FIRE ENDURANCE TEST OF 3M INTERAM™ MAT FIRE PROTECTIVE ENVELOPES (24 in. and 6 in. Cable Trays, 5 in., 3 in., and 1 in. Conduits, 2 in. Air Drop and a 12 in. x 12 in. x 8 in. Junction Box)

Project No. 14540-99123

FIRE ENDURANCE TEST TO QUALIFY PROTECTIVE ENVELOPES FOR CLASS 1E ELECTRICAL CIRCUITS

December 5, 1995

Prepared For:

Peak Seals, Inc.
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OMEGA POINT LABORATORIES

CTP-2003
August 7, 1996

FOREWORD

In accordance with PROMATEC Internal Audit Report No. Q1A-100-95, this foreword shall serve as notice of review by the Product Assurance Manager as stated in QAM20188, Issue C, dated March 28, 1993, Section XI, paragraph 4.5.

The PROMATEC Quality Assurance Department has approved the applicable procedures, monitored the construction of the test specimens, monitored the application of the fire proofing material, maintained complete documentation of the fire proofing material application and hereby verifies that approved procedures were utilized in the application of fire proofing material into various assemblies.

Copies of the applicable manufacturer's Certificates of Compliance are available from the PROMATEC Quality Assurance Department upon written request and may be excluded from the contents of this documentation package.

The Quality Assurance/Quality Control functions performed by PROMATEC personnel are governed within the applicable sections of the PROMATEC Quality Assurance Program and the applicable Quality Control Procedures.

L. Charles Spriggs
VP/Product Assurance

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ABSTRACT

Several steel raceway assemblies clad with 3M Interam™ Mat materials as described herein, were evaluated in accordance with the Peak Seals, Inc. TEST PLAN No. CTP-2003 "Three (3) Hour Fire Endurance Test 3M Interam™ Fire Wrap," and Supplement 1 to the U.S. Nuclear Regulatory Commission Generic Letter 86-10.

The details, procedures and observations reported herein are correct and true within the limits of sound engineering practice. All specimens and test sample assemblies were produced, installed and tested under the surveillance of either Peak Seals, Inc.'s or the testing laboratory's in-house Quality Assurance Program. This report describes the analysis of a distinct assembly and includes descriptions of the test procedure followed, the assembly tested, and all results obtained. All test data are on file and remain available for review by authorized persons.

Herbert W. Stansberry II
Project Manager

3/21/96
Date

Constance A. Humphrey
Manager, QA Dept.

3/20/96
Date

Deggary N. Priest
President

3/21/96
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INTRODUCTION

The protection of vital electrical circuits from the effects of an external fire exposure is of primary concern in the design and construction of an electrical power generating plant. Typical "fire protective envelopes" are designed to protect the contents of an electrical raceway for fire exposure periods of one to three hours, during which time the electrical circuitry must remain functional, as defined in Generic Letter 86-10, Supp. 1.

The external fire exposure selected to evaluate protective envelope systems is that described in the ASTM E119-88 Fire Tests of Building Construction and Materials (E119 Time-Temperature Curve, described later in this document). The ASTM E119 test procedure is identical or very similar to the following standard test methods:

UL 263
UBC 7-1(43-1)
NFPA 251

Typical fire test programs involve the selection and construction of a specific electrical raceway system, instrumentation for thermal and circuit integrity measurements, followed by the application of the protective envelope system by qualified personnel.

This standard should be used to measure and describe the properties of materials, products, or assemblies in response to heat and flame under controlled laboratory conditions and should not be used to describe or appraise the fire hazard or risk of materials, products, or assemblies under actual fire conditions. However, results of this test may be used as elements of a fire risk assessment that takes into account all the factors that are pertinent to an assessment of the fire hazard of a particular end use.

OBJECTIVE

The objective of this project was to evaluate specific assemblies for use as 3-hour fire-protective envelopes for redundant electrical systems. The entire program was carried out in accordance with the Peak Seals, Inc., TEST PLAN No. CTP-2003, *Three (3) Hour Fire Endurance Test 3M Interam™ Fire Wrap*, which may be found in Appendix B of this document. For reasons of clarity and to reduce redundancy, many items discussed in the Test Plan have not been duplicated elsewhere in this document.

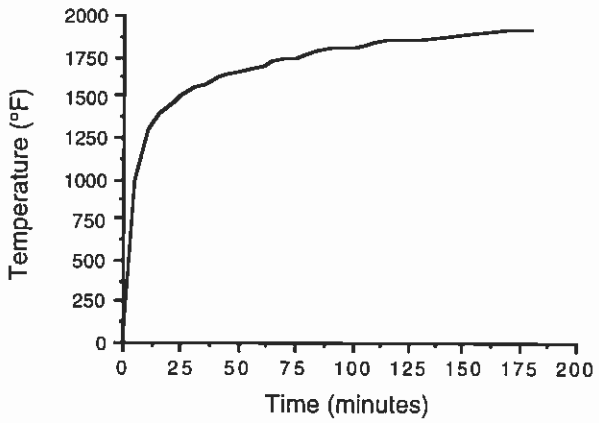
TEST PROCEDURE

FIRE TEST FURNACE

The 12 ft x 18 ft x 7 ft deep horizontal test furnace is designed to allow the test specimen to be uniformly exposed to the specified time-temperature conditions. It is fitted with 12 symmetrically-located premixed propane/air gas burners, located 6 feet below the top ledge of the furnace, and designed to allow an even heat flux distribution across the under surface of a horizontal test specimen. Furnace pressures may be maintained at any value from +0.5 in. W.C. to -0.05 in. W.C. at the exposed surface of the test article. The burners, when fully fired, will deliver 20 MBtu/hr total heat input. The furnace consists of a structural steel frame, lined with sheet metal and insulated with a six inch thick layer of ceramic fiber. One wall of the furnace contains a personnel door to allow access to the inside with the test article in place.

The temperature within the furnace is determined to be the mathematical average of thermocouples located symmetrically within the furnace and positioned twelve inches away from the exposed face of the test specimen. The materials used in the construction of these thermocouples are those suggested in the test standard. During the performance of a fire exposure test, the furnace temperatures are monitored at least every 15 seconds and displayed for the furnace operator to allow control along the specified temperature curve. A paper printout of the data is produced every 30 seconds, and all data is saved to hard disk at intervals of once per minute unless more often is requested.

The fire exposure is controlled to conform with the standard time-temperature curve shown in Figure 1, as determined by the table below:



Temperature (°F)	Time (min)
1000	5
1300	10
1462	20
1550	30
1700	60
1792	90
1850	120
1888	150
1925	180

Figure 1

The fire test is controlled according to the standard time-temperature curve, as indicated by the average temperature obtained from the readings of the furnace interior thermocouples symmetrically located across the specimen, 12 in. away. The thermocouples are enclosed in protection tubes of such material and dimensions that the time constant of the thermocouple assembly lies between 5.0 and 7.2 minutes, as required by the E 119 standard. The furnace temperature during a test is controlled such that the area under the time-temperature curve is within 5% of the corresponding area under the standard time-temperature curve for the three hour test period.

The furnace pressure is controlled to be as nearly neutral with respect to the surrounding laboratory atmosphere as possible, measured at the vertical mid-height of the test specimen. Adjusting the neutral plane at that position results in a nominal +0.015 in. WC pressure at the top of the specimen (under the surface of the deck) and –0.015 in. WC pressure at the bottom of the specimen.

THERMOCOUPLES

Temperatures on the interior of the fire protected systems were measured with Type K, 24 gauge, Chromel-Alumel electrically welded thermocouples formed from Chromel and Alumel wires of "special limits of error (±1.1°C)," and covered with Teflon® PFA insulation. The Teflon® insulation material begins to break down at temperatures above 500°F. Temperature readings above 500°F can not be guaranteed as accurate since the thermocouple conductors may no longer be adequately separated.

DATA ACQUISITION SYSTEM

The outputs of the test article thermocouples and furnace probes are monitored by a total of two data acquisition systems consisting of: 1) a John Fluke Mfg. Co., Model HELIOS 2289A Computer Front End, a John Fluke Mfg. Co., Model HELIOS 2281A Extender Chassis, and an Apple Computer Co., Macintosh Classic microcomputer, yielding a channel capacity of 200 channels, and 2) an IOTech TempScan 1000, six IOTech TempScan 1000 EXP10 expansion chassises, an IOTech SCSI to IEEE488 Buss Converter, and an Apple Computer Co., Macintosh Centris 650 microcomputer, yielding a channel capacity of 416 channels. The HELIOS Computer Front Ends are connected to the RS422 Serial Interface Port of the Macintosh Classic Computers and the Extender Chassis is serially connected to one HELIOS Computer Front End. The TempScan units are daisy-chained together and connected via an IEEE488 buss to the SCSI to IEEE488 converter. The converter is then connected to the Macintosh Centris 650 via the

SCSI port. The computers are programmed in Microsoft BASIC to command the data acquisition units to sample the data input lines, receive and convert the data into a digital format, and to manipulate the raw data into usable units for display on screen and paper and for storage on hard disk.

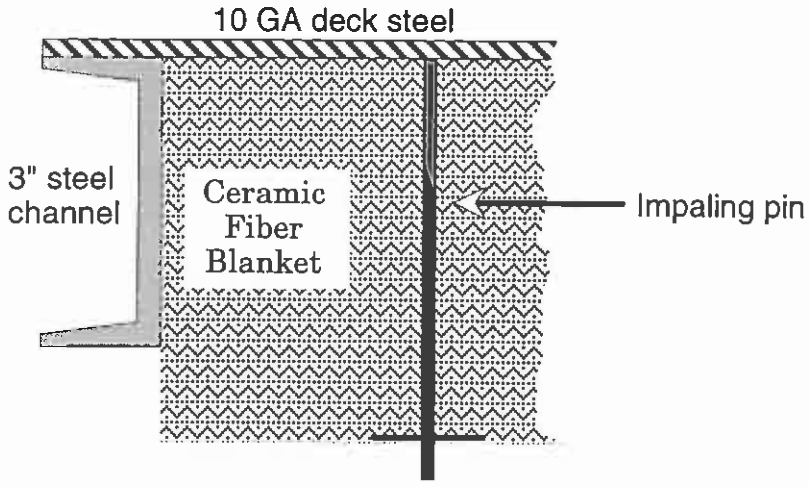
HOSE STREAM TEST

According to the Test Plan, following the fire exposure test, the test specimen is removed from the test furnace and exposed to the impact, erosion, and cooling effects of a hose stream directed perpendicular to the exposed surface of the test specimen as outlined in the standard. The stream is delivered, for a minimum period of 5 minutes, through a 1-1/2 in. fog nozzle with an adjustable stream, with a nozzle pressure of 75 psi, a spray angle of 30° and with the tip of the nozzle a distance of 5 ft. from the exposed face. The nozzle is to flow a minimum of 75 gpm during the hose stream test. It is recognized that, with a three-dimensional object, not all surfaces can be attacked by the hose stream test. For this reason, the hose is moved about to allow the stream to play against the sides, inside and outside vertical surfaces and the underside of the item, resulting in little, if any, direct force being applied to the inside top surface of the specimen.

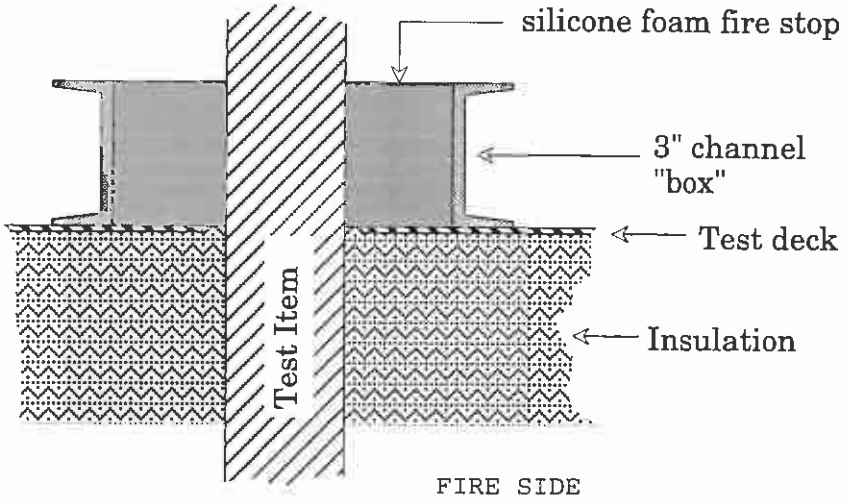
TEST ASSEMBLY

TEST DECK

The test deck consisted of a perimeter of 3 in. structural steel channel, welded together into an 13 ft by 13 ft square, with the flanges outward. Over the top of this framework, a layer of 10 GA steel sheet was welded to form a continuous, smooth top. Pipe sockets (4 in. ø, sch. 40 steel pipe) were then welded onto each corner, so that 3 in. ø steel pipe legs could be attached to hold the assembly at a comfortable working level. Holes were then cut into the deck steel at the appropriate locations to allow the test item to be installed into the deck assembly. Structural elements were typically attached to the test item on the exterior of the deck, to rigidly fix the item to the deck. Following the installation of the test item, the deck was reinforced with structural steel positioned so as to minimize any warping, bending or sagging during the fire test (the size of the channel being selected on the basis of the amount of stiffness required for that particular assembly), and then insulated on the fire-side with two 2 in. thick layers of 6 pcf ceramic fiber blanket, held in place with impaling pins, spaced a maximum of 12 in. o.c. The figure below illustrates a cross-sectional view of one edge of a typical deck assembly, showing the structural steel, the decking and the insulation.



Following complete installation of the test item, the underside of the deck was insulated as previously described, with the ceramic blanket being pushed into direct contact with the test item. A "box" around the penetration point in the deck steel was formed of 3 in. steel channel on edge and the enclosed area completely filled to a nominal depth of 3 in. with silicone foam fire seal.



CROSS-SECTION VIEW OF POINT OF PENETRATION
OF THE DECK BY A TEST ITEM

This method of sealing around the point where a test item penetrates the test deck has proven very effective at withstanding the 180 minute fire exposure. Since the penetration seal is considered a part of the support system, and is not in itself being evaluated by this test method, the important aspect of the seal is that it be "typical" of a field installation and withstand the fire exposure test. The silicone foam system used in this design does not unduly act as a heat sink, nor does it offer significant physical support to the penetrating item. Its purpose is to seal the gap without affecting the evaluation of the protective envelope system.

TEST ITEMS (GENERAL)

Cable tray and conduit materials used in this test were purchased by Omega Point Laboratories, Inc., from B-Line Systems, Inc., Summers Electric, Graybar Electric and various other approved vendors. The tables on the following page provide pertinent information about the raceway items used. The weight of the bare #8 copper conductor is considered negligible and is therefore not included.

Cable Trays

ATTRIBUTE	DIMENSION / WEIGHT
6 in. x 4 in. Cable Tray	
Side rail thickness	0.048
Rung thickness	18 GA
Rung spacing	9 in. o.c.
Rung dimensions	1-5/8 in. w x 13/16 in. h x 3/8 in. leg
Weight per linear foot	1.29 lbs
24 in. x 4 in. Cable Tray	
Side rail thickness	0.048
Rung thickness	18 GA
Rung spacing	9 in. o.c.
Rung dimensions	1-5/8 in. w x 13/16 in. h x 3/8 in. leg
Weight per linear foot	1.93 lbs

Conduits

ATTRIBUTE	DIMENSION / WEIGHT
5" Conduit	
Weight per linear foot	12.81 lbs
Weight of assembled LB	46 lbs
3" Conduit	
Weight per linear foot	6.70 lbs
Weight of assembled LB	14 lbs
2" Conduit	
Weight per linear foot	3.42 lbs
Weight of assembled LB	6 lbs
1" Conduit	
Weight per linear foot	1.49 lbs
Weight of assembled LB	2 lbs
Junction Box	12 in. x 12 in. x 8 in. x 16 GA.

Electrical cable used in this test was obtained by Omega Point Laboratories, Inc. and are described as follows:

Cable Function	Description	Diameter (in.)	Cross-Sectional Area (in^2)	Weight (lbs/lin. ft)
Power	3C/#6 AWG, 600V	0.750	0.442	0.410
Power	3C/#8 AWG, 600V	0.633	0.315	0.295
Control	5C/#12 AWG, 600V	0.608	0.290	0.292
Control	7C/#12 AWG, 600V	0.600	0.283	0.215
Instrument.	4 Shld. Tw. Pr. #16 AWG, 600V	0.642	0.324	0.268

The diameters and cross-sectional areas listed herein represent the Laboratory's average of ten measurements of the cable type.

3M Interam™ Mat Materials/Installation/Inspection

3M Interam™ Mat materials were supplied by 3M, St. Paul, MN. Materials included Interam™ E-54A Mat (rolls 24.5 in. wide x 20 ft long), Interam™ T-49 Tape (rolls 4 in. wide x 180 ft. long), Interam™ FireDam™ 150 Caulk (10-1/2 fl. oz cartridges). All 3M materials were measured, cut and installed onto the respective test assembly by Peak Seals, Inc. craft personnel (insulators) using approved Peak Seals, Inc. drawings, procedures and specifications. The various phases of inspection were accomplished by Peak Seals, Inc. Quality Control personnel.

Other Materials

Materials used in conjunction with the 3M components previously identifies were 3M Scotch™ Brand Premium Grade Filament Tape P-898 (rolls 3/4 in. wide x 60 yd long). and 1/2 in. wide x 0.020 in. thick stainless steel banding straps and stainless steel banding clips.

TEST ITEM (CABLE TRAYS AND CONDUIT)

The 6 in. cable tray assembly consisted of a B-Line Systems, Inc. 6 in. wide x 4 in. deep, ladder back vertical cable tray (Catalog No. 248P-09-06-144), assembled into a "U-shaped" configuration having a horizontal dimension of 104 in. and a vertical dimension of 76 in. at each leg. Both vertical legs transitioned through the upper steel deck into the horizontal section via a 6 in. wide x 4 in. deep ladder back 90° inside bend fitting having an inside radius of 12 in. (Catalog No. 248P-06-90VI12).

The 24 in. cable tray assembly consisted of a B-Line Systems, Inc. 24 in. wide x 4 in. deep, ladder back vertical cable tray (Catalog No. 248P-09-24-144), assembled into a "U-shaped" configuration having a horizontal dimension of 104 in. and a vertical dimension of 76 in. at each leg. Both vertical legs transitioned through the upper steel deck into the horizontal section via a 24 in. wide x 4 in. deep ladder back 90° inside bend fitting having an inside radius of 12 in. (Catalog No. 248P-24-90VI12). A 2 in. (3.42 lbs/lin.ft.) conduit stub assembly transitioned through the upper steel deck, extending 8 in. below the deck insulation, forming an air drop which transitioned into the center of the horizontal section of the 24 in. cable tray.

Both cable tray assemblies were supported with a common trapeze type hanger formed from 3x4.1 steel channel. The distance exposed from the bottom of the trays to the top of the support angle measured 36 in.

The 5 in. conduit assembly consisted of 5 in. diameter rigid steel galvanized conduit (12.81 lbs/lin.ft.) and fittings assembled into a "U-shaped" configuration

having an overall horizontal dimension of 102 in. and an overall vertical dimension of 76 in. at each leg. The conduit was assembled using standard conduit couplings, provided by the conduit manufacturer and was secured to the support mechanism with standard two-hole conduit straps, appropriate for the size of conduit used. One leg of the conduit assembly transitioned through the upper steel deck into a standard radius 90° elbow (38 in. from the start of the fitting to the back side of the opposite leg - approximate radius of 25 in.) and into the horizontal section. The horizontal section transitioned, through an iron condulet LB (long side vertical) into a vertical conduit section which penetrated the steel deck.

The 3 in. conduit assembly consisted of 3 in. diameter rigid steel galvanized conduit (6.70 lbs/lin.ft.) and fittings assembled into a "U-shaped" configuration having an overall horizontal dimension of 102 in. and a vertical dimension of 76 in. at each leg. The conduit was assembled using standard conduit couplings, provided by the conduit manufacturer and was secured to the support mechanism with standard two-hole conduit straps, appropriate for the size of conduit used. One leg of the conduit assembly transitioned through the upper steel deck into a standard radius 90° elbow (22 1/4 in. from the start of the fitting to the back side of the opposite leg - approximate radius of 15 in.) and into the horizontal section. The horizontal section transitioned, through an iron condulet LB (long side vertical) into a vertical conduit section, into a 12 in. x 12 in. x 8 in. steel junction box, and back into a vertical conduit section which penetrated the steel deck. The top of the junction box was located 12 in. below the insulated steel deck.

The 1 in. conduit assembly consisted of 1 in. diameter rigid steel galvanized conduit (1.49 lbs/lin.ft.) and fittings assembled into a "U-shaped" configuration having an overall horizontal dimension of 102 in. and a vertical dimension of 76 in. at each leg. The conduit was assembled using standard conduit couplings, provided by the conduit manufacturer and was secured to the support mechanism with standard two-hole conduit straps, appropriate for the size of conduit used. One leg of the conduit assembly transitioned through the upper steel deck into a standard radius 90° elbow (10 in. from the start of the fitting to the back side of the opposite leg - approximate radius of 6 in.) and into the horizontal section. The horizontal section transitioned, through an iron condulet LB (long side vertical) into a vertical conduit section which penetrated the steel deck.

The 1 in. conduit assembly consisted of 1 in. diameter rigid steel galvanized conduit and fittings assembled into a "U-shaped" configuration having a horizontal dimension of 102 in. and a vertical dimension of 76 in. at each leg. One leg of the conduit assembly transitioned through the upper steel deck into a standard radius 90° elbow and into the horizontal section. The horizontal section transitioned, through an iron condulet LB (long side vertical) into a vertical conduit section which penetrated the upper steel deck.

The three conduit assemblies were supported on a common trapeze type hanger formed from Unistrut P1000 channel. One end of the Unistrut hanger assembly was welded to the horizontal support for the cable tray systems and the other end was supported with a vertical section of Unistrut P1000 channel. The distance from the bottom of the conduits to the top of the support member measured 36 in.

A hole in the steel deck was provided around each penetrating raceway section. The perimeter of each hole was edged with 3 in. steel channel (flanges out). Each blockout was sealed with Dow Corning 3-6548 RTV silicone foam material (after installation of the fire barrier material onto the raceways). Internal seals were similarly constructed at all locations where a raceway exited the test furnace enclosure.

Drawings of the test items and supports are located in Appendix A: Construction Drawings.

ELECTRICAL CABLES

All electrical cables used in this project were obtained by the Laboratory. A mixture of power, control, and instrumentation cables was laid, in a single layer, into each of the two cable trays. The cable was salvaged from an assembly previously tested by Peak Seals, Inc. and was used for thermal mass in the trays. Sections of the cable runs were not contiguous but the levels of fill were uniformly maintained along the entire length of each tray. The conduit and air drop assemblies received no cable loading. The tables on the following page show, for each of the two cable trays used in this test, the number of each cable type present, the total cross-sectional area of each cable type, and the percent of the total available area taken up by each type.

