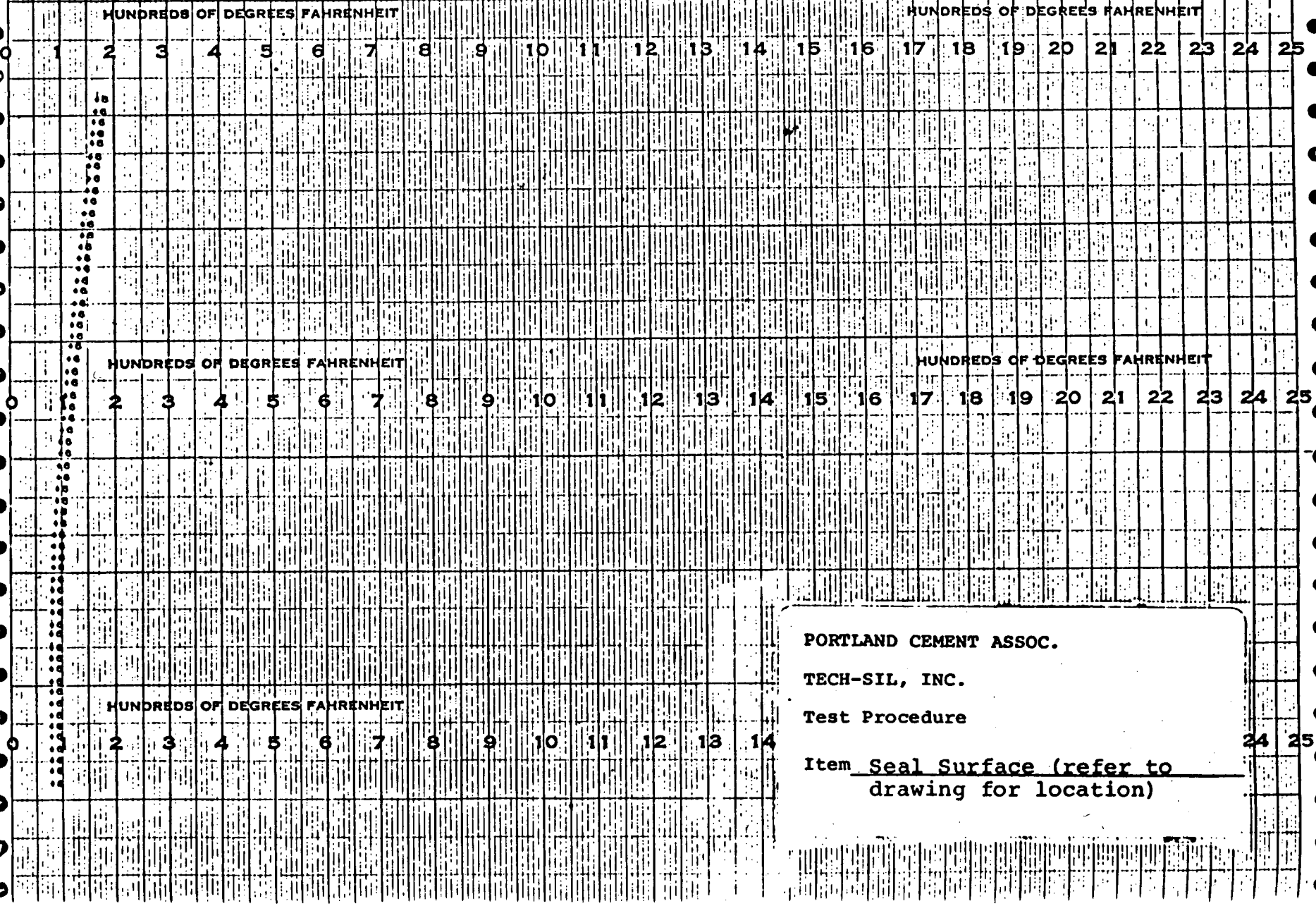
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)

GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

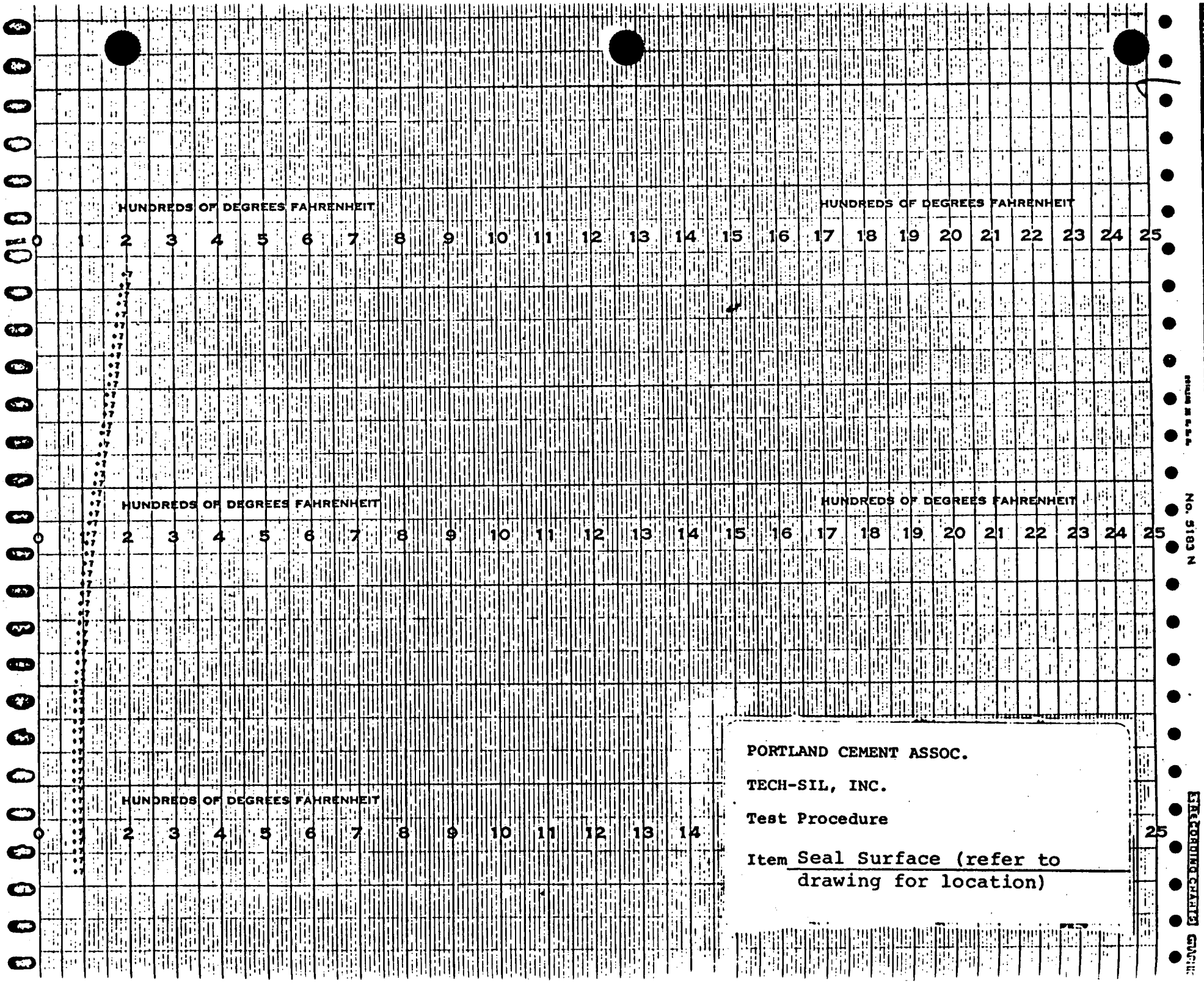


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)

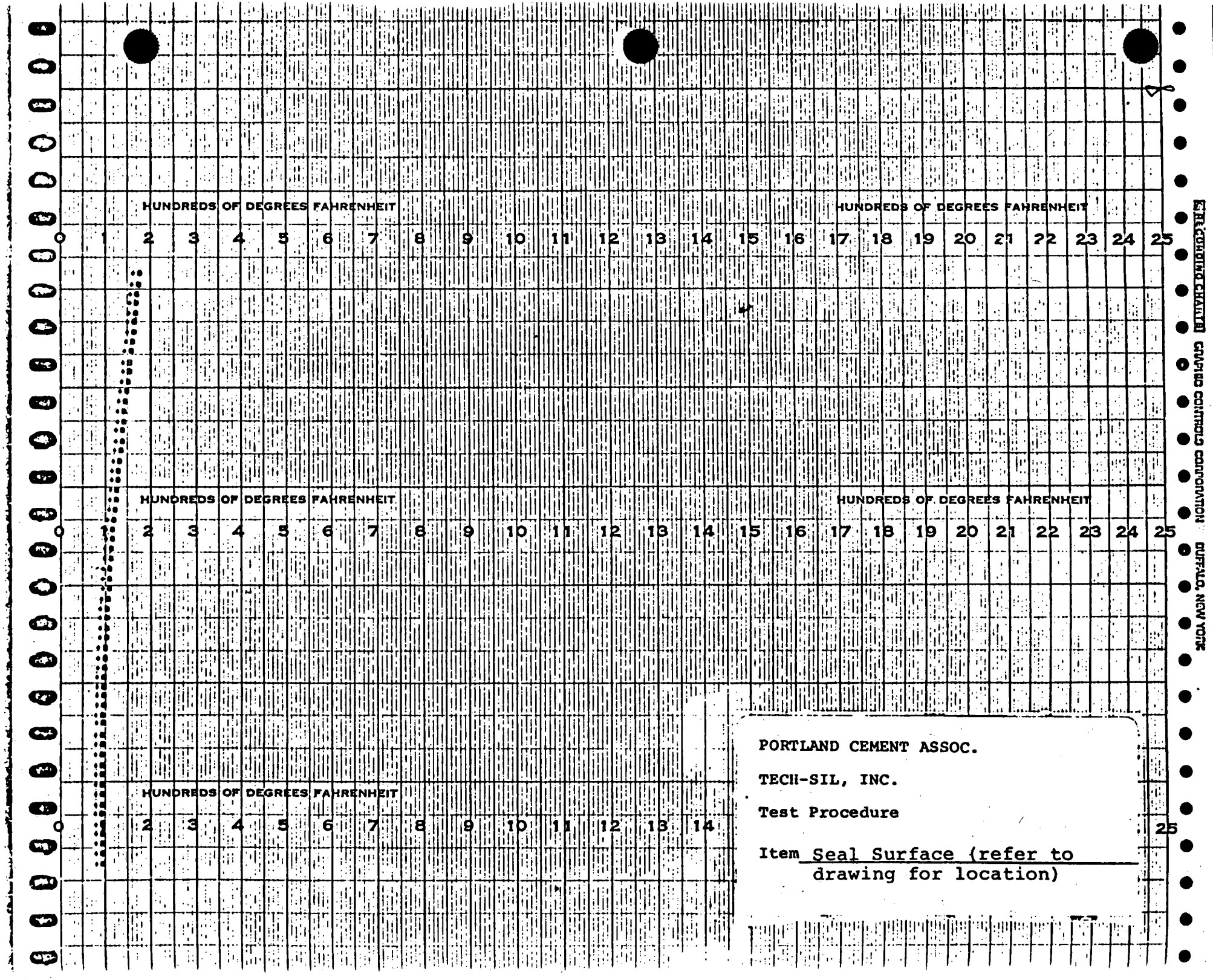


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)


HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
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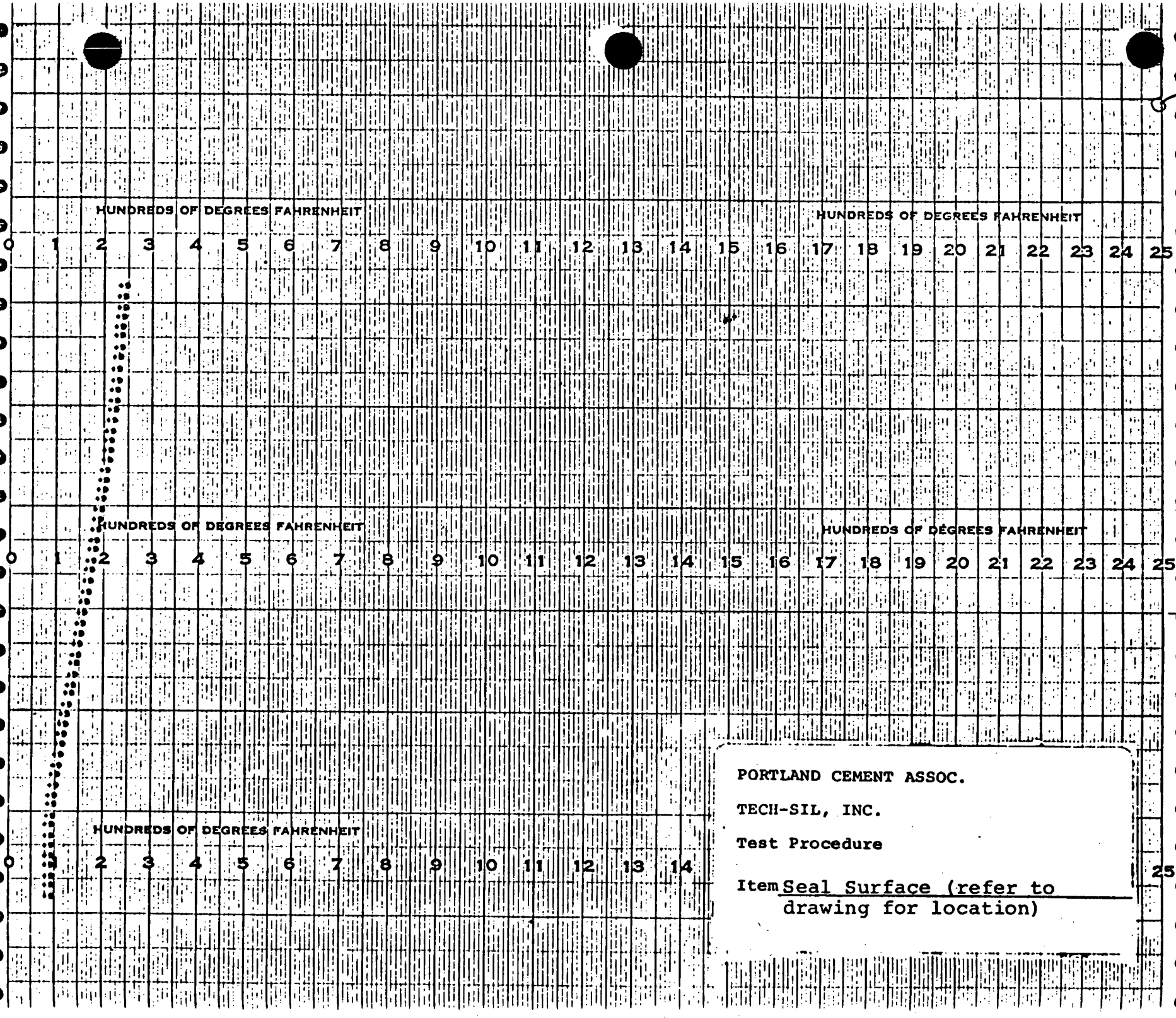
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item Seal Surface (refer to drawing for location)
GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK

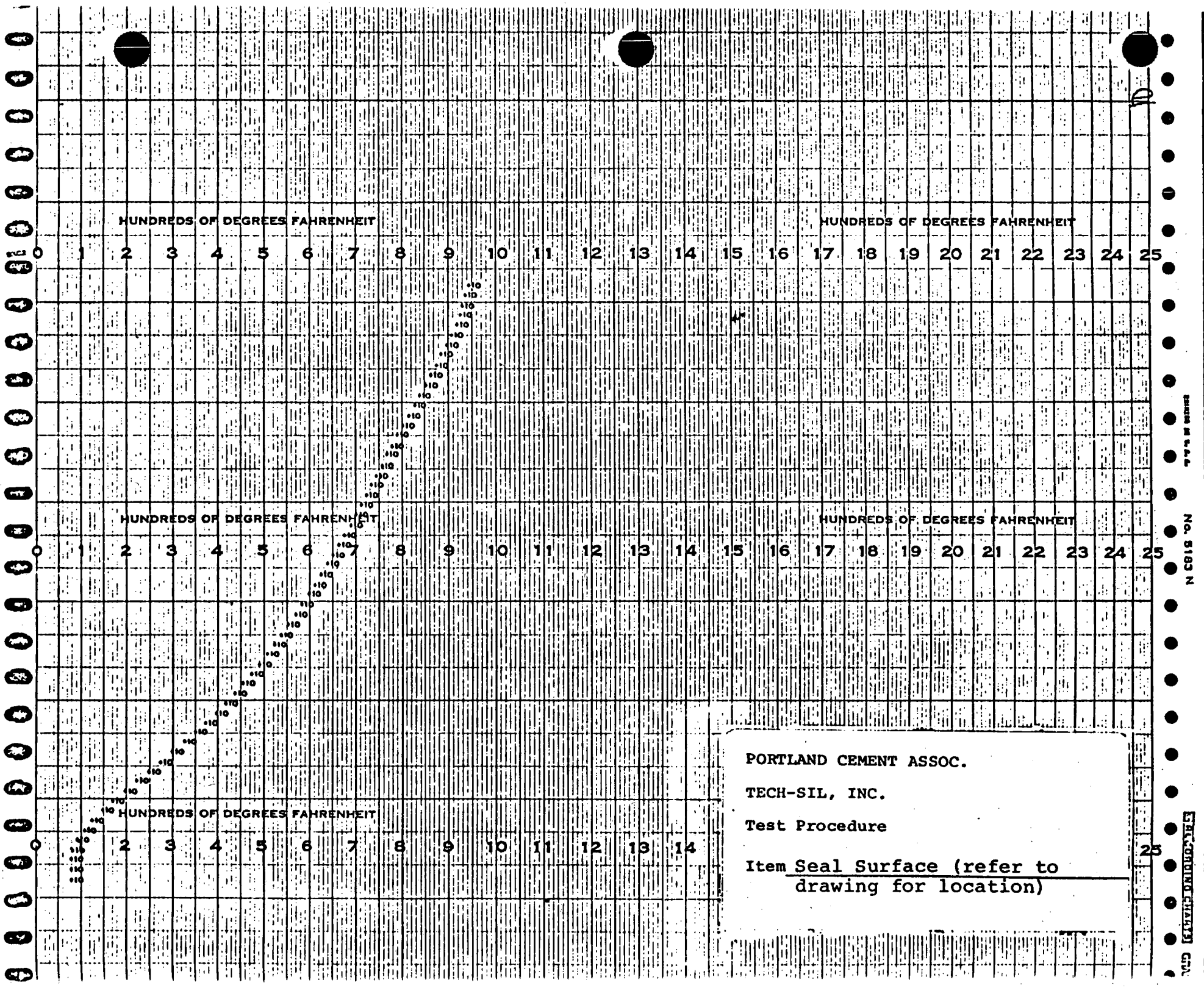


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)

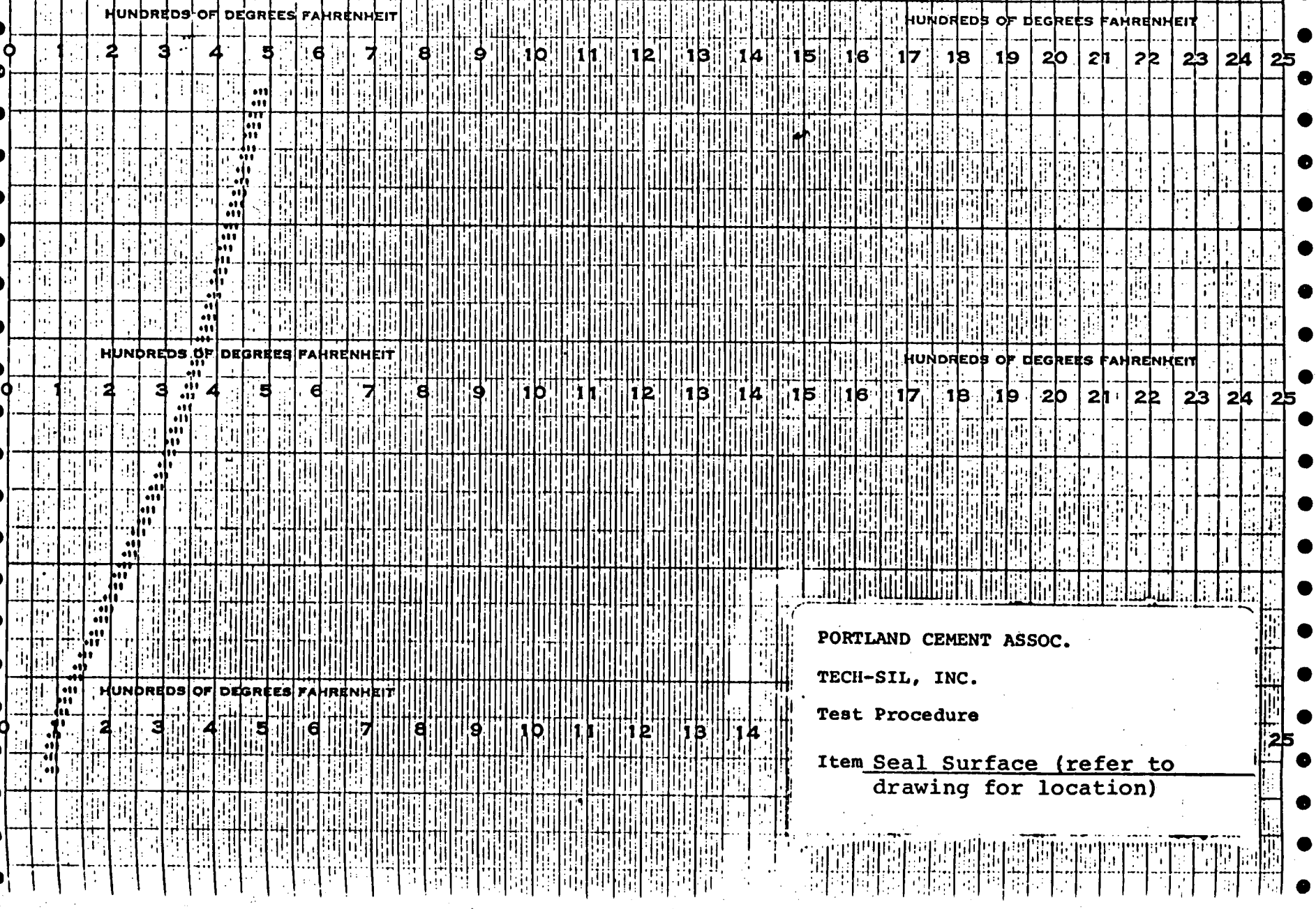


PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)



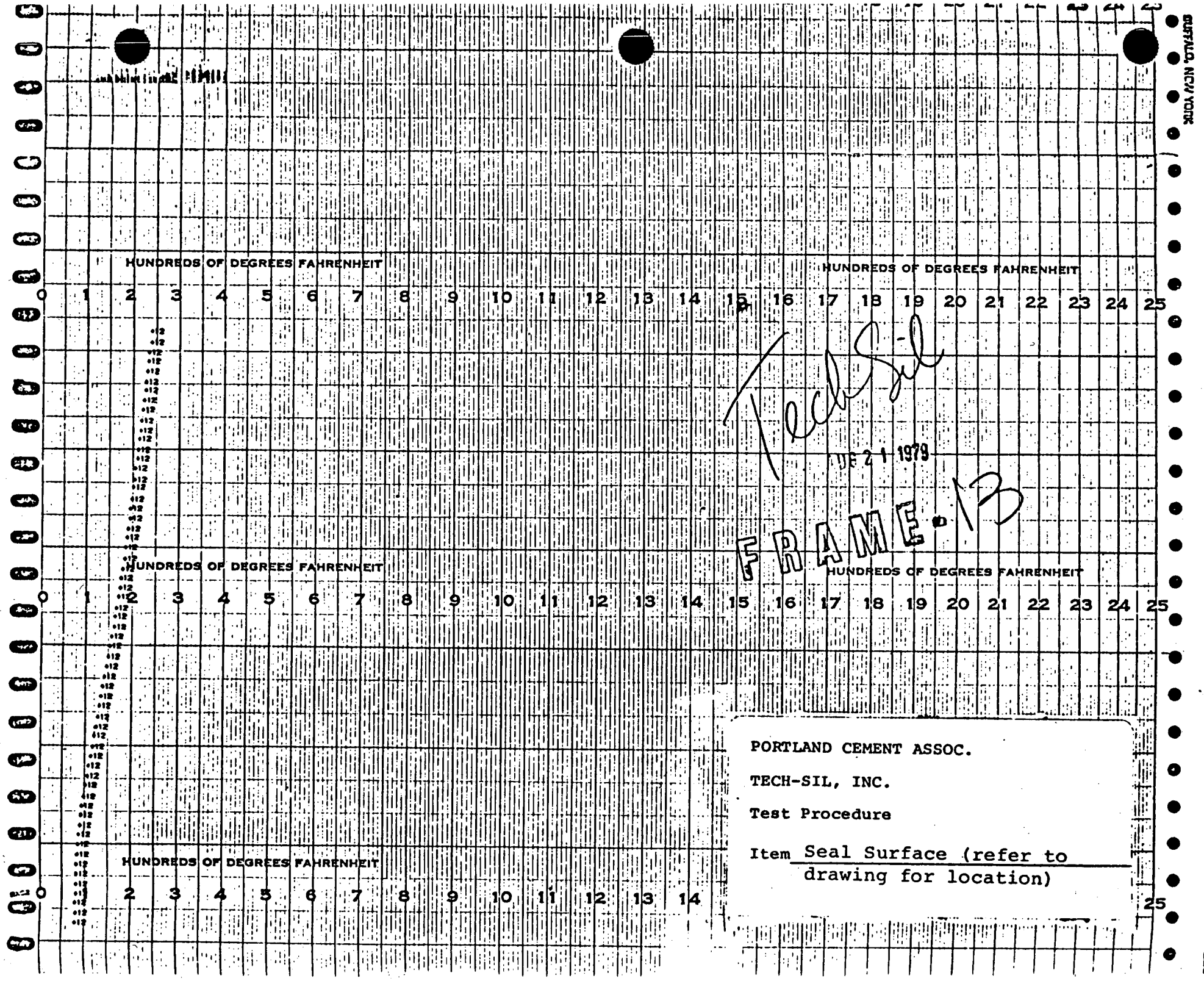
PORTLAND CEMENT ASSOC.

TECH-SIL, INC.

Test Procedure

Item Seal Surface (refer to drawing for location)

GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK


HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 2 3 4 5 6 7 8 9 10 11 12 13 14 25
Tech-Sil
DEC 21 1979
FRAME #13
PORTLAND CEMENT ASSOC.
TECH-SIL, INC.
Test Procedure
Item Seal Surface (refer to drawing for location)

TECH-SIL

TEST NO. 0048-C
FIRE & HOSE STREAM
TEST OF A SINGLE PENETRATION
SEALED WITH #TS-MS-0045-B SILICONE ELASTOMER

NO.	DATE	RELEASE	BY	CK.	CK.	CK.	APP.
1	1/7/85	FOR INFORMATION	SW	MK	DR.		

TEST #TS-TP-0048-C

FIRE & HOSE STREAM

TEST OF A SINGLE PENETRATION

SEALED WITH #TS-MS-0045-B SILICONE ELASTOMER

REVISION #1

Test: #TS-TP-0048-C
By: G.J. Jarosz
Date: 8/26/80

construction technology laboratories
a Division of the PORTLAND CEMENT ASSOCIATION

5420 Old Orchard Road, Skokie, Illinois 60077 • Area Code 312/966-6200

August 29, 1980

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois 60007

Dear Mr. Jarosz:

I have reviewed Test Report #TS-TP-0048-C entitled, "Fire & Hose Stream Test of a Single Penetration Sealed with #TS-MS-0045-B Silicone Elastomer."

The test was conducted on August 26, 1980, in the Fire Research Laboratory, Construction Technology Laboratories, of the Portland Cement Association.

The report accurately describes details of specimen fabrication, test procedures, observations during test, and test results.

Sincerely yours,

Melvin S. Abrams
Director
Fire Research Department

Melvin S. Abrams

kw

Copy to:
W. G. Corley
Central File

CR-4675-4324

AMERICAN NUCLEAR INSURERS MAERP MUTUAL ATOMIC ENERGY REINSURANCE POO

(#TS-TP-0048 A-D)

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
PORTLAND CEMENT ASSOCIATION
SKOKIE, ILLINOIS

TEST DATE: 8/26/80 | HOUR RATING: 3

GENERAL DATA

	PIPE PENETRATIONS - WITH OR WITHOUT INSULATION & ALUMINUM JACI	
Max. Penetration Size	2 - 2" pipes in 14" conc. opening	2 - 2" pipes in 12" steel slee
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	TS-MS-0060-C Leaded Silicone Elastomer; density 140-160 lbs./cu. ft. TS-MS-0045-B Silicone Elastomer Density: 70-95 lbs./cu. ft.	TS-MS-0060-D Leaded Silicone Elastomer Density: 140-160 lbs./cu. ft. TS-MS-0045-A Silicone Elastomer Density 55-65 lbs./cu. ft.
Fire Stop Thickness	9" TS-MS-0060-C Leaded Silicone Elastomer 6" TS-MS-0045-B Silicone Elastomer	9" TS-MS-0060-D Leaded Silicone Elastomer 6" TS-MS-0045-A Silicone Elasto
Form Material	Non-combustible forming material used and removed	Non-combustible forming materia used and removed

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 January 11, 1984
Date Issued

J. J. Carney (KEA)
John J. Carney

1.0 Synopsis:

This report describes a proof in principle fire (and hose stream) test for a single penetration sealing material/seal design. The seal design used here consisted of a six inch thick solid silicone elastomer seal (TECH-SIL, Inc. Part #TS-MS-0045-B) installed flush with the exposed surface of a 12" thick floor slab.

The test was conducted in accordance with current ANI and IEEE fire test standards. Both test standards (the ANI standard fire test for both cable and pipe penetration seals and the IEEE 634-1978 fire test standard for penetration seals) utilize the ASTM E-119 time/temperature curve for conducting the actual 3 hour long fire test. There are minor variations between the two standards (i.e., limiting seal surface temperatures, hose-stream test type and method, etc.). These variations were addressed as part of TECH-SIL's overall test procedure.

The 6" thick #TS-MS-0045-B seal was installed in a 14" diameter cast concrete opening. The opening was equipped with one bare 2" diameter steel pipe and one 2" diameter steel pipe covered with 1" thick calcium silicate thermal insulation.

The #TS-MS-0045-B material is a somewhat rigid material which can be used with relative success for sealing penetrations in concrete walls or floors where overall fire ratings need to be maintained. The material was installed as a liquid, two component material. Once the liquid had turned into a solid, all temporary forming material was removed to leave the symmetrical silicone elastomer seal.

The pass-fail criteria for this test was as follows:

1. That spontaneous combustion not occur on the unexposed surface of the penetration seals for the duration of the three hour fire test.

2. That fire does not penetrate through the seal specimen during the three hour test.

3. That the ASTM E-119 time/temperature curve is maintained for the three hour duration.

4. That the average unexposed seal surface does not exceed 325°F above ambient (ANI test standard).

5. That water does not penetrate or dislodge the seal during the regulation type and period ASTM E-119 hose-stream test (ANI test standard).

6. That water does not penetrate or dislodge the seal during the IEEE regulation type and period hose-stream test (IEEE 634 test standard).

The test was conducted Tuesday, August 26, 1980 at Portland Cement Association (Skokie, Illinois). The test was witnessed by R. Hall and M. Abrams of Portland Cement Association and Gregory J. Jarosz of TECH-SIL, Inc.

2.0 Slab Construction:

A forty-eight by forty-eight by twelve inch thick concrete slab was cast to represent a typical floor section. The penetration used for this test consisted of a fourteen inch diameter cast concrete opening. The test opening was set with three other penetrations which were filled with different types of sealing material (not part of this report).

As part of the slab fabrication, concrete reinforcing bars were embedded in the concrete around the penetration. The type of bar used was an ASTM-A615 grade 60 type steel with a minimum yield strength of 60,000 psi.

The concrete for the slab was mixed, formed and poured by Portland Cement Association personnel. The concrete was made from sand and gravel from Elgin, Illinois (predominately dolmitic aggregate). The sand used had a specific gravity of 2.67, absorption of 2%.

Checks were made for concrete slump, unit weight and air content. Batch quantities, properties of plastic concrete, and strength were approximately the following:

Average slump, (in.): . . . . . 3-1/2"
Average air content (%):. 4%
Average fresh unit weight:. . . . . 145 lbs./cu.ft.
Average compressive strength
@ 28 days: 4,000

The concrete was mixed at Portland Cement Association's test laboratory with a tilting drum mixer, distributed into the form around the penetration with an overhead dump bucket, and consolidated with an internal vibrator. The top surface was leveled with a wooden float and finished with a magnesium float.

3.0 Penetrating Members:

The test opening was penetrated by one 2" diameter bare steel pipe and one 2" diameter steel pipe covered with one inch thick calcium silicate (Johns-Manville) insulation and aluminum jacketing. Each pipe (and insulation ended 12" below the exposed surface of the slab and approximately 30" above the slab's unexposed surface.

4.0 Seal Type:

The penetration for this test was sealed with #TS-MS-0045-B silicone elastomer. The elastomer was installed six inches thick and located flush with exposed surface of the test slab. This was done to demonstrate the worst case condition whereby the seal is placed at its closest position to the fire source. In normal field installations, the seal would be installed flush with the top surface of a floor or flush with either side of a wall.

This opening and seal design was tested as a floor penetration in order to qualify its use in both floors and walls.

5.0 Thermocouples:

Three thermocouples were mounted to the unexposed surface of the seal specimen surface. Each thermocouple tip was protected with a small strip of mineral wool insulation (so that ambient temperatures would not affect seal surface temperature documentation). Small weights were placed on the patches of mineral wool to ensure thorough protection.

Thermocouples were also attached to the bare pipe, insulated pipe and seal/concrete substrate interface surfaces. These were also covered with small patches of mineral wool (either tied to the pipes or weighted over the seal/concrete substrate surfaces). Each of these three thermocouples were installed flush with the elastomer seals surface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. Results of these recordings are shown in Section 10.0 of this report.

The thermocouples used in this test are identified as follows:

T/C #13: Seal Surface . . . . . (247°F end point temp.)
T/C #14: Seal Surface . . . . . (249°F end point temp.)
T/C #15: Seal Surface . . . . . (242°F end point temp.)
T/C #16: Bare Pipe. . . . . (690°F end point temp.)
T/C #17: Insulated Pipe . . . . . (583°F end point temp.)
T/C #18: Seal/Substrate Interface (322°F end point temp.)

Three ceramically shielded thermocouples were also used in side of the test furnace (permanently mounted). These are described in Section 6.0. Furnace atmosphere records are also shown in Section 10.0.

6.0 Fire Test:

The fire test portion of the test procedure consisted of subjecting the test slab and seal specimens to a three hour long ASTM E-119 time/temperature curve fire test. For this, slab was placed on a small floor furnace.

Simply described, the furnace used for this type of test is a square shaped, refractory brick lined steel box heated by four gas burners (one on each side of the furnace). The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by three shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures were also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft as a result of fuel contribution and temperature variables) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

7.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas.

Throughout the test, an even blanket of flame was produced in the furnace. No smoke, fire, steam, etc. was noted from this seal specimen for the duration of the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and placed on its side for the hose-stream tests.

8.0 Hose-Stream Tests:

The first hose-stream was performed according to the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and a half inch diameter hose through a 30-90° set at 30° high velocity spray nozzle at seventy-five psi from a distance of ten feet.

The second hose-stream test was performed according to the ASTM E-119 test standard. Water was sprayed on the exposed surface of the 48" x 48" slab (with an exposed surface area of 30" x 30") for 12 seconds using a solid stream of water discharged from a two and half inch diameter hose through a one and one eighth inch diameter National Playpipe Nozzle at thirty psi from a distance of twenty feet.

9.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the fire test, fire did not occur on the unexposed surface as a result of heat conduction.

D. Seal surface thermocouples readings at the test conclusion were as follows:

T/C #13 = 247°F
T/C #14 = 249°F
T/C #15 = 242°F

E. That during the ASTM E-119 hose-stream test, water did not penetrate through the penetration seal.

F. That during the IEEE 634-1978 hose-stream test, water did not penetrate through the penetration seal.

G. It was noted that approximately 2-3" of flexible silicone elastomer remained intact inside of the penetration. Most of the char layer had been dislodged by the solid stream (ASTM E-119) hose stream test. Most of the pipe insulation (from the exposed surface) had been destroyed and dislodged from the pipe by the ASTM E-119 type hose stream test.

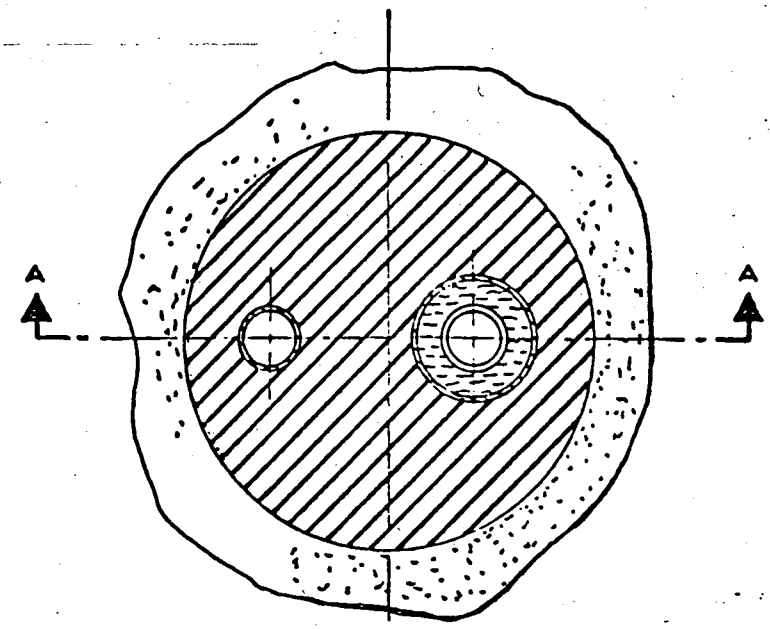
H. The unexposed surface of the seal suffered no visual change. This seal surface along with the pipe insulation passing through it remained completely intact at the conclusion of the fire and both hose stream tests.

TECH-SIL (CR4675) - 08/26/80
UNEXPOSED SURFACE TEMPERATURES (DEG F)

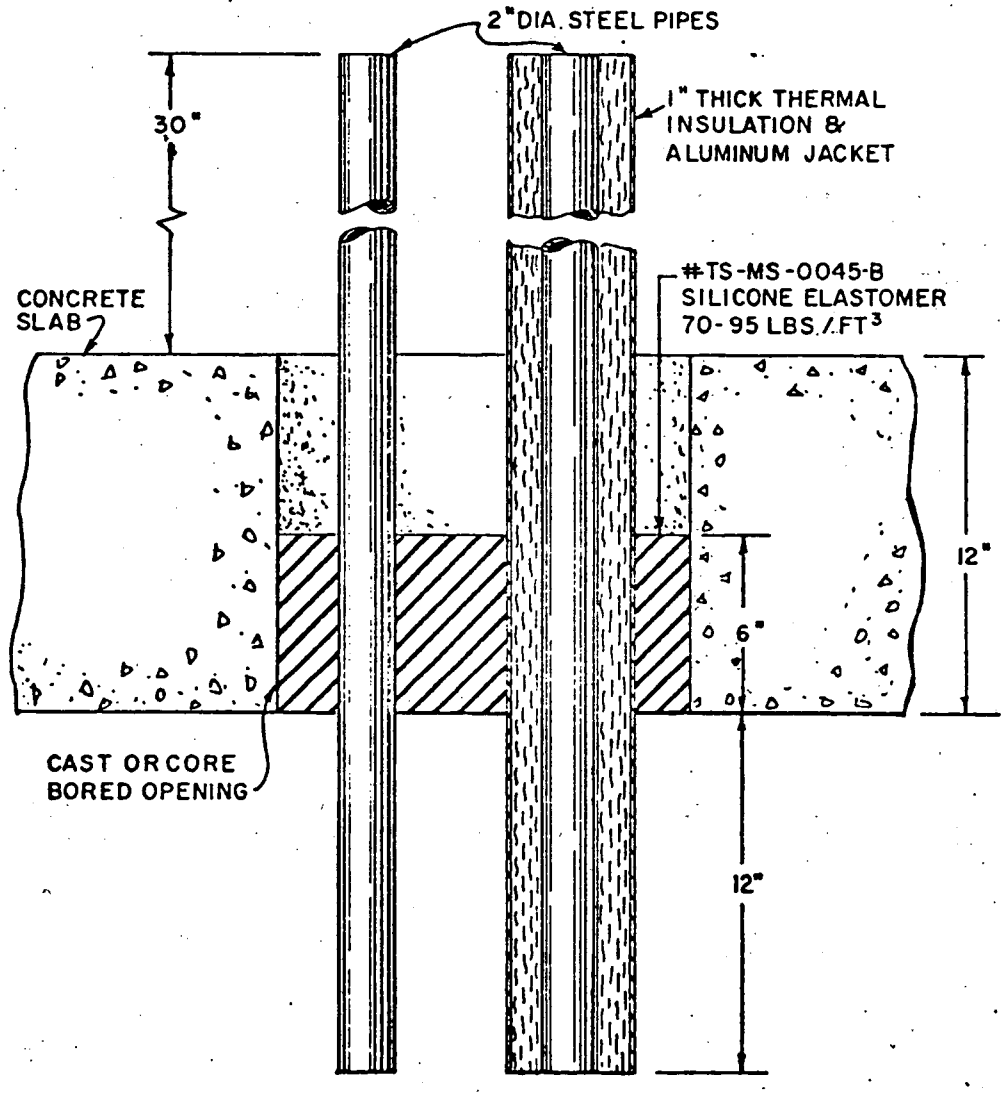
TEST TIME, Hr:Min	T/C NO.					
	13	14	15	16	17	18
0:00	79	79	79	79	79	79
0:05	79	79	79	90	109	79
0:10	79	79	79	123	140	79
0:15	79	79	79	169	169	79
0:20	79	80	79	217	196	80
0:25	80	81	80	260	219	81
0:30	81	83	81	296	239	84
0:35	82	86	82	327	255	90
0:40	84	90	83	352	270	98
0:45	86	94	85	375	284	107
0:50	89	99	87	397	302	117
0:55	92	104	90	419	324	128
1:00	95	109	93	443	347	138
1:05	99	115	97	471	369	148
1:10	104	121	101	495	386	158
1:15	109	127	106	516	402	168
1:20	114	134	111	533	417	178
1:25	121	140	117	546	430	189
1:30	127	147	124	557	442	199
1:35	134	153	130	569	452	208
1:40	140	160	137	578	463	211
1:45	147	167	145	587	473	212
1:50	155	174	152	595	483	213
1:55	162	180	159	603	492	217
2:00	169	186	166	613	501	223
2:10	183	198	180	632	516	236
2:20	197	210	193	650	531	251
2:30	210	220	205	661	544	268
2:40	223	231	218	669	557	287
2:50	235	240	229	681	570	305
3:00	247	249	242	690	583	322

TECH-SIL (CR4675) - 08/26/80
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	80	68	12
0:05	1028	1000	28
0:10	1285	1300	-15
0:15	1410	1399	11
0:20	1484	1462	22
0:25	1481	1510	-29
0:30	1551	1550	1
0:35	1581	1584	-3
0:40	1608	1613	-5
0:45	1636	1638	-2
0:50	1653	1661	-8
0:55	1679	1681	-2
1:00	1705	1700	5
1:05	1715	1718	-3
1:10	1735	1735	-0
1:15	1739	1750	-11
1:20	1770	1765	5
1:25	1770	1779	-9
1:30	1792	1792	-0
1:35	1801	1804	-3
1:40	1802	1815	-13
1:45	1826	1826	0
1:50	1832	1835	-3
1:55	1833	1843	-10
2:00	1856	1850	6
2:10	1872	1862	10
2:20	1885	1875	10
2:30	1887	1888	-1
2:40	1898	1900	-2
2:50	1908	1912	-4
3:00	1924	1925	-1



PLAN



SECTION A-A

TECH-SIL, INC.

