QUALIFICATION TEST #QR-5804

REPORT ON QUALIFICATION TESTS FOR

ROCKBESTOS FIREWALL III CHEMICALLY CROSS-LINKED POLYETHYLENE CONSTRUCTION

FOR

CLASS 1E SERVICE IN NUCLEAR GENERATING STATIONS

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TEST SUMMARY

The Rockbestos Company Firewall III wire and cable constructions have successfully completed the test program outlined in Test Plan TP-4804 in support of Qualification for Class 1E Service in Nuclear Generating Stations.

The primary insulation material used in these constructions was a Chemically Cured, Flame Retarded Cross-linked Polyethylene designated KXL-760D.

Cable samples tested included Power, Control, Instrumentation (Signal) and Thermocouple Extension.

Samples were subjected to a sequence of thermal conditioning, Irradiation conditioning, environmental exposure simulation of a LOCA, and Post LOCA testing, within the guidelines established by IEEE Std. 323-1974 and IEEE Std. 383-1974.

By successful completion of the test and conditions described herein, it has been concluded that the subject wire and cable is suitable for its intended application and during design basis event postulated to occur at any time during the design life of forty years.

Referenced Documents:

1. IEEE 323-1974 - Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations.

2. IEEE 383-1974 - Standard for Type Test of Class 1E Electric Cables Field Splices, and connections for Nuclear Power Generating Stations.

3. ICEA-S-66-524 - Cross-linked Thermosetting Polyethylene Insulated Wire and Cable for Transmission and Distribution of Electrical Energy.

4. ICEA-S-19-81 - Rubber Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

5. National Electrical Code 1984.

6. The Rockbestos Company, Technical Manual for Class 1E Qualification Tests - July 9, 1984 Rev. 5.

7. Nuclear Regulatory Commission Guide 1.131 dated August, 1977.

8. The Rockbestos Company, Qualification Test Procedure Manual.

9. Nuclear Regulatory Commission Guide 0588.

10. Nuclear Regulatory Commission 10 CFR Part 50, App. B.

11. RSS-3-021

12. Test Plan 4804 in Support of Qualification; FWIII Chemically Cross-linked Polyethylene, Generic Nuclear Incident, Class 1E Service in Nuclear Generating Power Stations.

13. Sandia National Laboratories Report SAND 81-2027/1 of 2.

14. EPRI Final Report EL-938.

THE ROCKBESTOS COMPANY
FW III CHEMICALLY CROSS-LINKED WIRE
NUCLEAR INCIDENT
TEST REPORT 5804

PART 1 ENVIRONMENTAL

1 OBJECTIVE

To conduct a program of predetermined conditions and tests to support the use of chemically cross-linked insulation material for Class 1E applications as outlined in Test Plan 4804.

The results of this test program are intended to demonstrate the suitability of Rockbestos Company trade name Firewall-III wires and cables, for Class 1E Service for Nuclear Generating Stations as outlined by standards IEEE-323-1974 and IEEE-383-1974. Results will also be utilized to reinforce the conclusions of previous Rockbestos Class 1E reports of similar constructions including:

QR1807, R, R1, R2,
QR1811 QR1813 QR1814 QR2802 QR2803 QR2804

2 REPRESENTATIVE CABLES:

Products of interest fall into four categories. Power, Control, Instrumentation (Signal), and Thermocouple Extention. A design variation in insulation thickness for individual conductors of some control cable, .030" and .025", results in a fifth basic construction of interest.

3 CABLE DESCRIPTIONS

Cables described below are Standard cables. For accounting internal charge purposes, Rockbestos Product Codes are preceeded by "E" to reflect their use as an engineering qualification project rather than customer product.

Cable "A"

7/C #14 AWG Control Cable 600V 90 Degrees C

Rockbestos Product Code E41-0114

7 x 1/C #14 AWG 7 Strand x .0242" Tinned Copper
.030" FW III Chemically Cross-Linked Flame Retardant Polyethylene KXL-760D Cabled with
.002" Nomex Binder Tape,
.045" Neoprene Jacket
ICEA Print Method 4

Cable "B"

7/C #14 AWG Control Cable 600V 90 Degrees C

Rockbestos Product Code E41-0112

7 x 1/C #14 AWG 7 Strand x .0242" Tinned Copper
.025" FW III Chemically Cross-Linked Flame Retardant Polyethylene KXL-760D Cabled with
.002" Nomex Binder Tape,
.045" Hypalon Jacket
ICEA Print Metho 4

Cable "C"

2/C #20 AWG Type KX Shielded Thermocouple Extension Cable 90 Degrees C

Rockbestos Product Code E41-0102

1/C #20 Solid Chromel
.020" FW III Chemically Cross-Linked Flame Retardant Polyethylene (Yellow) KXL-760D