Cable Loading Details - 24" Cable Tray*

Cable Type	Number present	Cross-Sectional Area (in^2)	% of Total Area	Total Weight (lbs/lin. ft.)
3C/#6	5	2.210	2.93	2.05
3C/#8	6	1.890	2.51	1.77
Total - Power Cables		**4.100**	**5.44**	**3.82**
7C/#12	6	1.740	2.31	1.75
5C/#12	6	1.698	2.25	1.29
Total - Control Cables		**3.438**	**4.56**	**3.04**
4 Shld. Tw.Pr. #16	11	3.564	4.72	2.95
Total - Instrument Cables		**3.564**	**4.72**	**2.95**
TOTAL =>		**11.102**	**14.72%**	**9.81**

Cable Loading Details - 6" Cable Tray*

Cable Type	Number present	Cross-Sectional Area (in^2)	% of Total Area	Total Weight (lbs/lin. ft.)
3C/#6	2	0.884	4.69	0.820
3C/#8	3	0.945	5.01	0.885
Total - Power Cables		**1.829**	**9.70**	**1.767**
7C/#12	2	0.580	3.08	0.584
5C/#12	1	0.283	1.50	0.215
Total - Control Cables		**0.863**	**4.58**	**0.799**
4 Shld. Tw.Pr. #16	3	0.972	5.15	0.804
Total - Instrument Cables		**0.972**	**5.15**	**0.804**
TOTAL =>		**3.664**	**19.43%**	**3.370**

* The fill depth of the cable tray used was 3.14 in. based on the specification given in the B-Line Cable Tray Catalog.

THERMOCOUPLE PLACEMENT

In order to monitor temperatures in the interior of the raceways, bare #8 AWG stranded copper wire was instrumented with 24 gauge, Type K, Chromel-Alumel electrically-welded thermocouples (Special Limits of Error: ±1.1°C, purchased with lot traceability and calibration certifications) placed nominally every 6 in. along the length of wire. The thermocouples were attached to the bare #8 AWG stranded copper wire by placing the thermojunction in direct contact with the top surface of the wire and crimping the junction to the copper wire with a copper Buchanan 2011S open-end splice cap fastened in place with a Buchanan C-24 "pres-SURE" tool. Wires instrumented as such were installed in the following locations: one on top of the cable bundles in each cable tray, one secured below the cable tray rungs in each cable tray and one pulled through each conduit and air drop assembly.

In order to get a realistic measurement of the temperatures on the cable tray side rails, conduit surfaces, and junction box surfaces, similar thermocouples were positioned nominally every 6 in. along the cable tray side rails and the bottom surface of the conduits, being held in position by clamping under the head of a #8 x 32 x 1/4 in. long stainless steel round-head machine screw in a drilled and threaded hole at each location. The thermocouple leads were run in the tray cavity where possible and were taped securely to the conduit at points away from the thermojunction by wrapping the tape completely around the conduit and thermocouple lead. Thermocouples were similarly attached in each square foot of junction box surface with additional thermocouples located within 1 in. of the conduit entry and exit points.

3M INTERAM™ MAT INSTALLATION HIGHLIGHTS

3M Interam™ Mat materials were installed in accordance with Peak Seals, Inc. design drawings and procedures. Application methods are presented in the Test Plan, contained in Appendix B.

TEST RESULTS

The completed test specimen was placed atop the Laboratory's large horizontal fire test furnace, on the Laboratory's facility at 16015 Shady Falls Rd., Elmendorf, Texas. The thermocouples were then connected to the data acquisition system and their outputs verified.

The test was conducted on November 28, 1995, by Herbert W. Stansberry II, Project Manager, with the following persons present:

Mike Jordan	-	Peak Seals, Inc.
Mike Murphy	-	Peak Seals, Inc.
Randy Brown	-	Peak Seals, Inc.
Ron Rispoli	-	Entergy
Ed Larkin	-	Construction Spec., Inc.
Wayne Guthrie	-	Construction Spec., Inc.
Deggary N. Priest	-	Omega Point Laboratories, Inc.
Kerry Hitchcock	-	Omega Point Laboratories, Inc.
Connie Humphrey	-	Omega Point Laboratories, Inc.
Cleda Patton	-	Omega Point Laboratories, Inc.
Laudencio Castanon	-	Omega Point Laboratories, Inc.
Oscar Estrada	-	Omega Point Laboratories, Inc.

The furnace was fired at 10:47 a.m. and the ASTM E119 standard time-temperature curve followed for a period of 180 minutes. The pressure differential between the laboratory surrounding the furnace and a point within the furnace level with the vertical midpoint of the exposed portion of the specimen was maintained at approximately 0.00 in. water column throughout the test. During the fire exposure, no visual openings into the raceway were observed. Other observations made during the test are as follows:

Time (min:sec)	**Observation**
0:00	Furnace fired at 10:47 a.m.
2:20	Spotty ignition of T-49 tape adhesive.
2:40	Blackening of the filament tape.
3:17	T-49 tape loosening from edges of raceway envelopes.
4:22	T-49 foil tape melting and falling from raceway envelopes.
12:12	Steam leakage from raceways above test deck. During the fire exposure, the leads of TC #334, #337 and #341 found to be reversed - repairs were made. TC #308 and #311 were unplugged for several minutes while correcting problems with the other thermocouples. TC #245 was found to be malfunctioning and was unplugged.
180:00	Test terminated; furnace extinguished.

At the end of the fire exposure period, the thermocouples were disconnected, the furnace extinguished and the specimen removed from the furnace. When the test item was removed from the furnace it was still flaming, which slowly decreased as it was positioned for the hose stream test. Prior to the hose stream test, the exposed surfaces of the test items were observed to be covered with a layer of white ash with all layers applied to the test specimens virtually intact. No openings were evident in the test assemblies.

The test specimen was suspended from an overhead crane and slowly spun (at approximately 6 to 8 revolutions per minute) while being exposed to a 30° angle 1-1/2 in. fog nozzle hose stream test with a minimum pressure at the nozzle of 75 psi at a distance of 5 feet, for a 5 minute duration. The minimum flow from the nozzle was 75 gpm. The hose stream was thus positioned to attack the sides, bottom and inside vertical surfaces of the test item, with only minimal exposure to the top surface. This exposure meets the intent of the hose stream application specified in USNRC GL 86-10, Supplement 1.

Following the hose stream test, the outermost layer of 3M material on the supports and the raceway assemblies had become dislodged by the water hose stream. An in-depth description of the condition of each protective envelope is presented later in this document.

The significant temperatures within the raceway systems at the end of the fire exposure test are presented in the table on the following page (shaded values indicate temperatures in excess of the allowable limits). An explanation of the allowable limits is given in the table on the following page.

LOCATION	MAX. INDIVIDUAL TEMP. (°F)	MAX. AVERAGE TEMP. (°F)
6" CABLE TRAY		
Front Tray Side Rail	433	384
Rear Tray Side Rail	437	387
Bare #8 Wire under Rungs	406	344
Bare #8 Wire on Cables	376	318
24" CABLE TRAY		
Front Tray Side Rail	412	371
Rear Tray Side Rail	419	369
Bare #8 Wire on Rungs	263	235
Bare #8 Wire on Cables	287	261
5" STEEL CONDUIT		
Conduit Surface	393	325
Bare #8 Wire in Conduit	373	259
3" STEEL CONDUIT		
Conduit Surface	452	413
Bare #8 Wire in Conduit	436	363
1" STEEL CONDUIT		
Conduit Surface	517	472
Bare #8 Wire in Conduit	507	461
2" CONDUIT AIR DROP		
Bare #8 Wire in Conduit	338	294
Conduit Stub	342	333
STEEL JUNCTION BOX	409	389

The average initial temperature for all thermocouples at the start of the test was 65°F, yielding an allowable temperature increase of 250°F, or 315°F actual for the average temperatures. (A 325°F increase above the 65°F initial temperature yields a maximum allowable individual temperature of 390°F, in accordance with ASTM E119-88.) The average and maximum temperatures on the bare #8 wire on the cables and beneath the rungs within the 24 in. wide cable tray system, on the bare #8 wire in the 2 in. air drop, on the bare #8 wire in the 5 in. conduit, and the

maximum temperature on the 2 in. air drop conduit stub, met the stated criteria for a fire endurance rating of three hour. The 6 in. wide cable tray system first exceeded the allowable criteria for average temperature increase (on the rear cable tray side rail) at 142 minutes. The 24 in. wide cable tray system first exceeded the allowable criteria for average temperature increase (on the front cable tray side rail) at 147 minutes. The 5 in. conduit system first exceeded the allowable criteria for average temperature increase (on the conduit surface) at 175 minutes. The 3 in. conduit system first exceeded the allowable criteria for average temperature increase (on the conduit surface) at 140 minutes. The 1 in. conduit system first exceeded the allowable criteria for average temperature increase (on the conduit surface) at 119 minutes. The 2 in. air drop conduit stub first exceeded the allowable criteria for average temperature increase (on the bare #8 wire) at 172 minutes. The junction box surface first exceeded the allowable criteria for average temperature increase at 146 minutes.

Post-Test Examination

Following the hose stream test and a cooling down period, the test items were systematically disassembled and examined for damage and general condition. A listing of those findings follows. In all cases, the layer number referenced is from the inside.

6 in. Cable Tray

The 5th (and outermost) layer of 3M material was mostly dislodged by the hose stream test. The 4th layer was also partially eroded from the water stream. The outer foil was mostly consumed and/or eroded. The 1st layer was completely intact and uncharred. The 2nd layer of material near the support area was partially discolored (due to heat) with approximately 1/4 in. of blue (unaffected) material. The remainder of the 2nd layer was intact but discolored (green). The 2nd layer of material in the radial areas was fully intact. The 3rd layer in both areas was mostly discolored (green) and partially charred. The foil in the inner three layers was completely intact. The FireDam™ caulk used in the three innermost layers was intact and undamaged. The cables within the raceway systems showed no signs of charring, swelling, blistering or cracking. The cable jackets were coated with an iridescent coating that could be wiped away easily indicating no permanent change in integrity.

24 in. Cable Tray

The 5th (and outermost) layer of 3M material was mostly dislodged by the hose stream test. The 4th layer was also partially eroded from the water stream. The outer foil was mostly consumed and/or eroded. The 1st layer was completely intact and uncharred. The 2nd layer of material both near the support area and in the radial areas was fully intact. The 3rd layer in both areas was mostly discolored (green) and partially charred. The foil in the inner three layers was completely intact. The FireDam™ caulk used in the three innermost layers was intact and undamaged. The cables within the raceway systems showed no signs of charring, swelling, blistering or cracking. The cable jackets were coated with an iridescent coating that could be wiped away easily indicating no permanent change in integrity.

2 in. Conduit Air Drop into 24 in. Cable Tray

The 5th (and outermost) layer of 3M material was mostly dislodged by the hose stream test. The 4th layer was also partially eroded from the water stream. The outer foil was mostly consumed and/or eroded. The 1st and 2nd layers were completely intact and uncharred. The 3rd layer of material near the support area was partially discolored with approximately 1/4 in. of unaffected (blue) material. The remainder of the 3rd layer was intact but discolored (green). The foil in the inner three layers was completely intact. The FireDam™ caulk used in the three innermost layers was intact and undamaged.

5 in. Conduit

The 5th (and outermost) layer of 3M material was mostly dislodged by the hose stream test. The 4th layer was also partially eroded from the water stream. The outer foil was mostly consumed and/or eroded. The 1st layer was completely intact and uncharred. The 2nd layer of material near the support area was partially discolored with approximately 1/4 in. of unaffected (blue) material. The remainder of the 2rd layer was intact but discolored (green). The 2nd layer of material in the radial and LB areas was fully intact. The 3rd layer in both areas was mostly discolored (green) and partially charred. The foil in the inner three layers was completely intact. The FireDam™ caulk used in the three innermost layers was intact and undamaged.

3 in. Conduit

The 5th (and outermost) layer of 3M material was mostly dislodged by the hose stream test. The 4th layer was also partially eroded from the water stream. The outer foil was mostly consumed and/or eroded. The 1st layer was completely intact and uncharred. The 2nd layer of material was partially discolored with 1/8 in. to 1/4 in. of unaffected (blue) material. The remainder of the 2nd layer was intact but discolored (green). The 3rd layer was mostly discolored (green) and partially charred. The foil in the inner three layers was completely intact. The FireDam™ caulk used in the three innermost layers was intact and undamaged.

Junction Box

The 5th (and outermost) layer of 3M material was mostly dislodged by the hose stream test. The 4th layer was also partially eroded from the water stream. The outer foil was mostly consumed and/or eroded. The 1st layer was completely intact and uncharred. The 2nd layer of material was partially discolored with 1/8 in. to 1/4 in. of unaffected (blue) material. The 3rd layer was mostly discolored (green) and partially charred. The foil in the inner three layers was completely intact. The FireDam™ caulk used in the three innermost layers was intact and undamaged.

1 in. Conduit

The 5th (and outermost) layer of 3M material was mostly dislodged by the hose stream test. The 4th layer was also partially eroded from the water stream. The outer foil was mostly consumed and/or eroded. The 1st layer was completely intact and uncharred. The 2nd layer of material was partially discolored with 1/8 in. of unaffected (blue) material. The remainder of the 2nd layer was intact but discolored (green). The 3rd layer was mostly discolored (green) and partially charred. The foil in the inner three layers was completely intact. The FireDam™ caulk used in the three innermost layers was intact and undamaged.

CONCLUSIONS

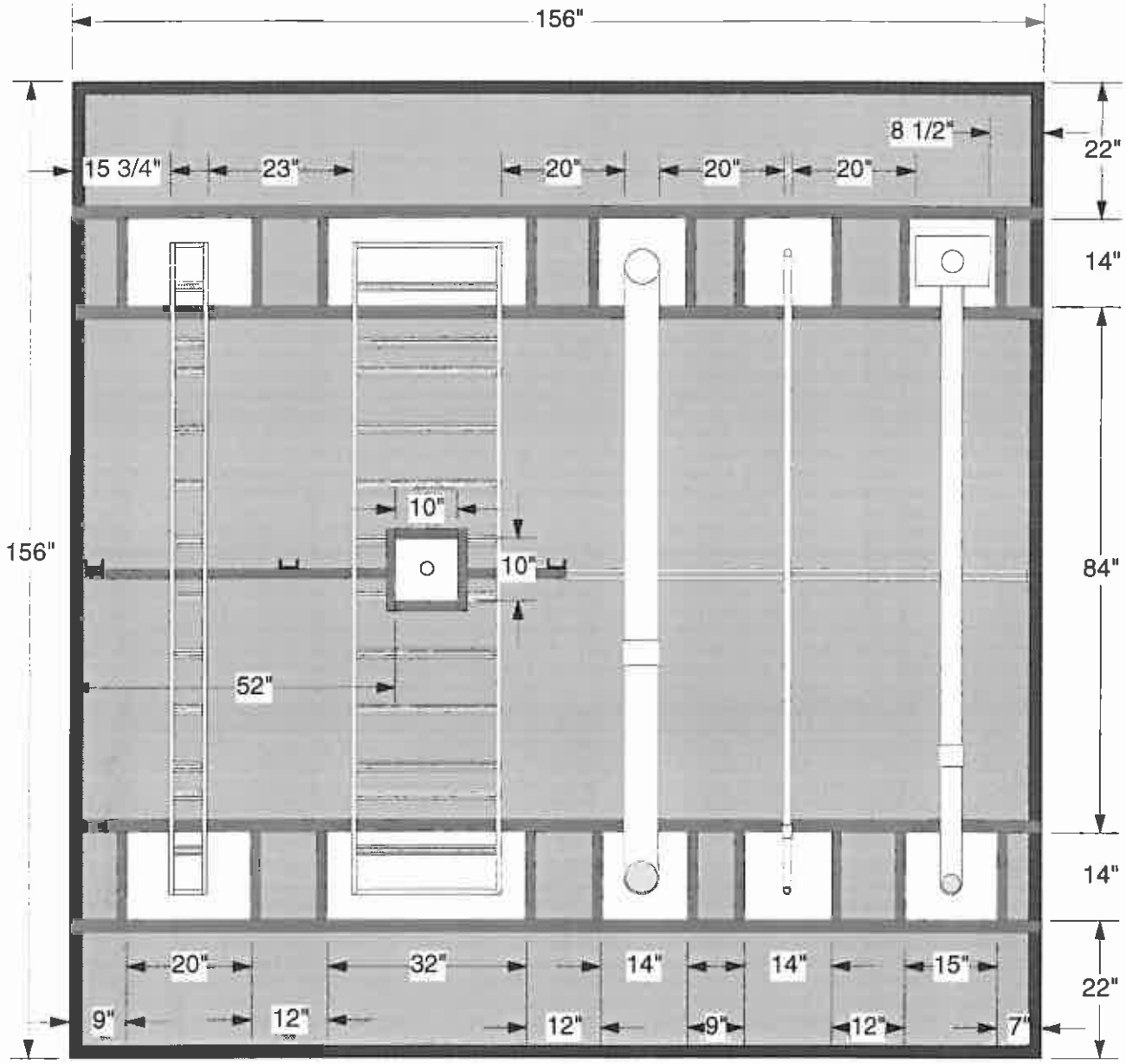
All of the raceway items evaluated in this fire exposure test, clad with 3M Interam™ Mat materials as presented herein, with the exception of the air drop between the 2 in. conduit stub and the 24 in. wide cable tray, failed to meet the requirements of the TEST PLAN for a fire resistance rating of three hours. The temperature increases on individual thermocouples and on the average of thermocouple sets were in excess of the allowable limits of 325°F (individual increase) and 250°F (average increase) in portions of each of the other raceway assemblies.

The table below outlines the fire endurance ratings, in minutes, achieved by the remaining raceway configurations:

Raceway Description	Fire Endurance Rating (min)
24 in. wide cable tray	146
2 in. diameter air drop	180
6 in. wide cable tray	141
3 in. diameter conduit	139
1 in. diameter conduit	118
5 in. diameter conduit	174
12x12x8 junction box	145

Appendix A

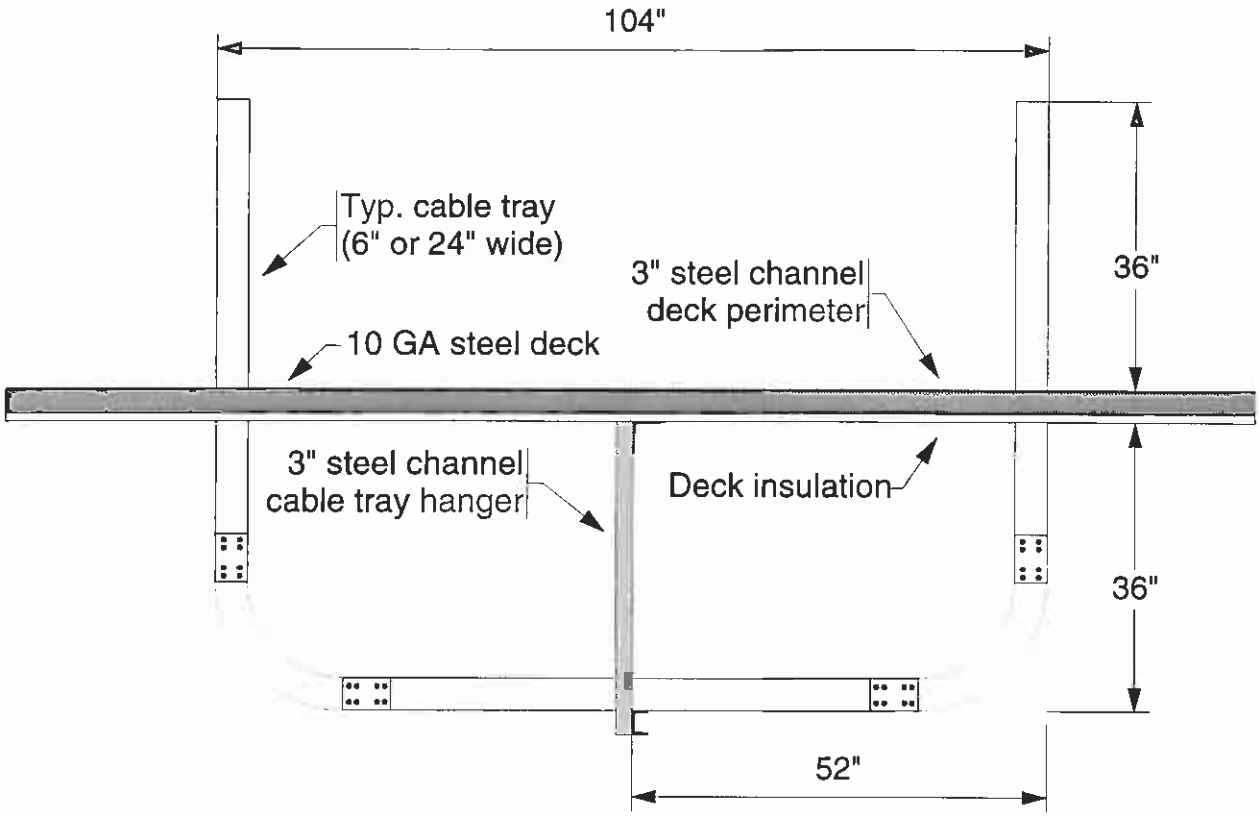
CONSTRUCTION DRAWINGS



NOTE:
A silicon foam firestop was installed into each penetration blockout prior to testing.