TEST #TS-TP-0048-C

TEST #TS-TP-0048-C

FIRE & HOSE STREAM

TEST OF A SINGLE PENETRATION

SEALED WITH #TS-MS-0045-B SILICONE ELASTOMER

Test: #TS-TP-00
By: G. J. Jar
Date: 8/26/80

construction technology laboratories
a Division of the PORTLAND CEMENT ASSOCIATION

5420 Old Orchard Road, Skokie, Illinois 60077 • Area Code 312/966-62

August 29, 1980

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois 60007

Dear Mr. Jarosz:

I have reviewed Test Report #TS-TP-0048-C entitled, "Fire & Hose Stream Test of a Single Penetration Sealed with #TS-MS-0045-B Silicone Elastomer."

The test was conducted on August 26, 1980, in the Fire Research Laboratory, Construction Technology Laboratories, of the Portland Cement Association.

The report accurately describes details of specimen fabrication, test procedures, observations during test, and test results.

Sincerely yours,

Melvin S. Abrams

Director
Fire Research Department

Melvin S. Abrams

kw

Copy to:
W. G. Corley
Central File

CR-4675-4324

TECH-SIL INC.

1.0 Synopsis:

This report describes a proof in principle fire (and hose stream) test for a single penetration sealing material/seal design. The seal design used here consisted of a six inch thick solid silicone elastomer seal (TECH-SIL, Inc. Part #TS-MS-0045-B) installed flush with the exposed surface of a 12" thick floor slab.

The test was conducted in accordance with current ANI and IEEE fire test standards. Both test standards (the ANI standard fire test for both cable and pipe penetration seals and the IEEE 634-1978 fire test standard for penetration seals) utilize the ASTM E-119 time/temperature curve for conducting the actual 3 hour long fire test. There are minor variations between the two standards (i.e., limiting seal surface temperatures, hose-stream test type and method, etc.). These variations were addressed as part of TECH-SIL's overall test procedure.

The 6" thick #TS-MS-0045-B seal was installed in a 14" diameter cast concrete opening. The opening was equipped with one bare 2" diameter steel pipe and one 2" diameter steel pipe covered with 1" thick calcium silicate thermal insulation.

The #TS-MS-0045-B material is a somewhat rigid material which can be used with relative success for sealing penetrations in concrete walls or floors where overall fire ratings need to be maintained. The material was installed as a liquid, two component material. Once the liquid had turned into a solid, all temporary forming material was removed to leave the symmetrical silicone elastomer seal.

The pass-fail criteria for this test was as follows:

1. That spontaneous combustion not occur on the unexposed surface of the penetration seals for the duration of the three hour fire test;

2. That fire does not penetrate through the seal specimen during the three hour test;

3. That the ASTM E-119 time/temperature curve is maintained for the three hour duration;

4. That the average unexposed seal surface does not exceed 325°F above ambient (ANI test standard);

5. That water does not penetrate or dislodge the seal during the regulation type and period ASTM E-119 hose-stream test (ANI test standard);

6. That water does not penetrate or dislodge the seal during the IEEE regulation type and period hose-stream test (IEEE 634 test standard);

The test was conducted Tuesday, August 26, 1980 at Portland Cement Association (Skokie, Illinois). The test was witnessed by R. Hall and M. Abrams of Portland Cement Association and Gregory J. Jarosz of TECH-SIL, Inc.

2.0 Slab Construction:

A forty-eight by forty-eight by twelve inch thick concrete slab was cast to represent a typical floor section. The penetration used for this test consisted of a fourteen inch diameter cast concrete opening. The test opening was set with three other penetrations which were filled with different types of sealing material (not part of this report).

As part of the slab fabrication, concrete reinforcing bars were embedded in the concrete around the penetration. The type of bar used was an ASTM-A615 grade 60 type steel with a minimum yield strength of 60,000 psi.

The concrete for the slab was mixed, formed and poured by Portland Cement Association personnel. The concrete was made from sand and gravel from Elgin, Illinois (predominately dolmitic aggregate). The sand used had a specific gravity of 2.67, absorption of 2%.

Checks were made for concrete slump, unit weight and air content. Batch quantities, properties of plastic concrete, and strength were approximately the following:

Average slump, (in.):	3-1/2"
Average air content (%):.	4%
Average fresh unit weight:.	145 lbs./cu.ft.
Average compressive strength @ 28 days:	4,000

The concrete was mixed at Portland Cement Association's test laboratory with a tilting drum mixer, distributed into the form around the penetration with an overhead dump bucket, and consolidated with an internal vibrator. The top surface was leveled with a wooden float and finished with a magnesium float.

3.0 Penetrating Members:

The test opening was penetrated by one 2" diameter bare steel pipe and one 2" diameter steel pipe covered with one inch thick calcium silicate (Johns-Manville) insulation and aluminum jacketing. Each pipe (and insulation ended 12" below the exposed surface of the slab and approximately 30" above the slab's unexposed surface.

4.0 Seal Type:

The penetration for this test was sealed with #TS-MS-0045-B silicone elastomer. The elastomer was installed six inches thick and located flush with exposed surface of the test slab. This was done to demonstrate the worst case condition whereby the seal is placed at its closest position to the fire source. In normal field installations, the seal would be installed flush with the top surface of a floor or flush with either side of a wall.

This opening and seal design was tested as a floor penetration in order to qualify its use in both floors and walls.

5.0 Thermocouples:

Three thermocouples were mounted to the unexposed surface of the seal specimen surface. Each thermocouple tip was protected with a small strip of mineral wool insulation (so that ambient temperatures would not affect seal surface temperature documentation). Small weights were placed on the patches of mineral wool to ensure thorough protection.

Thermocouples were also attached to the bare pipe, insulated pipe and seal/concrete substrate interface surfaces. These were also covered with small patches of mineral wool (either tied to the pipes or weighted over the seal/concrete substrate surfaces). Each of these three thermocouples were installed flush with the elastomer seals surface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. Results of these recordings are shown in Section 10.0 of this report.

The thermocouples used in this test are identified as follows:

T/C #13:	Seal Surface	(247°F end point temp.)
T/C #14:	Seal Surface	(249°F end point temp.)
T/C #15:	Seal Surface	(242°F end point temp.)
T/C #16:	Bare Pipe.	(690°F end point temp.)
T/C #17:	Insulated Pipe	(583°F end point temp.)
T/C #18:	Seal/Substrate Interface	(322°F end point temp.)

Three ceramically shielded thermocouples were also used inside of the test furnace (permanently mounted). These are described in Section 6.0. Furnace atmosphere records are also shown in Section 10.0.

6.0 Fire Test:

The fire test portion of the test procedure consisted of subjecting the test slab and seal specimens to a three hour long ASTM E-119 time/temperature curve fire test. For this, slab was placed on a small floor furnace.

Simply described, the furnace used for this type of test is a square shaped, refractory brick lined steel box heated by four gas burners (one on each side of the furnace). The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by three sheilded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures were also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft as a result of fuel contribution and temperature variables) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

7.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas.

Throughout the test, an even blanket of flame was produced in the furnace. No smoke, fire, steam, etc. was noted from this seal specimen for the duration of the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and placed on its side for the hose-stream tests.

8.0 Hose-Stream Tests:

The first hose-stream was performed according to the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and a half inch diameter hose through a 30-90° set at 30° high velocity spray nozzle at seventy-five psi from a distance of ten feet.

The second hose-stream test was performed according to the ASTM E-119 test standard. Water was sprayed on the exposed surface of the 48" x 48" slab(with an exposed surface area of 30" x 30") for 12 seconds using a solid stream of water discharged from a two and half inch diameter hose through a one and one eighth inch diameter National Playpipe Nozzle at thirty psi from a distance of twenty feet.

9.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the fire test, fire did not occur on the unexposed surface as a result of heat conduction.

D. Seal surface thermocouples readings at the test conclusion were as follows:

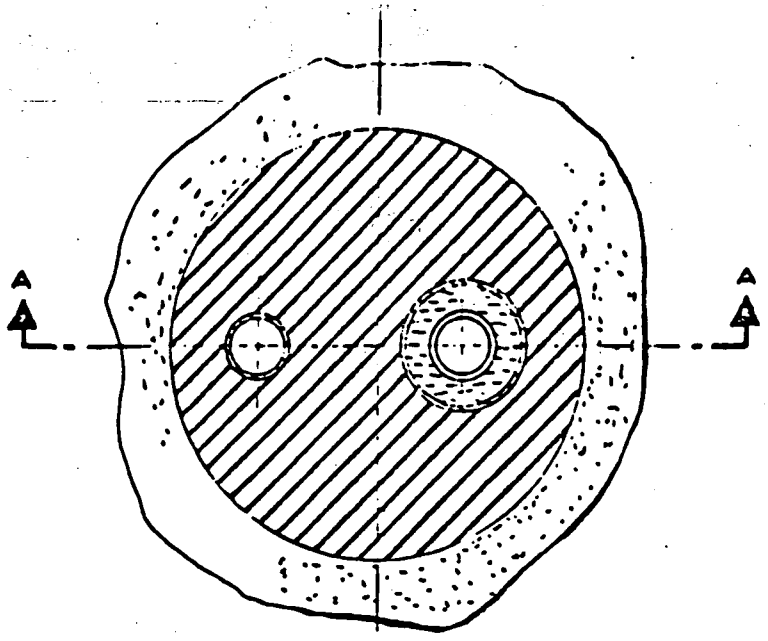
T/C #13 = 247°F
T/C #14 = 249°F
T/C #15 = 242°F

E. That during the ASTM E-119 hose-stream test, water did not penetrate through the penetration seal.

F. That during the IEEE 634-1978 hose-stream test, water did not penetrate through the penetration seal.

G. It was noted that approximately 2-3" of flexible silicone elastomer remained intact inside of the penetration. Most of the char layer had been dislodged by the solid stream (ASTM E-119) hose stream test. Most of the pipe insulation (from the exposed surface) had been destroyed and dislodged from the pipe by the ASTM E-119 type hose stream test.

H. The unexposed surface of the seal suffered no visual change. This seal surface along with the pipe insulation passing through it remained completely intact at the conclusion of the fire and both hose stream tests.



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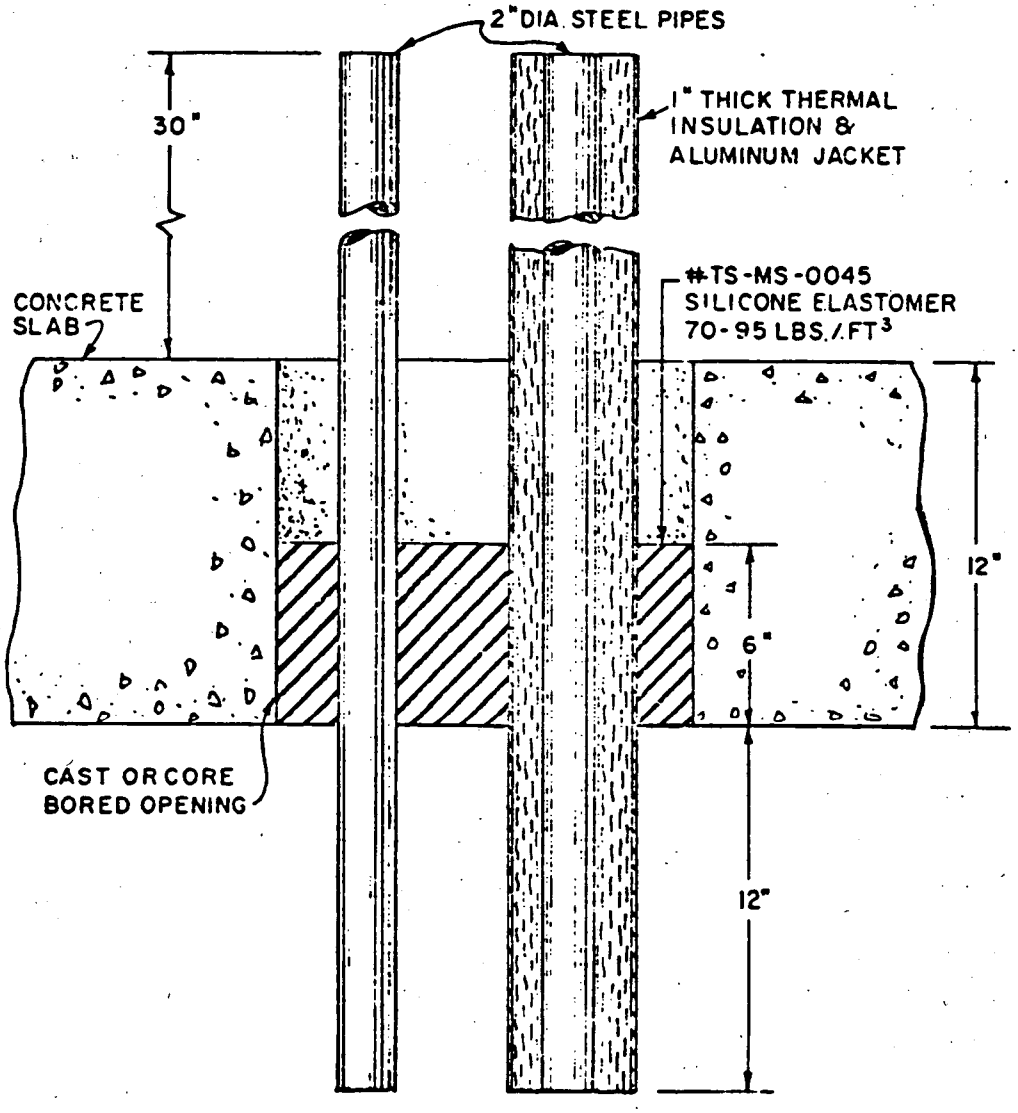


SECTION A-A

TECH-SIL, INC.

TEST #TS-TP-0048-C

TECH-SIL (CR4675) - 08/26/80

UNEXPOSED SURFACE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	13	14	15	16	17	18
0:00	79	79	79	79	79	79
0:05	79	79	79	90	109	79
0:10	79	79	79	123	140	79
0:15	79	79	79	169	169	79
0:20	79	80	79	217	196	80
0:25	80	81	80	260	219	81
0:30	81	83	81	296	239	84
0:35	82	86	82	327	255	90
0:40	84	90	83	352	270	98
0:45	86	94	85	375	284	107
0:50	89	99	87	397	302	117
0:55	92	104	90	419	324	128
1:00	95	109	93	443	347	138
1:05	99	115	97	471	369	148
1:10	104	121	101	495	386	158
1:15	109	127	106	516	402	168
1:20	114	134	111	533	417	178
1:25	121	140	117	546	430	189
1:30	127	147	124	557	442	199
1:35	134	153	130	569	452	208
1:40	140	160	137	578	463	211
1:45	147	167	145	587	473	212
1:50	155	174	152	595	483	213
1:55	162	180	159	603	492	217
2:00	169	186	166	613	501	223
2:10	183	198	180	632	516	236
2:20	197	210	193	650	531	251
2:30	210	220	205	661	544	268
2:40	223	231	218	669	557	287
2:50	235	240	229	681	570	305
3:00	247	249	242	690	583	322

TECH-SIL (CR4675) - 08/26/80

FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	80	68	12
0:05	1028	1000	28
0:10	1285	1300	-15
0:15	1410	1399	11
0:20	1484	1462	22
0:25	1481	1510	-29
0:30	1551	1550	1
0:35	1581	1584	-3
0:40	1608	1613	-5
0:45	1636	1638	-2
0:50	1653	1661	-8
0:55	1679	1681	-2
1:00	1705	1700	5
1:05	1715	1718	-3
1:10	1735	1735	-0
1:15	1739	1750	-11
1:20	1770	1765	5
1:25	1770	1779	-9
1:30	1792	1792	-0
1:35	1801	1804	-3
1:40	1802	1815	-13
1:45	1826	1826	0
1:50	1832	1835	-3
1:55	1833	1843	-10
2:00	1856	1850	6
2:10	1872	1862	10
2:20	1885	1875	10
2:30	1887	1888	-1
2:40	1898	1900	-2
2:50	1908	1912	-4
3:00	1924	1925	-1

TEST #TS-TP-0050-D

FIRE & HOSE STREAM

TEST OF A SINGLE PENETRATION

SEALED WITH #TS-MS-0009 SILICONE FOAM

UNDER 1" OF DAMMING MATERIAL

Test: #TS-TP-0050-D
By: G. J. Jarosz
Date: 8/29/80

TECH - SIL, INC. (#TS-TP-50A-D, 51A-D, 52A-D)

OCT 20 1980

AMERICAN NUCLEAR INSURERS

PROPERTY ENGINEERING DEPARTMENT
John J Carney, Vice President

RT C. PROOM, CPCU
sident

October 16, 1980

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois 60007

Dear Greg:

We have reviewed Tech-Sil, Inc. Test Reports TS-TP-0050-A, B, C, and D; TS-TP-0051-A, B, C, and D; and TS-TP-0052-A, B, C, and D of fire and hose stream tests of pipe penetrations sealed with TS-MS-0080-B, C, E, and F High Density Silicone Gel; TS-MS-0060-E, F, G, I, J and K Leaded Silicone Elastomer; TS-MS-0009 Silicone Foam; and TS-MS-0046-B Formulated Silicone Gel. These tests were conducted on August 29, September 2, and September 3, 1980 at Construction Technology Laboratories of the Portland Cement Association.

Enclosed are two copies each of the ANI/MAERP Penetration Fire Stop System Acceptance forms for the tested configurations. If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan

Robert F. MacMillan
Project Engineer

RFM:dm

TECH-SIL, INC.
REC'D 10-20-80
DISTRIBUTION
R. NOBLE
J. PALLUCCI ✓
G. JAROSZ ✓
G. KRUSE
L. ACERRA ✓
G. JOHNSON
JOBSITE
M. Welch ✓
ORIGINAL TO

ORIGINAL

AMERICAN NUCLEAR INSURERS

MAERP
MUTUAL ATOMIC ENERGY REINSURANCE POOL

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
PORTLAND CEMENT ASSOCIATION
SKOKIE, ILLINOIS

TEST DATE: 8/29 & 9/3, 1980 & 4/27/81	HOUR RATING: 3

GENERAL DATA

	PIPE PENETRATIONS-WITH OR WITHOUT INSULATION & ALUM. JACKET	
Max. Penetration Size	2-2" pipes in 14" conc.opening	2-2" pipes in 12" steel sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	TS-MS-0060-G Leaded Silicone Elastomer. Density: 147 lbs/cu ft. (Min.) TS-MS-0009 Silicone Foam Density: 15-23 lbs/cu. ft.	TS-MS-0046 OR TS-MS-0046-B Silicone Gel Density: 75-95 lbs/cu ft
Fire Stop Thickness	12" Leaded Silicone Elastomer 10" Silicone Foam & 1" Damming	8" Silicone Gel
Form Material	TS-MS-0013, 0014, or 0016 Damming used with Silicone Foam	Non-combustible Forming material used and removed.

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81 January 11, 1984
Date Issued

J. J. Carney (REM)
John J. Carney

(#TS-TP-0050-A-D, 0051-A-D, 0052-A-D)

construction technology laboratories
a Division of the PORTLAND CEMENT ASSOCIATION
5420 Old Orchard Road, Skokie, Illinois 60077 • Phone 312/966-6200

September 15, 1980

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois 60007

Dear Mr. Jarosz:

I have reviewed the following test reports:

#TS-TP-0050-A - Fire & Hose Stream Test of a Single Penetration Sealed with #TS-MS-0060-E Leaded Silicone Elastomer

#TS-TP-0050-B - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0060-F Leaded Silicone Elastomer

#TS-TP-0050-C - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0060G Leaded Silicone Elastomer

#TS-TP-0050-D - Fire & Hose-Steam Test of a Single Penetration Sealed with #TS-MS-0009 Silicone Foam Under 1 in. of Damming Material

#TS-TP-0051-A - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0080-B High Density Silicone Gel

#TS-TP-0051-B - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0080-E High-Density Silicone Gel

#TS-TP-0051-C - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0060-I Leaded Silicone Elastomer

#TS-TP-0051-D - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0080-C High-Density Silicone Gel

#TS-TP-0052-A - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0046-B Formulated Silicone Gel

ORIGINAL

construction technology laboratories

#TS-TP-0052-B - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0080-F High-Density Silicone Gel

#TS-TP-0052-C - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0060-K Leaded Silicone Elastomer

#TS-TP-0052-D - Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0060-J Leaded Silicone Elastomer

These tests were conducted on August 29, September 2 and 3, 1980, in the Fire Research Laboratory, Construction Technology Laboratories, of the Portland Cement Association.

These reports accurately describe details of specimen fabrication, test procedures, observations during test, and test results.

Sincerely yours,

Melvin S. Abrams

Director
Fire Research Department

Melvin S. Abrams

rk

Copy to-
W. G. Corley
Central File

CR-4675-4324
CR-4676-4324

TECH-SIL INC.

1.0 Synopsis:

This report describes a proof in principle fire (and hose-stream) test for a single penetration sealing material/seal design. The seal design used here consisted of a ten inch thick solid silicone foam seal (TECH-SIL, Inc. Part #TS-MS-0009 under 1" of #TS-MS-0013, 0014 and 0016 damming material installed flush with the exposed surface of a 12" thick floor slab.

The test was conducted in accordance with current ANI and IEEE fire test standards. Both test standards (the ANI standard fire test for both cable and pipe penetration seals and the IEEE-634 fire and hose-stream test for penetration seals) utilize the ASTM E-119 time/temperature curve for conducting the actual 3 hour long fire test. There are minor variations between the two standards (i.e., limiting seal surface temperatures, hose-stream test type and method, etc.). These variations were addressed as part of TECH-SIL's overall test procedure.

The 10" thick #TS-MS-0009 silicone foam (under damming material) seal was installed in a 14" diameter cast concrete opening. The opening was equipped with one bare 2" diameter steel pipe and one 2" diameter steel pipe covered with 1" thick calcium silicate thermal insulation.

The #TS-MS-0009/damming material is a material which can be used with relative success for sealing penetrations in concrete walls or floors where overall fire ratings need to be maintained. The material was installed as a liquid, two component material. In floor penetrations, the silicone foam is normally installed over the permanent damming material.

The pass-fail criteria for this test was as follows:

1. That spontaneous combustion does not occur on the unexposed surface of the penetration seal for the duration of the three hour fire test;
2. That fire does not penetrate through the seal specimen during the three hour test;
3. That the ASTM E-119 time/temperature curve is maintained for the three hour duration;
4. That the average unexposed seal surface does not exceed 325°F above ambient (ANI test standard);

5. That water does not penetrate or dislodge the seal during the regulation type and period ASTM E-119 hose-stream test (ANI test standard);

6. That water does not penetrate or dislodge the seal during the IEEE regulation type and period hose-stream test (IEEE 634 test standard);

The test was conducted Friday, August 29, 1980 at Portland Cement Association (Skokie, Illinois). The test was witnessed by R. Hall and M. Abrams of Portland Cement Association and Gregory J. Jarosz of TECH-SIL, Inc.

2.0 Slab Construction:

A forty-eight by forty-eight by twelve inch thick concrete slab was cast to represent a typical floor section. The penetration used for this test consisted of a fourteen inch diameter cast concrete opening. The test opening was set with three other penetrations which were filled with different types of sealing material (not part of this report).

As part of the slab fabrication, concrete reinforcing bars were embedded in the concrete around the penetration. The type of bar used was an ASTM-615 grade 60 type steel with a minimum yield strength of 60,000 psi.

The concrete for the slab was mixed, formed and poured by Portland Cement Association personnel. The concrete was made from sand and gravel from Elgin, Illinois (predominately dolmitic aggregate). The sand used had a specific gravity of 2.67, absorption of 2%.

Checks were made for concrete slump, unit weight and air content. Batch quantities, properties of plastic concrete, and strength were approximately the following:

Average slump, (in.):	3-1/2"
Average air content (%)	4%
Average fresh unit weight:.	145 lbs./cu.ft.
Average compressive strength @28 days:	4,000

The concrete was mixed at Portland Cement Association's test laboratory with a tilting drum mixer, distributed into the form around the penetration with an overhead dump bucket, and consolidated with an internal vibrator. The top surface was leveled with a wooden float and finished with a magnesium float.

3.0 Penetrating Members:

Two 2" diameter steel pipes penetrated this opening. Each extended 12" below the slab's exposed surface and approximately 30" above the unexposed surface. One member consisted of a bare 2" diameter steel pipe. The other was a 2" diameter pipe covered with 1" thick calcium silicate thermal insulation and jacket. The insulation was not sealed to the pipe in any way. Each pipe was capped (welded) at each end.

4.0 Seal Type:

The penetration for this test was sealed with #TS-MS-0009 silicone foam under 1" of #TS-MS-0013, 0014, and 0016 damming material. The foam was installed ten inches thick and located flush with exposed surface of the test slab. This was done to demonstrate the worst case condition whereby the seal is placed at its closest position to the fire source. In normal field installations, the seal would be installed flush with the top surface of a floor (with the damming on the bottom of the seal) or flush with either side of a wall.

This opening and seal design was tested as a floor penetration in order to qualify its use in both floors and walls.

5.0 Thermocouples:

Three thermocouples were mounted to the unexposed surface of the seal specimen. Each thermocouple tip was protected with a small strip of mineral wool insulation (so that ambient temperatures would not affect seal surface temperature documentation). Small weights were placed on the patches of mineral wool to ensure thorough protection.

Thermocouples were also attached to the bare pipe, insulated pipe and seal/concrete substrate interface surfaces. These were also covered with small patches of mineral wool (either tied to the pipes or weighted over the seal/concrete substrate surfaces). Each of these three thermocouples were installed flush with the seal's surface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. Results of these recordings are shown in Section 10.0 of this report.

The thermocouples used in this test are identified as follows:

T/C #19: Seal Surface . . . . . .(91°F end point temp.)
T/C #20: Seal Surface . . . . . .(268°F end point temp.)
T/C #21: Seal Surface . . . . . .(277°F end point temp.)
T/C #22: Bare Pipe . . . . . .(647°F end point temp.)
T/C #23: Insulated Pipe . . . . . .(535°F end point temp.)
T/C #24: Seal/Substrate Interface . .(419°F end point temp.)

Three ceramically shielded thermocouples were also used inside of the test furnace (permanently mounted). These are described in Section 6.0. Furnace atmosphere records are also shown in Section 10.0.

6.0 Fire Test:

The fire test portion of the test procedure consisted of subjecting the test slab and seal specimens to a three hour long ASTM E-119 time/temperature curve fire test. For this, slab was placed on a small floor surface.

Simply described, the furnace used for this type of test is a square shaped, refractory brick lined steel box heated by four gas burners (one on each side of the furnace). The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by three shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures were also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft as a result of fuel contribution and temperature variables) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

7.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas.

Throughout the test, an even blanket of flame was produced in the furnace. No smoke, fire, steam, etc. was noted from this seal specimen for the duration of the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and placed on its side for the hose-stream tests.

8.0 Hose-Stream Tests:

The first hose-stream was performed according to the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and a half inch diameter hose through a 30-90° set at 30° high velocity spray nozzle at seventy-five psi from a distance of ten feet.

The second hose-stream test was performed according to the ASTM E-119 test standard. Water was sprayed on the exposed surface of the 48" x 48" slab (with an exposed surface area of 30" x 30") for 12 seconds using a solid stream of water discharged from a two and half inch diameter hose through a one and one eighth inch diameter National Playpipe Nozzle at thirty psi from a distance of twenty feet.

9.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the fire test, fire did not occur on the unexposed surface as a result of heat conduction.

D. Seal surface thermocouples readings at the test conclusion were as follows:

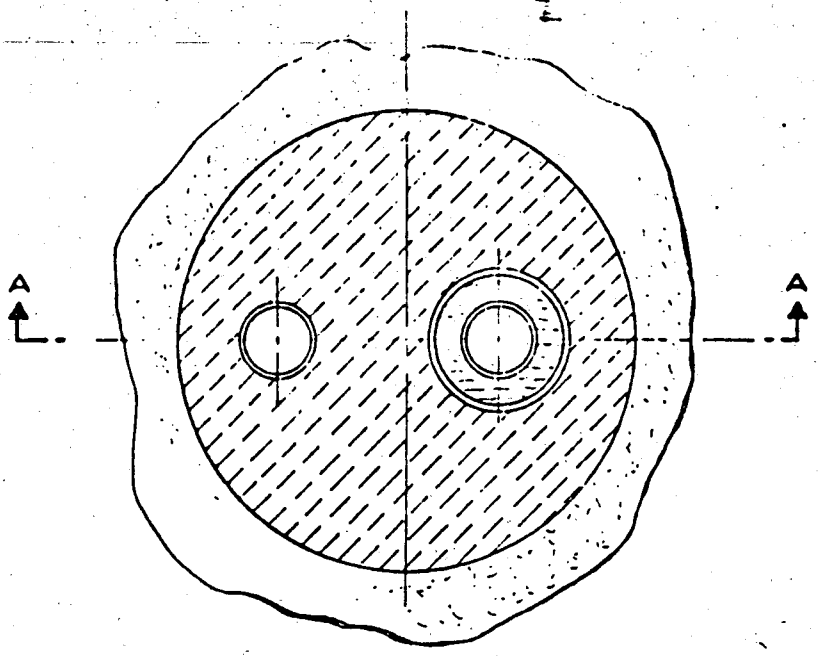
T/C #19 = 91°F
T/C #20 = 268°F
T/C #21 = 277°F

E. That during the ASTM E-119 hose-stream test, water did not penetrate through the penetration seal.

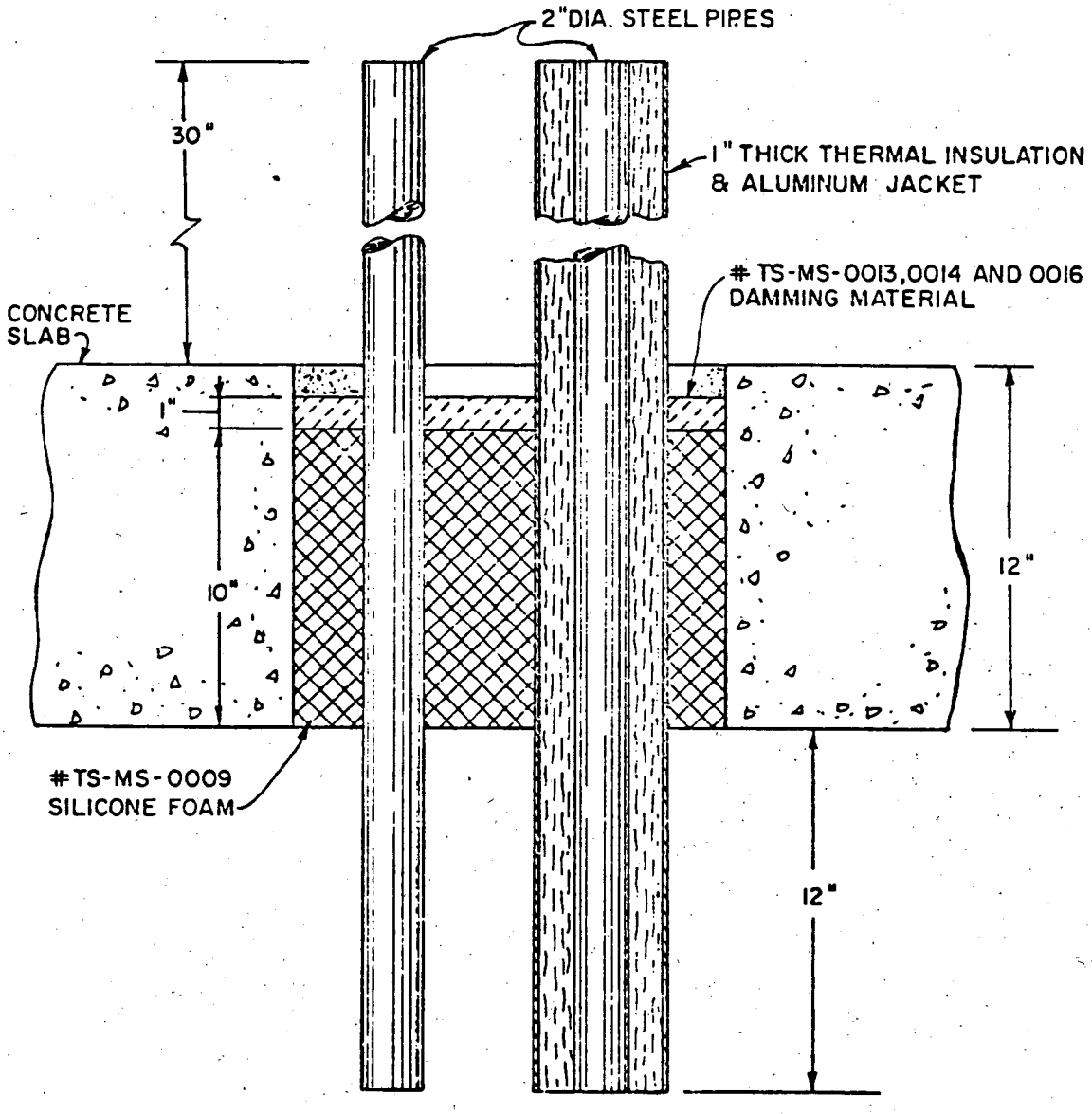
F. That during the IEEE 634-1978 hose-stream test, water did not penetrate through the penetration seal.

G. It was noted that approximately 1/2" - 1" of flexible silicone foam remained intact inside of the penetration. Most of the char layer had been dislodged by the solid stream (ASTM E-119) hose stream test. Most of the pipe insulation (from the exposed surface) had been destroyed and dislodged from the pipe by the ASTM E-119 type hose stream test.

H. The unexposed surface of the seal suffered no visual change. This seal surface along with the pipe insulation passing through it remained completely intact at the conclusion of the fire and both hose stream tests.



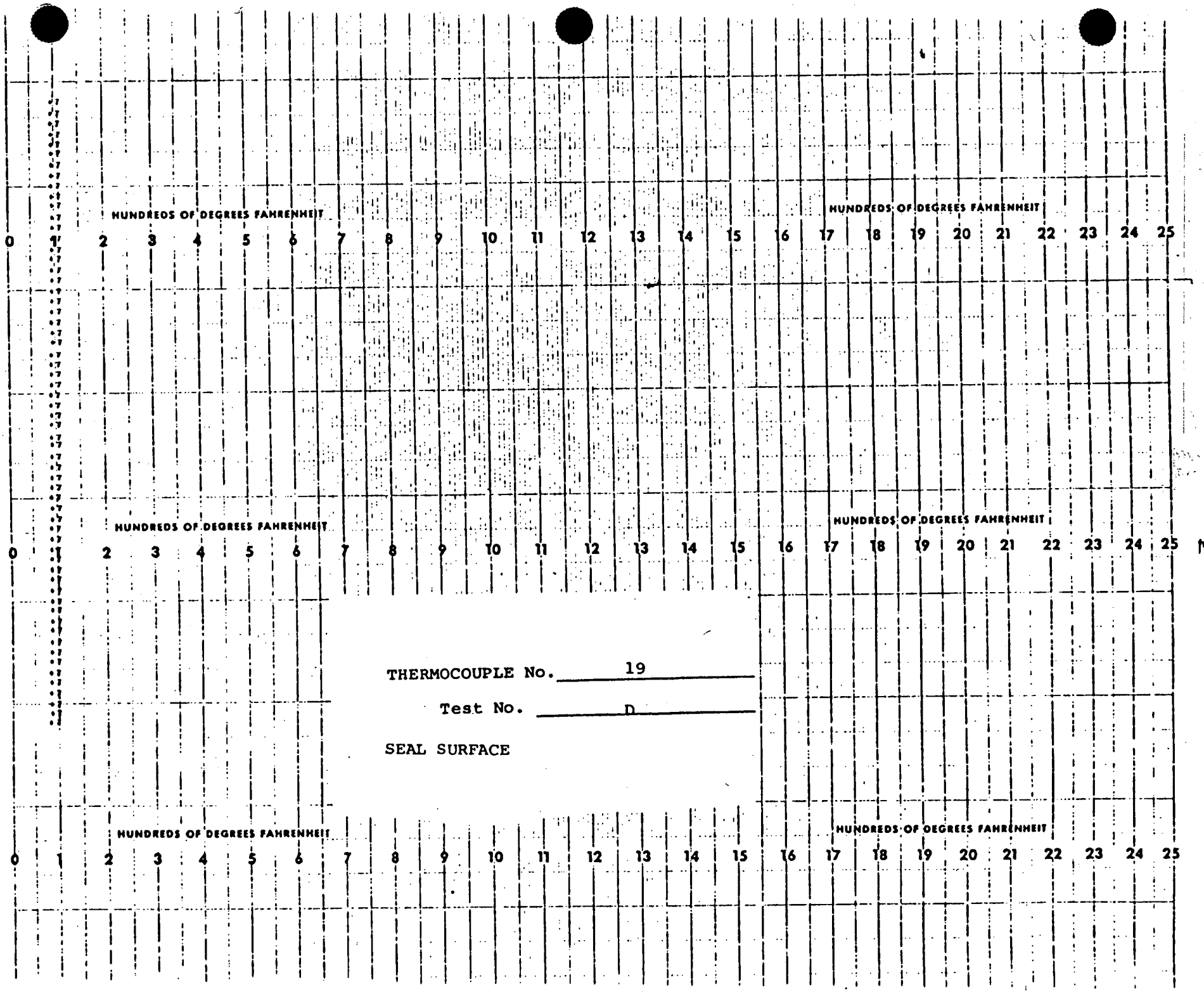
PLAN



SECTION A-A

TECH-SIL, INC.

