TEST REPORT

ASTM E119-00a

Fire Tests of Building Construction and Materials*

APPENDIX R, ONE-HOUR FIRE RESISTIVE CONTROL CABLE TEST

Project No. 14980-119368, Revision 1

*Modified in that the test specimen was not one that is described in the standard, but the exposure was in accordance with the E119 time-temperature curve.

August 11, 2004

AREVA	Framatome ANP, Inc., *an AREVA and Siemens company*
	58-5047207-01

Prepared for:
AREVA
(Framatome ANP DE&S)
6100 Southwest Blvd., Suite 400
Fort Worth, Texas 76109

OMEGA POINT
LABORATORIES, INC.
16015 Shady Falls Road
Elmendorf, TX 78112
(v) 210-635-8100
(f) 210-635-8101
800-966-5253
www.opl.com

Abstract

This document describes the evaluation of an 8/C #12 AWG Meggitt Safety Systems electrical cable and several support systems and attachment methods, when exposed to the ASTM E119 time-temperature heating curve for a period exceeding one hour. All supports and connections remained firm and secure. Electrical testing was performed on the cable before, during and after the testing, and the minimum acceptance criteria were met.

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 the manufacturer'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.

Deggary N. Priest, President

August 11, 2004
Date

Reviewed and approved:

QA Director

Date: August 11, 2004

Omega Point Laboratories, Inc.
16015 Shady Falls Road
Elmendorf, Texas 78112-9784
210-635-8100 / FAX: 210-635-8101 / 800-966-5253
www.opl.com / e-mail: dnpriest@ix.netcom.com

ACCREDITED
No. 0689-01

TABLE OF CONTENTS

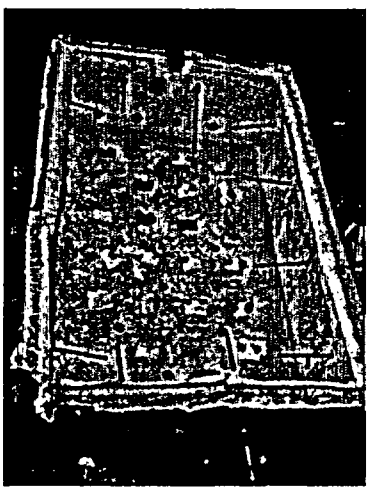
INTRODUCTION

The objective of this test program was to demonstrate the performance of an 8/C #12 AWG Meggitt Safety Systems, Inc. fire resistive cable and cable support designs during a 1-hour fire exposure and following exposure to a hose stream test. The furnace temperatures, furnace thermocouples, Megger testing and hose stream testing were conducted in accordance with Generic Letter 86-10 Supplement 1.

TEST PROCEDURE

Horizontal Test Furnace

The 7' x 12' x 40" deep horizontal test furnace is designed to allow the specimen to be uniformly exposed to the specified time-temperature conditions. It is fitted with 26 symmetrically-located diffuse-flame natural gas pipe burners 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 +0.03" W.C. to -0.05" W.C. The furnace has been constructed so that the front (40" x 12') wall section can be removed to allow the evaluations of wall/ceiling interfaces and other specific applications.

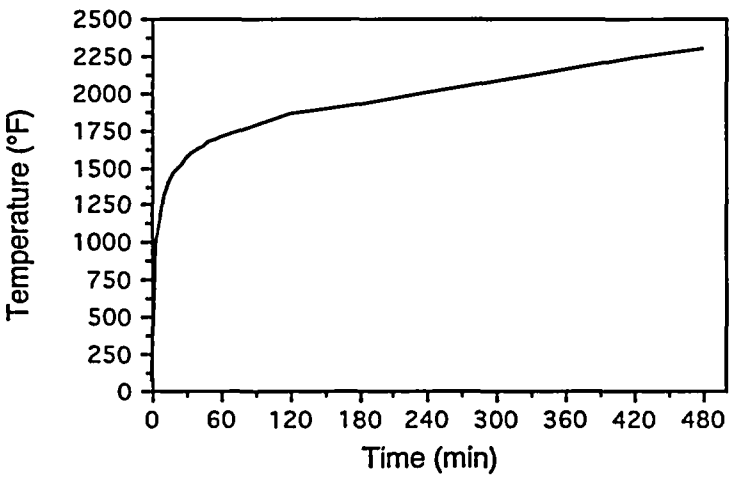


7' x 12' Horizontal Furnace (Plan View)

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 horizontal 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 recorded every 15 seconds and displayed for the furnace operator to allow control along the specified temperature curve. For report presentation purposes, the data is saved once per minute.

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



Time (min)	Temperature (°F)
0	68
5	1000
10	1300
20	1462
30	1550
60	1700
90	1792
120	1850
180	1925
240	2000
300	2075
360	2150
420	2225
480	2300

Figure 1

The furnace interior temperature during a test is controlled such that the area under the time-temperature curve is within 10% of the corresponding area under the standard time-temperature curve for 1 hour or less tests, 7.5% for those less than 2 hours and 5% for those tests of 2 hours or more duration.

Furnace Pressure

The pressure differential between the inside of the furnace (as measured approximately 3/4" below the exposed surface of the test slab) and the laboratory ambient air was maintained at +0.01 inches

of water column for the duration of the fire exposure test (after the first five minutes, during which furnace stabilization was achieved).

Thermocouple Locations

No temperatures were monitored within the heated area except for those used to monitor and control the furnace interior temperature.

Data Acquisition Systems

The furnace control thermocouples were monitored by a 100 channel Yokogawa, Inc. Model Darwin Data Acquisition Unit and a Macintosh computer. The computer was programmed in LabVIEW 5.0 to send the commands to the data acquisition system to sample the data input lines and to convert the raw data into a usable format for display on screen and storage as an ASCII tab-delimited text file. That files were then, after the test, imported into MS Excel for conversion to user units and tabular and graphical display.

Correction Factor

When the indicated resistance period is $^1/_2$ h or over, determined by the average or maximum temperature rise on the unexposed surface or within the test sample, or by failure under load, a correction shall be applied for variation of the furnace exposure from that prescribed, where it will affect the classification, by multiplying the indicated period by two thirds of the difference in area between the curve of average furnace temperature and the standard curve for the first three fourths of the period and dividing the product by the area between the standard curve and a base line of 68°F (20°C) for the same part of the indicated period, the latter area increased by 3240°F • min to compensate for the thermal lag of the furnace thermocouples during the first part of the test. For a fire exposure in the test higher than standard, the indicated resistance period shall be increased by the amount of the correction. For a fire exposure in the test lower than standard, the indicated resistance period shall be similarly decreased for fire exposure below standard. The correction is accomplished by mathematically adding the correction factor, C, to the indicated resistance period.

The correction can be expressed by the following equation:

$$C = \frac{2I(A - A_s)}{3(A_s + L)}$$

where:

C = correction in the same units as *I*,
I = indicated fire-resistance period,
A = area under the curve of indicated average furnace temperature for the first three fourths of the indicated period,
A_s = area under the standard furnace curve for the same part of the indicated period, and
L = lag correction in the same units as *A* and A_s (54°F•h or 30°C•h (3240°F•min or 1800°C•min))

Hose Stream Test

Immediately following the fire endurance test, a hose stream test was performed in accordance with USNRC Generic Letter 86-10, Supplement 1, Enclosure 1, Section VI. The hose stream was "applied at random to all exposed surfaces of the test specimen through a 1-1/2" fog nozzle set at a discharge angle of 30 degrees with a nozzle pressure of not less than 75 psi and a minimum discharge pressure of 75 gpm with the tip of the nozzle at a maximum of 5 feet from the test specimen. Duration of the hose stream application is 5 minutes." Prior to the hose stream application, the laboratory ensured the correct angle spray pattern, pressure and flow was achieved through calibrated gauges and other equipment as required.

Acceptance Criteria (Excerpted from Test Plan)

3.0 ACCEPTANCE CRITERIA

3.1 The acceptance criteria for the cable supports is that the cable supports remain attached to the test slab and that the cable remains attached to the supports, and that there is no functionally adverse physical interaction between the cable support material and the cable test specimen during the fire endurance test and the hose stream test.

3.2 A minimum conductor to conductor or conductor to cable sheath (shield) insulation resistance (IR) value of 5.7 megohms per foot is considered to be the test acceptance criteria. The cable IR values obtained during the fire test exposure and after application of the hose stream will be used to demonstrate the functional capability of FNP specific Appendix R control circuit applications.

3.3 The acceptance criteria for the conductor resistance is to show that conductor has continuity before the fire test and after the fire hose test.

3.4 The seals used for closure of the openings in the test slab will be ceramic fiber and are not being tested or considered part of the test assembly.

TEST SPECIMEN CONSTRUCTION

Test Slab

An 8' x 13' x 8" thick normal weight concrete slab (used previously) was in excellent condition and hence was utilized in this project after being turned over and any holes filled with ready-mix concrete. The slab was then cured at 350°F for one week, cooled and placed on a work stand. It was then cooled and the appropriate holes cored through to receive the cables and the all-thread rod used to attach some of the supports.

Meggitt Safety Systems, Inc. (MSSI) Cable Installation

Prior to installation in the test assembly, meggering tests were performed on all conductors in the MSSI cable in an "as received" condition. Results of this testing can be found in Appendix B.

The support slab was cored and prepared as described in the drawings supplied by AREVA (Framatome-ANP, see Appendix A Test Plan), including the installation of the required supports. A single 8/C #12 AWG Meggitt Safety Systems cable was installed, as indicated in the drawings. The length of cable exposed to the furnace heat was 24' 2" (24.167 ft).

The cable passed through a 5" diameter hole in the 8" thick concrete slab, entering the heated area of the assembly. After a series of 90° bends, the cable exited the heated area of the furnace by passing once again through a different 5" diameter hole in the concrete slab. Each cable end was identified as "in" or "out," to differentiate between ends. The "in" end was the end that entered the heated area and traveled along close to the slab. The "out" end was the end that was running horizontally 36" below the slab and then passing up and out. Once the cable installation was complete, the remaining openings were filled with ceramic fiber blanket stuffed as tightly as possible.

GENERAL

The cable was grounded to the slab through its metallic connections at all supports. Also the cable outer stainless steel shield was grounded to the slab and connections on the top surface of the slab. The support systems that were held in place by all-thread rods passing through the slab were all added to the ground circuit on the cold side of the slab.

A piece of plywood was mounted on top of the slab to serve as a panel for making connections when performing megger or conductor resistance testing. The actual conductors from each end of the cable were inserted from the back of the panel and stuck out several inches for the operators to make connections.

Representatives of Grubb Engineering, Inc. then arrived and performed Megger Testing and Conductor Resistance Testing in accordance with the test plan. These results are presented in Appendix B: Meggering & Conductor Resistance Results.

TEST RESULTS

The instrumented test article was placed on top of the furnace on June 17, 2004. The thermocouples were connected to the data acquisition system and their outputs verified. The furnace was fired, and heating continued for 20 minutes. Meggering was then performed between all conductors of the cable. The megger operator read his results to a representative of the OPL QA/QC Department, who noted the reading and the time at which that reading was taken.

The ambient temperature at the start of the test was 85°F, with 78% relative humidity. The furnace was fired at 10:52 AM and the standard time-temperature curve followed for 60 minutes. Then the temperature was held steady at the 60 minute E119 temperature (1700°F) from 60 minutes until test completion at 102 minutes. The pressure differential between the inside of the furnace (as measured approximately 3/4" below the exposed surface of the test slab) and the laboratory ambient air was maintained at +0.01 inches of water column for the duration of the fire exposure test (after the first five minutes, during which furnace stabilization was achieved).

Persons present to perform or witness the test were as follows:

Cal Banning	-	Framatome ANP
John Crowther	-	Framatome ANP
J.C. Vance	-	Southern Companies
Fred Rudek	-	Meggitt Safety Systems
Dhanesh Butani	-	Bechtel Power
Jeff Piel	-	Grubb Engineering
Deggary Priest	-	Omega Point Laboratories, Inc.
Connie Humphrey	-	Omega Point Laboratories, Inc.
Cleda Patton	-	Omega Point Laboratories, Inc.
Troy Bronstad	-	Omega Point Laboratories, Inc.
Oscar Estrada	-	Omega Point Laboratories, Inc.
Richard Beasley	-	Omega Point Laboratories, Inc.

Observations made during the test were as follows:

TIME	OBSERVATIONS
0:00	Furnace ignited at 10:52 AM.
5:00	Furnace interior pressure adjusted to +0.01" WC at a point 3/4" below the slab, resulting in a neutral pressure plane position approximately 12" below the underside of the slab.
20:00	Megger testing began.
30:00	Furnace operating normally. No visual observations within the furnace.
45:00	Furnace operating normally. Still no obvious changes inside.
60:00	Meggering still not completed for the first round. The client requested that the furnace be kept on, but that the temperature be held steady and continuously at the E119 sixty-minute temperature (1700°F).
61:00	First round of meggering completed.
62:00	Second round of meggering begun.
99:12	Second round of meggering completed.

TIME OBSERVATIONS (continued)

102:00 Furnace extinguished and test article removed from the furnace to be moved to the hose stream test area. All cable supports were red hot but solidly attached to the slab and the cable. No visible damage to either supports or cable.

105:56 Hose stream test started. Details: 75 psi, 30° fog nozzle, 75 gpm (min) from a distance of 5 feet. Slab was slowly spun to expose all parts of the heated area.

110:56 Hose stream test stopped. Slight amount of concrete paste fell from the slab. The cable supports remained firmly attached to both the concrete slab and the cable. No visible damage to either supports or cable.

120:12 Final conductor resistance test started.

121:23 Final conductor resistance test completed.

122:36 Final meggering test started.

127:57 Final meggering test completed.

In accordance with the E119 test standard, a calculation for any correction to the indicated fire resistance period was done. The correction factor was then mathematically added to the indicated fire resistance period, yielding the fire resistance period achieved by this specimen:

ITEM	DESCRIPTION	TEST VALUE
C	correction factor	-0.85 min (-51 seconds)
I	indicated fire-resistance period	102 min
A	area under the curve of indicated average furnace temperature for the first three fourths of the indicated period	109 616°F • min
As	area under the standard furnace curve for the same part of the indicated period	111 045°F • min
L	lag correction	3240°F • min
	FIRE RESISTANCE PERIOD ACHIEVED BY THIS SPECIMEN ==>	101 min

Note: The standard specifies that the fire resistance be determined to the nearest integral minute. Consequently, if the correction factor is less than 30 seconds, and the test specimen met the criteria for the full indicated fire resistance period, no correction is deemed necessary. In this case, the area was slightly low, and so the reduction in the fire resistance period has been reduced from 102 minutes to 101 minutes. It should be realized that the furnace temperature was not allowed to exceed that required by the standard at a time of 60 minutes, which was why the integration was a little low.

Listings and a plot of the furnace interior temperature can be found in Appendix C. A photographic documentation of each test has been included in Appendix E.

OBSERVATIONS AFTER THE FIRE AND HOSE STREAM TESTS

ITEM	POST FIRE TEST	POST HOSE STREAM TEST
Meggitt Cables & Supports	Upon removal from the furnace, the Meggitt cable cooled to below red heat immediately. The more massive steel supports remained bright red. All Meggitt cable supports remained straight and firmly attached, with no obvious effect of the heat. The Meggitt cable remained firmly in position, with insignificant sagging.	The Meggitt cable supports remained straight and firmly attached, with no obvious effects from the heat. The Meggitt cable remained firmly in position, with insignificant sagging over even the longest horizontal run. All items below the slab were covered with wet, calcined concrete (a common occurrence when hot concrete slabs are wetted). All clamps holding the Meggitt cable to the supports remained firmly in place. Removal of the clamps from several locations showed no damage to the outer shield.

Following the completion of all testing, the ceramic fiber was removed from the holes in the slab and the Meggitt cable was removed in one piece, rolled into a nominally 36" coil and placed in a cardboard box for shipping back to MSSI.

OBSERVATIONS MADE DURING THE MEGGER AND CONDUCTOR RESISTANCE TESTS

The results indicated below do not represent a full and precise analysis of the meggering and conductor resistance data obtained. The actual test data sheets have been included in Appendix B for analysis by qualified and authorized persons.

8/C #12 AWG CABLE

Pre-Test

The cable's conductors were tested with a megger between all possible combinations of conductors and shield at a voltage of 500 VDC. The results were obtained rapidly for each reading with the resistances all above 10,000 MΩ. The conductor resistances were all around 0.096 Ω.

During Fire Test (20 minutes)

The megger readings dropped significantly, to a low of 0.8 MΩ to a high of 1.6 MΩ. The time required for equilibrium took significantly longer than the pre-test meggering did. This series of measurements was not completed until 61 minutes. No conductor resistance readings were taken during the fire tests on any cable.

During Fire Test (60 minutes)

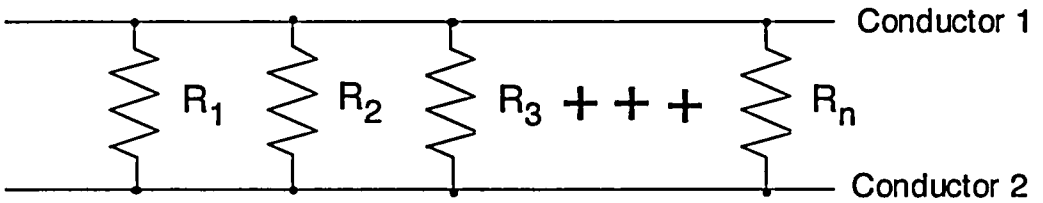
The megger readings remained fairly steady, ranging from a minimum of 0.92 MΩ to a maximum of 1.5 MΩ. The equilibrium times were somewhat shorter than before, being completed at a test time of 99 minutes.

Post Hose Stream Test

Meggering and conductor resistance tests were repeated immediately following the fire and hose stream tests. The megger readings were mostly >10,000 MΩ, with a low reading of 8.5 MΩ. The conductor resistance results ranged from a low of 0.101 Ω to a high of 0.105 Ω.

DETERMINING INSULATION RESISTANCE PER FOOT

For simplification, define the combined system insulation resistance to shield or another conductor as indicated. The overall resistance (R_T) can be considered to be the sum of the resistances per each foot of cable, as shown in the circuit below.



The total resistance of an electrical circuit made up of a number of resistances in parallel is represented by:

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots + \frac{1}{R_n}$$

Where:

R_T	=	Total resistance between conductor and shield or conductor and another conductor.
n	=	Number of feet of cable (in fire-heated area for this case)
R_1	=	Resistance between conductor and shield or conductor and another conductor over the first foot of heated cable.
R_n	=	Resistance between conductor and shield or conductor and another conductor over the n^{th} foot of heated cable.

Assuming that all resistance per foot values are equivalent, this equation reduces to:

$$\frac{1}{R_T} = n\left(\frac{1}{R_{ft}}\right) = \frac{n}{R_{ft}}$$

Rearranging and solving for the resistance per foot:

$$R_{ft} = nR_T$$

where:

n = 24.167

Minimum Insulation Resistance Values

TEST TIME	R_T (min)	R_{ft} (min)
Pre-Fire Test	>10,000 MΩ	>242 GΩ
Fire Test (20 - 61 min)	0.8 MΩ	19.3 MΩ
Fire Test (62 - 99 min)	0.92 MΩ	22.2 MΩ
Post Fire/Hose Stream Test	8.5 MΩ	205.4 MΩ

CONCLUSIONS

In accordance with the acceptance criteria listed in the Test Plan, all supports were successful and met the requirements of the Test Plan. None failed to hold up its load and all remained firmly attached to the concrete slab. There was no visible interaction between any of the support materials and the MSSI cable.

The minimum acceptable insulation resistance value was 5.7 MΩ. All of the conductor insulation values remained significantly above that minimum value throughout the entire test procedure.

The conductor resistance values pre- and post-test were not significantly affected by the test.

Appendix A

TEST PLAN & CONSTRUCTION DRAWINGS

AREVA

ENGINEERING INFORMATION RECORD

Document Identifier 51 - 5045887 - 01

Title Appendix R, One-Hour Fire Resistive Control Cable Test Plan

PREPARED BY:	REVIEWED BY:
Name John G. Crowther	Name Richard L. Dible
Signature [signature] Date 6/23/2004	Signature [signature] Date 6/23/2004

Technical Manager Statement: Initials [initials]

Reviewer is Independent.

Remarks:

This test plan documents the scope of this test, the objectives, the acceptance criteria, the responsibilities of the client (Meggitt Safety Systems, Inc.), Framatome ANP and the test laboratory (Omega Point Laboratories), the prerequisites for the test, the procedure to be followed in conducting the test and the preparation of the test report.

This revision of the test plan is to incorporate as built conditions.

TABLE OF CONTENTS

SCOPE

1.0 THIS TEST PLAN DESCRIBES THE METHODS AND GUIDELINES TO BE UTILIZED FOR THE PREPARATION OF TEST SPECIMEN, PERFORMANCE OF FIRE AND HOSE STREAM TESTS, TEMPERATURE MONITORING, MEGGER TESTING (INSULATION RESISTANCE) DATA COLLECTION, CONDUCTOR RESISTANCE DATA COLLECTION, AND ALL APPLICABLE DOCUMENTATION OF THESE TASKS AND THE TEST RESULTS. THE TEST SPECIMEN CONFIGURATION WILL BE REPRESENTATIVE OF THE PROPOSED MEGGITT SAFETY SYSTEMS, INC. (MSSI) 8 CONDUCTOR # 12 AWG APPENDIX R CONTROL CABLE INSTALLATION TO BE IMPLEMENTED BY DESIGN CHANGE PACKAGES (DCPS 03-1-9901, 03-1-9902, AND 03-2-9906) AT FARLEY NUCLEAR PLANT (FNP).

2.0 OBJECTIVE

The objective of this test program is to demonstrate the performance of the MSSI 8-conductor # 12 AWG fire resistive control cable and the cable support design during a 1-hour ASTM E-119 fire exposure and subsequent exposure to a hose stream test. The furnace temperatures, furnace thermocouples, Megger testing and hose stream testing will be conducted in accordance with US NRC Generic Letter 86-10 Supplement 1. The test will also include collection of electrical characteristic data (insulation resistance, conductor resistance) for the MSSI cable test specimen.

3.0 ACCEPTANCE CRITERIA

3.1 The acceptance criteria for the cable supports is that the cable supports remain attached to the test slab and that the cable remains attached to the supports, and that there is no functionally adverse physical interaction between the cable support material and the cable test specimen during the fire endurance test and the hose stream test.

3.2 A minimum conductor to conductor or conductor to cable sheath (shield) insulation resistance (IR) value of 5.7 megohms per foot is considered to be the test acceptance criteria. The cable IR values obtained during the fire test exposure and after application of the hose stream will be used to demonstrate the functional capability of FNP specific Appendix R control circuit applications.

3.3 The acceptance criteria for the conductor resistance is to show that conductor has continuity before the fire test and after the fire hose test.

3.4 The seals used for closure of the openings in the test slab will be ceramic fiber and are not being tested or considered part of the test assembly.

4.0 DEFINITIONS

4.1 Test Slab / Deck – An assembly designed to support the test item in position within the test furnace.

4.2 Test Item – All materials associated with Meggitt Cable including supports.

4.3 Test Assembly – The combination of the test item(s), thermocouples and test deck.

4.4 Thermocouple – An electrical assembly used to measure temperature, consisting of an electrically-welded, fused junction of dissimilar metals and their respective leads to the data acquisition system. The thermocouple leads are insulated with materials capable of withstanding the moisture and heat requirements of the test environment.

5.0 RESPONSIBILITIES

5.1 Meggitt Safety Systems, Inc.

5.1.1 Assume, through its contractor, total management responsibility of this test program.

5.1.2 Coordinate with FANP to provide designs for the specific test items. MSSI, in particular to provide designs for cable supports.

5.1.3 Once this test procedure is approved, MSSI must approve any changes in the test methodology. MSSI will coordinate such approval with Bechtel and / or Southern Nuclear-Farley as appropriate.

5.1.4 Provide the 8-conductor, 12 AWG cable to be tested and other materials as indicated on the Bill of Materials (Drawing 02-5045841A). MSSI will record the IR values between conductor to conductor and each conductor to cable sheath, (data to be recorded) prior to preparation of the cable for shipment to Omega Point Laboratories, Inc. (OPL).

5.1.5 Provide a representative to be present to witness the fire endurance and hose stream tests.

5.1.6 Provide review of DRAFT test report including one set of "consolidated" comments. MSSI will coordinate any approvals / reviews / comments, etc with Bechtel and / or Southern Nuclear-Farley as appropriate.

5.2 Framatome ANP (FANP)

5.2.1 In coordination with MSSI, establish the criteria, guidelines, drawings, bill of materials, recommendations, etc., to govern the construction of the Test Assembly.

5.2.2 Provide the test item installation drawings / instructions and QC instructions.

5.2.3 Provide scheduling of personnel, equipment and material necessary to perform the installation.

5.2.4 Coordinate all phases of the fire test preparation with the testing organization including approval of any changes to the test methodology described herein.

5.2.5 Contract testing laboratory services.

5.3 Omega Point Laboratories, Inc. (OPL)

5.3.1 OPL shall coordinate with FANP the development of the Test Plan.

5.3.2 Provide and prepare the test furnace, test slab, test items and provide required test instrumentation in accordance with the Laboratory's Quality Assurance Program and Quality Control Program.

5.3.3 Provide furnace thermocouples and thermocouple calibration and instrumentation.

5.3.4 Provide all test equipment necessary to provide Megger testing data collection and conductor resistance data collection. Megger testing shall be conducted in accordance with US NRC GL 86-10, Supplement 1 and as specified herein.

5.3.5 Procure the support materials as specified by FANP as required to construct the test assemblies. Such materials may include, but are not limited to, tools and equipment, fasteners, supports, structural steel, etc., as shown on FANP test assembly drawings.

5.3.6 Assemble, install and document the installation of all Meggitt Cable, supports, etc. This includes installing the attachment plates sufficient to hold the test articles during the test.

5.3.7 Provide computer-generated drawing, showing location of furnace thermocouples.

5.3.8 Record and overview, using the Laboratory Event Log, the QC documentation for the installation of all test items.

5.3.9 Conduct the fire endurance and hose stream test including performing all Megger testing data collection, and conductor resistance data collection in accordance with this test plan.

5.3.10 Inspect and document the physical condition of the test item following completion of the post-hose stream insulation test.

5.3.11 Document the test parameters and provide a formal detailed written report of the test program and test results (provide 5 copies).

5.3.12 Provide photographic coverage of the test items, the fire and hose stream tests and the post-test activities. Provide VHS video coverage of the test items during the fire and hose stream test and post-test.

5.4 Laboratory (OPL) Quality Assurance / Quality Control

5.4.1 Receive, inspect, and record all materials associated with the test items. The quality control documentation for these materials provided by the Laboratory will be documented in the final test report. OPL shall follow the unpacking, inspection and storage requirements of MSSI document ER 04-033 upon receipt of the test cable from MSSI including recording the IR values between conductor to conductor and each conductor to cable sheath, (data to be recorded) of the cable as received from MSSI prior to installation of the cable at OPL..

5.4.2 Inspect and document that the materials used and construction of test items comply with applicable drawings. OPL shall also measure and document the installed length of the cable test specimen located within the fire test chamber as constructed for the test.

5.4.3 Witness the process utilized in the installation of the test assembly and suitably document observations in event logs, inspection reports, etc.

5.4.4 Inspect and document the instrumentation of the test items.

5.4.5 Provide written calibration documentation of all thermocouples, measurement devices and data acquisition systems used in this test program.

5.4.6 Witness the fire endurance test and hose stream test to document test performance and confirm test results.

5.4.7 Complete the Test Article Attribute Checklist (Drawing 02-5045842A) prior to the start of the test.

6.0 PREREQUISITES

6.1 General Test Configuration Requirements

- The test items used in this test program shall be representative of the FNP configuration or intended plant configurations and shall be specified and designed by MSSI. MSSI shall be responsible for coordinating all design / review activities with Bechtel and Southern Nuclear Operating Company, Inc. (SNC). The test items to be subjected to fire endurance and hose stream tests shall be in accordance with the FANP assembly drawings and instructions. The following are the assembly drawings and instructions (latest revision shall apply):
    - Drawing 02-5045835A
    - Drawing 02-5045836A
    - Drawing 02-5045837A
    - Drawing 02-5045838A
    - Drawing 02-5045839A
    - Drawing 02-5045841A
    - Drawing 02-5045842A
- MSSI Document ER 04-033, Unpacking, Inspection, Installation and Standard Practices for Fire Rated Cable for J.M. Farley Nuclear Power Plant.