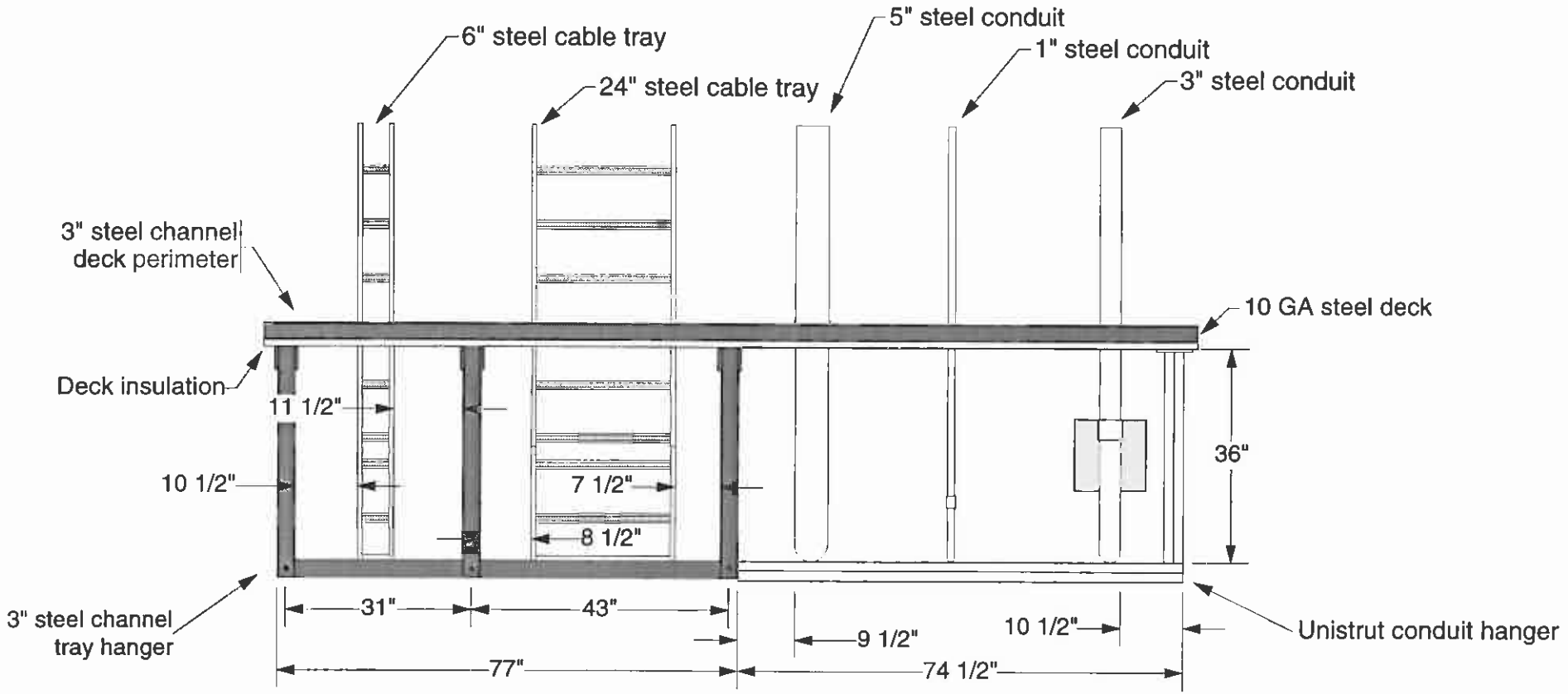
OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
PEAK SEALS, INC.
Fig. 1 Plan View - Raceway Layout, Rev.0

OMEGA POINT LABORATORIES

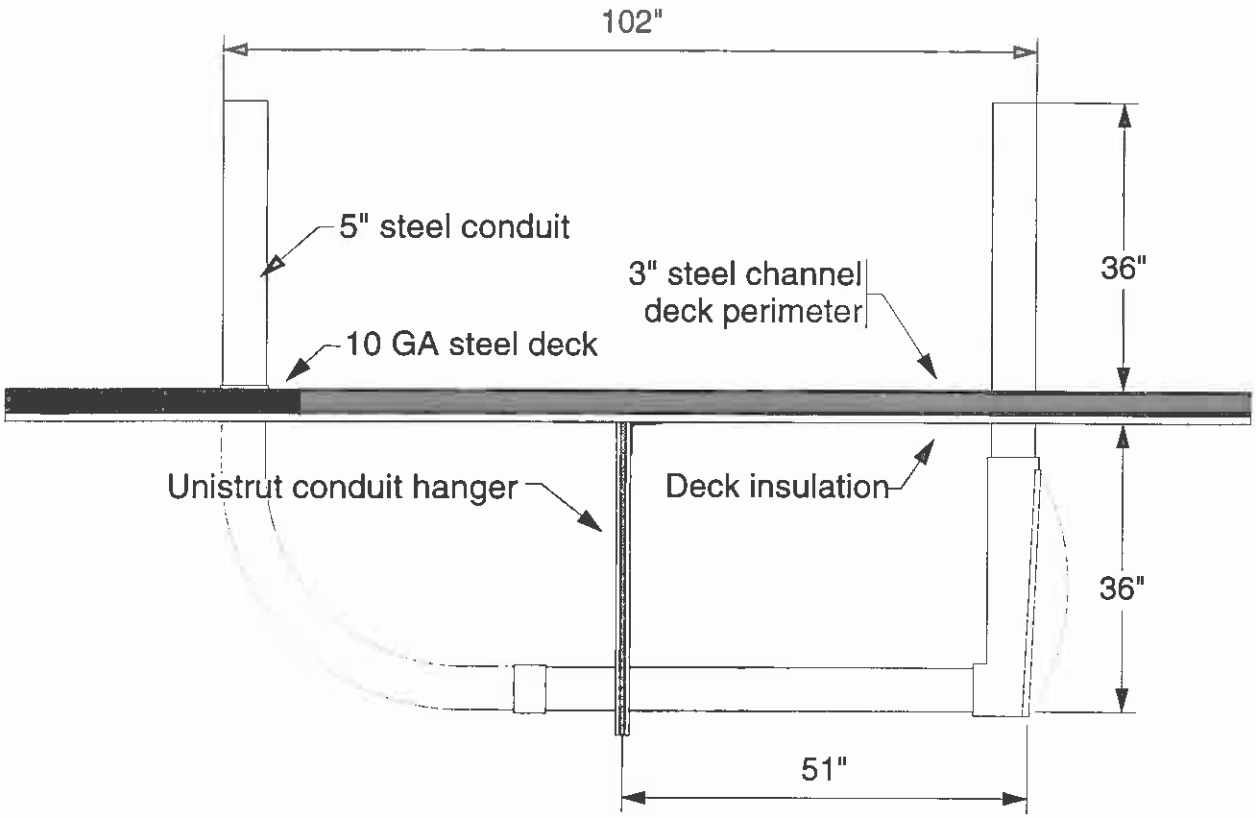


Note:
The cable tray raceways consisted of either 6" wide or 24" wide, by 4" deep, galvanized steel ladderback cable trays with a 9" o.c. rung spacing. The 90° inside bends had a bend radius of 12". No cable loading was present in the cable trays.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
PEAK SEALS, INC.
Fig. 3 Elevation View - Cable Trays, Rev. 0

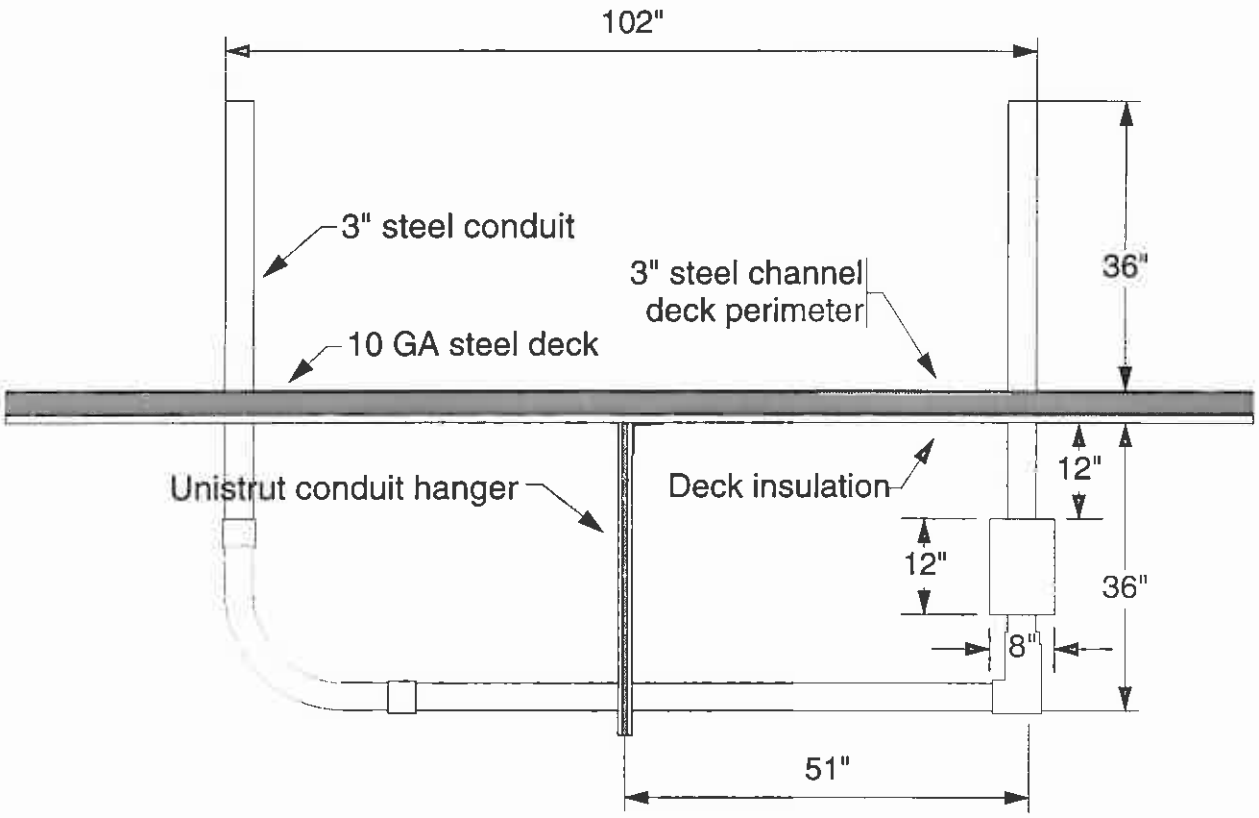


OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
PEAK SEALS, INC.
Fig. 2 End View - Raceway Layout, Rev.0



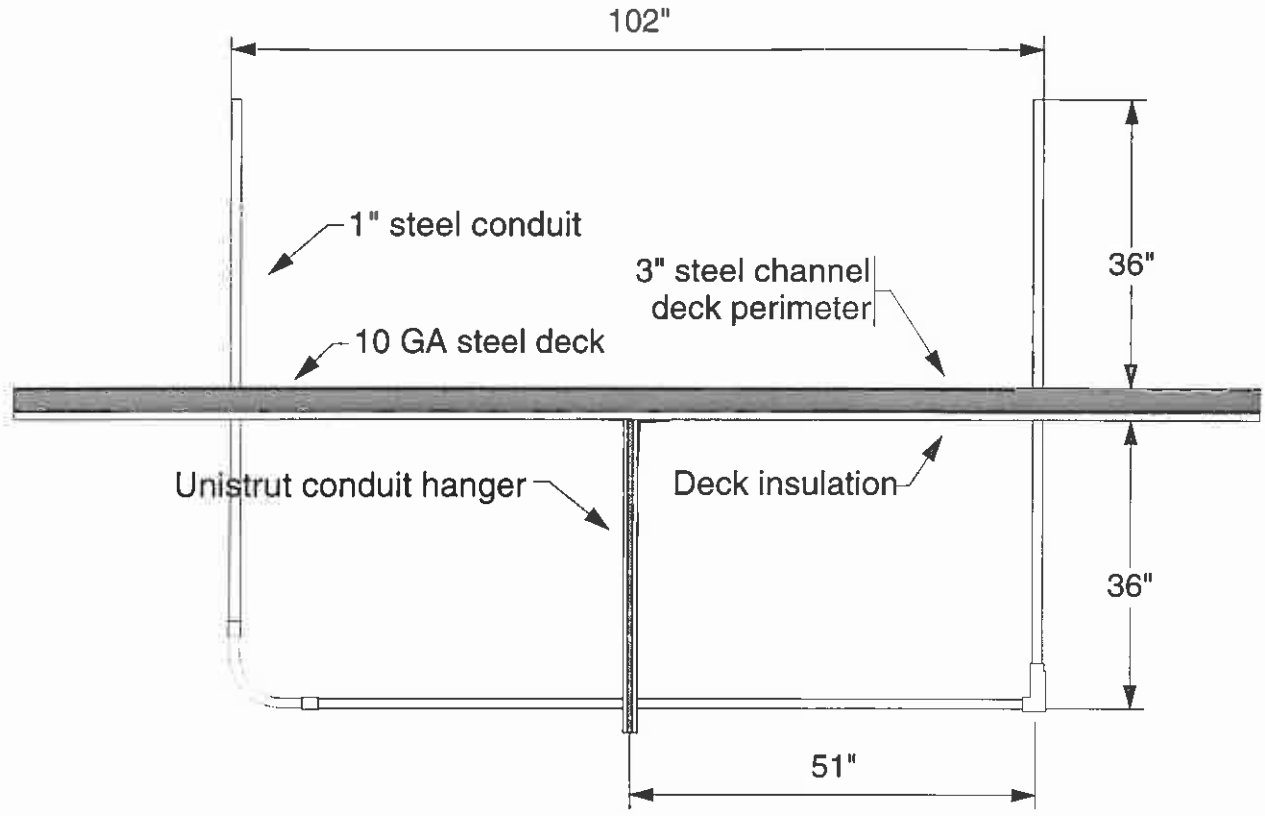
Note:
The 5" conduit raceway consisted of 5" diameter rigid galvanized steel conduit. The 90° elbow was a short radius bend and the condulet LB was cast iron. No cable loading was present in the conduit.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
PEAK SEALS, INC.
Fig. 4 Elevation View - 5" Conduit



Note:
The 3" conduit raceway consisted of 3" diameter rigid galvanized steel conduit. The 90° elbow was a short radius bend and the condulet LB was cast iron. The 12" x 12" x 8" junction box was installed above the LB, 12" below the deck insulation. No cable loading was present in the conduit.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
PEAK SEALS, INC.
Fig. 5 Elevation View - 3" Conduit



Note:
The 1" conduit raceway consisted of 1" diameter rigid galvanized steel conduit. The 90° elbow was a short radius bend and the condulet LB was cast iron. No cable loading was present in the conduit.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
PEAK SEALS, INC.
Fig. 6 Elevation View - 1" Conduit

Appendix B

TEST PLAN

PEAK SEALS INC.

TEST PLAN NO. CTP-2003

THREE(3) HOUR FIRE ENDURANCE TEST

3M INTERAM™ FIRE WRAP

Rev	Date	By	Approved	Issue Date	Comments
0	10/30/95	M. Murphy	L.C. Spriggs	10/30/95	Issue For Use
1	12/28/95	M. Murphy	L.C. Spriggs	12/28/95	General rewrite to reflect as built condition

TEST PLAN NO. CTP-2003

THREE(3) HOUR FIRE ENDURANCE TEST

3M INTERAM™ FIRE WRAP

1.0 PURPOSE

1.1 The purpose of this test is to qualify various configurations of 3M Interam™ E50 series fire wrap systems for a three hour rating in accordance with criteria established by the USNRC in Generic Letter GL-86-10, Supplement 1. This test will be performed and the results reported by a third-party test laboratory. The configurations to be tested are intended to qualify the following raceways and size ranges:

- Steel cable trays ranging in size from 6" - 24".
- Steel conduits ranging in size from 1" - 5".
- Steel condulet fittings ranging in size from 1" - 5".
- Steel junction boxes.
- Air drops.

1.2 In addition to formal qualification of the generic configurations and sizes described above, data derived from this test may be used as a basis for analyzing previous three hour fire endurance tests conducted by 3M prior to the issuance of GL-86-10, Supplement 1.

2.0 SCOPE

2.1 Test outline, including individual raceway configurations, sizes, applicable test standards, acceptance criteria, barrier wrap designs and reporting requirements.

2.2 Procedures for installation of 3M Interam™ fire wrap systems.

2.3 Procedures for quality verification of wrap installation, including material receipt and traceability, in-process inspection and final inspection.

2.4 Reporting and final test report requirements.

3.0 APPLICABLE DOCUMENTS

3.1 USNRC Generic Letter GL-86-10, Supplement 1, "Fire Endurance Test Acceptance Criteria For Fire Barrier Systems Used To Separate Redundant Safe Shutdown Trains Within The Same Fire Area".

3.2 ASTM E119-88, Standard Methods of Fire tests of Building Construction and Materials.

3.3 Promatec Quality Assurance Program Manual, Revision C, Dated March 28, 1994.

4.0 DEFINITIONS

4.1 Interam™ E50 series mat: Flexible endothermic wrap system manufactured by 3M Company for the separation and protection of redundant cables and equipment in nuclear power facilities (individual component and composite system descriptions are detailed in the body of this test plan).

4.2 Third-Party Testing Laboratory: A nationally recognized and independent testing organization capable of performing fire endurance and other tests for the purpose of qualifying systems and designs in accordance with governing codes and applicable standards.

4.3 Qualification Fire Test: A fire endurance test conducted at a third party test laboratory intended to provide objective and documentary evidence that the system tested meets the performance requirements of governing codes and standards.

4.4 Preliminary Test Report: A synopsis of the test, issued by the third-party test laboratory. Information reported includes test deck and raceway descriptions, observances made during the course of the test, thermocouple temperature data, basic drawings and sketches of the test assembly, hose stream results and preliminary conclusions.

4.5 Final Test Report: A detailed report issued by the third-party test laboratory that includes all relevant information applicable to the test including, but not limited to:

4.5.1 Detailed discussion on test purpose and scope.

4.5.2 Written description and drawings of raceway components used, configurations of the raceways and orientation of the test deck.

4.5.3 Specification of thermocouples and drawings showing the number and actual location of each thermocouple.

4.5.4 Furnace and test deck description.

4.5.5 Systems and applications methods observed and verified by the third-party quality assurance organization during installation.

4.5.6 Observances made on system behavior during the course of the fire and hose stream test.

4.5.7 Complete thermocouple data in tabular and graph form.

4.5.8 Complete quality assurance documentation of the overall test process, including material certifications, inspection reports and photographs.

4.5.9 Detailed discussion on the results and conclusions drawn from the fire and hose stream test.

4.5.10 Observances made on system condition after the course of the fire and hose stream test.

4.6 Longitudinal joint: A joint (or seam) which runs parallel to the item being protected.

4.7 Perimeter joint: A joint (or seam) which runs perpendicular to the item being protected.

4.8 Butt Joint: A joint (or seam) where the edges of two adjacent pieces of the same layer meet with no overlap.

4.9 Through Joint: A joint (or seam) where each layer terminates at the same location at a given butt joint.

4.10 Overlap Joint: A joint (or seam) where a piece of a given layer overlaps onto the same layer piece adjacent to it.

4.11 Offset Joint: A butt joint (or seam) that is staggered in its location from the butt joint occurring in the layer *above* or *below* it. (See also Through Joint).

4.12 Two Piece Wrap Method: An installation method whereby each layer is installed in two distinct pieces. (This method is normally employed for smaller diameter conduits at radial bends.)

4.13 Four piece Wrap Method: An installation method whereby each layer is installed in four distinct pieces. (This method is normally employed for larger diameter conduits and cable trays at radial bends.)

4.14 Circumference Wrap Method: An installation method whereby each layer of the mat is installed around the circumference or perimeter of the protected item in a continuous piece. At the longitudinal joint formed where the two edges of the mat meet an overlap is normally incorporated.

4.15 One Piece Corner Method: An installation method intended for a sharp transition (e.g. the horizontal to vertical transition at a condulet or corner of a support) whereby the transition is covered with a single piece of material. This type of pattern normally results in a longitudinal butt joint at the inside bend of the transition and a diagonal joint on each side of the item covered.

4.16 Two Piece Corner Method: An installation method intended for a sharp transition (e.g. the horizontal to vertical transition at a condulet or corner of a support) whereby the transition is covered with two distinct pieces. One piece is used for the horizontal portion, and the other is used for the vertical portion of the transition. The point at which the two pieces meet is mitered, forming the corner of the transition. This pattern normally results in a longitudinal overlap joint at the inside bend of the transition.

4.17 Collar: A strip of material of a minimum width which is utilized to cover final layer perimeter butt joints.

4.18 Cover Strip: A strip of material of a minimum width which is utilized to cover final layer butt joints which do not receive a collar.

4.19 Caulk: 3M Fire Dam-150

4.20 Tape: 3M T-49 Aluminum Tape

4.21 Strut: B-Line B72 galvanized steel channel 13/16" wide x 13/32" deep x 18 ga., .26 LB/ft.

5.0 RESPONSIBILITIES

5.1 **Peak Seals** shall be responsible for the following:

5.1.1 Supply of wrap system components, craft labor for wrap installation, and quality inspection of wrap installation activities.

5.1.2 Developing and issuing test plans that provide detailed information on the test purpose, items to be tested, wrap system designs to be used, installation procedures and quality control requirements.

5.1.3 Installation of fire barrier wrap systems in accordance with procedures and drawings provided in this test plan.

5.1.4 Inspection and documentation of material receipt, in-process installation and final verification in accordance with procedures provided with this test plan.

5.2 **The third-party test laboratory** shall be responsible for the following:

5.2.1 Supply of facilities, test deck, raceway components, thermocouples, wire, furnace, instrumentation, measuring equipment and technicians for construction and test activities.

5.2.2 Construction of the test deck and installation of raceways, penetration seals, cables and supports.

5.2.3 Installation and instrumenting of thermocouples in accordance with the requirements of Generic Letter GL-86-10, Supplement 1.

5.2.4 Quality Assurance monitoring and documentation during test deck assembly, thermocouple placement, wrap system installation, fire test performance, hose stream test and autopsy.

5.2.5 Actual performance of fire endurance and hose stream test.

5.2.6 Post-fire dissection and observances.

5.2.7 Preparation and issuance of preliminary and final test reports.

6.0 WRAP MATERIALS

Component	*Application*
Interam™ E54A Mat	Primary wrap system.
FireDam™ FD-150 Caulk	Filling gaps at seams and terminations.

T-49 Aluminum Foil Tape	Securing overlap joints, covering exposed mat and caulk at edges and seams.
1/2" Stainless Banding and Clips	Securement of final mat layer.

7.0 TEST ASSEMBLY

7.1 Test Deck

Horizontal steel deck constructed of 10 gauge sheet metal with 3" channel perimeter reinforcement. Approximate dimensions of 13' x 13'. Individual blockouts shall be constructed for each raceway penetration utilizing 3" channel framing . Insulate underside with approximately 4" thick ceramic fiber blanket.

7.2 Raceway Configurations

7.2.1 Cable Trays

- ***Article 1***: 24" wide x 4" deep steel ladder-back cable tray.
- ***Article 2***: 6" wide x 4" deep steel ladder-back cable tray.

Each tray is to be constructed in a standard U-shaped configuration with dimensions of 104" horizontal by 72" vertical (min. 36" exposed to the fire). Supports to be standard trapeze type constructed of 3" steel channel

A single AWG #8 stranded wire is to be routed along the centerline of the bottom tray rungs for the entire length. A second AWG #8 wire is to be installed on top of the cables.

7.2.2 Cable Loading

- ***Article 1***: 24" wide x 4" deep steel ladder-back cable tray:

Quantity	Cable Type
5	3C/#6
6	3C/#8
6	7C/#12
6	5C/#12
11	4 Shld. Tw. Pr.#16

- ***Article 2***: 6" wide x 4" deep steel ladder-back cable tray:

Quantity	Cable Type

2	3C/#6
3	3C/#8
2	7C/#12
1	5C/#12
3	4 Shld. Tw. Pr.#16

7.2.2 Conduits

- ***Article 3***: 1" std rigid steel conduit.
- ***Article 4***: 3" std rigid steel conduit.
- ***Article 5***: 5" std rigid steel conduit

Each conduit is to be in a U-Shaped configuration with nominal dimensions of 102" horizontal by 72" vertical (min. 36" exposed to the fire). 90° short radius elbows are to be used for the radius sweep on one end and LB condulets are to be used at the horizontal-to-vertical transition on the opposite end. Supports to be standard trapeze type constructed of P1001 Unistrut .