TEST # TS-TP-0050-D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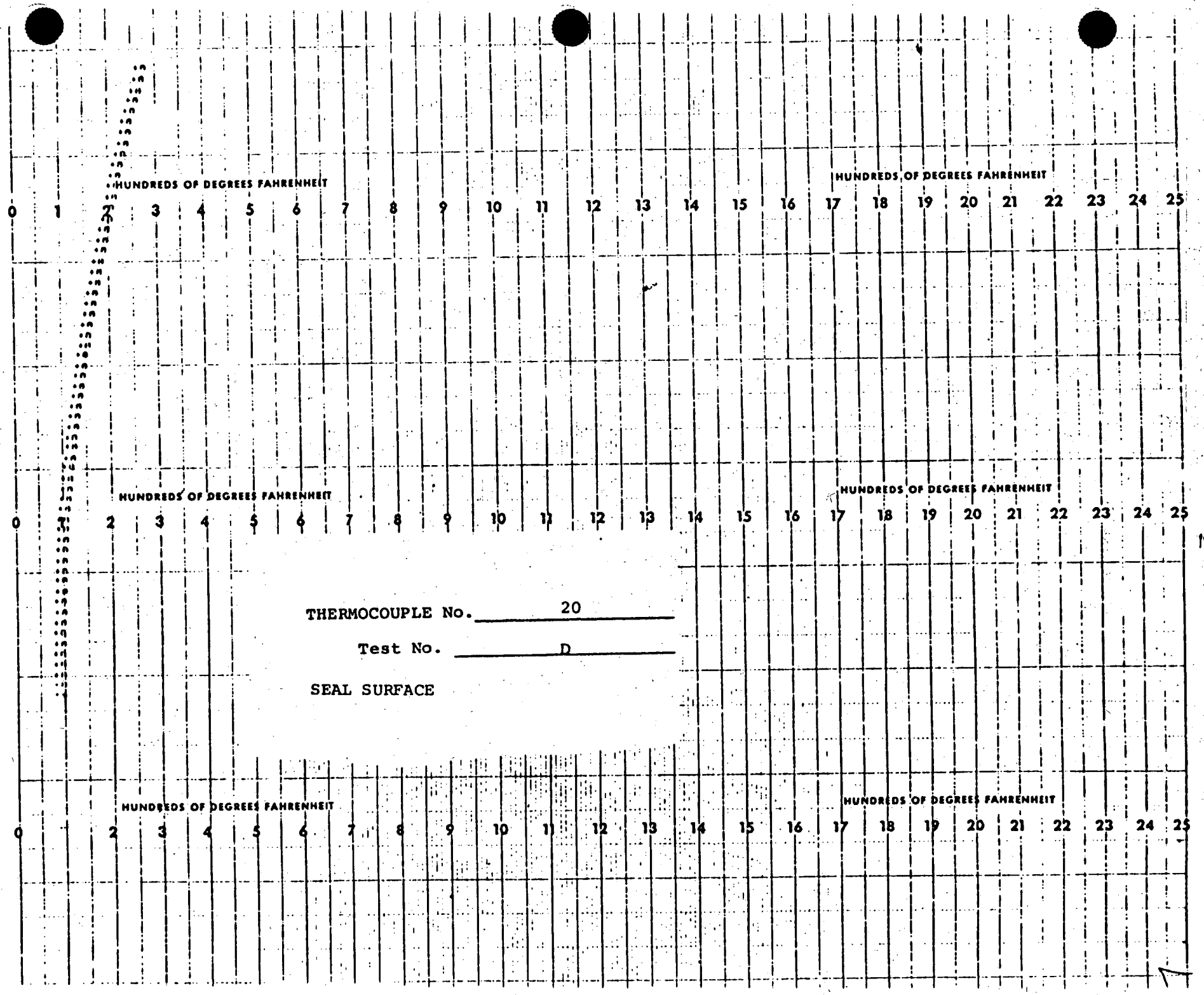
THERMOCOUPLE No. 19
Test No. D
SEAL SURFACE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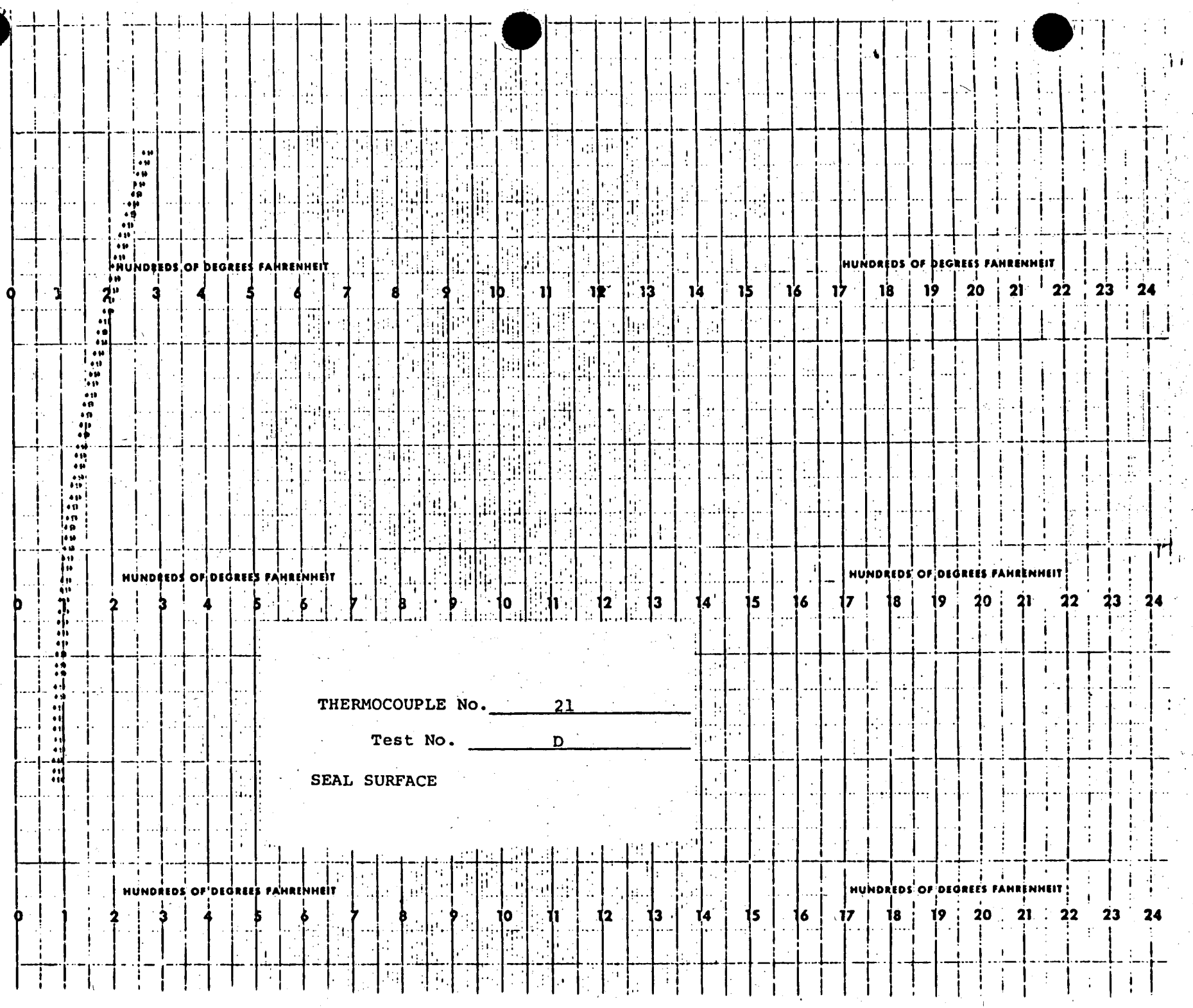
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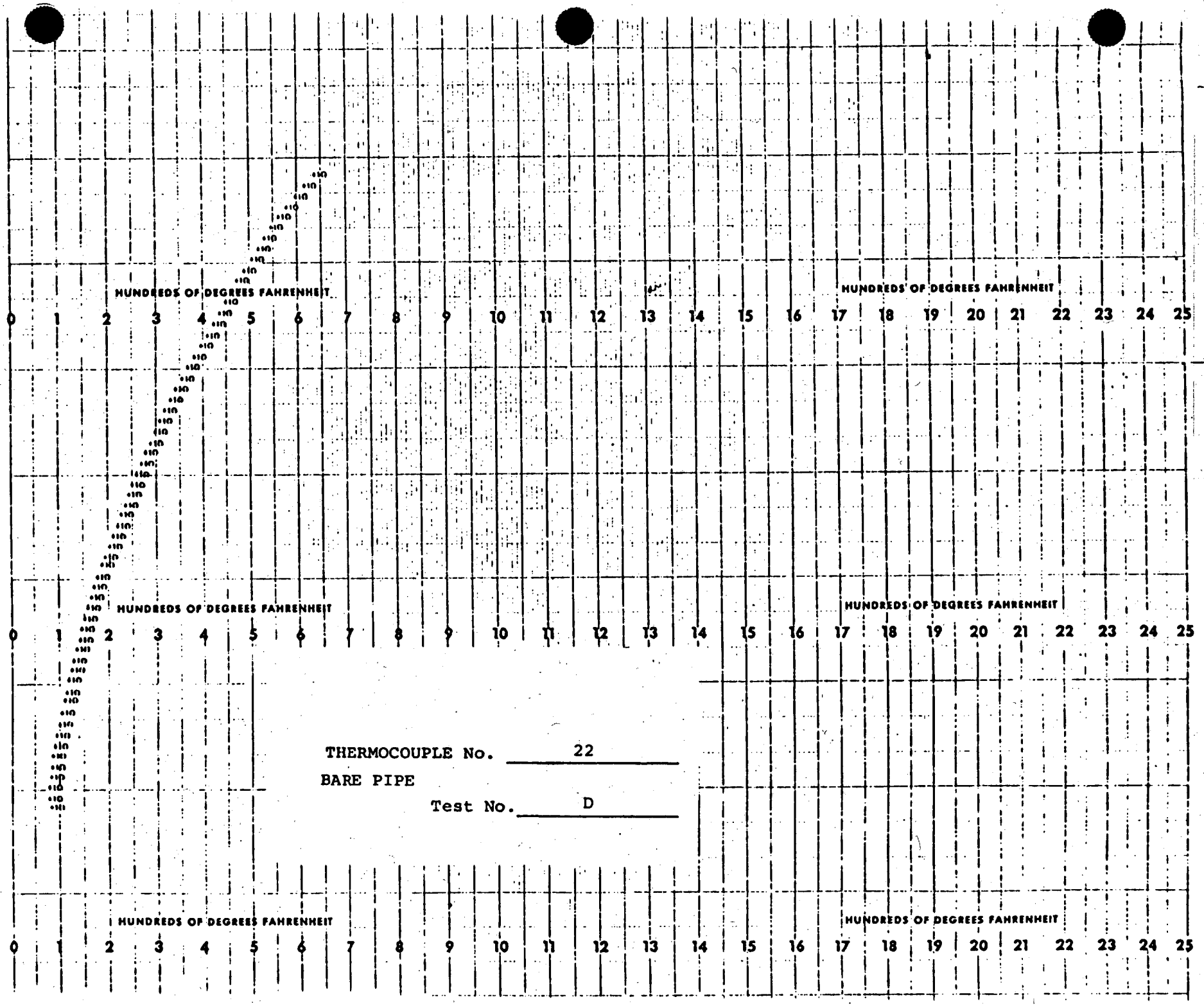
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
THERMOCOUPLE No. 21
Test No. D
SEAL SURFACE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HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
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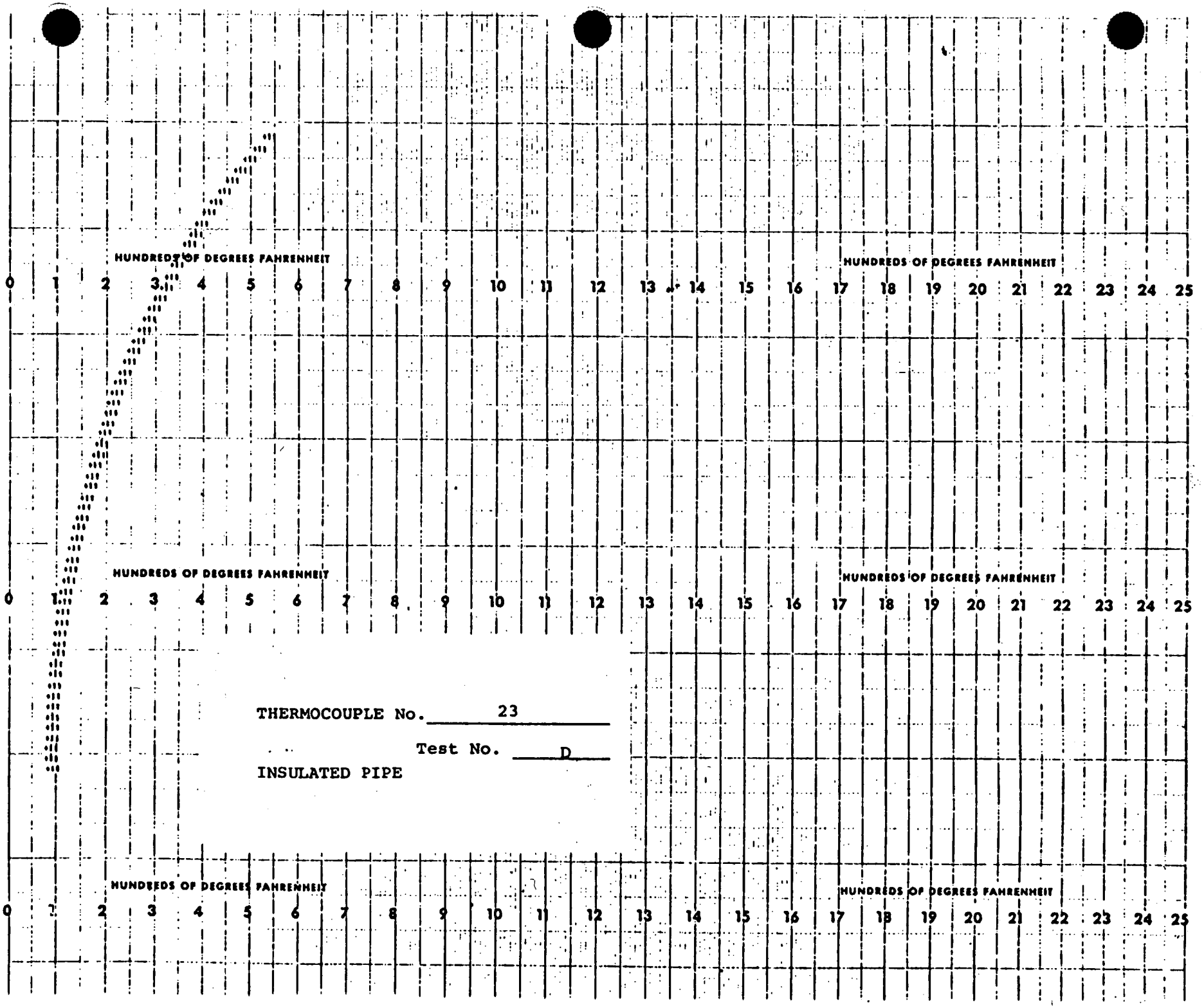
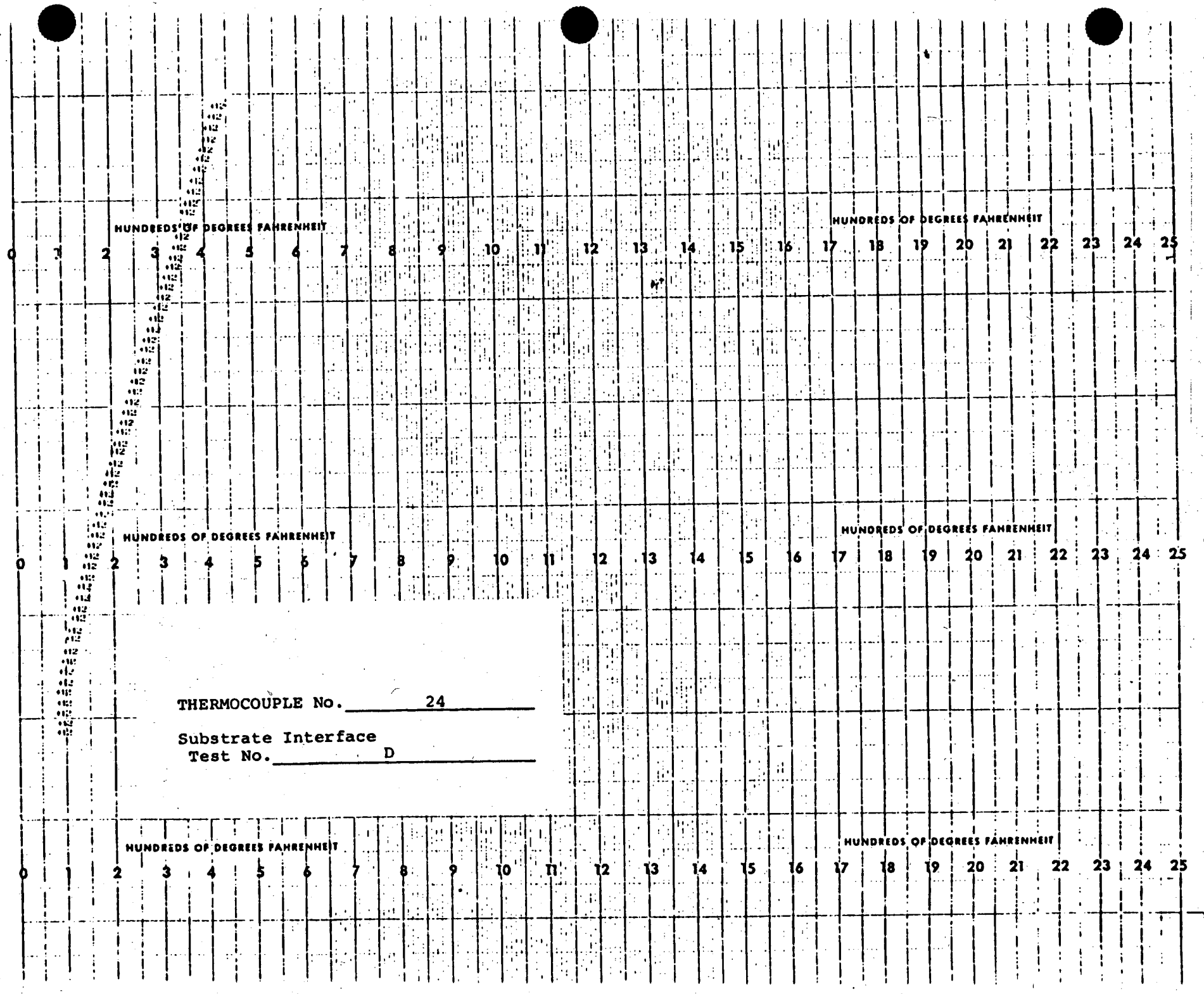
THERMOCOUPLE No. 22
BARE PIPE
Test No. D



SEMI-LOGARITHMIC CHARTS GRAPHIC CONTROLS CORPORATION BUFFALO
No. 5183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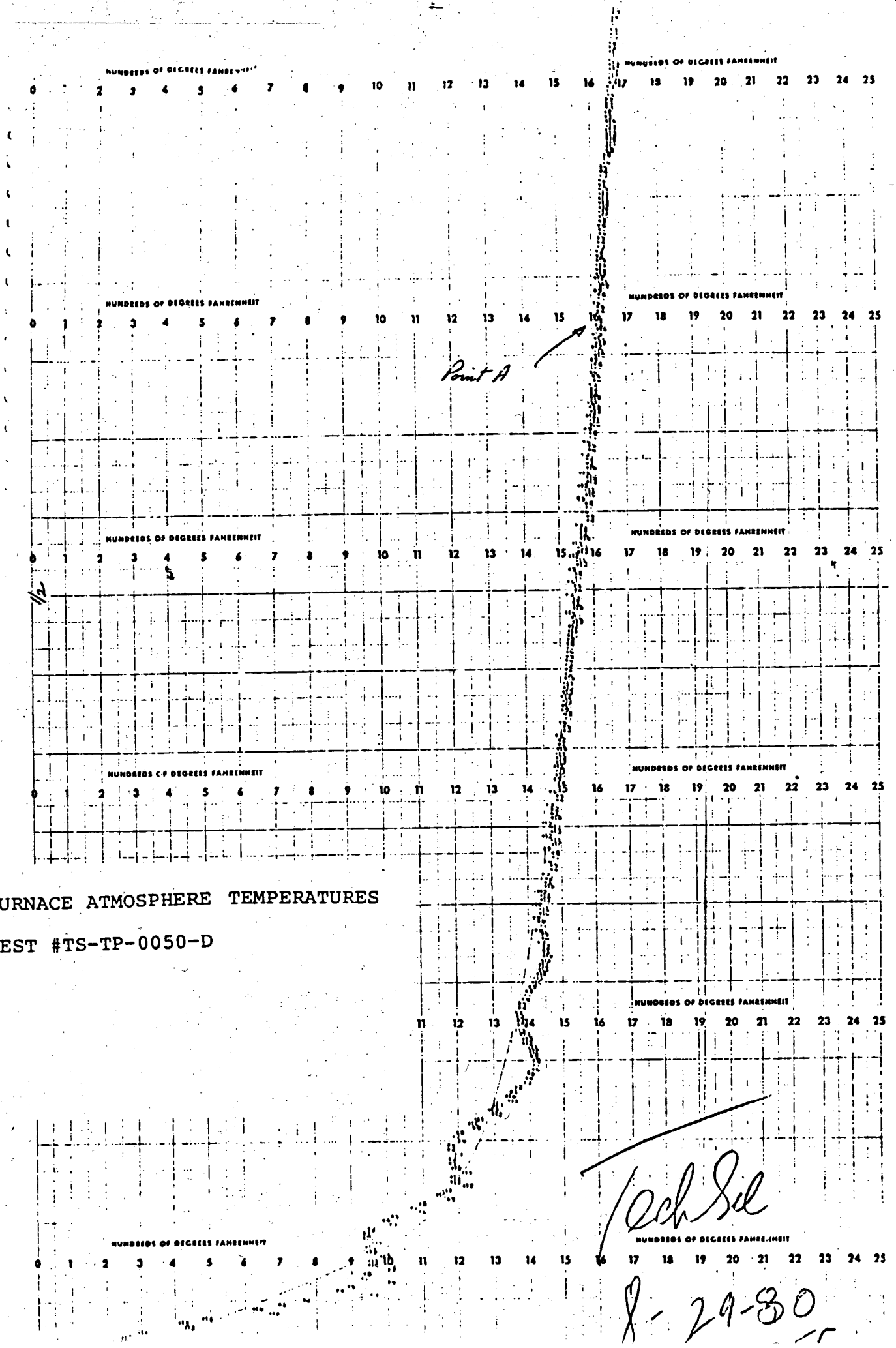
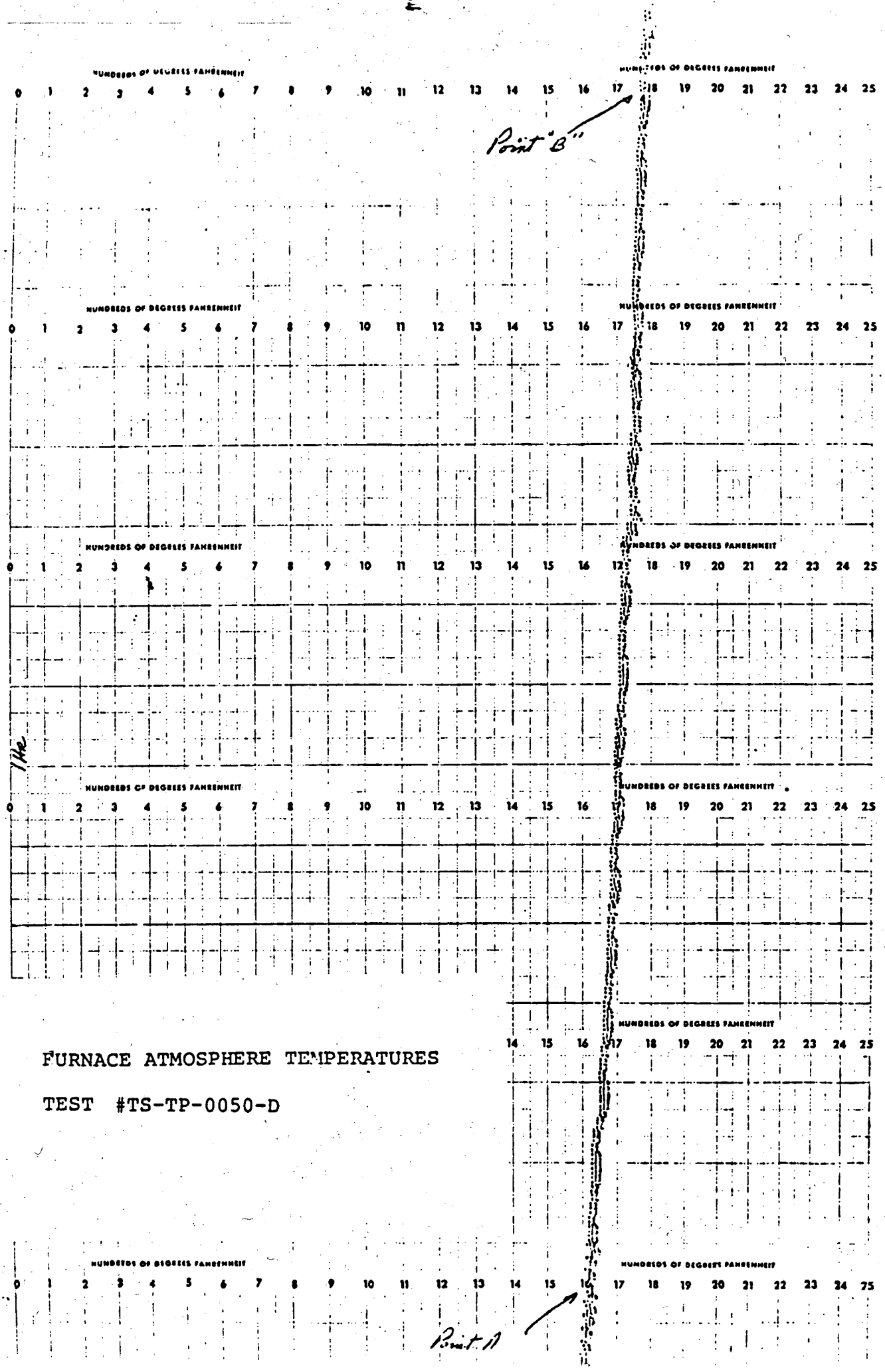
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
HUNDREDS OF DEGREES FAHRENHEIT
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
THERMOCOUPLE No. 24
Substrate Interface
Test No. D



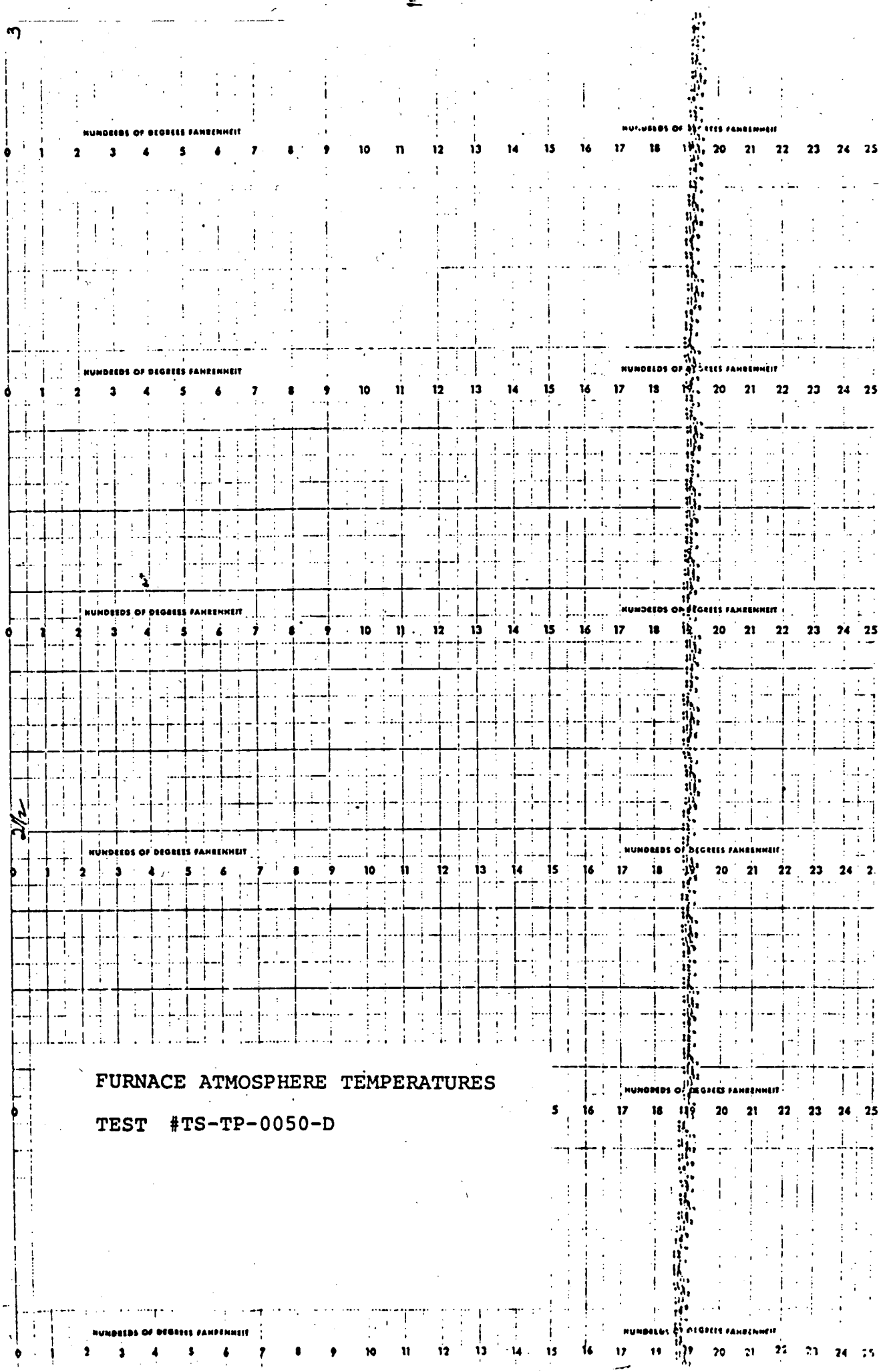
FURNACE ATMOSPHERE TEMPERATURES

TEST #TS-TP-0050-D



FURNACE ATMOSPHERE TEMPERATURES

TEST #TS-TP-0050-D



FURNACE ATMOSPHERE TEMPERATURES

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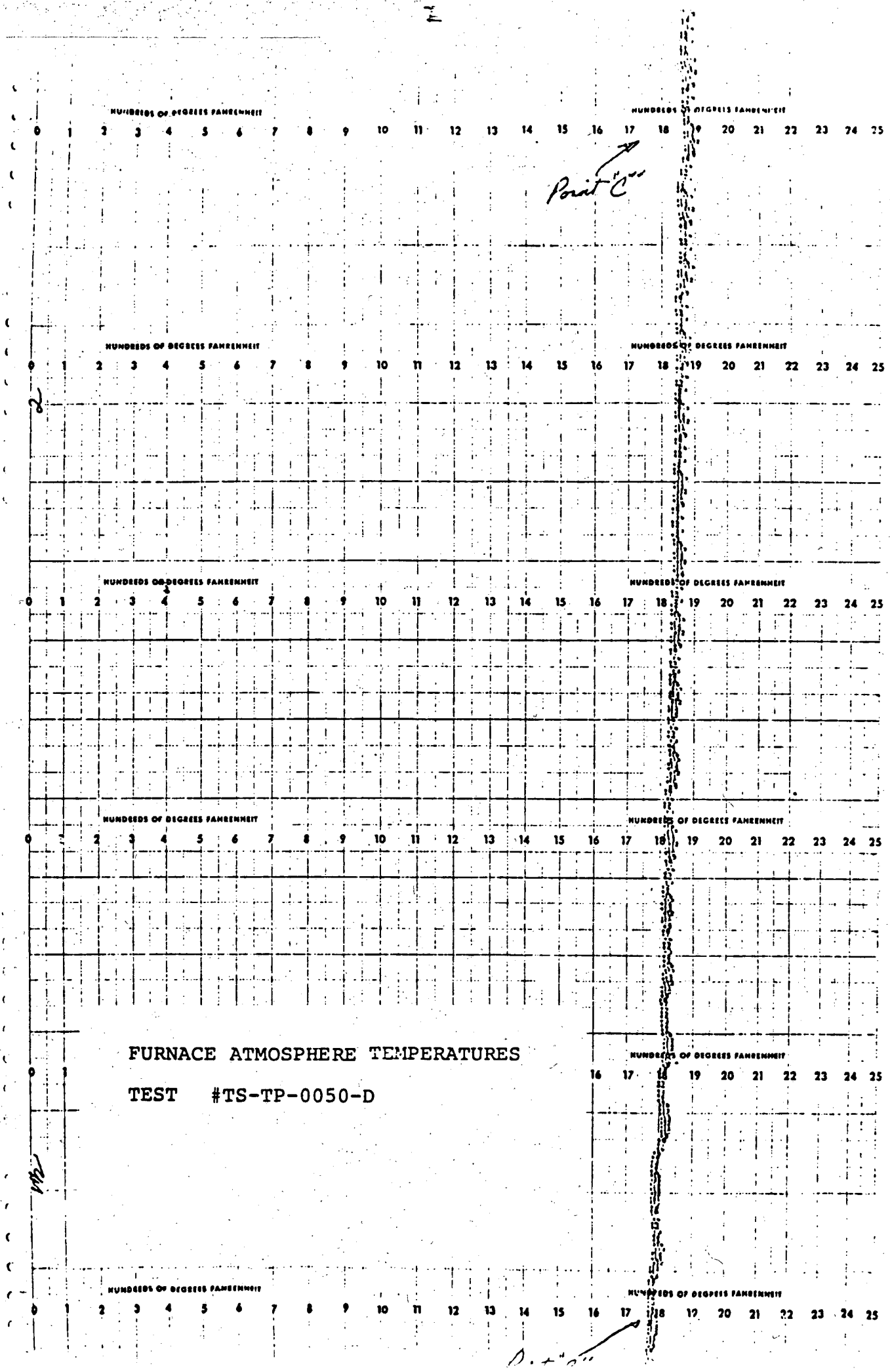
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0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
Point "C"
FURNACE ATMOSPHERE TEMPERATURES
TEST #TS-TP-0050-D

TECH-SIL

TEST NO. 0073-B
FIRE & HOSE-STREAM
TEST OF A SINGLE PENETRATION
SEALED WITH TS-MS-0045-B SILICONE ELASTOMER

NO.	DATE	RELEASE	BY	CK.	CK.	CK.	APP.
0	1/7/85	FOR INFORMATION	SW	RL	DR.	R	

TEST #TS-TP-0073-B

FIRE & HOSE-STREAM

TEST OF A SINGLE PENETRATION

SEALED WITH TS-MS-0045-B SILICONE ELASTOMER

Test: #TS-TP-0073-B
By: K.A. Kerr
Date: 4/27/81

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

TS-TP-0073B

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
PORTLAND CEMENT ASSOCIATION
SKOKIE, ILLINOIS

TEST DATE: 8/26/80 & 4/27/81 | HOUR RATING: 3

GENERAL DATA

	PIPE PENETRATIONS - WITH OR WITHOUT INSULATION & ALUMINUM JACK	
Max. Penetration Size	2 - 2" pipes in 14" conc. opening	2 - 2" pipes in 12" steel sleev
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	TS-MS-0060-C Leaded Silicone Elastomer; density 140-160 lbs/cu. ft. TS-MS-0045-B Silicone Elastomer Density:70-95 lbs/cu.ft. TS-MS-0045-A Silicone Elastomer Density: 60 lbs./cu. ft.	TS-MS-0060-D Leaded Silicone Elastomer Density: 140-160 lbs/cu. ft. TS-MS-0045-B Silicone Elastome Density: 70-95 lbs./cu. ft.
Fire Stop Thickness	9" TS-MS-0060-C Leaded Silicone Elastomer 6" TS-MS-0045-A Silicone Elast. 6" TS-MS-0045-B Silicone Elast.	9" TS-MS-0060-D Leaded Silicone Elastomer 5" TS-MS-0045-B Silicone Elastc
Form Material	Non-combustible forming material used and removed.	Non-combustible forming materia used and removed.

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81

January 11, 1984
Date Issued

John J. Carney

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

TS-TP-0073B

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
PORTLAND CEMENT ASSOCIATION
SKOKIE, ILLINOIS

TEST DATE: 8/26/80 & 4/27/81 | HOUR RATING: 3

GENERAL DATA

	PIPE PENETRATIONS - WITH OR WITHOUT INSULATION & ALUMINUM JACKET	
Max. Penetration Size	2 - 2" pipes in 14" conc. opening	2 - 2" pipes in 12" steel sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	TS-MS-0060-C Leaded Silicone Elastomer; density 140-160 lbs/cu. ft. TS-MS-0045-B Silicone Elastomer Density:70-95 lbs/cu.ft. TS-MS-0045-A Silicone Elastomer Density: 60 lbs./cu. ft.	TS-MS-0060-D Leaded Silicone Elastomer Density: 140-160 lbs/cu. ft. TS-MS-0045-B Silicone Elastomer Density: 70-95 lbs./cu. ft.
Fire Stop Thickness	9" TS-MS-0060-C Leaded Silicone Elastomer 6" TS-MS-0045-A Silicone Elast. 6" TS-MS-0045-B Silicone Elast.	9" TS-MS-0060-D Leaded Silicone Elastomer 5" TS-MS-0045-B Silicone Elastor
Form Material	Non-combustible forming material used and removed.	Non-combustible forming material used and removed.

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

Rev. 4/81

January 11, 1984
Date Issued

John J. Carney

construction technology laboratories
a Division of the PORTLAND CEMENT ASSOCIATION
5420 Old Orchard Road, Skokie, Illinois 60077 • Phone 312/966-6200

RECEIVED
TECH-SIL INC.
APR 29 1981

April 29, 1981

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois
60007

Dear Mr. Jarosz:

I have reivewed the following test reports:

Test Report #TS-TP-0073-A, "Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0046 Silicone Gel"

Test Report #TS-TP-0073-B,"Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0045 Silicone Elastomer"

Test Report #TS-TP-0073-C, "Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0100 Nitreseal"

Test Report #TS-TP-0073-D, "Fire & Hose-Stream Test of a Single Penetration Sealed with #TS-MS-0080 High Density Silicone Gel"

These tests were conducted on April 27, 1981, in the Fire Research Laboratory, Construction Technology Laboratories, of the Portland Cement Association.

These reports accurately describe details of specimen fabrication, test procedures, observations during test, and test results.

Sincerely yours,

Melvin S. Abrams
Director
Fire Research Department

Melvin S. Abrams

rk

CR-4760-4324

Copy to-
W. G. Corley
Central File

TEST PROCEDURE #TS-TP-0073-B

SEAL INSTALLATION & FIRE TEST

FOR 5" THICK #TS-MS-0045-B

SILICONE ELASTOMER SEAL

TECH-SIL INC.

Procedure for Seal Installation and Fire Test

For 5" Thick #TS-MS-0045-B Silicone Elastomer Seal

1.0 Test Construction:

Penetration Size: 12" Diameter Steel Sleeve; Penetrating members: One nominal 2" diameter bare pipe 60" long (approx.) and one nominal 2" diameter bare pipe covered with 1½" calcium silicate insulation plus standard aluminum jacket.

Seal Type: 5" thick #TS-MS-0045-B Silicone Elastomer installed flush with the exposed surface of the slab.

Test Slab: 12" thick concrete

Braces: On the unexposed surface only; weld or bolt pipes to braces so that approximately 12" of each pipe extends below exposed slab surface.

2.0 Seal Installation:

2.1 Substrate Preparation:

Clean substrate of all foreign materials, oily residue, etc.

2.2 Damming:

Use temporary form (as required) to form the seal flush with the exposed slab surface.

2.3 Seal Installation:

2.3.1 Mix all ingredients in original containers before adding to the machine.

2.3.2 Mix all materials again in machine (unless already homogenized) before pouring into the test penetration.

2.3.3 Perform QC verification checks (i.e., density check, etc.)

2.3.4 Install 5" of #TS-MS-0045-B Silicone Elastomer over the form, and allow to cure a minimum of 24 hours before the test.

2.3.5 Remove temporary forming before the test.

2.3.6 QC personnel shall perform all necessary final seal inspection and documentary entry.

3.0 Fire and Hose-Stream Test:

3.1 Fire test shall be conducted according to ASTM E-119 time/temperature curve for three hours. For this, the slab shall be placed on a small floor furnace.

3.2 Three thermocouples shall be embedded in the seal's surface before the test, plus one at each seal/pipe interfaces and one at each seal/sleeve interface. All temperature data shall be recorded and incorporated into the final test report.

3.3 At the conclusion of the fire test, the slab will be turned over on its side for the hose-stream tests conducted as follows:

4.0 Hose-Stream Tests:

4.1 The first hose-stream test shall be performed according to the IEEE 634-1978 test standard. Water is sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and one half inch diameter hose through a 30-90° high velocity spray nozzle (set at 30°) at seventy-five psi from a distance of ten feet.

4.2 The second hose-stream test shall be conducted according to the current ANI test standard. Water will be sprayed onto the exposed surface of the slab for 12 seconds using an even spray discharged from a one and one half inch diameter hose through a 30-90° high velocity spray nozzle (set at 15°) at seventy-five psi from a distance of ten feet.

4.3 The third hose-stream test shall be performed according to the ASTM E-119 test standard. Water will be sprayed onto the exposed surface of the slab for 12 seconds using a solid stream of water discharged from a two and one half inch diameter hose through a one and one eighth inch National Playpipe Nozzle at 30 psi from a distance of 20 feet.

5.0 Test Report:

5.1 The final test report shall include the following information sections:

5.1.1 Synopsis
5.1.2 Slab Construction
5.1.3 Penetrating Members
5.1.4 Seal Type
5.1.5 Thermocouples
5.1.6 Fire Test
5.1.7 Test Record
5.1.8 Hose-Stream Tests
5.1.9 Test Conclusions
5.1.10 Thermocouple Data

1.0 Synopsis:

This report describes a proof in principle fire (and hose-stream) test for a single penetration sealing material/seal design. The seal design used here consisted of a five inch thick solid silicone elastomer seal (TECH-SIL, Inc. Part #TS-MS-0045-B) installed flush with the exposed surface of a 12" thick floor slab.

The test was conducted in accordance with current ANI and IEEE fire test standards. Both test standards (the ANI standard fire test for both cable and pipe penetration seals and the IEEE 634-1978 fire test standard for penetration seals) utilize the ASTM E-119 time/temperature curve for conducting the actual 3 hour long fire test. There are minor variations between the two standards (i.e., limiting seal surface temperatures, hose-stream test type and method, etc.). These variations were addressed as part of TECH-SIL's overall test procedure.

The 5" thick #TS-MS-0045-B seal was installed in a 12" diameter steel sleeve opening. The opening was equipped with one bare 2" diameter steel pipe and one 2" diameter steel pipe covered with 1" thick calcium silicate thermal insulation.

The #TS-MS-0045-B material is a somewhat rigid material which can be used with relative success for sealing penetrations in concrete walls or floors where overall fire ratings need to be maintained. The material was installed as a liquid, two component material. Once the liquid had turned into a solid, all temporary forming material was removed to leave the symmetrical silicone elastomer seal.

The pass-fail criteria for this test was as follows:

1. That spontaneous combustion not occur on the unexposed surface of the penetration seals for the duration of the three hour fire test;

2. That fire does not penetrate through the seal specimen during the three hour test;

3. That the ASTM E-119 time/temperature curve is maintained for the three hour duration;

4. That the average unexposed seal surface does not exceed 325°F above ambient (ANI test standard);

5. That water does not penetrate or dislodge the seal during the regulation type and period ASTM E-119 hose-stream test (ANI test standard);

6. That water does not penetrate or dislodge the seal during the IEEE regulation type and period hose-stream test (IEEE 634 test standard);

The test was conducted Monday, April 27, 1981 at Portland Cement Association (Skokie, Illinois). The test was witnessed by R. Hall of Portland Cement Association, and K.A. Kerr of TECH-SIL, Inc.

2.0 Slab Construction:

A forty-eight by forty-eight by twelve inch thick concrete slab was cast to represent a typical floor section. The penetration used for this test consisted of a twelve inch diameter steel sleeve opening. The test opening was set with three other penetrations which were filled with different types of sealing material (not part of this report).

As part of the slab fabrication, concrete reinforcing bars were embedded in the concrete around the penetration. The type of bar used was an ASTM-A615 grade 60 type steel with a minimum yield strength of 60,000 psi.

The concrete for the slab was mixed, formed and poured by Portland Cement Association personnel. The concrete was made from sand and gravel from Elgin, Illinois (predominately dolmitic aggregate). The sand used had a specific gravity of 2.67, absorption of 2%.

Checks were made for concrete slump, unit weight and air content. Batch quantities, properties of plastic concrete, and strength were approximately the following:

Average slump, (in.): . . . . . 3-1/2"
Average air content (%): 4%
Average fresh unit weight: . . . . . .145 lbs./cu.ft.
Average compressive strength
@ 28 days: 4,000

The concrete was mixed at Portland Cement Association's test laboratory with a tilting drum mixer, distributed into the form around the penetration with an overhead dump bucket, and consolidated with an internal vibrator. The top surface was leveled with a wooden float and finished with a magnesium float.

3.0 Penetrating Members:

The test opening was penetrated by one 2" diameter bare steel pipe and one 2" diameter steel pipe covered with one inch thick calcium silicate (Johns-Manville) insulation and aluminum jacketing. Each pipe (and insulation ended 12" below the exposed surface of the slab and approximately 30" above the slab's unexposed surface.