6.2 Traceability Requirements

All thermocouples used in this test program shall be traceable to the respective thermocouple manufacturer, with calibration certification, provided by Omega Point Laboratories.

6.3 Dimensioned Drawings

6.3.1 The test articles shall conform to the dimensioned drawings provided by FANP. All changes to these drawings shall be implemented and controlled by FANP. Final revisions of all drawings shall be provided by FANP for inclusion into and use in preparing the final test report.

6.3.2 Final, dimensioned drawings depicting layout of the furnace thermocouples will be prepared by OPL, for inclusion in the final test report.

6.4 Electrical Wiring Diagrams

6.4.1 The external connections to the test cable shall conform to the Electrical Wiring Diagrams provided by OPL (See figure 1 in this test plan). All changes to the diagram shall be implemented and controlled by FANP and approved by MSSI. Final revisions of the diagram shall be implemented and controlled by FANP. Final revisions of all diagrams shall be provided by FANP in this Test Plan for inclusion into and use in preparing the final test report.

6.5 Test Configurations

6.5.1 General

6.5.1.1 The test specimen shall be sufficiently secured to the test deck and/or sealed by Laboratory personnel, in accordance with instructions and drawings. The test deck will consist of a concrete slab, reinforced with structural steel elements sufficient to carry the load of the test specimen and support assembly.

6.5.1.2 The concrete test slab is to be cured and conditioned to reduce the risk of spalling. Where an existing test slab is to be reused, it shall be inspected to ensure that it is in good condition. The slab will be conditioned to moisture equilibrium at indoor conditions or drier to ensure no spalling.

6.5.1.3 Penetration openings for the Meggitt cable will be sealed using ceramic fiber.

6.5.2 Test Specimen

All test items will be constructed in accordance with drawings provided by FANP, and in accordance with MSSI Document ER 04-033, Unpacking, Inspection, Installation and Standard Practice for Fire Rated Cable. Tools used for test cable bending shall be

approved by MSSI and identified by tool manufacturer and model number on the OPL QC documentation for the installation of the test items.

6.5.3 Grounding of Supports

Meggitt Cable supports will be grounded by attaching grounding cables to the through slab all thread rod located on top of the slab. This all thread rod attaches the surface mounted steel plates for each of the hangers to the slab.

6.6 Thermocouple Installation

6.6.1 Furnace thermocouples shall be provided and installed in accordance with US NRC GL 86-10, Supplement 1. All thermocouples used in this test program shall be provided and installed by OPL, with QC surveillance by Laboratory personnel.

6.6.2 The measured temperature to be compared with the standard time-temperature curve is to be the average temperature obtained from the reading of thermocouples symmetrically disposed and distributed to indicate the temperature near all parts of the specimen.

6.6.3 At least three thermocouples are to be used with no fewer than five thermocouples per 100 square feet of floor area. The junctions of the thermocouples are to be placed 12 inches from the exposed surface of the test assembly.

6.6.4 Each furnace thermocouple is to be enclosed in a sealed protection tube. The exposed combined length of protection tube and thermocouple in the furnace chamber is to be not less than 12 inches.

6.6.5 The time constant of the protected thermocouple assembly is to be within the range of 5.0 to 7.2 minutes. A typical thermocouple assembly complying with this time constant requirement is fabricated by fusion-welding the twisted ends of No. 18 AWG chromel-alumel wires, mounting the leads in porcelain insulators and inserting the assembly into a standard weight ½ inch (0.84 inch outside diameter) black wrought iron, black wrought steel or Inconel pipe, and sealing the end of the pipe that is inside the furnace. The thermocouple junction is to be inside the pipe, 1/2 inch from the sealed end.

6.6.6 The temperatures are to be read at intervals not exceeding 1 minute throughout the fire test.

6.6.7 The temperature of the furnace is to be controlled so that the area under the measured time-temperature curve, obtained by averaging the results from the thermocouple readings, is within 10 percent of the corresponding area under the standard time-temperature curve for a 1 hour test.

6.6.8 Engineering thermocouples for information only will be provided for temperature measurements of the cable sheath outside the fire test chamber. One thermocouple will

be placed on the each cable sheath as near to the cable exit from the test slab as practical, and another thermocouple will be placed on each cable sheath approximately 8 to 16 inches away from the previous measurement location on the cold side of the test slab.

6.7 Preburn Inspection

6.7.1 Prior to the commencement of the fire endurance test, a thorough check of the test assembly and associated equipment (including data recording equipment, megohmeter for Megger testing, and conductor resistance testing equipment) and completion of applicable Laboratory QA/QC checklists shall be performed and documented by the testing laboratory.

6.7.2 Written approval of the construction, assembly, installation and instrumentation will be supplied by FANP and OPL prior to performance of the fire exposure test (a sign-off sheet for this purpose will be supplied by the Laboratory).

7.0 PROCEDURE

7.1 General

7.1.1 The testing sequence will be as follows:

7.1.1.1 After construction and connection of the test assembly and prior to the start of the fire endurance test: Megger testing data collection shall be conducted in accordance with Section 7.2. Conductor resistance data collection shall be performed in accordance with Section 7.3.

7.1.1.2 During the 1-hour fire endurance test, Megger testing data collection shall be performed starting at 20 minutes into the fire test and will be conducted at 20 minute intervals during the test. The test may be extended past 1-hour as necessary to finalize the testing. Megger testing data collection shall be conducted in accordance with Section 7.2. .

7.1.1.3 At the completion of the fire endurance test the test assembly shall be subjected to a hose stream test in accordance with Section 7.4.

7.1.1.4 After the hose stream test, the following monitoring/data collection shall be performed: Megger testing data collection shall be conducted in accordance with Section 7.2. Conductor resistance data collection shall be performed in accordance with Section 7.3.

7.2 Megger Testing Data Collection

7.2.1 Megger testing data collection is to be conducted before and during the fire test and again after the hose stream test. The first Megger testing data collection is to be

conducted after the installation of the cable into the test structure and prior to commencement of the fire endurance test. Starting at 20 minutes into the fire test, Megger testing will be conducted and repeated at 20 minute intervals during the test, with the last set of readings obtained starting at 60 minutes into the fire test. The test duration may be extended as necessary to complete the testing. The final Megger testing data collection is to be conducted following the hose stream test.

7.2.2 The Megger testing is to be performed with a megohmeter. The 8-conductor, #12 AWG cable shall be tested at 500 VDC.

7.2.3 The Megger testing is to be performed on each adjacent conductor-to-conductor path and on each conductor-to-cable sheath path.

7.2.4 The Megger testing data collection results shall be corrected to reflect only that portion of insulation resistance which is contributed to by the Meggitt cable.

7.2.5 The results from each of the Megger testing data collections along with a detailed explanation of the data correction and the final corrected results shall be documented in the final test report.

7.3 Conductor Resistance Data Collection

7.3.1 Conductor resistance data collection will occur prior to the start of the Fire Endurance and after the hose stream test. Conductor resistance shall be measured for each conductor in each cable. Conductor resistance will be measured utilizing an Ohmmeter.

7.3.2 The results from each conductor resistance data collection shall be documented in the final test report.

7.4 Water Hose Stream Test

7.4.1 Immediately following the fire endurance test, a hose stream test will be performed in accordance with USNRC Generic Letter 86-10, Supplement 1, Enclosure 1, Section VI. The hose stream will be "applied at random to all exposed surfaces of the test specimen through a 1-1/2" fog nozzle set at a discharge angle of 30 degrees with a nozzle pressure of not less than 75 psi and a minimum discharge flow of 75 gpm with the tip of the nozzle at a maximum of 5 feet from the test specimen. Duration of the hose stream application is 5 minutes." Proper safety precautions shall be exercised. Only those personnel required to perform the hose stream test shall be allowed in the immediate area, and only then with appropriate breathing apparatus. Prior to the hose stream application, the laboratory will ensure the correct angle spray pattern, pressure and flow is being achieved through calibrated gauges and other equipment as required. This is to be documented by OPL.

CAUTION: THE TERMINATIONS AND CABLE TEST LEADS EXTERNAL TO THE FIRE CHAMBER SHALL BE PROTECTED FROM THE WATER SPRAY DURING THE HOSE TEST

7.5 Fire Endurance Test

7.5.1 The test equipment and test assembly are to be protected from any condition of wind or weather that influences the test results. The air temperature at the beginning of the test is to be within the range of 50 to 90°F, unless otherwise approved by MSSI.

7.5.2 The test item shall be exposed to the standard time/temperature curve found in ASTM E-119 (88) for a minimum period of sixty (60) minutes, unless directed by FANP to conclude the test.

7.5.3 Furnace pressure shall be controlled to be as nearly neutral as possible with respect to the surrounding laboratory atmosphere, measured at the vertical mid-point of the test specimen.

7.5.4 The testing organization shall adapt their testing procedures to assure the fire test complies with the requirements established by the referenced portions of the referenced standards. Any changes, revisions, or deviations required to comply with this requirement shall be documented and properly justified and included as part of the final test report.

7.6 Furnace Thermocouple monitoring

7.6.1 During the fire exposure period, the thermocouples will be scanned at one minute intervals or less. Data storage for reporting purposes will be at one minute intervals, although the furnace thermocouples will be scanned and displayed every 15 seconds, to allow close control of the furnace. The test report will contain thermocouple data at one minute intervals.

7.6.2 Monitoring of all thermocouples will be terminated upon completion of the fire endurance test.

8.0 FIRE TEST REPORT

8.1 The Laboratory will submit a report on the results of the test including whether the acceptance criteria for fire test were met. Initially, a DRAFT report will be sent within 14 days of test completion for one set of consolidated review comments by MSSI/FANP.

8.2 The Laboratory will assemble the final test report, containing the collected data and required quality control documentation. Five (5) hard copy sets of the final report along with (5) CD's of test reports and 5 copies of the VHS video of the test will be provided to FANP. The CD's will contain the test report in pdf format, all test data in Excel® format and all

photographs (whether or not they were selected for use in the final report) in high resolution jpeg format.

8.3 The test report shall be prepared in sufficient detail to summarize the total testing activity. The report shall include as a minimum:

a) Identification of the testing laboratory and identification of the employer of the personnel who witnessed the preparation of the test samples.
b) A description of the assembly, materials and installation of the fire resistive cable including drawings depicting the geometry and location of the fire resistive cable within the test assembly.
c) The type of fire resistive cable including description and manufacturers part number.
d) Complete description of the electrical circuit.
e) A record of the test instruments used and calibration verification.
f) The temperature of the furnace during the fire test.
g) A description of the equipment used for the hose stream test.
h) A record of the hose stream test.
i) A record of the Megger test measurements and the elapsed time between the end of the hose stream test and the beginning of the Megger test.
j) Observations on the behavior of the cable during the fire endurance test and during the hose stream test.
k) Observations on the behavior of the supports during the fire endurance test and during the hose stream test.
l) A record of the conductor resistance data collected.

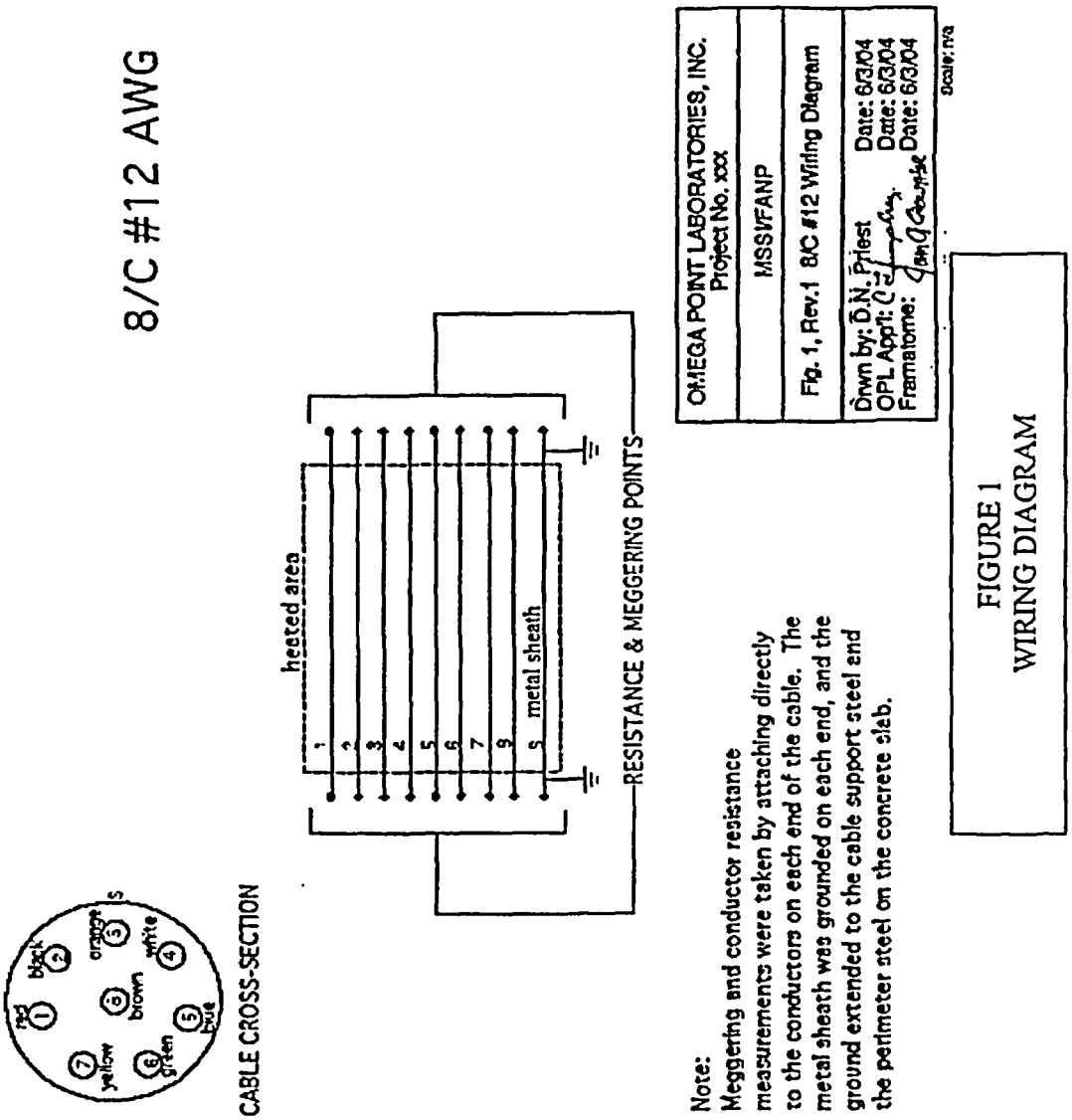
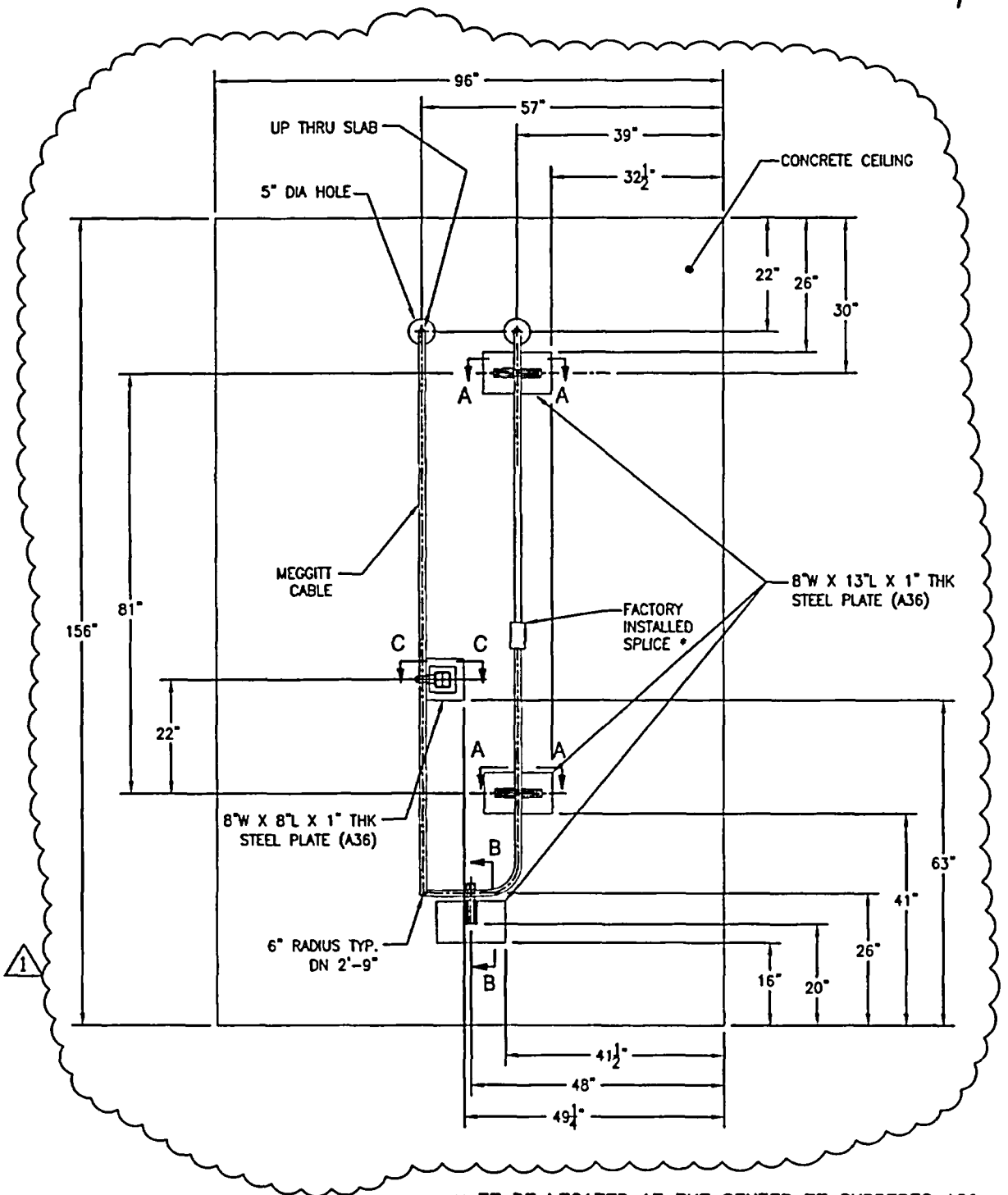


FIGURE 1
WIRING DIAGRAM

AREVA

REVISIONS				M F
REV	DESCRIPTION	DATE	APPROVAL	
0	ORIGINAL ISSUE	6/8/04	CA BANNING	
1	INCORPORATE AS BUILT CONDITIONS	6/23/04	CA Banning	



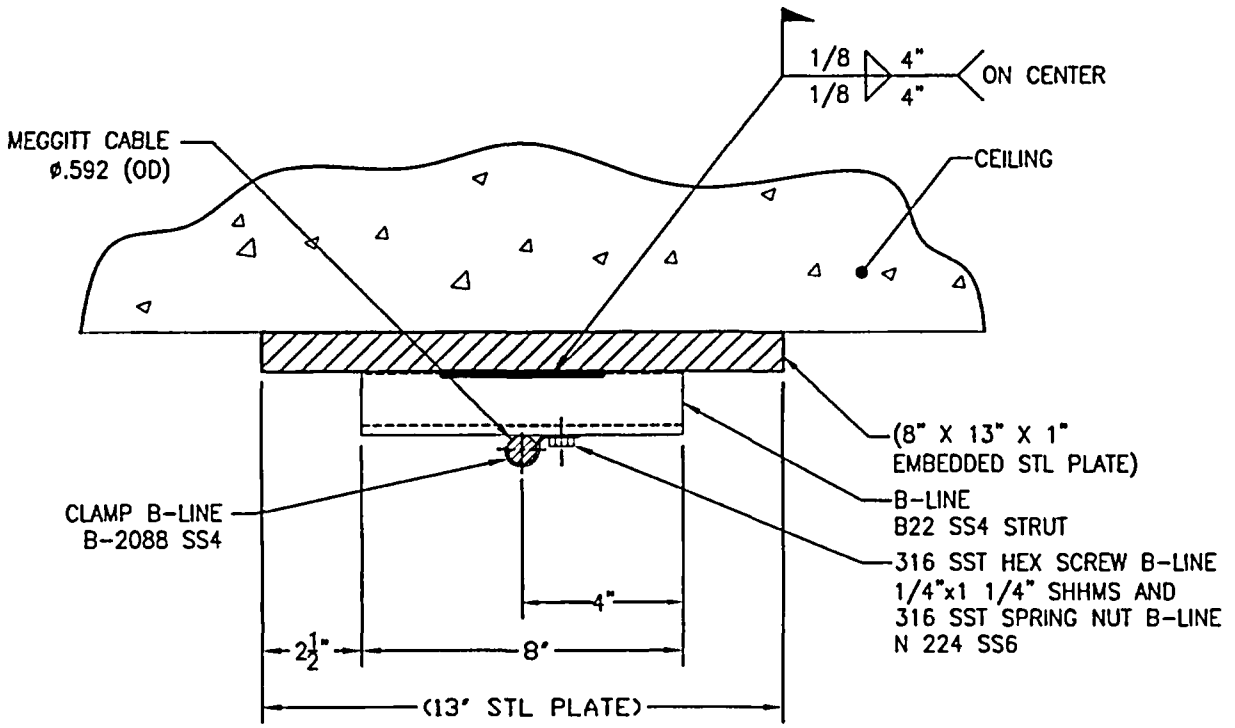
*-TO BE LOCATED AT THE CENTER OF SUPPORTS ±2"

DRAWN BY	CHECKED BY		
K. GROSZEK	JOHN G. CRAWFORD		
PASSED BY R.L. DIBLE	APPROVED BY C.A. Banning	MSSI FIRE RESISTIVE CABLE TEST PLAN VIEW ABOVE AND BELOW TEST SLAB	SCALE N.T.S. DATE 6/8/04
			DWG. NO. 02-5045835A-01

CAD FILE 02-5045835A-00

FRAMATOME ANP

REVISIONS				
REV	DESCRIPTION	DATE	APPROVAL	NF
0	ORIGINAL ISSUE	6/8/04		



SECTION A-A

NOTE:

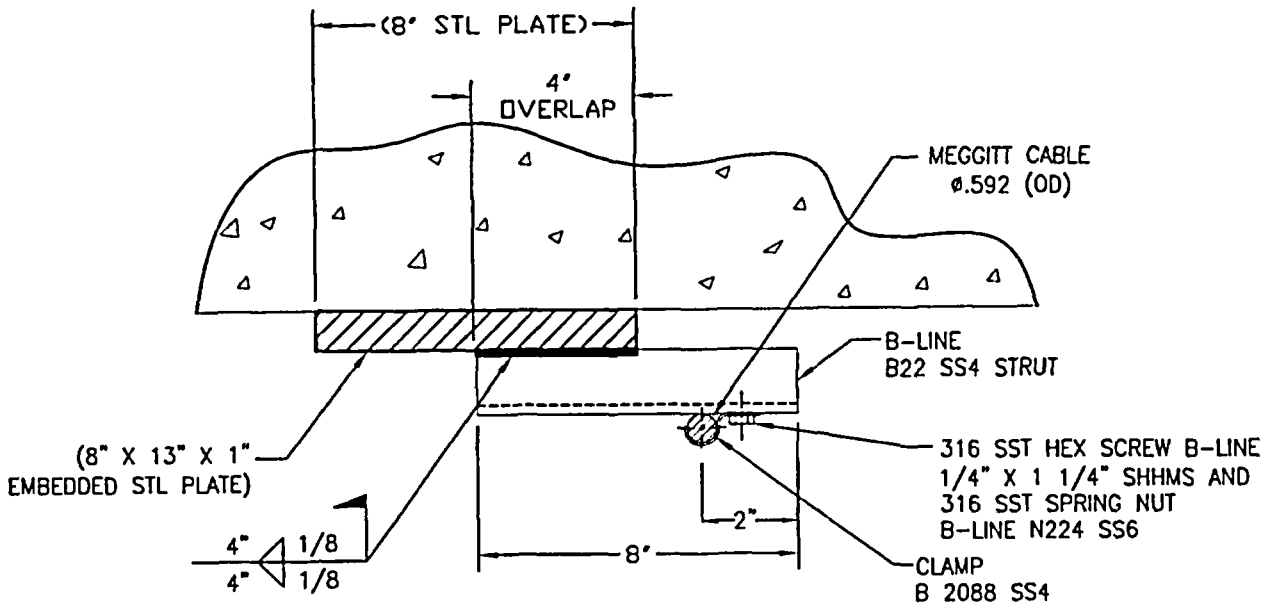
SUPPORT IS GROUNDED BY ATTACHING GROUND CABLES ON TOP OF TEST SLAB TO THE ATR WHICH ATTACHES THE EMBEDDED PLATE TO THE TEST SLAB.

DRAWN BY	CHECKED BY		
K GROSZEK	JOHN G CROUTHER		
PASSED BY: R.L. BIBLE	APPROVED BY: A.B. Cunning	MSSI FIRE RESISTIVE CABLE TEST SECTION A-A	SCALE N.T.S. DATE 6/8/04
			DWG. NO. 02-5045836A-00

CAD FILE 02-5045836A-00

FRAMATOME ANP

REVISIONS				
REV	DESCRIPTION	DATE	APPROVAL	
0	ORIGINAL ISSUE	6/8/04		



SECTION B-B

NOTE:

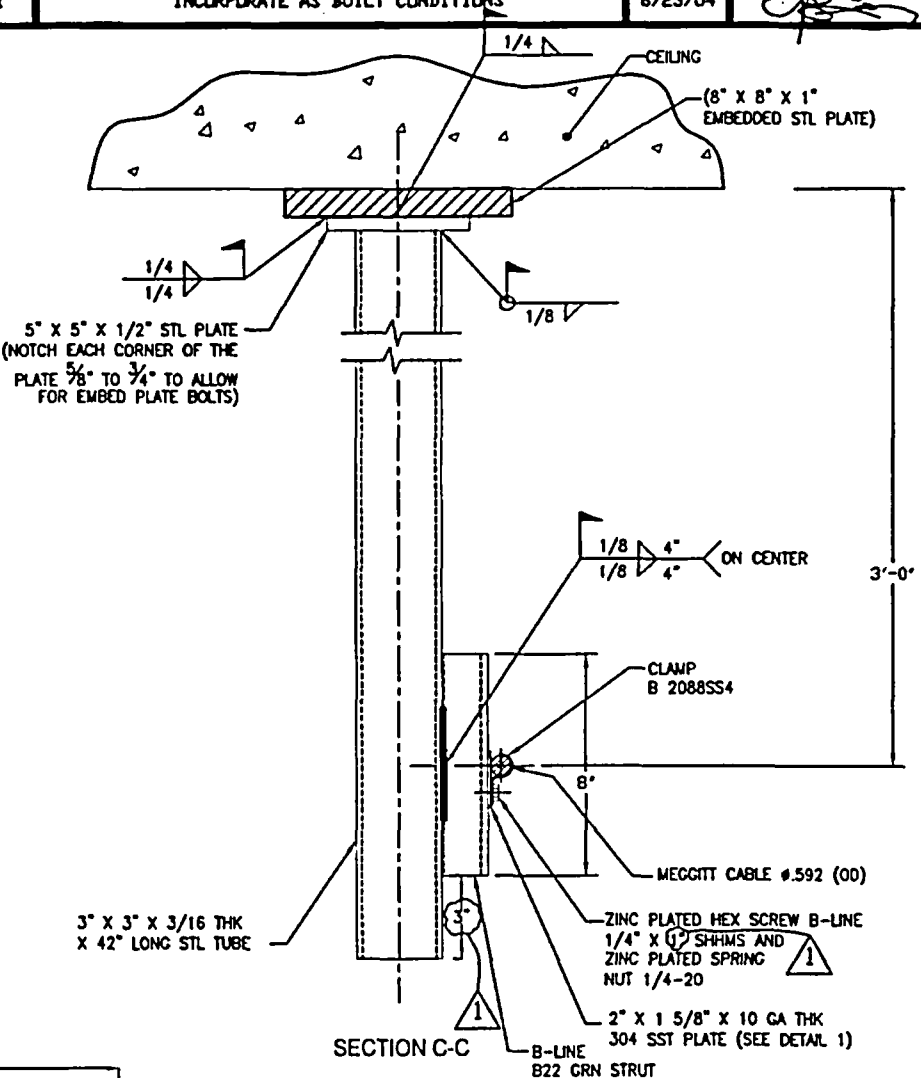
SUPPORT IS GROUNDED BY ATTACHING GROUND CABLES ON TOP OF TEST SLAB TO THE ATR WHICH ATTACHES THE EMBEDDED PLATE TO THE TEST SLAB.