1/C #20 Solid Alumel
.020" FW III Chemically Cross-Linked Flame Retardant Polyethylene (Red) KXL-760D

2/C Cabled with Flame Retardant Polypropylene Fillers

1/C #20 AWG 19 Strands x .008" Tinned Copper Drain Wire
.002" Aluminum/Mylar Shield Tape (.001/.001) Overall
.002" Nomex Binder Tape
.045" Hypalon Jacket

Cable "D"

2/C #16 AWG Instrumentation Cable 300V 90 Degrees C

Rockbestos Product Code E41-0108

2 x 1/C #16 AWG 7 Strand x .0912" Tinned Copper
.020" FW III Chemically Cross-Linked Flame Retardant Polyethylene KXL-760D

2/C Cabled with Flame Retardant Polypropylene Fillers

1/C #18 AWG 16 Strands .010" Tinned Copper Drain Wire

.002" Aluminum/Mylar Shield Tape (.001/.001) Overall
.002" Nomex Binder Tape
.045" Neoprene Jacket

Cable "E"

1/C #6 AWG Power Cable 90 Degrees C

Rockbestos Product Code E41-0115

#6 AWG 7 Strand x .0612" Tinned Copper
.045" FW III Chemically Cross-Linked Flame Retardant Polyethylene KXL-760D

4 SAMPLE SELECTION:

All samples were selected at random from completed cable which had successfully completed normal production Quality Control tests. These include all tests for dimensional, physical, and electrical requirements for insulation and jacket materials described in ICEA-S-66-524, S-19-81 and Rockbestos RSS-3-021.

Certified Test Reports containing results of normal production tests are found in Data Section 1.

A, B, and E Samples - For the environmental portion of the IEEE-383 suggested Type Test, single conductor samples are representative for the Power and Control cable types, and were utilized for this program.

D Samples - For the environmental portion of the IEEE-383 suggested Type Test, 1 pair shielded is representative for Instrumentation (Signal) cable and was utilized of this program.

C Samples - For the environmental portion of the IEEE-383 suggested Type Test, 2/C #20 AWG is representative of the Thermocouple Extension cable and was utilized for the program.

IEEE-383 further requires demonstration that samples be subjected to the most severe postulated conditions. For possible synergistic effects upon the electrical, chemical, and mechanical performance, "most severe" is interpreted as the other constructional extreme.

For control cable, the other constructional extreme from the IEEE-383 suggested Type Test is completed cable. The difference in potential failure mode, between control cable singles and completed cable, is created by the interaction of completed cable components. Since the cable components are of proven industry design, verified by such as U/L, the major anticipated potential failure mode variation is mechanical. This will be created by the interaction of component expansion and/or constriction during thermal excursions. On that basis, the largest volume expansion, therefore, greatest potential for change, will occur in the control cable with the thicker insulation. The completed Control Cable sample therefore, was the construction utilizing .030" insulation thickness.

Considering the Instrumentation and Thermocouple Extension cable together, since both utilize .020" insulation thickness, single conductors from the Instrumentation cable were chosen as the other constructional extreme. Again, completed cable components are of proven industry design. The singles from the Instrumentation cable were chosen on the basis of slightly larger exposed insulation surface area, due to conductor size.

Only single conductor Power cable was tested. Constructional variations between single conductor Power and multi-conductor Power, are similar to those involved in Control cable. However these variances are manifested to a greater degree in the 7 conductor control cable than a typical 3 conductor power cable. Synergistic effects due to constructional extremes for Power cable were not evaluated separately by testing.

Items for this program were manufactured under a standard production order utilizing normal manufacturing techniques and materials of construction. Completed cable lengths were sufficient to provide a selection consistent with random sampling philosophy.

All samples were approximately 15 feet, including terminations, taken from completed cable.

"A" Sample Environmental Profile (LOCA)

TP-4804 A1. Completed cable section
TP-4804 A2. Completed cable section
TP-4804 A3. Single conductor removed from cable
TP-4804 A4. Single conductor removed from cable
TP-4804 A5. Single conductor removed from cable
TP-4804 A6. Single conductor removed from cable

"B" Sample Environmental Profile (LOCA)

TP-4804 B1. Single conductor removed from cable
TP-4804 B2. Single conductor removed from cable
TP-4804 B3. Single conductor removed from cable
TP-4804 B4. Single conductor removed from cable

"C" Sample Environmental Profile (LOCA)

TP-4804 C1. Completed cable section
TP-4804 C2. Completed cable section

"D" Sample Environmental Profile (LOCA)

TP-4804 D1. Completed cable section
TP-4804 D2. Completed cable section
TP-4804 D3. Single conductor removed from cable
TP-4804 D4. Single conductor removed from cable
TP-4804 D5. Single conductor removed from cable
TP-4804 D6. Single conductor removed from cable

"E" Sample Environmental Profile (LOCA)

TP-4804 E1. Completed cable section
TP-4804 E2. Completed cable section
TP-4804 E3. Completed cable section
TP-4804 E4. Completed cable section

5 PRELIMINARY SAMPLE EVALUATION

Samples were evaluated for physical and electrical integrity prior to test initiation, to assure mechanical damage had not occurred in storage, transfer, or in the removal of single conductor samples from completed cable. Since normal production acceptance tests were previously performed, verification only was necessary to demonstrate suitability.