4.0 Seal Type:

The penetration for this test was sealed with #TS-MS-0045-B Elastomer. The elastomer was installed five inches thick and located flush with exposed surface of the test slab. This was done to demonstrate the worst case condition whereby the seal is placed at its closest position to the fire source. In normal field installations, the seal would be installed flush with the top surface of a floor or flush with either side of a wall.

This opening and seal design was tested as a floor penetration in order to qualify its use in both floors and walls.

5.0 Thermocouples:

Three thermocouples were mounted to the unexposed surface of the seal specimen surface. Each thermocouple tip was embedded 1/4"-3/8" deep into the seal so that ambient temperatures would not affect seal surface temperature documentation. Thermocouples were inserted into the bare pipe/seal, insulated pipe/seal and seal/steel sleeve interface surfaces (1/4"-3/8" below the seal's surface).

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. Results of these recordings are shown in Section 10.0 of this report.

T/C #13	Seal Surface
T/C #14	Seal Surface
T/C #15	Seal Surface
T/C #16	Bare Pipe
T/C #17	Insulated Pipe
T/C #18	Seal/Substrate Interface

Three ceramically shielded thermocouples were also used inside of the test furnace (permanently mounted). These are described in Section 6.0. Furnace atmosphere records are also shown in Section 10.0.

6.0 Fire Test:

The fire test portion of the test procedure consisted of subjecting the test slab and seal specimens to a three hour long ASTM E-119 time/temperature curve fire test. For this, slab was placed on a small floor furnace.

Simply described, the furnace used for this type of test is a square shaped, refractory brick lined steel box heated by four gas burners (one on each side of the furnace). The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by three shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures were also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft as a result of fuel contribution and temperature variables) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure through out the test.

7.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas.

Throughout the test, an even blanket of flame was produced in the furnace. No smoke, fire, steam, etc. was noted from this seal specimen for the duration of the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and placed on its side for the hose-stream tests.

8.0 Hose-Stream Tests:

The first hose-stream was performed according to the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and a half inch diameter hose through a 30-90° set at 30° high velocity spray nozzle at seventy-five psi from a distance of ten feet.

The second hose-stream test was performed according to the ANI test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and one half inch diameter hose through a 30-90° high velocity spray nozzle (set at 15°) at seventy-five psi from a distance of ten feet.

The third hose-stream test was performed according to the ASTM E-119 test standard. Water was sprayed on the exposed surface of the 48" x 48" slab (with an exposed surface area of 30" x 30") for 12 seconds using a solid stream of water discharged from a two and half inch diameter hose through a one and one eighth inch diameter National Playpipe Nozzle at thirty psi from a distance of twenty feet.

9.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the fire test, fire did not occur on the unexposed surface as a result of heat conduction.

D. Seal surface thermocouples readings at the test conclusion were as follows:

T/C #13 . . . . . (335°F)
T/C #14 . . . . . (330°F)
T/C #15 . . . . . (398°F)

E. That during the ASTM E-119 hose-stream test, water did not penetrate through the penetration seal.

F. That during the ANI standard hose-stream test, water did not penetrate through the penetration seal.

G. That during the IEEE 634-1978 hose-stream test, water did not penetrate through the penetration seal.

H. It was noted that approximately 4-1/2" of the #TS-MS-0045-B material remained intact inside of the penetration. Most of the char layer had been dislodged by the solid stream (ASTM E-119 hose stream) test. Part of the pipe insulation (from the exposed surface) had been destroyed and dislodged from the pipe by the ASTM E-119 hose-stream test.

I. The unexposed surface of the seal suffered no visual change. This seal surface, along with the pipe insulation passing through it remained completely intact at the conclusion of the fire and the hose-stream tests.

TECH-SIL (CR4760) - 04/27/81

TEST COMMENTS

0:05:00 T/C #12 OUT
0:07:00 T/C #12 CORRECTED
DRAFT RUN AT .08 NEG
0:40:00 T/C #24 OUT
0:42:00 T/C #24 CORRECTED
2:10:00 0080 MATERIAL EXPANDING UPWARDS
2:10:00 LIGHT SMOKE NOTED FROM 0100 MATERIAL
PASSED ANI HOSE STREAM TEST FOR 12 SEC.
PASSED IEEE-634 HOSE STREAM TEST FOR 12 SEC.
PASSED ASTM E-119 HOSE STREAM TEST FOR 12 SEC.

TECH-SIL (CR4760) - 04/27/81

FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	74	68	6
0:05	1173	1000	173
0:10	1252	1300	-48
0:15	1407	1399	8
0:20	1470	1462	8
0:25	1518	1510	8
0:30	1553	1550	3
0:35	1586	1584	2
0:40	1611	1613	-2
0:45	1636	1638	-2
0:50	1653	1661	-8
0:55	1683	1681	2
1:00	1700	1700	-0
1:05	1713	1718	-5
1:10	1738	1735	3
1:15	1741	1750	-9
1:20	1752	1765	-13
1:25	1774	1779	-5
1:30	1793	1792	1
1:35	1798	1804	-6
1:40	1814	1815	-1
1:45	1833	1826	7
1:50	1841	1835	6
1:55	1842	1843	-1
2:00	1852	1850	2
2:10	1872	1862	10
2:20	1873	1875	-2
2:30	1893	1888	5
2:40	1903	1900	3
2:50	1915	1912	3
3:00	1925	1925	-0

TECH-SIL (CR4760) - 04/27/81

THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
11	1	1	0100 SURFACE
11	2	2	0100 SURFACE
11	3	3	0100 SURFACE
11	4	4	0100 BARE PIPE
11	5	5	0100 INSULATED PIPE
11	6	6	0100 SEAL SUBSTRATE INT
11	7	7	0046 SURFACE
11	8	8	0046 SURFACE
11	9	9	0046 SURFACE
11	10	10	0046 BARE PIPE
11	11	11	0046 INSULATED PIPE
11	12	12	0046 SEAL SUBSTRATE INT
12	1	13	0045 SURFACE
12	2	14	0045 SURFACE
12	3	15	0045 SURFACE
12	4	16	0045 BARE PIPE
12	5	17	0045 INSULATED PIPE
12	6	18	0045 SEAL SUBSTRATE INT
12	7	19	0080 SURFACE
12	8	20	0080 SURFACE
12	9	21	0080 SURFACE
12	10	22	0080 BARE PIPE
12	11	23	0080 INSULATED PIPE
12	12	24	0080 SEAL SUBSTRATE INT

TECH-SIL (CR4760) - 04/27/81

0045 UNEXPOSED MATREIAL SURF. (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	13	14	15	16	17	18
0:00	70	73	70	70	70	70
0:05	72	75	72	88	78	85
0:10	73	74	73	134	85	130
0:15	76	73	75	186	95	174
0:20	82	71	80	234	108	218
0:25	90	66	87	276	123	255
0:30	99	59	97	313	141	288
0:35	111	51	108	346	162	315
0:40	123	42	121	376	180	342
0:45	135	31	134	403	196	365
0:50	148	135	147	426	204	384
0:55	159	146	162	448	223	405
1:00	170	157	176	468	240	425
1:05	184	170	189	488	258	443
1:10	191	179	204	503	272	461
1:15	200	190	217	519	289	478
1:20	208	199	232	533	303	495
1:25	217	208	247	546	318	511
1:30	227	219	259	561	332	526
1:35	232	226	271	573	345	540
1:40	244	237	282	585	360	554
1:45	248	244	293	597	372	568
1:50	253	251	303	608	384	581
1:55	259	257	315	619	395	593
2:00	265	264	321	628	407	605
2:10	274	275	339	644	427	627
2:20	292	292	354	660	452	647
2:30	310	310	362	676	477	663
2:40	319	320	373	689	496	683
2:50	327	328	384	701	512	700
3:00	335	330	398	713	525	717

TECH-SIL

TEST NO. 0075-A
FOR FIRE & HOSE-STREAM TESTS
OF FOUR PENETRATIONS

NO.	DATE	RELEASE	BY	CK.	CK.	CK.	APP.
2	1/7/85	FOR INFORMATION	SW	RK	D.R.		

TEST REPORT #TS-TP-0075-A

FOR FIRE & HOSE-STREAM TESTS

OF FOUR PENETRATIONS

REVISION #2

Test: #TS-TP-0075-A
By: G.J. Jarosz
Date: 7/23/81

construction technology laboratories

a Division of the PORTLAND CEMENT ASSOCIATION

5420 Old Orchard Road, Skokie, Illinois 60077 • Phone 312/966-6200

August 13, 1981

RECEIVED
TECH-SIL, INC.
Elk Grove
AUG 17 1981

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois
60007

Dear Mr. Jarosz:

I have reviewed Test Report #TS-TP-0075-A entitled, Fire & Hose-Stream Tests of Four Penetrations."

This test was conducted on July 15, 1981, in the Fire Research Laboratory, Construction Technology Laboratories, of the Portland Cement Association.

This report accurately describes details of specimen fabrication, test procedures, observations during test, and test results.

Sincerely yours,

Melvin S. Abrams
Director
Fire Research Department

Melvin S. Abrams

rk

CR-4803

Copy to-
W. G. Corley
Central File

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PROPERTY ENGINEERING DEPARTMENT
John J Carney, Vice President

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President

RECEIVED
TECH-SIL, INC.
Elk Grove
OCT 26 1981

October 23, 1981

Mr. Gregory J. Jarosz
Manager of Technical Development
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois 60007

Dear Mr. Jarosz:

We have reviewed Tech-Sil, Inc. Test Reports TS-TP-0075-A and TS-TP-0075-B which were conducted on July 15 and August 24, 1981 at Construction Technology Laboratories of the Portland Cement Association. These three hour fire endurance and hose stream tests were conducted to qualify a minimum 1/8" clearance between electrical or mechanical penetrations and a concrete or steel lined substrate. The following fire stop materials successfully completed the fire and hose stream tests:

TS-MS-0060-E	Leaded Silicone Elastomer (147-177 lbs./cu. ft.)
TS-MS-0080-A	Self-supporting High Density Silicone Gel (147-177 lbs./cu. ft.)
TS-MS-0046-A	Silicone Gel (90 lbs./cu. ft. minimum)
TS-MS-0009	Dow Corning 3-6548 Silicone Foam (15-23 lbs./cu. ft.) with 1" Kaowool "M-Board" or "Ceraform Board"
TS-MS-0080-C	High Density Silicone Gel (147-177 lbs./cu. ft.)
TS-MS-0045-B	Silicone Elastomer (70-90 lbs./cu. ft.)

In addition, five 1/4" copper tubes were tested to qualify a 0" clearance between the substrate and copper tubing to a maximum of 1/4" diameter copper tubing with a 1/2" clearance between the tubes. A 2 5/8" steel pipe covered with 1/2" Cerablanket and aluminum jacketing was also tested with a 1/8" clearance.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan

Robert F. MacMillan
Project Engineer

cc: Mr. G. Buxton - Middle South Services
Mr. T. S. Killen - Bechtel Power Corporation, Gaithersburg, Md.
Mr. C. Eckenboy - Bechtel Power Corporation, Gaithersburg, Md.

The Exchange, Suite 245 / 270 Farmington Avenue / Farmington Connecticut 06032 / (203) 677-7305 ■ Eng. Dept. (203) 677-7715 / TLX. No. 643-029

REVISION LOG

All pages	Changed revision #1 to revision #2.
p. 1, 1.0, para. 1	Changed #TS-MS-0046-A Silicone Gel density to read "(90-105 lbs./cu.ft.)" instead of "(90 lbs./cu.ft., minimum)".
p. 5, 4.0, D.	Changed #TS-MS-0046-A Silicone Gel density to read "(90-105 lbs./cu.ft.)" instead of "(90 lbs./cu.ft., minimum)".
p. 6, T/C #14	Changed "(224°F)" to "(244°F)".
p. 7, Chart, "B"	Changed "Pipe/Tray"/Seal thermocouple temperature from "224°F" to "244°F".
p. 7, Chart, "C"	Changed "Pipe/Tray"/Seal thermocouple temperature from "280°F" to "234°F".
p. 7, Chart, "C"	Changed Insulated Pipe thermocouple temperature from "185°F" to "280°F".
p. 7, Chart, "C"	Changed Copper Tube thermocouple temperature from "177°F" to "185°F".
Drawing, Pen. "C"	Changed #TS-MS-0046-A Silicone Gel density to read "(90-105 lbs./ft.^{3})" instead of "(90 lbs./ft.^{3})".

1.0 Scope:

This report describes a qualification fire/hose-stream test for four different materials. These materials are:

Penetration "A": #TS-MS-0060-E Leaded Silicone Elastomer (147-177 lbs./cu.ft.).

Penetration "B": #TS-MS-0080-A Self-Supporting High Density Silicone Gel (147-177 lbs./cu.ft.).

Penetration "C": #TS-MS-0046-A Silicone Gel (90-105 lbs-/cu.ft.); and,

Penetration "F": #TS-MS-0009 (Dow Corning #3-6548) RTV Silicone Foam (15-23 lbs./cu.ft.) and one 1" thick Kaowool "M-Board" dam (half of penetration's exposed surface) and one 1" thick Johns-Manville "Ceraform Board" dam (other half of the penetration's exposed surface).

The test consisted of subjecting a 48" x 48" x 12" thick concrete slab which contained these four sealed openings to a three hour long ASTM E-119 time/temperature curve fire test. Applicable portions of both current ANI and IEEE (634-78) fire test standards had been addressed as described later in this test. At the conclusion of the fire test, the slab was removed from the test furnace and then was subjected to three different types of hose stream tests in order to address all current variations of this portion of the qualification test.

The test as described was not conducted to duplicate specific penetrations that may be found in the field, but rather to show specific conditions (such as minimum annular space between a penetrating member and substrate). These conditions and the methods by which they were addressed are as follows:

A. Each of the four 12" x 12" x 12" deep openings utilized one "pipe/tray" penetrating member. This type of member consisted of a three sided channel fabricated from 1/4" thick steel plate welded together at each corner. A "pipe/tray" was assembled and located in each opening so that each provided a 1/8" wide gap (approximately 34-1/4" long) between the "pipe/tray" and the opening's substrate. The back (middle) of each "pipe/tray" was situated so that it ran parallel to each test openings single 1/4" thick steel substrate. This steel liner located on one side of each penetration was used to show field conditions where either concrete or steel substrates occur. The "pipe/tray" was used to demonstrate a condition where either a pipe or cable tray (etc.) closely follows (within 1/8") a penetration's substrate. This was an important field variable which required testing since earlier qualifications tests could not prove that.

1) Sufficient amounts of the different sealing materials would flow into a long narrow space to provide adequate fire protection; and,

2) That sealing materials installed between two closely located substrates would provide adequate fire protection in consideration of the destructive tendency of substrates conducting heat into a seal's unprotected surfaces.

The channel shape for the "pipe/tray" was chosen since it geometrically includes representations of all possible combinations of standard pipe sizes (for mechanical openings) where a shorter (length) gap would be produced by a non-concentric pipe inside of a sleeve. The length of the gap resulting from the use of the channel shaped "pipe/tray" also demonstrated conditions where wider cable trays (or penetrating members with flat surfaces) are located closely to a substrate.

B. Each opening also used five 1/4" diameter copper tubes (0" clearance from the substrate) to demonstrate field conditions where single or multiple small diameter copper tubing serve as the penetrating members. This was a condition not shown in previous fire tests.

C. Each opening also used a single 2-5/8" diameter steel pipe (capped at both ends) covered with 1/2" thick Johns-Manville Cerablanket and standard aluminum jacketing. The Cerablanket was held in place by the jacketing which in turn was joined with small sheet metal screws.

A bead of TECH-SIL, Inc. #TS-MS-0001 (Dow Corning #96-081) Silicone Adhesive was spread over the jacket's seam as it passed through the simulated penetration seal. This was done in order to prevent the different sealing materials from flowing into the Cerablanket insulation during seal installation.

This item was included to show a field condition where pipes may be off center to such a degree that standard pipe insulation will not fit completely around the pipe as it passes through the penetration. Where this occurs in the field and where sealing materials must be protected from pipes which exceed the operating temperature limitations of the sealing materials, the Cerablanket/aluminum jacketing is proposed as a substitute or alternate to standard pipe insulation for insulating a pipe as it passes through an opening and therefore was shown in this qualification test.

These penetrating members were located in a corner of each penetration 1/8" from one substrate to show minimum annular space. By placing these members as such, a second qualification feature for this item was provided. These member locations demonstrated a maximum annular space of 11-5/16" (diagonally from the edge of the penetrating member to the opposite inside corner of the "pipe/tray"). This, in accordance with previous tests conducted, showed that a pipe penetrating member (whether it is insulated or bare) can produce a maximum annular space of 11-5/16" while the respective sealing material in turn provides adequate fire protection.

D. Each opening was equipped with a section of non-functional Unistrut steel welded to the inside of the "pipe/tray" at the center of the seal (parallel to the slab surfaces). This piece of material was added to demonstrate conditions, where Unistrut or steel are used in normal field conditions to support cable trays and anchor conduits. These supports often become embedded in the different sealing materials. The intent of this item was to prove that these support mechanisms do not affect the fire endurance capabilities of the overall seal designs.

E. Penetration "B" had an additional 4" diameter by 24" long rigid steel conduit penetrating member which was filled with cable. The purpose of this was to provide an additional penetration which would qualify the use of the #TS-MS-0080-A Self-Supporting High Density Silicone Gel as a conduit seal.

F. Penetration "F" which consisted of 9" of TECH-SIL #TS-MS-0009 (Dow Corning #3-6548) RTV Silicone Foam over one 1" thick section of damming material used two different types of damming material. Half of the opening was dammed with Kaowool "M-Board" while the other half of the opening was dammed with Johns-Manville Ceraform Board. The purpose of this item was to demonstrate that either of these generic damming material could be used with the silicone foam in conjunction with Items A through E of this section.

As stated earlier, these items reflect specific conditions and were not intended to duplicate actual penetrations found in the field. This test was designed to use the tested conditions in conjunction with other tests performed for these specific materials.

This test was conducted 7/15/81 at Portland Cement Association (Skokie, Illinois). The test was witnessed by representatives of Portland Cement Association, TECH-SIL, Inc., Mssrs. W. Bornhoft (of American Nuclear Insurers) and G. Buxton (Middle South Energy).

2.0 Slab Construction:

A forty-eight by forty-eight by twelve inch thick concrete slab was cast to represent a typical floor section. The slab contained four 12" x 12" x 12" penetrations. One surface of each opening consisted of a 1/4" thick steel plate. As a result, each opening showed representative cast (or core bored) and steel substrate surfaces.

As part of the slab fabrication, concrete reinforcing bars were embedded in the concrete around the penetration. The type of bar used was an ASTM A615 grade 60 type steel with a minimum yield strength of 60,000 psi.

The concrete for the slab was mixed, formed and poured by Portland Cement Association personnel. The concrete was made from sand and gravel from Elgin, Illinois (predominately dolmitic aggregate). The sand used had a specific gravity of 2.67, absorption of 2%.

Checks were made for concrete slump, unit weight and air content. Batch quantities, properties of plastic concrete, and strength were approximately the following:

Average slump, (in.): 3-1/2
Average air content: 4%
Average fresh unit weight:. . . . . .145 lbs./cu.ft.
Average compressive strength: 4,000

The concrete was mixed at Portland Cement Association's test laboratory with a tilting drum mixer distributed into the form around the penetration with an overhead dump bucket, and consolidated with an internal vibrator. The top surface was leveled with wooden float and finished with a magnesium float.

Braces fabricated from 3" x 3" x 1/4" thick angle steel were mounted to the slab approximately 6" above its unexposed surface. The braces were used to anchor all of the penetrating members with the exception of the cables used in penetration "B" (these were mounted from a separate brace approximately 24" above the unexposed surface of the slab). No braces were used on the slab's exposed surface.

3.0 Penetrating Members:

The following items were used in each opening to represent penetrating members:

A. A 11-3/4" x 11 3/4" x 11-3/4" channel shaped "pipe/tray" fabricated from 1/4" steel plate welded together at each corner (one "pipe/tray" per opening). This thickness of steel plate was chosen since it was believed to represent a more severe condition (in regard to heat conduction) than the thinner galvanized steel used for cable tray construction and also since it would adequately represent a pipe.

Each "pipe/tray" passed through the test openings so that they extended 12" below the exposed surface of the slab and 6" above its unexposed surface. The 6" extension above the slab also posed a more severe condition since the heat sink effect of a longer 36" extension of the penetrating member above the slab's unexposed surface was not taken advantage of. This step was implemented to demonstrate conditions where cable trays might terminate closer to a penetration seal surface than 36".

This "pipe/tray" member was located 1/8" from three of each opening substrates. The bottom (middle) of the channel shape was located 1/8" from each opening's steel substrate.

B. A 2-5/8" diameter by 54" long steel pipe capped at both ends (one each opening). The pipe was wrapped with 1/2" of Johns-Manville Cerablanket and standard aluminum jacket. The aluminum jacket was fastened at its overlapping seam with short sheet metal screws. A bead of TECH-SIL #TS-MS-0001 (Dow Corning #96-061) Silicone Adhesive was spread over the jacket's seam as it passed through the opening.

These members were mounted so that they passed through the opening and extended 12" below the slab's exposed surface and 30" above its unexposed surface. These members were located 1/8" from each opening's substrate surface.

C. Five (each opening) 1/4" diameter by 54" long copper tubes crimped at both ends. These tubes were mounted so that they passed through the opening and extended 12" below the slab's exposed surface and 30" above its unexposed surface. These members were located so that there was no clearance (0") between a tube and substrate. Each tube was located within 1/2" of another tube.

D. Each opening also was penetrated (horizontally) with a section of unistrut steel located at the center of each seal's overall depth.

E. Penetration "B" (only) was penetrated by a 4" diameter by 24" long rigid steel conduit. This conduit was located so that it passed through the opening and extended 12" above the slab's unexposed surface. The conduit was located 1/8" from the penetration's substrate. The conduit was filled with the following cable:

QTY.	- Description	- dia.	- Sectional Area
25	- IKN (25 c/small conductor), PVC jacketed	- 0.24	- 1.13 in.^{2}
8	- 2/c #10 Rockbestos Firewall III, XLPE jacketed	- 0.555"	-1.90 in.^{2}
7	- 3/c #10 Okonite Okolon, EPR/H jacketed	- 0.639"	-2.24 in.^{2}
			5.27 in.^{2}

5.27 in.= 41.93% fill = 105% loading.

4.0 Seal-Types:

The test openings were filled accordingly:

A. Penetration A: Sealed with #TS-MS-0060-E Leaded Silicone Elastomer (147-177 lbs./cu.ft.) not less than 12" deep.

B. Penetration B: Sealed with #TS-MS-0080-A Self Supporting High Density Silicone Gel (147-177 lbs./cu.ft.) not less than 12" deep.

C. Conduit passing through Penetration "B": Sealed with #TS-MS-0080-A Self Supporting High Density Silicone Gel (147-177 lbs./cu.ft.) not less than 24" deep.

D. Penetration C: Sealed with #TS-MS-0046-A Silicone Gel (90-105 lbs./cu.ft.) not less than 12" deep. It should be noted that boot seals are normally used in conjunction with the #TS-MS-0046-A Silicone Gel (the boots act as flexible membrane forms). The test was conducted without the use of these boots.

E. Penetration F: Sealed with #TS-MS-0009 (Dow Corning #3-6548) RTV Silicone Foam, 15-23 lbs./cu.ft., not less than 9" deep. The silicone foam was installed over a split 1" thick dam consisting of both Johns-Manville "Ceraform Board" and Kaowool "M-Board". The 1/8" wide gap between the "pipe/tray" and the substrate was filled with 11" of silicone foam over the respective damming material.

5.0 Thermocouples:

A total of 36 thermocouples were attached to the four test assemblies in order to obtain temperature data during the fire test. These thermocouples can be divided into three separate groups which are:

1. Thermocouples for monitoring seal surface temperatures.

2. Thermocouples for monitoring seal surface/penetrating member interface temperatures; and,

3. Thermocouples for monitoring seal surface/penetration substrate interface temperatures.

Seal surface thermocouples (group 1) were mounted so that the tip of the thermocouple was embedded between 1/4-1/2" into the seal below its unexposed surface. Thermocouples to be used for monitoring penetrating member and substrate temperatures (groups 2 and 3) were mounted 1/4"-1/2" below the seal's unexposed surface by prying the seal back slightly and inserting the top of the thermocouple into the separation. As a result, an interface temperature was obtained which is more accurate than temperatures obtained by other methods.

Thermocouples used for this test are identified as follows:

T/C # 1:	Pen. "A" - Seal Surface	(134°F)
T/C # 2:	Pen. "A" - Seal Surface	(139°F)
T/C # 3:	Pen. "A" - Seal Surface	(165°F)
T/C # 4:	Pen. "A" - Seal/Concrete Substrate Interface	(81°F)
T/C # 5:	Pen. "A" - Seal/Steel Substrate Interface	(334°F)
T/C # 6:	Pen. "A" - "Pipe/Tray"/Seal Interface	(208°F)
T/C # 7:	Pen. "A" - Insulated Pipe	(237°F)
T/C # 8:	Pen. "A" - Copper Tube	(177°F)
T/C # 9:	Pen. "B" - Seal Surface	(120°F)
T/C #10:	Pen. "B" - Seal Surface	(123°F)
T/C #11:	Pen. "B" - Seal Surface	(144°F)
T/C #12:	Pen. "B" - Seal/Concrete Substrate Interface	(160°F)
T/C #13:	Pen. "B" - Seal/Steel Substrate Interface	(320°F)
T/C #14:	Pen. "B" - "Pipe/Tray"/Seal Interface	(244°F)
T/C #15:	Pen. "B" - Insulated Pipe	(260°F)
T/C #16:	Pen. "B" - Copper Tube	(273°F)
T/C #17:	Pen. "B" - Pen. Seal/Conduit Interface	(268°F)
T/C #18:	Pen. "B" - Conduit Seal/Conduit Interface	(129°F)
T/C #19:	Pen. "B" - Conduit Seal Surface	(83°F)
T/C #20:	Pen. "B" - Conduit Seal Surface	(146°F)
T/C #21:	Pen. "C" - Seal Surface	(126°F)
T/C #22:	Pen. "C" - Seal Surface	(113°F)
T/C #23:	Pen. "C" - Seal Surface	(125°F)
T/C #24:	Pen. "C" - Seal/Concrete Substrate Interface	(163°F)
T/C #25:	Pen. "C" - Seal/Steel Substrate Interface	(323°F)
T/C #26:	Pen. "C" - "Pipe/Tray"/Seal Interface	(234°F)
T/C #27:	Pen. "C" - Insulated Pipe	(280°F)
T/C #28:	Pen. "C" - Copper Tube	(185°F)
T/C #29:	Pen. "F" - Seal Surface	(177°F)
T/C #30:	Pen. "F" - Seal Surface	(357°F)
T/C #31:	Pen. "F" - Seal Surface	(193°F)
T/C #32:	Pen. "F" - Seal/Concrete Substrate Interface	(199°F)
T/C #33:	Pen. "F" - Seal/Steel Substrate Interface	(147°F)
T/C #34:	Pen. "F" - "Pipe/Tray"/Seal Interface	(293°F)
T/C #35:	Pen. "F" - Insulated Pipe	(378°F)
T/C #36:	Pen. "F" - Copper Tube	(391°F)

The final temperature readings at the conclusion of the three hour fire test are shown in parenthesis after the above thermocouple identification. The following chart shows a comparison of the different temperatures at the test conclusion:

Penetration	"A"	"B"	"C"	"F"
Seal Surface	134°	120°	126°	177°
Seal Surface	139°	123°	113°	357°
Seal Surface	165°	144°	125°	193°
Concrete Interface	81°	160°	163°	199°
Steel Interface	334°	320°	323°	147°(*)
"Pipe/Tray"/Seal	208°	244°	234°	293°
Insulated Pipe	237°	260°	280°	378°
Copper Tube	177°	273°	185°	391°

(*) Seal inside of "pipe/tray" had separated from "pipe/tray" early in the test leaving an approximately 3/4" wide gap. This gap may have allowed for cooling at this portion of the seal.

6.0 Fire Test:

The fire test procedure consisted of subjecting the test slab and seal specimens to a three hour long ASTM E-119 time/temperature curve fire test. For this, the slab was placed on a small floor furnace.

Simply described, the furnace used for this type of test is a square shaped, refractory brick lined steel box heated by four gas burners (one on each side of the furnace). The burners are automatically ignited from the outside of the furnace.

The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by three shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures were also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft as a result of fuel contribution and temperature variables) during the test.

7.0 Test Record:

The fire test was conducted for 3 hours in accordance with the ASTM E-119 time/temperature curve. Furnace atmosphere temperature data along with individual unexposed surface thermocouple documentation is shown in table form at the end of this report. Other items noted during this test are as follows:

A. The entire test was conducted using a -.08 in. H_2O draft on the exposed side of the slab.

B. At one hour and five minutes into the test, the silicone foam seal used in penetration "F" began to slide up against the back inside wall of the "pipe/tray". As the foam rose, it peeled back away from the "pipe/tray" to produce an approximately 3/4" wide by 4" deep gap. It was postulated that the silicone foam had expanded from the initial heat of the test (a normal feature attributed to this material) and instead of expanding laterally in the opening, the back portion of the seal slid up against the smooth surface of the "pipe/tray".

C. At one hour and fifty-five minutes, a light veil of smoke was noted originating from Penetration "C". The smoke density increased slightly for the duration of the test. It was observed that most of the smoke was generating from the area where the copper tubing penetrated the seal. It was suspected that the heated tubes might have caused a small pocket of uncured or reverted gel material to smoke.

8.0 Hose-Stream Test:

Although only one hose-stream test is normally required in order to qualify a seal assembly, three different hose-stream tests were conducted to include available test standard variations.

The first hose-stream test was performed according to the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and one half inch diameter hose through a 30-90° high velocity spray nozzle (set at 30°) at 75 psi from a distance of 10 feet.

The second hose-stream test was performed according to the current ANI test standard. Water was sprayed on the exposed surface of the slab for 12 seconds using an even spray discharged from a one and one half inch diameter hose through a 30-90° high velocity spray nozzle (set at 15°) at seventy-five psi from a distance of ten feet.

The third hose-stream test was performed according to the ASTM E-119 test standard. Water was sprayed onto the exposed surface of the slab for 12 seconds using a solid stream of water discharged from a two and one half inch hose with a 1-1/8" National Playpipe Nozzle at 30 psi from a distance of 20 feet.

9.0 Test Conclusions:

A. At the conclusion of the fire test, it was confirmed that fire did not penetrate through the seal assemblies nor did fire occur on any of the different seal surfaces as a result of spontaneous combustion, etc.

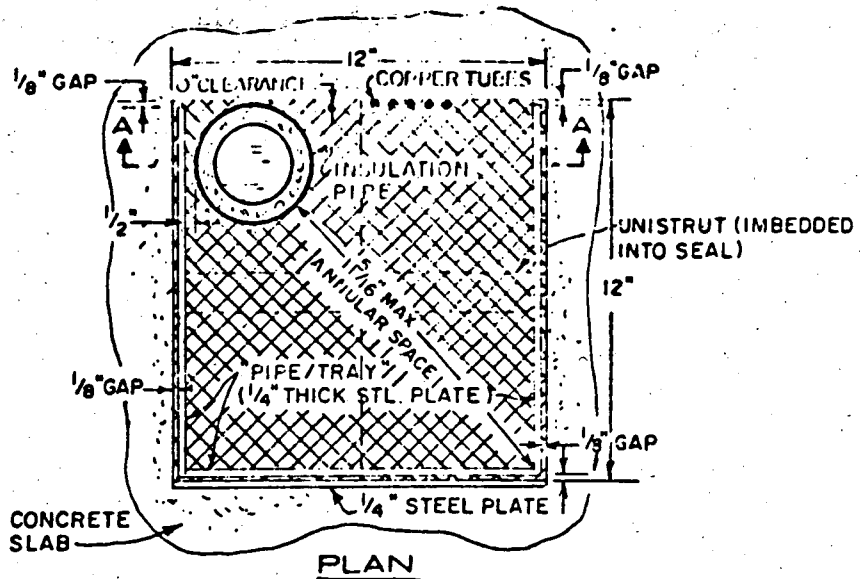
B. None of the surface temperatures exceeded the ANI pass/fail seal temperature limitations (325°F + ambient, maximum). At the end of the test, the seal surface temperatures were shown to be:

Penetration "A":	134°, 139°, and 165°F
Penetration "B":	120°, 123°, and 144°F
Conduit Seal in Penetration "B":	83° and 146°F
Penetration "C":	126°, 113°, and 125°F
Penetration "F":	177°, 357°, and 193°F

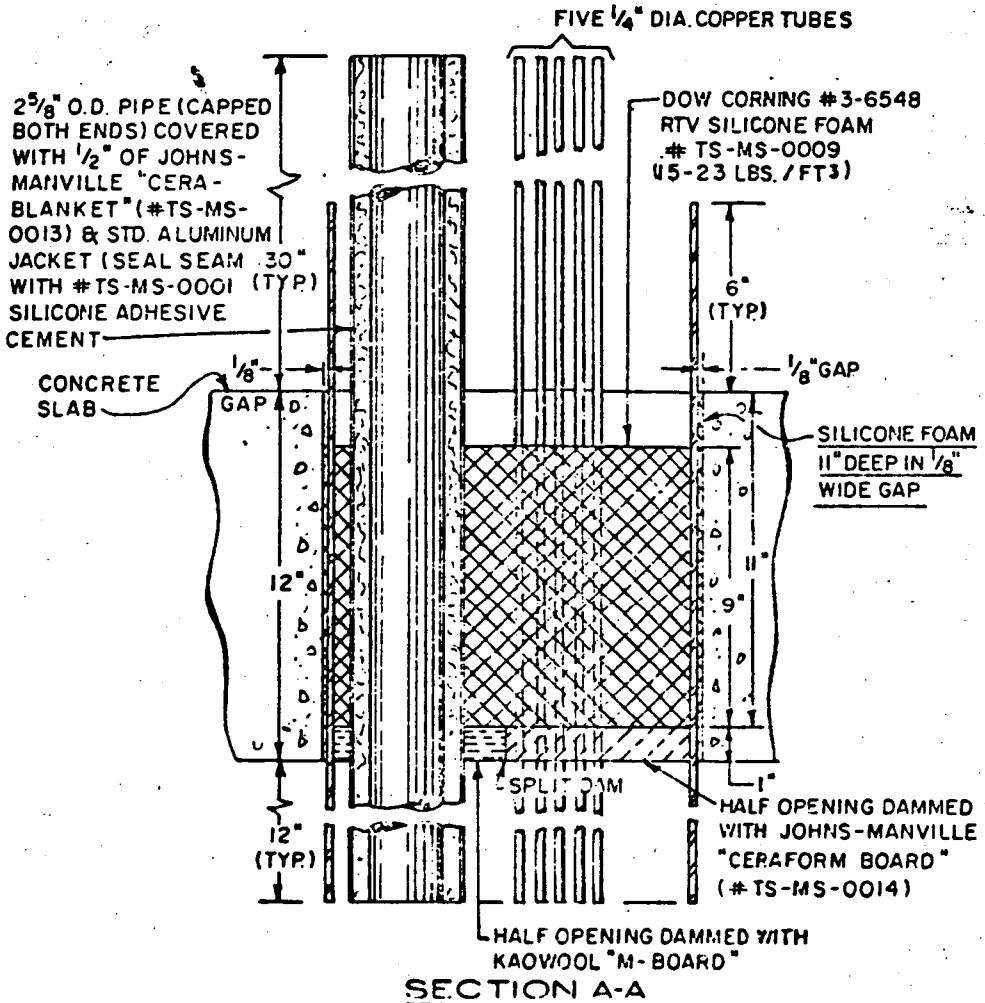
C. Water did not penetrate through any of the seal assemblies during any of the three hose-stream tests.

D. It was noted (after the hose-stream tests) that the following amounts of material had been destroyed by fire and had been washed away during the hose-stream tests:

1. Penetration "A": Main Seal: 3-5", in 1/8" gap: 8"
2. Penetration "B": Main Seal and 1/8" gap: None (hard char)
3. Penetration "C": Main Seal: 5-7", in 1/8" gap: 4"
4. Penetration "F": Main Seal: 6-7-1/2", in 1/8" gap: 9-11".



PLAN



SECTION A-A

PENETRATION "F"

TECH-SIL, INC.

TEST #TS-TP-0075-A

TECH-SIL (CR4803) - 07/15/81

FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	80	68	12
0:05	914	1000	-86
0:10	1484	1300	184
0:15	1401	1399	2
0:20	1481	1462	19
0:25	1526	1510	16
0:30	1553	1550	8
0:35	1571	1584	-13
0:40	1605	1613	-8
0:45	1639	1638	1
0:50	1673	1661	12
0:55	1692	1681	11
1:00	1703	1700	3
1:05	1692	1718	-26
1:10	1728	1735	-7
1:15	1760	1750	10
1:20	1759	1765	-6
1:25	1786	1779	7
1:30	1790	1792	-2
1:35	1823	1804	19
1:40	1819	1815	4
1:45	1825	1826	-1
1:50	1847	1835	12
1:55	1854	1843	11
2:00	1869	1850	19
2:10	1892	1882	10
2:20	1894	1875	19
2:30	1894	1888	6
2:40	1904	1900	4
2:50	1918	1912	6
3:00	1935	1925	10
~~3:10~~	~~1945~~	~~1938~~	~~[illegible]~~
~~3:20~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~

TECH-SIL (CR4303) - 07/15/81

UNEXPOSED SURFACE TEMP. (DEG F.)

TEST TIME, Hr:Min	T/C NO. 1	2	3	4	5	6
0:00	77	77	78	75	78	77
0:05	77	77	77	75	78	77
0:10	77	77	77	75	79	78
0:15	77	77	77	75	84	80
0:20	77	77	77	75	89	83
0:25	77	77	78	76	95	87
0:30	77	77	78	76	102	90
0:35	78	78	78	76	109	93
0:40	78	78	79	77	117	96
0:45	78	78	80	77	126	99
0:50	79	79	82	77	137	103
0:55	79	80	84	78	150	106
1:00	80	81	85	79	162	110
1:05	81	83	88	79	181	114
1:10	82	84	91	78	196	118
1:15	84	85	94	78	199	123
1:20	85	88	97	78	200	129
1:25	87	90	100	78	202	131
1:30	88	91	103	79	207	140
1:35	90	94	106	80	214	145
1:40	92	97	110	82	222	151
1:45	94	99	113	82	229	155
1:50	96	102	117	83	236	160
1:55	99	105	120	81	244	163
2:00	101	107	123	85	252	167
2:10	106	112	130	86	266	177
:20	112	118	137	86	280	[illegible]
2:30	117	123	144	87	294	188
2:40	123	130	151	88	308	195
2:50	128	135	158	84	321	201
3:00	134	139	165	81	334	208
~~3:10~~	~~74~~	~~77~~	~~116~~	~~64~~	~~[illegible]~~	~~[illegible]~~
~~3:20~~	~~74~~	~~74~~	~~74~~	~~[illegible]~~	~~[illegible]~~	~~[illegible]~~

TECH-SIL (CR4803) - 07/15/81

UNEXPOSED SURFACE TEMP. (DEG F.)

TEST TIME, Hr:Min	T/C NO.					
	7	8	9	10	11	12
0:00	77	76	77	76	78	77
0:05	77	77	77	76	77	77
0:10	77	78	77	76	77	77
0:15	79	80	77	76	77	77
0:20	80	82	77	76	77	77
0:25	83	84	77	76	77	77
0:30	86	87	77	77	78	78
0:35	89	89	77	77	78	78
0:40	93	91	78	78	78	79
0:45	97	94	78	78	79	81
0:50	102	96	78	79	80	82
0:55	106	100	79	80	81	84
1:00	111	102	80	81	82	86
1:05	116	105	81	82	83	88
1:10	121	107	81	83	84	90
1:15	126	111	82	84	86	93
1:20	132	114	83	85	88	95
1:25	138	118	85	87	90	98
1:30	143	120	86	89	92	101
1:35	149	124	87	90	94	104
1:40	154	127	89	91	96	107
1:45	160	132	90	94	99	110
1:50	166	134	92	95	101	114
1:55	171	138	93	98	104	117
2:00	177	140	95	99	107	120
2:10	187	149	99	103	112	127
2:20	199	155	103	107	118	133
2:30	209	159	107	112	124	140
2:40	219	165	111	115	129	146
2:50	228	171	116	119	136	153
3:00	237	177	120	123	144	160
~~3:10~~	~~131~~	~~97~~	~~66~~	~~117~~	~~79~~	~~66~~
~~3:20~~	~~24~~	~~18~~	~~12~~	~~111~~	~~15~~	~~14~~

TECH-SIL (CR4803) - 07/15/81

UNEXPOSED SURFACE TEMP. (DEG F.)

TEST TIME, Hr:Min	T/C NO.					
	13	14	15	16	17	18
0:00	78	77	77	77	77	76
0:05	78	77	77	77	77	75
0:10	78	78	78	80	77	75
0:15	82	80	80	86	78	75
0:20	87	83	82	93	81	75
0:25	93	88	85	101	84	76
0:30	100	92	88	108	88	76
0:35	107	97	92	114	93	77
0:40	115	102	96	121	98	78
0:45	126	107	101	127	104	79
0:50	139	112	105	134	110	80
0:55	150	117	111	140	114	82
1:00	158	123	115	146	120	84
1:05	165	128	121	153	127	87
1:10	172	133	126	158	133	89
1:15	180	139	131	164	140	92
1:20	187	144	137	170	147	95
1:25	195	149	142	176	153	98
1:30	202	154	148	181	160	100
1:35	209	160	154	187	167	103
1:40	216	165	160	193	175	106
1:45	222	171	165	199	181	101
1:50	229	176	171	206	188	103
1:55	235	181	177	212	194	105
2:00	242	187	182	219	200	107
2:10	255	197	193	247	212	109
2:20	267	208	203	256	224	113
2:30	281	217	215	255	235	116
2:40	294	225	226	257	246	119
2:50	306	235	251	265	256	124
3:00	320	244	260	273	268	129
~~3:10~~	~~176~~	~~134~~	~~259~~	~~150~~	~~148~~	~~678~~
~~3:20~~	~~33~~	~~25~~	~~258~~	~~28~~	~~27~~	~~1227~~

TECH-SIL (CR4803) - 07/15/81

UNEXPOSED SURFACE TEMP. (DEG F.)