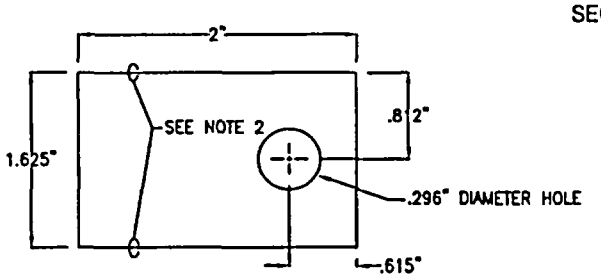
DRAWN BY K. GROSZEK	CHECKED BY JOHN G. CROUTHER		
PASSED BY RL DIBLE	APPROVED BY CA Canning	MSSI FIRE RESISTIVE CABLE TEST SECTION B-B	SCALE N.T.S. DATE 6/8/04
			DWG. NO. 02-5045837A-00

CAD FILE 02-5045837A-00

AREVA

REVISIONS				
REV	DESCRIPTION	DATE	APPROVAL	MF
0	ORIGINAL ISSUE	6/8/04	CA Banning	
1	INCORPORATE AS BUILT CONDITIONS	6/23/04	CA Banning	





DETAIL 1

2" x1 5/8" x10 GA THICK 304 SST PLATES

NOTE:

1. SUPPORT IS GROUNDED BY ATTACHING GROUND CABLES ON TOP OF TEST SLAB TO THE ATR WHICH ATTACHES THE EMBEDDED PLATE TO THE TEST SLAB.
2. THESE TWO EDGES SHOULD BE CHAMFERED OR ROUNDED TO PROTECT AGAINST KNICKS TO CABLE SHEATH.

DRAWN BY K GROSZEK	CHECKED BY John A Gartner	MSSI FIRE RESISTIVE CABLE TEST SECTION C-C	SCALE N.T.S. DATE 6/8/04
PASSED BY R.F. DIBLE	APPROVED BY C.A. Banning		DWG. NO. 02-5045838A-01

CAD FILE 02-5045838A-00

GENERAL NOTES

1. Meggitt Si 2400 Cable Installation:

   a) Cable must be uncoiled as the cable is fed out along the routing path. Whether on a reel or in factory coils, the cable must be unrolled in a tangential (circular) manner. DO NOT UNCOIL BY PULLING ON THE END AND HELICALLY STRETCHING.
   b) Minimum bend radius is 6 inches. At least one bend shall be installed with a minimum bend radius as indicated on Drawing No. 02-5045835A.
   c) Each cable contains a factory installed splice located approximately 12' from one end of the cable sample. The factory installed splice shall be located as shown on drawing 02-5045835A at approximately the midpoint between the supports.
   d) Each cable has factory installed terminations at each end of the cable. The terminations each have pigtails approximately 3' long.
   e) Repeated bending and straightening of the cable should be avoided.
   f) Any smooth surface or appropriate radius may be used to form the cable. EMT tube benders are suitable. In many cases the cable can be hand formed.
   g) Smooth contour changes such as dents, digs, ripples, or wrinkles are acceptable.
   h) Gouges or cuts in the cable sheath which exceed 10% of cable wall thickness may be cause for rejection. Wall thickness is nominally .015".
   i) Outside diameter for the Meggitt cable is 0.592"

2. Where the Meggitt cable is attached to the B-Line strut using B-Line 2088 SS4 clamp and a SST plate, place the hex screw through the clamp then through the SST plate and into the spring nut. The applied torque on all hex screws for attaching the B-Line 2088 SS4 clamps should be approximately 6 lbf-ft.

3. 1" thick plate steel shall be installed against the test slab to simulate embed plates. The plates shall be bolted to the test slab utilizing ½" ATR extending through the test slab to ensure that the plate stays in place. ATR shall be placed at least at each of the 4 corners of the plate, no closer than 1" to the edge of the plate. Additional ATR may be utilized if necessary to ensure that the plate remains in place.

AREVA

REVISIONS				
REV	DESCRIPTION	DATE	APPROVAL	M F
0	ORIGINAL ISSUE	6/8/04	C.A. BANNING	
1	INCORPORATE AS BUILT CONDITIONS	6/23/04	C.A. Banning	

BILL OF MATERIAL

SUPPLIED BY MEGGITT SAFETY SYSTEMS INC

QUANTITY	UNIT	DESCRIPTION
40	LF	8C #12 AWG SI2400 FIRE CABLE, PN: 300283-5 NOTE: FACTORY INSTALLED CABLE SPLICE AT APPROX 12' FROM ONE END AND FACTORY INSTALLED CABLE TERMINATIONS AT EACH ENDS
4	EA	CLAMP B 2088 SS4
3	EA	316 SST HEX SCREW B-LINE 1/4" X 1 1/4" SHHMS
3	EA	316 SST SPRING NUT B-LINE N224 SS6
1	EA	2" X 1 5/8" X 10 GA THK 304 SST PLATE
3	LF	B-LINE B22 SS4 STRUT
1	LF	B-LINE B22 DURA GREEN STRUT B22 GRN
1	EA	B-LINE ZINC ELECTROPLATED SPRING NUT 1/4-20 N224ZN
1	EA	B-LINE ZINC ELECTROPLATED HEX SCREW 1/4"x (1") SHHMS (1)

SUPPLIED BY OMEGA POINT LABORATORIES

QUANTITY	UNIT	DESCRIPTION
4	LF	3" X 3" X 3/16 THK STEEL TUBING, ASTM A500 GR B
5	LF	8" X 1" THK STEEL PLATE A36
1	EA	5" X 5" X 1/2" THK STEEL PLATE A36
1	EA	CONCRETE SLAB 96"X156"
AR		PENETRATION SEAL MATERIAL (CERAMIC FIBER)
20	LF	1/2" ATR
32	EA	1/2" STEEL WASHER
32	EA	1/2" A-307 STEEL NUT

DRAWN BY K GROSZEK	CHECKED BY JOHN G. CROWTHER	MSSI FIRE RESISTIVE CABLE TEST BILL OF MATERIALS	SCALE N.T.S. DATE 6/8/04
PASSED BY R.L. DIBLE	APPROVED BY C.A. Banning		DWG. NO. 02-5045841A-01

CAD FILE 02-5045841A-00

TEST ARTICLE ATTRIBUTE CHECKLIST

PROJECT NUMBER:

PROJECT TITLE: MEGGITT FIRE RESISTIVE CABLE TESTING

		ATTRIBUTE	SAT	UNSAT
I	TEST DECK			
	A	Test deck configuration and dimensions per approved drawings		
	B	Condition of test deck		
	C	Test deck conditioned to moisture equilibrium at indoor conditions		
II	SUPPORTS/STEEL PLATES			
	A.	Correct materials used		
	B.	Installed per approved drawings		
	C.	Spacing between the two Section A-A supports is equal to or greater than shown on approved drawings		
	D.	Supports for Meggitt cable are properly grounded		
	E.	Applied torque values for strut clamps per approved drawings		
	F.	Welds per approved drawings		
III	MEGGITT CABLE			
	A.	Cable installed per approved drawings		
	B.	Minimum bend radius installed where shown on approved drawings		
	C.	Factory installed splices installed as shown on approved drawings		
	D.	Factory installed terminations provided at each end of cable		
	E.	No gouges or cuts in the cable sheath which exceed 10% of cable wall thickness		
V	TEST EQUIPMENT			
	A.	Wiring of test articles conform to the Figure 1 in the Test Plan		
	B.	All electrical devices and equipment have been tested prior to the start of the test to ensure that they are properly connected and functioning as required, showing proper readings on data acquisition equipment		
	C.	Furnace thermocouples are the correct type and are installed per the Test Plan		

NOTE: Verification to be made using initials of OPL Quality Assurance Personnel

Appendix B

MEGGERING AND CONDUCTOR RESISTANCE RESULTS

MEGGERING DATA SHEET

Client: AREVA Date: 6-14-04
Project No: 14980-119368
Test Condition: Receipt inspection
(Pre Test) During Test Post Hose Stream Post Test Cold (circle one)

Megger Operator: Jeff Piel Scribe: [signature]
Megger ID: 720 Calibration Due: 1-7-2005

8/C #12 - CABLE #2

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	2	Black	10K+	1:52
1	Red	3	Orange	10K+	
1	Red	4	White	10K+	
1	Red	5	Blue	10K+	1:53
1	Red	6	Green	10K+	
1	Red	7	Yellow	10K+	
1	Red	8	Brown	10K+	1:54
1	Red	Shield	-	10K+	1:58
2	Black	3	Orange	10K+	
2	Black	4	White	10K+	
2	Black	5	Blue	10K+	1:59
2	Black	6	Green	10K+	
2	Black	7	Yellow	10K+	2:00
2	Black	8	Brown	10K+	2:01
2	Black	Shield	-	10K+	
3	Orange	4	White	10K+	
3	Orange	5	Blue	10K+	
3	Orange	6	Green	10K+	
3	Orange	7	Yellow	10K+	2:02
3	Orange	8	Brown	10K+	
3	Orange	Shield	-	10K+	
4	White	5	Blue	10K+	
4	White	6	Green	10K+	2:02
4	White	7	Yellow	10K+	
4	White	8	Brown	10K+	
4	White	Shield	-	10K+	2:03
5	Blue	6	Green	10K+	
5	Blue	7	Yellow	10K+	
5	Blue	8	Brown	10K+	
5	Blue	Shield	-	10K+	2:03

Jeffrey D. Piel

8/C #12 – (continued)

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
6	Green	7	Yellow	10K+	2:04
6	Green	8	Brown	10K+	
6	Green	Shield	-	10K+	
7	Yellow	8	Brown	10K+	
7	Yellow	Shield	-	10K+	
8	Brown	Shield	-	2500	2:05

CONDUCTOR RESISTANCE

FROM		TO		RESISTANCE (Ohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	1	Red	.10	2:15
2	Black	2	Black	.092	2:15
3	Orange	3	Orange	.091	2:16
4	White	4	White	.092	2:16
5	Blue	5	Blue	.094	2:16
6	Green	6	Green	.095	2:17
7	Yellow	7	Yellow	.095	2:17
8	Brown	8	Brown	.094	2:17

Jeffrey D. Pino

6-14-04

MEGGERING DATA SHEET

Client: AREVA Date: 6-17-04
Project No: 14980-119368

Test Condition: (Pre Test) During Test Post Hose Stream Post Test Cold (circle one)

Megger Operator: Jeffery Piel Scribe: [signature]
Megger ID: 720 Calibration Due: 1-7-2005

8/C #12 - CABLE #2 500 volts DC

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	2	Black	10K+	9:43
1	Red	3	Orange	10K+	
1	Red	4	White	10K+	9:44
1	Red	5	Blue	10K+	
1	Red	6	Green	10K+	
1	Red	7	Yellow	10K+	
1	Red	8	Brown	10K+	
1	Red	Shield	-	10K+	9:44
2	Black	3	Orange	10K+	
2	Black	4	White	10K+	
2	Black	5	Blue	10K+	
2	Black	6	Green	10K+	
2	Black	7	Yellow	10K+	
2	Black	8	Brown	10K+	
2	Black	Shield	-	10K+	
3	Orange	4	White	~~10K+ 6000~~	9:48
3	Orange	5	Blue	10K+	9:49
3	Orange	6	Green	10K+	
3	Orange	7	Yellow	10K+	
3	Orange	8	Brown	10K+	
3	Orange	Shield	-	10K+	
4	White	5	Blue	10K+	9:49
4	White	6	Green	10K+	
4	White	7	Yellow	10K+	
4	White	8	Brown	10K+	
4	White	Shield	-	10K+	
5	Blue	6	Green	10K+	9:50
5	Blue	7	Yellow	10K+	
5	Blue	8	Brown	10K+	
5	Blue	Shield	-	10K+	

Jeffery D. Piel

S/C #12 – (continued)

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
6	Green	7	Yellow	10K+	9:50
6	Green	8	Brown	10K+	
6	Green	Shield	-	10K+	
7	Yellow	8	Brown	10K+	9:50
7	Yellow	Shield	-	10K+	
8	Brown	Shield	-	10K+	9:51

CONDUCTOR RESISTANCE

FROM		TO		RESISTANCE (Ohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	1	Red	.096	9:41
2	Black	2	Black	.095	
3	Orange	3	Orange	.093	
4	White	4	White	.095	9:42
5	Blue	5	Blue	.096	
6	Green	6	Green	.096	
7	Yellow	7	Yellow	.097	
8	Brown	8	Brown	.095	9:42

Jeffrey D. Pilo

6-17-04

MEGGERING DATA SHEET

Client: AREVA Date: 6-17-04
Project No: 14980-119368 Drum.

Test Condition: Pre Test (During Test) Post Hose Stream Post Test Cold (circle one)

Megger Operator: Jeff Piel Scribe: D Dalton
Megger ID: 720 Calibration Due: 1-7-2005

8/C #12 - CABLE #2

FROM		TO		RESISTANCE	
COND. #	COLOR	COND. #	COLOR	(Megohms)	TIME
1	Red	2	Black	1.5	11:17
1	Red	3	Orange	1.5	11:17
1	Red	4	White	1.55	
1	Red	5	Blue	1.6	
1	Red	6	Green	1.6	
1	Red	7	Yellow	1.6	
1	Red	8	Brown	1.6	11:18
1	Red	Shield	-	1.6	11:18
2	Black	3	Orange	~~1.8~~ .8	11:22
2	Black	4	White	.8	
2	Black	5	Blue	.82	
2	Black	6	Green	.82	
2	Black	7	Yellow	.91	11:23
2	Black	8	Brown	.91	
2	Black	Shield	-	.94	11:23
3	Orange	4	White	.8	11:29
3	Orange	5	Blue	.8	
3	Orange	6	Green	.82	
3	Orange	7	Yellow	.82	
3	Orange	8	Brown	.82	
3	Orange	Shield	-	.85	11:29
4	White	5	Blue	.8	11:33
4	White	6	Green	.8	11:34
4	White	7	Yellow	.82	
4	White	8	Brown	.82	
4	White	Shield	-	.85	11:34
5	Blue	6	Green	1.18	11:40
5	Blue	7	Yellow	1.18	
5	Blue	8	Brown	1.18	
5	Blue	Shield	-	1.18	11:40

Jeff Hz D.P.P

14980-119368

8/C #12 – (continued)

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
6	Green	7	Yellow	1.0	11:45
6	Green	8	Brown	1.02	11:46
6	Green	Shield	-	1.02	11:46
7	Yellow	8	Brown	.9	11:49
7	Yellow	Shield	-	.9	11:49
8	Brown	Shield	-	.85	11:53

CONDUCTOR RESISTANCE

FROM		TO		RESISTANCE (Ohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	1	Red		
2	Black	2	Black		
3	Orange	3	Orange		
4	White	4	White		
5	Blue	5	Blue		
6	Green	6	Green		
7	Yellow	7	Yellow		
8	Brown	8	Brown		

Greg D. P.D

JDrien. During test

6-17-04

Page 2 of 2

MEGGERING DATA SHEET

Client: AREVA Date: 6-17-04
Project No: 14980-119368 60min

Test Condition: Pre Test (During Test) Post Hose Stream Post Test Cold (circle one)

Megger Operator: Jeff Piel Scribe: C Dalton
Megger ID: 720 Calibration Due: 1-7-2005

8/C #12 - CABLE #2

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	2	Black	1.4	11:58
1	Red	3	Orange	1.4	
1	Red	4	White	1.4	
1	Red	5	Blue	1.43	
1	Red	6	Green	1.43	
1	Red	7	Yellow	1.43	
1	Red	8	Brown	1.5	
1	Red	Shield	-	1.5	11:59
2	Black	3	Orange	.92	12:03
2	Black	4	White	.95	
2	Black	5	Blue	.95	
2	Black	6	Green	.98	
2	Black	7	Yellow	.98	
2	Black	8	Brown	1.00	
2	Black	Shield	-	1.00	12:03
3	Orange	4	White	1.15	12:09
3	Orange	5	Blue	1.18	
3	Orange	6	Green	1.18	
3	Orange	7	Yellow	1.18	
3	Orange	8	Brown	1.18	
3	Orange	Shield	-	1.18	12:09
4	White	5	Blue	1.2	12:15
4	White	6	Green	1.2	
4	White	7	Yellow	1.2	
4	White	8	Brown	1.21	12:16
4	White	Shield	-	1.21	12:16
5	Blue	6	Green	1.15	12:21
5	Blue	7	Yellow	1.15	
5	Blue	8	Brown	1.17	
5	Blue	Shield	-	1.17	12:21

Jeffrey D. Piel

14980-119363

8/C #12 – (continued)

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
6	Green	7	Yellow	1.2	12:25
6	Green	8	Brown	1.21	
6	Green	Shield	-	1.21	12:25
7	Yellow	8	Brown	1.21	12:29
7	Yellow	Shield	-	1.21	12:29
8	Brown	Shield	-	1.2	12:32

CONDUCTOR RESISTANCE

FROM		TO		RESISTANCE (Ohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	1	Red		
2	Black	2	Black		
3	Orange	3	Orange		
4	White	4	White		
5	Blue	5	Blue		
6	Green	6	Green		
7	Yellow	7	Yellow		
8	Brown	8	Brown		

60 min Burning test
6-17-04
Page 2 of 2

MEGGERING DATA SHEET

Client: AREVA Date: 6-17-04
Project No: 14980-119368

Test Condition: Pre Test During Test (Post Hose Stream) Post Test Cold (circle one)

Megger Operator: Jeff Piel Scribe: C Patton
Megger ID: 720 Calibration Due: 1-7-2005

8/C #12 - CABLE #2

FROM		TO		RESISTANCE	
COND. #	COLOR	COND. #	COLOR	(Megohms)	TIME
1	Red	2	Black	10K+	12:56
1	Red	3	Orange	10K+	
1	Red	4	White	10K+	
1	Red	5	Blue	10K+	
1	Red	6	Green	10K+	
1	Red	7	Yellow	10K+	
1	Red	8	Brown	10K+	
1	Red	Shield	-	10K+	
2	Black	3	Orange	10K+	
2	Black	4	White	10K+	
2	Black	5	Blue	10K+	
2	Black	6	Green	10K+	12:56 57
2	Black	7	Yellow	10K+	
2	Black	8	Brown	10K+	
2	Black	Shield	-	10K+	
3	Orange	4	White	10K+	
3	Orange	5	Blue	10K+	
3	Orange	6	Green	10K+	
3	Orange	7	Yellow	10K+	
3	Orange	8	Brown	10K+	
3	Orange	Shield	-	10K+	
4	White	5	Blue	10K+	
4	White	6	Green	10K+	
4	White	7	Yellow	10K+	
4	White	8	Brown	10K+	
4	White	Shield	-	10K+	12:57
5	Blue	6	Green	8.5	~~12:58~~ 12:59
5	Blue	7	Yellow	8.5	1:00
5	Blue	8	Brown	8.8	
5	Blue	Shield	-	8.9	1:00

Jeffrey D. Piel

S/C #12 – (continued)

FROM		TO		RESISTANCE (Megohms)	TIME
COND. #	COLOR	COND. #	COLOR		
6	Green	7	Yellow	10K+	1:00
6	Green	8	Brown	10K+	
6	Green	Shield	-	10K+	
7	Yellow	8	Brown	10K+	1:01
7	Yellow	Shield	-	10K+	
8	Brown	Shield	-	10K+	1:01

CONDUCTOR RESISTANCE

FROM		TO		RESISTANCE (Ohms)	TIME
COND. #	COLOR	COND. #	COLOR		
1	Red	1	Red	.104	12:53
2	Black	2	Black	.101	
3	Orange	3	Orange	.100	
4	White	4	White	.103	12:54
5	Blue	5	Blue	.104	
6	Green	6	Green	.105	
7	Yellow	7	Yellow	.105	
8	Brown	8	Brown	.104	12:54

Jeffrey D. Pirl

Post Hose Stream
6-17-04
Page 2 of 2

MEGGITT

MEGGITT SAFETY SYSTEMS INC

FILE 5839IR-1

QA: SSD QE 3 05-12-04

ACCEPTANCE TEST DATA SHEET

FOR

FIRE CABLE ASSEMBLY

PART NUMBER: 300283E0040B28J SERIAL NUMBER: 002

TEST PROGRAM NUMBER: 5181 REVISON C

1.0 Dielectric Strength at room temperature per STP 2191, Revision C.

1.1 3200 VDC between conductor and sheath for 60 seconds. No indication of breakdown.

(Pass)/Fail 3 SSD JUN 04 2004
Tech Stamp/Date

1.2 3200 VDC conductor to conductor for 60 seconds. No indication of breakdown.

(Pass)/Fail 3 SSD JUN 04 2004
Tech Stamp/Date

2.0 Insulation Resistance at room temperature per STP 2190, Revision C.
(All unused pins connected to sheath. Record values.)

1	1.0 x 10^{12} ohms	7	1.0 x 10^{12} ohms
2	1.0 x 10^{12} ohms	8	1.0 x 10^{12} ohms
3	1.0 x 10^{12} ohms	9	N/A x 10 ohms
4	1.0 x 10^{12} ohms	10	N/A x 10 ohms
5	1.0 x 10^{12} ohms	11	N/A x 10 ohms
6	1.0 x 10^{12} ohms	12	N/A x 10 ohms

3 SSD JUN 04 2004
Tech Stamp/Date

MEGGITT

MEGGITT SAFETY SYSTEMS INC

FILE 5839IR-1

PART NUMBER: 300283E0528 J

PAGE 2 OF 2

SERIAL NUMBER: 002

3.0 DC Continuity per STP 2207, Revision B. (Limit: Refer to cable drawing.)

3.1 Cable Length: _____ feet

3.2 Conductor Resistance:

1	0.1 ohms	5	0.1 ohms	9	N/A ohms
2	0.1 ohms	6	0.1 ohms	10	N/A ohms
3	0.1 ohms	7	0.1 ohms	11	N/A ohms
4	0.1 ohms	8	0.1 ohms	12	N/A ohms

Pass / Fail SSD JUN 04 2004

Tech Stamp/Date

4.0 Test Equipment List

Nomenclature	Manufacturer & Model No.	Identification No.	Calibration Due Date
High Resistance Bridge	GR 1644 A	A 14672	6-2-05
Hi-Pot	AR 5205 A	A 14600	7-18-05
Digital Multimeter	FLUKE 73	B 131	2-18-05

MSSI QA REVIEW: SSD QE 6-4-04

DATE: SSD 6-4-04

MEGGITT

MEGGITT SAFETY
SYSTEMS INC
1915 VOYAGER AVE. SIMI VALLEY, CA. 93063
805-584-4100 FAX 805-584-9157

Packing Slip

Pickslip	81945
Page	1
Date	6/04/04
Customer No.	69444
Order Number	260500-005 SO
Related P.O.	
Brn/Plt	200

Ship To:

OMEGA POINT LABORATORIES
ATTN: CONSTANCE HUMPHREY
210-635-8120
16015 SHADY FALLS ROAD
ELMENDORF TX 78112

Invoice To:

IN-HOUSE/MEGGITT SAFETY SYSTEMS
1915 VOYAGER AVENUE
SIMI VALLEY CA 93063

INSP	Priority
DT	E

Ord Date	Promised	Customer P.O.	F.O.B.	Contract Administrator
10/15/03	11/15/03	Fred Rudek	Destination	DIANA COX, EXT 8127

Line	Item Number/Location,Lot	Description	Shipped	Tag	Avail.	UM	Due Date	Schedule B
IN HOUSE SALES ORDER TO PROVIDE TEST CABLES FOR LABORATORY TESTS TO BE PRESENTED TO NRC. *MSSI WILL HAVE JOINT RIGHTS SHARING THE QUALIFICATION TO TEST RESULTS* *TEST FACILITY WILL BE READY END OF NOVEMBER* *SPLICE REQUIRED AT MIDPOINT IN CABLE*								
31.000 *FG* *Rev.* *Serial # 002*	300283E0040B28J	FIRE CABLE	1			EA	11/15/03	Blank - Sales R

Page 50

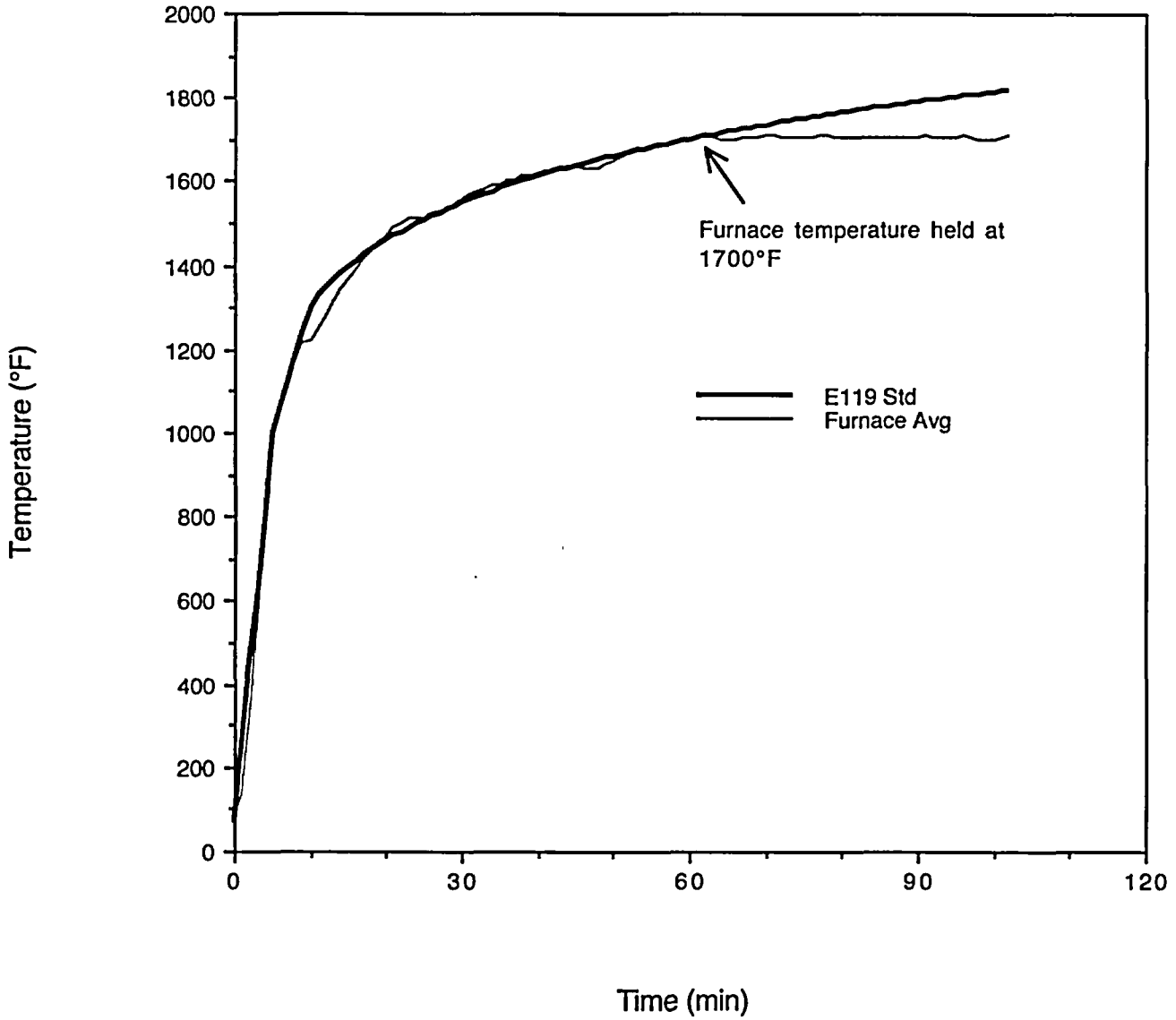
RL 06-04-04.