See Data Section 2 for detailed evaluation results. The evaluation results were all satisfactory.

6 TEST PROCEDURE - ENVIRONMENTAL

Testing was conducted in accordance with procedures outlined in the latest revision of the Rockbestos Technical Manual and applicable sections in the Rockbestos Qualification Test Procedure Manual.

7 SAMPLE CONDITIONING

Preparation: Completed cable sections from all cables were obtained. Completed cable sections from cables "A", "B" and "D" were disassembled to obtain the necessary single conductor samples. Care was exercised during disassembly so as not to damage the single conductor samples.

Each sample, single conductor and completed section, had a permanent metal tag affixed, each embossed with the appropriate sample number.

All samples had termination points prepared, i.e., exposed metal conductor at each end of the sample.

Thermal Aging: For those samples which required it, thermal aging was accomplished prior to irradiation aging. Results reported by Sandia National Laboratories SAND 81-2027/1 of 2, indicated comparable final results, whether conditioning is accomplished simultaneously or in either sequence of thermal and irradiation conditioning.

121 Degree C Aging - Jacketed samples TP-4804-A1, A2, C1, C2, D1, D2, were placed in a hot air circulating oven at a temperature of 121 Degrees C for 168 hours. The samples were arranged on perforated shelves located in the center one-third of the oven space. They were in coil form with an approximate diameter of 20 inches. IEEE 383 is not specific for coil diameters during aging. Post LOCA performance tests include a 40X diameter bend. By inference, 40X should be more severe than prior test portions.

The temperature and time for these samples were selected as a compromise for the aging capabilities of the jackets. The thermal aging utilized does not represent end of life condition for the complete cable. It does represent significant aging for the jackets. This is based upon thermal aging parameters outlined in ICEA S-66-524 which requires 50% or 65% retained elongation after thermal aging of 168 hours at 100 degrees C for Neoprene and Hypalon respectively.

By the increase in temperature, (121 degrees C) the thermal aging utilized was intended to demonstrate that "significant" aging of the jackets occurred. Therefore, any effects upon cable performance by interaction of the jacket material has occurred and would be manifested in final test results.

150 Degree C Aging - Single Conductor Samples TP-4804-A3, A4, B1, B2, D3, D4, E1, and E2 were placed in a hot air circulating oven for 941 hours at 150 degrees C plus 12 hours at 148 degrees C for a total thermal exposure of 953 hours. The samples were mounted on a metal mandrel consisting of two circular rings, supported by eight equally spaced 1/2" stainless pipe, resulting in an approximate circumscribed diameter of 20 inches. Samples were supported along the surface of the pipes by metal hooks. The mandrel was placed on a shelf in the oven such that the mandrel was located in the center- half of the oven space. The temperature and time for these samples were utilized on the basis of Arrhenius aging characteristics for the primary insulation material. A normal operating service temperature 90 degrees C was adopted as this is the industry recognized temperature for cross-linked polyethylene.

This thermal aging to represent end-of-life condition for a 40 year postulated life, with margin, for the primary insulation material.

At 150 degrees C, the intersection of the Arrhenius plot for the primary insulation is 850 hours. 941 Hours of exposure represents in excess of 45 years at 90 degrees C with further small increase represented by 12 hours at 148 degrees C aging. This represents in excess of 10% above the postulated 40-year life. Reference Data Section 3.

For normal operating temperatures below 90 degrees C, margin is increased.

Irradiation Aging:

All samples, thermally aged and not thermally aged, were Irradiation aged. Those samples thermally aged at 150 degrees C remained on the mandrel. The unaged samples and the samples aged at 121 degrees C were mounted on the mandrel. Care was exercised during the mounting procedure to avoid damage. The mandrel and samples were suitably protected from damage during transportation to and from Isomedix Inc.

Irradiation was performed by Isomedix Inc., Parsippany, NJ, and they documented dose rate, time of exposure and total dose.

While still on the mandrel, all samples were exposed to Gamma radiation from a Cobalt 60 source in air at a rate of .47 megarads per hour for 427.6 hours, resulting in a total accumulated dose of 200.97 megarads. Refer to Data Section 4 for Isomedix report.