A single AWG #8 stranded wire is to be inserted the full length through each conduit for internal thermocouple placement.

7.2.3 Junction Box

- ***Article 6***: 12" x 12" x 8" steel junction box

The junction box is to be installed approximately 12" above the 3" LB along the vertical run.

7.2.4 Air Drop

- ***Article 7***: AWG bare #8 single stranded wire air drop

The air drop configuration will consist of a single bare #8 AWG wire installed in a 2" sleeve penetrating through the deck 12" to 15" off the center point of the 24" cable tray, and sufficiently away from the cable tray support. The wire is to drop vertically into the center of the cable tray, and be tied off to a cable tray rung. (Not to the support beneath the tray.)

7.3 **Wrap System Attributes**

7.3.1 Article 1 - 4" x 24" Cable tray

- Five (5) layers of Interam E54A @ 0.4" nominal thickness per layer.

- Total nominal thickness of system: 2"

7.3.2 Article 2 - 4" x 6" Cable Tray

- Five(5) layers of Interam E54A @ 0.4" nominal thickness per layer.
- Total nominal thickness of system: 2"

7.3.3 Article 3 - 1" Conduit

- Five (5) layers of Interam E54A @ 0.4" nominal thickness per layer.
- Total nominal thickness of system: 2.0"

7.3.4 Article 4 - 3" Conduit

- Five(5) layers of Interam E54A @ 0.4" nominal thickness per layer.
- Total nominal thickness of system: 2"

7.3.5 Article 5 - 5" Conduit

- Five (5) layers of Interam E54A @ 0.4" nominal thickness per layer.
- Total nominal thickness of system: 2"

7.3.6 Article 6 - 12" x 12" x 8" Junction Box

- Five (5) layers of Interam E54A @ 0.4" nominal thickness per layer.
- Total nominal thickness of system: 2.0"

7.3.7 Article 7 - Air Drop

- Five(5) layers of Interam E54A @ 0.4" nominal thickness per layer.
- Total nominal thickness of system: 2"

8.0 THERMOCOUPLE REQUIREMENTS

8.1 **Thermocouple Placement**

8.1.1 Cable trays

- Every 6" along the centerline of both side rails.
- Directly to the #8 wire installed along the centerline of the bottom rungs, at 6" intervals.
- Directly to the #8 wire installed along the outer top surface of the cables closest to the top and towards the center of the fire barrier material, at 6" intervals.
- Immediately adjacent to supports.

8.1.2 Conduits

- Every 6" along the bottom external surface of the conduit.
- Every 6" along the bare #8 wire inside the conduit.
- Immediately adjacent to supports.

8.1.3 Junction Box

- One thermocouple for every square foot of surface area with a minimum of one thermocouple geometrically centered on each inside surface .
- On the JB surface within 1" distance of the 3" conduit at both the point of entry and the point of exit.

8.1.4 Air Drop

- Along the #8 wire within 1" of the sleeve interface and conduit interface.
- Every 6" along the length of the #8 wire.

8.2 **Thermocouple Groups**

Temperature conditions on the unexposed surface of the fire barrier shall be determined by averaging all thermocouples measured in a specific group. Thermocouple groups are defined as follows:

8.2.1 Cable Trays

- Left side rail.
- Right side rail.
- #8 wire along bottom rungs.
- #8 wire along top of cables.

8.2.2 Conduit

- External conduit surface.
- #8 bare wire inside conduit.

8.2.3 Junction Box

- Average of all thermocouples

8.2.4 Air Drop

- Average of all thermocouples

9.0 INTERAM™ INSTALLATION PARAMETERS

9.1 Craft shall be indoctrinated and trained in accordance with the Peak Seals training program for Interam™. Training shall be documented in accordance with the Promatec Quality Assurance Program.

9.2 Install the wrap systems in accordance with guidelines established by the 3M "Installation Booklet Including Quality Assurance Guidelines and Typical

Drawings", Issue No. 5500-005, Dated 6/19/87. The following specific requirements apply regardless of options that may be allowed in the installation guide:

Note:

- Extend the wrap at least to the top of the 3" channel mounted to the top of the test deck.
- Butt joints are reasonably tight with gaps not exceeding 1/4".
- Gaps greater than 1/8" and up to 1/4" shall be caulked with FD-150.
- Each layer upon installation shall be numbered for layer identification.
- Exposed mat such as edges of collars and cover strips, longitudinal joints and terminations shall be covered on the final layer only with tape, *except* where collars are applied or where specifically noted otherwise. Where collars are used, tape shall be applied after collars are installed
- For primary items, (conduits ,cable trays, etc.) 1/2" x 0.020 stainless steel banding shall be installed 12" on center (+1" -0") (minimum one band per piece) and with in 1" of the edge of all collars. (Min. two bands required per collar.) and within 2" of all final layer butt joints and overlap joints where collars have not been applied. (Example: the transition from the 2" conduit to the junction box; edges of the one piece corners.)
- Supports shall be banded 12" on center (+1/2" -0") (minimum one band per piece) and within 2" of butt joints and terminations. Criss-cross banding shall applied around each conduit and cable tray at its intersection with the support

9.3 **24" x 4" CABLE TRAY**

9.3.1 5 layers of E-54-A shall be used.

9.3.2 Prior to installing the first layer of wrap material, install strut spanning the inside width just below the lip of the tray, on 12" centers (max.) and within 2" of first layer butt joints on both sides of each joint.

9.3.2.1 The strut shall be friction fit however, P-898 filament tape may be used to secure the strut when necessary.

VERTICAL & HORIZONTAL SECTIONS:

9.3.3 For the vertical and horizontal sections of this tray the material shall be applied using the circumference wrap method.

9.3.3.1 At the interface of the tray with the air drop the joint shall be caulked and taped at each layer. Gaps at this interface shall not exceed 1/4"

9.3.4 Each layer of the circumference wrap method shall have a 2" (-1/2" + 0") longitudinal overlap joint. These joints may occur at any point around the item.

9.3.5 Adjacent sections of the same layer shall be abutted (see butt joint definition) to one another resulting in 2" (-1/2" + 0") offset joints for subsequent layers applied, except at the transition to the radial bend from the vertical and horizontal portion of the tray run.

TRAY RADIUS:

9.3.5.1 The joint between the adjacent pieces at the transition from the horizontal tray run to the radial bend shall be an offset joint: (6" -1/2" + 0).

9.3.5.2 The joint between the adjacent pieces at the transition from the vertical tray run to the radial bend shall be perimeter through joints, and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.3.6 For the two radial bends, the material shall be applied using the four piece wrap method, using full width pieces where possible to avoid unnecessary joints.

9.3.6.1 The third and fourth pieces applied for each layer shall overlap the first and second pieces applied by the thickness of the mat, and shall be caulked with a nominal 1/4" bead and taped along this joint. *Except* for the last layer.

9.3.6.2 On the last layer, the first and second pieces applied shall be cut to a width necessary to cover the item ***plus an additional 3-1/2" to 4-1/2".***

9.3.6.3 The pieces above shall be centered over the item providing a 1-3/4" to 2-1/4" overlap onto the third and fourth sides.

9.3.6.4 The 1-3/4" to 2-1/4" overlap on each side may be "V" notched as necessary to permit the overlap portion to lay flat against the third and fourth sides, and shall be caulked with a nominal 1/4" bead and taped after installation.

9.3.6.5 The final layer third and fourth sides shall be installed covering the overlap described above, and shall be caulked with a nominal 1/4" bead and taped after installation.

9.3.6.6 Where joints occur on the *outside* radial bend, they shall also be an overlap joint, 6" (-1/2" + 0").

9.3.6.7 Where joints occur on the inside radial bend, they may abut.

9.3.7 4" wide collars shall be installed over all final layer butt joints.

9.3.7.1 Nominal 2" wide shim pieces shall be used under the collar at the transition from the four piece method to the circumference wrap method occurring at the radial bends of the tray where necessary to fill in gaps.

9.3.8 See notes at the beginning of this section.

9.4 6" x 4" CABLE TRAY

9.4.1 See notes at the beginning of this section.

9.4.2 5 layers of E-54 A shall be used.

VERTICAL & HORIZONTAL SECTIONS:

9.4.3 For the horizontal section of this tray the material shall be applied using the circumference wrap method.

9.4.4 Each layer of the circumference wrap method shall have a 2" (-1/2" + 0") longitudinal overlap joint. These joints may occur at any point around the item.

9.4.5 Adjacent sections of the same layer shall be abutted (see butt joint definition) to one another resulting in 2" (-1/2" + 0") offset joints for subsequent layers applied, except at the transition to the radial bend from the vertical and horizontal portion of the tray run.

TRAY RADIUS:

9.4.5.1 The joint between the adjacent pieces at the transition from the horizontal tray run to the radial bend shall be an offset joint: (6" -1/2" + 0).

9.4.5.2 Transitions to the radial bend from the vertical portions of the tray run shall be perimeter through joints, and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.4.6 For the two radial bends and the vertical section of the tray, the material shall be applied using the four piece wrap method.

9.4.6.1 The third and fourth pieces applied for each layer shall overlap the first and second pieces applied by the thickness of the mat, and shall be caulked with a nominal 1/4" bead and taped along this joint. *Except* for the last layer.

9.4.6.2 On the last layer, the first and second pieces applied shall be cut to a width necessary to cover the item ***plus an additional 3-1/2" to 4-1/2".***

9.4.6.3 The pieces above shall be centered over the item providing a 1-3/4" to 2-1/4" overlap onto the third and fourth sides.

9.4.6.4 The 1-3/4" to 2-1/4" overlap on each side may be "V" notched as necessary to permit the overlap portion to lay flat against the third and fourth sides, and shall be caulked with a nominal 1/4" bead and taped after installation.

9.4.6.5 The final layer third and fourth sides shall be installed covering the overlap described above, and shall be caulked with a nominal 1/4" bead and taped after installation.

9.4.7 4" wide collars shall be installed over all final layer butt joints.

9.4.7.1 Nominal 2" wide shim pieces shall be used under the collar at the transition from the four piece method to the circumference wrap method occurring at the radial bends of the tray where necessary to fill in gaps.

9.4.8 See notes at the beginning of this section.

9.5 1" CONDUIT

9.5.1 See notes at the beginning of this section.

9.5.2 5 layers of E-54A shall be used.

VERTICAL & HORIZONTAL SECTIONS:

9.5.3 For the vertical and horizontal sections of this conduit the material shall be applied using the circumference wrap method.

9.5.4 Each layer of the circumference wrap method shall have a 2" (-1/2" + 0") longitudinal overlap joint. These joints may occur at any point around the item.

9.5.5 Adjacent sections of the same layer shall be abutted (see butt joint definition) to one another resulting in 2" (-1/2" + 0") offset joints for subsequent layers applied, except at the transition to the radial bend and condulet from the vertical and horizontal portion of the conduit run.

CONDUIT RADIUS:

9.5.5.1 Transitions to the radial bend and condulet from the horizontal and vertical portions of the conduit run shall be perimeter through joints, and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.5.6 For the radial bend of the conduit run, the material shall be applied using the two piece wrap method.

9.5.6.1 The edges of the two pieces shall meet forming a longitudinal through joint and shall be caulked with a nominal 1/4" bead and taped at each layer.

CONDULET:

9.5.7 For the condulet end of the conduit run shall be treated as follows:

9.5.7.1 All layers shall be installed using the two piece corner method, and shall be caulked at the miter joint.

9.5.7.2 The first layer joint at both the vertical and horizontal transition to the conduit shall be a butt joint.

9.5.7.4 The second layer applied to the condulet shall overlap onto the first layer applied to the *conduit* by 2" (-1/2" + 0") in both the vertical and horizontal directions.

9.5.7.5 The third, fourth and fifth layers applied to the condulet shall overlap onto the second layer applied to the *conduit* by 2" (-1/2" + 0") in both the vertical and horizontal directions.

9.5.8 4" wide collars shall be installed over all final layer perimeter butt joints.

9.5.9 2" wide cover strips shall be applied centrally over all final layer butt joints which do not receive a collar.

9.5.10 See notes at the beginning of this section.

9.6 3" CONDUIT

9.6.1 See notes at the beginning of this section.

9.6.2 5 layers of E-54 A shall be used.

VERTICAL & HORIZONTAL SECTIONS:

9.6.3 For the vertical and horizontal sections of this tray the material shall be applied using the circumference wrap method.

9.6.4 Each layer of the circumference wrap method shall have a 2" (-1/2" + 0") longitudinal overlap joint. These joints may occur at any point around the item.

9.6.5 Adjacent sections of the same layer shall be abutted (see butt joint definition) to one another resulting in 2" (-1/2" + 0") offset joints for subsequent layers applied, *except* at the transition to the radial bend and the condulet from the vertical and horizontal portion of the conduit run.

COUPLING:

9.6.6 The first layer applied to the conduit shall abut to the coupling on each side. (The coupling shall not be covered as part of the first layer applied to the conduit.)

9.6.7 The remaining layers applied to the conduit shall cover the coupling

9.6.7.1 These layers shall be marked to indicate the location of the coupling.

9.6.8 An additional piece shall be applied to the conduit for the area over the coupling providing fifth layer coverage for the coupling.

9.6.8.1 This piece shall be cut to provide for a 2" (-1/2" + 0") overlap onto the adjacent fifth layer pieces applied to the conduit, and shall have a 2" (-1/2" + 0") longitudinal overlap joint.

CONDULET:

9.6.9 For the condulet portion of the conduit run the material shall be applied using the one piece corner method.

9.6.9.1 The resulting diagonal and longitudinal joint shall be caulked with a nominal 1/4" bead and taped each layer.

9.6.9.2 Transition to the condulet from the horizontal portion of the conduit run shall be a through joint, for the first two layers and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.6.9.2.1 The final layer transition to the condulet from the horizontal portion of the conduit run shall be a 2" (-1/2" + 0") perimeter overlap joint from the condulet onto the horizontal portion of the conduit.

9.6.9.3 Transition to the condulet from the vertical portion of the conduit run shall be a through joint, and shall be caulked with a nominal 1/4" bead and taped at each layer.

CONDUIT RADIUS:

9.6.10 For the radial bend of the conduit run, the material shall be applied using the two piece wrap method.

9.6.10.1 The edges of the two pieces shall meet forming a longitudinal butt joint and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.6.10.2 The longitudinal joint may be offset 0^0 to 90° for each subsequent layer applied.

9.6.10.3 Transitions to the radial bend from the horizontal and vertical portions of the conduit run shall be through joints, and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.6.11 4" wide collars shall be installed over all final layer perimeter butt joints.

9.6.12 2" wide cover strips shall be installed over all final layer butt joints which do not receive a collar.

9.6.13 See notes at the beginning of this section.

9.7 5" CONDUIT

9.7.1 See notes at the beginning of this section.

9.7.2 5 layers of E-54 A shall be used.

VERTICAL & HORIZONTAL SECTIONS:

9.7.3 For the vertical and horizontal sections of this conduit the material shall be applied using the circumference wrap method

9.7.4 Each layer of the circumference wrap method shall have a 2" (-1/2" + 0") longitudinal overlap joint. These joints may occur at any point around the item.

9.7.5 Adjacent sections of the same layer shall be abutted (see butt joint definition) to one another resulting in 2" (-1/2" + 0") offset joints for subsequent layers applied, *except* at the transition to the radial bend and condulet from the vertical and horizontal portion of the conduit run..

COUPLING:

9.7.6 The first layer applied to the conduit shall abut to the coupling on each side. (The coupling shall not be covered as part of the first layer applied to the conduit.)

9.7.7 The second and third layers applied to the conduit shall cover the coupling

9.7.7.1 These layers shall be marked to indicate the location of the coupling.

9.7.8 An additional piece shall be applied to the conduit for the area over the coupling providing third layer coverage for the coupling.

9.7.8.1 This piece shall be cut to provide for a 2" (-1/2" + 0") overlap onto the adjacent third layer pieces applied to the conduit, and shall have a 2" (-1/2" + 0") longitudinal overlap joint.

CONDULET:

9.7.9 The joint between the adjacent pieces at the transition from the vertical and horizontal conduit run to the condulet shall be perimeter through joints, and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.7.10 For the condulet, the material shall be cut to fit as necessary, using pieces as large as possible to minimize the number of joints.

9.7.10.1 Pieces of E-54A may be used as shims between fastening lugs on each side of the condulet to provide a more even surface for application of the mat

9.7.10.2 The horizontal to vertical transition of the condulet shall be covered with the one piece corner method.

9.7.10.3 Adjacent sections of the same layer shall be abutted, resulting either through joints or joints which are slightly offset.

CONDUIT RADIUS:

9.7.11 The joint between the adjacent pieces at the transition from the vertical and horizontal conduit run to the radial bend shall be perimeter through joints, and shall be caulked with a nominal 1/4" bead and taped at each layer.

9.7.12 For the radial bend, the material shall be applied using the four piece wrap method,

9.7.12.1 The third and fourth pieces applied for each layer shall overlap the first and second pieces applied by 1" (-1/4" + 0").

9.7.13 4" wide collars shall be installed over all final layer perimeter butt joints.

9.7.14 2" wide cover strips shall be applied centrally over all final layer butt joints which do not receive a collar.

9.7.15 See notes at the beginning of this section.

9.8 JUNCTION BOX

9.8.1 See notes at the beginning of this section.

9.8.2 5 layers of E-54 A shall be used.

9.8.3 The first four layers of the mat shall be applied using the four piece wrap method.

9.8.3.1 The third and fourth pieces, for each layer applied to the sides of the box, shall overlap the first and second pieces applied by the thickness of the mat.

9.8.3.2 Top and bottom pieces shall overlap the side pieces applied by the thickness of the mat.

9.8.3.2.1 A cut may be made in each top and bottom piece to permit its installation around the conduit, and shall be caulked with a nominal 1/4" bead along the seam and around the conduit for each layer.

9.8.3.2.2 This joint may abut however, shall not be a through joint; (The joint shall alternate for each layer a minimum of 90^0.)

9.8.3.3 Each joint shall be caulked with a nominal 1/4" bead and taped. *Except* for the final layer.

9.8.4 The final layer (fifth), for the sides of the box, the material shall be applied using the circumference wrap method, with a 2" (-1/2" + 0") longitudinal overlap joint.

9.8.5 The final layer (fifth), for the top and bottom pieces shall be cut a width and length necessary to cover the item, ***plus an additional 6"***

9.8.5.1 The pieces above shall be centered over the top and bottom of the item providing a 3" (-1/2" + 0") overlap onto the sides.

9.8.5.2 The overlap shall be banded with 1/2" x 0.020 stainless steel banding within 1" of the edge.

9.8.6 Two 1/2" x 0.020 stainless steel bands shall be installed on each side of the box on either side of the conduit.

9.8.7 See notes at the beginning of this section.

9.9 AIR DROP

9.9.1 See notes at the beginning of this section.

9.9.2 The application of the mat to the air drop shall be completed prior to the application of mat to the tray.

9.9.3 5 layers of E-54A shall be used.

9.9.4 The material shall be applied to the air drop using the circumference wrap method.

9.9.5 Each layer of the circumference wrap method shall have a 2" (-1/2" + 0") longitudinal overlap joint. These joints may occur at any point around the item.

9.9.6 The mat covering the air drop shall extend into the tray as far as possible, however shall not be less than flush with the bottom of the innermost layer applied around the tray.

9.9.7 A strut shall be installed spanning the inside width of the tray just below the lip of the tray, within 6"of the air drop on both sides after the final layer has been applied to the air drop.

9.9.7.1 The strut shall be friction fit however, P-898 filament may be used to secure the strut when necessary.

9.9.8 A double layer 4" (-1/2" + 0") wide collar shall be applied around the air drop at the interface of the airdrop and the final layer applied around the tray. The joint at the interface of the collar and the final layer applied around the tray shall be caulked with a nominal 1/4" bead.

9.10 CONDUIT & CABLE TRAY SUPPORT

9.10.1 See notes at the beginning of this section.

9.10.2 The application of the mat to the protected items (conduit or cable tray) shall be completed prior to the application of mat to the support.

9.10.3 At the junction of the conduits and the support, under the conduit strap, the area shall be filled as completely as possible with caulk.

9.10.4 For supports constructed of channel, the channel shall be filled with pieces of mat prior to application of the wrap to facilitate installation.

9.10.5 Unistrut shall be filled with ceramic fiber in the area where the wrap will be applied, and the end sealed with 5 layers of mat cut to fit inside the Unistrut channel.

9.10.6 5 layers of E-54A shall be used.

9.10.7 The material shall be applied using the four piece wrap method for all layers of the support constructed of channel (cable tray section)

9.10.8 For the conduit portion of the support the third and fourth *pieces* applied shall overlap the first and second *pieces* applied by the thickness of the mat for each *layer* installed *except* the final layer.

9.10.8.1 On the final layer, the first and second pieces applied shall be cut to a width necessary to cover the item ***plus an additional 3-1/2" to 4-1/2".***

9.10.8.2 The pieces above shall be centered over the item providing a 1-3/4" to 2-1/4" overlap onto the third and fourth sides.

9.10.8.3 The final layer third and fourth sides shall be installed covering the overlap described above, and shall be caulked with a nominal 1/4" bead and taped after installation.

9.10.9 The joint for adjacent pieces of the same layer shall be a butt joint providing for an offset joint (2" -1/2" +0") for subsequent layers installed except at the interface of the conduit portion of the support with the cable tray portion of the support where the two different wrapping methods meet which shall be a through joint and will not receive a collar.

9.10.10 The material shall cover the support to a distance 12" away from the protected item in each direction from the item as measured from the point of contact with the support.

9.10.11 See notes at the beginning of this section.

10.0 INTERAM™ SYSTEM INSPECTION CRITERIA

10.1 Prior to use, receipt inspect all materials in accordance with procedure no. QCP-0050, "Receiving, Handling, and Storage Inspection".

10.2 On 24" trays, verify that strut (maximum of 12" intervals and within 2" of first layer butt joints) has been installed.

10.3 During wrap installation, verify the following attributes:

10.3.1 Each section installed with the circumference wrap method has a 2" (-1/2" + 0") longitudinal overlap joint.

10.3.2 Each section installed with the four piece method has the necessary overlaps. (The thickness of the mat or 1" whichever is applicable.)

10.3.3 Butt joints are reasonably tight with gaps not exceeding 1/4".

10.3.4 Gaps greater than 1/8" and up to 1/4" are filled with caulk prior to installing the next layer.

10.3.5 Correct layer count for each item.

10.3.6 Support wrap has been applied in accordance with the installation instructions in the above sections.

10.3.7 Exposed mat, such as edges of collars and cover strips, longitudinal joints and terminations, has been covered with tape on the final layer only, except where specifically noted otherwise.