Quality Assurance | Packer | Track/Airbill # | Weight: | Ship Via: BEST WAY PREPAY ONLY 2 day

Appendix C

TEST DATA - FURNACE INTERIOR TEMPERATURES

Project No. 14980-119368
AREVA - Meggitt Cable Test
Furnace Interior Temperature



Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F•min)	Integration of E119 Std Average (°F•min)	Error (%)	Furnace Probe #1 (°F)	Furnace Probe #2 (°F)	Furnace Probe #3 (°F)
0	68	85	0	0	0.00%	84	84	84
1	254	133	41	466	-91.2%	143	126	113
2	441	305	192	932	-79.4%	281	287	bad TC
3	627	575	564	1398	-59.7%	553	538	bad TC
4	814	856	1211	1864	-35.0%	838	809	bad TC
5	1000	1002	2072	2330	-11.1%	989	948	993
6	1060	1073	3042	3412	-10.9%	1087	1029	1080
7	1120	1121	4071	4494	-9.42%	1172	1094	1148
8	1180	1169	5148	5576	-7.68%	1259	1164	1214
9	1240	1214	6271	6658	-5.81%	1343	1235	1279
10	1300	1223	7422	7740	-4.11%	1390	1282	1318
11	1328	1250	8590	9022	-4.78%	1408	1301	1334
12	1347	1278	9786	10304	-5.03%	1435	1322	1354
13	1364	1311	11013	11586	-4.95%	1483	1357	1388
14	1381	1343	12272	12868	-4.64%	1519	1393	1425
15	1396	1369	13559	14150	-4.17%	1550	1425	1454
16	1410	1393	14873	15514	-4.13%	1573	1453	1482
17	1424	1415	16209	16878	-3.97%	1589	1476	1504
18	1436	1434	17565	18242	-3.71%	1607	1495	1524
19	1448	1453	18940	19606	-3.40%	1625	1512	1545
20	1459	1467	20332	20970	-3.04%	1643	1527	1561
21	1470	1487	21741	22386	-2.88%	1657	1542	1577
22	1480	1498	23166	23802	-2.67%	1659	1550	1591
23	1490	1509	24601	25218	-2.45%	1656	1550	1603
24	1499	1510	26043	26634	-2.22%	1652	1544	1601
25	1508	1514	27487	28050	-2.01%	1648	1543	1599
26	1517	1521	28936	29512	-1.95%	1649	1545	1605
27	1525	1526	30392	30974	-1.88%	1654	1547	1606
28	1533	1535	31855	32436	-1.79%	1666	1553	1618
29	1541	1546	33327	33898	-1.68%	1681	1564	1630
30	1549	1555	34809	35360	-1.56%	1688	1575	1644
31	1556	1566	36302	36875	-1.55%	1696	1583	1651
32	1563	1573	37803	38390	-1.53%	1700	1589	1658
33	1570	1582	39313	39905	-1.48%	1711	1596	1665
34	1576	1589	40830	41420	-1.42%	1713	1601	1670
35	1583	1592	42353	42935	-1.36%	1716	1605	1673
36	1589	1600	43881	44450	-1.28%	1728	1615	1685
37	1595	1605	45415	45965	-1.20%	1728	1619	1690
38	1601	1612	46956	47480	-1.10%	1738	1625	1695
39	1606	1616	48502	48995	-1.01%	1740	1627	1699
40	1612	1620	50051	50510	-0.91%	1742	1632	1701
41	1617	1623	51605	52111	-0.97%	1743	1635	1704
42	1623	1627	53162	53712	-1.03%	1744	1638	1709
43	1628	1632	54724	55314	-1.07%	1751	1643	1717

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F•min)	Integration of E119 Std Average (°F•min)	Error (%)	Furnace Probe #1 (°F)	Furnace Probe #2 (°F)	Furnace Probe #3 (°F)
44	1633	1637	56290	56915	-1.10%	1756	1646	1721
45	1638	1636	57858	58516	-1.12%	1748	1643	1716
46	1643	1629	59422	60117	-1.16%	1720	1632	1707
47	1648	1630	60983	61718	-1.19%	1710	1631	1710
48	1652	1631	62546	63320	-1.22%	1704	1630	1721
49	1657	1641	64114	64921	-1.24%	1713	1642	1730
50	1661	1650	65691	66522	-1.25%	1721	1649	1741
51	1666	1658	67277	68123	-1.24%	1726	1657	1748
52	1670	1668	68871	69724	-1.22%	1730	1664	1761
53	1674	1674	70474	71326	-1.19%	1736	1671	1764
54	1678	1678	72082	72927	-1.16%	1741	1677	1766
55	1682	1679	73693	74528	-1.12%	1752	1672	1766
56	1686	1683	75306	76129	-1.08%	1764	1674	1767
57	1690	1688	76923	77730	-1.04%	1762	1678	1772
58	1694	1694	78546	79332	-0.99%	1760	1688	1777
59	1698	1697	80173	80933	-0.94%	1762	1693	1784
60	1701	1701	81805	82534	-0.88%	1761	1697	1790
61	1705	1702	83438	84135	-0.83%	1761	1698	1786
62	1709	1704	85073	85736	-0.77%	1763	1700	1785
63	1712	1703	86708	87338	-0.72%	1764	1698	1779
64	1716	1699	88341	88939	-0.67%	1761	1694	1774
65	1719	1697	89971	90540	-0.63%	1762	1689	1775
66	1722	1700	91602	92249	-0.70%	1771	1690	1771
67	1726	1704	93236	93957	-0.77%	1777	1695	1773
68	1729	1704	94872	95666	-0.83%	1779	1693	1775
69	1732	1706	96509	97375	-0.89%	1777	1698	1779
70	1735	1708	98148	99084	-0.94%	1770	1703	1783
71	1738	1708	99788	100793	-1.00%	1777	1700	1777
72	1742	1707	101428	102501	-1.05%	1773	1699	1776
73	1745	1705	103066	104210	-1.10%	1769	1695	1773
74	1748	1705	104703	105919	-1.15%	1774	1691	1769
75	1751	1705	106340	107628	-1.20%	1783	1688	1768
76	1753	1706	107977	109336	-1.24%	1780	1689	1770
77	1756	1709	109616	111045	-1.29%	1778	1697	1772
78	1759	1709	111257	112754	-1.33%	1773	1700	1774
79	1762	1707	112897	114463	-1.37%	1769	1698	1771
80	1765	1706	114536	116171	-1.41%	1769	1696	1768
81	1768	1707	116174	117880	-1.45%	1768	1696	1767
82	1770	1706	117812	119589	-1.49%	1766	1693	1769
83	1773	1707	119451	121298	-1.52%	1765	1694	1770
84	1776	1705	121088	123006	-1.56%	1763	1691	1769
85	1778	1703	122724	124715	-1.60%	1762	1688	1757
86	1781	1702	124358	126424	-1.63%	1753	1687	1749
87	1783	1703	125992	128133	-1.67%	1748	1687	1743

Time (min)	E119 Std Average (°F)	Furnace Average (°F)	Integration of Furnace Average (°F•min)	Integration of E119 Std Average (°F•min)	Error (%)	Furnace Probe #1 (°F)	Furnace Probe #2 (°F)	Furnace Probe #3 (°F)
88	1786	1705	127628	129841	-1.70%	1755	1689	1746
89	1788	1705	129265	131550	-1.74%	1754	1689	1743
90	1791	1707	130903	133259	-1.77%	1752	1690	1747
91	1793	1710	132543	134968	-1.80%	1758	1694	1762
92	1796	1706	134183	136676	-1.82%	1757	1690	1751
93	1798	1705	135821	138385	-1.85%	1753	1688	1746
94	1800	1703	137456	140094	-1.88%	1743	1686	1743
95	1803	1704	139092	141803	-1.91%	1746	1687	1741
96	1805	1708	140730	143511	-1.94%	1755	1689	1746
97	1807	1704	142367	145220	-1.96%	1752	1686	1741
98	1809	1699	144001	146929	-1.99%	1740	1682	1733
99	1812	1698	145632	148638	-2.02%	1738	1680	1730
100	1814	1699	147262	150346	-2.05%	1739	1681	1733
101	1816	1707	148897	152055	-2.08%	1743	1689	1743
102	1818	1711	150539	153764	-2.10%	1747	1693	1743

Time (min)	Furnace Probe #4 (°F)	Furnace Probe #5 (°F)	Furnace Probe #6 (°F)	Furnace Probe #7 (°F)	Furnace Probe #8 (°F)	Lab Ambient Temp. (°F)	"In" Cable at Top Surface of Slab (°F)
0	84	85	91	84	84	87	86
1	124	142	bad TC	136	147	88	88
2	297	338	bad TC	298	330	88	88
3	608	649	bad TC	529	571	88	89
4	905	965	bad TC	793	825	87	92
5	1043	1098	bad TC	973	970	87	97
6	1084	1124	bad TC	1074	1034	87	105
7	1115	1133	bad TC	1120	1066	87	114
8	1158	1151	bad TC	1149	1087	87	122
9	1215	1173	bad TC	1158	1097	87	127
10	1257	1197	1048	1176	1115	87	137
11	1273	1217	1115	1208	1143	87	145
12	1292	1242	1168	1237	1170	87	153
13	1323	1272	1211	1263	1194	87	160
14	1354	1299	1246	1288	1217	87	167
15	1382	1322	1274	1309	1238	88	168
16	1409	1342	1299	1330	1257	88	177
17	1435	1363	1321	1352	1277	88	181
18	1456	1381	1341	1371	1294	88	185
19	1478	1401	1360	1391	1312	89	190
20	1494	1400	1377	1408	1328	89	188
21	1511	1447	1392	1424	1344	89	199
22	1524	1454	1410	1440	1359	89	202
23	1526	1486	1424	1456	1372	89	197
24	1523	1469	1436	1469	1385	89	199
25	1522	1471	1445	1485	1399	89	211
26	1524	1479	1456	1498	1413	89	213
27	1526	1484	1463	1505	1422	89	215
28	1531	1492	1472	1518	1433	90	221
29	1541	1500	1482	1524	1443	90	220
30	1550	1509	1491	1532	1452	90	230
31	1559	1519	1502	1550	1465	91	229
32	1565	1527	1512	1559	1476	91	216
33	1573	1536	1521	1570	1484	91	229
34	1579	1544	1530	1580	1494	91	223
35	1584	1547	1535	1578	1497	90	235
36	1593	1554	1542	1581	1503	90	234
37	1598	1560	1550	1587	1509	90	234
38	1605	1567	1557	1594	1516	90	229
39	1608	1570	1562	1597	1521	91	236
40	1614	1575	1567	1601	1527	91	235
41	1618	1578	1571	1603	1530	91	240
42	1622	1585	1576	1609	1536	91	241
43	1627	1587	1580	1612	1540	91	236

Time (min)	Furnace Probe #4 (°F)	Furnace Probe #5 (°F)	Furnace Probe #6 (°F)	Furnace Probe #7 (°F)	Furnace Probe #8 (°F)	Lab Ambient Temp. (°F)	"In" Cable at Top Surface of Slab (°F)
44	1630	1592	1585	1618	1544	90	251
45	1630	1595	1588	1621	1547	91	246
46	1628	1589	1588	1620	1544	91	246
47	1630	1592	1592	1624	1547	91	239
48	1630	1594	1595	1627	1550	91	236
49	1640	1603	1604	1636	1558	91	235
50	1648	1614	1614	1645	1567	91	249
51	1658	1621	1622	1653	1575	91	248
52	1671	1632	1633	1664	1585	91	259
53	1678	1640	1640	1670	1593	92	265
54	1680	1642	1644	1676	1598	91	256
55	1676	1642	1645	1677	1601	92	261
56	1678	1646	1649	1682	1605	92	264
57	1684	1653	1655	1687	1611	92	260
58	1692	1661	1663	1693	1616	92	268
59	1697	1663	1665	1695	1620	92	267
60	1701	1668	1670	1700	1624	93	276
61	1701	1669	1672	1701	1627	93	272
62	1701	1671	1674	1705	1631	91	273
63	1698	1670	1673	1706	1632	91	278
64	1690	1667	1671	1704	1630	91	274
65	1687	1664	1669	1703	1629	92	272
66	1687	1669	1673	1708	1634	92	276
67	1693	1671	1675	1709	1636	92	270
68	1691	1672	1676	1709	1637	92	276
69	1696	1673	1677	1711	1638	93	272
70	1700	1675	1679	1714	1641	92	277
71	1698	1675	1680	1715	1642	92	272
72	1697	1675	1680	1716	1643	92	279
73	1694	1673	1678	1715	1642	92	276
74	1690	1675	1680	1717	1645	92	281
75	1686	1674	1679	1717	1645	93	277
76	1686	1675	1680	1718	1647	93	281
77	1694	1678	1683	1721	1649	93	277
78	1698	1676	1682	1719	1649	93	267
79	1697	1675	1681	1718	1648	93	269
80	1695	1674	1680	1718	1648	94	269
81	1696	1675	1681	1720	1649	94	262
82	1694	1675	1681	1720	1649	94	268
83	1695	1677	1682	1721	1651	94	274
84	1689	1675	1680	1720	1650	94	269
85	1685	1674	1681	1723	1653	93	266
86	1681	1675	1684	1727	1657	93	267
87	1681	1678	1688	1733	1662	94	276

Time (min)	Furnace Probe #4 (°F)	Furnace Probe #5 (°F)	Furnace Probe #6 (°F)	Furnace Probe #7 (°F)	Furnace Probe #8 (°F)	Lab Ambient Temp. (°F)	"In" Cable at Top Surface of Slab (°F)
88	1682	1678	1689	1733	1664	93	277
89	1683	1680	1691	1736	1666	93	276
90	1684	1683	1694	1740	1668	94	279
91	1690	1682	1690	1735	1665	94	282
92	1685	1679	1689	1734	1664	94	274
93	1682	1679	1689	1736	1665	94	274
94	1679	1679	1690	1736	1666	93	279
95	1680	1680	1692	1738	1667	93	279
96	1682	1683	1694	1742	1670	93	274
97	1679	1679	1691	1738	1667	92	274
98	1675	1676	1688	1735	1664	92	275
99	1674	1676	1688	1736	1665	92	275
100	1674	1677	1688	1734	1664	93	278
101	1682	1688	1698	1742	1674	93	276
102	1687	1691	1702	1746	1679	93	275

Time (min)	"In" Cable 12" Above Top of Slab (°F)	"Out" Cable Top Surface of Slab (°F)	"Out" Cable 12" Above Top of Slab (°F)
0	86	86	86
1	86	87	86
2	87	89	86
3	87	93	86
4	87	99	86
5	87	100	86
6	87	108	86
7	87	114	87
8	88	117	88
9	88	128	88
10	89	133	89
11	90	142	89
12	90	150	90
13	92	153	91
14	93	163	92
15	94	159	93
16	95	171	94
17	96	173	95
18	97	177	96
19	98	182	97
20	97	178	96
21	99	183	98
22	99	191	99
23	99	187	97
24	100	174	97
25	101	196	100
26	102	195	100
27	102	203	101
28	103	204	102
29	102	198	100
30	105	214	103
31	105	215	104
32	104	198	102
33	106	220	103
34	106	208	102
35	106	220	103
36	107	220	105
37	107	226	106
38	105	226	103
39	106	226	104
40	104	218	101
41	104	225	101
42	103	210	100
43	103	225	101

Time (min)	"In" Cable 12" Above Top of Slab (°F)	"Out" Cable Top Surface of Slab (°F)	"Out" Cable 12" Above Top of Slab (°F)
44	104	224	100
45	104	235	100
46	104	234	100
47	102	225	100
48	103	236	99
49	103	226	100
50	103	241	99
51	105	248	102
52	106	236	102
53	106	264	103
54	107	242	104
55	106	241	102
56	109	233	103
57	108	248	104
58	110	239	105
59	107	260	104
60	109	246	105
61	109	239	105
62	110	239	106
63	112	248	107
64	110	261	105
65	111	233	106
66	112	240	106
67	110	255	105
68	109	240	105
69	110	239	105
70	111	237	107
71	111	238	105
72	114	254	107
73	114	228	107
74	114	255	107
75	114	245	108
76	113	240	107
77	115	234	107
78	109	250	104
79	110	248	105
80	110	253	105
81	108	245	103
82	108	248	103
83	109	247	104
84	108	245	103
85	110	240	105
86	112	252	107
87	111	248	105

Time (min)	"In" Cable 12" Above Top of Slab (°F)	"Out" Cable Top Surface of Slab (°F)	"Out" Cable 12" Above Top of Slab (°F)
88	111	244	106
89	113	249	107
90	112	254	106
91	111	253	106
92	111	254	105
93	114	234	107
94	113	249	107
95	116	258	109
96	114	245	108
97	116	250	110
98	115	246	110
99	113	254	110
100	113	248	107
101	112	261	106
102	113	269	108

Appendix D

QUALITY ASSURANCE

Quality Assurance Statement

Omega Point Laboratories, Inc. is an independent, wholly owned company incorporated in the state of Texas, devoted to engineering, inspection, quality assurance and testing of building materials, products and assemblies. The company has developed and implemented a Quality Assurance Program designed to provide its clients with a planned procedure of order and document processing for inspection and testing services it provides to assure conformity to requirements, codes, standards and specifications. The Program is designed to meet the intent of ANSI 45.2 Quality Assurance Program Requirements for Nuclear Power Plants, and complies with the requirements of the ASME Code, SPPE, Military Standards and other less stringent programs. It is the Laboratory's intention to adhere strictly to this Program, to assure that the services offered to its clients remains of the highest quality and accuracy possible.

The overall responsibility of the supervision, operation and coordination of this Quality Assurance Program is that of the Quality Assurance Manager, a person not involved with the performance of the inspection or testing services, and who is under the full time employ of the Laboratory. This individual is responsible for implementing and enforcing all procedures presented in the Quality Assurance Manual and the Procedures Manual. All personnel involved with activities which fall under the scope of this Program are required to cooperate with the letter and intent of this Program.

All QA Surveillance documents remain on file at the Laboratory, and are available for inspection by authorized personnel in the performance of an on-site QA Audit. All materials, services and supplies utilized herein were obtained with appropriate QA Certifications of Compliance, and the inclusion of these in this report would not be practical nor useful to the reader.

OMEGA POINT ® LABORATORIES

ACCEPTABILITY DOCUMENTATION

PROJECT NO. 14980-119368

AREVA

The following signatures attest to the review and acceptance of each attribute listed regarding the above-noted project:

I. TEST ARTICLE ASSEMBLY

Constance J Humphrey — 6/17/04
Omega Point Laboratories, Inc. — Date

John G Crawford — 6/17/04
AREVA — Date

II. CABLE INSTALLATION

Constance J Humphrey — 6/17/04
Omega Point Laboratories, Inc. — Date

John G Crawford — 6/17/04
AREVA — Date

Omega Point Laboratories, Inc.
16015 Shady Falls Road
Elmendorf, Texas 78112-9784 USA
210-635-8100 / FAX: 210-635-8101 / 800-966-5253
www.opl.com moreinfo@opl.com

III. ACCEPTANCE OF:

PRETEST MEGGERING RESULTS
PRETEST CONDUCTOR RESISTANCE MEASUREMENT

Constance Humphrey — 6/17/04
Omega Point Laboratories, Inc. — Date

John G Rowsell — 6/17/04
AREVA — Date

IV. FINAL PRE-BURN INSPECTION

Constance A. Humphrey — 6/17/04
Omega Point Laboratories, Inc. — Date

John G Rowsell — 6/17/04
AREVA — Date

OMEGA POINT LABORATORIES ®

EVENT LOG

Fire Resistance Test of Horizontal Concrete Slab Supporting a Meggitt Safety System Cable

PROJECT NUMBER:

14980-119368

AREVA

EVENT LOG

AREVA
Client # 14980

NOTE:
This Log is used to document the date and note the significant events during the completion of test project #119368 for AREVA. The following is a brief description of this project:

Project No. 119368 **Fire Resistance Test of Horizontal Concrete Slab Supporting a Fire-Rated Electrical Cable**

ITEM	DATE	INIT'L
Reg Priest, President of OPL, issues Proposal No. P040601-01 to John Crowther, Project Manager of Areva (Framatome ANP).	6/1/04	CH
Framatome AND – Areva Purchase Order No. 149126 is received by OPL by fax.	6/4	CH
OPL Technicians order project steel.	6/7	CH
OPL receives the project test plan and drawings from John Crowther by email. Also received is Meggitt Safety Systems Document ER-04-0033, unpacking, inspection and installation practices for the fire-rated cable.	6/9	CH
OPL QA/QC personnel receive the S/C #12 cable and project support hardware (stud, Clamps, spring nuts & bolts) from Meggitt.	6/9	CH
Holes of San Antonio Abrasive holes in the test article concrete slab.	6/10	CH
OPL QA/QC personnel verify the placement of the holes.		
OPL technicians begin installing the test article supports.	6/11	CH
Hubb Engineering Technician Jeff Piel arrived O.T. to do the receipt inspection/measurements with Chad Patton, OPL QA/QC.	6/14	CH
John Crowther, Areva Proj. Mgr. arrives at OPL. OPL Technicians install electrical cable. Installation is verified by OPL QA/QC personnel. John Crowther departs OPL.	6/15	CH

EVENT LOG

AREVA
Client # 14980

NOTE:
This Log is used to document the date and note the significant events during the completion of test project #119368 for AREVA. The following is a brief description of this project:

Project No. 119368 **Fire Resistance Test of Horizontal Concrete Slab Supporting a Fire-Rated Electrical Cable**

ITEM	DATE	INIT'L
The following personnel arrive to inspect the test assembly:	6/16/04	CH
Dhanesh Butani Bechtel J.C. Vance Southern Nuclear		
Jeff Piel, Stubb Engineering arrives to do the second pre-test meggering with QA/QC personnel.	6/17	CH
On site to witness the fire test of project 119368 are:	6/17	CH
John Crowther Areva Cal Banning " Jeff Piel & Stubb Eng. Dhanesh Butani & Bechtel J.C. Vance Southern Nuclear Fred Ruden Meggitt Safety Systems Dee Piepot Omega Point Connie Humphrey " " Oda Patton " " Richard Beasley " " Oscar Estrada " " Troy Brostad " "		
acceptance was done on a bolt that was purchased by Mr. Butani and Mr Vance C.H. 6/17/04 This is a zinc electro-plated bolt.	6/17	CH
The test article is mounted on the test furnace by OPL technicians using the overhead cranes.	6/17	CH
The one hour fire test began at 10:52 am. The meggering during the test began at twenty minutes into the test by Jeff Piel, Stubb	6/17/04	CH

EVENT LOG

AREVA
Client # 14980

NOTE:
This Log is used to document the date and note the significant events during the completion of test project #119368 for AREVA. The following is a brief description of this project:

Project No. 119368 **Fire Resistance Test of Horizontal Concrete Slab Supporting a Fire-Rated Electrical Cable**

ITEM	DATE	INIT'L
Engineering and Aleda Patton, OPL QA/QC personnel. This first meggering into the test continued until 11:53 am.	6/17/04	CH
The client decided to begin another series of meggering starting the at 11:58 am.	6/17	CH
The meggering was completed at 12:30 pm. The fire test ran for a total of one hour and 42 minutes.	6/17	CH
Following the fire test, the test assembly was moved to begin the hose stream test. This five minute test uses a fog nozzle with a 30° spray, O. verified by an OPL Technician. The water pressure at the nozzle is 75 PSI from a distance of 20 fine feet to the test assembly. Immediately following the hose stream the post hose stream meggering was performed by Quality Engineering and OPL QA/QC also Conductor Resistance was performed.	6/17	CH
The cables will be sent back to Meggitt.	6-17-04	SP
	6-17-04	SP
— end —		

A FRAMATOME ANP

REVISIONS			
REV	DESCRIPTION	DATE	APPROVAL
0	ORIGINAL ISSUE	6/8/04	CAB Canning

TEST ARTICLE ATTRIBUTE CHECKLIST

PROJECT NUMBER:

PROJECT TITLE: MEGGITT FIRE RESISTIVE CABLE TESTING

		ATTRIBUTE	SAT	UNSAT
I	TEST DECK			
	A	Test deck configuration and dimensions per approved drawings		
	B	Condition of test deck	✓	
	C	Test deck conditioned to moisture equilibrium at indoor conditions	✓	
II	SUPPORTS/STEEL PLATES			
	A.	Correct materials used	✓	
	B.	Installed per approved drawings	✓	
	C.	Spacing between the two Section A-A supports is equal to or greater than shown on approved drawings	✓	
	D.	Supports for Meggitt cable are properly grounded	✓	
	E.	Applied torque values for strut clamps per approved drawings	✓	
	F.	Welds per approved drawings	✓	
III	MEGGITT CABLE			
	A.	Cable installed per approved drawings	✓	
	B.	Minimum bend radius installed where shown on approved drawings	✓	
	C.	Factory installed splices installed as shown on approved drawings	✓	
	D.	Factory installed terminations provided at each end of cable	✓	
	E.	No gouges or cuts in the cable sheath which exceed 10% of cable wall thickness	✓	
V	TEST EQUIPMENT			
	A.	Wiring of test articles conform to the Figure 1 in the Test Plan	✓	
	B.	All electrical devices and equipment have been tested prior to the start of the test to ensure that they are properly connected and functioning as required, showing proper readings on data acquisition equipment	✓	
	C.	Furnace thermocouples are the correct type and are installed per the Test Plan	✓	

NOTE: Verification to be made using initials of OPL Quality Assurance Personnel

QA/QC
6-17-04

6/17/04
John G. Crowther
AREVA

DRAWN BY K GROSZEK	CHECKED BY JOHN G. CROWTHER		
PASSED BY R L DIBLE	APPROVED BY CAB Canning	MSSI FIRE RESISTIVE CABLE TEST TEST ARTICLE ATTRIBUTE CHECKLIST	SCALE N.T.S. DATE 6/8/04
			DWG. NO. 02-5045842A-00

CAD FILE 02-5045842A-00

Q/A RECEIVING REPORT

CLIENT/PROJECT NAME Omega Point Labs
CLIENT/PROJECT NUMBER OPL Equipment
RECEIVED FROM PMC
PROJECT LOCATION Omega Point Labs

REPORT NUMBER 2303 . OPL
DATE RECEIVED 2-11-02
DATE INSPECTED 3-11-02
INSPECTED BY: [illegible]

ITEM DESCRIPTION	P.O. NO.	QUANTITY			I.D. NO.	CONTD MATL Y/N	CERT. RECD Y/N	CONTAINER INTEGRITY	EXCEPTIONS	ACCEPTANCE			REMARKS
		Order	Rec'd	B.O.						Accept	Hold	Reject	
Chromel TC Wire	13454Q	10#	11#	0	KKP-16 Spool-00395248	Y	Y	Good	None	K			
Alumel TC Wire	13454Q	10#	11#	0	KKN-16 Spool-00395246	Y	Y	Good	None	K			

Page 71

09-016-9/97

OMEGA POINT LABORATORIES
16015 SHADY FALLS RD.
ELMENDORF, TEXAS 78112
PH. (210) 635-8100
FAX (210) 635-8101

PURCHASE ORDER 13454Q

Date: 1/31/2002
Page: 1 of 1

Order From: PMC
680 Hayward Street
Manchester
NH 03103
603-622-3500

Deliver to: Omega Point Laboratories, Inc
16015 Shady Falls Road
Elmendorf
TX 78112
(210) 635-8100

Vendor No: 0024

Your Item Number / Item Description	Our Reference	Qty Ordered	Units	Unit Cost	Extension
KP-16 Chromel TC Wire	001	10.00	Pounds	$23.20	$232.00
KN-16 Alumel TC Wire	002	10.00	Pounds	$27.00	$270.00
Calibration Services	003	2.00	Each	$8.50	$17.00

Peg

"See Special Instructions Regarding Purchasing Specifications for Quality Assurance Requirements"
QA Approval C Dalton
Date 1-31-2002

Please Quote Purchase Order Number on all correspondence.