Samples were not exposed to Beta radiation. Industry accepts that for purposes of demonstration of damage, equal doses of Beta or Gamma produce equal damage. Gamma radiation therefore, satisfied irradiation conditioning requirement.

8 POST CONDITIONING EVALUATION

Upon completion of the irradiation conditioning of the samples a visual examination, and an electrical evaluation consisting of Dielectric Withstand and Insulation Resistance measurement, were conducted. This was accomplished to insure sample integrity prior to the extended environmental exposure. See Data Section 5 for detailed evaluation results.

9 ENVIRONMENTAL PROFILE (LOCA)

On the basis of the Post Conditioning Evaluation, one of each configuration was selected for the LOCA. Duplicate samples were withdrawn from the program at this point.

Samples to be subjected to the LOCA test were selected on the basis of physical condition first, Insulation Resistance second, and Conductor Resistance third, or random in the case of comparable evaluation. See Section 5 for explanation of evaluation, and part A of "Unanticipated Variations."

Preconditioning Summary:

LOCA Samples

Sample	Thermal Aging	Irradiation Aging
TP-4804-A1	121 Deg C/168 Hours	200.97 Megarads
A3	150 Deg C/941 Hours	"
A5	None	"
B1	150 Deg C/941 Hours	"
B4	None	"
C2	121 Deg C/168 Hours	"
D2	121 Deg C/168 Hours	"
D4	150 Deg C/941 Hours	"
D5	None	"
E1	150 Deg C/941 Hours	"
E3	None	"

Preparation:

An extension lead consisting of a multi-conductor control cable, was utilized to connect the samples within the vessel, to exit the penetration of the environmental test vessel. Connection was made by crimp connectors covered by nuclear grade heat sealable shrink tubing to complete a water tight connection.

LOCA

General - Samples were loosely coiled on the perforated steel grating located approximately 1 foot from the bottom of the cylindrical vessel. All samples were connected to an extension lead. All electrical connections to the samples under test were made external to the test vessel through the extension leads.

Jacketed samples were placed on the grating first. Single conductor samples placed on top. All samples were arranged to expose the majority of their surface area to the environmental conditions. Crossover of various samples was present resulting in numerous contact points within individual, and adjacent samples.

All input data to the Data Logger was scanned at the fixed design rate of every two (2) seconds. In addition, the initial transients of the first and second peak thermal excursions were monitored by a continuous recording thermocouple measurement instrument.

Inputs to the data logger and continuous recorder are analog voltages developed by the various instruments used for the various test parameters.

Print cycles were varied and were dependent upon the change rates of the measured parameters. Maximum print rate was utilized during profile ramps. Lesser print rates were utilized during extended stabilized profile portions. Printed data represents trends for the selected print cycle time periods.

Profile - The intended LOCA profile is described in IEEE-323-1974 Appendix A Fig. A1, combined PWR/BWR.

When the maximum temperature of the first transient of the profile was achieved, a chemical spray was initiated and continued for 24 hours.

Total cumulative environmental exposure was 105 days.

See Data Section 6 for tabulated data acquisition of all Data Logger channels for environmental parameters. Also refer to Unanticipated Variations sections B and C.

With the exception of the Insulation Resistance measurements, which were planned, and other short-term unanticipated interruptions, samples were electrically energized at their rated voltage and current as described by the National Electric Code - 1984. See Data Section 7 for tabulated voltage and current loadings.

Insulation Resistance measurements were made on each sample through the extension cables during the environmental profile at the various temperature levels. See Data Section 8 for tabulated measurements.

10 POST LOCA TESTS

Upon completion of the enviromental profile, the samples were allowed to cool to room temperature and were removed from the test vessel. After resolution of difficulties encountered in preparing the samples for POST LOCA TESTS (Refer to section E, Unanticipated Variations), the samples were tested as below. Prior to the voltage withstand test, each sample was straightened and wrapped around an approximate 40X diameter metal mandrel, secured in this orientation, removed from the mandrel, and placed in room temperature tap water.

1st Test, After 1 hour Soak (See Section E, Unanticipated Variations for Samples TP4804-B1, B4, C2, D4, D5)

Sample	40X (inches)	Wraps (360 deg.)	80 v/mil (5 minutes)	Active Length (feet)
TP-4804-A1	18.75	2	-	10
Cndr #2			Pass	-
#4			Pass	-
#6			Pass	-
TP-4804-A3	5	6	Pass	10
-A5	5	6	Pass	10
TP-4804_D2	11	3	-	10
Cndr #1			Pass	-
#2			Pass	-
TP-4804-E1	11	3	Pass	8
E3	11	3	Pass	8

2nd Test, After 18 hour Soak

Sample	80 v/mil 5 minute	Insulation Resistace Megohms - 1000 feet	Temperature (Deg. C)
TP-4804-A1	-	-	-
Cndr #2	Pass	3,900	23
#4	Pass	4,200	"
#6	Pass	4,400	"
TP-4804-A3	Pass	10,000	"
A5	Pass	7,000	"
TP-4804-D2	-		-
Cndr #1	Pass	5,000	"
#2	Pass	5,100	"
TP-4804-E1	Pass	5,600	"
E3	Pass	2,600	"

After completion of the 2nd test above, sample TP-4804-E3 was tested at 5000 Vac (111 v/mil average) for 1 minute. The sample withstood this test.