10.3.8 4" collars are installed around all final layer perimeter butt joints, and cover strips have been installed over all other final layer butt joints.

10.3.9 For primary items (conduits ,cable trays, etc.) 1/2" x 0.020 stainless steel banding has been installed 12" on center (+1/2" -0")(minimum one band per piece) and within 1" of the edge of all collars (min. two bands required per collar.

10.3.10 For supports 1/2" x 0.020 stainless steel banding has been installed 12" on center (+1/2" -0")(minimum one band per piece)and within 2" of butt joints and terminations. Criss-cross banding shall applied around each conduit and cable tray at its intersection with the support

10.4 Upon completion of all wrap installation and prior to the pouring of penetration seals, perform a final visual inspection of the system. Verify that wrap is securely installed and all bands are tight. Verify that there is no exposed mat. Where mat is exposed it shall be covered with T-49 tape.

11.0 TEST PERFORMANCE

11.1 Fire Endurance Test

11.1.1 The prepared test assembly shall be exposed to a one hour fire endurance test in a horizontal furnace based upon the standard ASTM E 119 time-temperature curve. Temperatures shall be measured and recorded at one minute intervals.

11.1.2 Upon completion of the one hour duration, the test assembly shall be immediately exposed to a hose stream test by randomly spraying all exposed surfaces utilizing a 1½" fog nozzle set at a discharge angle of 30° with a nozzle pressure of 75 psi and a minimum discharge of 75 gpm. The distance between the nozzle and specimen shall be a maximum of five feet and the total duration five minutes.

11.2 Acceptance Criteria

The testing organization shall assess the performance of the test assembly based upon the following pass criteria:

11.2.1 The average temperature rise recorded for each thermocouple group shall not exceed 250°F above the initial temperature.

11.2.2 The temperature rise recorded for any individual thermocouple shall not exceed the 250°F limit by more than 30%.

11.2.3 The wrap system remained intact during the fire exposure and hose stream tests without developing any openings through which the protected component, or raceway, is visible.

11.3 In the event that any of the above criteria are exceeded, further evaluation may be required to determine the acceptability of the wrap designs.(e.g., air oven tests) If necessary, such additional evaluations will be determined and specified at the conclusion of the fire/hose stream test.

11.4 Final Report

11.4.1 Results shall be documented in a Final Test Report. This Final Report shall contain:

a) Applicable Corporate Test Procedure

b) Quality Control documentation, as applicable

c) Summation of Test Results

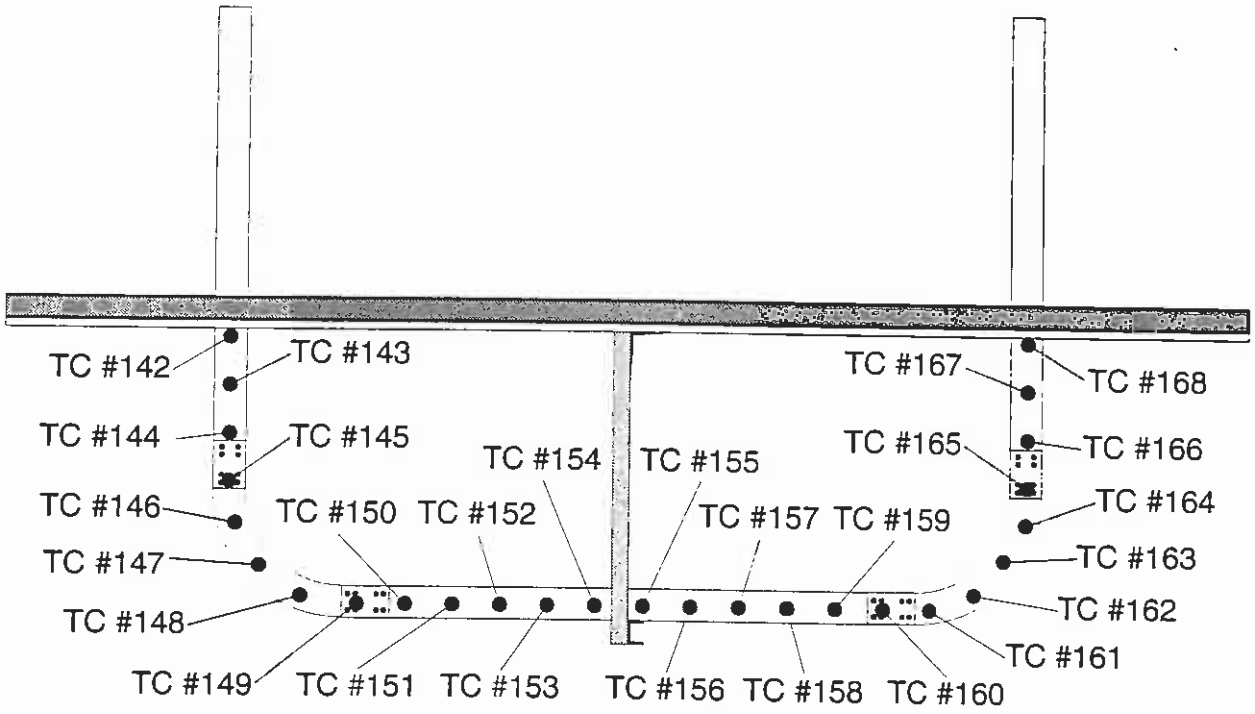
d) Test report as supplied by Third Party Testing organization.

12.0 ATTACHMENTS

12.1 None.

Appendix C

THERMOCOUPLE LOCATIONS

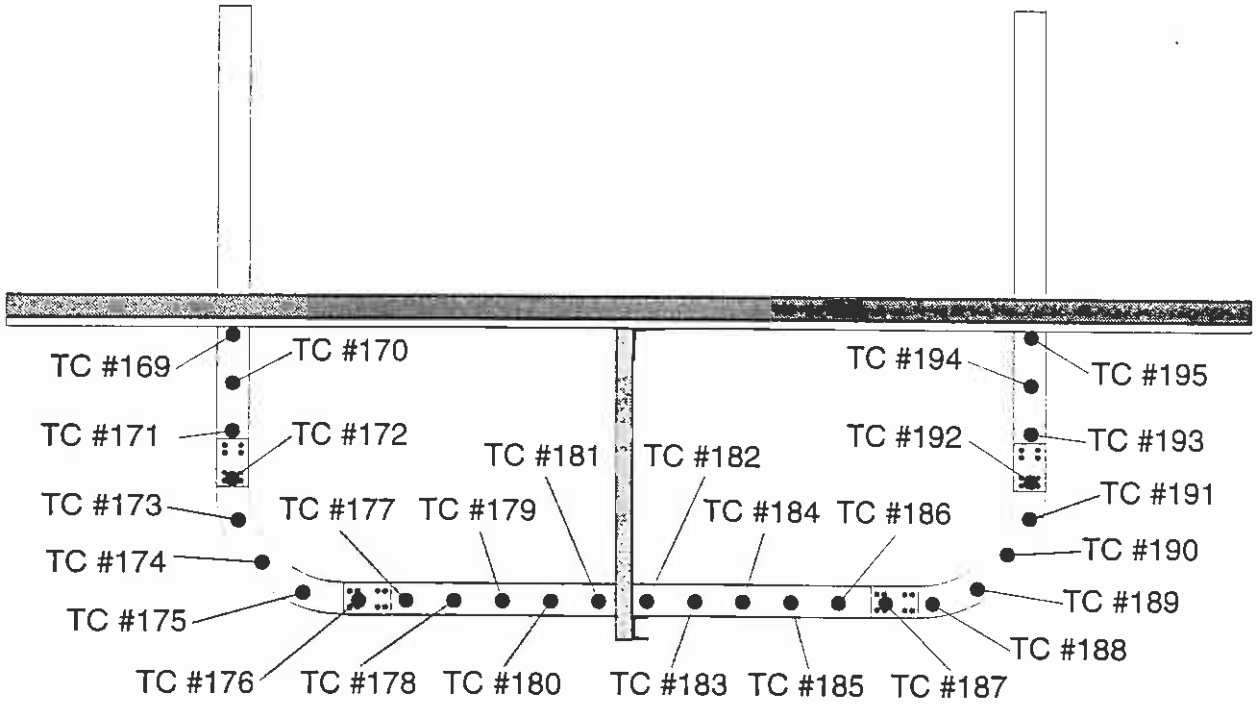


ELEVATION VIEW - VIEWED FROM FRONT

Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the cable tray side rails on 6" intervals. The thermojunctions were fastened under the heads of screws threaded into the metal side rail, at the vertical mid-height of the tray rails.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 7 Thermocouple Locations - 6" Cable Tray, Rear Tray Rail

OMEGA POINT LABORATORIES

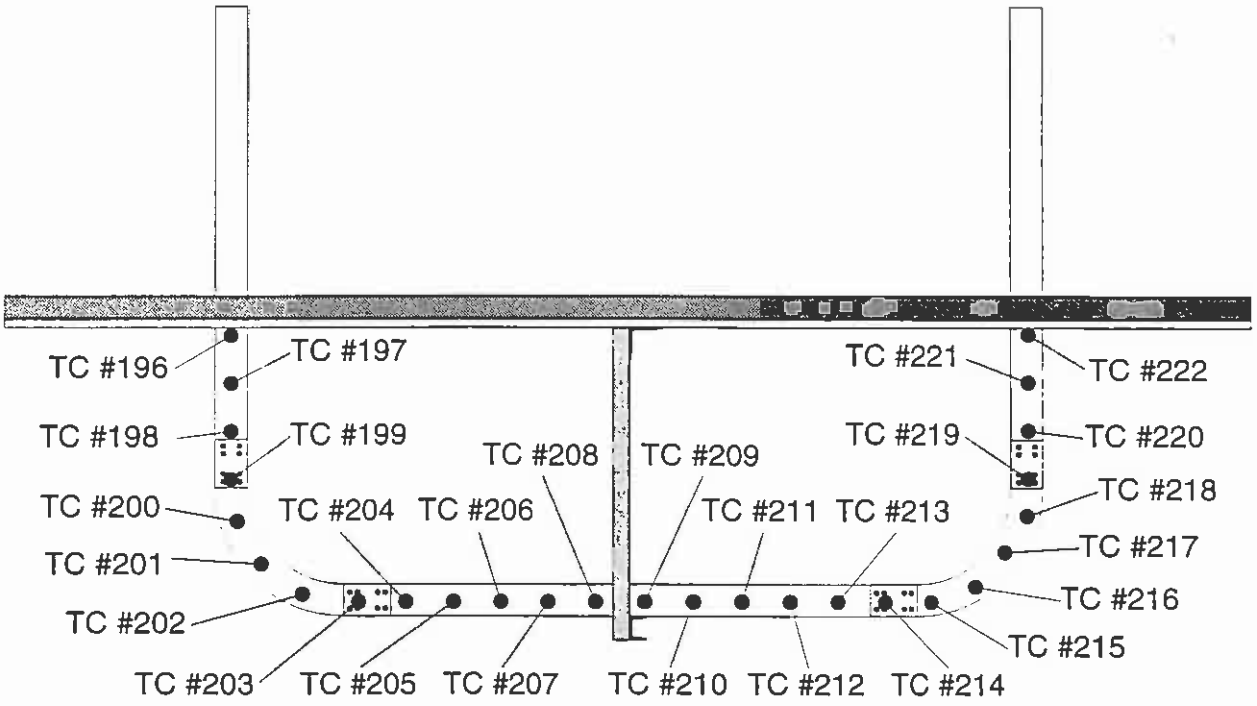


ELEVATION VIEW - VIEWED FROM FRONT

Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the cable tray side rails on 6" intervals. The thermojunctions were fastened under the heads of screws threaded into the metal side rail, at the vertical mid-height of the tray rails.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 8 Thermocouple Locations - 6" Cable Tray, Front Tray Rail

OMEGA POINT LABORATORIES

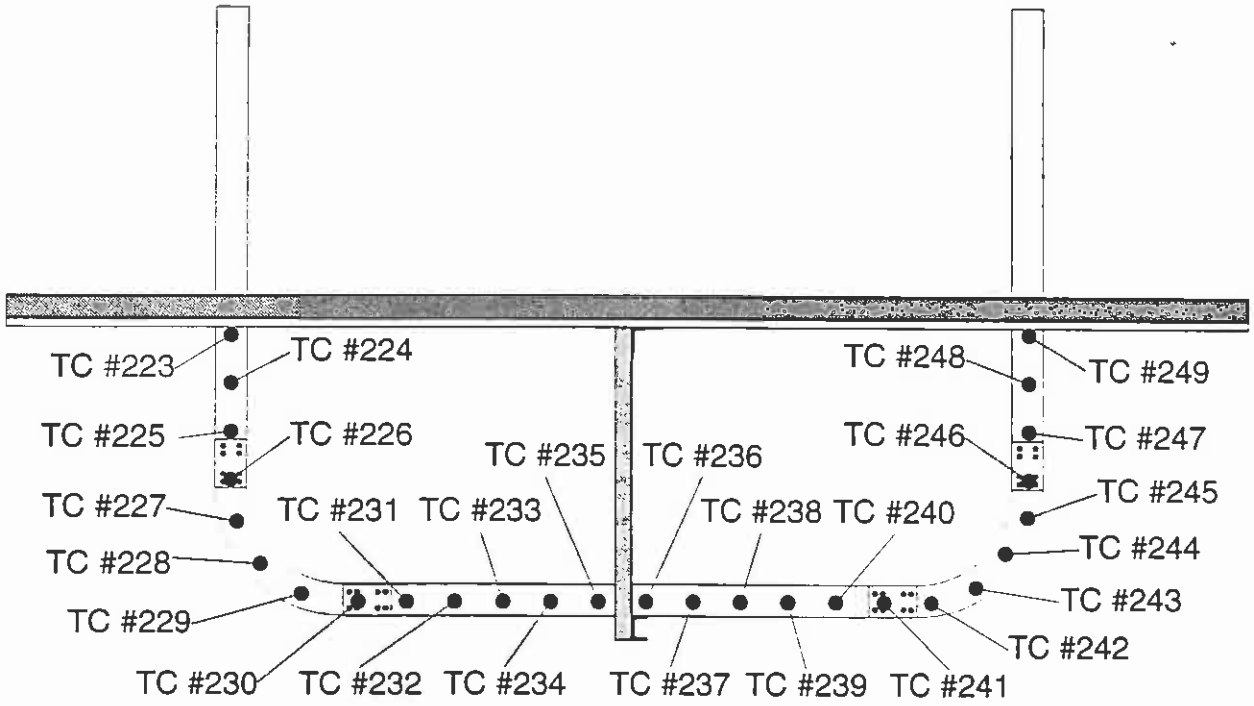


ELEVATION VIEW - VIEWED FROM FRONT

Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the cable tray side rails on 6" intervals. The thermojunctions were fastened under the heads of screws threaded into the metal side rail, at the vertical mid-height of the tray rails.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 9 Thermocouple Locations - 24" Cable Tray, Rear Tray Rail

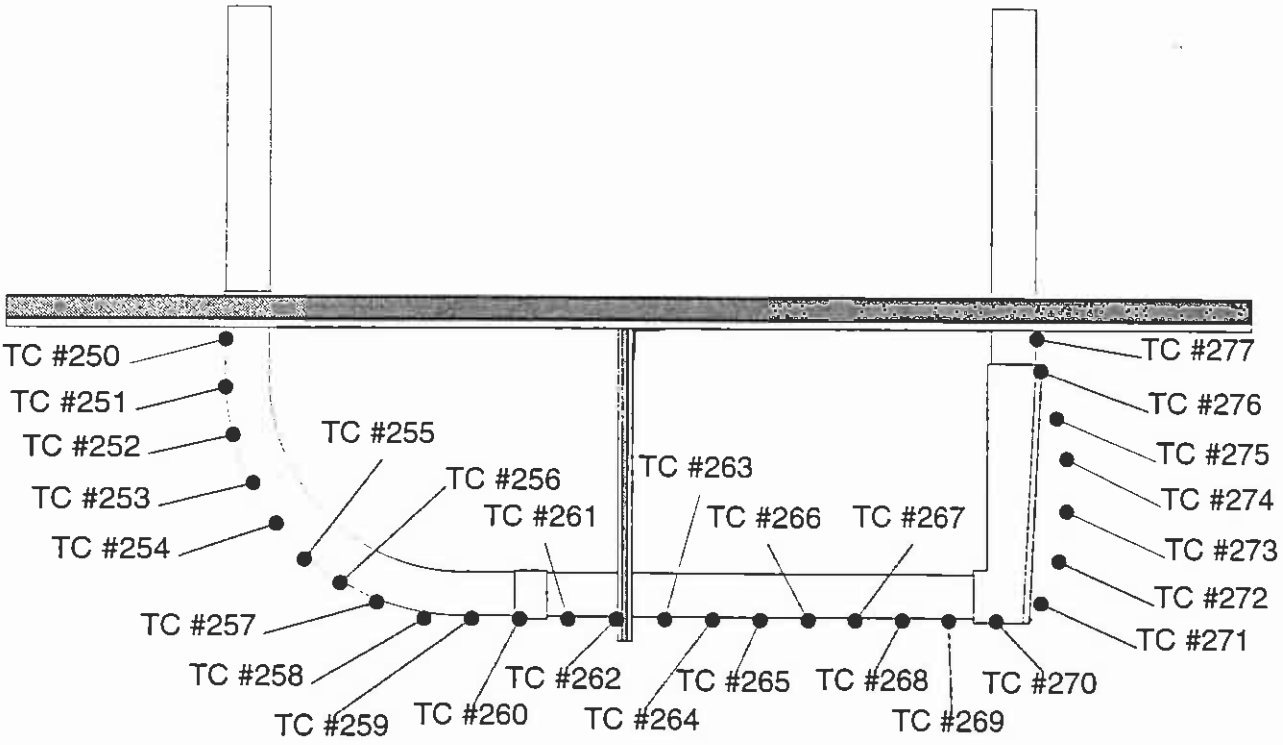
OMEGA POINT LABORATORIES



ELEVATION VIEW - VIEWED FROM FRONT

Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the cable tray side rails on 6" intervals. The thermojunctions were fastened under the heads of screws threaded into the metal side rail, at the vertical mid-height of the tray rails.

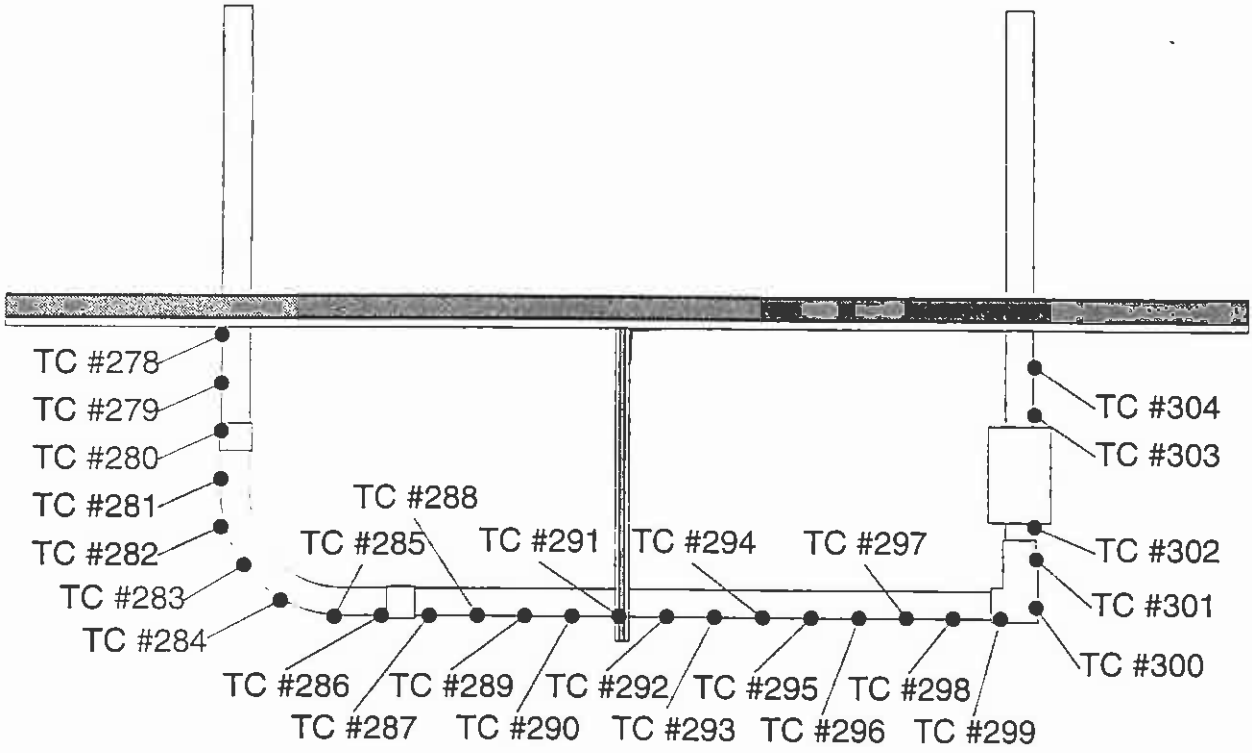
OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 10 Thermocouple Locations - 24" Cable Tray, Front Tray Rail



Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the outside of the conduit surface on 6" intervals. The thermojunctions were fastened under the heads of screws threaded into the metal conduit surface.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 11 Thermocouple Locations - 5" Conduit Raceway Design