TEST TIME, Hr:Min	T/C NO.					
	19	20	21	22	23	24
0:00	73	76	78	77	78	77
0:05	73	75	78	77	78	77
0:10	74	75	77	77	77	77
0:15	74	75	78	77	77	77
0:20	73	75	77	77	77	78
0:25	74	75	77	77	77	78
0:30	74	76	78	77	77	79
0:35	74	76	77	77	77	79
0:40	74	77	78	77	78	81
0:45	75	78	78	77	78	82
0:50	75	79	78	78	78	83
0:55	75	81	79	78	78	85
1:00	76	83	79	78	79	87
1:05	77	85	80	79	79	89
1:10	75	87	81	80	80	91
1:15	76	89	82	80	81	93
1:20	76	92	83	81	82	96
1:25	76	95	84	82	83	99
1:30	75	98	86	83	85	101
1:35	75	100	87	84	86	104
1:40	76	103	89	85	88	107
1:45	76	106	90	86	89	110
1:50	78	109	92	88	91	113
1:55	78	112	94	89	93	116
2:00	79	115	96	90	95	120
2:10	78	120	100	93	99	126
2:20	80	126	105	97	104	133
2:30	82	131	110	100	109	141
2:40	80	136	115	104	114	148
2:50	83	141	121	108	119	156
3:00	83	146	126	113	125	163
~~3:10~~	~~79~~	~~80~~	~~70~~	~~62~~	~~69~~	~~90~~
~~3:20~~	~~75~~	~~15~~	~~12~~	~~12~~	~~13~~	~~17~~

TECH-SIL (CR4803) - 07/15/81

UNEXPOSED SURFACE TEMP. (DEG F.)

TEST TIME, Hr:Min	T/C NO.					
	25	26	27	28	29	30
0:00	78	78	77	77	78	78
0:05	78	77	77	77	78	78
0:10	78	78	77	78	77	79
0:15	81	79	79	79	78	83
0:20	84	82	81	81	79	91
0:25	90	85	83	83	80	99
0:30	96	89	87	85	82	109
0:35	103	93	90	87	84	119
0:40	110	97	95	89	86	128
0:45	118	101	99	91	89	141
0:50	127	105	104	93	91	152
0:55	135	110	109	97	93	160
1:00	145	114	115	99	95	172
1:05	154	119	120	102	98	182
1:10	162	123	126	105	102	192
1:15	172	128	132	108	105	201
1:20	181	132	138	112	109	211
1:25	189	137	144	115	112	212
1:30	198	141	149	118	116	228
1:35	206	146	155	121	119	236
1:40	213	151	162	124	123	243
1:45	220	155	168	128	126	251
1:50	226	160	174	132	130	257
1:55	234	165	182	135	133	252
2:00	241	171	189	138	137	271
2:10	255	182	206	147	144	284
2:20	269	193	221	154	150	299
2:30	284	204	238	163	157	313
2:40	296	215	252	170	164	327
2:50	310	225	267	177	170	342
3:00	323	234	280	185	177	357
~~3:10~~	~~672~~	~~129~~	~~154~~	~~102~~	~~98~~	~~197~~
~~3:20~~	~~1421~~	~~24~~	~~29~~	~~19~~	~~18~~	~~37~~

TECH-SIL (CR4803) - 07/15/81

UNEXPOSED SURFACE TEMP. (DEG F.)

TEST TIME, Hr:Min	T/C NO.					
	31	32	33	34	35	36
0:00	77	78	77	77	77	77
0:05	77	78	76	78	82	114
0:10	77	78	76	82	98	153
0:15	77	80	77	95	114	163
0:20	78	81	78	111	126	172
0:25	78	83	78	124	139	180
0:30	80	85	80	137	152	186
0:35	81	87	81	148	164	192
0:40	83	90	82	157	177	198
0:45	84	93	83	165	189	204
0:50	86	96	85	172	201	211
0:55	89	99	86	177	213	217
1:00	91	102	88	183	222	221
1:05	94	105	90	189	233	226
1:10	97	109	92	195	242	233
1:15	100	112	94	201	251	[illegible]
1:20	104	116	96	207	260	[illegible]
1:25	107	120	98	212	269	250
1:30	111	123	100	217	278	258
1:35	115	127	103	221	[illegible]	265
1:40	120	131	106	226	[illegible]	272
1:45	124	135	108	230	296	277
1:50	128	139	111	232	303	285
1:55	132	143	114	238	307	291
2:00	137	147	117	241	314	299
2:10	146	155	124	250	328	312
2:20	155	163	129	257	338	322
2:30	164	172	130	266	347	334
2:40	173	181	136	274	360	346
2:50	183	194	141	278	369	333
3:00	193	199	147	293	378	391
~~3:10~~	~~214~~	~~164~~	~~111~~	~~161~~	~~200~~	~~216~~
~~3:20~~	~~1435~~	~~120~~	~~75~~	~~30~~	~~95~~	~~13~~

TECH-SIL

TEST NO. 0075-B
QUALIFICATION FIRE/HOSE-STREAM TEST
FOR
THREE DIFFERENT MATERIALS

NO.	DATE	RELEASE	BY	CK.	CK.	CK.	APP.
0	1/7/85	FOR INFORMATION	SW	AL	D.L.	CK	AF

AMERICAN NUCLEAR INSURERS

BURT C. PROOM, CPCU
President

PROPERTY ENGINEERING DEPARTMENT
John J Carney, Vice President

TECH-SIL, INC.
Elk Grove
RECEIVED
OCT 26 1981

October 23, 1981

Mr. Gregory J. Jarosz
Manager of Technical Development
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois 60007

Dear Mr. Jarosz:

We have reviewed Tech-Sil, Inc. Test Reports TS-TP-0075-A and TS-TP-0075-B which were conducted on July 15 and August 24, 1981 at Construction Technology Laboratories of the Portland Cement Association. These three hour fire endurance and hose stream tests were conducted to qualify a minimum 1/8" clearance between electrical or mechanical penetrations and a concrete or steel lined substrate. The following fire stop materials successfully completed the fire and hose stream tests:

TS-MS-0060-E	Leaded Silicone Elastomer (147-177 lbs./cu. ft.)
TS-MS-0080-A	Self-supporting High Density Silicone Gel (147-177 lbs./cu. ft.)
TS-MS-0046-A	Silicone Gel (90 lbs./cu. ft. minimum)
TS-MS-0009	Dow Corning 3-6548 Silicone Foam (15-23 lbs./cu. ft.) with 1" Kaowool "M-Board" or "Ceraform Board"
TS-MS-0080-C	High Density Silicone Gel (147-177 lbs./cu. ft.)
TS-MS-0045-B	Silicone Elastomer (70-90 lbs./cu. ft.)

In addition, five 1/4" copper tubes were tested to qualify a 0" clearance between the substrate and copper tubing to a maximum of 1/4" diameter copper tubing with a 1/2" clearance between the tubes. A 2 5/8" steel pipe covered with 1/2" Cerablanket and aluminum jacketing was also tested with a 1/8" clearance.

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

R. F. MacMillan

Robert F. MacMillan
Project Engineer

cc: Mr. G. Buxton - Middle South Services
Mr. T. S. Killen - Bechtel Power Corporation, Gaithersburg, Md.
Mr. C. Eckenboy - Bechtel Power Corporation, Gaithersburg, Md.

The Exchange Suite 245 / 270 Farmington Avenue / Farmington, Connecticut 06032 / (203) 677-7305 ■ Eng. Dept. (203) 677-7715 / TLX. No. 643-029

construction technology laboratories

a Division of the PORTLAND CEMENT ASSOCIATION

5420 Old Orchard Road, Skokie, Illinois 60077 • Phone 312/966-6200

September 25, 1981

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois
60007

Dear Mr. Jarosz:

I have reviewed Test Reports #TS-TP-0075-B entitled, "Qualification Fire-Hose-Stream Test for Three Different Materials," and #TS-TP-0081 entitled, "Fire and Hose-Stream Test for #TS-MS-0080-A - Self-Supporting High-Density Silicone Gel."

These tests were conducted on August 24, 1981, and September 11, 1981, in the Fire Research Laboratory, Construction Technology Laboratories, of the Portland Cement Association.

These reports accurately describe details of specimen, fabrication, test procedures, observations during test, and test results.

Sincerely yours,

Melvin S. Abrams

Director
Fire Research Department

Melvin S. Abrams

rk

CR-4795
CR-4844

Copy to-
W. G. Corley
Central File

TEST REPORT #TS-TP-0075-B

QUALIFICATION FIRE/HOSE-STREAM TEST

FOR

THREE DIFFERENT MATERIALS

1.0 Scope:

This report describes a qualification fire/hose-stream test for three different materials. These materials are:

Penetration "D": #TS-MS-0009 Silicone Foam (15-23 lbs./cu.ft.) and one 1" thick Kaowool "M-Board" dam (half of penetration's unexposed surface) and one 1" thick Johns-Manville "Ceraform Board" dam (other half of the penetration's unexposed surface);

Penetration "E": #TS-MS-0080-C High Density Silicone Gel (147-177 lbs./cu.ft.);

Penetration "H": #TS-MS-0045-B Silicone Elastomer (70-95 lbs./cu.ft. minimum)

The test consisted of subjecting a 48" x 48" x 12" thick concrete slab which contained these three sealed openings to a three hour long ASTM E-119 time/temperature curve fire test. Applicable portions of both current ANI and IEEE (634-78 fire test standards) had been addressed as described later in this test. At the conclusion of the fire test, the slab was removed from the test furnace and then was subjected to three different types of hose-stream tests in order to address all current variations of this portion of the qualification test.

The test as described was not conducted to duplicate specific penetrations that may be found in the field, but rather to show specific conditions (such as minimum annular space between a penetrating member and substrate). These conditions and the methods by which they were addressed are as follows:

A. Each of the three 12" x 12" x 12" deep openings utilized one "pipe/tray" penetrating member. For penetrations "D" and "E", this type of member consisted of a three sided channel fabricated from 1/4" thick steel plate welded together at each corner. The "pipe/tray" was assembled and located in each of the three openings so that it provided a 1/8" wide gap (approximately 34-1/4" long) between the "pipe/tray" and the opening's substrate. The back (middle) of each "pipe/tray" was situated so that it ran parallel to each test opening's single 1/4" thick steel substrate. This steel liner located on one side of each penetration was used to show field conditions where either concrete or steel substrates occur. The "pipe/tray" was used to demonstrate a condition where either a pipe or cable tray (etc.) closely follows (within 1/8") a penetration's substrate. This was an important field variable which required testing since earlier qualifications tests could not prove that:

1.) Sufficient amounts of the different sealing materials would flow into a long narrow space to provide adequate fire protection; and,

2.) That sealing materials installed between two closely located substrates would provide adequate fire protection in consideration of the destructive tendency of substrates conducting heat into a seal's unprotected surfaces.

The channel shape for the "pipe/tray" was chosen since it geometrically includes representations of all possible combinations of standard pipe sizes (for mechanical openings) where a shorter (length) gap would be produced by a non-concentric pipe inside of a sleeve. The length of the gap resulting from the use of the channel shaped "pipe/tray" also demonstrated conditions where wider cable trays (or penetrating members with flat surfaces) are located closely to a substrate.

B. Each opening also used five 1/4" diameter copper tubes (0" clearance from the substrate) to demonstrate field conditions where single or multiple small diameter copper tubing serve as the penetrating members. This was a condition not shown in previous fire tests.

C. Each opening also used a single 2-5/8" diameter steel pipe (capped at both ends) covered with 1/2" thick Johns-Manville Cerablanket and standard aluminum jacketing. The Cerablanket was held in place by the jacketing which in turn was joined with small sheet metal screws.

A bead of TECH-SIL, Inc. #TS-MS-0001 (Dow Corning #96-081) Silicone Adhesive was spread over the jacket's seam as it passed through the simulated penetration seal. This was done in order to prevent the different sealing materials from flowing into the Cerablanket insulation during seal installation.

This item was included to show a field condition where pipes may be off center to such a degree that standard pipe insulation will not fit completely around the pipe as it passes through the penetration. Where this occurs in the field and where sealing materials must be protected from pipes which exceed the operating temperature limitations of the sealing materials, the Cerablanket/aluminum jacketing is proposed as a substitute or alternate to standard pipe insulation for insulating a pipe as it passes through an opening and therefore was shown in this qualification test.

These penetrating members were located in a corner of each penetration 1/8" from one substrate to show minimum annular space. By placing these members as such, a second qualification feature for this item was provided. These member locations demonstrated a maximum annular space of 11-5/16" for penetrations "D" and "E" and 11-1/4" for penetration "H" (diagonally from the edge of the penetrating member to the opposite inside corner of the "pipe/tray"). This, in accordance with previous tests conducted, showed that a pipe penetrating member (whether it is insulated or bare) can produce a maximum annular space of 11-5/16" (11-1/4" for penetration "H") while the respective sealing material in turn provides adequate fire protection.

D. Each opening was equipped with a section of non-functional Unistrut steel welded to the inside of the "pipe/tray" at the center of the seal (parallel to the slab surfaces). This piece of material was added to demonstrate conditions, where Unistrut or steel are used in normal field conditions to support cable trays and anchor conduits. These supports often become embedded in the different sealing materials. The intent of this item was to prove that these support mechanisms do not affect the fire endurance capabilities of the overall seal designs.

E. Penetration "H", which consisted of 6" of #TS-MS-0045-B Silicone Elastomer, was sealed (inside of the gap outside of the 4 sided "pipe/tray") with 2" of #TS-MS-0013 Cerablanket and #TS-MS-0016 Cerafiber covered with 2" of #TS-MS-0001 Silicone Adhesive. This seal was placed on the exposed surface of the slab, and as tested, qualified it for use with any other qualified sealing material.

F. Penetration "D", which consisted of 9" of TECH-SIL #TS-MS-0009 (Dow Corning #3-6548) RTV Silicone Foam under one 1" thick section of damming material, used two different types of damming material. Half of the opening was dammed with Kaowool "M-Board" while the other half of the opening was dammed with Johns-Manville Ceraform Board. The purpose of this item was to demonstrate that either of these generic damming materials could be used with the silicone foam in conjunction with Items A through E of this section.

As stated earlier, these items reflect specific conditions and were not intended to duplicate actual penetrations found in the field. This test was designed to use the tested conditions in conjunction with other tests performed for these specific materials.

This test was conducted 8/24/81 at Portland Cement Association (Skokie, Illinois). The test was witnessed by representatives of Portland Cement Association, and TECH-SIL, Inc.

2.0 Slab Construction:

A forty-eight by forty-eight by twelve inch thick concrete slab was cast to represent a typical floor section. The slab contained four 12" x 12" x 12" penetrations. One surface of each opening consisted of a 1/4" thick steel plate. As a result, each opening showed representative cast (or core bored) and steel substrate surfaces.

As part of the slab fabrication, concrete reinforcing bars were embedded in the concrete around the penetration. The type of bar used was an ASTM A615 grade 60 type steel with a minimum yield strength of 60,000 psi.

The concrete for the slab was mixed, formed and poured by Portland Cement Association personnel. The concrete was made from sand and gravel from Elgin, Illinois (predominately dolmitic aggregate). The sand used had a specific gravity of 2.67, absorption of 2%.

Checks were made for concrete slump, unit weight and air content. Batch quantities, properties of plastic concrete, and strength were approximately the following:

Average slump, (in.): 3-1/2
Average air content (%): 4%
Average fresh unit weight: . . . . . .145 lbs./cu.ft.
Average compressive strength: 4,000

The concrete was mixed at Portland Cement Association's test laboratory with a tilting drum mixer distributed into the form around the penetration with an overhead dump bucket, and consolidated with an internal vibrator. The top surface was leveled with wooden float and finished with a magnesium float.

Braces fabricated from 3" x 3" x 1/4" thick angle steel were mounted to the slab approximately 6" above its unexposed surface. The braces were used to anchor all of the penetrating members. No braces were used on the slab's exposed surface.

3.0 Penetrating Members:

The following items were used in each opening to represent penetrating members:

A. For penetrations "D" and "E", an 11-3/4" x 11-3/4" x 11-3/4" (three sided) channel shaped "pipe/tray", and for penetration "H", an 11-7/8" x 11-3/4" (four sided) channel shaped "pipe/tray", fabricated from 1/4" steel plate welded together at each corner (one "pipe/tray" per opening). This thickness of steel plate was chosen since it was believed to represent a more severe condition (in regard to heat conduction) than the thinner galvanized steel used for cable tray construction and also since it would adequately represent a pipe.

Each "pipe/tray" passed through the test openings so that it extended 12" below the exposed surface of the slab and 6" above its unexposed surface. The 6" extension above the slab also posed a more severe condition since the heat sink effect of a longer 36" extension of the penetrating member above the slab's unexposed surface was not taken advantage of. This step was implemented to demonstrate conditions where cable trays might terminate closer to a penetration seal surface than 36".

For penetrations "D" and "E", each "pipe/tray" member was located 1/8" from three of each opening's substrates and the bottom (middle) of the channel shape was located 1/8" from each opening's steel substrate. For penetration "H", the "pipe/tray" member was located 1/8" from one substrate, creating a 7/32" gap, a 1/32" gap, and a 0" gap on the opposite substrate.

B. A 2-5/8" diameter by 54" long steel pipe capped at both ends (one each opening). The pipe was wrapped with 1/2" of Johns-Manville Cerablanket and standard aluminum jacket. The aluminum jacket was fastened at its overlapping seam with short sheet metal screws. A bead of TECH-SIL #TS-MS-0001 (Dow Corning #96-061) Silicone Adhesive was spread over the jacket's seam as it passed through the opening.

These members were mounted so that they passed through the opening and extended 12" below the slab's exposed surface and 30" above its unexposed surface. These members were located 1/8" from each opening's substrate surface.

C. Five (each opening) 1/4" diameter by 54" long copper tubes crimped at both ends. These tubes were mounted so that they passed through the opening and extended 12" below the slab's exposed surface and 30" above its unexposed surface. These members were located so that there was no clearance (0") between a tube and substrate. Each tube was located within 1/2" of another tube.

D. Each opening also was penetrated (horizontally) with a section of unistrut steel located at the center of each seal's overall depth.

4.0 Seal Types:

The test openings were filled accordingly:

A. Penetration "D": Sealed with 9" of #TS-MS-0009 Silicone Foam under 1" split damming material. Half of the opening was dammed with Johns-Manville Ceraboard (#TS-MS-0014) and Cerafiber (#TS-MS-0016). The other half of the opening was dammed with Koawool.

B. Penetration "E": Sealed with 12" of #TS-MS-0080-C High Density Silicone Gel.

C. Penetration "H": Sealed with 6" of #TS-MS-0045-B Silicone Elastomer. The gap outside of the 4 sided "pipe/tray" was sealed with 2" of #TS-MS-0013 Cerablanket and #TS-MS-0016 Cerafiber covered with 2" of #TS-MS-0001 Silicone Adhesive. This seal was placed on the exposed surface of the slab. This seal, as tested, qualified for use (by ANI) in conjunction with any other qualified sealing materials.

5.0 Thermocouples:

A total of 21 thermocouples were attached to the three test assemblies in order to obtain temperature data during the fire test. These thermocouples can be divided into three separate groups which are:

1. Thermocouples for monitoring seal surface temperatures;

2. Thermocouples for monitoring seal surface/penetrating member interface temperatures; and,

3. Thermocouples for monitoring seal surface/penetration substrate interface temperatures.

Seal surface thermocouples (group 1) were mounted so that the tip of the thermocouple was embedded between 1/4"-1/2" into the seal below its unexposed surface. Thermocouples to be used for monitoring penetrating member and substrate temperatures (groups 2 and 3) were mounted 1/4"-1/2" below the seal's unexposed surface by prying the seal back slightly and inserting the top of the thermocouple into the separation. As a result, an interface temperature was obtained which is more accurate than temperatures obtained by other methods.

Thermocouples used for this test are identified as follows:

T/C # 1:	Pene. "D"	- Seal Surface	(188°F)
T/C # 2:	Pene. "D"	- Seal Surface	(188°F)
T/C # 3:	Pene. "D"	- Seal Surface	(173°F)
T/C # 4:	Pene. "D"	- Insulated Pipe	(420°F)
T/C # 5:	Pene. "D"	- Copper tubing	(419°F)
T/C # 6:	Pene. "D"	- Inside "pipe/ tray" Seal Interface	(129°F)
T/C # 7:	Pene. "D"	- 1/8" wide gap	(565°F)
T/C # 8:	Pene. "E"	- Seal Surface	(130°F)
T/C # 9:	Pene. "E"	- Seal Surface	(364°F)
T/C #10:	Pene. "E"	- Seal Surface	(54°F)
T/C #11:	Pene. "E"	- Insulated Pipe	(110°F)
T/C #12:	Pene. "E"	- Copper Tubing	(251°F)
T/C #13:	Pene. "E"	- "Pipe/Tray" Seal Interface	(233°F)
T/C #14:	Pene. "E"	- 1/8" wide gap	(291°F)
T/C #23:	Pene. "H"	- Seal Surface	(316°F)
T/C #24:	Pene. "H"	- Seal Surface	(241°F)
T/C #25:	Pene. "H"	- Seal Surface	(255°F)
T/C #26:	Pene. "H"	- Insulated Pipe	(520°F)
T/C #27:	Pene. "H"	- Copper Tubing	(459°F)
T/C #28:	Pene. "H"	- Inside "Pipe/ Tray" Interface	(603°F)
T/C #29:	Pene. "H"	- 5/32" Gap	(1251°F)

6.0 Fire Test:

The fire test procedure consisted of subjecting the test slab and seal specimens to a three hour long ASTM E-119 time/temperature curve fire test. For this, the slab was placed on a small floor furnace.

Simply described, the furnace used for this type of test is a square shaped, refractory brick lined steel box heated by four gas burners (one on each side of the furnace). The burners are automatically ignited from the outside of the furnace.

The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by three shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures were also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly.

The furnace draft was controlled both manually and automatically (to correct the draft as a result of fuel contribution and temperature variables) during the test.

7.0 Test Record:

The fire test was conducted for 3 hours in accordance with the ASTM E-119 time/temperature curve. Furnace atmosphere temperature data along with individual unexposed surface thermocouple documentation is shown in table form at the end of this report. Other items noted during this test are as follows:

A. The entire test was conducted using a -.08 in. H_2O draft on the exposed side of the slab.

B. No smoke or flames were observed from the three test penetrations for the duration of the fire test.

C. At the conclusion of the three-hour fire test, the slab was removed from the furnace and turned over on its side for the three hose stream tests.

8.0 Hose-Stream Test:

Although only one hose-stream test is normally required in order to qualify a seal assembly, three different hose-stream tests were conducted to include available test standard variations.

The first hose-stream test was performed according to the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 12 seconds using an even spray discharged from a one and one half inch diameter hose through a 30-90° high velocity spray nozzle (set at 30°) at 75 psi from a distance of 10 feet.

The second hose-stream test was performed according to the current ANI test standard. Water was sprayed on the exposed surface of the slab for 12 seconds using an even spray discharged from a one and one half inch diameter hose through a 30-90° high velocity spray nozzle (set at 15°) at 75 psi from a distance of ten feet.

The third hose-stream test was performed according to the ASTM E-119 test standard. Water was sprayed onto the exposed surface of the slab for 12 seconds using a solid stream of water discharged from a two and one half inch hose with a 1-1/8" National Playpipe Nozzle at 30 psi from a distance of 20 feet.

9.0 Test Conclusions:

A. At the conclusion of the fire test, it was confirmed that fire did not penetrate through the seal assemblies nor did fire occur on any of the different seal surfaces as a result of spontaneous combustion, etc.

B. None of the surface temperatures exceeded the ANI pass/fail seal temperature limitations (325°F + ambient maximum). At the end of the test, the seal surface temperatures were shown to be:

Penetration "D":	188°, 188°, and 173°F
Penetration "E":	130°, 364°, and 54°F
Penetration "H":	316°, 241°, and 255°F

C. Water did not penetrate through the seal assemblies during the first two of the three hose-stream tests.

D. During the 12 Second ASTM E-119 Hose-Stream Test, water was noted to project beyond the unexposed surfaces of penetrations "D" and "H". The water appeared to be streaming from the gap at the concrete/steel interface.

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FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	78	68	10
0:05	951	1000	-49
0:10	1428	1300	128
0:15	1435	1399	36
0:20	1465	1462	3
0:25	1544	1510	34
0:30	1545	1550	-5
0:35	1580	1584	-4
0:40	1631	1613	18
0:45	1631	1638	-7
0:50	1676	1661	15
0:55	1695	1681	14
1:00	1702	1700	2
1:05	1728	1718	10
1:10	1735	1735	0
1:15	1754	1750	4
1:20	1761	1765	-4
1:25	1782	1779	3
1:30	1787	1792	-5
1:35	1796	1804	-8
1:40	1819	1815	4
1:45	1820	1826	-6
1:50	1829	1835	-6
1:55	1848	1843	5
2:00	1852	1850	2
2:10	1868	1862	6
2:20	1878	1875	3
2:30	1895	1888	7
2:40	1908	1900	8
2:50	1919	1912	7
3:00	1926	1925	1

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THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	SEAL SURFACE - PEN D
9	2	2	SEAL SURFACE - PEN D
9	3	3	SEAL SURFACE - PEN D
9	4	4	INSULATED PIPE - PEN D
9	5	5	COPPER TUBING - PEN D
9	6	6	PIPE/TRAY SEAL INT'RF. - PEN D
9	7	7	1/8 IN. WIDE GAP - PEN D
9	8	8	SEAL SURFACE - PEN E
9	9	9	SEAL SURFACE - PEN E
9	10	10	SEAL SURFACE - PEN E
9	11	11	INSULATED PIPE - PEN E
9	12	12	COPPER TUBING - PEN E
11	1	13	PIPE/TRAY SEAL INT'RF. - PEN E
11	2	14	1/8 IN. WIDE GAP - PEN E
11	3	15	SEAL SURFACE - PEN G
11	4	16	SEAL SURFACE - PEN G
11	5	17	SEAL SURFACE - PEN G
11	6	18	TRAY/SEAL INTERFACE - PEN G
11	7	19	CONDUIT/SEAL INTERFACE - PEN G
11	8	20	CONDUIT/SEAL SURFACE - PEN G
11	9	21	CONDUIT CABLE - PEN G
11	10	22	CABLE TRAY - PEN G
11	11	23	SEAL SURFACE - PEN H
11	12	24	SEAL SURFACE - PEN H
12	1	25	SEAL SURFACE - PEN H
12	2	26	INSULATED PIPE - PEN H
12	3	27	COPPER TUBING - PEN H
12	4	28	PIPE/TRAY INTERFACE - PEN H
12	5	29	5/32 IN. WIDE - PEN H

3

7< B

TECH-SIL (CR4795) - 08/24/81

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO. 1	2	3	4	5	6
0:00	78	78	78	77	77	77
0:05	78	78	78	81	105	77
0:10	78	78	78	97	147	77
0:15	79	78	78	111	162	77
0:20	80	79	79	124	172	77
0:25	83	80	81	135	183	77
0:30	86	82	82	147	191	78
0:35	88	84	84	159	200	78
0:40	91	85	86	171	207	78
0:45	94	87	88	183	215	79
0:50	97	89	90	195	222	79
0:55	100	91	92	207	230	80
1:00	104	94	95	218	237	81
1:05	107	96	97	229	243	82
1:10	110	98	100	239	248	83
1:15	113	100	103	250	253	84
1:20	116	103	105	259	259	86
1:25	119	105	108	268	268	88
1:30	122	108	110	278	274	89
1:35	125	110	113	287	279	91
1:40	128	113	116	295	284	93
1:45	130	115	119	302	288	95
1:50	134	117	122	311	293	96
1:55	138	121	125	321	300	99
2:00	142	124	128	329	305	101
2:10	149	131	135	345	323	106
2:20	155	138	141	358	351	110
2:30	163	147	148	374	369	115
2:40	171	158	155	389	378	120
2:50	178	171	163	403	389	124
3:00	188	188	173	420	419	129

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THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	7	8	9	10	11	12
0:00	77	77	77	79	78	77
0:05	79	77	78	79	78	78
0:10	96	77	82	79	78	82
0:15	122	77	97	80	78	86
0:20	145	78	115	80	79	91
0:25	161	78	132	80	79	96
0:30	176	78	148	80	80	101
0:35	196	79	161	80	80	106
0:40	215	79	173	80	81	111
0:45	239	80	185	80	82	117
0:50	261	81	196	80	83	123
0:55	260	81	205	79	84	129
1:00	253	83	215	79	85	134
1:05	264	84	226	79	85	140
1:10	293	85	234	78	86	146
1:15	308	86	241	78	86	151
1:20	319	88	249	77	87	157
1:25	334	90	253	76	89	162
1:30	348	91	257	75	90	167
1:35	362	93	262	75	90	173
1:40	377	95	266	74	91	178
1:45	392	96	269	73	92	182
1:50	407	98	275	71	94	187
1:55	420	101	279	71	98	192
2:00	432	103	283	70	97	196
2:10	454	107	291	68	100	209
2:20	469	112	300	65	102	219
2:30	490	116	313	63	105	228
2:40	514	120	327	58	109	236
2:50	540	125	341	57	110	244
3:00	565	130	364	54	110	251

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TECH-SIL (CR4795) - 08/24/81

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	13	14	15	16	17	18
0:00	77	77	77	78	77	77
0:05	77	77	77	78	77	88
0:10	77	77	78	78	78	141
0:15	79	80	81	79	82	199
0:20	82	83	88	81	88	243
0:25	86	87	96	83	97	274
0:30	90	91	106	86	108	304
0:35	94	96	116	88	120	332
0:40	99	102	126	91	132	360
0:45	103	108	137	94	145	385
0:50	109	115	149	97	159	408
0:55	114	122	159	100	170	429
1:00	119	130	169	102	182	450
1:05	125	139	179	105	193	468
1:10	130	148	189	108	204	487
1:15	136	156	198	111	214	504
1:20	141	165	209	113	225	521
1:25	147	174	223	117	238	540
1:30	152	182	231	119	246	553
1:35	157	188	241	121	256	568
1:40	162	195	251	124	268	582
1:45	168	202	247	126	260	562
1:50	172	208	234	125	228	584
1:55	177	215	237	126	248	612
2:00	182	221	252	129	260	631
2:10	191	235	293	136	304	665
2:20	200	247	283	139	276	633
2:30	209	259	304	141	316	714
2:40	217	270	319	146	323	745
2:50	225	281	310	145	338	730
3:00	233	291	310	146	329	772

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TECH-SIL (CR4795) - 08/24/81

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	19	20	21	22	23	24
0:00	77	77	77	77	77	77
0:05	80	78	86	92	77	77
0:10	99	98	141	171	78	78
0:15	129	140	220	270	80	80
0:20	161	188	299	366	85	83
0:25	192	233	370	424	93	86
0:30	221	278	435	463	102	89
0:35	252	318	479	500	111	94
0:40	277	350	517	528	121	99
0:45	303	377	549	542	131	104
0:50	325	401	577	541	142	110
0:55	341	426	612	558	153	115
1:00	358	447	644	583	161	121
1:05	378	468	675	598	171	127
1:10	393	489	703	617	179	134
1:15	413	505	733	631	187	140
1:20	423	522	759	649	198	146
1:25	440	541	782	682	207	153
1:30	449	555	804	711	215	159
1:35	463	569	823	739	223	164
1:40	490	584	841	775	230	172
1:45	461	572	856	845	236	171
1:50	464	501	846	871	244	177
1:55	478	573	873	896	252	185
2:00	497	612	894	917	256	193
2:10	521	647	927	961	269	201
2:20	488	578	939	973	278	214
2:30	459	641	965	1018	292	217
2:40	547	635	977	1057	301	226
2:50	581	690	996	1033	309	235
3:00	546	563	978	1088	316	241

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TECH-SIL (CR4795) - 08/24/81

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.				
	25	26	27	28	29
0:00	77	77	77	77	77
0:05	77	81	89	85	287
0:10	79	94	124	122	495
0:15	80	113	160	164	578
0:20	33	134	189	199	643
0:25	87	155	212	232	702
0:30	92	176	234	260	749
0:35	97	197	247	281	797
0:40	104	217	264	302	837
0:45	111	236	278	321	872
0:50	118	255	292	339	905
0:55	125	273	304	356	933
1:00	132	289	316	372	958
1:05	139	304	325	386	980
1:10	146	319	337	401	1000
1:15	154	333	341	414	1018
1:20	160	347	355	427	1037
1:25	167	360	357	439	1054
1:30	173	372	372	451	1069
1:35	180	383	378	462	1082
1:40	187	394	385	472	1096
1:45	188	403	387	483	1108
1:50	193	413	393	491	1120
1:55	200	423	406	501	1133
2:00	208	433	413	510	1145
2:10	215	450	420	526	1165
2:20	227	467	431	543	1185
2:30	232	482	439	559	1203
2:40	241	495	444	573	1220
2:50	250	508	455	588	1238
3:00	255	520	459	603	1251

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TECH-SIL (CR4795) - 03/24/81

TEST COMMENTS

11:30 AM PRINTED AMBIENT TEMPERATURES ON FRAMES #9-1.-12.

00:05:00 HEAVY FLAMING OCCURED IN FURNACE.

01:00:00 SMOKE OBSERVED FROM UNEXPOSED SURFACE OF CABLE AREA - PEN G.

01:40:00 FLAME OBSERVED FROM CABLE JACKETS ON UNEXPOSED SURFACE - PEN G.

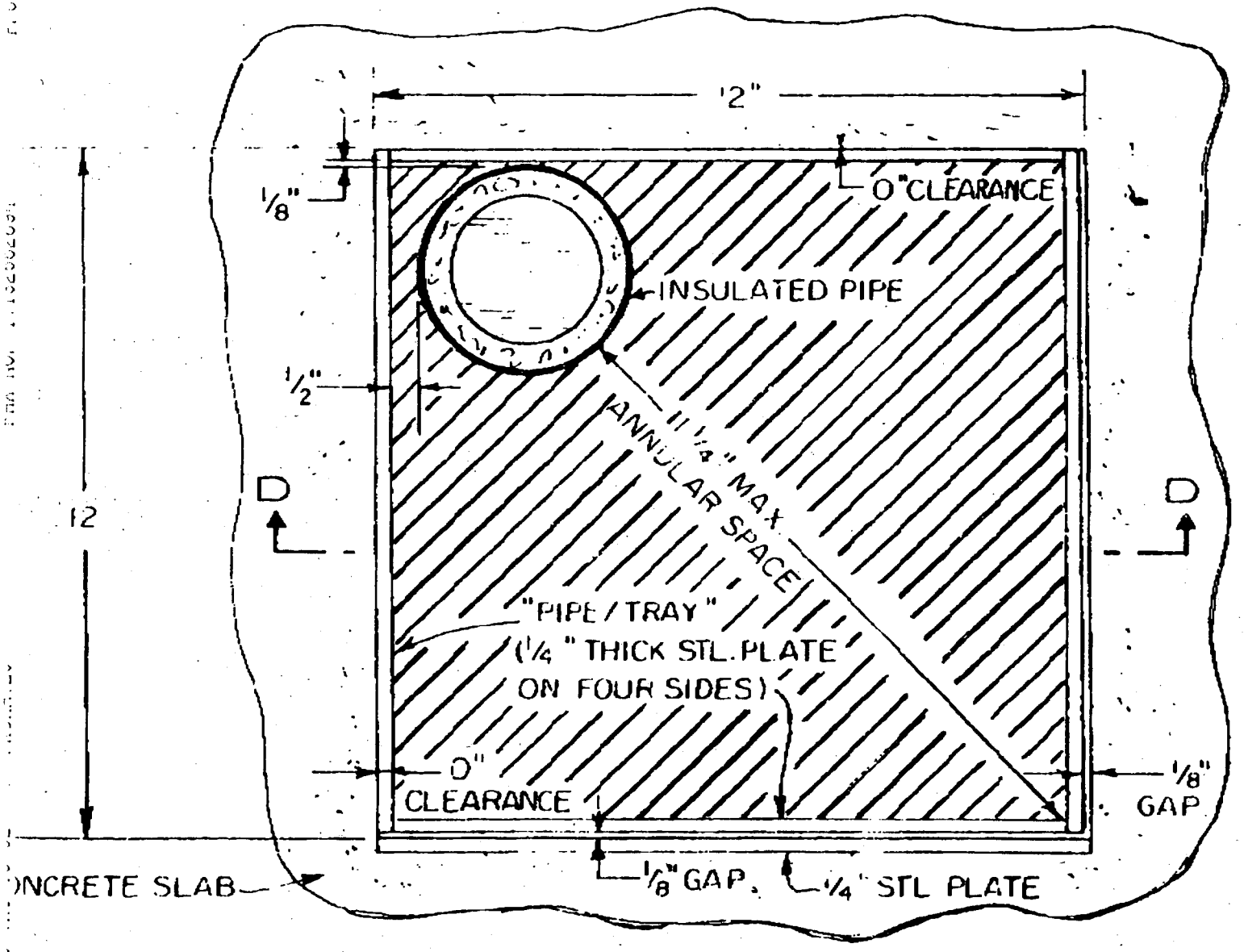
FLAMES WERE SPRAYED WITH WATER TO STOP FLAMING.

01:47:00 FLAMES RE-OCCURED - PEN G.

HOSE STREAM TESTS:

NO WATER PROJECTED BEYOND UNEXPOSED SURFACE OF SPECIMEN DURING 12 SECOND IEEE-634 AND ANI HOSE STREAM TESTS.

NO WATER PROJECTED BEYOND UNEXPOSED SURFACE OF PENETRATIONS E & G DURING 12 SECOND ASTM E119 HOSE STREAM TEST. WATER PROJECTED [illegible] UNEXPOSED SURFACE OF PENETRATION D & H DURING ASTM E119 HO[illegible] STREAM TEST. WATER APPEARED TO BE STREAMING FROM GAP AT CONCRETE/STEEL [illegible]ACE.



A

A

PLAN

PENETRATION "H"

Post-it™ brand fax transmittal memo 7671 | # of pages ▸ 3

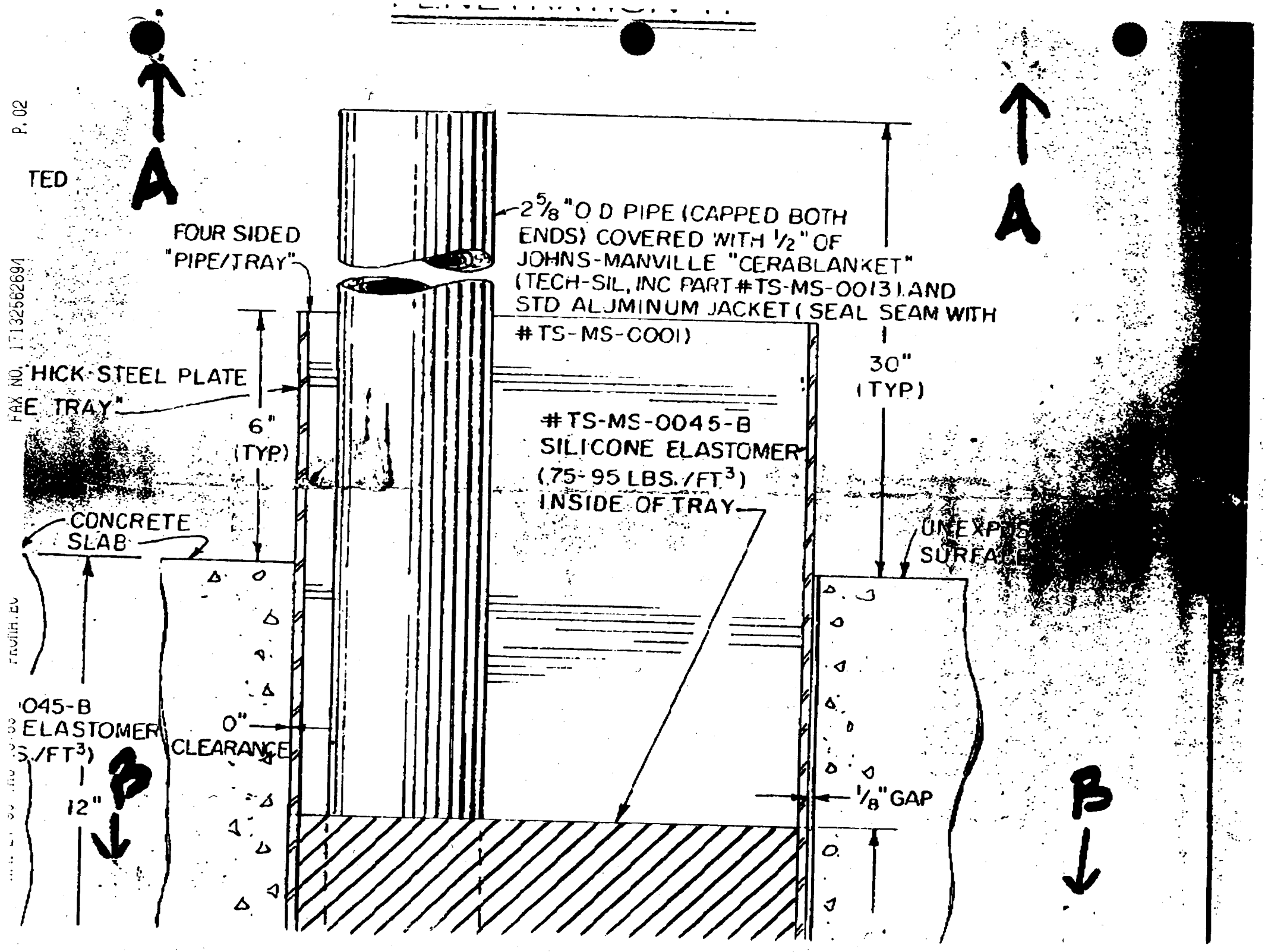
To Steve Wilkie | From Bill Renfro

Co. | Co. Dezmotec

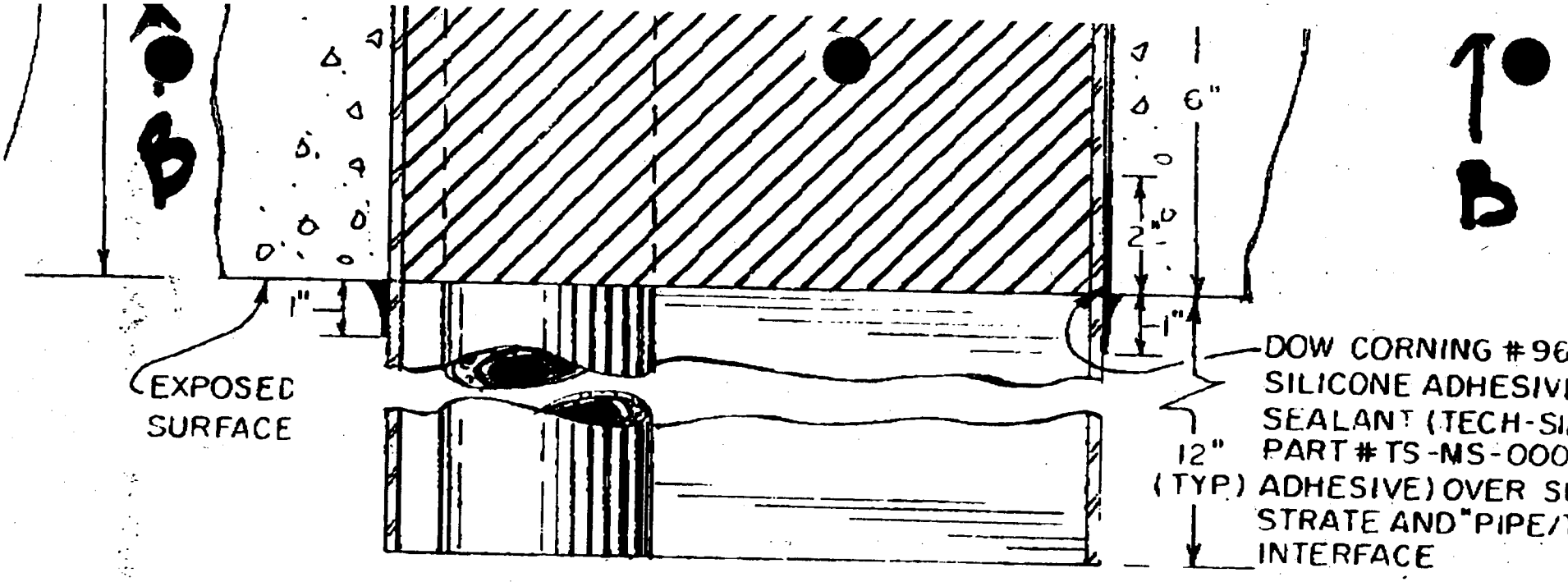
Dept. | Phone # (800) 966-6060

Fax # | Fax # (713) 256-2694

TED



FAX NO. 17132562694



SECTION D-D

TECH-SIL, INC.