The modified samples (Refer to section E, Unanticipated Variations) were tested as below. Prior to the voltage withstand tests, each sample was wrapped around an approximate 40X diameter metal mandrel for the second time, secured in this orientation, removed from the mandrel and placed in room temperature water.

After 3 hour Soak

Sample	40X (inches)	Wraps (360 Deg.)	80 v/mil (5 minutes)	100 v/mil (1 minute)	Active Length (feet)
TP-4804-B1	4	9	Pass	Pass	10
B4	4	9	Pass	Pass	10
TP-4804-C2	-	-	-	-	-
(3 Ft) Red	5	2	Pass	Pass	3
Yellow	5	2	Pass	Pass	3
(6 Ft) Red	11	2	Pass	Pass	6
Yellow	11	2	Pass	Pass	6
TP-4804-D4	3	11	Pass	Pass	9
D5	3	12	Pass	Pass	10

After 6 hour Soak

Sample	Insulation Resistance Megohms - 1000 feet	Temperature (Deg. C)
TP-4804-B1	7600	25
B4	5600	25
TP-4804-C2	-	-
3 feet Red	8400	25
Yellow	7500	25
6 feet Red	6600	26
Yellow	5400	26
TP-4804-D4	4800	25
D5	4900	25

Test Variations:- The established criteria for final POST LOCA tests is a single sequence of a 40X diameter bend and withstand of 80 v/mil for 5 minutes. As documented in section E of Unanticipated Variations, several unsatisfactory results were obtained upon performace of the defined testing.

These unsatisfactory results were determined to be anomalous due to primarily mechanical damage. This damage predicated a variance in active length: reduction from 10 feet, and sample configuration: severely damaged areas wrapped with tape.

To clearly demonstrate the validity of the conclusion drawn and compensate for the sample modification, significant test margin was added. Margin was in different forms for various samples as noted. These included two 80 v/mil 5 minute dielectric proof tests, two 40X Bends, and 100 v/mil or higher, 1 minute dielectric proof test.

A minor variation from the test plan also occurred relative to soak time prior to dielectric test. The test plan indicates a minimum 6 hour soak. This requirement was derived from ICEA standards which is in reference to full reel production testing. In that vein, the intent of the 6 hour soak is to insure sufficient time is given for the water to penetrate to the inner layers of the reels to be tested and temperature stabilize for Insulation Resistance measurements. For the samples included in this program, i.e. 10-15 feet, immediate water contact is achieved, and 1 hour is sufficient for temperature stabilization. Therefore, a minimum of 1 hour soak was adopted.

Test plan also states that each individual insulated conductor will be tested. Rockbestos tested three of the seven conductors. refer to Section 5 item C.

2 PASS/FAIL CRITERIA
Samples were considered to have passed the LOCA test by:

1. Successful withstand of the continuous application of voltage and current, with the exception of Insulation Resistance measurement time, for a cumulative 100 Days environmental exposure: and

2. By successful withstand of 80 volts/mil AC RMS 60 Hz stress after a 40X diameter bend.

Results Evaluation:

All Samples Met the established criteria and passed the test.

12 CERTIFIED CONCLUSION

Firewall III Chemically cured Cross-linked Polyethylene material, and wire and cable constructions utilizing this material, have successfully withstood the conditions and tests documented in the preceeding pages. Therefore, it is certified that they can be expected to function in their normal intended application and during conditions simulated herein, postulated to occur at any time during the anticipated installed life of forty years.

Unanticipated Variations

A. Test Plan TP-4804 criteria for Post Conditioning evaluation included an Insulation Resistance Constant (K) minimum requirement of 10,000. Several samples did not meet this requirement.

The requirement was incorporated on the basis of ICEA requirements for "fresh" cable. The magnitude of the apparent effect of conditioning, was not expected. On the basis of actual values obtained, which represent more than adequate resistance for the products of interest, the engineering judgement was made to proceed with the test program as planned.