Special Instructions: Please include Certificate of Conformance to attached Specification Sheet and Calibration Data traceable to NIST

Subtotal:	$519.00
Freight:	0.00
Tax Amount:	0.00
Total Value:	$519.00

OMEGA POINT LABORATORIES
MATERIAL PURCHASING SPECIFICATIONS

SPECIFICATION NUMBER: MS-04-1345AQ-OPL

VENDOR: PMC Corporation

VENDOR PRODUCT NUMBER	PRODUCT DESCRIPTION
KP-16	Bare Chromel Thermocouple Wire (16 gauge)
KN-16	Bare Alumel Thermocouple Wire (16 gauge)

Material as defined above shall be provided in accordance with the Critical Characteristics as listed below:

TEST	DESCRIPTION	TEMPERATURE RANGES MIN. - MAX
ASTM E220-96	Std. Test Method for Calibration of Thermocouples by Comparison	32°F - 2300°F
Thermocouple Type K	Table 2 "Calibration Uncertainties in Calibrating Thermocouples by Comparison Method – Temperatures in Degrees Fahrenheit	

Note: Temperature deviations above 2000°F are for reference only when using 16 gauge wire.

QUALITY ASSURANCE REQUIREMENTS

1.0 QUALITY PROGRAM

Seller shall furnish this item in accordance with Quality Program approved by Omega Point Laboratories. Material specified herein is to be produced and tested in accordance with vendor quality standards, methods, guidelines and manufacturing instructions as defined in that Quality Program.

2.0 QUALITY VERIFICATION

Receiving Inspection - Buyer shall inspect items upon receipt to verify compliance with purchase order requirements. Rejected items shall be returned at seller's expense.

Document Review - Final acceptance shall be based on satisfactory review of required certifications and/or supporting documents.

3.0 CERTIFICATIONS

3.1 Certification that supplied materials comply with this material specification and listing Critical Characteristics shall be provided. This certificates shall reference Omega Point Labs purchase order number and specification number for all material furnished under this specification. This Certification shall be signed by the appropriate vendor representative.

3.2 The material furnished under this specification shall be a product that complies with the following:

3.2.1 Has been tested and passed all tests specified herein.

3.2.2 Manufacturing methods for this material have not changed. Vendor will advise Omega Point in writing of any changes in the manufacturing prior to material manufacture.

3.2.3 Raw materials used in the manufacture of this material meet Vendor specifications.

4.0 AUDITS/RIGHTS OF ACCESS

Omega Point Labs reserves the right to audit your facility to verify compliance with the purchase order and specification requirements with a minimum ten (10) day notice.

5.0 IDENTIFICATION

Seller shall identify each item with a unique traceability number by physical marking or tagging. These identification numbers shall be traceable to certifications and packing lists.

6.0 PACKING/SHIPPING

All materials shall be packaged in air tight, moisture free containers and shall be free of foreign substances such as dirt, oil, grease or other deleterious materials.

All materials shall be suitably crated, boxed or otherwise prepared for shipment to prevent damage during handling and shipping.

QUALITY ASSURANCE APPROVAL:

T Button

Title QA Assist

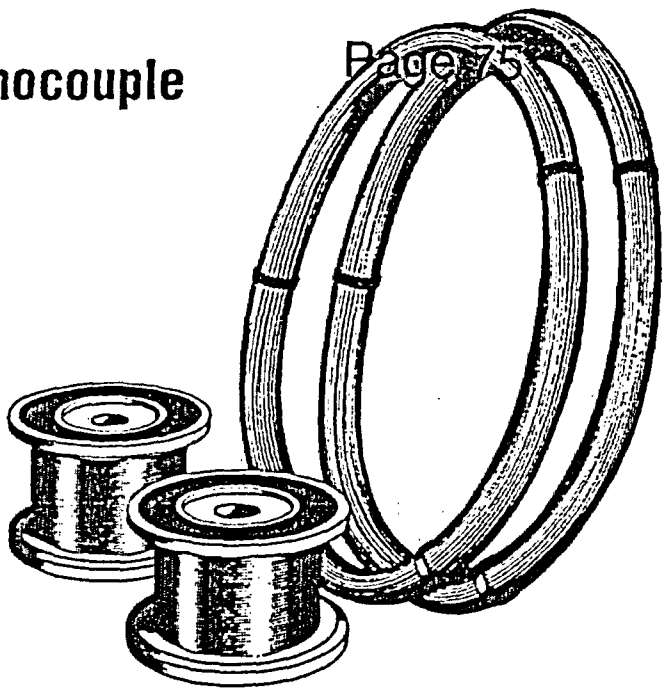
Date 1-31-02

AVL Verification

Class: A

PMC®

Bare Thermocouple Wire



PMC is continuously committed to meet the specific needs of the industry and it's customers. In order to meet this committment, PMC has become a full service company. Therefore along with insulated wire product capabilities, PMC operates high speed stranders and spooling equipment to provide a full line of bare wire items.

Customers may select from the items listed below as matched pairs to meet standard limits of error. On most items, variations are available to meet particular applications, including special limits of error or extension grade tolerances.

You will find our qualified sales and engineering staff eager to assist you in these selections.

SOLID BARE THERMOCOUPLE WIRE PART NUMBERS												
		TYPE J		TYPE K		TYPE T		TYPE E		TYPE N		
WIRE GA B&S	WIRE SIZE DIA.	Iron JP +	Constantan JN -	Chromel KP +	Alumel KN -	Copper TP +	Constantan TN -	Chromel EP +	Constantan EN -	Nicrosil NP +	Nisil NN -	STANDARD PACKAGE COIL/REEL LBS
8	.128	JP-8	JN-8	KP-8	KN-8	—	—	EP-8	EN-8	NP-8	NN-8	COIL 50#
14	.064	JP-14	JN-14	KP-14	KN-14	TP-14	TN-14	EP-14	EN-14	NP-14	NN-14	REEL 50#
16	.050	JP-16	JN-16	KP-16	KN-16	TP-16	TN-16	EP-16	EN-16	NP-16	NN-16	REEL 25#
18	.040	JP-18	JN-18	KP-18	KN-18	TP-18	TN-18	EP-18	EN-18	NP-18	NN-18	REEL 10#
20	.032	JP-20	JN-20	KP-20	KN-20	TP-20	TN-20	EP-20	EN-20	NP-20	NN-20	REEL 10#
24	.020	JP-24	JN-24	KP-24	KN-24	TP-24	TN-24	EP-24	EN-24	NP-24	NN-24	REEL 5#
26	.015	JP-26	JN-26	KP-26	KN-26	TP-26	TN-26	EP-26	EN-26	NP-26	NN-26	REEL 5#
28	.012	JP-28	JN-28	KP-28	KN-28	TP-28	TN-28	EP-28	EN-28	NP-28	NN-28	REEL 1#
30	.010	JP-30	JN-30	KP-30	KN-30	TP-30	TN-30	EP-30	EN-30	NP-30	NN-30	REEL 1#
— STRANDED BARE THERMOCOUPLE WIRE PART NUMBERS —												
16 7/24	.060	JP-16F	JN-16F	KP-16F	KN-16F	TP-16F	TN-16F	EP-16F	EN-16F	NP-16F	NN-16F	REEL 40#
18 19/30	.050	JP-1819	JN-1819	KP-1819	KN-1819	TP-1819	TN-1819	EP-1819	EN-1819	NP-1819	NN-1819	REEL 30#
18 7/26	.048	JP-18F	JN-18F	KP-18F	KN-18F	TP-18F	TN-18F	EP-18F	EN-18F	NP-18F	NN-18F	REEL 30#
20 7/28	.037	JP-20F	JN-20F	KP-20F	KN-20F	TP-20F	TN-20F	EP-20F	EN-20F	NP-20F	NN-20F	REEL 15#
24 7/32	.024	JP-24F	JN-24F	KP-24F	KN-24F	TP-24F	TN-24F	EP-24F	EN-24F	NP-24F	NN-24F	REEL 5#

The above part numbers represent the more popular constructions. However, other designs are available upon request.

PMC CORPORATION
57 Harvey Road
Londonderry, NH
03053

Tel. (603) 432-9473
FAX (800) 639-5701

Upper > temperature limits for bare thermocouple wire

UPPER TEMPERATURE LIMITS FOR BARE THERMOCOUPLE WIRE							
THERMOCOUPLE TYPE	ANSI SYMBOL	WIRE GAUGE (A.W.G.)					
		8 GA.	14 GA.	16 GA.	20 GA.	24 GA.	28 GA.
IRON-CONSTANTAN™	J	1400°F (760°C)	1100°F (600°C)	900°F (500°C)	900°F (500°C)	700°F (370°C)	700°F (370°C)
CHROMEL™-ALUMEL™	K	2300°F (1260°C)	2000°F (1100°C)	2000°F (1100°C)	1800°F (1000°C)	1600°F (870°C)	1600°F (870°C)
COPPER-CONSTANTAN™	T	—	700°F (370°C)	500°F (260°C)	500°F (260°C)	400°F (200°C)	400°F (200°C)
CHROMEL™-CONSTANTAN™	E	1600°F (870°C)	1200°F (650°C)	1000°F (550°C)	1000°F (550°C)	800°F (430°C)	800°F (430°C)
NICROSIL™-NISIL™	N	2300°F (1260°C)	2000°F (1100°C)	2000°F (1100°C)	1800°F (1000°C)	1600°F (870°C)	1600°F (870°C)

™Trademark, Hoskins Mfg. Co.

Approximate > yields for bare solid thermocouple wire

— BARE SOLID THERMOCOUPLE WIRE FEET/LB —											
		TYPE J		TYPE K		TYPE T		TYPE E		TYPE N	
Wire GA B&S	Wire Size DIA.	Iron JP +	Constantan JN -	Chromel KP +	Alumel KN -	Copper TP +	Constantan TN -	Chromel EP +	Constantan EN -	Nicrosil NP +	Nisil NN -
6	.162	14.2	12.6	13	13	12.6	12.6	13	12.6	13	13
8	.128	22.8	20.2	21	21	19.8	20.2	21	20.2	21	21
14	.064	91.2	80.9	83	83	80.5	80.9	83	80.9	83	83
16	.050	144	127	130	130	128	128	130	127	130	130
18	.040	233	207	212	212	203	203	212	207	212	212
20	.032	365	324	331	331	324	324	331	324	331	331
24	.020	925	821	838	838	820	820	838	821	838	838
26	.015	1478	1312	1340	1340	1299	1299	1340	1312	1340	1340
28	.012	2353	2089	2130	2130	2062	2062	2130	2089	2130	2130
30	.010	3736	3316	3370	3370	3294	3294	3370	3316	3370	3370
36	.005	14940	13260	13500	13500	13250	13250	13500	13260	13500	13500

Approximate > yields for bare stranded thermocouple wire

— BARE STRANDED THERMOCOUPLE WIRE FEET/LB —											
		TYPE J		TYPE K		TYPE T		TYPE E		TYPE N	
Wire GA B&S	Wire Size DIA.	Iron JP +	Constantan JN -	Chromel KP +	Alumel KN -	Copper TP +	Constantan TN -	Chromel EP +	Constantan EN -	Nicrosil NP +	Nisil NN -
14 7/22	.073	83	74	75	76	74	74	75	74	75	76
16 7/24	.060	132	117	119	121	117	117	119	117	119	121
18 19/30	.050	197	175	177	180	173	175	177	175	177	180
18 7/26	.048	211	187	190	193	186	187	190	187	190	193
20 7/28	.037	336	298	303	307	295	298	303	298	303	307
22 7/30	.030	534	474	480	488	471	474	480	474	480	488
24 7/32	.024	952	833	833	833	737	833	833	833	833	833

PRICING POLICY > Shipments will be invoiced at PMC's prices in effect at time of shipment. Quotations are given with an escalation clause and prices, terms, and conditions are subject to change without prior notice. PMC will, however, make every attempt to hold to current quoted prices. All prices quoted are in United States currency, and shall be subject to correction for errors. Unless otherwise stated in writing to PMC

REELS, SPOOLS & COILS > All shipments, unless specified otherwise by PMC, are made on non-returnable reels, spools or coils in one continuous length.

SHORTAGES & RETURNS > All claims for shortage or incorrect material must be made within 10 days after receipt of the goods to which such claim pertains. Goods may only be returned for credit within 1 month of the date of authorization. Goods that are special in any way shall not be returned to PMC. Material returned for any reason, without written authorization will be refused and returned at shipper's expense. A return request must be processed through our Londonderry, N.H. sales office.

TOLERANCES > Due to allowances in manufacturing processes for wire, cable and similar products, PMC reserves the right to ship a variation of ± 10% from the quantity of such goods ordered. Physical tolerances shown are nominal. Shipping weights are an average of all types of conductors and are listed for estimating only. These weights can vary substantially due to different types of spools, reels and/or conductors.

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORPORATION
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

TO: OMEGA POINT LABS
16015 SHADY FALLS ROAD
ELMENDORF, TX 78112

Date: 02/11/02
Cust PO#: 13454Q
Job #: PSO055960-1+2

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-93, IPTS90, AND AMS 2750 REV C.

TEST RESULTS FOR: SPOOLS PMC P/N: KKP-16 Spool 00395248 TOTAL: 11 LBS.
KKN-16 Spool 00395246 11 LBS

Test Temperature (°F)	Inside End	Outside End	Test Temperature (°F)	Inside End	Outside End
800	-1.9	-2.0	2000	-5.6	-5.2
1000	-0.5	-0.5	2300	-6.4	-5.8
1500	-2.0	-1.9			

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 00291335
REEL # NEG LEG: 00291346
CALIBRATION DATE: 3/17/00

NIST #:263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525C
SERIAL #: 306172
CALIBRATION DUE DATE: 07/25/02

EDC 100RC SERIAL# 15075
CERTIFICATE # 01-020
DUE 07/10/02

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SR
SERIAL #: 306179
CALIBRATION DUE DATE: 07/25/02

HART DIGITAL THERMOMETER
SERIAL# 15448
DUE 05/21/02

Calibration Certificate Acceptance

Item Alumel & Chromel Thermocouple Wire
SN Spools 00395248 & 00395246

	Eng.
NIST Traceability Adequate	N/A
As Found/As Left Verified	ES
Calibration Data Sufficient	ES
Tolerance Range Adequate	ES
Date of Review	3/11/02 3/11/02

OPL QA/QC Mgr. Eng./ Dept. Mgr.

QUALITY ASSURANCE TECHNICIAN DATE 2-11-02

PMC Division of RSCC
680 Hayward Street
Manchester, NH 03103
Phone: (603) 622-3500 Fax: (603) 622-7023

Delivery Note

35607

Ship To: OMEGA POINT LABS
16015 SHADY FALLS ROAD
ELMENDORF, TX 78112

Attention: CLEDA

Ship Date	Customer P.O.	Ship Via	Due Date	
Feb 11 2002	13454Q	UPS GROUND	FEB 05 2002	Page : 1

Item and Description	Qty Ordered	Back ordered	Qty Shipped
1. KP-16 Spool#: 00395248-CAR	10	0	11
2. KN-16 Spool#: 00395246-CAR	10	0	11
3. CALIBRATION CHARGE CALIBRATION CHARGE. Item 1 & 2 to be calibrated at 800, 1000, 1500, 2000 & 2300°F I/O to ASTME E220-96	1	0	1

OMEGA POINT LABORATORIES, INC.
16015 Shady Falls Road
Elmendorf, Texas 78112-9784
(210) 635-8100 / FAX (210) 635-8101

ACCREDITED

Fax Transmittal Sheet

To:	Janice Welch	From:	Cleda Patton
Phone:	603-622-3500	Date:	1/31/2002
Fax:	800-639-5701		

Comments:

Janice,

P.O. 13454Q and OPL Material Purchasing Specifications.

Best regards,

Cleda

Pages Transmitted, Including This Sheet: 4

Original Sent Via:
_____ U.S. Mail
_____ Overnight Delivery Service
__X__ FAX only; Originals Not Sent

Q/A RECEIVING REPORT

CLIENT/PROJECT NAME Omega Point Labs
CLIENT/PROJECT NUMBER OPL Equipment
RECEIVED FROM PMC
PROJECT LOCATION Omega Point Labs

REPORT NUMBER 2398 - OPL
DATE RECEIVED 10-31-03
DATE INSPECTED 11-3-03
INSPECTED BY: Obatton

ITEM DESCRIPTION	P.O. NO.	QUANTITY Order	Rec'd	B.O.	I.D. NO.	COMM MATL Y/N	CERT. RECD Y/N	SAFETY RELATED Y/N	CONTAINER INTEGRITY	ACCEPTANCE Accept	Hold	Reject	REMARKS
Fiberglass TC Wire	141490	~~1BAK~~	~~1BAK~~	0	KK-FB/FB-24	Y	Y	N	Good	X			PO complete. Spool #'s 0048597S, 0048437 0048378 & 0048379

Page 80

09-016-11/02

16015 SHADY FALLS RD.
ELMENDORF, TEXAS 78112
PH. (210) 635-8100
FAX (210) 635-8101

PURCHASE ORDER

14149Q

Date: 10/17/2003
Page: 1 of 1

Order From: PMC
680 Hayward Street
Manchester
NH 03103
603-622-3500

Deliver to: Omega Point Laboratories, Inc
16015 Shady Falls Road
Elmendorf
TX 78112
(210) 635-8100

Vendor No: 0024

Your Item Number / Item Description	Our Reference	Qty Ordered	Units	Unit Cost	Extension
Fiberglass TC Wire KK-FB/FB-24	001	16,400	Feet	$182.00	$2984.00
Calibration Services	002	1.00	Each	$207.00	$207.00

"See Special Instructions Regarding Purchasing Specifications for Quality Assurance Requirements."
QA Approval [signature]
Date 10-17-03

Please Quote Purchase Order Number on all correspondence.

Special Instructions: Please include Certificate of Conformance to attached Specification Sheet and Calibration Data traceable to NIST

Subtotal:	$3191.00
Freight:	0.00
Tax Amount:	0.00
Total Value:	$3191.00

OMEGA POINT LABORATORIES
MATERIAL PURCHASING SPECIFICATIONS

SPECIFICATION NUMBER: MS-14149Q-OPL

VENDOR: PMC Corporation

ITEM NO.	VENDOR PRODUCT NUMBER	PRODUCT DESCRIPTION
	KK-TA/TA-24	Teflon Coated Thermocouple Wire
1	KK-FB/FB-24	Fiberglas Braided Thermocouple Wire
	KK-TE/TE-24	FEP Insulated Thermocouple Wire

Material as defined above shall be provided in accordance with the Critical Characteristics as listed below:

TEST	DESCRIPTION	SPECIFICATION RANGES MIN. - MAX.
ASTM E220-96	Std. Test Method for Calibration of Thermocouples by Comparison	Temp. Range +32°F to +545°F Special Limits of Error ± 2% °F
	(Chromel/Alumel wire alloy)	Temp. Range +545°F to +2300°F Special Limits of Error ± .4%
ASTM E220-96	Std. Test Method for Calibration of Thermocouples by Comparison	Temp. Range -85°F to +270°F Special Limits of Error ±.9%°F
	(Copper/Constantan wire alloy)	Temp. Range +270°F to +660°F Special Limits of Error ±.4%

QUALITY ASSURANCE REQUIREMENTS

1.0 QUALITY PROGRAM

Seller shall furnish this item in accordance with Quality Program approved by Omega Point Laboratories. Material specified herein is to be produced and tested in accordance with vendor quality standards, methods, guidelines and manufacturing instructions as defined in that Quality Program.

2.0 QUALITY VERIFICATION

Receiving Inspection - Buyer shall inspect items upon receipt to verify compliance with purchase order requirements. Rejected items shall be returned at seller's expense.

Document Review - Final acceptance shall be based on satisfactory review of required certifications and/or supporting documents.

3.0 CERTIFICATIONS

3.1 Certification that supplied materials comply with this material specification and listing Critical Characteristics shall be provided. This certificates shall reference Omega Point Labs purchase order number and specification number for all material furnished under this specification. This Certification shall be signed by the appropriate vendor representative.

3.2 The material furnished under this specification shall be a product that complies with the following:

3.2.1 Has been tested and passed all tests specified herein.

3.2.2 Manufacturing methods for this material have not changed. Vendor will advise Omega Point in writing of any changes in the manufacturing prior to material manufacture.

3.2.3 Raw materials used in the manufacture of this material meet Vendor specifications.

4.0 AUDITS/RIGHTS OF ACCESS

Omega Point Labs reserves the right to audit your facility to verify compliance with the purchase order and specification requirements with a minimum ten (10) day notice.

5.0 IDENTIFICATION

Seller shall identify each item with a unique traceability number by physical marking or tagging. These identification numbers shall be traceable to certifications and packing lists.

6.0 PACKING/SHIPPING

All materials shall be packaged in air tight, moisture free containers and shall be free of foreign substances such as dirt, oil, grease or other deleterious materials.

All materials shall be suitably crated, boxed or otherwise prepared for shipment to prevent damage during handling and shipping.

QUALITY ASSURANCE APPROVAL:

Ueda Patton

Title QA Assistant

Date 10/16/03

AVL Verification

Class: A

FIBERGLASS Braided Thermocouple and Extension Wire

PRODUCT CODE: FB/FB

Our customers have grown to expect only the highest quality products from PMC.

This construction is one of the earliest insulations used and is perhaps still the most widely used. It consists of the single conductors insulated with a fiberglass braid then impregnated with a special binder to improve moisture and abrasion resistance. The singles are then laid parallel and a braided jacket of the same material is applied and impregnated.

While wire gauge size, calibration and atmosphere will affect maximum useful temperature in applications, This insulation is designed to withstand a maximum continuous use at 900°F (482°C) and a single exposure use at 1000°F (537°C). (Note: Impregnations retained to 400°F (204°C)).

You will find our qualified sales and engineering staff eager to assist in selecting a design to meet the requirements of your specific application. Variations of this construction including protective metal coverings for improved abrasion resistance are available upon request.

Typical applications include aerospace, aluminum mills, foundries, ovens, furnaces, heat treating, plastics industry, sensor leads as well as others.

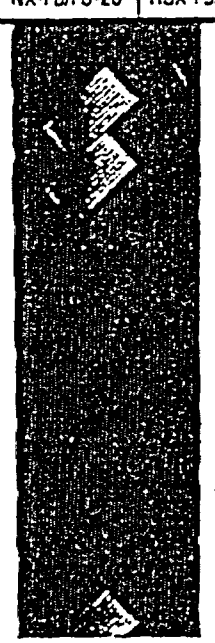
Calibrated conductors for high system accuracy

900°F (482°C) Braided fiberglass insulation for abrasion resistance at high temperatures

900°F (482°C) Braided fiberglass jacket for additional flexibility and abrasion resistance at high temperatures

GRADE OF WIRE	GAUGE SIZE	WIRE TYPE	PART NUMBERS					
			TYPE J	TYPE K	TYPE T	TYPE E	TYPE N	TYPE RSX
THERMOCOUPLE	16	SOLID	J-FB/FB-16	K-FB/FB-16	T-FB/FB-16	E-FB/FB-16	N-FB/FB-16	
THERMOCOUPLE	20	SOLID	J-FB/FB-20	K-FB/FB-20	T-FB/FB-20	E-FB/FB-20	N-FB/FB-20	
THERMOCOUPLE	20 7/28	STRANDED	J-FB/FB-20F	K-FB/FB-20F	T-FB/FB-20F	E-FB/FB-20F	N-FB/FB-20F	
THERMOCOUPLE	24	SOLID	J-FB/FB-24	K-FB/FB-24	T-FB/FB-24	E-FB/FB-24	N-FB/FB-24	
EXTENSION	16	SOLID	JX-FB/FB-16	KX-FB/FB-16	TX-FB/FB-16	EX-FB/FB-16	NX-FB/FB-16	RSX-FB/FB-16
EXTENSION	20	SOLID	JX-FB/FB-20	KX-FB/FB-20	TX-FB/FB-20	EX-FB/FB-20	NX-FB/FB-20	RSX-FB/FB-20

The above part numbers represent the more popular constructions. However, other designs are available upon request.



PMC CORPORATION
57 Harvey Road
Londonderry, NH
03053

Tel. (603) 432-9473
FAX (603) 432-0435

Color code > & initial calibration tolerances for thermocouple wire

THERMOCOUPLE TYPE		COLOR CODE		INITIAL CALIBRATION TOLERANCES		
WIRE ALLOYS	ANSI SYMBOL	+/- INDIVIDUAL	JACKET	TEMPERATURE RANGE	STANDARD LIMITS	SPECIAL LIMITS
*Iron (+) vs. Constantan™(-)	J	WHITE/RED	BROWN w/ BLACK TRACER	+32°F (0°C) to +545°F (+285°C) +545°F (+285°C) to +1400°F (+750°C)	±4°F (2.2°C) ±.75%	±2°F (1.1°C) ±.4%
Chromel™ (+) vs. *Alumel™ (-)	K	YELLOW/RED	BROWN w/YELLOW TRACER	-330°F (-200°C) to -165°F (-110°C) -165°F (-110°C) to +32°F (0°C) +32°F (0°C) to +545°F (+285°C) +545°F (+285°C) to +2300°F (+1250°C)	±2% ±4°F (2.2°C) ±4°F (2.2°C) ±.75%	±2°F (1.1°C) ±.4%
Copper (+) vs. Constantan™ (-)	T	BLUE/RED	BROWN w/ BLUE TRACER	-330°F (-200°C) to -85°F (-65°C) -85°F (-65°C) to +270°F (+130°C) +270°F (+130°C) to +660°F (+350°C)	±1.5% ±1.8°F (1°C) ±.75%	±.8% ±.9°F (.5°C) ±.4%
Chromel ™ (+) vs. Constantan ™ (-)	E	PURPLE/RED	BROWN w/ PURPLE TRACER	-330°F (-200°C) to -270°F (-170°C) -270°F (-170°C) to +480°F (+250°C) +480°F (+250°C) to +640°F (+340°C) +640°F (+340°C) to +1600°F (+900°C)	±1% ±3°F (1.7°C) ±3°F (1.7°C) ±.5%	±1.8°F (1°C) ±1.8°F (1°C) ±.4% ±.4%
Nicrosil™ (+) vs. Nisil™ (-)	N	ORANGE/RED	BROWN w/ ORANGE TRACER	+32°F (0°C) to +545°F (+285°C) +545°F (+285°C) to +2300°F (+1250°C)	±4°F (2.2°C) ±.75%	±2°F (1.1°C) ±.4%

Color code > & initial calibration tolerances for extension wire

*Iron vs. Constantan™	JX	WHITE/RED	BLACK	+32°F (0°C) to +400°F (+200°C)	±4°F (2.2°C)	±2°F (1.1°C)
Chromel™ vs. *Alumel™	KX	YELLOW/RED	YELLOW	+32°F (0°C) to +400°F (+200°C)	±4°F (2.2°C)	±2°F (1.1°C)
Copper vs. Constantan™	TX	BLUE/RED	BLUE	-75°F (-60°C) to +210°F (+100°C)	±2°F (1.1°C)	±1°F (.5°C)
Chromel™ vs. Constantan™	EX	PURPLE/RED	PURPLE	+32°F (0°C) to +400°F (+200°C)	±3°F (1.7°C)	±2°F (1.1°C)
Nicrosil™ vs. Nisil™	NX	ORANGE/RED	ORANGE	+32°F (0°C) to +400°F (+200°C)	±4°F (2.2°C)	±2°F (1.1°C)
Copper vs. Copper Alloy	SX RX	BLACK/RED	GREEN	+75°F (+25°C) to +400°F (+200°C)	±12°F (7°C)	

* Magnetic
™Trade Mark, Hoskins Mfg Co

NOTE – Percent limits apply directly to temperatures in °C units, but for °F equivalents are applied to the numbers of °F above or below the ice point (+32°F).
(i.e., Limit (°F) = (Temp °F – 32°F) X Percentage)

Thermocouple wire cannot be expected to meet the limits of error at temperatures below the ice point unless specified at time of purchase.