FOR INFORMATION

DRAWING RELEASE RECORD							
REV.	DATE	RELEASED TO:	BY	CK	CK	CK	APP
0	6/26/81	ANI	MK				

MISSISSIPPI POWER & LIGHT CO.
GRAND GULF N.P.S.

PENETRATION SEAL QUALIFICATION TEST FOR MINIMUM ANNULAR SPACE

BY	M.K	6/26/81
CKD		
CKD		6-30-81
CKD		
APPD		

Tech-Sil, inc

DRAWING NO.
TS-TP-0075
SHEET 2A

PROMATEC®

PROGRESSIVE MATERIALS AND TECHNOLOGIES, INC.

TEST REPORT: #TS-TP-0084

PENETRATION "A"

FIRE & HOSE-STREAM TEST for 6" of

#TS-MS-0045-B SILICONE ELASTOMER

Test: #TS-TP-0084
By: K.A. Kerr
Date: 4-14-82

P.O. BOX 309 • CYPRESS, TEXAS 77429
(713) 373-4040 • FAX (713) 256-2694

construction technology laboratories
a Division of the PORTLAND CEMENT ASSOCIATION
5420 Old Orchard Road, Skokie, Illinois 60077 • Phone 312/966-6200

June 15, 1982

LOG NO. 0263

RECEIVED

Mr. G. J. Jarosz
Tech-Sil, Inc.
1800 Elmhurst Road
Elk Grove Village, Illinois
60007

JUN 18 1982

Dear Mr. Jarosz:

I have reviewed the following test reports:

#TS-TP-0084 dated April 14, 1982

Penetration "A" - Fire & Hose-Stream Test for 6-in. of #TS-MS-0045-B Silicone Elastomer

Penetration "D" - Fire & Hose-Stream Test for a 12-in. Deep Blanket Gap Seal

Penetration "E" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0080-C High Density Silicone Gel

Penetration "G" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0080 - A Self-Supporting High Density Silicone Gel

Penetration "H" - Fire & Hose-Stream for 12-in. of #TS-MS-0080-C High Density Silicone Gel

Penetration "J" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0080 - A Self-Supporting High Density Silicone Gel

Penetration "L" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0080-H High Density Silicone Gel

Penetration "N" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0080-H High Density Silicone Gel

Penetration "P" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0080-H High Density Silicone Gel

Penetration "Q" - Fire & Hose-Stream Test for 6-in. of #TS-MS-0045-B Silicone Elastomer

construction technology laboratories

Penetration "R" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0045-B Silicone Elastomer

Penetration "S" - Fire & Hose-Stream Test for 12-in. of #TS-MS-0080-H High Density Silicone Gel

These tests were conducted on April 14, 1982 in the Fire Research Laboratory, Construction Technology Laboratories, of the Portland Cement Association.

These reports accurately describe details of specimen fabrication, test procedures, observations during test, and test results.

Sincerely yours,

Melvin S. Abrams
Director
Fire Research Department

Melvin S. Abrams

rk

CR-4889-4324

Copy to-
W. G. Corley
Central File

AMERICAN NUCLEAR INSURERS
URT C. PROOM, CPCU
esident and Chief Executive Officer

TECH-SIL, INC.
Rec'd. 1-16-84
PROPERTY ENGINEERING DEPARTMENT
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M. Walch ✓

ORIGINAL TO DOCUMENT CONTROL

January 12, 1984

Mr. Tom Hansen
Manager, Technical Operations
Tech-Sil, Inc.
9990 Richmond
Suite 106
Houston, Texas 77042

Dear Mr. Hansen:

We have reviewed your test report TS-TP-0084-D for seismic gap seals, submitted with your letter of January 6, 1984 to Bill Bornhoeft. This installation procedure for gaps up to 6" in width is acceptable to American Nuclear Insurers for Insurance Purposes. This fire endurance and hose stream test was conducted on April 14, 1982 at Construction Technology Laboratories of the Portland Cement Association. The procedure tested utilized the following materials:

TS-MS-0081	Aluminized Fabric (with 3" overlap)
TS-MS-0008	Silicone Adhesive (for cementing to floor)
TS-MS-0013	Damming Blanket (8" minimum depth, density 2-3 lbs./cu. ft., 16 gauge 1" wide galvanized steel strips 1/4" X 1" expansion anchors)

If we can be of any further assistance, please do not hesitate to contact us.

Sincerely,

David Dalkowski

David Dalkowski
Project Engineer

DD:dm

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

TS-TP-0084-A
TS-TP-0084-E

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
PORTLAND CEMENT ASSOCIATION
SKOKIE, ILLINOIS

TEST DATE: 4/14/82 | HOUR RATING: 3

GENERAL DATA

	CABLE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	53" X 53" with or without steel lining	2 3/8" pipe in 12" steel sleeve
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	TS-MS-0045-B Silicone Elastomer. Density: 70-95 lbs./cu. ft.	TS-MS-0080-C High Density Silicone Gel (147-177 lbs./cu. ft TS-MS-0091 Boot attached to 16 ga sleeve extension TS-MS-0001 silicone adhesive TS-MS-0071 clamps; TS-MS-0074 pri
Fire Stop Thickness	6" depth TS-MS-0045-B reinforce seal using unistrut steel channel welded to the steel lining or anchored to the concrete.	12" TS-MS-0080 HDSG and fill sleeve and boot TS-MS-0071 clamps tightened to 50 in. lbs. minimum
Form Material	Non-combustible forming material used and removed.	Non-combustible forming material used and removed.

SPECIAL LIMITATIONS

Tray Types: Open Ladder and Solid Bottom Cable Construction: No Limitations
% Cable Loading: 100% visual Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

AMERICAN NUCLEAR INSURERS

MAERP

MUTUAL ATOMIC ENERGY REINSURANCE POOL

TS-TP-0084-G
TS-TP-0084-H

ACCEPTANCE OF TESTING
(for insurance purposes)

CABLE AND PIPE PENETRATION FIRE STOP SYSTEM

The following fire stop supplier or installer has successfully completed the "ANI/MAERP Standard Method of Fire Tests of Cable and Pipe Penetration Fire Stops".

FIRE STOP SUPPLIER OR INSTALLER:
TECH-SIL, INC.
HOUSTON, TEXAS

TESTING ORGANIZATION:
PORTLAND CEMENT ASSOCIATION
SKOKIE, ILLINOIS

TEST DATE: 4/14/82 | HOUR RATING: 3

GENERAL DATA

	PIPE PENETRATIONS	PIPE PENETRATIONS
Max. Penetration Size	2 3/8" pipe in 12" steel sleeve	2 3/8" pipe in 12" Ø cast concre openin
Accepted for Floor	YES	YES
Accepted for Wall	YES	YES
Material	TS-MS-0080-A High Density Gel (147-177 lbs./cu. ft.) TS-MS-0091 Boot attached to 16 gauge sleeve extension using TS-MS-0001 silicone adhesive TS-MS-0074 primer TS-MS-0071 clamps	TS-MS-0080-C High Density Silicon Gel (147-177 lbs./cu. ft.) TS-MS-0091 boot attached to 16 ga sleeve using TS-MS-0001 silicone adhesive TS-MS-0071 clamps; TS-MS-0074 pri
Fire Stop Thickness	12" TS-MS-008A HDG TS-MS-0071 clamps tightened to 50 in. lbs. minimum	12" TS-MS-0080C HDSG and fill sle and boot TS-MS-0071 clamps tightened to 50 in.-lbs.minimum.
Form Material	Non-combustible forming material used and removed.	Non-combustible forming material used and removed.

SPECIAL LIMITATIONS

Tray Types: N/A Cable Construction: N/A
% Cable Loading: N/A Tray, N/A Conduit Max. Conduit Sleeve Size: N/A
(Note: % Loading = Total Cross-sectional area of cable/Cross-sectional area of tray/conduit)

Complete details of proposed fire stop installations are to be submitted to American Nuclear Insurers or Mutual Atomic Energy Reinsurance Pool prior to actual installation. Acceptance of the testing is only for insurance coverage related to fire protection of the property and is based on information provided.

This form is valid for two (2) years from the date issued unless withdrawn prior thereto.

TECH-SIL INC.

1.0 Scope:

This test consisted of subjecting a simulated penetration assembly sealed with 6" of TECH-SIL, Inc. #TS-MS-0045-B Silicone Elastomer (70-95 lbs./cu.ft.) to a three hour long ASTM E-119 time/temperature curve fire test. The fire test was witnessed by and conducted at Portland Cement Association (Skokie, Illinois) on 4/14/82.

2.0 Configuration:

The 53" x 53" wide x 6" deep penetration consisted of two sides lined with 1/4" thick steel; and two sides of cast concrete. The opening was penetrated by two cable trays; each one located in a corner so that it was one inch from the side of the opening. The penetration had a single piece of unistrut steel channel which was imbedded in the seal three inches deep. The unistrut was welded to one of the penetration's steel sides and anchored to one concrete side with steel expansion anchors.

3.0 Penetrating Members:

The two cable trays penetrating the opening had the following dimensions and cable loadings:

"B" One 4" x 30" wide x 54" long steel ladder back tray.
Cable loading for this tray:

80 pcs. of 4C/#12 PVC Cable,	.229" in.^{2} ea.	= 18.32 in.^{2} total
60 pcs. of 12C/#12 PVC Cable,	.5318" in.^{2} ea.	= 31.90 in.^{2} total
		= 50.22 in.^{2} total
		= 105% Total Fill

"A" One 4" x 24" wide 54" long steel solid back cable tray.
Cable loading for this tray:

95 pcs. of 4C/#12 PVC Cable,	.229" in.^{2} ea.	= 21.755 in.^{2} total
40 pcs. of 12C/#12 PVC Cable,	.5318" in.^{2} ea.	= 21.27 in.^{2} total
		= 43.025 in.^{2} Total
		= 110% Total Fill

NOTE: All cables had the top ends wrapped with electrical tape.

4.0 Penetration Seal:

The penetration was sealed with 6" of #TS-MS-0045-B Silicone Elastomer (70-95 lbs./cu.ft.) flush with the exposed surface of the slab.

5.0 Thermocouples:

Two thermocouples were embedded approximately 1/4" - 1/2" deep into the elastomer seal's surface for monitoring seal surface temperatures throughout the test. Two thermocouples were also used for monitoring the tray/interface temperatures, while two others were used to measure the seal/concrete interface and the seal/sleeve interface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. The thermocouple readings at the end of the test were as follows:

T/C	#40	Tray Interface	413°F
T/C	#44	Tray Interface	392°F
T/C	#45	Surface North.	126°F
T/C	#46	Surface Center	130°F
T/C	#47	Seal/Concrete Interface.	274°F
T/C	#48	Seal/Steel Interface	326°F

Fire Test Procedure:

The fire test consisted of subjecting the test slab with the seal specimen to a three hour long ASTM E-119 time/temperature curve fire test. Simply described, the furnace used for this type of test is a deep rectangular shaped, refractory brick lined box heated by gas burners. The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures was also made from time to time during the test. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

6.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three-hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas. Temperatures were also recorded by a computer controlled data acquisition system which printed temperatures in accordance with the IEEE 674-78 test standard requirements.

Throughout the test, an even blanket of flame was produced in the furnace. It was noted that flames propogated along the exposed slab surface.

During the test, light smoke was observed coming from the PVC jacketed cable. The PVC jacketing had begun to melt and become disfigured because of heat conduction along the metal conductors of the cables (approximately 4-6" above the seal's unexposed surface). It was also noted that the center of the seal began to deflect down (approximately 1-1½") at about 2½ hours into the test. This did not change for the remainder of the test.

The seal remained intact for the three-hour long test. Two hose-stream tests (ANI and IEEE) were performed with no water penetrating the seal. The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and tilted on its side (at approximately 45°) for the hose-stream tests.

7.0 Hose-Stream Tests:

The first hose-stream was performed according to ANI test requirements. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 15°, at 75 psi from a distance of five feet.

The second hose-stream was conducted in accordance with the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 30°, at seventy-five psi from a distance of ten feet.

8.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, fire did not occur on the unexposed surface of the penetration seal as a result of heat conduction.

C. During the fire test, light smoke was observed coming from the PVC jacketed cable. The PVC jacketing had begun to melt and become disfigured because of heat conduction along the metal conductors of the cables (approximately 4-6" above the seal's unexposed surface).

D. During the fire test, it was also noted that the center of the seal had begun to deflect down (approximately 1-1½") at about 2½ hours into the test. This did not change for the remainder of the test.

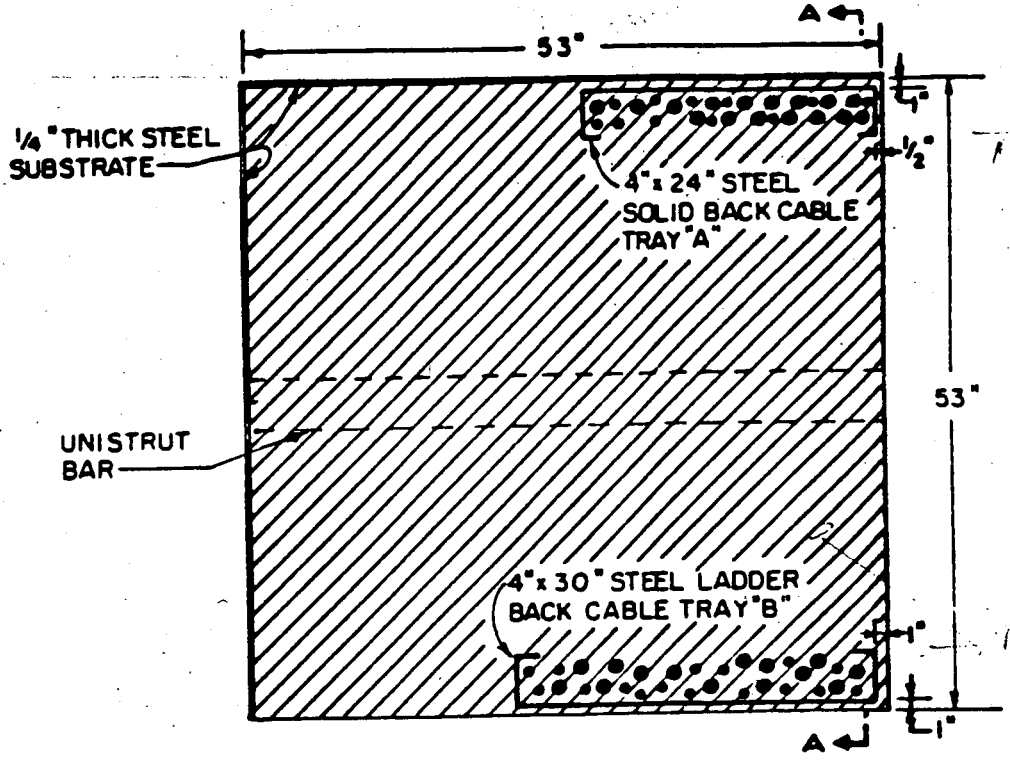
E. During the IEEE-634-1978 and the ANI hose-stream tests, water did not penetrate through the penetration seal.

9.0 Post Test Observations:

The slab and penetration was dismantled on 4/19/82. At this time, the following observations were made:

A. 3-4" of the elastomer seal (on the exposed side) had become brittle and charred.

B. The unistrut steel had become badly warped by the heat of the fire.



53
-10
43
÷ 2
21/2

~43 * — ACCUM. 15/3

20

FREE KICKT
AREA 3 10
or 32½

PLAN

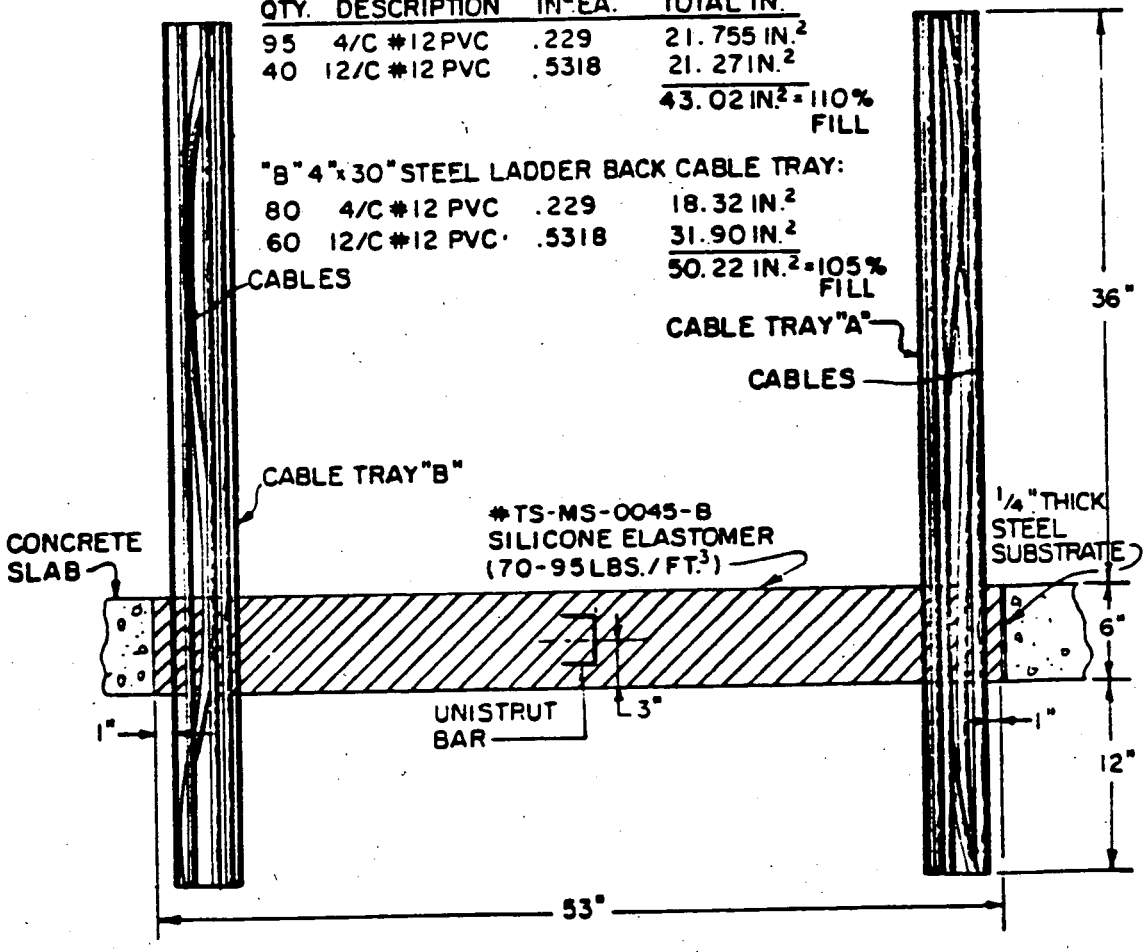
CABLE LOADING:

"A" 4"x24" STEEL SOLID BACK CABLE TRAY:

QTY.	DESCRIPTION	IN.^{2} EA.	TOTAL IN.^{2}
95	4/C #12 PVC	.229	21.755 IN.^{2}
40	12/C #12 PVC	.5318	21.27 IN.^{2}
			43.02 IN.^{2} = 110% FILL

"B" 4"x30" STEEL LADDER BACK CABLE TRAY:

80	4/C #12 PVC	.229	18.32 IN.^{2}
60	12/C #12 PVC	.5318	31.90 IN.^{2}
			50.22 IN.^{2} = 105% FILL



SECTION A-A

TECH-SIL, INC.

TEST # TS-TP-0084

PENETRATION "A"

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	87	68	19
0:05	1109	1000	109
0:10	1321	1300	21
0:15	1426	1399	27
0:20	1469	1462	7
0:25	1510	1510	0
0:30	1542	1550	-8
0:35	1585	1584	1
0:40	1615	1613	2
0:45	1638	1638	0
0:50	1654	1661	-7
0:55	1680	1681	-1
1:00	1696	1700	-4
1:05	1718	1718	-0
1:10	1727	1735	-8
1:15	1749	1750	-1
1:20	1753	1765	-12
1:25	1770	1779	-9
1:30	1784	1792	-8
1:35	1801	1804	-3
1:40	1811	1815	-4
1:45	1815	1826	-11
1:50	1831	1835	-4
1:55	1842	1843	-1
2:00	1859	1850	9
2:10	1870	1862	8
2:20	1874	1875	-1
2:30	1892	1888	4
2:40	1907	1900	7
2:50	1913	1912	1
3:00	1955	1925	30

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	PEN C SURFACE NORTH
9	2	2	PEN C SEAL & CONCRETE INT.
9	3	3	PEN C BUS BAR
9	4	4	PEN C DUCT & SEAL INT.
9	5	5	PEN D SURFACE SOUTH
9	6	6	PEN D SURFACE NORTH
9	7	7	PEN S SURFACE
9	8	8	PEN S CONTROL CABLE INT.
9	9	9	PEN S SEAL & SLEEVE INT.
9	10	10	PEN Q SURFACE
9	11	11	PEN Q CONTROL CABLE INT.
9	12	12	PEN Q SEAL & SLEEVE INT.
12	1	13	PEN L SURFACE
12	2	14	PEN L PIPE INT.
12	3	15	PEN L INSUL. PIPE INT.
12	4	16	PEN L SEAL & SLEEVE INT.
12	5	17	PEN P SURFACE
12	6	18	PEN P PIPE INT.
12	7	19	PEN P INSUL. PIPE INT.
12	8	20	PEN P SEAL & SLEEVE INT.
12	9	21	PEN N SURFACE
12	10	22	PEN N DUCT INT.
12	11	23	PEN N SEAL & CONCRETE INT.
12	12	24	PEN R SURFACE
13	1	25	PEN J SURFACE
13	2	26	PEN J PIPE INT.
13	3	27	PEN J SEAL & SLEEVE INT.
13	4	28	PEN H SURFACE
13	5	[illegible]	PEN H PIPE INT.
13	6	30	PEN H SEAL & SLEEVE INT.
13	7	31	PEN G SURFACE
13	8	32	PEN G PIPE INT.
13	9	33	PEN G SEAL & SLEEVE INT.
13	10	34	PEN E SURFACE
13	11	35	PEN E PIPE INT.
13	12	36	PEN E SEAL & SLEEVE INT.
14	1	37	PEN A T1 1/4 PT. N (INST.)
14	2	38	PEN A T1 CENTER (CONTROL)
14	3	39	PEN A T1 1/4 PT. S (CONTROL)
14	4	40	PEN A T1 TRAY INT.
14	5	41	PEN A T2 1/4 PT. N (INST.)
14	6	42	PEN A T2 CENTER (CONTROL)

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
14	7	43	PEN A T2 1/4 PT. S (INST.)
14	8	44	PEN A T2 TRAY INT
14	9	45	PEN A SURFACE NORTH
14	10	46	PEN A SURFACE CENTER
.4	11	47	PEN A SEAL & CONCRETE INT.
14	12	48	PEN A SEAL & SLEEVE INT.
16	1	49	PEN B T1 1/4 PT. N (INST.)
16	2	50	PEN B T1 CENTER (INST.)
16	3	51	PEN B T1 1/4 PT. S (CONTROL)
16	4	52	PEN B T1 TRAY INT.
16	5	53	PEN B T2 1/4 PT. N (CONTROL)
16	6	54	PEN B T2 CENTER (CONTROL)
16	7	55	PEN B T2 1/4 PT. S (INST.)
16	8	56	PEN B T2 TRAY INT.
16	9	57	PEN B SURFACE NORTH
16	10	58	PEN B SURFACE CENTER
16	11	59	PEN B SEAL & CONCRETE INT.
16	12	60	PEN B SEAL & SLEEVE INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	37	38	39	40	41	42
0:00	73	74	74	73	73	74
0:05	73	73	73	74	78	77
0:10	78	78	79	83	94	95
0:15	86	87	89	97	116	121
0:20	97	100	104	114	139	150
0:25	111	117	122	132	162	188
0:30	128	136	143	147	181	208
0:35	150	155	164	162	198	228
0:40	167	171	184	178	215	257
0:45	178	186	200	192	231	282
0:50	189	201	217	206	248	305
0:55	201	237	237	221	261	325
1:00	217	279	263	236	275	345
1:05	231	314	306	248	286	368
1:10	245	348	328	260	297	381
1:15	260	366	346	270	307	394
1:20	275	376	364	280	314	405
1:25	289	381	385	289	325	418
1:30	300	386	391	299	338	430
1:35	311	389	395	305	346	441
1:40	320	393	401	312	354	453
1:45	327	399	406	319	365	465
1:50	335	403	411	328	373	475
1:55	341	411	423	334	380	485
2:00	348	420	439	339	388	495
2:10	363	440	467	354	408	514
2:20	377	465	492	364	427	531
2:30	391	495	528	377	452	547
2:40	406	522	538	385	476	565
2:50	422	556	570	397	498	583
3:00	439	584	590	413	518	616

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	43	44	45	46	47	48
0:00	73	73	72	72	72	70
0:05	78	75	71	72	73	69
0:10	94	89	71	71	81	69
0:15	114	108	71	71	94	69
0:20	135	128	71	72	108	69
0:25	156	147	72	71	123	70
0:30	174	168	72	72	139	72
0:35	191	188	72	72	156	76
0:40	208	210	73	72	165	81
0:45	228	219	73	73	154	90
0:50	248	235	74	74	155	106
0:55	268	241	75	74	159	126
1:00	285	251	76	75	164	131
1:05	298	260	75	77	155	133
1:10	312	270	75	77	169	137
1:15	317	277	76	79	177	144
1:20	321	285	77	81	184	149
1:25	328	295	79	83	192	199
1:30	335	304	80	85	198	210
1:35	335	308	82	87	204	222
1:40	343	312	84	89	210	230
1:45	347	317	86	92	216	228
1:50	353	321	88	94	221	226
1:55	358	326	90	97	227	228
2:00	367	331	93	99	232	232
2:10	376	337	98	104	241	237
2:20	388	346	104	110	249	252
2:30	404	357	110	115	255	259
2:40	413	374	116	120	262	274
2:50	419	383	121	126	268	300
3:00	416	392	126	130	274	326

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

TEST COMMENTS

2:49:00 FLAMETHROUGH OCCURRED ON PEN. B

HOSE STREAM TESTS:

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND ANI HOSE STREAM TEST.

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND IEEE HOSE STREAM TEST.

TECH - SIL
HF106-3

DATE OF TEST - 14 AUG 84

PROJECT NO. 01-7900-002

DATA FILE - 227TSIL

TEST TYPE - SMALL HORIZ

TIME MIN	SEC	TC 01	TC 02	TC 03	TC 04	TC 05	TC 06	TC 08	TC 09	TC 10	TC 11	TC 12	TC 13	TC 14	FURN AVG
136	33	242	252	175	133	135	124	89	474	374	246	480	264	419	1869
136	45	242	253	175	133	135	124	89	475	375	247	480	265	420	1869
137	3	242	253	175	133	135	125	89	474	376	247	481	265	421	1869
137	15	242	253	175	133	135	125	90	475	377	247	481	265	421	1870
137	33	242	254	176	133	136	125	90	475	377	248	483	266	423	1870
137	45	243	254	176	134	136	125	90	475	379	248	484	266	423	1870
138	3	243	255	176	134	136	125	91	475	379	248	485	267	424	1871
138	15	243	255	176	134	136	125	90	475	380	248	485	267	425	1872
138	33	244	255	176	134	136	126	91	474	381	249	484	267	424	1872
138	45	244	255	177	134	136	126	90	474	382	249	484	268	426	1872
139	3	244	256	177	135	137	126	90	474	383	249	484	268	427	1873
139	15	245	256	177	135	137	126	89	474	383	249	484	269	427	1874
139	33	245	257	177	135	137	126	89	474	384	249	483	269	427	1875
139	45	246	257	177	135	137	126	90	474	382	249	483	269	427	1876
140	3	246	257	177	135	137	126	90	474	384	250	484	270	427	1877
140	15	246	257	178	135	137	126	90	474	386	250	484	270	429	1877
140	33	247	258	178	135	138	127	90	475	387	250	483	270	431	1878
140	45	247	258	178	136	138	127	90	475	388	250	482	271	431	1878
141	3	248	258	178	136	138	127	91	474	387	250	481	271	431	1879
141	15	248	258	178	136	138	127	91	474	387	250	481	272	431	1879
141	33	248	259	178	136	138	127	92	474	386	250	480	272	432	1880
141	45	249	259	179	136	138	127	92	474	387	250	481	272	432	1880
142	3	249	259	179	136	138	128	92	473	389	250	481	273	434	1880
142	15	250	260	179	136	139	128	93	474	389	251	481	273	433	1881
142	33	250	260	179	137	139	128	92	474	390	251	481	273	435	1882
142	45	250	260	179	137	139	128	92	474	391	251	480	274	435	1883

TECH - SIL
HF106-3

DATE OF TEST - 14 AUG 84

PROJECT NO. 01-7900-002

DATA FILE - 227TSIL

TEST TYPE - SMALL HORIZ

TIME MIN	SEC	TC 01	TC 02	TC 03	TC 04	TC 05	TC 06	TC 08	TC 09	TC 10	TC 11	TC 12	TC 13	TC 14	FURN AVG
143	2	251	260	180	137	139	128	93	473	391	251	480	274	437	1884
143	15	251	261	180	137	139	128	93	473	392	251	480	275	438	1884
143	32	252	261	180	137	139	128	93	473	392	251	481	275	438	1885
143	45	252	261	180	138	140	129	94	473	392	252	480	276	438	1886
144	3	252	262	181	138	140	129	94	474	392	252	481	276	439	1887
144	15	253	262	181	138	140	129	94	474	393	252	481	276	438	1887
144	33	253	262	181	138	140	129	94	474	395	252	481	277	440	1888
144	45	253	262	181	138	140	129	94	474	394	252	480	277	441	1889
145	3	254	263	181	138	140	129	93	474	396	252	479	278	440	1889
145	15	254	263	181	138	140	129	94	474	396	253	478	278	441	1888
145	33	255	264	182	139	141	130	94	474	397	253	478	278	442	1888
145	45	255	264	182	139	141	130	93	474	397	253	478	279	442	1888
146	3	255	264	182	139	141	130	93	473	397	253	478	279	443	1887
146	15	256	264	182	139	141	130	93	473	396	253	478	279	443	1887
146	33	256	265	183	139	141	130	92	474	397	253	479	280	443	1886
146	45	256	265	183	140	141	130	92	475	399	253	480	280	444	1886
147	3	257	265	183	140	142	131	92	476	397	253	480	281	444	1885
147	15	257	266	183	140	142	131	92	477	395	253	480	281	443	1885
147	33	257	266	183	140	142	131	92	477	398	254	480	281	443	1885
147	45	257	266	184	140	142	131	92	477	399	254	480	282	445	1886
148	3	258	267	184	140	142	131	93	477	400	254	480	282	445	1886
148	15	258	267	184	141	142	131	93	478	401	255	480	282	447	1887
148	33	258	267	184	141	143	131	93	477	402	255	479	283	448	1887
148	45	259	268	184	141	143	132	93	478	403	255	479	283	448	1887
149	3	259	268	185	141	143	132	94	478	401	255	478	284	448	1888
149	15	259	268	185	141	143	132	94	478	401	255	479	284	448	1888

TECH - SIL
HF106-3

DATE OF TEST - 14 AUG 84 PROJECT NO. 01-7500-002

DATA FILE - 227TSIL TEST TYPE - SMALL HORIZ

TIME MIN	SEC	TC 01	TC 02	TC 03	TC 04	TC 05	TC 06	TC 08	TC 09	TC 10	TC 11	TC 12	TC 13	TC 14	FURN AVG
149	33	260	269	185	142	143	132	92	479	403	256	479	285	449	1888
149	45	260	269	185	142	144	132	92	479	403	256	478	285	449	1888
150	2	260	269	185	142	144	132	92	479	403	256	478	285	449	1888
150	15	261	270	186	142	144	133	92	479	404	256	478	286	449	1888
150	33	261	270	186	142	144	133	93	479	404	256	478	286	450	1888
150	45	262	270	186	142	144	133	94	478	405	256	478	286	451	1887
151	3	262	271	186	143	144	133	94	478	406	256	478	287	453	1886
151	15	262	271	186	143	145	133	94	477	406	256	478	287	453	1886
151	33	263	271	187	143	145	133	94	477	408	257	478	288	454	1886
151	45	263	272	187	143	145	133	94	478	408	257	478	288	455	1886
152	3	263	272	187	143	145	134	95	477	408	257	479	288	455	1886
152	15	264	272	187	143	145	134	95	477	408	257	479	289	455	1887
152	33	264	273	187	144	145	134	95	478	408	257	479	289	455	1887
152	45	264	273	188	144	146	134	94	478	405	258	480	290	454	1887
153	2	265	273	188	144	146	134	94	479	408	258	480	290	455	1888
153	15	265	273	188	144	146	134	94	479	408	258	480	290	456	1888
153	32	265	274	188	144	146	135	95	480	411	258	480	291	457	1888
153	45	266	274	188	144	146	135	94	480	411	258	479	291	458	1889
154	2	266	274	188	145	146	135	93	480	411	259	478	292	458	1889
154	15	266	275	189	145	147	135	94	480	411	259	478	292	459	1889
154	33	267	275	189	145	147	135	95	479	410	259	479	292	457	1890
154	45	267	275	189	145	147	135	95	480	409	259	480	293	457	1891
155	3	267	276	189	145	147	136	93	480	411	259	481	293	458	1891
155	15	267	276	189	145	147	136	93	480	411	260	480	293	459	1892
155	33	268	276	190	146	148	136	95	480	413	260	480	294	461	1893
155	45	268	277	190	146	148	136	95	480	414	260	480	294	460	1893

TECH - SIL
HF106-3

DATE OF TEST - 14 AUG 84 PROJECT NO. 01-7900-002

DATA FILE - 227TSIL TEST TYPE - SMALL HORIZ

TIME MIN	SEC	TC 01	TC 02	TC 03	TC 04	TC 05	TC 06	TC 08	TC 09	TC 10	TC 11	TC 12	TC 13	TC 14	FURN AVG
156	3	269	277	190	146	148	136	94	481	416	260	480	294	461	1894
156	15	269	277	190	146	148	136	95	481	416	260	481	295	462	1895
156	33	269	278	190	146	148	137	93	481	417	260	481	295	463	1896
156	45	269	278	190	146	148	137	92	481	416	261	480	295	462	1896
157	3	270	278	191	147	148	137	93	482	414	261	482	296	462	1897
157	15	270	279	191	147	149	137	94	482	415	261	482	296	463	1897
157	32	270	279	191	147	149	137	94	482	413	261	483	296	462	1898
157	45	271	279	191	147	149	137	94	482	414	261	483	297	462	1898
158	3	271	280	191	147	149	138	93	483	417	262	484	297	464	1898
158	15	271	280	191	147	149	138	93	484	418	262	484	297	464	1898
158	32	272	280	192	148	149	138	93	484	418	262	484	298	465	1898
158	45	272	281	192	148	150	138	94	484	419	262	484	298	466	1899
159	3	272	281	192	148	150	138	95	483	419	263	484	298	467	1899
159	15	273	281	192	148	150	138	96	484	420	263	485	299	468	1899
159	33	273	282	192	148	150	139	96	485	422	263	486	299	469	1899
159	45	273	282	193	149	150	139	95	485	421	263	486	299	469	1898
160	3	273	282	193	149	151	139	93	487	421	263	486	299	466	1898
160	15	273	283	193	149	151	139	92	488	417	263	486	300	460	1897
160	33	273	283	193	149	151	139	91	491	415	263	483	299	463	1897
160	45	274	284	194	149	151	140	91	492	415	264	483	300	463	1897
161	3	274	284	194	150	151	140	92	492	416	264	484	300	464	1896
161	15	274	284	194	150	152	140	93	492	418	265	485	300	467	1896
161	33	275	285	194	150	152	140	94	491	420	265	487	301	469	1897
161	45	275	285	194	150	152	140	95	491	421	265	488	301	470	1897
162	3	275	286	195	151	152	140	95	491	420	266	490	301	470	1898
162	15	275	286	195	151	152	141	96	491	421	266	490	301	470	1899

TECH - SIL
HF106-3

DATE OF TEST - 14 AUG 84

PROJECT NO. 01-7900-002

DATA FILE - 227TSIL

TEST TYPE - SHALL HORIZ

TIME MIN	SEC	TC 01	TC 02	TC 03	TC 04	TC 05	TC 06	TC 08	TC 09	TC 10	TC 11	TC 12	TC 13	TC 14	FURN AVG
162	33	276	287	195	151	153	141	96	492	422	266	491	302	469	1900
162	45	276	287	195	151	153	141	95	492	423	266	491	302	471	1901
163	2	276	287	195	151	153	141	94	493	426	267	491	303	470	1901
163	15	276	288	196	151	153	141	93	495	424	267	490	303	469	1901
163	32	277	288	196	152	154	142	95	496	427	267	490	303	472	1902
163	45	277	289	196	152	154	142	95	496	426	267	491	303	472	1902
164	3	277	289	196	152	154	142	96	496	425	268	492	304	472	1902
164	15	277	289	196	152	154	142	96	495	427	268	492	304	473	1902
164	33	277	290	197	152	154	142	94	496	429	268	491	304	474	1903
164	45	278	290	197	153	155	142	94	496	429	268	490	305	473	1903
165	3	278	291	197	153	155	143	94	496	429	269	490	305	473	1904
165	15	278	291	197	153	155	143	95	496	430	269	490	305	474	1904
165	32	279	291	198	153	155	143	96	495	429	269	490	306	472	1905
165	45	279	292	198	153	155	143	95	495	430	269	490	306	474	1905
166	2	279	292	198	153	156	143	95	496	429	269	490	307	474	1906
166	15	280	292	198	154	156	143	95	496	430	269	489	307	474	1906
166	33	280	293	198	154	156	144	94	497	433	270	489	307	475	1907
166	45	280	293	198	154	156	144	93	497	433	270	489	308	476	1907
167	3	281	293	199	154	156	144	94	497	434	270	489	308	477	1908
167	15	281	293	199	154	156	144	93	497	433	270	488	308	477	1908
167	33	281	294	199	155	157	144	94	497	435	270	488	309	478	1908
167	45	282	294	199	155	157	145	96	496	435	270	487	309	479	1909
168	3	282	294	199	155	157	145	96	494	437	270	486	309	480	1909
168	15	282	295	200	155	157	145	97	493	437	271	486	309	480	1909
168	33	283	295	200	155	157	145	96	493	438	271	486	310	480	1910
168	45	283	295	200	155	157	145	95	493	439	271	485	310	480	1910

TECH - SIL
HF106-3

DATE OF TEST - 14 AUG 84

PROJECT NO. 01-7900-002

DATA FILE - 227TSIL

TEST TYPE - SMALL HORIZ

TIME MIN	SEC	TC 01	TC 02	TC 03	TC 04	TC 05	TC 06	TC 08	TC 09	TC 10	TC 11	TC 12	TC 13	TC 14	FURN AVG
169	3	283	295	200	156	158	145	95	494	440	271	484	311	480	1910
169	15	284	296	200	156	158	145	95	494	439	271	484	311	480	1911
169	33	284	296	200	156	158	146	94	494	440	271	484	311	481	1911
169	45	284	296	200	156	158	146	94	495	440	271	483	312	482	1911
170	2	285	296	201	156	158	146	95	495	439	271	483	312	482	1911
170	15	285	297	201	157	158	146	96	495	439	271	484	312	482	1911
170	33	285	297	201	157	159	146	95	495	441	271	485	313	483	1912
170	45	286	297	201	157	159	147	95	496	442	272	485	313	483	1912
171	2	286	298	202	157	159	147	94	497	443	272	484	313	483	1913
171	15	286	298	202	157	159	147	93	497	443	272	484	313	485	1913
171	32	287	298	202	158	159	147	94	497	445	272	483	314	486	1914
171	45	287	299	202	158	159	147	95	496	445	272	482	314	486	1915
172	3	287	299	202	158	160	147	95	496	444	272	482	315	486	1915
172	15	287	299	203	158	160	148	95	495	441	272	483	315	485	1915
172	32	288	300	203	158	160	148	94	496	441	272	481	315	485	1915
172	45	288	300	203	159	160	148	94	497	443	272	482	315	486	1915
173	2	288	300	203	159	160	148	95	498	443	273	484	316	486	1915
173	15	288	300	203	159	160	148	96	498	444	273	486	316	487	1915
173	33	289	300	204	159	161	148	96	497	445	273	488	316	488	1915
173	45	289	301	204	159	161	149	95	497	445	273	489	317	488	1915
174	3	289	301	204	160	161	149	95	497	447	274	490	317	490	1916
174	15	289	301	204	160	161	149	95	498	445	274	490	317	489	1916
174	33	289	302	205	160	161	149	95	500	447	274	490	318	488	1916
174	45	289	302	205	160	162	149	94	502	446	274	490	318	487	1916
175	3	290	303	205	160	162	150	93	505	443	274	489	318	482	1917
175	15	290	303	205	161	162	150	93	506	446	275	489	319	486	1917

TECH - SIL
HF106-3

DATE OF TEST - 14 AUG 84

PROJECT NO. 01-7900-002

DATA FILE - 227TSIL

TEST TYPE - SMALL HORIZ

TIME MIN	SEC	TC 01	TC 02	TC 03	TC 04	TC 05	TC 06	TC 08	TC 09	TC 10	TC 11	TC 12	TC 13	TC 14	FURN AVG
175	32	291	303	206	161	162	150	94	507	446	275	488	319	489	1918
175	45	291	304	206	161	163	150	94	507	446	275	488	319	489	1919
176	2	291	304	206	161	163	150	94	508	450	276	489	319	491	1920
176	15	291	305	206	162	163	151	94	508	449	276	489	320	491	1920
176	33	291	305	207	162	164	151	94	509	450	276	491	320	492	1921
176	45	291	306	207	162	164	151	95	509	450	277	492	320	493	1921
177	3	292	306	207	162	164	151	95	509	453	277	495	321	493	1922
177	15	292	306	207	162	164	151	95	510	449	277	495	321	491	1922
177	33	292	307	208	163	165	152	95	510	451	278	495	321	492	1923
177	45	292	307	208	163	165	152	94	511	452	278	495	322	493	1923
178	3	293	308	208	163	165	152	93	510	453	278	494	322	494	1925
178	15	293	308	208	163	165	152	94	509	453	278	493	322	494	1928
178	33	293	308	208	164	165	152	94	509	453	279	492	323	495	1932
178	45	294	309	208	164	166	153	95	508	453	279	491	323	496	1934
179	2	294	309	209	164	166	153	96	508	455	279	491	323	496	1935
179	15	294	309	209	164	166	153	97	507	454	279	491	324	496	1935
179	33	295	310	209	164	166	153	97	508	454	279	492	324	496	1933
179	45	295	310	209	164	166	153	97	508	455	279	494	324	496	1931
180	3	295	310	210	165	167	154	97	508	455	279	496	325	495	1929
180	15	296	310	210	165	167	154	95	0	0	0	496	325	496	1923
180	33	0	0	0	0	0	0	0	0	0	0	0	0	0	1890
180	45	0	0	0	0	0	0	0	0	0	0	0	0	0	1865
181	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1781
181	15	0	0	0	0	0	0	0	0	0	0	0	0	0	1704
181	32	0	0	0	0	0	0	0	0	0	0	0	0	0	1597
181	45	0	0	0	0	0	0	0	0	0	0	0	0	0	1531

TEST REPORT: #TS-TP-0084

PENETRATION "D"

FIRE & HOSE-STREAM TEST for a 12" DEEP

BLANKET GAP SEAL

Test: #TS-TP-0084
By: K.A. Kerr

TECH-SIL INC.