B. The first and second Peak Temperature Transient did not follow the intended profile of Figure A1, IEEE-323-1974.

Actual Achieved Profile Transients

1st Peak		2nd Peak	
Time	Temperature Deg. F	Time	Temperature
Initial	169	Initial	168
10 sec.	226	10 sec.	219
20 sec.	230	20 sec.	230
30 sec.	234	30 sec.	234
60 sec.	237	60 sec.	247
90 sec.	246	90 sec.	258
120 sec,	253	120 sec.	271
180 sec.	267	150 sec.	280
240 sec.	277	180 sec.	293
246 sec.	280	240 sec.	317
300 sec.	305	300 sec.	329
360 sec.	324	340 sec.	342
420 sec.	341		

The intended profile included achievement of 280 deg. F within 10 seconds. The first and second peak took 246 seconds and 150 seconds respectively. Further, the intended profile included achievement of 340 deg. F within 5 minutes (300 seconds). The first and second peak took 420 seconds and 340 seconds respectively.

The primary cause of this delay in each case was equipment limitations. The first peak was further delayed by technician error in failure to close the chamber vent at the proper time. It was closed between 45 seconds and 1 minute.

The purpose of the extreme thermal transients is to demonstrate resistance to Thermal Shock effects. This type of effect would be significant in components or assemblies which contain pressure boundaries, such as seals.

For the chemically cross-linked polyethylene insulation being tested, this type of effect is not a factor. The primary insulation is one continuous layer of identical material. It does not contain pressure boundaries or an interface of dissimilar material.

Conclusion: The variation in ramp profile results in a variation of the rate of rise in temperature only. Cable performance, and thus potential mode of failure, is unaffected by rate of temperature rise within the established test parameters. Therefore, test plan variations relative to ramp Thermal Transients did not affect cable performance in either a positive or negative sense and results obtained are acceptable as meeting outlined parameters and criteria.

C. Loss of steam pressure occurred eleven times during the course of the 200 degree F portion of the profile. Of these, the majority were of little significance since the temperature did not fall below the 200 Degrees F level.

Three occurrances were of significance:

The first of significance occurred during Day 32, with the lowest measured temperature of 172 Degrees F. Time at temperature below the planned 200 degrees F was less than 2 hours.

The second occurred during Day 56 and was the result of loss of facility electrical power. This power loss also interrupted the Data Logger monitoring system and therefore, a minimum temperature was not measured. When the Data Logger was placed in service again, environmental parameters were normal, as power was restored several hours prior to this. Data Logger monitoring was lost for approximately 15.5 hours.

The third occurred during Day 96 with the lowest measured temperature of 180 degrees F. Time at temperature below 200 degrees F was less than 1.5 hours.

With the exception of the period of total power loss, each steam loss was the result of plant boiler malfunction.

The total environmental profile was therefore extended from 100 Days to 105 Days. Time/Temperature exposure accomplished by the 5 Day extension more than compensated for the above variances. Thermal excursions, minor or major are considered more severe than steady state conditions. The variances and profile extension noted above therefore, may be considered as positive margin.

Conclusion: Time/Temperature exposure requirements were exceeded.

Results obtained are therefore acceptable as meeting outlined parameters and criteria.

D. Voltage and Current loading of the samples was interrupted at various times throughout the profile. Loading was discontinued eight times for measurement of Insulation Resistace, as noted in Data Section 8. Each occurrence was approximately 20 minutes.

In addition, the following unscheduled interruptions occurred:

Approx. Time	Approx. Duration	Affected Samples	Voltage	Current	Cause
49 Hours	10 secs.	TP-4804-A1,A3,A5,B1, B4,E1,E3	Yes	No	Accidental trip during adjustment.
11 Day	57 hours	TP-4804-C2,D2,D4,D5 TP-4804-A3,A5,B1 B4,E1,E3	Yes No	No Yes	Momentary power loss due to storm.
17 Day	11 hours	TP-4804-E1,E2	No	Yes	Faulty external connection to current source.
56 Day	14.5 hours	All	Yes	Yes	Complete power loss due to storm

In each case no indication of fault was present. In each case, samples were re-energized without incident. From final occurrence to profile termination, all samples withstood applicable voltage and current loading without incident.

The total environmental exposure, voltage, and current loading, was extended from 100 Days to 105 Days. Voltage and current loading exposure accomplished by the 5 Day extension more than compensated for the above variances. In addition to the extended time, minor positive margin was added by the voltage and current transients, as transients are more detrimental than steady state conditions.

Conclusion: Voltage and current loading exposure requirements were exceeded. Variances which occurred resulted in minor positive margin as transients are more detrimental than steady state conditions. Results obtained are therefore acceptable as meeting outlined parameters and criteria.

E. At the conclusion of the profile, removal of the samples from the vessel and separation of the samples from each other, resulted in several faults during the initial POST LOCA test sequence.