FB/FB > physical properties

INSULATION CHARACTERISTICS	INSULATION	JACKET	GAUGE SIZE	NOMINAL INSULATION WALL (INCHES)	NOMINAL JACKET WALL (INCHES)	NOMINAL DIAMETER (INCHES)	APPROX. SHIP. WT. LBS. PER 1000 FT
SPECIFIC GRAVITY	2.54	2.54	16	.006	.006	.080 X .144	22
TENSILE STRENGTH p.s.i. (min.)	250,000 at 1000°F (537°C)	250,000 at 1000°F (537°C)					
ELONGATION% (min.)	4.8%	4.8%	20 7/28	.006	.006	.066 X .118	11
MINIMUM BEND RADIUS	5 X O.D.	10 X O.D.					
ABRASION RESISTANCE	GOOD	GOOD	20	.006	.006	.060 X .106	10
CUT THROUGH RESISTANCE	EXCELLENT	EXCELLENT					
MOISTURE RESISTANCE	GOOD	GOOD	24	.006	.006	.048 X .082	6
SOLDER IRON RESISTANCE	EXCELLENT	EXCELLENT					
SERVICE TEMPERATURE	900°F(482° C) CONTINUOUS 1000°F (537°C) SINGLE EXPOSURE	900°F(482° C) CONTINUOUS 1000°F (537°C) SINGLE EXPOSURE					
FLAME TEST	NON-FLAMMABLE	NON-FLAMMABLE					

PRICING POLICY > Shipments will be invoiced at PMC's prices in effect at time of shipment. Quotations are given with an escalation clause and prices, terms, and conditions are subject to change without prior notice. PMC will, however, make every attempt to hold to current quoted prices. All prices quoted are in United States currency, and shall be subject to correction for errors. Unless otherwise stated in writing to PMC

REELS, SPOOLS & COILS > All shipments, unless specified otherwise by PMC, are made on non-returnable reels, spools or coils in one continuous length.

SHORTAGES & RETURNS > All claims for shortage or incorrect material must be made within 10 days after receipt of the goods to which such claim pertains. Goods may only be returned for credit within 1 month of the date of authorization. Goods that are special in any way shall not be returned to PMC. Material returned for any reason, without written authorization will be refused and returned at shipper's expense. A return request must be processed through our Londonderry, N.H. sales office.

TOLERANCES > Due to allowances in manufacturing processes for wire, cable and similar products, PMC reserves the right to ship a variation of ± 10% from the quantity of such goods ordered. Physical tolerances shown are nominal. Shipping weights are an average of all types of conductors and are listed for estimating only. These weights can vary substantially due to different types of spools, reels and/or conductors.

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORPORATION
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00484378
REVISED

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS1419Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 2400'

Test Temperature (°F)	Inside End	Outside End
200°	-0.2	-0.2
400°	-0.8	-0.4
600°	-1.5	-1.4
800°	-2.7	-1.9
1000°	-1.4	-0.6

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Laura Robitaille 10-23-03
QUALITY ASSURANCE TECHNICIAN DATE

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORPORATION
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00484378
REVISED

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS1419Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 5000'

Test Temperature (°F)	Inside End	Outside End
200°	+0.1	+0.5
400°	-0.4	+0.1
600°	+0.5	+0.2
800°	-1.9	-1.5
1000°	-0.9	-0.6

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Laura LeBoeuf 10-23-03
QUALITY ASSURANCE TECHNICIAN DATE

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORPORATION
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00484377
REVISED

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS1419Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 5000'

Test Temperature (°F)	Inside End	Outside End
200°	-0.1	-0.4
400°	-1.0	-0.8
600°	-1.1	-1.9
800°	-2.4	-2.3
1000°	-0.9	-0.9

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Dawn Rebouel 10-23-03
QUALITY ASSURANCE TECHNICIAN) DATE

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORPORATION
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00485975
REVISED

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS1419Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 4000'

Test Temperature (°F)	Inside End	Outside End
200°	+0.6	+0.3
400°	+0.6	+0.3
600°	-0.8	-0.9
800°	+0.8	+0.7
1000°	+1.0	+1.5

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Bruce Rebeiro 10-23-03
QUALITY ASSURANCE TECHNICIAN DATE

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORP.
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00485975

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS12985Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 4000'

Test Temperature (°F)	Inside End	Outside End
200°	+0.6	+0.3
400°	+0.6	+0.3
600°	-0.8	-0.9
800°	+0.8	+0.7
1000°	+1.0	+1.5

Calibration Certificate Acceptance

Item Fiberglass TC Wire
SN 00485975

	QA	Eng.
NIST Traceability Adequate	✓	✓
As Found/As Left Values	✓	✓
Calibration Data Sufficient	✓	✓
Tolerance Range Adequate	✓	✓
Date of Review:	11/3/03	11/3/03

OPL QA/QC Dept. Eng./Dept. Mgr.

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Lucie LeBlanc 10-23-03
QUALITY ASSURANCE TECHNICIAN DATE

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORP.
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00484377

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS12985Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 5000'

Test Temperature (°F)	Inside End	Outside End
200°	-0.1	-0.4
400°	-1.0	-0.8
600°	-1.1	-1.9
800°	-2.4	-2.3
1000°	-0.9	-0.9

Calibration Certificate Acceptance
Item Silverglass TC Wire
SN 00484377
NIST Traceability Adequate — Q/A
As Found/As Left Values — Eng.
Calibration Data Sufficient
Tolerance Range Adequate
Date of Review: 11-3-03 11/7/03
OPL QA/QC Dept. Eng./Dept. Mgr.

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Laura LeBoeuf 10-23-03
QUALITY ASSURANCE TECHNICIAN DATE

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORP. CANADA
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00484378

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS12985Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 5000'

Test Temperature (°F)	Inside End	Outside End
200°	+0.1	+0.5
400°	-0.4	+0.1
600°	+0.5	+0.2
800°	-1.9	-1.5
1000°	-0.9	-0.6

Calibration Certificate Acceptance
Item Fiberglass TC Wire
SN 00484378

	Q/A	Eng
NIST Traceability Adequate		
As Found/As Left Values		
Calibration Data Sufficient		
Tolerance Range Adequate		
Date of Review:	11-3-03	11/3/03

OPL QA/QC Dept. Eng./Dept. Mgr.

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Bruce LaBoeuf 10-23-03
QUALITY ASSURANCE TECHNICIAN DATE

PMC A DIVISION OF ROCKBESTOS-SURPRENANT CABLE CORP.
680 HAYWARD STREET, MANCHESTER, NH 03103 (603) 622-3500
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY FAX (800) 639-5701

CERTIFICATE OF CALIBRATION

SPOOL # 00484379

TO: OMEGA POINT LABS, INC.
16015 SHADY FALLS ROAD
ELMENDORF,TX 78112
USA

Date: 10/23/2003
Cust PO#: MS1419Q-OPL
JOB # PSO063934-1

CALIBRATION RESULTS ARE TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST) AND MEET SPECIAL LIMITS DEVIATION TOLERANCES AS DEFINED IN ISA MC96.1 (FORMERLY ANSI) AND ASTM E 230-03. MS12985Q-OPL.

TEST RESULTS FOR: PMC P/N: KK-FB/FB-24 Total Footage: 2400'

Test Temperature (°F)	Inside End	Outside End
200°	-0.2	-0.2
400°	-0.8	-0.4
600°	-1.5	-1.4
800°	-2.7	-1.9
1000°	-1.4	-0.6

Calibration Certificate Acceptance
Item Fiberglass TC Wire
SN 00484379

	Q/A	Eng.
NIST Traceability Adequate	✓	✓
As Found/As Left Values	✓	✓
Calibration Data Sufficient	✓	✓
Tolerance Range Adequate	✓	✓
Date of Review:	11-3-03	11/3/03

OPL QA/QC Dept. Eng./Dept. Mgr.

REPORTED RESULTS ARE DEVIATIONS FROM TEST TEMPERATURES. FOR CORRECTION FACTORS REVERSE THE SIGNS.

THE MATERIAL REFERENCED ABOVE HAS BEEN CALIBRATED UTILIZING TECHNIQUES CONSISTENT WITH THE GUIDELINES SET FORTH IN ANSI Z540-1 AND ASTM E-220-02. THIS IS TO CERTIFY THE MATERIAL FURNISHED ON THIS SHIPMENT ARE IN CONFORMANCE WITH THE REQUIREMENTS, SPECIFICATIONS, AND DRAWINGS OF THE ABOVE REFERENCED CUSTOMER PURCHASE ORDER. INSPECTION AND TEST RECORDS ARE ON FILE AND AVAILABLE FOR CUSTOMER REVIEW.

SECONDARY STANDARD THERMOCOUPLE: TYPE K
REEL # POS LEG: 291335
REEL # NEG LEG: 291346
CALIBRATION DATE: 3/17/00

NIST #: 263094C&A
263094B&D
(SINGLE USE THERMOCOUPLE FROM CALIBRATED REEL)

DIGITAL VOLT METER
MODEL: KAYE INSTRUMENTS: X1525S
SERIAL # 306172
CALIBRATION DUE DATE: 01/20/2004

EDC 100RC SERIAL # 15075
NIST # 811/267966-03
DUE : 12/17/2005

ICE POINT THERMOCOUPLE REFERENCE
MODEL, KAYE INSTRUMENTS: K-170-SP
SERIAL #: 306179
CALIBRATION DUE DATE: 01/27/2004

TYPE T STANDARD
REEL # 25926 & 26369
NIST # 258779B

Janice LeBoeuf 10-23-03
QUALITY ASSURANCE TECHNICIAN DATE

PMC Division of RSCC
680 Hayward Street
Manchester, NH 03103
Tel : (603) 622-3500 Fax : (603) 622-7023
SPECIALIZING IN WIRE & CABLE FOR THE SENSOR INDUSTRY

DELIVERY NOTE

DELIVERY TO
OMEGA POINT LABS
16015 SHADY FALLS ROAD
ELMENDORF, TX 78112
USA

Attention: CLEDA

SHIPMENT :	OUR ORDER :	DATE :	CUSTOMER PO :	CONTACT :
0000105577	PSO063934	Oct 23 2003	MS1419Q-OPL	CLEDA
ACCOUNT :	**FOB :**	**SHIP VIA :**	**TRACKER# :**	**PAGE :**
OMEG01	Manchester, NH	UPS GROUND	-	1

LINE	ITEM	UOM	QTY	QTY SHIPPED	QTY B/O
001	KK-FB/FB-24 Spool #: 00484377 00484378 00484379 00485975	MFT	16,400	16,400	0
002	CALIBRATION CHARGE Spool #:	EACH	1	1	0

Omega Point Laboratories, Inc.
16015 Shady Falls Road
Elmendorf, Texas 78112
800-966-5253 FAX 210-635-8101

Certificate of Calibration

Certification No.: 92125

Calibration Date: 3/10/04

Recalibration Date: 9/10/2004

Manufacturer: Yokogawa

Model No.: 100 Channel DAU

Serial No.: 99LE004

Equipment Description: 100 Channel Data Acquisition System with YOKOGAWA Darwin Series

Calibration Sources: TEGAM Model 840-A, SN: T-207318. Calibration due 06-04-2004

PERFORMANCE:

Temperature: (75°F) +0.7/-0.2	Temperature: (150°F) +0.8/-0.3	Temperature: (300°F) +0.7/-0.5	Temperature: (400°F) +0.8/-0.4	Temperature: (1000°F) +0.9/-0.3	Temperature: (2000°F) +1/-0.2

3-10-04

Calibration Performed by:

Mike Dey
Manager of Fire Resistance

Calibration Approved by:

Javier Trevino
Manager of Special Projects

Channel Verification for Yokogawa 100 Channel

Serial No.: 99-LE-004

Within specs? Yes/No

Calibrator Used: Tegam T-207318

Performed by: Mike Dey
Title: Mgr. Dept. 2

Temperature Setting (°F): 75.0

Approved by:
Title: MGR SPECIALIST

Date: 3/10/04

Channel No.	Reading (°F)	+/-	Channel No.	Reading (°F)	+/-
1	75.7	0.7	51	74.8	-0.2
2	75.4	0.4	52	75.0	0.0
3	75.6	0.6	53	74.8	-0.2
4	75.6	0.6	54	74.8	-0.2
5	75.6	0.6	55	75.2	0.2
6	75.6	0.6	56	75.0	0.0
7	75.6	0.6	57	75.0	0.0
8	75.6	0.6	58	75.2	0.2
9	75.7	0.7	59	75.2	0.2
10	75.7	0.7	60	75.2	0.2
11	75.2	0.2	61	75.6	0.6
12	75.0	0.0	62	75.2	0.2
13	75.0	0.0	63	75.2	0.2
14	75.2	0.2	64	75.2	0.2
15	75.0	0.0	65	75.2	0.2
16	75.0	0.0	66	75.2	0.2
17	75.0	0.0	67	75.2	0.2
18	75.2	0.2	68	75.4	0.4
19	75.2	0.2	69	75.4	0.4
20	75.4	0.4	70	75.7	0.7
21	75.2	0.2	71	75.2	0.2
22	75.2	0.2	72	75.2	0.2
23	75.2	0.2	73	75.0	0.0
24	75.2	0.2	74	75.0	0.0
25	75.2	0.2	75	75.2	0.2
26	75.2	0.2	76	75.0	0.0
27	75.2	0.2	77	75.0	0.0
28	75.2	0.2	78	75.2	0.2
29	75.6	0.6	79	75.2	0.2
30	75.7	0.7	80	75.4	0.4
31	75.2	0.2	81	75.4	0.4
32	75.2	0.2	82	75.2	0.2
33	75.2	0.2	83	75.2	0.2
34	75.0	0.0	84	75.2	0.2
35	75.0	0.0	85	75.2	0.2
36	75.2	0.2	86	75.2	0.2
37	75.2	0.2	87	75.4	0.4
38	75.2	0.2	88	75.4	0.4
39	75.2	0.2	89	75.4	0.4
40	75.6	0.6	90	75.7	0.7
41	75.2	0.2	91	74.8	-0.2
42	75.2	0.2	92	74.8	-0.2
43	75.2	0.2	93	74.8	-0.2
44	75.2	0.2	94	75.0	0.0
45	75.2	0.2	95	75.2	0.2
46	75.2	0.2	96	75.2	0.2
47	75.2	0.2	97	75.0	0.0
48	75.2	0.2	98	75.2	0.2
49	75.4	0.4	99	75.2	0.2
50	75.6	0.6	100	75.2	0.2

			Lower	Upper	
Range of 75°F Readings:	+0.7/-0.2	Allowable limits	73.2	76.8	(±1.8)

Channel Verification for Yokogawa 100 Channel

Serial No.: 99-LE-004

Within specs? Yes/No

Calibrator Used: Tegam T-207318

Performed by: Mike Dey

Title: Mgr. Dept. 2

Temperature Setting (°F): 150.0

Approved by:

Title: Mgr of

Date: 3/10/04

Channel No.	Reading (°F)	+/-	Channel No.	Reading (°F)	+/-
1	150.4	0.4	51	149.7	-0.3
2	150.4	0.4	52	149.7	-0.3
3	150.4	0.4	53	149.7	-0.3
4	150.4	0.4	54	149.7	-0.3
5	150.4	0.4	55	149.7	-0.3
6	150.4	0.4	56	149.7	-0.3
7	150.4	0.4	57	149.9	-0.1
8	150.4	0.4	58	149.9	-0.1
9	150.8	0.8	59	150.1	0.1
10	150.8	0.8	60	150.3	0.3
11	150.1	0.1	61	150.4	0.4
12	150.1	0.1	62	150.1	0.1
13	150.1	0.1	63	150.1	0.1
14	150.1	0.1	64	149.9	-0.1
15	150.1	0.1	65	149.9	-0.1
16	150.1	0.1	66	150.1	0.1
17	150.1	0.1	67	150.1	0.1
18	150.1	0.1	68	150.1	0.1
19	150.3	0.3	69	150.3	0.3
20	150.4	0.4	70	150.6	0.6
21	150.3	0.3	71	150.3	0.3
22	150.1	0.1	72	149.9	-0.1
23	150.1	0.1	73	150.1	0.1
24	150.1	0.1	74	150.1	0.1
25	150.1	0.1	75	149.9	-0.1
26	150.1	0.1	76	150.1	0.1
27	150.1	0.1	77	150.1	0.1
28	150.3	0.3	78	150.1	0.1
29	150.3	0.3	79	150.3	0.3
30	150.6	0.6	80	150.3	0.3
31	150.4	0.4	81	149.7	-0.3
32	150.3	0.3	82	149.9	-0.1
33	150.1	0.1	83	149.9	-0.1
34	150.1	0.1	84	149.9	-0.1
35	150.3	0.3	85	149.9	-0.1
36	150.1	0.1	86	149.9	-0.1
37	150.1	0.1	87	149.9	-0.1
38	150.3	0.3	88	149.9	-0.1
39	150.3	0.3	89	150.3	0.3
40	150.6	0.6	90	150.4	0.4
41	150.3	0.3	91	149.7	-0.3
42	150.3	0.3	92	149.7	-0.3
43	150.3	0.3	93	149.7	-0.3
44	150.3	0.3	94	149.7	-0.3
45	150.3	0.3	95	149.7	-0.3
46	150.3	0.3	96	149.7	-0.3
47	150.3	0.3	97	150.1	0.1
48	150.3	0.3	98	149.9	-0.1
49	150.3	0.3	99	150.1	0.1
50	150.6	0.6	100	150.3	0.3

Range of 150°F Readings: +0.8/-0.3

	Lower	Upper	
Allowable limits	148.2	151.8	(±1.8)

Channel Verification for Yokogawa 100 Channel

Serial No.: 99-LE-004

Within specs? Yes/No

Calibrator Used: Tegam T-207318

Performed by: Mike Dey

Title: Mgr. Dept. 2

Temperature Setting (°F): 300.0

Approved by:

Title: Mgr 04

Date: 3/10/04

Channel No.	Reading (°F)	+/-	Channel No.	Reading (°F)	+/-
1	300.6	0.6	51	299.7	-0.3
2	300.2	0.2	52	299.7	-0.3
3	300.4	0.4	53	299.7	-0.3
4	300.2	0.2	54	299.7	-0.3
5	300.2	0.2	55	299.8	-0.2
6	300.4	0.4	56	299.8	-0.2
7	300.4	0.4	57	299.8	-0.2
8	300.6	0.6	58	299.8	-0.2
9	300.6	0.6	59	300.2	0.2
10	300.7	0.7	60	300.2	0.2
11	300.0	0.0	61	300.4	0.4
12	299.7	-0.3	62	300.2	0.2
13	299.8	-0.2	63	300.2	0.2
14	299.8	-0.2	64	300.2	0.2
15	299.7	-0.3	65	300.2	0.2
16	299.7	-0.3	66	300.2	0.2
17	299.7	-0.3	67	300.2	0.2
18	299.8	-0.2	68	300.2	0.2
19	300.2	0.2	69	300.2	0.2
20	300.2	0.2	70	300.6	0.6
21	300.2	0.2	71	300.2	0.2
22	300.0	0.0	72	300.2	0.2
23	300.0	0.0	73	300.0	0.0
24	300.0	0.0	74	300.0	0.0
25	300.0	0.0	75	300.2	0.2
26	300.0	0.0	76	300.2	0.2
27	300.2	0.2	77	300.0	0.0
28	300.2	0.2	78	300.2	0.2
29	300.2	0.2	79	300.2	0.2
30	300.6	0.6	80	300.4	0.4
31	300.2	0.2	81	300.0	0.0
32	300.2	0.2	82	300.0	0.0
33	300.2	0.2	83	299.8	-0.2
34	300.2	0.2	84	299.8	-0.2
35	300.2	0.2	85	300.2	0.2
36	300.2	0.2	86	300.0	0.0
37	300.2	0.2	87	300.0	0.0
38	300.2	0.2	88	300.2	0.2
39	300.2	0.2	89	300.2	0.2
40	300.4	0.4	90	300.4	0.4
41	300.2	0.2	91	299.5	-0.5
42	300.0	0.0	92	299.5	-0.5
43	300.0	0.0	93	299.5	-0.5
44	300.0	0.0	94	299.5	-0.5
45	300.0	0.0	95	299.7	-0.3
46	300.2	0.2	96	299.7	-0.3
47	300.2	0.2	97	299.7	-0.3
48	300.2	0.2	98	299.8	-0.2
49	300.4	0.4	99	300.0	0.0
50	300.6	0.6	100	300.2	0.2

		Lower	Upper	
Range of 300°F Readings:	+0.7/-0.5	Allowable limits	298.1	301.9 (±1.9)

Channel Verification for Yokogawa 100 Channel

Serial No.: 99-LE-004

Within specs? Yes/No

Calibrator Used: Tegam T-207318

Performed by: Mike Dey

Title: Mgr. Dept. 2

Temperature Setting (°F): 400.0

Approved by:

Title: Mgr Dept

Date: 3/10/04

Channel No.	Reading (°F)	+/-	Channel No.	Reading (°F)	+/-
1	400.5	0.5	51	399.9	-0.1
2	400.3	0.3	52	399.9	-0.1
3	400.3	0.3	53	399.7	-0.3
4	400.3	0.3	54	399.9	-0.1
5	400.5	0.5	55	399.9	-0.1
6	400.3	0.3	56	399.9	-0.1
7	400.3	0.3	57	399.9	-0.1
8	400.5	0.5	58	400.1	0.1
9	400.6	0.6	59	400.1	0.1
10	400.8	0.8	60	400.3	0.3
11	399.9	-0.1	61	400.5	0.5
12	399.9	-0.1	62	400.3	0.3
13	399.9	-0.1	63	400.1	0.1
14	399.9	-0.1	64	400.1	0.1
15	399.9	-0.1	65	400.1	0.1
16	399.9	-0.1	66	400.1	0.1
17	399.7	-0.3	67	400.1	0.1
18	399.9	-0.1	68	400.3	0.3
19	400.1	0.1	69	400.3	0.3
20	400.3	0.3	70	400.6	0.6
21	400.1	0.1	71	400.3	0.3
22	399.9	-0.1	72	400.3	0.3
23	400.1	0.1	73	400.1	0.1
24	399.9	-0.1	74	400.1	0.1
25	399.9	-0.1	75	400.3	0.3
26	400.1	0.1	76	400.1	0.1
27	400.1	0.1	77	400.3	0.3
28	400.1	0.1	78	400.3	0.3
29	400.3	0.3	79	400.3	0.3
30	400.5	0.5	80	400.5	0.5
31	400.3	0.3	81	400.3	0.3
32	400.1	0.1	82	399.9	-0.1
33	400.3	0.3	83	399.9	-0.1
34	400.1	0.1	84	399.9	-0.1
35	400.1	0.1	85	399.9	-0.1
36	400.1	0.1	86	399.9	-0.1
37	400.3	0.3	87	400.1	0.1
38	400.1	0.1	88	400.1	0.1
39	400.3	0.3	89	400.3	0.3
40	400.5	0.5	90	400.5	0.5
41	400.3	0.3	91	399.6	-0.4
42	400.3	0.3	92	399.6	-0.4
43	399.9	-0.1	93	399.6	-0.4
44	400.1	0.1	94	399.6	-0.4
45	400.3	0.3	95	399.7	-0.3
46	400.3	0.3	96	399.6	-0.4
47	400.3	0.3	97	399.6	-0.4
48	400.3	0.3	98	399.9	-0.1
49	400.3	0.3	99	399.9	-0.1
50	400.6	0.6	100	400.1	0.1

Range of 400°F Readings: +0.8/-0.4

	Lower	Upper	
Allowable limits	398.0	402.0	(±2.0)

Channel Verification for Yokogawa 100 Channel

Serial No.: 99-LE-004

Within specs? Yes/No

Calibrator Used: Tegam T-207318

Performed by: Mike Dey

Title: Mgr. Dept. 2

Temperature Setting (°F): 1000.0

Approved by:

Title: Mgr Dept

Date: 3/10/04

Channel No.	Reading (°F)	+/-	Channel No.	Reading (°F)	+/-
1	1000.6	0.6	51	999.7	-0.3
2	1000.6	0.6	52	999.7	-0.3
3	1000.4	0.4	53	999.7	-0.3
4	1000.6	0.6	54	999.9	-0.1
5	1000.6	0.6	55	999.7	-0.3
6	1000.4	0.4	56	999.7	-0.3
7	1000.6	0.6	57	1000.0	0.0
8	1000.6	0.6	58	999.9	-0.1
9	1000.6	0.6	59	999.9	-0.1
10	1000.9	0.9	60	1000.0	0.0
11	1000.0	0.0	61	1000.6	0.6
12	1000.0	0.0	62	1000.4	0.4
13	1000.0	0.0	63	1000.4	0.4
14	1000.0	0.0	64	1000.2	0.2
15	1000.0	0.0	65	1000.2	0.2
16	1000.0	0.0	66	1000.4	0.4
17	1000.0	0.0	67	1000.4	0.4
18	1000.0	0.0	68	1000.4	0.4
19	1000.0	0.0	69	1000.4	0.4
20	1000.4	0.4	70	1000.8	0.8
21	1000.4	0.4	71	1000.2	0.2
22	1000.2	0.2	72	1000.0	0.0
23	1000.0	0.0	73	1000.2	0.2
24	1000.2	0.2	74	1000.0	0.0
25	1000.2	0.2	75	1000.0	0.0
26	1000.2	0.2	76	1000.2	0.2
27	1000.4	0.4	77	1000.2	0.2
28	1000.4	0.4	78	1000.0	0.0
29	1000.4	0.4	79	1000.4	0.4
30	1000.8	0.8	80	1000.6	0.6
31	1000.4	0.4	81	1000.0	0.0
32	1000.0	0.0	82	1000.0	0.0
33	1000.0	0.0	83	1000.0	0.0
34	1000.0	0.0	84	1000.0	0.0
35	1000.0	0.0	85	1000.0	0.0
36	1000.0	0.0	86	1000.0	0.0
37	1000.0	0.0	87	1000.0	0.0
38	1000.0	0.0	88	1000.0	0.0
39	1000.0	0.0	89	1000.2	0.2
40	1000.6	0.6	90	1000.4	0.4
41	1000.0	0.0	91	1000.0	0.0
42	999.9	-0.1	92	999.7	-0.3
43	1000.0	0.0	93	999.9	-0.1
44	1000.0	0.0	94	999.9	-0.1
45	1000.0	0.0	95	999.9	-0.1
46	1000.0	0.0	96	1000.0	0.0
47	1000.2	0.2	97	1000.0	0.0
48	1000.0	0.0	98	1000.0	0.0
49	1000.0	0.0	99	1000.0	0.0
50	1000.6	0.6	100	1000.4	0.4

		Lower	Upper	
Range of 2000°F Readings:	+0.9/-0.3	Allowable limits	997.7	1002.3 (±2.3)