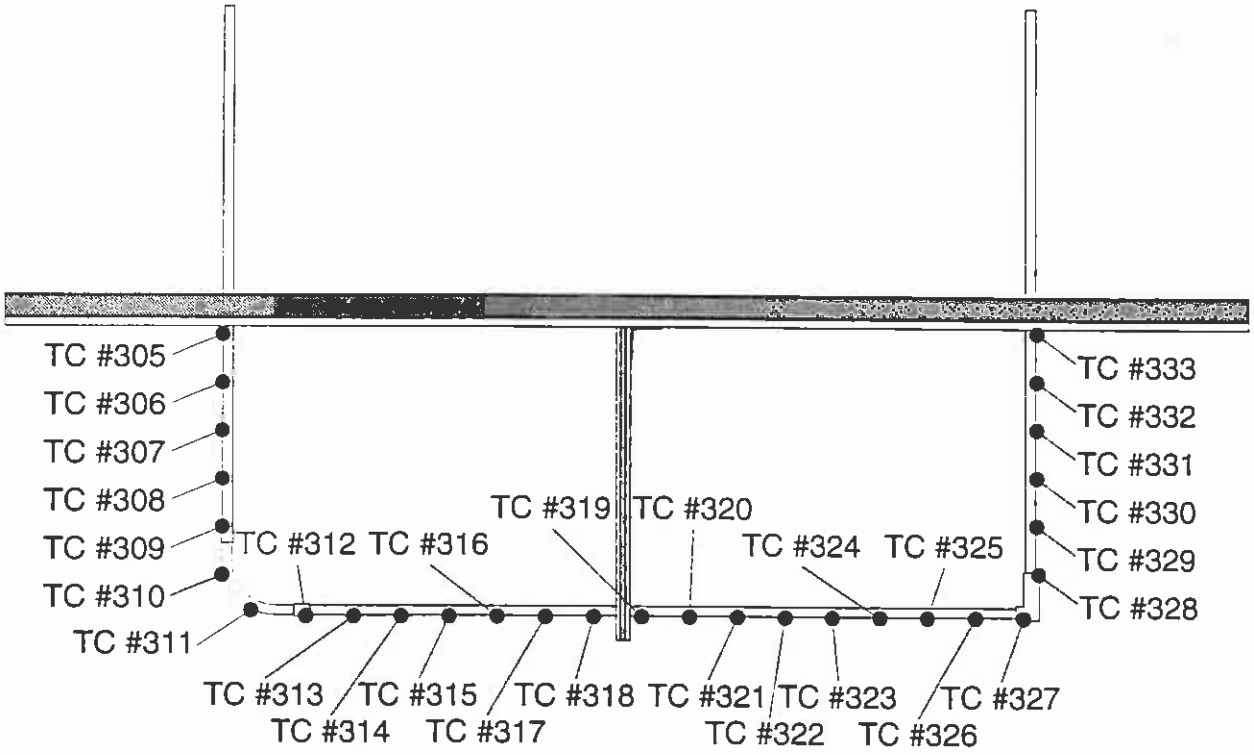
OMEGA POINT LABORATORIES



Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the outside of the conduit surface on 6" intervals. The thermojunctions were fastened under the heads of screws threaded into the metal conduit surface.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 12 Thermocouple Locations - 3" Conduit Raceway Design

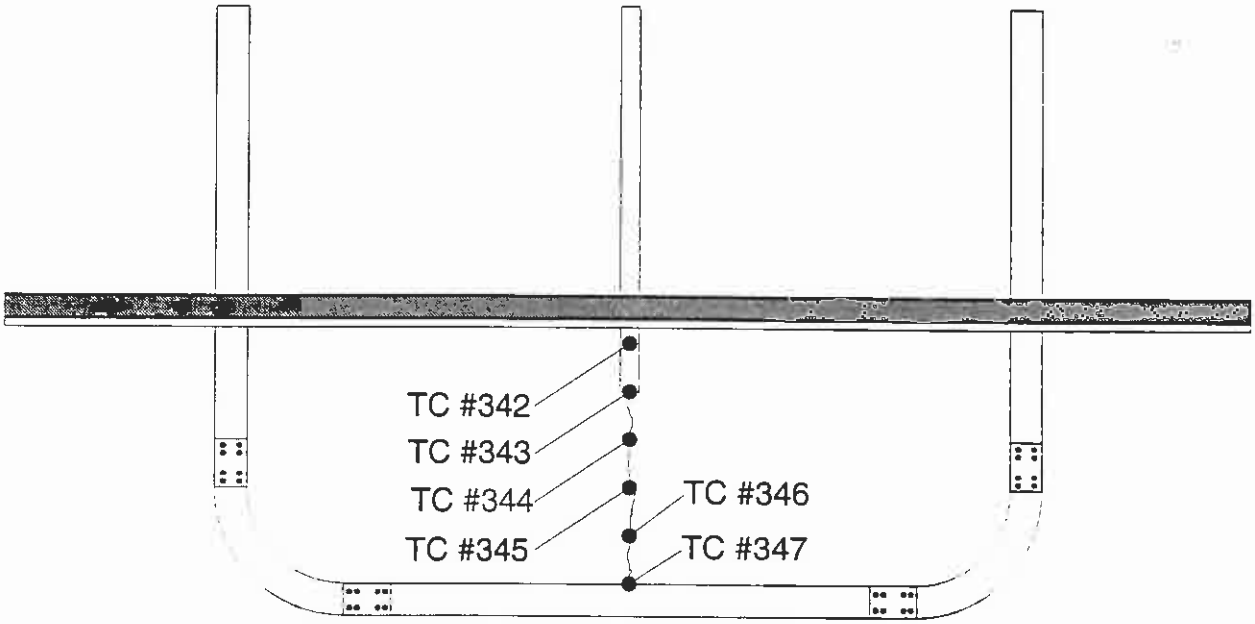
OMEGA POINT LABORATORIES



Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the outside of the conduit surface on 6" intervals. The thermojunctions were fastened under the heads of screws threaded into the metal conduit surface.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 13 Thermocouple Locations - 1" Conduit Raceway Design

OMEGA POINT LABORATORIES



ELEVATION VIEW - VIEWED FROM FRONT

Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the bare #8 coppper wire on 6" intervals. The thermojunctions were fastened to the wire with copper crimp connector.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 14 Thermocouple Locations - 2" Air Drop into 24" Cable Tray

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THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

NOTE:
This Log is to be used to document the precise location of the thermocouples located on each test item. The back of this sheet may be used for any necessary drawings or schematics.

Project #: 99123

Test Deck #: 1

Item: Bare #8 AWG Copper Wire on Cables in 6" Wide Cable Tray

TC Number	Description of exact physical location
C1	On bare #8 wire on cables, 2" below deck insulation.
C2	On bare #8 wire on cables, 6" below previous thermocouple.
C3	On bare #8 wire on cables, 6" below previous thermocouple.
C4	On bare #8 wire on cables, 6" below previous thermocouple.
C5	On bare #8 wire on cables, 6" below previous thermocouple.
C6	On bare #8 wire on cables, 6" below previous thermocouple.
C7	On bare #8 wire on cables, 6" below previous thermocouple.
C8	On bare #8 wire on cables, 6" from previous thermocouple.
C9	On bare #8 wire on cables, 6" from previous thermocouple.
C10	On bare #8 wire on cables, 6" from previous thermocouple.
C11	On bare #8 wire on cables, 6" from previous thermocouple.
C12	On bare #8 wire on cables, 6" from previous thermocouple.
C13	On bare #8 wire on cables, 6" from previous thermocouple.
C14	On bare #8 wire on cables, 6" from previous thermocouple.
C15	On bare #8 wire on cables, 6" from previous thermocouple.
C16	On bare #8 wire on cables, 6" from previous thermocouple.
C17	On bare #8 wire on cables, 6" from previous thermocouple.
C18	On bare #8 wire on cables, 6" from previous thermocouple.
C19	On bare #8 wire on cables, 6" from previous thermocouple.
C20	On bare #8 wire on cables, 6" from previous thermocouple.
C21	On bare #8 wire on cables, 6" from previous thermocouple.
C22	On bare #8 wire on cables, 6" from previous thermocouple.
C23	On bare #8 wire on cables, 6" from previous thermocouple.
C24	On bare #8 wire on cables, 6" from previous thermocouple.
C25	On bare #8 wire on cables, 6" from previous thermocouple.
C26	On bare #8 wire on cables, 6" from previous thermocouple.
C27	On bare #8 wire on cables, 6" from previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance C1, E35, etc.

PLEASE USE THE BACK OF THIS SHEET FOR DRAWINGS, IF NECESSARY

THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

NOTE:
This Log is to be used to document the precise location of the thermocouples located on each test item. The back of this sheet may be used for any necessary drawings or schematics.

Project #: 99123

Test Deck #: 1

Item: Bare #8 AWG Copper Wire on Cables in 24" Wide Cable Tray

TC Number	Description of exact physical location
C28	On bare #8 wire on cables, 2" below deck insulation.
C29	On bare #8 wire on cables, 6" below previous thermocouple.
C30	On bare #8 wire on cables, 6" below previous thermocouple.
C31	On bare #8 wire on cables, 6" below previous thermocouple.
C32	On bare #8 wire on cables, 6" below previous thermocouple.
C33	On bare #8 wire on cables, 6" below previous thermocouple.
C34	On bare #8 wire on cables, 6" below previous thermocouple.
C35	On bare #8 wire on cables, 6" from previous thermocouple.
C36	On bare #8 wire on cables, 6" from previous thermocouple.
C37	On bare #8 wire on cables, 6" from previous thermocouple.
C38	On bare #8 wire on cables, 6" from previous thermocouple.
C39	On bare #8 wire on cables, 6" from previous thermocouple.
C40	On bare #8 wire on cables, 6" from previous thermocouple.
C41	On bare #8 wire on cables, 6" from previous thermocouple.
C42	On bare #8 wire on cables, 6" from previous thermocouple.
C43	On bare #8 wire on cables, 6" from previous thermocouple.
C44	On bare #8 wire on cables, 6" from previous thermocouple.
C45	On bare #8 wire on cables, 6" from previous thermocouple.
C46	On bare #8 wire on cables, 6" from previous thermocouple.
C47	On bare #8 wire on cables, 6" from previous thermocouple.
C48	On bare #8 wire on cables, 6" from previous thermocouple.
C49	On bare #8 wire on cables, 6" from previous thermocouple.
C50	On bare #8 wire on cables, 6" from previous thermocouple.
C51	On bare #8 wire on cables, 6" from previous thermocouple.
C52	On bare #8 wire on cables, 6" from previous thermocouple.
C53	On bare #8 wire on cables, 6" from previous thermocouple.
C54	On bare #8 wire on cables, 6" from previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

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Project #: 99123

Test Deck #: 1

Item: Bare #8 AWG Copper Wire in 5" Steel Conduit Assembly

TC Number	Description of exact physical location
C55	On bare #8 wire in conduit, 2" below deck insulation.
C56	On bare #8 wire in conduit, 6" below previous thermocouple.
C57	On bare #8 wire in conduit, 6" below previous thermocouple.
C58	On bare #8 wire in conduit, 6" below previous thermocouple.
C59	On bare #8 wire in conduit, 6" below previous thermocouple.
C60	On bare #8 wire in conduit, 6" below previous thermocouple.
C61	On bare #8 wire in conduit, 6" below previous thermocouple.
C62	On bare #8 wire in conduit, 6" from previous thermocouple.
C63	On bare #8 wire in conduit, 6" from previous thermocouple.
C64	On bare #8 wire in conduit, 6" from previous thermocouple.
C65	On bare #8 wire in conduit, 6" from previous thermocouple.
C66	On bare #8 wire in conduit, 6" from previous thermocouple.
C67	On bare #8 wire in conduit, 6" from previous thermocouple.
C68	On bare #8 wire in conduit, 6" from previous thermocouple.
C69	On bare #8 wire in conduit, 6" from previous thermocouple.
C70	On bare #8 wire in conduit, 6" from previous thermocouple.
C71	On bare #8 wire in conduit, 6" from previous thermocouple.
C72	On bare #8 wire in conduit, 6" from previous thermocouple.
C73	On bare #8 wire in conduit, 6" from previous thermocouple.
C74	On bare #8 wire in conduit, 6" from previous thermocouple.
C75	On bare #8 wire in conduit, 6" from previous thermocouple.
C76	On bare #8 wire in conduit, 6" from previous thermocouple.
C77	On bare #8 wire in conduit, 6" from previous thermocouple.
C78	On bare #8 wire in conduit, 6" from previous thermocouple.
C79	On bare #8 wire in conduit, 6" from previous thermocouple.
C80	On bare #8 wire in conduit, 6" from previous thermocouple.
C81	On bare #8 wire in conduit, 6" from previous thermocouple.
C82	On bare #8 wire in conduit, 6" from previous thermocouple.
C83	On bare #8 wire in conduit, 6" from previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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Project #: 99123

Test Deck #: 1

Item: Bare #8 AWG Copper Wire in 3" Steel Conduit Assembly

TC Number	Description of exact physical location
C84	On bare #8 wire in conduit, 2" below deck insulation.
C85	On bare #8 wire in conduit, 6" below previous thermocouple.
C86	On bare #8 wire in conduit, 6" below previous thermocouple.
C87	On bare #8 wire in conduit, 6" below previous thermocouple.
C88	On bare #8 wire in conduit, 6" below previous thermocouple.
C89	On bare #8 wire in conduit, 6" below previous thermocouple.
C90	On bare #8 wire in conduit, 6" below previous thermocouple.
C91	On bare #8 wire in conduit, 6" from previous thermocouple.
C92	On bare #8 wire in conduit, 6" from previous thermocouple.
C93	On bare #8 wire in conduit, 6" from previous thermocouple.
C94	On bare #8 wire in conduit, 6" from previous thermocouple.
C95	On bare #8 wire in conduit, 6" from previous thermocouple.
C96	On bare #8 wire in conduit, 6" from previous thermocouple.
C97	On bare #8 wire in conduit, 6" from previous thermocouple.
C98	On bare #8 wire in conduit, 6" from previous thermocouple.
C99	On bare #8 wire in conduit, 6" from previous thermocouple.
C100	On bare #8 wire in conduit, 6" from previous thermocouple.
C101	On bare #8 wire in conduit, 6" from previous thermocouple.
C102	On bare #8 wire in conduit, 6" from previous thermocouple.
C103	On bare #8 wire in conduit, 6" from previous thermocouple.
C104	On bare #8 wire in conduit, 6" from previous thermocouple.
C105	On bare #8 wire in conduit, 6" from previous thermocouple.
C106	On bare #8 wire in conduit, 6" from previous thermocouple.
C107	On bare #8 wire in conduit, 6" from previous thermocouple.
C108	On bare #8 wire in conduit, 6" from previous thermocouple.
C109	On bare #8 wire in conduit, 6" from previous thermocouple.
C110	On bare #8 wire in conduit, 6" from previous thermocouple.
C111	On bare #8 wire in conduit, 6" from previous thermocouple.
C112	On bare #8 wire in conduit, 6" from previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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Project #: 99123

Test Deck #: 1

Item: Bare #8 AWG Copper Wire in 1" Steel Conduit Assembly

TC Number	Description of exact physical location
C113	On bare #8 wire in conduit, 2" below deck insulation.
C114	On bare #8 wire in conduit, 6" below previous thermocouple.
C115	On bare #8 wire in conduit, 6" below previous thermocouple.
C116	On bare #8 wire in conduit, 6" below previous thermocouple.
C117	On bare #8 wire in conduit, 6" below previous thermocouple.
C118	On bare #8 wire in conduit, 6" below previous thermocouple.
C119	On bare #8 wire in conduit, 6" below previous thermocouple.
C120	On bare #8 wire in conduit, 6" from previous thermocouple.
C121	On bare #8 wire in conduit, 6" from previous thermocouple.
C122	On bare #8 wire in conduit, 6" from previous thermocouple.
C123	On bare #8 wire in conduit, 6" from previous thermocouple.
C124	On bare #8 wire in conduit, 6" from previous thermocouple.
C125	On bare #8 wire in conduit, 6" from previous thermocouple.
C126	On bare #8 wire in conduit, 6" from previous thermocouple.
C127	On bare #8 wire in conduit, 6" from previous thermocouple.
C128	On bare #8 wire in conduit, 6" from previous thermocouple.
C129	On bare #8 wire in conduit, 6" from previous thermocouple.
C130	On bare #8 wire in conduit, 6" from previous thermocouple.
C131	On bare #8 wire in conduit, 6" from previous thermocouple.
C132	On bare #8 wire in conduit, 6" from previous thermocouple.
C133	On bare #8 wire in conduit, 6" from previous thermocouple.
C134	On bare #8 wire in conduit, 6" from previous thermocouple.
C135	On bare #8 wire in conduit, 6" from previous thermocouple.
C136	On bare #8 wire in conduit, 6" from previous thermocouple.
C137	On bare #8 wire in conduit, 6" from previous thermocouple.
C138	On bare #8 wire in conduit, 6" from previous thermocouple.
C139	On bare #8 wire in conduit, 6" from previous thermocouple.
C140	On bare #8 wire in conduit, 6" from previous thermocouple.
C141	On bare #8 wire in conduit, 6" from previous thermocouple.

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Project #: 99123

Test Deck #: 1

Item: 6" Wide Cable Tray Assembly

Rear Tray Rail

TC Number	Description of exact physical location
E142	On centerline of tray rail, 2" below deck insulation.
E143	On centerline of tray rail, 6" below previous thermocouple.
E144	On centerline of tray rail, 6" below previous thermocouple.
E145	On centerline of tray rail splice plate, 6" below previous thermocouple.
E146	On centerline of tray rail, 6" below previous thermocouple.
E147	On centerline of tray rail, 6" below previous thermocouple.
E148	On centerline of tray rail, 6" from previous thermocouple.
E149	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E150	On centerline of tray rail, 6" right of previous thermocouple.
E151	On centerline of tray rail, 6" right of previous thermocouple.
E152	On centerline of tray rail, 6" right of previous thermocouple.
E153	On centerline of tray rail, 6" right of previous thermocouple.
E154	On centerline of tray rail, 6" right of previous thermocouple.
E155	On centerline of tray rail, 6" right of previous thermocouple.
E156	On centerline of tray rail, 6" right of previous thermocouple.
E157	On centerline of tray rail, 6" right of previous thermocouple.
E158	On centerline of tray rail, 6" right of previous thermocouple.
E159	On centerline of tray rail, 6" right of previous thermocouple.
E160	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E161	On centerline of tray rail, 6" right of previous thermocouple.
E162	On centerline of tray rail, 6" right of previous thermocouple.
E163	On centerline of tray rail, 6" above previous thermocouple.
E164	On centerline of tray rail, 6" above previous thermocouple.
E165	On centerline of tray rail splice plate, 6" above previous thermocouple.
E166	On centerline of tray rail, 6" above previous thermocouple.
E167	On centerline of tray rail, 6" above previous thermocouple.
E168	On centerline of tray rail, 6" above previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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Project #: 99123

Test Deck #: 1

Item: 6" Wide Cable Tray Assembly

Front Tray Rail

TC Number	Description of exact physical location
E169	On centerline of tray rail, 2" below deck insulation.
E170	On centerline of tray rail, 6" below previous thermocouple.
E171	On centerline of tray rail, 6" below previous thermocouple.
E172	On centerline of tray rail splice plate, 6" below previous thermocouple.
E173	On centerline of tray rail, 6" below previous thermocouple.
E174	On centerline of tray rail, 6" below previous thermocouple.
E175	On centerline of tray rail, 6" from previous thermocouple.
E176	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E177	On centerline of tray rail, 6" right of previous thermocouple.
E178	On centerline of tray rail, 6" right of previous thermocouple.
E179	On centerline of tray rail, 6" right of previous thermocouple.
E180	On centerline of tray rail, 6" right of previous thermocouple.
E181	On centerline of tray rail, 6" right of previous thermocouple.
E182	On centerline of tray rail, 6" right of previous thermocouple.
E183	On centerline of tray rail, 6" right of previous thermocouple.
E184	On centerline of tray rail, 6" right of previous thermocouple.
E185	On centerline of tray rail, 6" right of previous thermocouple.
E186	On centerline of tray rail, 6" right of previous thermocouple.
E187	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E188	On centerline of tray rail, 6" right of previous thermocouple.
E189	On centerline of tray rail, 6" right of previous thermocouple.
E190	On centerline of tray rail, 6" above previous thermocouple.
E191	On centerline of tray rail, 6" above previous thermocouple.
E192	On centerline of tray rail splice plate, 6" above previous thermocouple.
E193	On centerline of tray rail, 6" above previous thermocouple.
E194	On centerline of tray rail, 6" above previous thermocouple.
E195	On centerline of tray rail, 6" above previous thermocouple.

NOTE: **TCs shall be numbered** sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), **and E** (engineering TC), **for instance** c1, E35, **etc.**

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THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

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Project #: 99123

Test Deck #: 1

Item: 24" Wide Cable Tray Assembly

Rear Tray Rail

TC Number	Description of exact physical location
E196	On centerline of tray rail, 2" below deck insulation.
E197	On centerline of tray rail, 6" below previous thermocouple.
E198	On centerline of tray rail, 6" below previous thermocouple.
E199	On centerline of tray rail splice plate, 6" below previous thermocouple.
E200	On centerline of tray rail, 6" below previous thermocouple.
E201	On centerline of tray rail, 6" below previous thermocouple.
E202	On centerline of tray rail, 6" from previous thermocouple.
E203	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E204	On centerline of tray rail, 6" right of previous thermocouple.
E205	On centerline of tray rail, 6" right of previous thermocouple.
E206	On centerline of tray rail, 6" right of previous thermocouple.
E207	On centerline of tray rail, 6" right of previous thermocouple.
E208	On centerline of tray rail, 6" right of previous thermocouple.
E209	On centerline of tray rail, 6" right of previous thermocouple.
E210	On centerline of tray rail, 6" right of previous thermocouple.
E211	On centerline of tray rail, 6" right of previous thermocouple.
E212	On centerline of tray rail, 6" right of previous thermocouple.
E213	On centerline of tray rail, 6" right of previous thermocouple.
E214	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E215	On centerline of tray rail, 6" right of previous thermocouple.
E216	On centerline of tray rail, 6" right of previous thermocouple.
E217	On centerline of tray rail, 6" above previous thermocouple.
E218	On centerline of tray rail, 6" above previous thermocouple.
E219	On centerline of tray rail splice plate, 6" above previous thermocouple.
E220	On centerline of tray rail, 6" above previous thermocouple.
E221	On centerline of tray rail, 6" above previous thermocouple.
E222	On centerline of tray rail, 6" above previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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Project #: 99123

Test Deck #: 1

Item: 24" Wide Cable Tray Assembly

Front Tray Rail

TC Number	Description of exact physical location
E223	On centerline of tray rail, 2" below deck insulation.
E224	On centerline of tray rail, 6" below previous thermocouple.
E225	On centerline of tray rail, 6" below previous thermocouple.
E226	On centerline of tray rail splice plate, 6" below previous thermocouple.
E227	On centerline of tray rail, 6" below previous thermocouple.
E228	On centerline of tray rail, 6" below previous thermocouple.
E229	On centerline of tray rail, 6" from previous thermocouple.
E230	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E231	On centerline of tray rail, 6" right of previous thermocouple.
E232	On centerline of tray rail, 6" right of previous thermocouple.
E233	On centerline of tray rail, 6" right of previous thermocouple.
E234	On centerline of tray rail, 6" right of previous thermocouple.
E235	On centerline of tray rail, 6" right of previous thermocouple.
E236	On centerline of tray rail, 6" right of previous thermocouple.
E237	On centerline of tray rail, 6" right of previous thermocouple.
E238	On centerline of tray rail, 6" right of previous thermocouple.
E239	On centerline of tray rail, 6" right of previous thermocouple.
E240	On centerline of tray rail, 6" right of previous thermocouple.
E241	On centerline of tray rail splice plate, 6" right of previous thermocouple.
E242	On centerline of tray rail, 6" right of previous thermocouple.
E243	On centerline of tray rail, 6" right of previous thermocouple.
E244	On centerline of tray rail, 6" above previous thermocouple.
E245	On centerline of tray rail, 6" above previous thermocouple.
E246	On centerline of tray rail splice plate, 6" above previous thermocouple.
E247	On centerline of tray rail, 6" above previous thermocouple.
E248	On centerline of tray rail, 6" above previous thermocouple.
E249	On centerline of tray rail, 6" above previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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Project #: 99123