As the photos in Section 4 show, as installed, the samples contacted each other and splice sleeves in a large number of places. It was immediately apparent when removing the samples from the vessel, that these contact points had developed significant adhesion. In general, a greater degree of adhesion appeared between the heat shrink sleeves and insulation surfaces than between an insulation to insulation contact point. Little or no adhesion was evidenced by jacketed samples. Extreme difficulty was encountered in separation of the samples due to the interweaving nature of orientation and areas of several adhesive contact points in close proximity.

Care was exercised to the extent possible in actual separation, but obvious damage occurred such as insulation tears. A visual examination was conducted to identify the obvious damage with the intent of minimizing their exposure to the POST LOCA tests. A detailed examination was not conducted based upon the concern that the handling required to conduct a detailed examination would increase the potential for further mechanical damage and subsequent faults.

Samples TP-4804-A1,A3,A5 and D2 passed the POST LOCA test sequence as intended without incident.

Samples TP-4804-E1,E3 were tested as intended and passed, with modification as follows; Each was immersed in water for the 80v/mil Dielectric test. Length was reduced from 10 feet to 8 feet due to damage as described above - tears in the insulation which exposed the metal conductor.

The remaining samples, specifically TP-4804-B1,B4,C2 (Yellow conductor pass, Red conductor fault), D4 and D5, experienced a fault during the initial 80 v/mil Dielectric test. While the precise voltage at the moment of fault was not determined, each faulted during voltage increase, at less than 1000 volts.

Recognizing the problems encountered in separation of samples, a detailed examination of each faulted sample was conducted. Examination primarily consisted of microscopic examination from 10x - 70x. Numerous areas of contact, crossovers etc. were identified in each sample. These areas were identifiable by:

1. Color - General surface of samples was black. Contact points by comparison were gray and closely resembled the original sample color.

2. Geometry - Determined by color outline and tangential deposits of foreign material with the outline.

3. Surface Appearance - Majority of surface area which was exposed to test environment i.e. away from contact points, ranged from smooth, cratered, rust colored deposits, white powdery deposits, and a black "membrane" type material with uneven coverage. By contrast, contact points had none of the above. They had a rippled appearance with irregular sharp peaks.

4. Damage - At some of the contact points, it was apparent that sections, or chunks, or insulation were removed to varying degrees. The range of damage was minor to severe, where the conductor was exposed.

In addition to the contact areas, the indented areas caused by Thermal Aging were also noted. (Refer to Post Conditioning Evaluation).

Examination results were:

Sample TP-4804-B1; 17 contact points were identified with varying degrees of damage. Numerous Thermal Aging indents were also identified. Fault area was examined, but fault current destroyed evidence completely. Unable to determine cause.

Sample TP-4804-B4; 31 contact points were identified with varying degrees of damage. Fault area was examined and fault occurred at an identifiable contact point.

Sample TP-4804-D4; 20 contact points were identified with varying degrees of damage. Numerous Thermal Aging indents also identified. Fault area was examined and fault occurred at an identifiable Thermal Aging indent.

Sample TP-4804-D5; 42 contact points were identified with varying degrees of damage. Fault area was examined and fault occurred at an identifiable contact point.

Based upon the considerable evidence of mechanical damage noted above, it was apparent that a strong likelihood existed, that the faults were a direct result of this damage. To demonstrate this, the samples were modified as below and retested.

Sample TP-4804-B1; The fault area, four severely damaged contact points, and five severe Thermal Aging indents were covered by high voltage termination tape. Twelve contact points remained uncovered.

Sample TP-4804-B4; The fault area and eight severely damaged contact points were covered by high voltage terminating tape. Twenty two contact points remained uncovered.

Sample TP-4804-D4; The fault area, six severe contact points, and five Thermal Indents were covered by high voltage terminating tape. Fourteen contact points remained uncovered.

Sample T-4804-D5; The fault area and eight severe contact points were covered by high voltage termination tape. Thirty three contact points remained uncovered.

Each taped area extended approximately 1 inch longitudinally. Due to extreme damage, (exposed conductor), the active length of sample TP-4804-D4 was reduced to nine (9) feet.

Each sample was straightened, wrapped around an approximate 40X Diameter metal mandrel and re-tested as below, after a three hour soak in room temperature tap water.

Sample	40X Bend Diameter	Active Length	80v/mil 5 minutes	100v/mil 1 minute
TP-4804-B1	4 inch	10 feet	Pass	Pass
B4	4 inch	10 feet	Pass	Pass
D4	3 inch	9 feet	Pass	Pass
D5	3 inch	10 feet	Pass	Pass

After the samples soaked an additional three hours, 6 hours total, Insulation Resistance was measured. 500 Vdc, 1 minute at 25 Deg. C:

Sample	Measurement (ohms)	*Megohms - 1000 feet
T-4804-B1	.76 x 1T	6900
B4	.56 x 1T	5180
D4	4.8 x 100G	3880
D5	4.9 x 100G	4500

*Calculation for "Megohms - 1000 feet" utilized sample active length minus 1 inch for each taped area, which effectively eliminates any contribution from the taped area. The calculated value is therefore conservative.