Channel Verification for Yokogawa 100 Channel

Serial No.: 99-LE-004

Within specs? Yes/No

Calibrator Used: Tegam T-207318

Performed by: Mike Dey
Title: Mgr. Dept. 2

Temperature Setting (°F): 2000.0

Approved by:
Title: Mgr 04

Date: 3/10/04

Channel No.	Reading (°F)	+/-	Channel No.	Reading (°F)	+/-
1	2000.5	0.5	51	1999.9	-0.1
2	2000.5	0.5	52	1999.9	-0.1
3	2000.5	0.5	53	1999.9	-0.1
4	2000.5	0.5	54	1999.9	-0.1
5	2000.7	0.7	55	1999.9	-0.1
6	2000.7	0.7	56	1999.9	-0.1
7	2000.5	0.5	57	1999.9	-0.1
8	2000.7	0.7	58	2000.1	0.1
9	2000.7	0.7	59	2000.3	0.3
10	2001.0	1.0	60	2000.3	0.3
11	2000.1	0.1	61	2000.7	0.7
12	2000.1	0.1	62	2000.5	0.5
13	2000.1	0.1	63	2000.3	0.3
14	1999.9	-0.1	64	2000.3	0.3
15	2000.1	0.1	65	2000.3	0.3
16	2000.1	0.1	66	2000.5	0.5
17	1999.9	-0.1	67	2000.3	0.3
18	2000.1	0.1	68	2000.7	0.7
19	2000.3	0.3	69	2000.7	0.7
20	2000.5	0.5	70	2000.7	0.7
21	1999.9	-0.1	71	2000.7	0.7
22	1999.9	-0.1	72	2000.7	0.7
23	1999.9	-0.1	73	2000.7	0.7
24	1999.9	-0.1	74	2000.5	0.5
25	1999.9	-0.1	75	2000.7	0.7
26	2000.1	0.1	76	2000.7	0.7
27	2000.1	0.1	77	2000.5	0.5
28	2000.1	0.1	78	2000.7	0.7
29	2000.3	0.3	79	2000.7	0.7
30	2000.7	0.7	80	2000.8	0.8
31	2000.5	0.5	81	1999.9	-0.1
32	2000.3	0.3	82	1999.9	-0.1
33	2000.3	0.3	83	1999.8	-0.2
34	2000.3	0.3	84	1999.9	-0.1
35	2000.3	0.3	85	1999.9	-0.1
36	2000.3	0.3	86	1999.8	-0.2
37	2000.3	0.3	87	1999.9	-0.1
38	2000.3	0.3	88	1999.9	-0.1
39	2000.5	0.5	89	1999.9	-0.1
40	2000.7	0.7	90	2000.3	0.3
41	1999.9	-0.1	91	1999.9	-0.1
42	1999.9	-0.1	92	1999.9	-0.1
43	1999.9	-0.1	93	1999.9	-0.1
44	1999.9	-0.1	94	1999.9	-0.1
45	1999.9	-0.1	95	1999.9	-0.1
46	1999.9	-0.1	96	1999.9	-0.1
47	1999.9	-0.1	97	1999.9	-0.1
48	2000.3	0.3	98	1999.9	-0.1
49	2000.3	0.3	99	2000.1	0.1
50	2000.5	0.5	100	2000.3	0.3

Range of 2000°F Readings: +1/-0.2

	Lower	Upper	
Allowable limits	1997.2	2002.8	(±2.8)

Q/A RECEIVING REPORT

CLIENT/PROJECT NAME Omega Point Labs
CLIENT/PROJECT NUMBER OPL Equipment
RECEIVED FROM SSC Lab Div.
PROJECT LOCATION Omega Point Labs

REPORT NUMBER 2435 . OPL
DATE RECEIVED 5-5-04
DATE INSPECTED 5-6-04
INSPECTED BY:

ITEM DESCRIPTION	P.O. NO.	QUANTITY Ordd	Rec'd	B.O.	I.D. NO.	CONID MATL Y/N	CERT. REC'D Y/N	SAFETY RELATED Y/N	CONTAINER INTEGRITY	ACCEPTANCE Accept	Hold	Reject	REMARKS
200g Weight	143570	1	1	0	23137	Y	Y	N	Good	X			Dial indicator 5". SN: 013232851 was beyond repair - see Page 102 memo
200g Weight	143570	1	1	0	23138	Y	Y	N	Good	X			
0-100psi Pressure Gage	143570	1	1	0	99LE001	Y	Y	N	Good	X			
0-100psi Pressure Gage	143570	1	1	0	98LE001	Y	Y	N	Good	X			
5" dial indicator	143570	1	1	0	013021466	Y	Y	N	Good	X			
0-1000lb. Load Cell	143570	1	1	0	343765	Y	Y	N	Good	X			
6" digital caliper	143570	1	1	0	60246504	Y	Y	N	Good	X			
digital Multimeter	143570	1	1	0	5700109	Y	Y	N	Good	X			

16015 SHADY FALLS RD.
ELMENDORF, TEXAS 78112
PH. (210) 635-8100
FAX (210) 635-8101

PURCHASE ORDER

14357Q

Date: 04/19/2004
Page: 1 of 1

Order From:	Deliver to:
SSC Lab Division 7715 Distribution Dr. Little Rock AR 72209 501-562-2900/888-278-9292	Omega Point Laboratories, Inc 16015 Shady Falls Road Elmendorf TX 78112 (210) 635-8100

Vendor No:

Your Item Number Item Description	Our Reference	Qty Ordered	Units	Unit Cost	Extension
0-100psi Pressure Gage SN:99LE001	001	1.00	Each	$45.00	$45.00
0-100psi Pressure Gage SN: 98LE001	002	1.00	Each	$75.00	$75.00
Dial Indicator SN: 013021466	003	1.00	Each	$20.00	$20.00
Dial Indicator SN: 013232851 **Calibration&Repair**	004	1.00	Each	$120.00	$120.00
Load Cell 1k pound SN: 343765 **Calibration & Repair**	005	1.00	Each	$175.00	$175.00
Digital Multimeter SN: 5700109 **Calibration & Repair**	006	1.00	Each	$100.00	$100.00
Digital Caliper SN:6Q-2465-04	007	1.00	Each	$70.00	$70.00
200g Weight—SN: 23137	008	1.00	Each	$10.00	$10.00
200g Weight—SN: 23138	009	1.00	Each	$10.00	$10.00

CALIBRATION CERT. REQUIREMENTS
1. Statement of NIST traceability
2. NIST test or I.D. number
3. As Found
4. As Left Values

5. Uncertainties of calibration measurements
6. Calibration data

7. Calibration certificates must show accreditation to ISO/IEC 17025

"See Special Instructions Regarding Purchasing Specifications for Quality Assurance Requirements."

QA Approval [signature]

Date 4-19-04

Please Quote Purchase Order Number on all correspondence.

Special Instructions: Please include Certificate of Conformance to attached Specification Sheet and Calibration Data traceable to NIST.

Subtotal:	$620.00
Freight:	0.00
Tax Amount:	0.00
Total Value:	$620.00

VENDOR PURCHASING SPECIFICATION AND QUALITY ASSURANCE REQUIREMENTS

Vendor: SSC Lab Division
Purchase Order No. 14357 Q

Any of the following Quality Assurance requirements shall be incorporated as conditions to this procurement when corresponding box is marked. Failure to comply with any requirement specified may result in rejection and/or return of shipment at seller's expense.

1.0 QUALITY PROGRAM

☒ Seller shall furnish all items on this Purchase Order in accordance with Quality Program approved by Buyer.

2.0 Quality Verification

When additional quality verification activities are required as a condition to this procurement, invoices will not be paid until satisfactory completion of such activities.

☒ Receiving Inspection- Buyer shall inspect items upon receipt to verify compliance with purchase order requirements. Rejected items shall be returned at seller's expense.

☐ Independent Laboratory Tests- Samples of materials furnished shall be tested independently for conformance to specification requirements prior to final acceptance. Rejected materials shall be returned at seller's expense.

☒ Document Review- Final acceptance shall be based on satisfactory review or required certifications and other supporting documents.

3.0 CERTIFICATIONS

When certifications are required as a condition to this procurement, the seller shall furnish one reproducible copy either with or prior to each shipment. Shipments will not be accepted and invoices will not be paid until certifications are in buyer's possession.

☐ Certificate of Compliance/Conformance Required – Certification that materials and /or services comply with purchase order requirements. Certification shall reference purchase order number and traceability numbers (when applicable).

☐ Certified Test Report Required – Certification that material complies with applicable material specification (s) and the purchase order. Include actual results of required tests.

☒ Certificate of Calibration Required - Certification shall be traceable to National Bureau of Standards. (NIST, Nat'l Inst. of Science & Technology).

4.0 AUDITS/RIGHT OF ACCESS

☒ The buyer reserves the right to audit your facility to verify compliance with purchase order, code and specification requirements with (10) days notice,

☒ Shipments shall only originate form facilities approved by the buyer.

☐ Buyer reserves the right to inspect any or all work included in this order at seller's facility with as early notice as practicable.

5.0 IDENTIFICATION

☐ Seller shall identify each item with a unique traceability number by physical marking or tagging. Traceability numbers shall be traceable to certifications and packing lists.

☒ Seller shall identify each container with a unique identification number. The identification number shall be traceable to certifications and packing lists.

6.0 10CFR,PART 21

☐ The material, equipment and/or services to be furnished under this purchase order are involved in the testing of basic components of a Nuclear Regulatory Commission (NRC) licensed facility. Accordingly, the seller is subject to the provisions of 10 CFR, Part 21 (Reporting of Defects and Noncompliance)

7.0 PACKING/SHIPPING

☒ All materials shall be packaged in air tight, moisture free containers and shall be free from all foreign substance such as dirt, oil, grease or other deleterious material.

☐ All materials and equipment shall be suitable crated, boxed or otherwise prepared for shipment to prevent damage during handling and shipping. Wherever practical, equipment shall be palletized for ease of unloading and storage at destination. Each container shall be clearly marked with buyer's purchase order number.

QUALITY ASSURANCE APPROVAL _____ DATE 4/19/04

SSC LAB DIVISION
a Division of System Scale Corporation
Employee Owned

"Quality You Can Measure"

CERTIFICATE NO: 36283-0003

ACCREDITED
Cert. #1754.01
Calibration Laboratory
ISO / IEC / 17025

CERTIFICATE OF CALIBRATION

SSC LAB DIVISION certifies that this instrument conforms to original manufacturers specifications or to tolerances indicated below and has been calibrated using standards with accuracies traceable to a National Measurement Institute, or to accepted values of natural physical constants, or have been derived by ratio techniques. This certificate complies with ISO / IEC 17025 & ANSI Z540. Unless otherwise stated, the M&TE for which this certificate is issued, based on interpretation of data, was found to meet the required specification. Reported uncertainty represents expanded uncertainty at approximately 95% confidence level, coverage factor of k=2.

Customer:	OMEGA POINT LAB.	Date Received:	4/21/04
Location:	16015 SHADY FALLS RD. ELMENDORF TX 78112	Date of Issue/Calibration:	04/22/2004
		Next Calibration Due:	04/22/2005
P.O. #:	14357Q	Metrologist:	Sean Rainey

Manufacturer:	McDANIEL CONTROLS INC.	Model:	316SS
Nomenclature:	GAGE- PRESSURE	Serial Number:	99LE001
Range:	0-100 PSI	Equipment ID:	99LE001

Calibration Data Temp 68°F Humidity 38%

Calibration Accuracy: ± 2.5% FULL SCALE

Note: if the AS LEFT column is blank, no adjustments were required.

Note: Many factors may cause out of calibration condition prior to due date.The Calibration interval has been specified by the Customer. Current procedures and methods utilized by SSC Lab Division are approved by the Customer.

APPLIED	AS FOUND	AS LEFT	UNCERTAINTY	PROCEDURE #
25 LBS	25.78	25.78	2.9	NA17-20MP-06
50 LBS	51.24	51.24	2.9	
75 LBS	76.38	76.38	2.9	
100 LBS	101.72	101.72	2.9	

STANDARDS(S) USED

Identification Number	Description	Calibration Date	Expiration Date	Traceability Number
SSC30LD029	CALIBRATOR- PRESSURE	7/30/2003	7/30/2004	33426-0044
SSC30LD048	TRANSDUCER- PRESSURE	8/11/2003	8/11/2004	1000154760

Calibration Certificate Acceptance

Item 0-100 psi Pressure Gage
SN 99LE001

	Q/A	Eng.
NIST Traceability Adequate		
As Found/As Left Values		
Calibration Data Sufficient		
Tolerance Range Adequate		
Date of Review:	5-6-04	5/14/04

OPL QA/QC Dept. Eng. Dept. Mgr.

Comments

Gary McCourt
Chief Metrology Engineer

THE THREE 1/4"x1" ZINC PLATED HEXAGONAL HEAD MACHINE SCREWS WERE OBTAINED FROM B-LINE ZN PLATED RIGID CONDUIT CLAMPS PART# B2010, (SUMMIT ELECTRIC, SAN ANTONIO, TX)

Dhansh G Butani

D. G. BUTANI
BECHTEL.
J. C. VANCE

NOTE THESE SCREWS WERE DELIVERED TO OMEGA POINT LAB (CREDA PATTON) FOR INSTALLATION @ SECTION C-C DETAIL OF AREVA'S TEST PLAN DOC # 51-5045887-00.

Approved for use
Fred P Rudek 6/17/04
FRED P. RUDEK
MEGGITT SAFETY SYSTEMS

APPROVED FOR USE
John G Crowther 6/17/04
JOHN G CROWTHER
AREVA

Q/A RECEIVING REPORT

CLIENT/PROJECT NAME Areva
CLIENT/PROJECT NUMBER 14980-119368
RECEIVED FROM Mesgitt
PROJECT LOCATION Omega Point Labs

REPORT NUMBER 2447 - 14980
DATE RECEIVED 6-9-04
DATE INSPECTED 6-9-04
INSPECTED BY: [signature]

ITEM DESCRIPTION	P.O. NO.	QUANTITY Ordd	Rec'd	B.O.	I.D. NO.	CONID MATL Y/N	CERT. RECD Y/N	SAFETY RELATED Y/N	CONTAINER INTEGRITY	ACCEPTANCE Accept	Hold	Reject	REMARKS
Spring Nuts	NA	Ø	3	Ø	N2242N	Y	N	N	GOOD	X			Receiving verification only
Spring Nuts	NA	Ø	6	Ø	N224	Y	N	N	GOOD	X			
Clamps	NA	Ø	7	Ø	B2088S54	Y	N	N	GOOD	X			
Plates	NA	Ø	7	Ø	2" X 1 5/8"	Y	N	N	GOOD	X			
Bolts	NA	Ø	7	Ø	1/4" X 1 1/4"	Y	N	N	GOOD	X			
Strut - B-Line - 5 1/4"	NA	Ø	1	Ø	B22 SS4	Y	N	N	GOOD	X			
Strut - Green 3 1/4 X 1 5/8"	NA	Ø	1	Ø	B22 GREEN	Y	N	N	GOOD	X			

09-016-11/02

MEGGITT

Meggitt Safety Systems, Inc.
1915 Voyager Avenue • Simi Valley, CA 93063 • (805) 584-4100

SHIPPING MEMO

TO: Omega Point Laboratories
16015 Shady Falls Road
Elmendorf, TX 78112

5109

DATE

ATTENTION: Constance Humphrey (210) 635-8120

DEPARTMENT

PURCHASE ORDER NO

SHIP VIA: UPS - Red or Fed Ex P1

FOB

YOUR REF.

THIS SHIPMENT ☐ COMPLETE ☐ PARTIAL

ITEM	QUANTITY	PART NO /DESCRIPTION	VALUE
1	7 ea	clamp - # 2088	✓
2	7 ea	Bolt - 1/4 x 1 1/4 SHHMS	✓
3	6 ea	N22Y nut w/ spring	✓
4	7 ea	plate - 2" x 1 5/8"	
5	3 ea	N2242N 1/4-20 nut	
6	5 ft	B22 SS4 strut	
7	3 ft	B22 Green strut	

COMMENTS OR SPECIAL INSTRUCTIONS

AUTHORIZATION

STOCK PULLED BY	SHIPPING CLERK	ABOVE DESCRIBED ITEMS RECEIVED IN GOOD ORDER	
SHIPPED VIA	WEIGHT BILL NO	COMPANY	
WEIGHT - LBS	NO CARTONS	DATE SHIPPED	BY / DATE

WHITE-VENDOR / GREEN-VENDOR ACKNOWLEDGEMENT / CANARY-ACCOUNTING / PINK-SHIPPING / GOLDENROD-EXTRA

BILL OF MATERIAL		
SUPPLIED BY MEGGITT SAFETY SYSTEMS INC		
QUANTITY	UNIT	DESCRIPTION
40	LF	8C #12 AWG SI2400 FIRE CABLE, PN: 300283-5 NOTE: FACTORY INSTALLED CABLE SPLICE AT APPROX 12' FROM ONE END AND FACTORY INSTALLED CABLE TERMINATIONS AT EACH ENDS
✓ ~~X~~ 7	EA	CLAMP B 2088 SS4
✓ ~~X~~ 7	EA	316 SST HEX SCREW B-LINE 1/4" X 1 1/4" SHHMS
✓ ~~X~~ 6	EA	316 SST SPRING NUT B-LINE N224 SS6
✓ ~~X~~ 7	EA	2" X 1 5/8" X 10 GA THK 304 SST PLATE
~~X~~ 5ft	LF	B-LINE B22 SS4 STRUT (5Ft) - In machine
1	LF	B-LINE B22 DURA GREEN STRUT B22 GRN 3 ft
~~X~~ 3	EA	B-LINE Zinc ELECTROPLATED SPRING NUT 1/4-20 N224ZN

Q/A RECEIVING REPORT

CLIENT/PROJECT NAME Areva
CLIENT/PROJECT NUMBER 14980-119368
RECEIVED FROM Mesquite Safety
PROJECT LOCATION Omega Point Labs

REPORT NUMBER 2448-14980
DATE RECEIVED 6-9-04
DATE INSPECTED 6-9-04
INSPECTED BY: [signature]

ITEM DESCRIPTION	P.O. NO.	QUANTITY Ordered	QUANTITY Rec'd	QUANTITY B.O.	I.D. NO.	CONID MATL Y/N	CERT. RECD Y/N	SAFETY RELATED Y/N	CONTAINER INTEGRITY	ACCEPTANCE Accept	ACCEPTANCE Hold	ACCEPTANCE Reject	REMARKS
Stainless Steel Cable	NA	8	Full	8	300283E00-40B28J	Y	Y	N	Good	X			Receiving Verification Only

Page 111

09-016-11/02

FILE 5839IR-1

QA: SSD QE 3 05-12-04

ACCEPTANCE TEST DATA SHEET

FOR

FIRE CABLE ASSEMBLY

PART NUMBER: 300283E0040B28J SERIAL NUMBER: 002

TEST PROGRAM NUMBER: 5181 REVISON C

1.0 Dielectric Strength at room temperature per STP 2191, Revision C.

1.1 3200 VDC between conductor and sheath for 60 seconds. No indication of breakdown.

(Pass)/Fail 3 SSD JUN 04 2004
Tech Stamp/Date

1.2 3200 VDC conductor to conductor for 60 seconds. No indication of breakdown.

(Pass)/Fail 3 SSD JUN 04 2004
Tech Stamp/Date

2.0 Insulation Resistance at room temperature per STP 2190, Revision C.
(All unused pins connected to sheath. Record values.)

1	1.0 x 10^{12} ohms	7	1.0 x 10^{12} ohms
2	1.0 x 10^{12} ohms	8	1.0 x 10^{12} ohms
3	1.0 x 10^{12} ohms	9	N/A x 10 ohms
4	1.0 x 10^{12} ohms	10	N/A x 10 ohms
5	1.0 x 10^{12} ohms	11	N/A x 10 ohms
6	1.0 x 10^{12} ohms	12	N/A x 10 ohms

3 SSD JUN 04 2004
Tech Stamp/Date

3.0 DC Continuity per STP 2207, Revision B. (Limit: Refer to cable drawing.)

3.1 Cable Length: _____ feet

3.2 Conductor Resistance:

1	0.1 ohms	5	0.1 ohms	9	N/A ohms
2	0.1 ohms	6	0.1 ohms	10	N/A ohms
3	0.1 ohms	7	0.1 ohms	11	N/A ohms
4	0.1 ohms	8	0.1 ohms	12	N/A ohms

Pass/Fail SSD JUN 04 2004
Tech Stamp/Date

4.0 Test Equipment List

Nomenclature	Manufacturer & Model No.	Identification No.	Calibration Due Date
High Resistance Bridge	GR 1644 A	A 14672	6-2-05
Hi-Pot	AR 5205 A	A 14600	7-18-05
Digital Multimeter	FLUKE 73	B 131	2-18-05

MSSI QA REVIEW: SSD QE 6-4-04 DATE: SSD 6-4-04

MEGGITT

MEGGITT SAFETY SYSTEMS INC
1915 VOYAGER AVE., SIMI VALLEY, CA. 93063
805-584-4100 FAX 805-584-9157

Packing Slip

Pickslip	81945
Page	1
Date	6/04/04
Customer No.	69444
Order Number	260500-005 SO
Related P.O.	
Brn/Plt	200

Ship To:

OMEGA POINT LABORATORIES
ATTN: CONSTANCE HUMPHREY
210-635-8120
16015 SHADY FALLS ROAD
ELMENDORF TX 78112

Invoice To:

IN-HOUSE/MEGGITT SAFETY SYSTEMS
1915 VOYAGER AVENUE
SIMI VALLEY CA 93063

INSP	Priority
DT	E

Ord Date	Promised	Customer P.O.	F.O.B.	Contract Administrator
10/15/03	11/15/03	Fred Rudek	Destination	DIANA COX, EXT 8127

Line	Item Number/Location,Lot	Description	Shipped	Tag	Avail.	UM	Due Date	Schedule B
IN HOUSE SALES ORDER TO PROVIDE TEST CABLES FOR LABORATORY TESTS TO BE PRESENTED TO NRC. MSSI WILL HAVE JOINT RIGHTS SHARING THE QUALIFICATION TO TEST RESULTS *TEST FACILITY WILL BE READY END OF NOVEMBER* *SPLICE REQUIRED AT MIDPOINT IN CABLE*								
31.000 *FG* *Rev.* *Serial # 002*	300283E0040B28J	FIRE CABLE	1			EA	11/15/03	Blank - Sales R

Page 114

KL 06-04-04.

Quality Assurance | Packer | Track/Airbill # | Weight: | Ship Via: BEST WAY PREPAY ONLY 2 day

MEGGITT

MEGGITT SAFETY SYSTEMS INC

ENGINEERING DEPARTMENT

DOCUMENT

ER 04-033

TITLE

UNPACKING, INSPECTION, INSTALLATION AND STANDARD PRACTICES FOR 8/C #12 AWG Si 2400 FIRE RATEC CABLE FOR J.M. FARLEY NUCLEAR POWER PLANT

APPROVALS			CONTROLLED DISTRIBUTION		
PREPARED: 06-04-04	ENG: 06-04-04	Q.A.: 6/4/04	SIZE A	CAGE CODE: 25693	ER 04-033
MFG: 6/4	CHECKED: 06-04-04			REV. A	SHEET 1 of 8

REV.	DATE	DESCRIPTION	APPROVALS
A	040604	INITIAL RELEASE	BW AC

(R)

SIZE A	CAGE CODE 25693	ER 04-033
	REV A	SHEET 2 OF 8

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this document is to provide guidelines for installation and field handling of MSSI Fire Cable.

2.0 INSTALLATION AND STANDARD PRACTICES

a. A Si 2400 cable is designed for use in Class 1, Division 1, Group A, B, C and D locations. When properly installed, it easily withstands extreme temperatures and high humidity. In fire danger applications, it continues to perform at temperatures in excess of 2000°F. Cable construction consists of a thin-wall, stainless steel outer sheath, silicon dioxide dielectric, and nickel or nickel coated copper conductors. Other types of sheaths and conductors are also available if specified in the purchase order. When installed in areas where chemicals corrosive to stainless steel are present, an outer covering of a cross-linked polyethylene or similar PVC material can be provided. Cables may be cut to length and terminated in the field, using ordinary tools and equipment.

b. Meggitt is staffed to provide formal training in the handling and installation of Si 2400 cables, tailored to specific customer needs. Supervision during actual installation can be provided to augment classroom instruction and offers the customer's craftsmen the advantage of on-the-job training (OJT).

c. This document provides basic guidelines for handling and installing Si 2400 cables, from receipt to completion of installation. Field terminations are described in an accompanying document, FTP-9234.

3.0 UNPACKING AND INSPECTION

a. Do not remove cable from reels or factory coils until ready to install.

b. Visually inspect cables for evidence of shipping damage, such as dents, gouges, or kinks. Small superficial scratches in the cable sheath will not degrade performance.

c. Do not unroll the cable from its shipping container to perform electrical tests. IMMEDIATELY FOLLOWING ELECTRICAL TESTING, RESEAL CABLE ENDS. The dielectric must be protected from prolonged exposure to the atmosphere or direct exposure to water. Cable ends may be resealed with epoxies provided in the termination kits or with heat shrink boots. Use of electrical tape for sealing cable ends for extended periods is not recommended.

4.0 ROUTING AND INSTALLATION

NOTE: EMPHASIS SHOULD BE ON "PLACING" AND "FORMING" RATHER THAN "PULLING" AND BENDING" THROUGHOUT THE INSTALLATION PROCESS.

a. Visually inspect the routing path of the cable and note areas that pose a hazard for the cable. Hazards may include:

   1. Sharp metal edges, which the cable might be dragged across.
   2. Moving machinery or equipment along or adjacent to the planned cable route.
   3. Extremely sharp or restrictive bends along the cable path.
   4. Live electrical circuits near the planned routing path.

b. Station a person at each routing hazard noted and at all locations where a change of direction occurs. As a rule of thumb, the cable should be manned about every 20 feet during initial installation.

c. Structural interferences, which the cable must pass over or around, should be padded. Bell rollers may be used, but are seldom needed.

d. Cables must be uncoiled as the cable is fed out along the routing path. Whether on a reel or in factory coils, the cable must be unrolled in a tangential (circular) manner. **DO NOT UNCOIL BY PULLING ON THE END AND HELICALLY STRETCHING.**

e. Si 2400 can withstand a high pull force as noted in Table 1. In virtually all installations, only a fraction of the allowable pull tension is utilized. Pushing the cable from one manning point to the next is by far the easiest technique and has added advantages when negotiating restricted areas and interferences.

f. When changing direction or bypassing a routing hazard, use large sweeping loops, rather than tight radii turns. This loose or excess cable will be dressed after the cable is in place at both ends.

g. Ensure sufficient length is available to install field terminations prior to final forming. A minimum of two feet of wrinkle free, round cable is required for the termination, so ensure the cable end was not bent, twisted, or flattened during cable installation. If this occurs, the deformed cable segment must be removed prior to final cable positioning.

h. See Table 1 for minimum advisable bend radius of SI 2400, but be aware repeated bending/straightening in the same location is potentially more harmful than a tight bend that is left in position. The stainless steel sheath may become weakened or work hardened during repeated bending, resulting in severe wrinkles, kinks or stress cracks.

CABLE DIAMETER	WALL THICKNESS	MINIMUM BEND RADIUS	MAXIMUM PULL FORCE
0.592 in.	0.015 in.	6 in. (nom)	500 lbs.

Any smooth surface or appropriate radius may be used to form the cable. EMT tube benders modified to eliminate sharp edges are suitable and are normally readily available. In many cases, the cable can be hand formed.

i. Cable runs should be supported at least every eighty-one inches and within approximately three feet of the beginning or end of a bend or ≥ 45°. See Table 2 for recommended cable mounting and support options for cable runs.

j. SI 2400 Fire Cable may be routed in cable trays; Stainless steel trays are recommended. Cable should not be installed in galvanized trays and should NOT be in direct contact with galvanized or aluminum trays or structures.

TABLE 2 – Cable Mounting and Attachment

1.	B-line stainless steel strut.
2.	B-Line Part No B2088SS4 clamps for a 0.592 inch dia. Cable.
3.	Standard hardware for single hole clamp.
4.	Panduit stainless steel ty-wraps or equivalent.

5.0 POST INSTALLATION INSPECTION OF SI 2400 FIRE CABLE

a. Smooth, contour changes such as dents, dings, ripples, or wrinkles are acceptable except in areas where termination kits must be installed. See Figure 1.

b. Kinks or wrinkles whose upper radii are extremely pronounced or touching indicate a potential problem area, as straightening may result in cracking the sheath. See Figure 1.

c. Gouges or cuts in the cable sheath which exceed 10% of cable wall thickness may be cause for rejection. Wall thickness is normally .015". The depth of gouges or cuts should be calculated based on a measurement of the distance from the root point of the gouge or

cut to the direct opposite point on the cable O.D. and known O.D. of the cable. Recommend measuring instrument: blade or point micrometer.

d. Electrical continuity and installation resistance should remain essentially the same as pre-installation test results. Any significant difference, even if within acceptable limits, should be investigated.