Test Deck #: 1

Item: 5" Steel Conduit Assembly

Outside Conduit Surface

TC Number	Description of exact physical location
E250	On the outside conduit surface, 2" below deck insulation.
E251	On the outside conduit surface, 6" below previous thermocouple.
E252	On the outside conduit surface, 6" below previous thermocouple.
E253	On the outside conduit surface, 6" below previous thermocouple.
E254	On the outside conduit surface, 6" below previous thermocouple.
E255	On the outside conduit surface, 6" below previous thermocouple.
E256	On the outside conduit surface, 6" right of previous thermocouple.
E257	On the outside conduit surface, 6" right of previous thermocouple.
E258	On the outside conduit surface, 6" right of previous thermocouple.
E259	On the outside conduit surface, 6" right of previous thermocouple.
E260	On the outside conduit surface, 6" right of previous thermocouple.
E261	On the outside conduit surface, 6" right of previous thermocouple.
E262	On the outside conduit surface, 6" right of previous thermocouple.
E263	On the outside conduit surface, 6" right of previous thermocouple.
E264	On the outside conduit surface, 6" right of previous thermocouple.
E265	On the outside conduit surface, 6" right of previous thermocouple.
E266	On the outside conduit surface, 6" right of previous thermocouple.
E267	On the outside conduit surface, 6" right of previous thermocouple.
E268	On the outside conduit surface, 6" right of previous thermocouple.
E269	On the outside conduit surface, 6" right of previous thermocouple.
E270	On the outside bottom condulet surface, 6" right of previous thermocouple.
E271	On the outside condulet cover surface, 6" above previous thermocouple.
E272	On the outside condulet cover surface, 6" above previous thermocouple.
E273	On the outside condulet cover surface, 6" above previous thermocouple.
E274	On the outside condulet cover surface, 6" above previous thermocouple.
E275	On the outside condulet cover surface, 6" above previous thermocouple.
E276	On the outside condulet surface, 6" above previous thermocouple.
E277	On the outside conduit surface, 6" above previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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Project #: 99123

Test Deck #: 1

Item: 3" Steel Conduit Assembly

Outside Conduit Surface

TC Number	Description of exact physical location
E278	On the outside conduit surface, 2" below deck insulation.
E279	On the outside conduit surface, 6" below previous thermocouple.
E280	On the outside conduit surface, 6" below previous thermocouple.
E281	On the outside conduit surface, 6" below previous thermocouple.
E282	On the outside conduit surface, 6" below previous thermocouple.
E283	On the outside conduit surface, 6" below previous thermocouple.
E284	On the outside conduit surface, 6" right of previous thermocouple.
E285	On the outside conduit surface, 6" right of previous thermocouple.
E286	On the outside conduit surface, 6" right of previous thermocouple.
E287	On the outside conduit surface, 6" right of previous thermocouple.
E288	On the outside conduit surface, 6" right of previous thermocouple.
E289	On the outside conduit surface, 6" right of previous thermocouple.
E290	On the outside conduit surface, 6" right of previous thermocouple.
E291	On the outside conduit surface, 6" right of previous thermocouple.
E292	On the outside conduit surface, 6" right of previous thermocouple.
E293	On the outside conduit surface, 6" right of previous thermocouple.
E294	On the outside conduit surface, 6" right of previous thermocouple.
E295	On the outside conduit surface, 6" right of previous thermocouple.
E296	On the outside conduit surface, 6" right of previous thermocouple.
E297	On the outside conduit surface, 6" right of previous thermocouple.
E298	On the outside conduit surface, 6" right of previous thermocouple.
E299	On the outside bottom condulet surface, 6" right of previous thermocouple.
E300	On the outside condulet cover surface, 6" above previous thermocouple.
E301	On the outside condulet cover surface, 6" above previous thermocouple.
E302	On the outside conduit surface, 1" below the junction box.
E303	On the outside conduit surface, 1" above the junction box.
E304	On the outside condulet surface, 6" above previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

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Project #: 99123

Test Deck #: 1

Item: 1" Steel Conduit Assembly

Outside Conduit Surface

TC Number	Description of exact physical location
E305	On the outside conduit surface, 2" below deck insulation.
E306	On the outside conduit surface, 6" below previous thermocouple.
E307	On the outside conduit surface, 6" below previous thermocouple.
E308	On the outside conduit surface, 6" below previous thermocouple.
E309	On the outside conduit surface, 6" below previous thermocouple.
E310	On the outside conduit surface, 6" below previous thermocouple.
E311	On the outside conduit surface, 6" right of previous thermocouple.
E312	On the outside conduit surface, 6" right of previous thermocouple.
E313	On the outside conduit surface, 6" right of previous thermocouple.
E314	On the outside conduit surface, 6" right of previous thermocouple.
E315	On the outside conduit surface, 6" right of previous thermocouple.
E316	On the outside conduit surface, 6" right of previous thermocouple.
E317	On the outside conduit surface, 6" right of previous thermocouple.
E318	On the outside conduit surface, 6" right of previous thermocouple.
E319	On the outside conduit surface, 6" right of previous thermocouple.
E320	On the outside conduit surface, 6" right of previous thermocouple.
E321	On the outside conduit surface, 6" right of previous thermocouple.
E322	On the outside conduit surface, 6" right of previous thermocouple.
E323	On the outside conduit surface, 6" right of previous thermocouple.
E324	On the outside conduit surface, 6" right of previous thermocouple.
E325	On the outside conduit surface, 6" right of previous thermocouple.
E326	On the outside conduit surface, 6" right of previous thermocouple.
E327	On the outside bottom condulet surface, 6" right of previous thermocouple.
E328	On the outside condulet surface, 6" above previous thermocouple.
E329	On the outside conduit surface, 6" above previous thermocouple.
E330	On the outside conduit surface, 6" above previous thermocouple.
E331	On the outside condulet surface, 6" above previous thermocouple.
E332	On the outside conduit surface, 6" above previous thermocouple.
E333	On the outside conduit surface, 6" above previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

PLEASE USE THE BACK OF THIS SHEET FOR DRAWINGS, IF NECESSARY

THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

NOTE:
This Log is to be used to document the precise location of the thermocouples located on each test item. The back of this sheet may be used for any necessary drawings or schematics.

Project #: 99123

Test Deck #: 1

Item: 3" Steel Conduit Assembly

(with Junction Box)

Inside Junction Box Surface

TC Number	Description of exact physical location
E334	On the inside surface of the JB, centered on the cover.
E335	On the inside surface of the JB, centered on the front JB face.
E336	On the inside surface of the JB, centered on the left JB face (opposite the cover).
E337	On the inside surface of the JB, centered on the rear JB face.
E338	On the inside surface of the JB, on the top face, 1" right of the conduit entry point.
E339	On the inside surface of the JB, on the top face, 1" forward of the conduit entry point.
E340	On the inside surface of the JB, on the bottom face, 1" right of the conduit entry point.
E341	On the inside surface of the JB, on the top face, 1" forward of the conduit entry point.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

PLEASE USE THE BACK OF THIS SHEET FOR DRAWINGS, IF NECESSARY

THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

NOTE:
This Log is to be used to document the precise location of the thermocouples located on each test item. The back of this sheet may be used for any necessary drawings or schematics.

Project #: 99123

Test Deck #: 1

Item: Bare #8 AWG Copper Wire in Air Drop Assembly and 2" Conduit Stub

TC Number	Description of exact physical location
C342	On bare #8 wire in air drop, 2" below deck insulation.
C343	On bare #8 wire in air drop, 6" below previous thermocouple.
C344	On bare #8 wire in air drop, 6" below previous thermocouple.
C345	On bare #8 wire in air drop, 6" below previous thermocouple.
C346	On bare #8 wire in air drop, 6" below previous thermocouple.
C347	On bare #8 wire in air drop, 6" below previous thermocouple,.
E348	On 2" conduit stub, 1" above free end.
E349	On 2" conduit stub, 2" below deck insulation.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance c1, E35, etc.

PLEASE USE THE BACK OF THIS SHEET FOR DRAWINGS, IF NECESSARY

THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

NOTE:
This Log is to be used to document the precise location of the thermocouples located on each test item. The back of this sheet may be used for any necessary drawings or schematics.

Project #: 99123

Test Deck #: 1

Item: Bare #8 AWG Copper Wire Under Rungs in 6" Wide Cable Tray

TC Number	Description of exact physical location
C350	On bare #8 wire under rungs, 2" below deck insulation.
C351	On bare #8 wire under rungs, 6" below previous thermocouple.
C352	On bare #8 wire under rungs, 6" below previous thermocouple.
C353	On bare #8 wire under rungs, 6" below previous thermocouple.
C354	On bare #8 wire under rungs, 6" below previous thermocouple.
C355	On bare #8 wire under rungs, 6" below previous thermocouple.
C356	On bare #8 wire under rungs, 6" below previous thermocouple.
C357	On bare #8 wire under rungs, 6" from previous thermocouple.
C358	On bare #8 wire under rungs, 6" from previous thermocouple.
C359	On bare #8 wire under rungs, 6" from previous thermocouple.
C360	On bare #8 wire under rungs, 6" from previous thermocouple.
C361	On bare #8 wire under rungs, 6" from previous thermocouple.
C362	On bare #8 wire under rungs, 6" from previous thermocouple.
C363	On bare #8 wire under rungs, 6" from previous thermocouple.
C364	On bare #8 wire under rungs, 6" from previous thermocouple.
C365	On bare #8 wire under rungs, 6" from previous thermocouple.
C366	On bare #8 wire under rungs, 6" from previous thermocouple.
C367	On bare #8 wire under rungs, 6" from previous thermocouple.
C368	On bare #8 wire under rungs, 6" from previous thermocouple.
C369	On bare #8 wire under rungs, 6" from previous thermocouple.
C370	On bare #8 wire under rungs, 6" from previous thermocouple.
C371	On bare #8 wire under rungs, 6" from previous thermocouple.
C372	On bare #8 wire under rungs, 6" from previous thermocouple.
C373	On bare #8 wire under rungs, 6" from previous thermocouple.
C374	On bare #8 wire under rungs, 6" from previous thermocouple.
C375	On bare #8 wire under rungs, 6" from previous thermocouple.
C376	On bare #8 wire under rungs, 6" from previous thermocouple.
C377	On bare #8 wire under rungs, 6" from previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance C1, E35, etc.

PLEASE USE THE BACK OF THIS SHEET FOR DRAWINGS, IF NECESSARY

THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

NOTE:
This Log is to be used to document the precise location of the thermocouples located on each test item. The back of this sheet may be used for any necessary drawings or schematics.

Project #: 99123

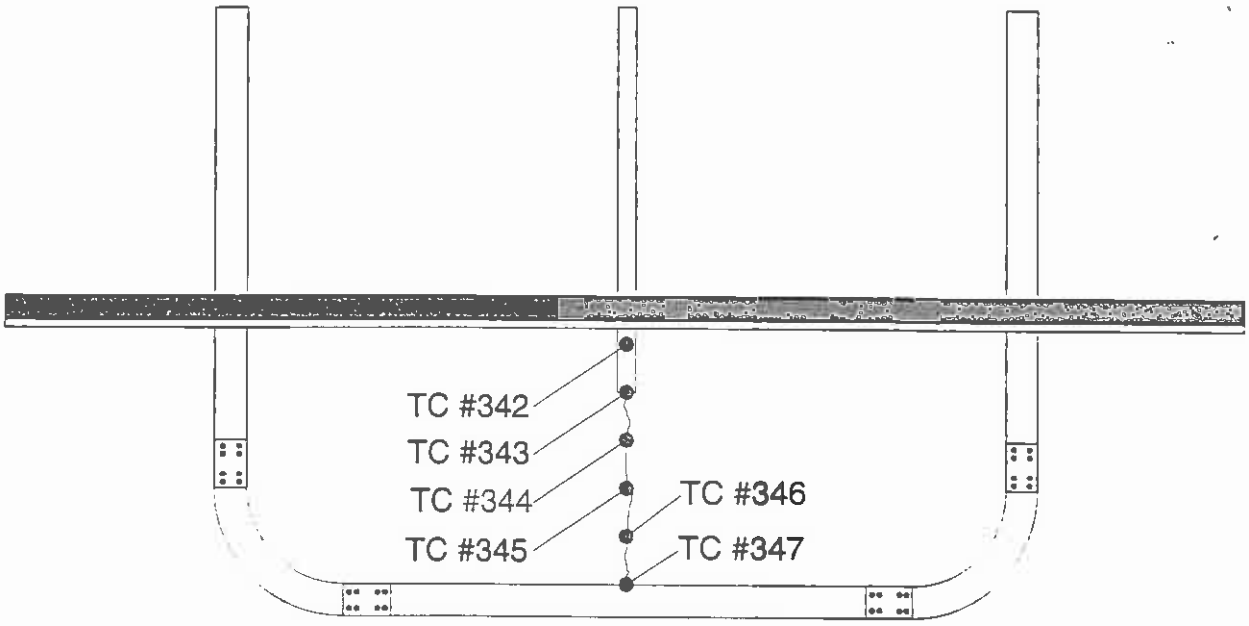
Test Deck #: 1

Item: Bare #8 AWG Copper Wire Under Rungs in 24" Wide Cable Tray

TC Number	Description of exact physical location
C378	On bare #8 wire under rungs, 2" below deck insulation.
C379	On bare #8 wire under rungs, 6" below previous thermocouple.
C380	On bare #8 wire under rungs, 6" below previous thermocouple.
C381	On bare #8 wire under rungs, 6" below previous thermocouple.
C382	On bare #8 wire under rungs, 6" below previous thermocouple.
C383	On bare #8 wire under rungs, 6" below previous thermocouple.
C384	On bare #8 wire under rungs, 6" below previous thermocouple.
C385	On bare #8 wire under rungs, 6" from previous thermocouple.
C386	On bare #8 wire under rungs, 6" from previous thermocouple.
C387	On bare #8 wire under rungs, 6" from previous thermocouple.
C388	On bare #8 wire under rungs, 6" from previous thermocouple.
C389	On bare #8 wire under rungs, 6" from previous thermocouple.
C390	On bare #8 wire under rungs, 6" from previous thermocouple.
C391	On bare #8 wire under rungs, 6" from previous thermocouple.
C392	On bare #8 wire under rungs, 6" from previous thermocouple.
C393	On bare #8 wire under rungs, 6" from previous thermocouple.
C394	On bare #8 wire under rungs, 6" from previous thermocouple.
C395	On bare #8 wire under rungs, 6" from previous thermocouple.
C396	On bare #8 wire under rungs, 6" from previous thermocouple.
C397	On bare #8 wire under rungs, 6" from previous thermocouple.
C398	On bare #8 wire under rungs, 6" from previous thermocouple.
C399	On bare #8 wire under rungs, 6" from previous thermocouple.
C400	On bare #8 wire under rungs, 6" from previous thermocouple.
C401	On bare #8 wire under rungs, 6" from previous thermocouple.
C402	On bare #8 wire under rungs, 6" from previous thermocouple.
C403	On bare #8 wire under rungs, 6" from previous thermocouple.
C404	On bare #8 wire under rungs, 6" from previous thermocouple.
C405	On bare #8 wire under rungs, 6" from previous thermocouple.

NOTE: TCs shall be numbered sequentially from 1 upwards for each deck assembly. Prefixes shall be added as follows: C (copper wire), and E (engineering TC), for instance C1, E35, etc.

PLEASE USE THE BACK OF THIS SHEET FOR DRAWINGS, IF NECESSARY



ELEVATION VIEW - VIEWED FROM FRONT

Note:
Type K, chromel-alumel, 24 GA, electrically welded thermocouples were attached to the bare #8 coppper wire on 6" intervals. The thermojunctions were fastened to the wire with copper crimp connector.

OMEGA POINT LABORATORIES, INC. Project No. 14540-99123
Peak Seals, Inc.
Fig. 14 Thermocouple Locations - 2" Air Drop into 24" Cable Tray

OMEGA POINT LABORATORIES

THERMOCOUPLE PLACEMENT LOG - PROJECT NO. 99123

NOTE:
This Log is to be used to document the precise location of the thermocouples located on each test item. The back of this sheet may be used for any necessary drawings or schematics.

Project #: 99123

Test Deck #: 1

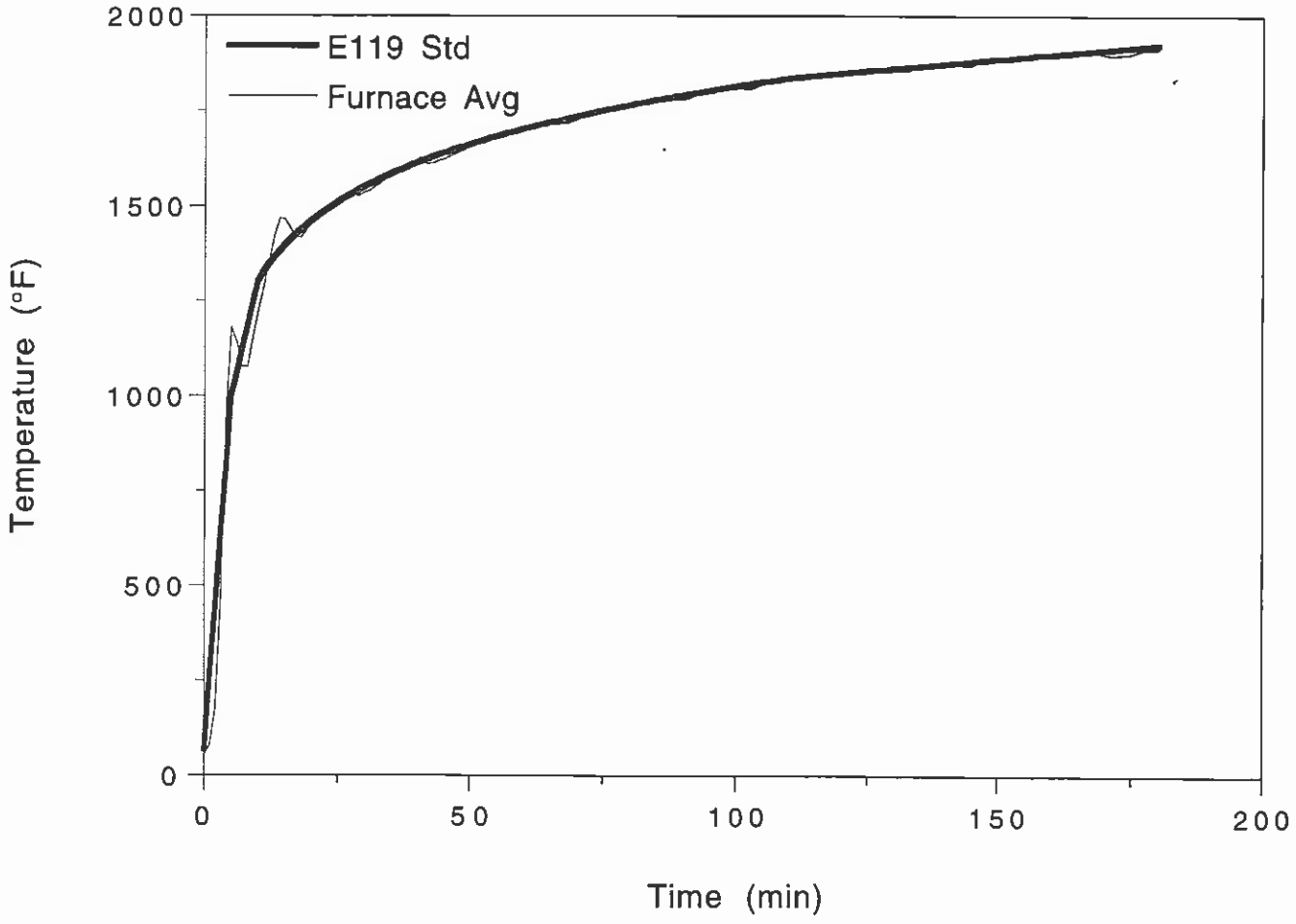
Item: Bare #8 AWG Copper Wire in Air Drop Assembly and 2" Conduit Stub

TC Number	Description of exact physical location
C342	On bare #8 wire in air drop, 2" below deck insulation.
C343	On bare #8 wire in air drop, 6" below previous thermocouple.
C344	On bare #8 wire in air drop, 6" below previous thermocouple.
C345	On bare #8 wire in air drop, 6" below previous thermocouple.
C346	On bare #8 wire in air drop, 6" below previous thermocouple.
C347	On bare #8 wire in air drop, 6" below previous thermocouple,.
E348	On 2" conduit stub, 1" above free end.
E349	On 2" conduit stub, 2" below deck insulation.