1.0 Scope:

This test consisted of subjecting a sealed opening which represented a section of seismic gap between two buildings, to a three-hour long ASTM E-119 time/temperature curve fire test. The fire test was immediately followed by two separate hose-stream tests. The test was witnessed by and conducted at Portland Cement Association (Skokie, Illinois) on 4/14/82.

2.0 Configuration:

The test opening was 53" long by 6" wide by 12" deep. All four sides of the test opening consisted of cast concrete. The opening was sealed by first draping a piece of #TS-MS-0081 Aluminized Fabric into the opening. Three inches of this fabric extended over the unexposed side of the test slab. These three-inch wide pieces were cemented to the slab with #TS-MS-0008 Silicone Adhesive. Next, the opening was filled with #TS-MS-0013 Damming Blanket (four layers, approximately 2" thick each, of 2-3 pcs. blanket material). The void was filled completely (12" deep). Another layer of #TS-MS-0081 Aluminized Fabric was used to cover the entire assembly on the unexposed surface. The long edges of the assembly were covered with 16 GA. x 1" wide strips of galvanized steel. Each of the two strips were held in place with three 1/4" x 1" expansion anchors.

3.0 Thermocouples:

Two thermocouples were mounted on the seal's surface for monitoring seal surface temperatures throughout the test. Each thermocouple was covered with a weighted asbestos pad. The thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. The thermocouple readings at the end of the test were as follows:

T/C #5 Seal Surface . . . . . 149°F

T/C #6 Seal Surface . . . . . 134°F

4.0 Fire Test Procedure:

The fire test consisted of subjecting the test slab with the seal specimen to a three hour long ASTM E-119 time/temperature curve fire test. Simply described, the furnace used for this type of test is a deep rectangular shaped, refractory brick lined box heated by gas burners. The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by a grid of shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures was also made from time to time. Manual control of this system was

instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

5.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three-hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas. Temperatures were also recorded by a computer controlled data acquisition system which printed temperatures in accordance with the IEEE 634-1978 test standard requirements.

Throughout the test, an even blanket of flame was produced in the furnace. It was noted that flames propogated along the exposed slab surface. No smoke or fire was noted from the seal specimen for the duration of the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and tilted on its side (at approximately 45°) for the hose-stream tests.

6.0 Hose-Stream Tests:

The first hose-stream test was performed according to ANI test requirements. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 15°, at 75 psi from a distance of five feet.

The second hose-stream test was conducted in accordance with the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 30°, at seventy-five psi from a distance of ten feet.

7.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, no smoke or fire penetrated through the seal.

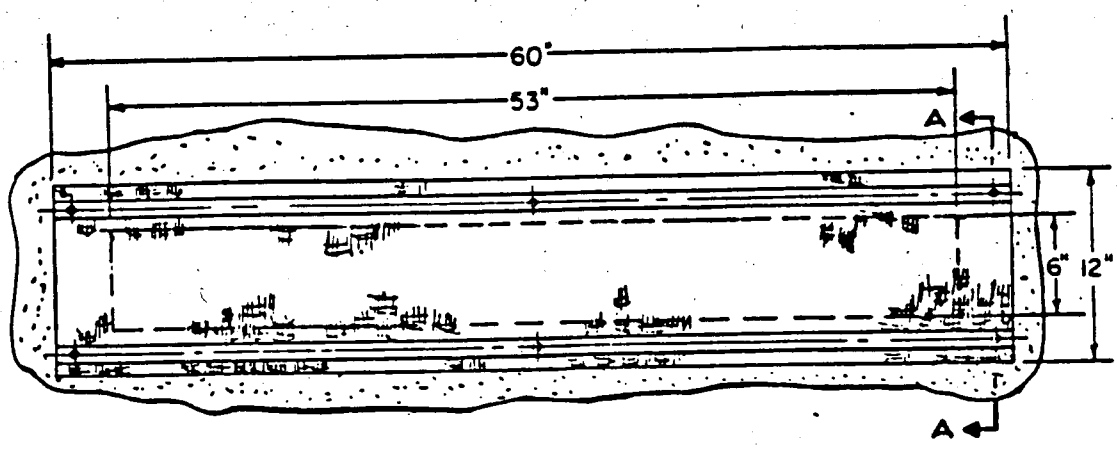
C. During the fire test, fire did not occur on the unexposed surface of the penetration seal as a result of heat conduction.

D. During the IEEE-1978 and the ANI hose-stream tests, water did not penetrate through the penetration seal.

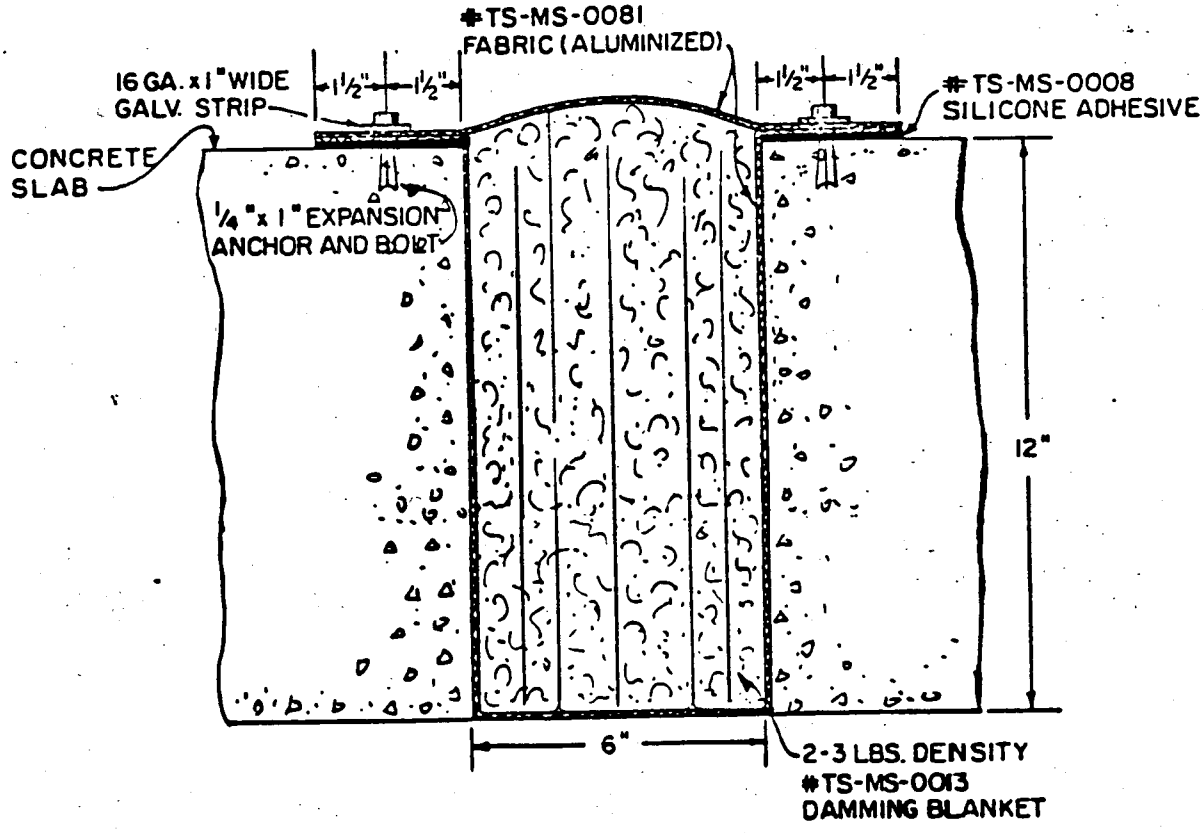
8.0 Post Test Observations:

The slab and penetration was dismantled on 4/19/82. At this time the following observation was made:

A. It was noted that only the bottom layer of the #TS-MS-0081 Aluminized Fabric had burnt away where it was exposed to fire on the exposed side of the assembly.



PLAN



SECTION A-A

TECH-SIL, INC.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	87	68	19
0:05	1109	1000	109
0:10	1321	1300	21
0:15	1426	1399	27
0:20	1469	1462	7
0:25	1510	1510	0
0:30	1542	1550	-8
0:35	1585	1584	1
0:40	1615	1613	2
0:45	1638	1638	0
0:50	1654	1661	-7
0:55	1680	1681	-1
1:00	1696	1700	-4
1:05	1718	1718	-0
1:10	1727	1735	-8
1:15	1749	1750	-1
1:20	1753	1765	-12
1:25	1770	1779	-9
1:30	1784	1792	-8
1:35	1801	1804	-3
1:40	1811	1815	-4
1:45	1815	1826	-11
1:50	1831	1835	-4
1:55	1842	1843	-1
2:00	1859	1850	9
2:10	1870	1862	8
2:20	1874	1875	-1
2:30	1892	1888	4
2:40	1907	1900	7
2:50	1913	1912	1
3:00	1955	1925	30

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	PEN C SURFACE NORTH
9	2	2	PEN C SEAL & CONCRETE INT.
9	3	3	PEN C BUS BAR
9	4	4	PEN C DUCT & SEAL INT.
9	5	5	PEN D SURFACE SOUTH
9	6	6	PEN D SURFACE NORTH
9	7	7	PEN S SURFACE
9	8	8	PEN S CONTROL CABLE INT.
9	9	9	PEN S SEAL & SLEEVE INT.
9	10	10	PEN Q SURFACE
9	11	11	PEN Q CONTROL CABLE INT.
9	12	12	PEN Q SEAL & SLEEVE INT.
12	1	13	PEN L SURFACE
12	2	14	PEN L PIPE INT.
12	3	15	PEN L INSUL. PIPE INT.
12	4	16	PEN L SEAL & SLEEVE INT.
12	5	17	PEN P SURFACE
12	6	18	PEN P PIPE INT.
12	7	19	PEN P INSUL. PIPE INT.
12	8	20	PEN P SEAL & SLEEVE INT.
12	9	21	PEN N SURFACE
12	10	22	PEN N DUCT INT.
12	11	23	PEN N SEAL & CONCRETE INT.
12	12	24	PEN R SURFACE
13	1	25	PEN J SURFACE
13	2	26	PEN J PIPE INT.
13	3	27	PEN J SEAL & SLEEVE INT.
13	4	28	PEN H SURFACE
13	5	[illegible]	PEN H PIPE INT.
13	6	30	PEN H SEAL & SLEEVE INT.
13	7	31	PEN G SURFACE
13	8	32	PEN G PIPE INT.
13	9	33	PEN G SEAL & SLEEVE INT.
13	10	34	PEN E SURFACE
13	11	35	PEN E PIPE INT.
13	12	36	PEN E SEAL & SLEEVE INT.
14	1	37	PEN A T1 1/4 PT. N (INST.)
14	2	38	PEN A T1 CENTER (CONTROL)
14	3	39	PEN A T1 1/4 PT. S (CONTROL)
14	4	40	PEN A T1 TRAY INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
14	7	43	PEN A T2 1/4 PT. S (INST.)
14	8	44	PEN A T2 TRAY INT.
14	9	45	PEN A SURFACE NORTH
14	10	46	PEN A SURFACE CENTER
14	11	47	PEN A SEAL & CONCRETE INT.
14	12	48	PEN A SEAL & SLEEVE INT.
16	1	49	PEN B T1 1/4 PT. N (INST.)
16	2	50	PEN B T1 CENTER (INST.)
16	3	51	PEN B T1 1/4 PT. S (CONTROL)
16	4	52	PEN B T1 TRAY INT.
16	5	53	PEN B T2 1/4 PT. N (CONTROL)
16	6	54	PEN B T2 CENTER (CONTROL)
16	7	55	PEN B T2 1/4 PT. S (INST.)
16	8	56	PEN B T2 TRAY INT.
16	9	57	PEN B SURFACE NORTH
16	10	58	PEN B SURFACE CENTER
16	11	59	PEN B SEAL & CONCRETE INT.
16	12	60	PEN B SEAL & SLEEVE INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	1	2	3	4	5	6
0:00	73	73	73	73	73	73
0:05	72	73	76	82	72	72
0:10	72	73	103	96	72	72
0:15	73	73	154	114	72	72
0:20	73	73	214	130	72	72
0:25	73	73	258	144	73	72
0:30	74	73	292	159	73	73
0:35	74	73	330	171	73	73
0:40	74	74	361	181	74	73
0:45	75	74	395	192	74	73
0:50	76	74	403	202	74	74
0:55	76	75	416	212	75	74
1:00	77	75	433	222	76	75
1:05	77	76	446	231	77	75
1:10	77	78	460	209	79	76
1:15	78	81	472	209	80	77
1:20	78	85	474	209	83	79
1:25	79	89	469	209	86	80
1:30	79	94	471	209	90	82
1:35	80	97	476	209	94	85
1:40	80	102	476	210	98	87
1:45	79	105	482	210	102	90
1:50	79	107	487	211	105	93
1:55	80	110	514	216	109	96
2:00	81	113	522	241	113	99
2:10	82	122	495	278	121	106
2:20	83	128	494	296	126	111
2:30	86	134	496	306	132	117
2:40	87	139	494	315	140	123
2:50	88	143	493	321	143	127
3:00	91	148	492	327	149	134

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

TEST COMMENTS

2:49:00 FLAMETHROUGH OCCURRED ON PEN. B

HOSE STREAM TESTS:

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND ANI HOSE STREAM TEST.

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND IEEE HOSE STREAM TEST.

TECH-SIL

TEST NO. 0084
PENETRATION "E"
FIRE & HOSE-STREAM TEST FOR 12" OF
#TS-MS-0080-C HIGH DENSITY SILICONE GEL

NO.	DATE	RELEASE	BY	CK.	CK.	CK.	APP.
0	1/7/85	FOR INFORMATION	SW	AL	DR		

TEST REPORT: #TS-TP-0084

PENETRATION "E"

FIRE & HOSE-STREAM TEST FOR 12" OF

#TS-MS-0080-C HIGH DENSITY SILICONE GEL

Test: #TS-TP-0084
By: K.A. Kerr
Date: 4-14-82

1.0 Scope:

This test consisted of subjecting a penetration seal assembly consisting of a 12" diameter steel sleeve penetrated by a single 2-3/8" bare steel pipe (capped on both ends) located on center to the opening, to a three hour long ASTM E-119 time/temperature curve fire test. The fire test was immediately followed by two separate hose-stream tests. The test was witnessed by and conducted at Portland Cement Association (Skokie, Illinois), on 4/14/82.

2.0 Configuration:

The test opening was sealed with 12" (inside of the slab of #TS-MS-0080-C High Density Silicone Gel (147-177 lbs./cu.ft.). The opening used a 13-1/2" long, 16 gauge galvanized sheet metal sleeve (primed on the outside surface of the sleeve with #TS-MS-0074 Primer) which extended through the entire seal and 1-1/2" below the slab (the slab was 12" thick). The sheet metal sleeve used in the steel sleeve opening was cemented in place with #TS-MS-0001 Silicone Adhesive. The penetration had a single #TS-MS-0091 Boot attached to the pipe and sheet metal sleeve below the slab's exposed surface. The boot was used in an "S" shape and was cemented to the pipe and the sleeve with #TS-MS-0001 Silicone Adhesive. The outside (only) of the boot's zipper was covered with approximately 1/8" thick of #TS-MS-0001 Silicone Adhesive. After the boot was cemented to the pipe and the sheet metal sleeve, the boot end was covered with #TS-MS-0071 Clamps which were tightened to 50 in.-lbs., minimum. Both the boot end and the clamps were then completely covered with #TS-MS-0001 Silicone Adhesive.

3.0 Penetration Seal:

The penetration, (including the boot), was completely filled with #TS-MS-0080-C High Density Silicone Gel (147-177 lbs./cu.ft.).

4.0 Thermocouples:

One thermocouple was embedded approximately 1/4"-1/2" deep into the high density silicone gel's surface for monitoring the seal surface temperatures throughout the test. One thermocouple was also used for monitoring the pipe/interface temperatures, while one other was used to measure temperatures of the seal/sleeve interface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. The thermocouple readings at the end of the test were as follows:

T/C #34 Seal Surface . . . . . 143°F
T/C #35 Pipe/Interface . . . . . 142°F
T/C #36 Seal/Sleeve. . . . . 228°F

5.0 Fire Test Procedure:

The fire test consisted of subjecting the test slab with the seal specimen to a three-hour long ASTM E-119 time/temperature curve fire test. Simply described, the furnace used for this type of test is a deep rectangular shaped, refractory brick lined box heated by gas burners. The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by a grid of shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures was also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

6.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/ temperature curve for the three-hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas. Temperatures were also recorded by a computer controlled data acquisition system which printed temperatures in accordance with the IEEE 634-78 test standard requirements.

Throughout the test, an even blanket of flame was produced in the furnace. It was noted that flames propagated along the exposed slab surface. No smoke or fire was noted from the seal specimen for the duration of the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and tilted on its side (at approximately 45°) for the hose-stream tests.

7.0 Hose-Stream Tests:

The first hose-stream test was performed according to ANI test requirements. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 15°, at seventy-five psi from a distance of five feet.

The second hose-stream test was conducted in accordance with the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 30°, at seventy-five psi from a distance of ten feet.

8.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/ temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the fire test, fire did not occur on the unexposed surface of the penetration seal as a result of heat conduction.

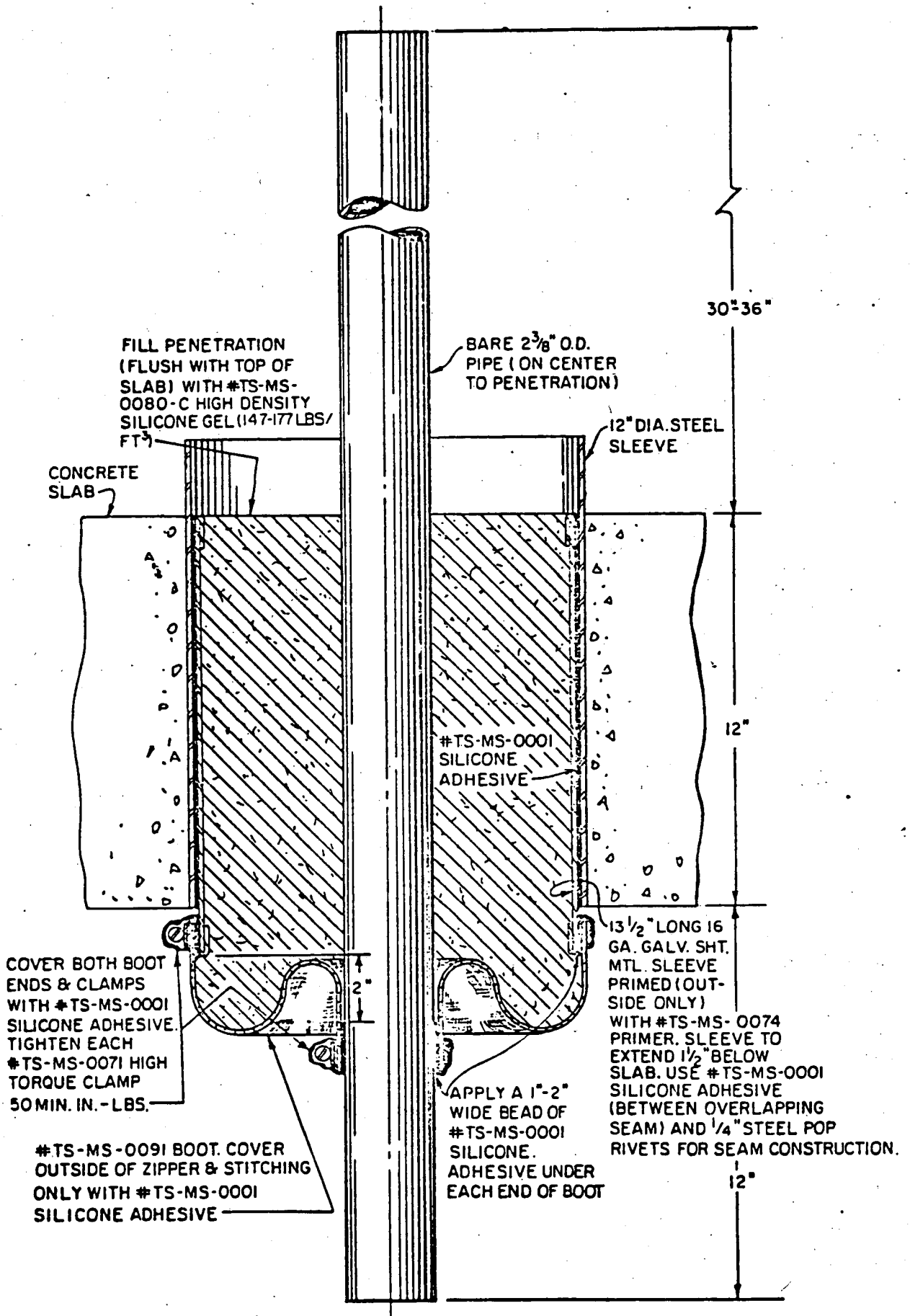
D. During the IEEE 634-1978 and the ANI hose-stream tests, water did not penetrate through the penetration seal.

9.0 Post Test Observations:

The slab and penetration were dismantled on 4/19/82. At this time the following observations were made:

A. The #TS-MS-0091 Boot had completely burned away.

B. The #TS-MS-0080-C High Density Silicone Gel had charred approximately 4-6" into the opening.



SECTION

TECH-SIL, INC.
TEST # TS-TP-0084
PENETRATION "E"

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	87	68	19
0:05	1109	1000	109
0:10	1321	1300	21
0:15	1426	1399	27
0:20	1469	1462	7
0:25	1510	1510	0
0:30	1542	1550	-8
0:35	1585	1584	1
0:40	1615	1613	2
0:45	1638	1638	0
0:50	1654	1661	-7
0:55	1680	1681	-1
1:00	1696	1700	-4
1:05	1718	1718	-0
1:10	1727	1735	-8
1:15	1749	1750	-1
1:20	1753	1765	-12
1:25	1770	1779	-9
1:30	1784	1792	-8
1:35	1801	1804	-3
1:40	1811	1815	-4
1:45	1815	1826	-11
1:50	1831	1835	-4
1:55	1842	1843	-1
2:00	1859	1850	9
2:10	1870	1862	8
2:20	1874	1875	-1
2:30	1892	1888	4
2:40	1907	1900	7
2:50	1913	1912	1
3:00	1955	1925	30

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	PEN C SURFACE NORTH
9	2	2	PEN C SEAL & CONCRETE INT.
9	3	3	PEN C BUS BAR
9	4	4	PEN C DUCT & SEAL INT.
9	5	5	PEN D SURFACE SOUTH
9	6	6	PEN D SURFACE NORTH
9	7	7	PEN S SURFACE
9	8	8	PEN S CONTROL CABLE INT.
9	9	9	PEN S SEAL & SLEEVE INT.
9	10	10	PEN Q SURFACE
9	11	11	PEN Q CONTROL CABLE INT.
9	12	12	PEN Q SEAL & SLEEVE INT.
12	1	13	PEN L SURFACE
12	2	14	PEN L PIPE INT.
12	3	15	PEN L INSUL. PIPE INT.
12	4	16	PEN L SEAL & SLEEVE INT.
12	5	17	PEN P SURFACE
12	6	18	PEN P PIPE INT.
12	7	19	PEN P INSUL. PIPE INT.
12	8	20	PEN P SEAL & SLEEVE INT.
12	9	21	PEN N SURFACE
12	10	22	PEN N DUCT INT.
12	11	23	PEN N SEAL & CONCRETE INT.
12	12	24	PEN R SURFACE
13	1	25	PEN J SURFACE
13	2	26	PEN J PIPE INT.
13	3	27	PEN J SEAL & SLEEVE INT.
13	4	28	PEN H SURFACE
13	5	29	PEN H PIPE INT.
13	6	30	PEN H SEAL & SLEEVE INT.
13	7	31	PEN G SURFACE
13	8	32	PEN G PIPE INT.
13	9	33	PEN G SEAL & SLEEVE INT.
13	10	34	PEN E SURFACE
13	11	35	PEN E PIPE INT.
13	12	36	PEN E SEAL & SLEEVE INT.
14	1	37	PEN A T1 1/4 PT. N (INST.)
14	2	38	PEN A T1 CENTER (CONTROL)
14	3	39	PEN A T1 1/4 PT. S (CONTROL)
14	4	40	PEN A T1 TRAY INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
14	7	43	PEN A T2 1/4 PT. S (INST.)
14	8	44	PEN A T2 TRAY INT.
14	9	45	PEN A SURFACE NORTH
14	10	46	PEN A SURFACE CENTER
14	11	47	PEN A SEAL & CONCRETE INT.
14	12	48	PEN A SEAL & SLEEVE INT.
16	1	49	PEN B T1 1/4 PT. N (INST.)
16	2	50	PEN B T1 CENTER (INST.)
16	3	51	PEN B T1 1/4 PT. S (CONTROL)
16	4	52	PEN B T1 TRAY INT.
16	5	53	PEN B T2 1/4 PT. N (CONTROL)
16	6	54	PEN B T2 CENTER (CONTROL)
16	7	55	PEN B T2 1/4 PT. S (INST.)
16	8	56	PEN B T2 TRAY INT.
16	9	57	PEN B SURFACE NORTH
16	10	58	PEN B SURFACE CENTER
16	11	59	PEN B SEAL & CONCRETE INT.
16	12	60	PEN B SEAL & SLEEVE INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	31	32	33	34	35	36
0:00	72	72	73	72	72	72
0:05	71	71	72	71	71	71
0:10	71	73	72	71	71	71
0:15	71	76	73	71	72	72
0:20	72	79	76	71	72	74
0:25	72	84	80	71	73	76
0:30	73	90	84	72	74	79
0:35	73	95	89	72	74	83
0:40	75	100	95	73	75	87
0:45	76	106	102	74	76	92
0:50	78	112	111	75	77	100
0:55	81	117	122	76	78	109
1:00	83	121	136	78	80	119
1:05	85	125	147	80	81	128
1:10	87	128	154	83	82	137
1:15	91	133	159	86	84	144
1:20	93	138	163	89	85	151
1:25	96	142	166	92	87	155
1:30	98	143	169	95	89	159
1:35	101	148	173	97	91	162
1:40	103	152	176	101	92	166
1:45	104	152	179	103	95	170
1:50	107	155	182	105	98	174
1:55	110	158	187	109	100	177
2:00	111	159	191	111	101	180
2:10	116	165	198	116	109	187
2:20	120	170	208	121	114	195
2:30	123	176	218	126	122	204
2:40	127	179	228	131	127	211
2:50	131	186	236	137	137	219
3:00	137	190	245	143	142	228

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

TEST COMMENTS

2:49:00 FLAMETHROUGH OCCURRED ON PEN. B

HOSE STREAM TESTS:

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND ANI HOSE STREAM TEST.

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND IEEE HOSE STREAM TEST.

TEST REPORT: #TS-TP-0084

PENETRATION "G"

FIRE & HOSE-STREAM TEST FOR 12" OF

#TS-MS-0080-A SELF-SUPPORTING

HIGH DENSITY SILICONE GEL

Test: #TS-TP-0084
By: K.A. Kerr
Date: 4-14-82

TECH-SIL

TEST NO. 0084
PENETRATION "G"
FIRE & HOSE-STREAM TEST FOR 12" OF
#TS-MS-0080-A SELF-SUPPORTING
HIGH DENSITY SILICONE GEL

NO.	DATE	RELEASE	BY	CK.	CK.	CK.	APP.
0	1/7/85	FOR INFORMATION	SW	AK	DL	ER	BZ

1.0 Scope:

This test consisted of subjecting a penetration seal assembly consisting of a 12" diameter steel sleeve penetrated by a single 2-3/8" bare steel pipe (capped on both ends) located on center to the opening, to a three hour long ASTM E-119 time/temperature curve fire test. The fire test was immediately followed by two separate hose-stream tests. The test was witnessed by and conducted at Portland Cement Association (Skokie, Illinois), on 4/14/82.

2.0 Configuration:

The test opening was sealed with 12" (inside of the slab) of #TS-MS-0080-A Self-Supporting High Density Gel (147-177 lbs./cu.ft.) The opening used a 16 gauge galvanized sheet metal sleeve (primed on the outside surface of the sleeve with #TS-MS-0074 Primer) which was 10-3/4" long and did not extend completely through the gel seal. This sleeve was cemented into the opening so that it extended 3-3/4" below the exposed surface of the slab. The sheet metal sleeve used in the steel sleeve opening was cemented in place with #TS-MS-0001 Silicone Adhesive. The penetration had a single #TS-MS-0091 Boot attached to the pipe and sheet metal sleeve below the slab's exposed surface. The boot was used in an "S" shape and was cemented to the pipe and the sleeve with #TS-MS-0001 Silicone Adhesive. The outside (only) of the boot's zipper was covered with approximately 1/8" thick of #TS-MS-0001 Silicone Adhesive. After the boot was cemented to the pipe and the sheet metal sleeve, the boot end was covered with #TS-MS-0071 Clamps which were tightened to 50 in.-lbs., minimum. Both the boot end and the clamps were then completely covered with #TS-MS-0001 Silicone Adhesive.

3.0 Seal Penetration:

The penetration was completely filled (excluding the boot), with #TS-MS-0080-A Self-Supporting High Density Gel (147-177 lbs./cu.ft.).

4.0 Thermocouples:

One thermocouple was embedded approximately 1/4"-1/2" deep into the self-supporting high density gel's surface for monitoring the seal surface temperatures throughout the test. One thermocouple was also used for monitoring the pipe/interface temperatures, while another was used to measure temperatures of the seal/sleeve interface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. The thermocouple readings at the end of the test were as follows:

T/C #31 Seal Surface . . . . . 137°F
T/C #32 Pipe/Interface . . . . . 190°F
T/C #33 Seal/Sleeve. . . ' . . . . . 245°F

5.0 Fire Test Procedure:

The fire test consisted of subjecting the test slab with the seal specimen to a three-hour long ASTM E-119 time/temperature curve fire test. Simply described, the furnace used for this type of test is a deep rectangular shaped, refractory brick lined box heated by gas burners. The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by a grid of shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures was also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

6.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three-hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas. Temperatures were also recorded by a computer controlled data acquisition system which printed temperatures in accordance with the IEEE 634-78 test standard requirements.

Throughout the test, an even blanket of flame was produced in the furnace. It was noted that flames propagated along the exposed slab surface. No smoke or fire was noted from the seal specimen for the duration of the test. The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and tilted on its side (at approximately 45°) for the hose-stream tests.

7.0 Hose-Stream Tests:

The first hose-stream test was performed according to ANI test requirements. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 15°, at seventy-five psi from a distance of five feet.

The second hose-stream test was conducted in accordance with the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 30°, at seventy-five psi from a distance of ten feet.

8.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/ temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration specimen.

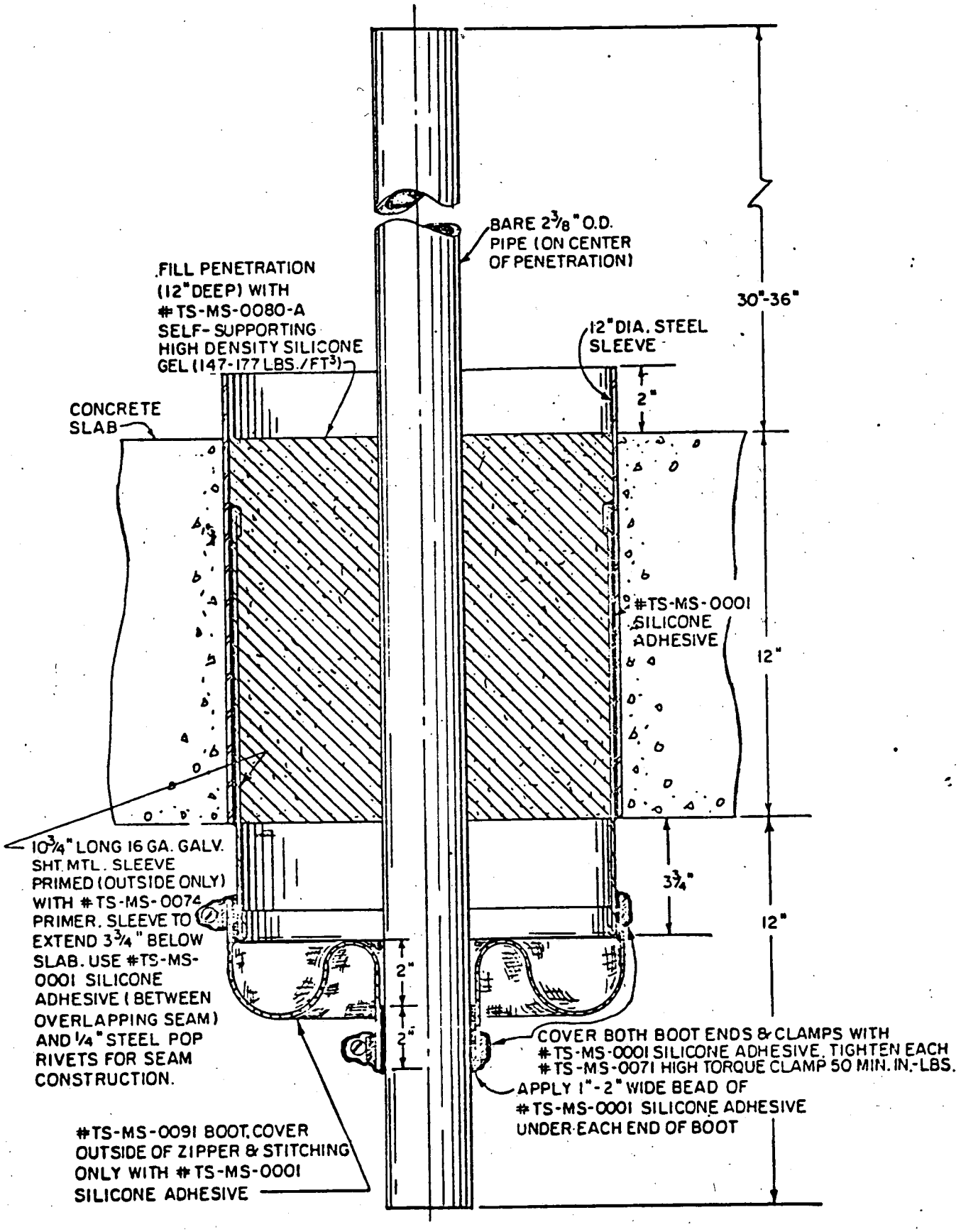
C. During the fire test, fire did not occur on the unexposed surface of the penetration seal as a result of heat conduction.

D. During the IEEE 634-1978 and the ANI hose-stream tests, water did not penetrate through the penetration seal.

9.0 Post Test Observations:

The slab and penetration were dismantled on 4/19/82. At this time the following observation was made:

A. The #TS-MS-0080-A Self-Supporting High Density Gel had charred approximately 4-6" into the opening.



SECTION

TECH-SIL, INC.
TEST #TS-TP-0084
PENETRATION "G"

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	87	68	19
0:05	1109	1000	109
0:10	1321	1300	21
0:15	1426	1399	27
0:20	1469	1462	7
0:25	1510	1510	0
0:30	1542	1550	-8
0:35	1585	1584	1
0:40	1615	1613	2
0:45	1638	1638	0
0:50	1654	1661	-7
0:55	1680	1681	-1
1:00	1696	1700	-4
1:05	1718	1718	-0
1:10	1727	1735	-8
1:15	1749	1750	-1
1:20	1753	1765	-12
1:25	1770	1779	-9
1:30	1784	1792	-8
1:35	1801	1804	-3
1:40	1811	1815	-4
1:45	1815	1826	-11
1:50	1831	1835	-4
1:55	1842	1843	-1
2:00	1859	1850	9
2:10	1870	1862	8
2:20	1874	1875	-1
2:30	1892	1888	4
2:40	1907	1900	7
2:50	1913	1912	1
3:00	1955	1925	30

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	PEN C SURFACE NORTH
9	2	2	PEN C SEAL & CONCRETE INT.
9	3	3	PEN C BUS BAR
9	4	4	PEN C DUCT & SEAL INT.
9	5	5	PEN D SURFACE SOUTH
9	6	6	PEN D SURFACE NORTH
9	7	7	PEN S SURFACE
9	8	8	PEN S CONTROL CABLE INT.
9	9	9	PEN S SEAL & SLEEVE INT.
9	10	10	PEN Q SURFACE
9	11	11	PEN Q CONTROL CABLE INT.
9	12	12	PEN Q SEAL & SLEEVE INT.
12	1	13	PEN L SURFACE
12	2	14	PEN L PIPE INT.
12	3	15	PEN L INSUL. PIPE INT.
12	4	16	PEN L SEAL & SLEEVE INT.
12	5	17	PEN P SURFACE
12	6	18	PEN P PIPE INT.
12	7	19	PEN P INSUL. PIPE INT.
12	8	20	PEN P SEAL & SLEEVE INT.
12	9	21	PEN N SURFACE
12	10	22	PEN N DUCT INT.
12	11	23	PEN N SEAL & CONCRETE INT.
12	12	24	PEN R SURFACE
13	1	25	PEN J SURFACE
13	2	26	PEN J PIPE INT.
13	3	27	PEN J SEAL & SLEEVE INT.
13	4	28	PEN H SURFACE
13	5	[illegible]	PEN H PIPE INT.
13	6	30	PEN H SEAL & SLEEVE INT.
13	7	31	PEN G SURFACE
13	8	32	PEN G PIPE INT.
13	9	33	PEN G SEAL & SLEEVE INT.
13	10	34	PEN E SURFACE
13	11	35	PEN E PIPE INT.
13	12	36	PEN E SEAL & SLEEVE INT.
14	1	37	PEN A T1 1/4 PT. N (INST.)
14	2	38	PEN A T1 CENTER (CONTROL)
14	3	39	PEN A T1 1/4 PT. S (CONTROL)
14	4	40	PEN A T1 TRAY INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
14	7	43	PEN A T2 1/4 PT. S (INST.)
14	8	44	PEN A T2 TRAY INT.
14	9	45	PEN A SURFACE NORTH
14	10	46	PEN A SURFACE CENTER
.4	11	47	PEN A SEAL & CONCRETE INT.
14	12	48	PEN A SEAL & SLEEVE INT.
16	1	49	PEN B T1 1/4 PT. N (INST.)
16	2	50	PEN B T1 CENTER (INST.)
16	3	51	PEN B T1 1/4 PT. S (CONTROL)
16	4	52	PEN B T1 TRAY INT.
16	5	53	PEN B T2 1/4 PT. N (CONTROL)
16	6	54	PEN B T2 CENTER (CONTROL)
16	7	55	PEN B T2 1/4 PT. S (INST.)
16	8	56	PEN B T2 TRAY INT.
16	9	57	PEN B SURFACE NORTH
16	10	58	PEN B SURFACE CENTER
16	11	59	PEN B SEAL & CONCRETE INT.
16	12	60	PEN B SEAL & SLEEVE INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	31	32	33	34	35	36
0:00	72	72	73	72	72	72
0:05	71	71	72	71	71	71
0:10	71	73	72	71	71	71
0:15	71	76	73	71	72	72
0:20	72	79	76	71	72	74
0:25	72	84	80	71	73	76
0:30	73	90	84	72	74	79
0:35	73	95	89	72	74	83
0:40	75	100	95	73	75	87
0:45	76	106	102	74	76	92
0:50	78	112	111	75	77	100
0:55	81	117	122	76	78	109
1:00	83	121	136	78	80	119
1:05	85	125	147	80	81	128
1:10	87	128	154	83	82	137
1:15	91	133	159	86	84	144
1:20	93	138	163	89	85	151
1:25	96	142	166	92	87	155
1:30	98	143	169	95	89	159
1:35	101	148	173	97	91	162
1:40	103	152	176	101	92	166
1:45	104	152	179	103	95	170
1:50	107	155	182	105	98	174
1:55	110	158	187	109	100	177
2:00	111	159	191	111	101	180
2:10	116	165	198	116	109	187
2:20	120	170	208	121	114	195
2:30	123	176	218	126	122	204
2:40	127	179	228	131	127	211
2:50	131	186	236	137	137	219
3:00	137	190	245	143	142	228

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

TEST COMMENTS

2:49:00 FLAMETHROUGH OCCURRED ON PEN. B

HOSE STREAM TESTS:

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND ANI HOSE STREAM TEST.