6.0 TERMINATIONS

a. SI 2400 Fire Cable may be purchased with factory terminating pigtails on one or both ends, or terminating kits are available for field use.

b. Terminations, whether factory or field installed, are designed for attachment to junction or terminal boxes such as Hoffman's. Standard fittings such as Myer hubs or lock nuts and bushings are acceptable.

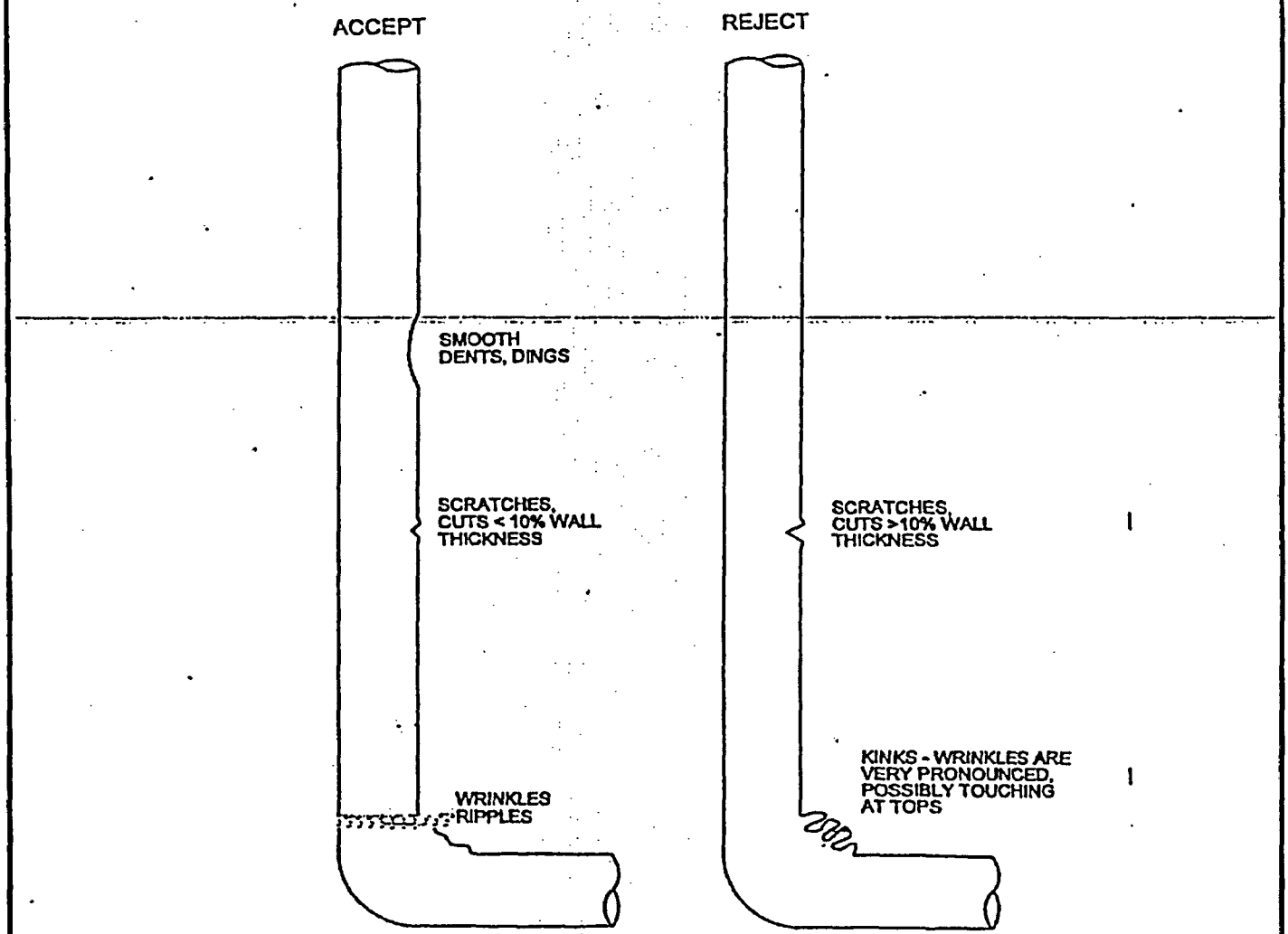


FIGURE 1 – SI 2400 Fire Cable Inspection Criteria

SIZE A	CAGE CODE 25693	ER 04-033
	REV A	SHEET 8 OF 8

Q/A RECEIVING REPORT

CLIENT/PROJECT NAME Areva
CLIENT/PROJECT NUMBER 14980-119368
RECEIVED FROM Alamo Iron Works
PROJECT LOCATION Omega Point Labs

REPORT NUMBER 2449 - 14980
DATE RECEIVED 6-9-04
DATE INSPECTED 6-9-04
INSPECTED BY:

ITEM DESCRIPTION	P.O. NO.	QUANTITY Order	Rec'd	B.O.	I.D. NO.	COMD MATL Y/N	CERT. RECD Y/N	SAFETY RELATED Y/N	CONTAINER INTEGRITY	ACCEPTANCE Accept	Hold	Reject	REMARKS
A36 Steel Plate	144270	1	1	0	90802-Flat 1"x8"x20' 27.2#	Y	Y	N	Good	X			
1"x8"x20'													

09-016-11/02

OMEGA POINT LABORATORIES
16015 SHADY FALLS RD.
ELMENDORF, TEXAS 78112
PH. (210) 635-8100
FAX (210) 635-8101

PURCHASE ORDER

14427Q

Date: 6/8/2004
Page: 1 of 1

Order From: Alamo Iron Works
943 SBC Center Prkwy
San Antonio
TX 78219
210-229-6161

Deliver to: Omega Point Laboratories, Inc
16015 Shady Falls Road
Elmendorf
TX 78112
(210) 635-8100

Vendor No:

Your Item Number / Item Description	Our Reference	Qty Ordered	Units	Unit Cost	Extension
A36 Steel Plate 1"x8"x20'	1.00	001	Each	$218.10	$218.10

"See Special Instructions Regarding Purchasing Specifications for Quality Assurance Requirements"
QA Approval [signature]
Date 6-9-04

Please Quote Purchase Order Number on all correspondence.

Please certify that the items supplied conform to applicable standards and specifications.

Subtotal:	$218.10
Freight:	0.00
Tax Amount:	0.00
Total Value:	$218.10

080625/11-99

AIW_TRANS_PACKLIST_200211_HP

PACKING TICKET

DATE
06-08-04
ORDER #
T353415

Alamo Iron Works
943 SBC CENTER PRKWY
San Antonio, Texas 78219
Phone: (210) 223-6161 Fax: (210) 704-8351
HAZMAT RESPONSE 1-800-322-5085

12345 999

PAGE
1

16:05

SHIP TO:
OMEGA POINT LABORATORIES, INC.
16015 SHADY FALL ROAD

ELMENDORF TX 78112

BILL TO:
OMEGA POINT LAB., INC.

16015 SHADY FALLS RD.
ELMENDORF TX 78112

CUSTOMER PHONE# 210635-8100

CUSTOMER #	647913801	PO #	14427Q	TERR #	012
SHIP VIA	OUR TRUCK	BUYER	TROY	WRITER #	161

LN	QUANTITY ORDERED	UOM	QUANTITY SHIPPED / PCS	QUANTITY B/O	A/W ITEM NUMBER / DESCRIPTION	PRICE	HAZ MAT	PKG	TYPE	ZONE
1	1.00	LG	1.00 1.00	0.00 FLAT 1"X8"X20' 27.20#'	908020	218.10		1 0	LG	2B2

ZONE/LOAD	
WEIGHT	544.00

RECEIVED BY:_____ DATE:_____

COMMENTS:_____ LOADED BY:_____

NOTIFICATION OF SHORTAGES MUST BE MADE TO CUSTOMER SERVICE DEPT WITHIN 7 DAYS OF RECEIPT.
THANK YOU.

B/LN 295376
Date 3/22/04

NUCOR
BAR MILL GROUP
JEWETT DIVISION

CERTIFIED MILL TEST REPORT

A Division of NUCOR Corporation
Post Office Box 126 Jewett, Texas 75846 Telephone (903) 626-4461 Sales (800) 527-6445

ISO 9002 Registered by
SRI Quality System Registrar

43003
Sold To: ALAMO IRON WORKS
ACCOUNTS PAYABLE #66365
P.O. BOX 231
SAN ANTONIO TX 78291-0231

Ship TO: ALAMO IRON WORKS
943 SBC PARKWAY
SAN ANTONIO TX

SIZE / GRADE	HEAT NUMBER	CUSTOMER PO NUMBER	C	Mn	Si	S	P	V	Nb	Cu	Cr	Ni	Mo	Sn	Bend Test
1 X 6	345-1014	SP-83556	.14	.67	.24	.033	.008	.005	.007	.60	.24	.19	.060	.011	
A36-03A/A709-03A/SA36-98			Tensile 1: 70700 Yield 1: 47000 Elong% 1: 21												
			Tensile 2: 73100 Yield 2: 49200 Elong% 2: 21												
1 X 6	343-0985	SP-83556	.20	.80	.22	.031	.007	.004	.007	.52	.10	.13	.044	.011	
A36-03A/A709-03A/SA36-98			Tensile 1: 72300 Yield 1: 47100 Elong% 1: 20												
			Tensile 2: 76800 Yield 2: 49100 Elong% 2: 20												
1 X 8	343-0579	SP-83556	.10	.66	.20	.035	.011	.004	.004	.39	.10	.13	.036	.013	
A36-03A/A709-03A/SA36-98			Tensile 1: 59200 Yield 1: 40000 Elong% 1: 25												
			Tensile 2: 61700 Yield 2: 41500 Elong% 2: 24												
1 X 8	345-0597	SP-83556	.19	.72	.22	.043	.022	.006	.004	.49	.17	.12	.034	.016	
A36-03A/A709-03A/SA36-98			Tensile 1: 60700 Yield 1: 41600 Elong% 1: 21												
			Tensile 2: 62700 Yield 2: 41700 Elong% 2: 21												
1/4 X 10	345-0836	SP-81725	.12	.66	.18	.050	.014	.003	.004	.45	.13	.14	.035	.014	
A36-03A/A709-03A/SA36-98			Tensile 1: 64100 Yield 1: 45500 Elong% 1: 28												
			Tensile 2: 64100 Yield 2: 44800 Elong% 2: 27												
1/4 X 12	345-0911	SP-79509	.15	.63	.17	.038	.006	.003	.004	.45	.11	.15	.038	.013	
A36-03A/A709-03A/SA36-98			Tensile 1: 70400 Yield 1: 50400 Elong% 1: 26												
			Tensile 2: 68800 Yield 2: 47500 Elong% 2: 25												

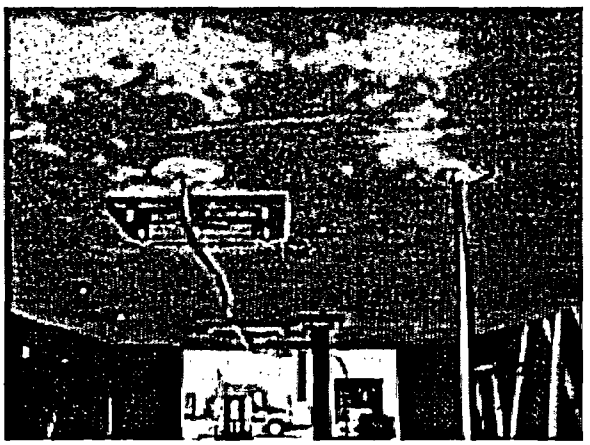
ELONGATION IN 8 INCH SCALE
MELTED AND MANUFACTURED IN U.S.A.

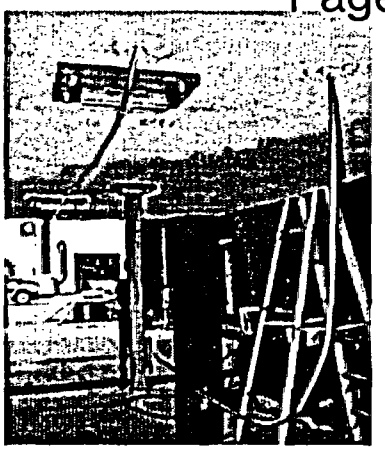
ALL MATERIAL STRAND CAST

Ben R Campo
CHIEF METALLURGIST

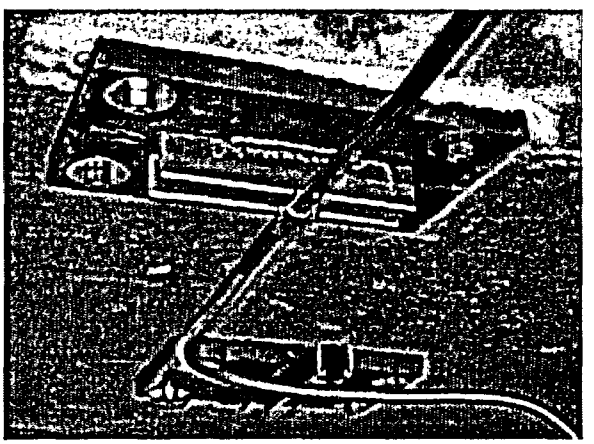
Appendix E

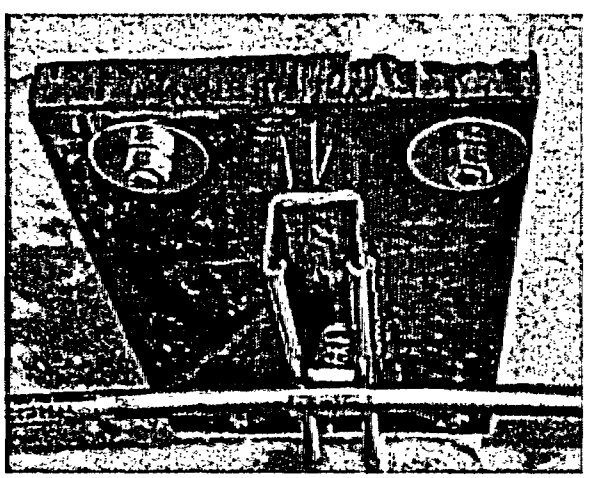
PHOTOGRAPHS


#1: Cables in and out of heat.

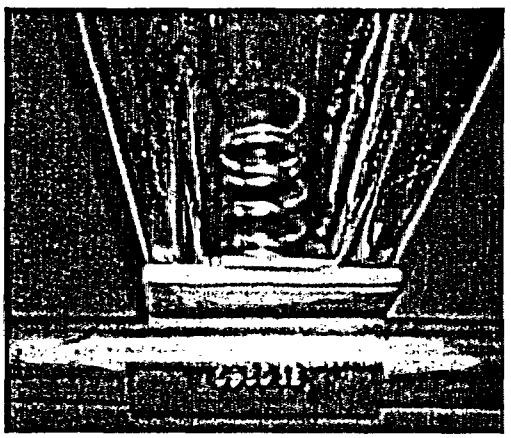

#2: Cables mounted under slab.


#3: 3" x 3" vertical cable support system.

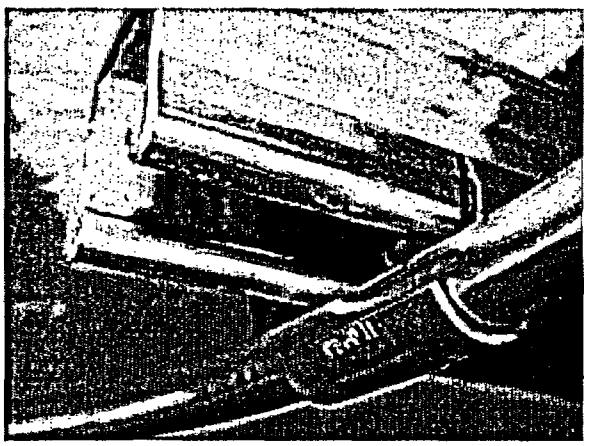

#4: Supports against slab.


#5: Upper support with clamp.


#6: Lower support showing clamp.



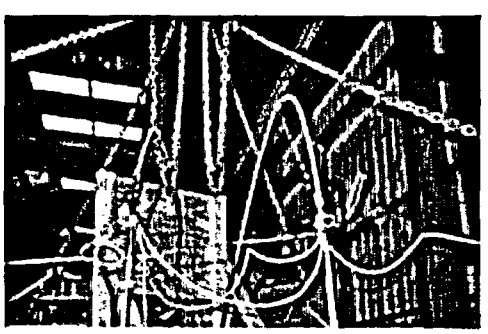
#7: Lower support showing clamp & spring.



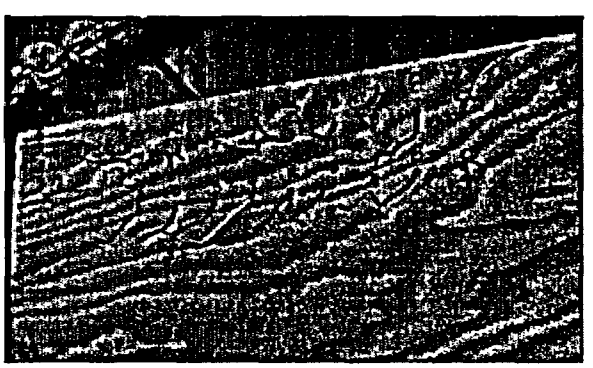
#8: Upper support clamp.

#9: Under side of slab.

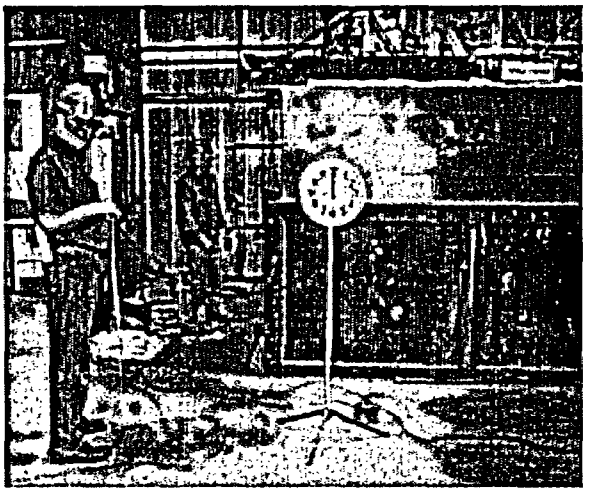
#10: Loading test article on furnace.



#11: Cables exiting slab on top.

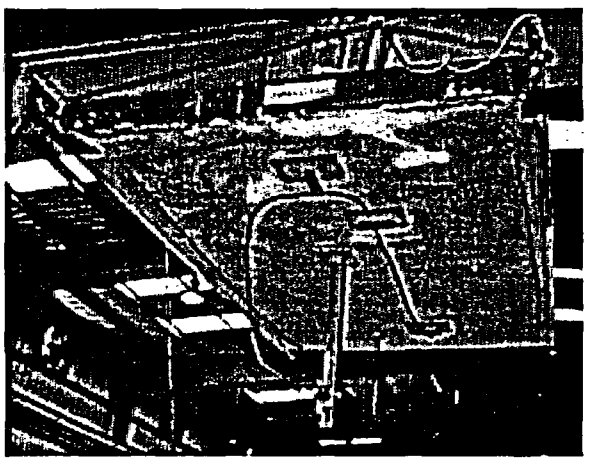


#12: Cable ends for megger testing.

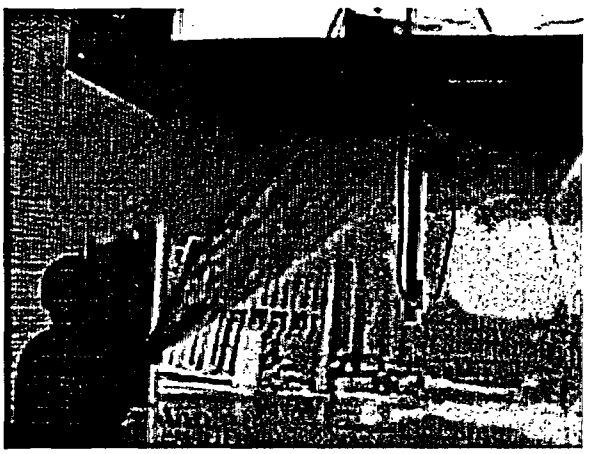


#13: Start of test.

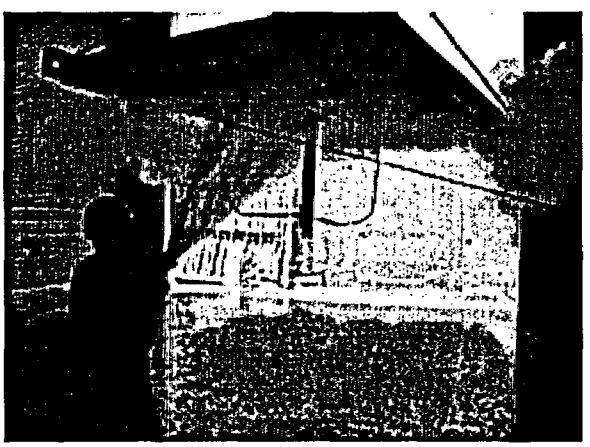
#14: Meggering the cable conductors.



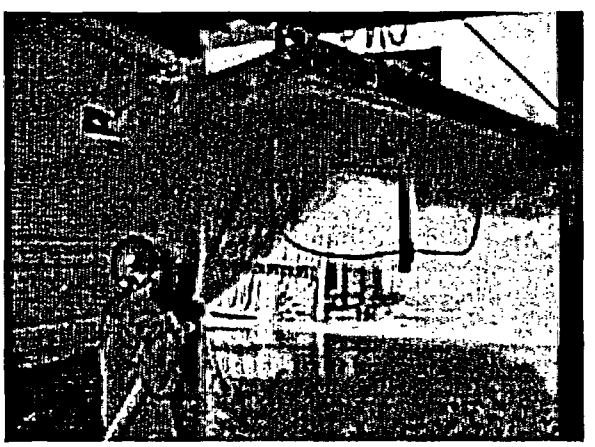
#15: Specimen immediately after fire test.



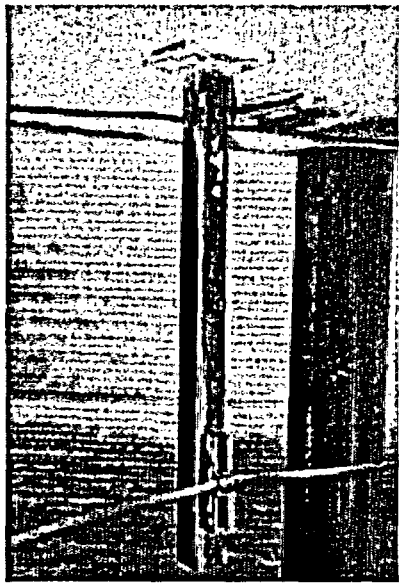
#16: Hose stream test.



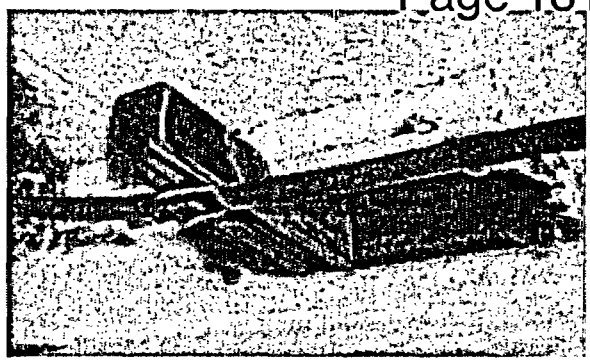
#17: Hose stream test.



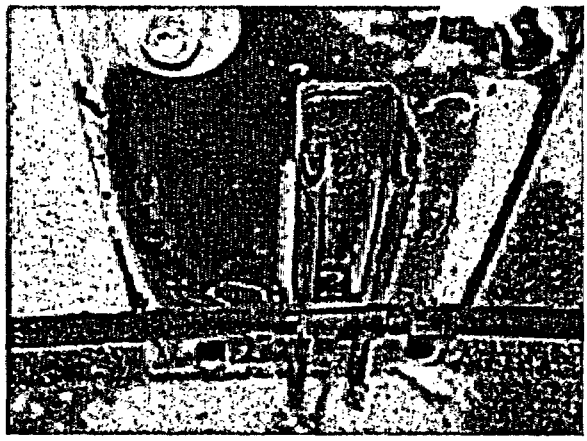
#18: Hose stream test.



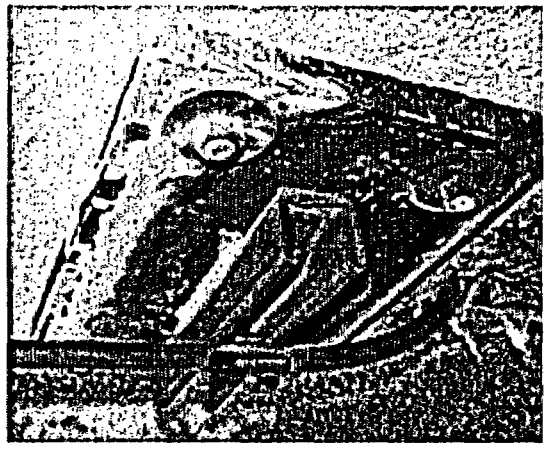
#19: Vertical support after hose stream.



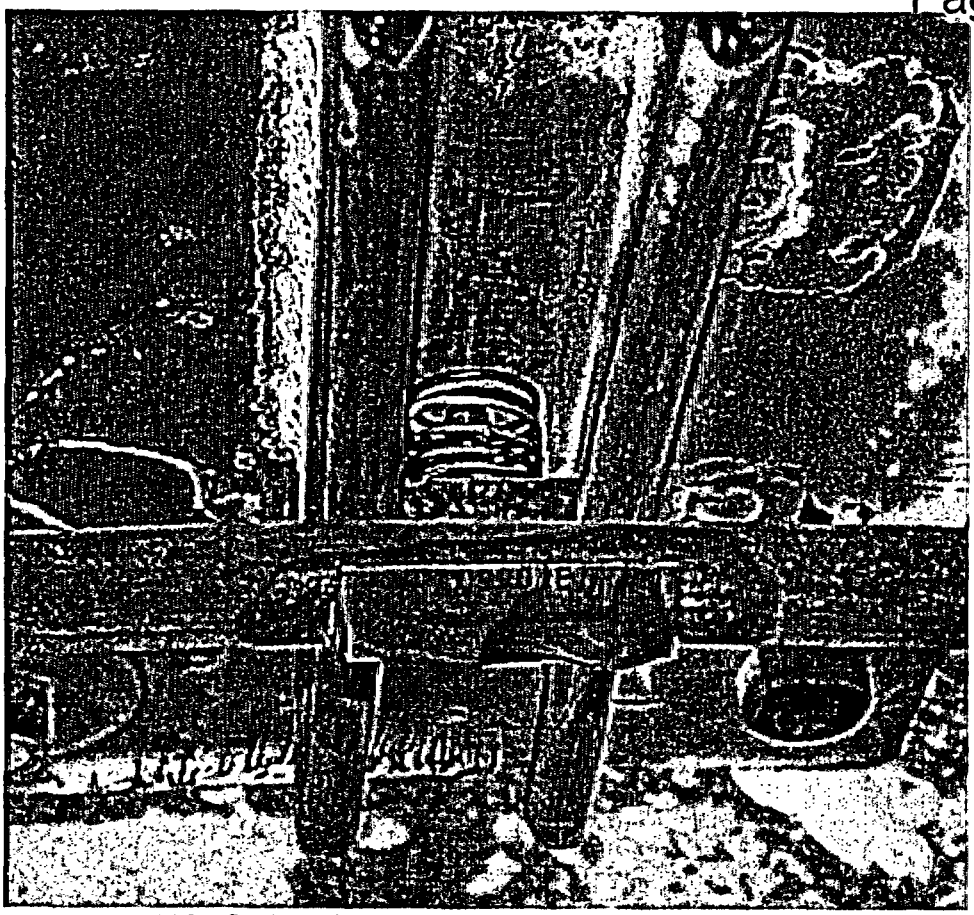
#20: Upper support after hose stream.



#21: Upper support after hose stream.



#22: Upper support after hose stream.



#23: Spring clamp on upper support remains intact.