NOTE: **TCs shall be numbered** sequentially from 1 upwards for each deck **assembly**. Prefixes shall be added **as** follows: C (copper wire), **and E** (engineering TC), **for instance** c1, E35, **etc.**

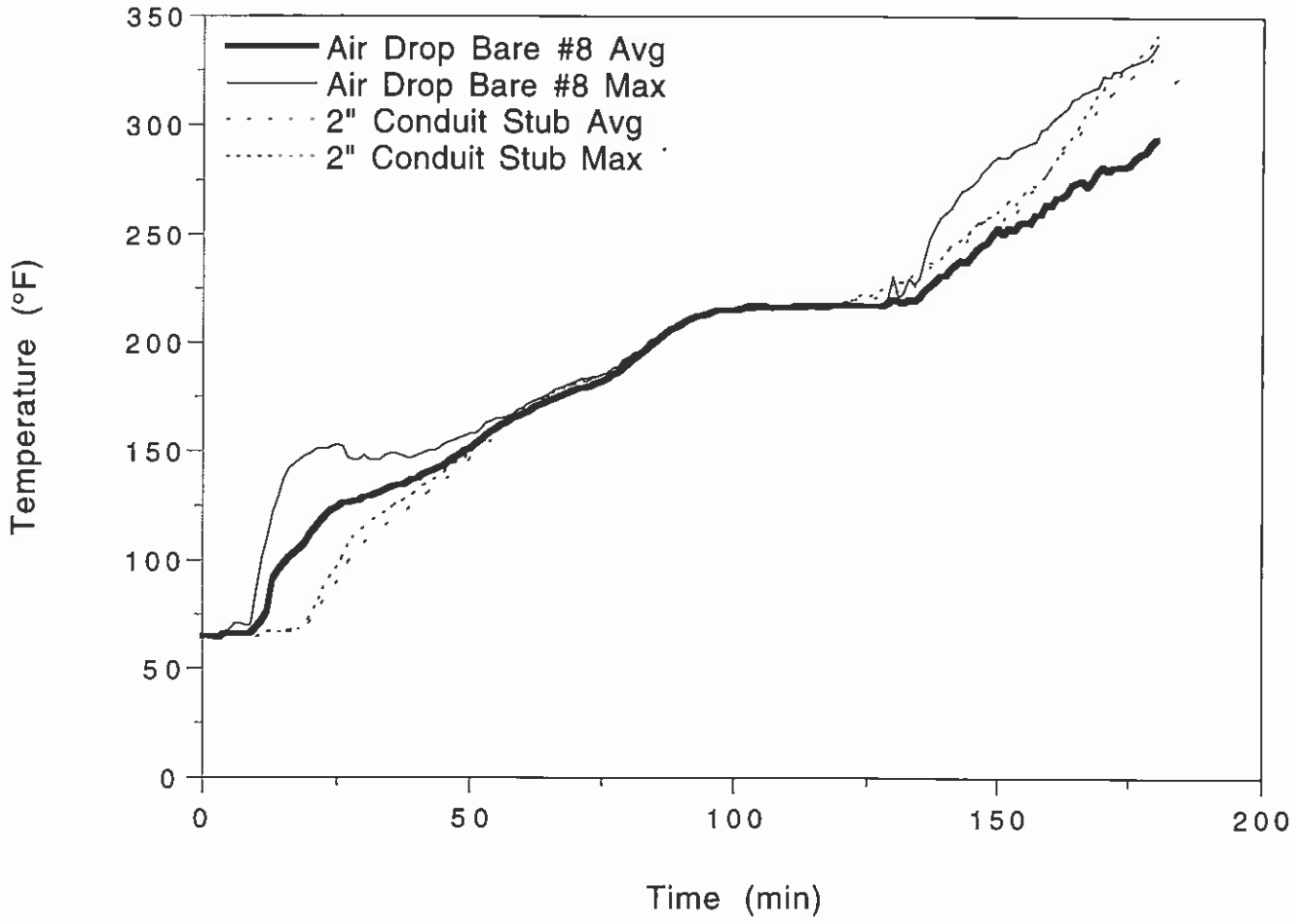
PLEASE USE THE BACK OF THIS SHEET FOR DRAWINGS, IF NECESSARY

Project No. 14540-99123
Peak Seals, Inc.
Furnace Temperatures



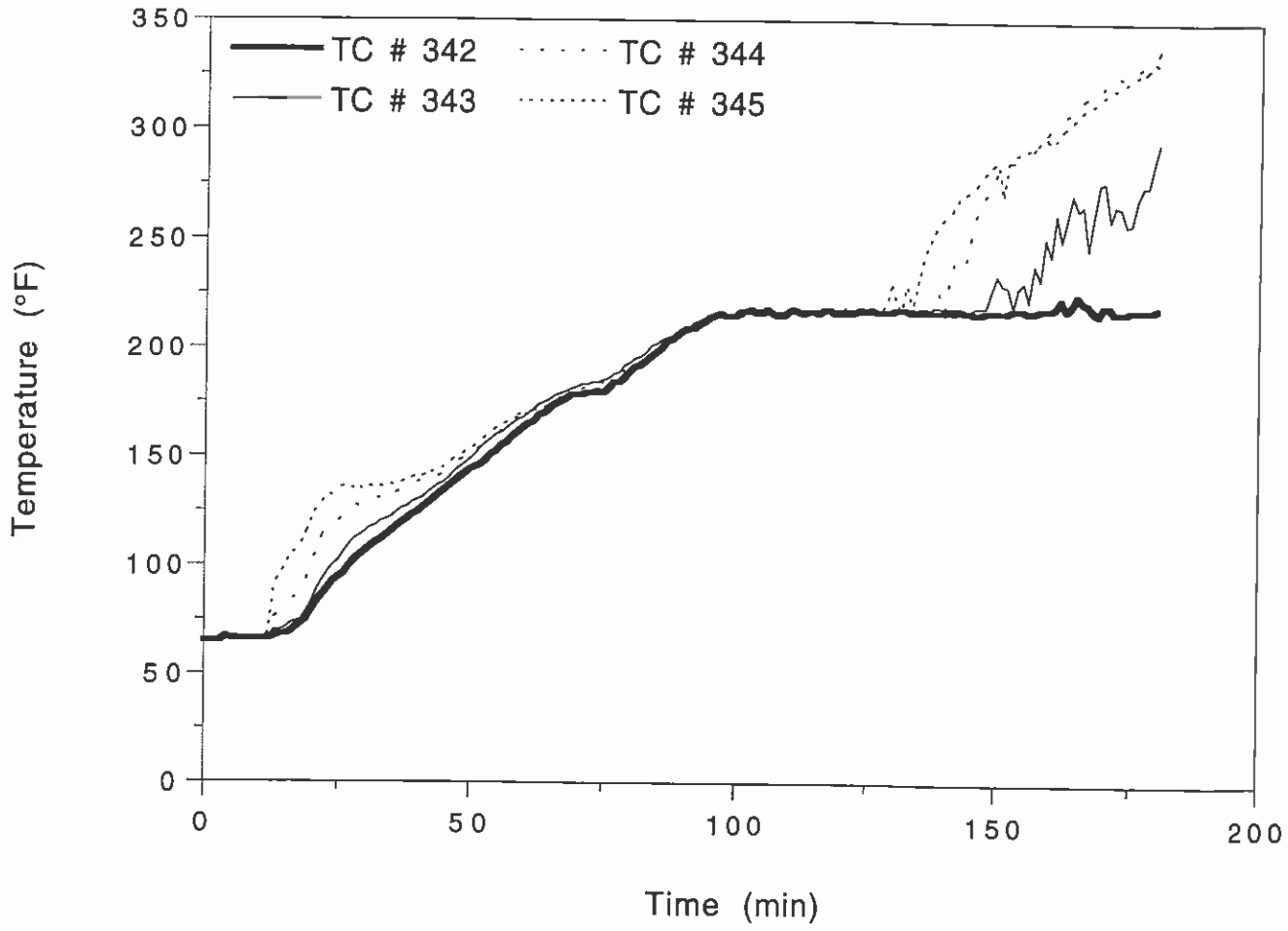
OMEGA POINT LABORATORIES

Project No. 14540-99123
Peak Seals, Inc.
2" Air Drop Temperatures



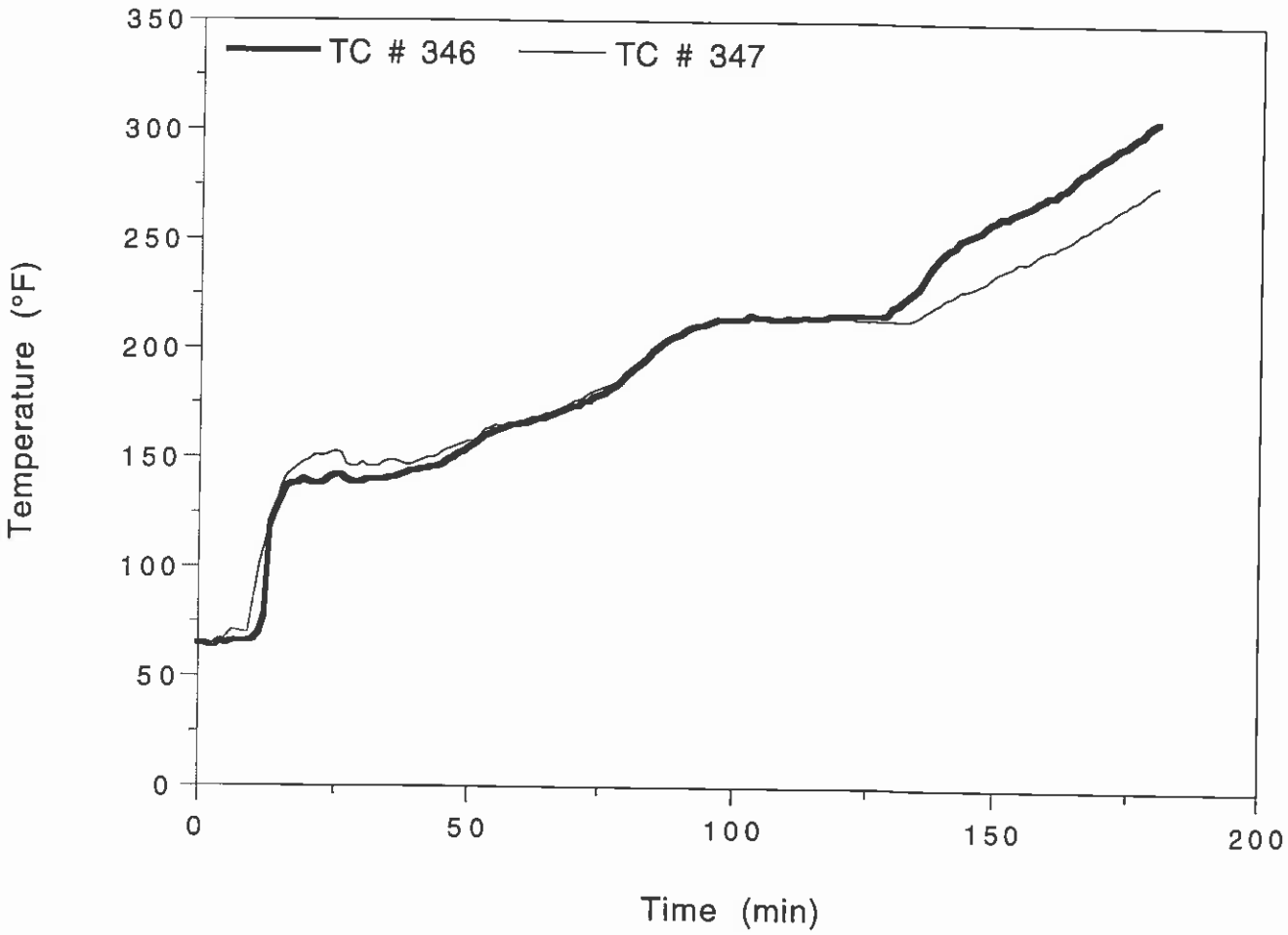
OMEGA POINT LABORATORIES

Project No. 14540-99123
Peak Seals, Inc.
2" Air Drop Bare #8



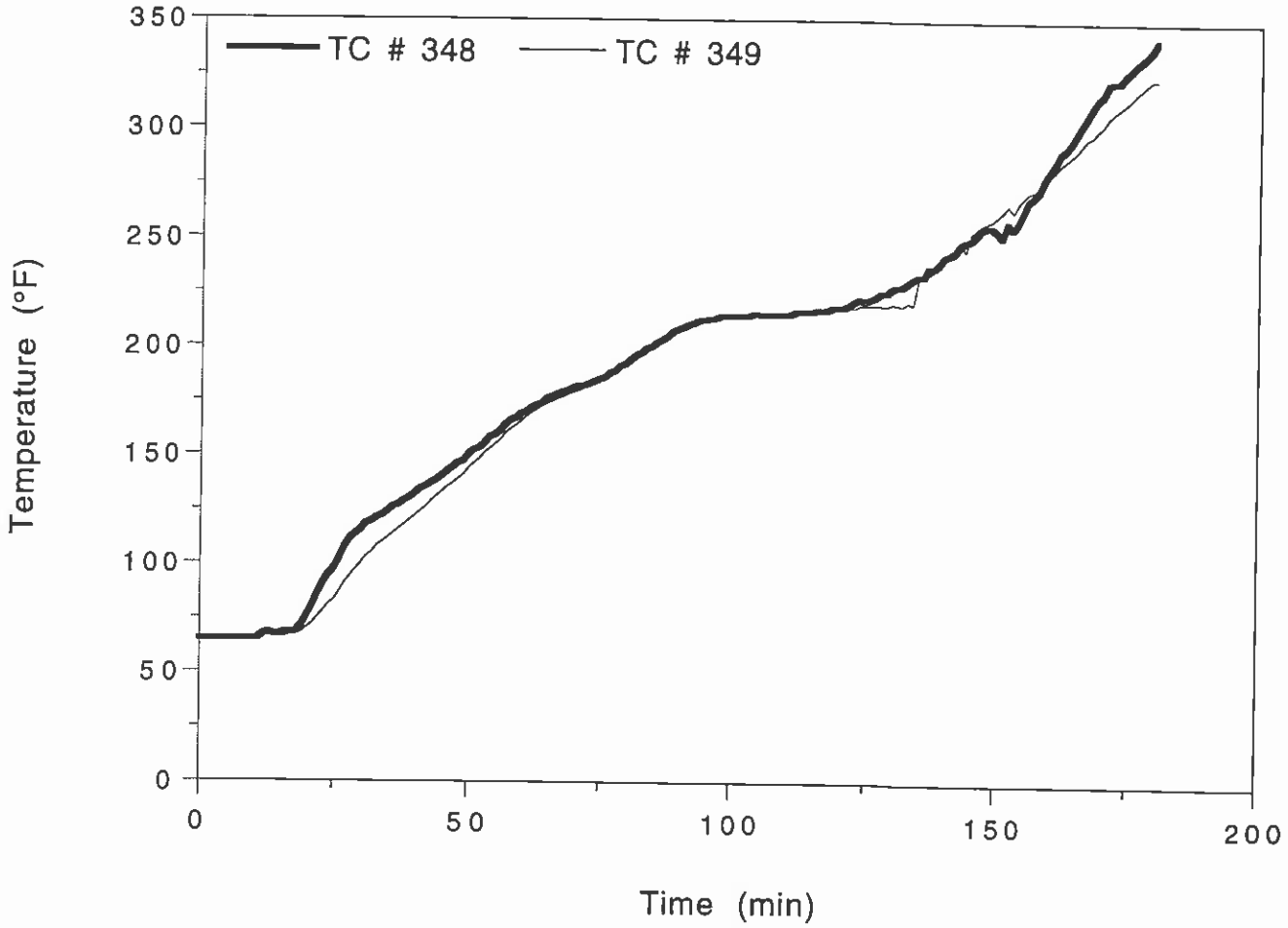
OMEGA POINT LABORATORIES

Project No. 14540-99123
Peak Seals, Inc.
2" Air Drop Bare #8



OMEGA POINT LABORATORIES

Project No. 14540-99123
Peak Seals, Inc.
2" Air Drop Conduit Stub



OMEGA POINT LABORATORIES

Peak Seals, Inc. Project No. 14540-99123 November 28, 1995

Time (min)	Air Drop Bare #8 Avg (°F)	Air Drop Bare #8 Max (°F)	2" Conduit Stub Avg (°F)
0	65	65	65
1	65	65	65
2	65	65	65
3	64	65	65
4	66	67	65
5	66	68	65
6	66	71	65
7	66	71	65
8	66	70	65
9	66	70	65
10	69	86	65
11	72	101	65
12	76	110	67
13	91	122	67
14	95	129	67
15	98	137	67
16	101	142	67
17	103	144	67
18	105	146	68
19	108	148	69
20	112	149	72
21	115	151	76
22	118	151	80
23	121	151	84
24	123	152	87
25	124	153	90
26	126	152	94
27	126	147	99
28	127	146	103
29	127	146	105
30	129	148	108
31	129	146	110
32	130	146	112
33	131	146	114
34	132	148	116
35	133	149	118
36	134	149	120
37	134	148	121
38	135	147	123
39	137	147	125
40	137	148	127
41	139	149	129
42	140	150	131
43	141	150	133
44	142	151	135
45	143	153	136
46	145	154	138
47	147	155	140
48	148	156	142
49	150	157	144
50	151	158	147
51	153	158	149
52	155	160	151
53	157	163	153
54	159	164	155
55	160	165	157
56	162	165	159
57	163	166	162
58	165	167	164
59	166	169	166
60	167	170	167
61	168	172	169
62	170	173	171
63	171	174	172
64	172	175	174
65	173	176	175
66	174	178	176

Peak Seals, Inc. Project No. 14540-99123 November 28, 1995

Time (min)	Air Drop Bare #8 Avg (°F)	Air Drop Bare #8 Max (°F)	2" Conduit Stub Avg (°F)
67	175	179	177
68	176	180	178
69	177	181	179
70	178	182	180
71	179	183	181
72	179	183	182
73	180	184	183
74	181	184	184
75	182	185	185
76	183	186	186
77	185	188	188
78	186	189	189
79	188	192	191
80	190	193	192
81	192	195	194
82	194	196	196
83	196	198	197
84	198	201	199
85	200	202	200
86	202	204	202
87	204	205	204
88	206	207	205
89	207	209	207
90	208	210	208
91	210	211	209
92	211	212	210
93	212	213	211
94	212	214	212
95	213	214	213
96	214	215	213
97	215	216	213
98	215	216	214
99	215	216	214
100	215	216	214
101	215	217	215
102	216	217	215
103	217	218	215
104	216	218	215
105	216	218	215
106	216	218	215
107	216	217	215
108	216	217	216
109	216	217	216
110	216	217	216
111	216	218	216
112	217	218	216
113	216	218	216
114	217	218	216
115	217	218	216
116	216	218	217
117	216	218	217
118	217	218	217
119	217	218	218
120	217	218	218
121	217	219	218
122	217	218	218
123	217	218	220
124	217	218	220
125	217	218	220
126	217	218	220
127	217	218	221
128	217	218	222
129	218	221	222
130	220	231	223
131	219	221	224
132	218	223	224
133	220	230	225

Peak Seals, Inc. Project No. 14540-99123 November 28, 1995

Time (min)	2" Conduit Stub Avg (°F)
134	226
135	232
136	234
137	235
138	237
139	239
140	242
141	244
142	245
143	248
144	247
145	252
146	253
147	256
148	257
149	257
150	258
151	257
152	262
153	259
154	263
155	267
156	270
157	271
158	274
159	278
160	281
161	284
162	288
163	290
164	292
165	295
166	299
167	302
168	304
169	308
170	310
171	314
172	316
173	317
174	320
175	322
176	325
177	326
178	328
179	331
180	333
Max Temp:	333
Max Allowed:	315

OMEGA POINT LABORATORIES

Peak Seals, Inc. Project No. 14540-99123 November 28, 1995

Time (min)	2" Condult Stub Max (°F)
0	65
1	65
2	65
3	65
4	65
5	65
6	65
7	65
8	65
9	65
10	65
11	65
12	67
13	68
14	67
15	67
16	68
17	68
18	68
19	71
20	75
21	80
22	85
23	90
24	94
25	97
26	102
27	107
28	111
29	113
30	115
31	118
32	119
33	121
34	122
35	124
36	126
37	127
38	129
39	130
40	132
41	134
42	135
43	137
44	138
45	140
46	142
47	144
48	146
49	147
50	150
51	152
52	153
53	155
54	158
55	159
56	161
57	164
58	166
59	167
60	169
61	170
62	172
63	173
64	174
65	176
66	177

Time (min)	2" Conduit Stub Max (°F)
67	178
68	179
69	180
70	181
71	182
72	182
73	183
74	184
75	185
76	186
77	188
78	189
79	191
80	192
81	194
82	196
83	197
84	199
85	201
86	202
87	204
88	206
89	207
90	209
91	210
92	211
93	212
94	212
95	213
96	214
97	214
98	214
99	214
100	215
101	215
102	215
103	215
104	215
105	216
106	216
107	216
108	216
109	216
110	216
111	216
112	216
113	216
114	217
115	216
116	217
117	217
118	217
119	218
120	218
121	218
122	219
123	221
124	222
125	221
126	222
127	223
128	225
129	225
130	227
131	228
132	228
133	230

Peak Seals, Inc. Project No. 14540-99123 November 28, 1995

Time (min)	2" Conduit Stub Max (°F)
134	232
135	233
136	235
137	237
138	237
139	239
140	242
141	245
142	246
143	248
144	249
145	253
146	255
147	257
148	258
149	259
150	261
151	263
152	266
153	263
154	267
155	270
156	272
157	273
158	275
159	278
160	282
161	285
162	290
163	292
164	295
165	299
166	303
167	307
168	311
169	315
170	317
171	322
172	323
173	323
174	326
175	328
176	331
177	333
178	335
179	338
180	342
Max Temp:	342
Max Allowed:	390

OMEGA POINT LABORATORIES

TC # 342 (°F)	TC # 343 (°F)	TC # 344 (°F)	TC # 345 (°F)	TC # 346 (°F)	TC # 347 (°F)	TC # 348 (°F)	TC # 349 (°F)
65	65	65	65	65	65	65	65
65	65	65	65	65	65	65	65
65	65	65	64	64	65	65	65
65	65	64	64	64	65	65	65
67	66	66	66	66	66	65	65
66	66	65	65	65	68	65	65
66	66	65	65	66	71	65	65
66	66	65	65	66	71	65	65
66	66	65	65	66	70	65	65
66	66	65	65	66	70	65	65
66	66	65	65	67	86	65	65
66	66	65	66	70	101	65	65
66	66	67	69	78	110	67	66
67	70	76	91	119	122	68	67
68	70	78	95	126	129	67	66
68	71	81	99	131	137	67	66
69	73	84	105	137	142	68	66
71	74	85	106	138	144	68	67
73	75	88	109	138	146	68	67
75	79	93	115	140	148	71	68
79	83	101	121	139	149	75	70
83	89	107	126	138	151	80	72
86	93	113	129	138	151	85	75
89	97	117	132	139	151	90	78
92	100	118	132	141	152	94	81
94	102	120	135	142	153	97	83
96	106	123	136	142	152	102	87
99	109	126	136	140	147	107	91
102	112	128	135	139	146	111	94
104	113	127	135	139	146	113	97
106	115	128	135	139	148	115	100
108	117	129	136	140	146	118	103
110	118	130	136	140	146	119	105
111	120	131	136	140	146	121	108
113	121	132	136	140	148	122	110
115	122	132	137	141	149	124	112
117	124	133	137	141	149	126	114
119	126	134	138	142	148	127	116
121	127	135	139	143	147	129	118
123	129	137	140	144	147	130	120
124	130	138	141	144	148	132	122
126	131	139	141	145	149	134	124
128	133	140	142	145	150	135	126
130	135	140	143	146	150	137	129
132	137	141	144	146	151	138	131
134	138	142	145	147	153	140	133
136	140	144	147	149	154	142	135
138	143	146	149	150	155	144	137
140	145	148	150	152	156	146	139

142	147	150	152	153	157	147	141
144	149	151	153	155	158	150	144
145	151	153	155	156	158	152	146
146	154	154	157	158	160	153	148
148	156	156	159	160	163	155	151
151	158	158	161	161	164	158	153
152	160	160	163	162	165	159	155
155	161	162	164	163	165	161	157
156	163	164	166	164	165	164	160
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	218	232	298	296	269	245	273	275
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	218	243	302	294	272	247	282	280
	219	262	304	297	271	247	285	282
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	221	246	316	311	283	256	307	297
	218	261	317	313	285	258	311	298
	216	276	318	315	287	259	315	301
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	218	269	329	326	299	270	331	318
	218	275	330	327	300	272	333	320
	218	275	331	329	303	274	335	322
	218	286	334	332	305	276	338	324
	219	295	338	331	306	277	342	324
Max Temp:	225	295	338	332	306	277	342	324
Max Allowed:	390	390	390	390	390	390	390	390