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND IEEE HOSE STREAM TEST.

TEST REPORT: #TS-TP-0084

PENETRATION "H"

FIRE & HOSE-STREAM for 12" of

#TS-MS-0080-C HIGH DENSITY SILICONE GEL

Test: #TS-TP-0084
By: K.A. Kerr
Date: 4-14-82

TECH-SIL

TEST NO. 0084
PENETRATION "H"
FIRE & HOSE-STREAM FOR 12" OF
#TS-MS-0080-C HIGH DENSITY SILICONE GEL

NO.	DATE	RELEASE	BY	CK.	CK.	CK.	APP.
0	1/7/85	FOR INFORMATION	SW	AK	DL		

1.0 Scope:

This test consisted of subjecting a penetration seal assembly consisting of a 12" diameter cast concrete opening penetrated by a single 2-3/8" diameter bare steel pipe (capped on both ends) located on center to the opening, to a three-hour long ASTM E-119 time/temperature curve fire test. The fire test was immediately followed by two separate hose-stream tests. The test was witnessed by and conducted at Portland Cement Association (Skokie, Illinois), on 4/14/82.

2.0 Configuration:

The test opening was sealed with 12" (inside of the slab) of #TS-MS-0080-C High Density Silicone Gel (147-177 lbs./cu.ft.). The opening used a 13-1/2" long, 16 gauge galvanized sheet metal sleeve (primed on the outside surface of the sleeve with #TS-MS-0074 Primer) which extended through the entire seal and 1-1/2" below the slab (the slab was 12" thick). The sheet metal sleeve used in the cast concrete opening was cemented in place with #TS-MS-0008 Silicone Adhesive. The penetration had a single #TS-MS-0091 Boot attached to the pipe and sheet metal sleeve below the slab's exposed surface. The boot was used in an "S" shape and was cemented to the pipe and the sleeve with #TS-MS-0001 Silicone Adhesive. The outside (only) of the boot's zipper was covered with approximately 1/8" thick of #TS-MS-0001 Silicone Adhesive. After the boot was cemented to the pipe and the sheet metal sleeve, the boot end was covered with #TS-MS-0071 Clamps which were tightened to 50 in.-lbs., minimum. Both the boot end and the clamps were then completely covered with #TS-MS-0001 Silicone Adhesive.

3.0 Penetration Seal:

The penetration, (including the boot), was completely filled with #TS-MS-0080-C High Density Silicone Gel (147-177 lbs./cu.ft.).

4.0 Thermocouples:

One thermocouple was embedded approximately 1/4"-1/2" deep into the high density silicone gel's surface for monitoring the seal surface temperatures throughout the test. One thermocouple was also used for monitoring the pipe/interface temperatures, while one other was used to measure temperatures of the seal/concrete interface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. The thermocouple readings at the end of the test were as follows:

T/C #28 Seal Surface . . . . . 117°F
T/C #29 Pipe/Interface . . . . . 150°F
T/C #30 Seal/Concrete. . . . . 149°F

5.0 Fire Test Procedure:

The fire test consisted of subjecting the test slab with the seal specimen to a three-hour long ASTM E-119 time/temperature curve fire test. Simply described, the furnace used for this type of test is a deep rectangular shaped, refractory brick lined box heated by gas burners. The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by a grid of shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures was also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

6.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/ temperature curve for the three-hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas. Temperatures were also recorded by a computer controlled data acquisition system which printed temperatures in accordance with the IEEE 634-1978 test standard requirements.

Throughout the test, an even blanket of flame was produced in the furnace. It was noted that flames propagated along the exposed slab surface. No smoke or fire was noted from the seal specimen for the duration of the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and tilted on its side (at approximately 45°) for the hose-stream tests.

7.0 Hose-Stream Tests:

The first hose-stream test was performed according to ANI test requirements. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 15°, at seventy-five psi from a distance of five feet.

The second hose-stream test was conducted in accordance with the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 30°, at seventy-five psi from a distance of ten feet.

8.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/ temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the fire test, fire did not occur on the unexposed surface of the penetration seal as a result of heat conduction.

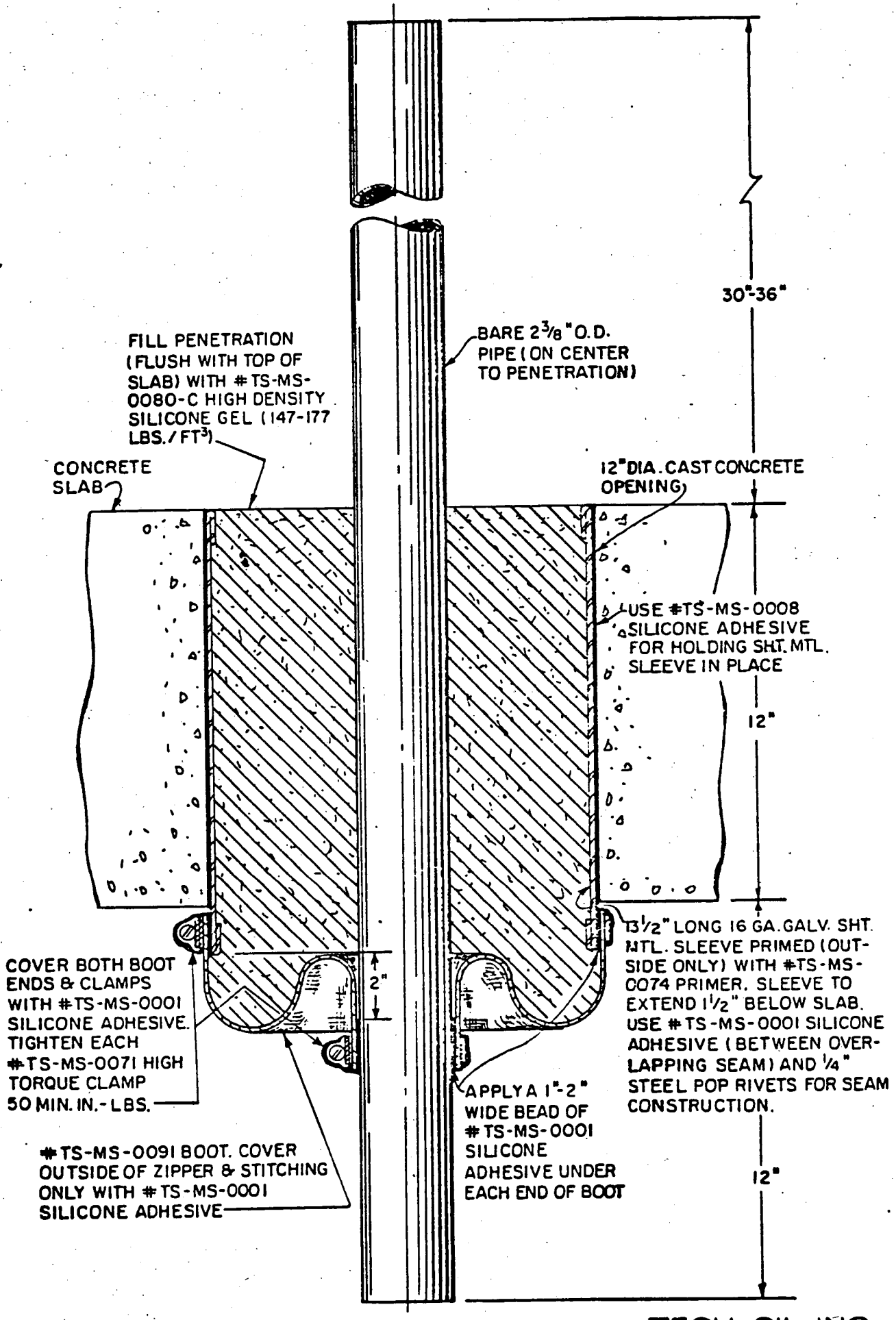
D. During the IEEE 634-1978 and the ANI hose-stream tests, water did not penetrate through the penetration seal.

9.0 Post Test Observations:

The slab and penetration was dismantled on 4/19/82. At this time the following observations were made:

A. The #TS-MS-0091 Boot had completely burned away.

B. The #TS-MS-0080-C High Density Silicone Gel had charred approximately 4-6" into the opening.



SECTION

TECH-SIL, INC.
TEST # TS-TP-0084

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	87	68	19
0:05	1109	1000	109
0:10	1321	1300	21
0:15	1426	1399	27
0:20	1469	1462	7
0:25	1510	1510	0
0:30	1542	1550	-8
0:35	1585	1584	1
0:40	1615	1613	2
0:45	1638	1638	0
0:50	1654	1661	-7
0:55	1680	1681	-1
1:00	1696	1700	-4
1:05	1718	1718	-0
1:10	1727	1735	-8
1:15	1749	1750	-1
1:20	1753	1765	-12
1:25	1770	1779	-9
1:30	1784	1792	-8
1:35	1801	1804	-3
1:40	1811	1815	-4
1:45	1815	1826	-11
1:50	1831	1835	-4
1:55	1842	1843	-1
2:00	1859	1850	9
2:10	1870	1862	8
2:20	1874	1875	-1
2:30	1892	1888	4
2:40	1907	1900	7
2:50	1913	1912	1
3:00	1955	1925	30

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	PEN C SURFACE NORTH
9	2	2	PEN C SEAL & CONCRETE INT.
9	3	3	PEN C BUS BAR
9	4	4	PEN C DUCT & SEAL INT.
9	5	5	PEN D SURFACE SOUTH
9	6	6	PEN D SURFACE NORTH
9	7	7	PEN S SURFACE
9	8	8	PEN S CONTROL CABLE INT.
9	9	9	PEN S SEAL & SLEEVE INT.
9	10	10	PEN Q SURFACE
9	11	11	PEN Q CONTROL CABLE INT.
9	12	12	PEN Q SEAL & SLEEVE INT.
12	1	13	PEN L SURFACE
12	2	14	PEN L PIPE INT.
12	3	15	PEN L INSUL. PIPE INT.
12	4	16	PEN L SEAL & SLEEVE INT.
12	5	17	PEN P SURFACE
12	6	18	PEN P PIPE INT.
12	7	19	PEN P INSUL. PIPE INT.
12	8	20	PEN P SEAL & SLEEVE INT.
12	9	21	PEN N SURFACE
12	10	22	PEN N DUCT INT.
12	11	23	PEN N SEAL & CONCRETE INT.
12	12	24	PEN R SURFACE
13	1	25	PEN J SURFACE
13	2	26	PEN J PIPE INT.
13	3	27	PEN J SEAL & SLEEVE INT.
13	4	28	PEN H SURFACE
13	5	[illegible]	PEN H PIPE INT.
13	6	30	PEN H SEAL & SLEEVE INT.
13	7	31	PEN G SURFACE
13	8	32	PEN G PIPE INT.
13	9	33	PEN G SEAL & SLEEVE INT.
13	10	34	PEN E SURFACE
13	11	35	PEN E PIPE INT.
13	12	36	PEN E SEAL & SLEEVE INT.
14	1	37	PEN A T1 1/4 PT. N (INST.)
14	2	38	PEN A T1 CENTER (CONTROL)
14	3	39	PEN A T1 1/4 PT. S (CONTROL)
14	4	40	PEN A T1 TRAY INT.
14	5	41	PEN A T2 1/4 PT. N (INST.)

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
14	7	43	PEN A T2 1/4 PT. S (INST.)
14	8	44	PEN A T2 TRAY INT.
14	9	45	PEN A SURFACE NORTH
14	10	46	PEN A SURFACE CENTER
14	11	47	PEN A SEAL & CONCRETE INT.
14	12	48	PEN A SEAL & SLEEVE INT.
16	1	49	PEN B T1 1/4 PT. N (INST.)
16	2	50	PEN B T1 CENTER (INST.)
16	3	51	PEN B T1 1/4 PT. S (CONTROL)
16	4	52	PEN B T1 TRAY INT.
16	5	53	PEN B T2 1/4 PT. N (CONTROL)
16	6	54	PEN B T2 CENTER (CONTROL)
16	7	55	PEN B T2 1/4 PT. S (INST.)
16	8	56	PEN B T2 TRAY INT.
16	9	57	PEN B SURFACE NORTH
16	10	58	PEN B SURFACE CENTER
16	11	59	PEN B SEAL & CONCRETE INT.
16	12	60	PEN B SEAL & SLEEVE INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	25	26	27	28	29	30
0:00	73	73	73	73	73	73
0:05	72	72	72	72	72	72
0:10	72	74	72	72	72	72
0:15	72	78	73	72	73	72
0:20	73	83	74	72	74	73
0:25	73	89	74	72	75	73
0:30	74	95	75	72	76	75
0:35	75	102	76	73	77	75
0:40	76	108	78	73	78	77
0:45	77	113	81	73	79	79
0:50	79	119	96	74	81	130
0:55	80	124	151	74	82	149
1:00	82	130	160	75	83	133
1:05	83	135	163	77	85	129
1:10	85	140	167	79	87	131
1:15	87	145	168	81	88	147
1:20	89	149	169	83	90	149
1:25	92	153	169	85	92	148
1:30	94	156	170	87	94	146
1:35	97	160	170	89	97	145
1:40	100	163	171	91	99	147
1:45	102	166	172	93	102	146
1:50	105	170	172	95	104	148
1:55	107	173	174	97	107	150
2:00	109	176	173	99	110	153
2:10	114	183	173	103	116	152
2:20	117	190	174	106	122	154
2:30	122	196	175	109	129	155
2:40	125	203	175	112	136	154
2:50	128	208	173	114	143	157
3:00	132	214	177	117	150	149

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

TEST COMMENTS

2:49:00 FLAMETHROUGH OCCURRED ON PEN. B

HOSE STREAM TESTS:

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND ANI HOSE STREAM TEST.

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND IEEE HOSE STREAM TEST.

Post-it™ brand fax transmittal memo 7671	# of pages ▸ 10
To Steve Wilkie	From Bill Renfro
Co. NVPO	Co. Promatec
Dept.	Phone # (800)466.4060
Fax # (914)736.8817	Fax # (713)256.2694

TEST REPORT: #TS-TP-0084

PENETRATION "Q"

FIRE & HOSE-STREAM TEST for 6" of

#TS-MS-0045-B SILICONE ELASTOMER

TECH · SIL

DOCUMENT CONTROL

Test: #TS-TP-0084
By: K.A. Kerr
Date: 4-14-82

TECH-SIL INC.

1.0 Scope:

This test consisted of subjecting a penetration seal assembly consisting of a 6" diameter steel conduit (approximately 7" long) located in a 6" thick floor section, to a three-hour long ASTM E-119 time/temperature curve fire test. The fire test was immediately followed by two separate hose-stream tests. The test was witnessed and conducted at Portland Cement Association (Skokie, Illinois), on 4/14/82.

2.0 Configuration:

The 6" diameter steel conduit extended 1" above the 6" thick slab, where it was covered with a standard plastic bushing. The conduit contained 24 pieces of 12/C #12 PVC cables, which were taped on the top ends with standard electrical tape. The conduit was sealed with 6" of #TS-MS-0045-B Silicone Elastomer (70-95 lbs./cu.ft.) flush with the exposed surface of the slab.

3.0 Penetration Seal:

The 6" diameter conduit was sealed with 6" of #TS-MS-0045-B Silicone Elastomer (70-95 lbs./cu.ft.).

4.0 Cable Types:

The conduit, which extended 1" above the slab where it was covered with a standard plastic bushing, contained the following cable loading:

24 pieces of 12/C #12 PVC cables (.5318" in.^{2} ea.) = 12.76 in.^{2} (112% fill)

The top ends of the cables were taped with standard electrical tape.

5.0 Thermocouples:

One thermocouple was embedded approximately 1/4"-1/2" deep into the silicone elastomer's surface for monitoring the seal surface temperatures throughout the test. One thermocouple was also used for monitoring the cable interface temperatures, while one other was used to measure temperatures of the seal/sleeve interface.

All of the thermocouples were eventually attached to both strip chart recorders and a computer run data acquisition system. The thermocouple readings at the end of the test were as follows:

T/C #10 Seal Surface . . . . . 539°F
T/C #11 Cable Interface. . . . . 629°F
T/C #12 Seal/Sleeve Interface. . . . 525°F

6.0 Fire Test Procedure:

The fire test consisted of subjecting the test slab with the seal specimen to a three-hour long ASTM E-119 time/temperature curve fire test. Simply described, the furnace used for this type of test is a deep rectangular shaped, refractory brick-lined box heated by gas burners. The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by a grid of shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures was also made from time to time. Manual control of this system was instituted at different points during the test, in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually and automatically (to correct the draft) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

7.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three-hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas. Temperatures were also recorded by a computer controlled data acquisition system which printed temperatures in accordance with the IEEE 634-1978 test standard requirements.

Throughout the test, an even blanket of flame was produced in the furnace. It was noted that flames propogated along the exposed slab surface.

During the fire test, slight smoke was noted coming from around the cables. The PVC jacketing on the cables began to melt approximately 4-6" above the slab because of heat conduction along the metal conductors of the cables.

No fire occurred on the seal's unexposed surface during or after the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and tilted on its side (at approximately 45°) for the hose-stream tests.

8.0 Hose-Stream Tests:

The first hose-stream test was performed according to ANI test requirements. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 15°, at seventy-five psi from a distance of five feet.

The second hose-stream test was conducted in accordance with the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 30°, at seventy-five psi from a distance of ten feet.

9.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

B. During the fire test, fire did not penetrate through the penetration seal specimen.

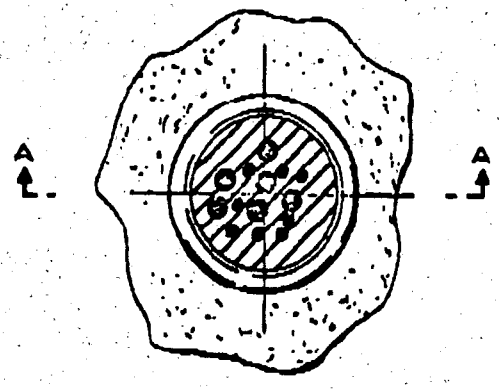
C. During the fire test, slight smoke was noted coming from around the cables. The PVC jacketing on the cables began to melt approximately 4-6" above the slab because of heat conduction along the metal conductors of the cables.

D. During the IEEE 634-1978 and the ANI hose-stream tests, water did not penetrate through the penetration seal.

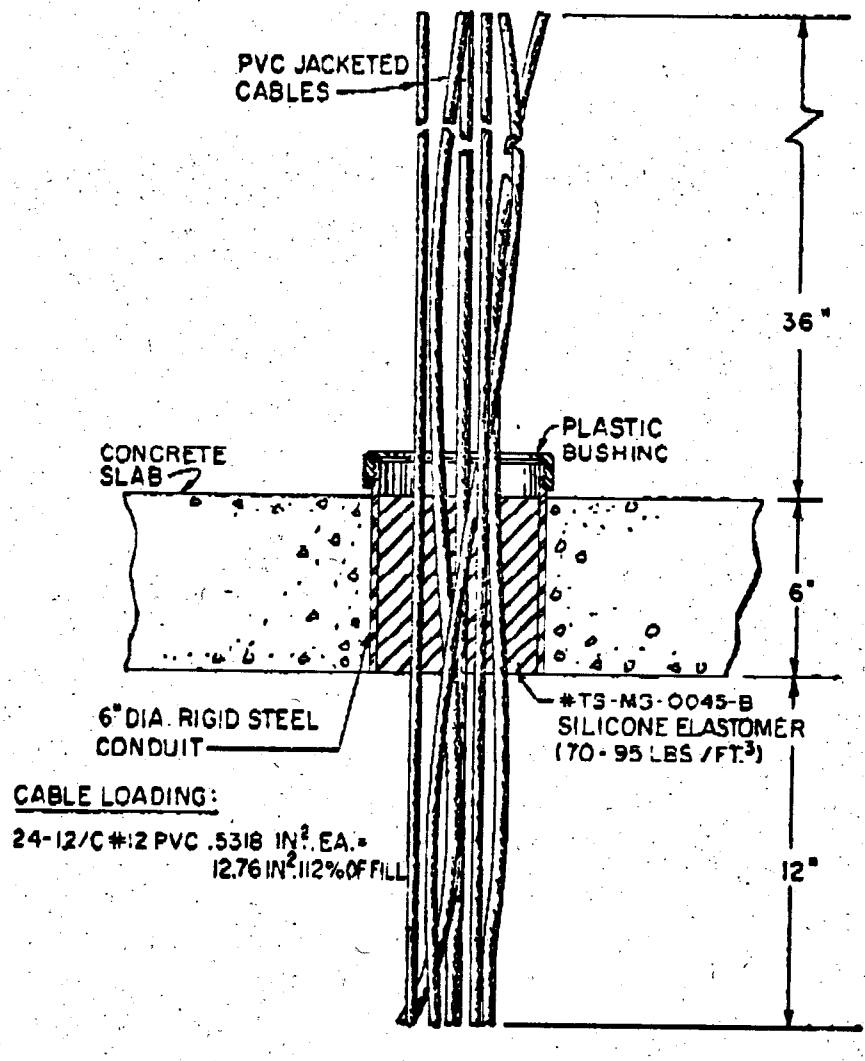
10.0 Post Test Observation:

The slab and penetration were dismantled on 4/19/82. At this time the following observation was made:

A. It was not possible to determine how much of the seal had been destroyed by the test.



PLAN



SECTION A-A

TECH-SIL, INC.

TEST #TS-TP-0084
PENETRATION "Q"

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	87	68	19
0:05	1109	1000	109
0:10	1321	1300	21
0:15	1426	1399	27
0:20	1469	1462	7
0:25	1510	1510	0
0:30	1542	1550	-8
0:35	1585	1584	1
0:40	1615	1613	2
0:45	1638	1638	0
0:50	1654	1661	-7
0:55	1680	1681	-1
1:00	1696	1700	-4
1:05	1718	1718	-0
1:10	1727	1735	-8
1:15	1749	1750	-1
1:20	1753	1765	-12
1:25	1770	1779	-9
1:30	1784	1792	-8
1:35	1801	1804	-3
1:40	1811	1815	-4
1:45	1815	1826	-11
1:50	1831	1835	-4
1:55	1842	1843	-1
2:00	1859	1850	9
2:10	1870	1862	8
2:20	1874	1875	-1
2:30	1892	1888	4
2:40	1907	1900	7
2:50	1913	1912	1
3:00	1955	1925	30

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	PEN C SURFACE NORTH
9	2	2	PEN C SEAL & CONCRETE INT.
9	3	3	PEN C DUG BAR
9	4	4	PEN C DUCT & SEAL INT.
9	5	5	PEN D SURFACE SOUTH
9	6	6	PEN D SURFACE NORTH
9	7	7	PEN S SURFACE
9	8	8	PEN S CONTROL CABLE INT.
9	9	9	PEN S SEAL & SLEEVE INT.
9	10	10	PEN Q SURFACE
9	11	11	PEN Q CONTROL CABLE INT.
9	12	12	PEN Q SEAL & SLEEVE INT.
12	1	13	PEN L SURFACE
12	2	14	PEN L PIPE INT.
12	3	15	PEN L INSUL. PIPE INT.
12	4	16	PEN L SEAL & SLEEVE INT.
12	5	17	PEN P SURFACE
12	6	18	PEN P PIPE INT.
12	7	19	PEN P INSUL. PIPE INT.
12	8	20	PEN P SEAL & SLEEVE INT.
12	9	21	PEN N SURFACE
12	10	22	PEN N DUCT INT.
12	11	23	PEN N SEAL & CONCRETE INT.
12	12	24	PEN R SURFACE
13	1	25	PEN J SURFACE
13	2	26	PEN J PIPE INT.
13	3	27	PEN J SEAL & SLEEVE INT.
13	4	28	PEN H SURFACE
13	5	[illegible]	PEN H PIPE INT.
13	6	30	PEN H SEAL & SLEEVE INT.
13	7	31	PEN G SURFACE
13	8	32	PEN G PIPE INT.
13	9	33	PEN G SEAL & SLEEVE INT.
13	10	34	PEN E SURFACE
13	11	35	PEN E PIPE INT.
13	12	36	PEN E SEAL & SLEEVE INT.
14	1	37	PEN A T1 1/4 PT. N (INST.)
14	2	38	PEN A T1 CENTER (CONTROL)
14	3	39	PEN A T1 1/4 PT. S (CONTROL)
14	4	40	PEN A T1 TRAY INT.
14	5	41	PEN A T2 1/4 PT. N (INST.)
14	6	42	PEN A T2 CENTER (CONTROL)

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
14	7	43	PEN A T2 1/4 PT. S (INST.)
14	8	44	PEN A T2 TRAY INT.
14	9	45	PEN A SURFACE NORTH
14	10	46	PEN A SURFACE CENTER
14	11	47	PEN A SEAL & CONCRETE INT.
14	12	48	PEN A SEAL & SLEEVE INT.
16	1	49	PEN B T1 1/4 PT. N (INST.)
16	2	50	PEN B T1 CENTER (INST.)
16	3	51	PEN B T1 1/4 PT. S (CONTROL)
16	4	52	PEN B T1 TRAY INT.
16	5	53	PEN B T2 1/4 PT. N (CONTROL)
16	6	54	PEN B T2 CENTER (CONTROL)
16	7	55	PEN B T2 1/4 PT. S (INST.)
16	8	56	PEN B T2 TRAY INT.
16	9	57	PEN B SURFACE NORTH
16	10	58	PEN B SURFACE CENTER
16	11	59	PEN B SEAL & CONCRETE INT.
16	12	60	PEN B SEAL & SLEEVE INT.

TECH-SIL FLOOR TEST (CR4389) - 04/14/82
THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	7	8	9	10	11	12
0:00	73	73	73	73	73	73
0:05	72	72	72	72	73	73
0:10	72	72	72	77	78	82
0:15	72	73	72	79	88	95
0:20	72	74	73	88	103	113
0:25	73	76	73	99	122	132
0:30	74	79	74	114	146	154
0:35	76	83	77	130	172	178
0:40	79	88	78	147	197	199
0:45	82	94	81	165	224	226
0:50	85	100	85	181	250	248
0:55	90	107	88	195	275	266
1:00	95	114	92	206	297	281
1:05	100	121	96	224	323	300
1:10	105	129	100	237	358	315
1:15	111	136	103	278	380	329
1:20	117	144	109	304	394	345
1:25	123	152	113	322	406	360
1:30	129	160	118	337	416	373
1:35	135	168	123	349	425	387
1:40	142	176	127	359	435	397
1:45	148	184	132	368	446	409
1:50	155	193	138	377	457	419
1:55	161	199	141	388	469	428
2:00	168	206	147	398	483	439
2:10	180	221	158	419	511	453
2:20	189	232	166	444	537	468
2:30	198	242	171	474	561	491
2:40	207	252	181	496	585	501
2:50	214	261	186	522	610	516
3:00	221	271	191	539	629	525

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

TEST COMMENTS

2:49:00 FLAMETHROUGH OCCURRED ON PEN. B
HOSE STREAM TESTS:
NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN
DURING 4 MINUTE 48 SECOND ANI HOSE STREAM TEST.
NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN
DURING 4 MINUTE 48 SECOND IEEE HOSE STREAM TEST.

PROMATEC®

PROGRESSIVE MATERIALS AND TECHNOLOGIES, INC.

TEST REPORT: #TS-TP-0084

PENETRATION "R"

FIRE & HOSE-STREAM TEST for

#TS-MS-0045-B SILICONE ELASTOMER

Test: #TS-TP-0084
By: K.A. Kerr
Date: 4-14-82

P.O. BOX 309 • CYPRESS, TEXAS 77429
(713) 373-4040 • FAX (713) 256-2694

TECH-SIL INC.

1.0 Scope:

This test consisted of subjecting a penetration seal assembly consisting of a 6" diameter steel conduit (approximately 7" long) located in a 6" thick floor section, to a three-hour long ASTM E-119 time/temperature curve fire test. The fire test was immediately followed by two separate hose-stream tests. The test was witnessed and conducted at Portland Cement Association (Skokie, Illinois), on 4/14/82.

2.0 Configuration:

The 6" diameter steel conduit extended 1" above the 6" thick slab, where it was covered with a standard plastic bushing. The conduit was sealed with 6" of #TS-MS-0045-B (70-95 lbs./cu.ft.) flush with the exposed surface of the slab.

3.0 Penetration Seal:

The 6" diameter conduit was sealed with of #TS-MS-0045-B Silicone Elastomer (70-95 lbs./cu.ft.).

4.0 Thermocouple:

One thermocouple was embedded approximately 1/4"-1/2" deep into the silicone elastomer's surface for monitoring the seal surface temperatures throughout the test.

The thermocouple was eventually attached to both strip chart recorders and a computer run data acquisition system. The thermocouple reading at the end of the test was as follows:

T/C #24 Seal Surface . . . . . 219°F

5.0 Fire Test Procedure:

The fire test consisted of subjecting the test slab with the seal specimen to a three-hour long ASTM E-119 time/temperature curve fire test. Simply described, the furnace used for this type of test is a deep rectangular shaped, refractory brick lined box heated by gas burners. The burners are automatically ignited from the outside of the furnace. The burners in the furnace operate in unison so that a uniform blanket of flame covers the plan area of the furnace space at burner level. The furnace atmosphere temperatures are controlled and monitored by a grid of shielded chromel-alumel thermocouples located exactly twelve inches down from the top of the furnace. The furnace atmosphere temperatures were controlled automatically throughout the test. Visual inspection of the furnace atmosphere temperatures was also made from time to time. Manual control of this system was instituted at different points during the test in order to make adjustments for fuel contribution and heat loss of the test assembly. The furnace draft was controlled both manually

and automatically (to correct the draft) during the test. The furnace draft operated at approximately .05 to .08 inches of negative water pressure throughout the test.

6.0 Test Record:

The entire test was conducted in accordance with the ASTM E-119 time/temperature curve for the three-hour long test.

Temperatures were measured and documented at three minute intervals (on strip chart recorders) for the unexposed surface of the test assembly. Visual checks of these temperatures were made throughout the test in order to detect possible problem areas. Temperatures were also recorded by a computer controlled data acquisition system which printed temperatures in accordance with the IEEE 634-1978 test standard requirements.

Throughout the test, an even blanket of flame was produced in the furnace. It was noted that flames propogated along the exposed slab surface.

During the fire test, no smoke or fire was noted. No fire occurred on the seal's unexposed surface during or after the test.

The test was conducted for three hours. At the conclusion of the regulation test period, the furnace burners were shut off, the slab removed from the furnace and tilted on its side (at approximately 45°) for the hose-stream tests.

7.0 Hose-Stream Tests:

The first hose-stream test was performed according to ANI test requirements. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 15°, at seventy-five psi from a distance of five feet.

The second hose-stream test was conducted in accordance with the IEEE 634-1978 test standard. Water was sprayed onto the exposed surface of the test slab specimen for a period of 4 minutes and 48 seconds, using an even spray discharged from a one and one half inch diameter hose, through a 30-90° high velocity spray nozzle, set at 30°, at seventy-five psi from a distance of ten feet.

8.0 Test Conclusions:

A. The fire test was conducted according to the ASTM E-119 time/temperature curve for three hours.

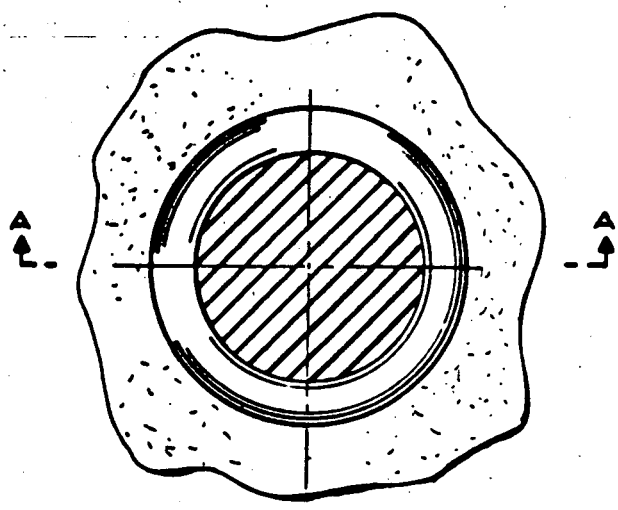
B. During the fire test, fire did not penetrate through the penetration seal specimen.

C. During the IEEE 634-1978 and the ANI hose-stream tests, water did not penetrate through the penetration seal.

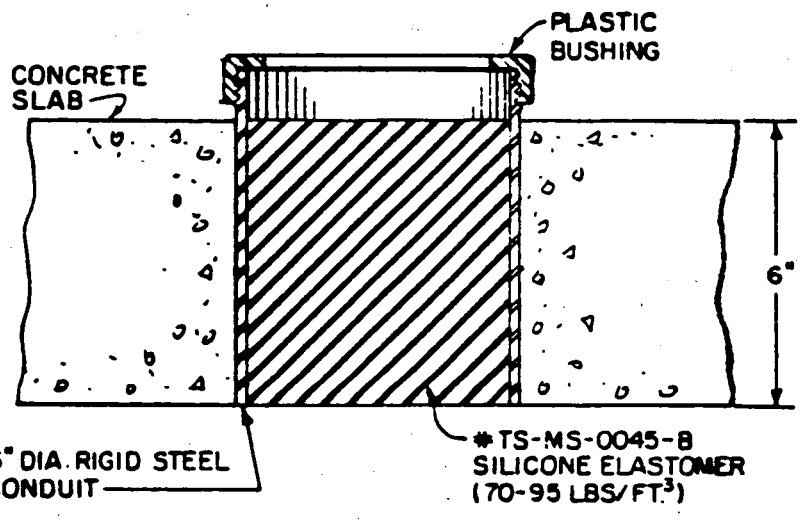
9.0 Post Test Observations:

The slab and penetration were dismantled on 4/19/82. At this time the following observation was made:

A. Approximately 3-4" of the silicone elastomer had charred away during the test.



PLAN

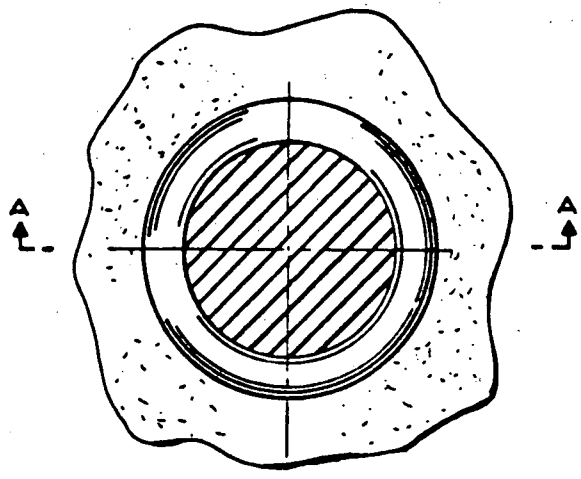


SECTION A-A

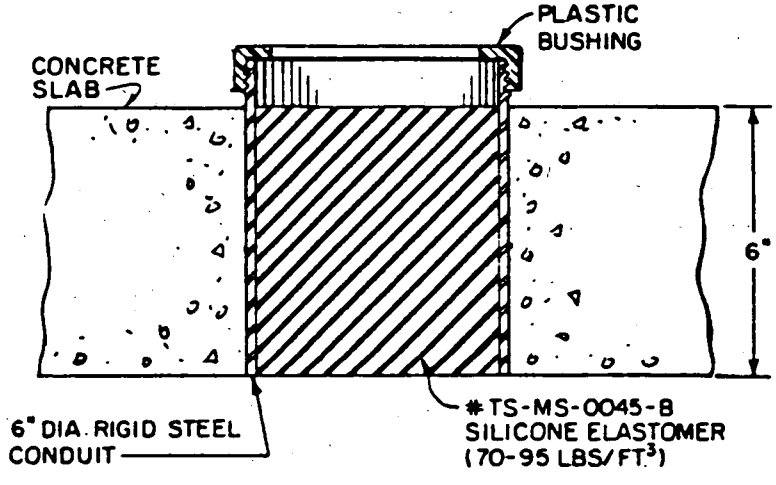
TECH-SIL, INC.

TEST # TS-TP-0084

PENETRATION "R"



PLAN



SECTION A-A

TECH-SIL, INC.
TEST # TS-TP-0084
PENETRATION "R"

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
FURNACE ATMOSPHERE TEMPERATURE (DEG. F)

TEST TIME, Hr:Min	FURNACE TEMP. F	ASTM E119 TEMP. F	VARIATION FROM ASTM TEMP. F
0:00	87	68	19
0:05	1109	1000	109
0:10	1321	1300	21
0:15	1426	1399	27
0:20	1469	1462	7
0:25	1510	1510	0
0:30	1542	1550	-8
0:35	1585	1584	1
0:40	1615	1613	2
0:45	1638	1638	0
0:50	1654	1661	-7
0:55	1680	1681	-1
1:00	1696	1700	-4
1:05	1718	1718	-0
1:10	1727	1735	-8
1:15	1749	1750	-1
1:20	1753	1765	-12
1:25	1770	1779	-9
1:30	1784	1792	-8
1:35	1801	1804	-3
1:40	1811	1815	-4
1:45	1815	1826	-11
1:50	1831	1835	-4
1:55	1842	1843	-1
2:00	1859	1850	9
2:10	1870	1862	8
2:20	1874	1875	-1
2:30	1892	1888	4
2:40	1907	1900	7
2:50	1913	1912	1
3:00	1955	1925	30

TECH-SIL FLOOR TEST (CR4889) - 04/14/82
THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
9	1	1	PEN C SURFACE NORTH
9	2	2	PEN C SEAL & CONCRETE INT.
9	3	3	PEN C BUS BAR
9	4	4	PEN C DUCT & SEAL INT.
9	5	5	PEN D SURFACE SOUTH
9	6	6	PEN D SURFACE NORTH
9	7	7	PEN S SURFACE
9	8	8	PEN S CONTROL CABLE INT.
9	9	9	PEN S SEAL & SLEEVE INT.
9	10	10	PEN Q SURFACE
9	11	11	PEN Q CONTROL CABLE INT.
9	12	12	PEN Q SEAL & SLEEVE INT.
12	1	13	PEN L SURFACE
12	2	14	PEN L PIPE INT.
12	3	15	PEN L INSUL. PIPE INT.
12	4	16	PEN L SEAL & SLEEVE INT.
12	5	17	PEN P SURFACE
12	6	18	PEN P PIPE INT.
12	7	19	PEN P INSUL. PIPE INT.
12	8	20	PEN P SEAL & SLEEVE INT.
12	9	21	PEN N SURFACE
12	10	22	PEN N DUCT INT.
12	11	23	PEN N SEAL & CONCRETE INT.
12	12	24	PEN R SURFACE
13	1	25	PEN J SURFACE
13	2	26	PEN J PIPE INT.
13	3	27	PEN J SEAL & SLEEVE INT.
13	4	28	PEN H SURFACE
13	5	[illegible]	PEN H PIPE INT.
13	6	30	PEN H SEAL & SLEEVE INT.
13	7	31	PEN G SURFACE
13	8	32	PEN G PIPE INT.
13	9	33	PEN G SEAL & SLEEVE INT.
13	10	34	PEN E SURFACE
13	11	35	PEN E PIPE INT.
13	12	36	PEN E SEAL & SLEEVE INT.
14	1	37	PEN A T1 1/4 PT. N (INST.)
14	2	38	PEN A T1 CENTER (CONTROL)
14	3	39	PEN A T1 1/4 PT. S (CONTROL)
14	4	40	PEN A T1 TRAY INT.
14	5	41	PEN A T2 1/4 PT. N (INST.)
14	6	42	PEN A T2 CENTER (CONTROL)

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

THERMOCOUPLE REFERENCE CHART

FRAME NO.	PRINT NO.	THERMOCOUPLE NO.	THERMOCOUPLE LOCATION
14	7	43	PEN A T2 1/4 PT. S (INST.)
14	8	44	PEN A T2 TRAY INT
14	9	45	PEN A SURFACE NORTH
14	10	46	PEN A SURFACE CENTER
.4	11	47	PEN A SEAL & CONCRETE INT.
14	12	48	PEN A SEAL & SLEEVE INT.
16	1	49	PEN B T1 1/4 PT. N (INST.)
16	2	50	PEN B T1 CENTER (INST.)
16	3	51	PEN B T1 1/4 PT. S (CONTROL)
16	4	52	PEN B T1 TRAY INT.
16	5	53	PEN B T2 1/4 PT. N (CONTROL)
16	6	54	PEN B T2 CENTER (CONTROL)
16	7	55	PEN B T2 1/4 PT. S (INST.)
16	8	56	PEN B T2 TRAY INT.
16	9	57	PEN B SURFACE NORTH
16	10	58	PEN B SURFACE CENTER
16	11	59	PEN B SEAL & CONCRETE INT.
16	12	60	PEN B SEAL & SLEEVE INT.

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

THERMOCOUPLE TEMPERATURES (DEG F)

TEST TIME, Hr:Min	T/C NO.					
	19	20	21	22	23	24
0:00	72	72	72	72	72	73
0:05	71	71	71	130	71	71
0:10	72	71	71	178	72	71
0:15	73	71	72	203	73	72
0:20	74	71	74	220	74	72
0:25	75	71	75	227	75	73
0:30	76	71	77	233	77	74
0:35	77	71	80	237	79	76
0:40	79	71	83	243	82	79
0:45	81	72	86	248	85	84
0:50	83	72	89	254	89	88
0:55	85	72	92	265	93	94
1:00	88	72	95	281	98	99
1:05	90	72	98	287	104	105
1:10	93	72	101	292	110	112
1:15	95	73	104	296	116	118
1:20	98	74	107	300	123	124
1:25	101	74	110	304	129	129
1:30	103	75	113	308	134	135
1:35	106	76	116	311	140	140
1:40	109	77	120	315	146	145
1:45	112	78	123	318	149	151
1:50	115	79	125	323	154	156
1:55	118	81	129	326	160	161
2:00	121	82	132	330	165	167
2:10	127	85	137	337	174	177
2:20	133	88	142	341	184	187
2:30	139	92	147	348	192	195
2:40	144	95	152	350	199	204
2:50	150	99	155	344	209	212
3:00	156	102	159	350	218	219

TECH-SIL FLOOR TEST (CR4889) - 04/14/82

TEST COMMENTS

2:49:00 FLAMETHROUGH OCCURRED ON PEN. B

HOSE STREAM TESTS:

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND ANI HOSE STREAM TEST.

NO WATER PROJECTED BEYOND THE UNEXPOSED SURFACE OF THE SPECIMEN DURING 4 MINUTE 48 SECOND IEEE HOSE STREAM TEST.