TP-4804-B1 - 10 feet minus 11 inches
B4 - 10 feet minus 9 inches
D4 - 9 feet minus 11 inches
D5 - 10 feet minus 9 inches

Sample TP-4804-C2 was also evaluated. The fault area was not readily apparent, which was to be expected since there was an overall jacket. Sections of the jacket were removed with moderate difficulty. The basic procedure was to cut through the majority of the jacket thickness and remove the jacket in tension, allowing the remaining jacket to tear.

Once located, 4 feet from one end, approximately 18 inches was cut from the sample. This was predicated on the need to separate cable components for examination.

The fault area was microscopically examined from 10 to 70 power. The following observations were made:

1. Fault current had destroyed all evidence as to cause.

2. Fault approximated 1/4 inch longitudinal.

3. Moderate damage to the yellow conductor insulation had occured due to the heat of the fault.

4. Conductor was exposed 360 deg.

The immediately adjacent areas (18 inch) were microscopically examined with the following observations:

1. Some insulation deformation had occurred in both the Red and Yellow insulated conductor, primarily at the contact points with the uninsulated drain wire.

2. Radial examination showed the deformation was not severe enough to reduce the insulation thickness below minimum acceptable (90% nominal).

3. The Red conductor (initially) was bleached to near natural color - off-white.

4. The Aluminum/Mylar shield tape was severly deteriorated. Some residue remained.

Actual, or potential, cause of the fault could not be determined from this examination.

Again, due to concern of mechanical damage during handling from a detailed examination, the two sections of the sample remaining were given a cursory visual examination, with no apparent anomalies.

One section was a three (3) foot active length with the jacket totally removed. The other was a six (6) foot active length with approximately 2 feet of jacket remaining.

The unjacketed sample (3 feet) was wrapped around a 5 inch metal mandrel. This was based upon the diameter of the unjacketed core, rather than the original 11 inches for the jacketed sample. The sample was immersed in room temperature tap water and allowed to soak for 3 hours. Each conductor was tested against the other plus water at ground potential.

TP-4804-C2 (3 ft.)	80v/mil 5 minutes	100v/mil 1 minute
Red	Pass	Pass
Yellow	Pass	Pass

After a 6 hour soak	Insulation Resistance (ohms)
Red	2.8 x 1T
Yellow	2.5 x 1T

The 6 foot section with remaining jacket was wrapped around an 11 inch metal mandrel, immersed in room temperature tap water and allowed to soak for 3 hours. Each conductor was tested as above:

TP-4804-C2 (6 ft.)	80v/mil 5 minutes	100v/mil 1 minute
Red	Pault	-
Yellow	Pass	Pass

The Red conductor faulted immediately upon being energized. Visual examination revealed the fault area near one end where the jacket had been removed. This section was examined under a microscope and revealed a small cut or slit directly adjacent, and extending to the edge of the fault. This damage was obviously caused by a razor blade and occurred during jacket removal. The sample was reterminated, 6 foot active length remaining, and testing was resumed. The sample was allowed to soak for 6 hours.

TP-4804-C2 (6 ft.)	80 v/mil 5 minutes	100 v/mil 1 minute
Red	Pass	Pass
Yellow	Previous Test	-

Insulation Resistance (ohms)	
Red	1.1 x 1T
Yellow	0.9 x 1T

Discussion: Single conductor samples TP-4804-B1,B4,D4 and D5 performed satisfactorily for the 105 Day term, with rated voltage and current applied. Scheduled shutdowns for Insulation Resistance measurements, and unscheduled interruptions as noted, created margin for electrical withstand since such excursions are recognized to be more severe than steady state conditions.

For 101 Days (4 Day - 105 Day), the nominal temperature was above 220 Deg. F vs 200 Deg. F required. This demonstrates considerable added margin in thermal history and highlights the performance of electrical withstand during the profile.

Insulation Resistance measurements remained at satisfactory levels throughout the entire profile.

EPRI Final Report EL-938 indicates a reduction in dielectric strength of XLPE due to temperature increase, of 70 kv/mm @ 30 Deg. C to 40 kv/mm @ 110 deg. C. The faults of these samples at less than 1000 volts @ 25 deg. C is inconsistant with the same samples surviving applied voltage @ 105 deg. C for 105 Days, without an anomaly as the cause.

It is concluded therefore, that the faults which occurred during the first attempted POST LOCA test sequence were the direct result of anomalous mechanical damage to samples TP-4804-B1,B4,D4 and D5. It is further concluded that having successfully completed two 40X Bends followed by 80 v/mil average stress for 5 minutes, 100 v/mil average stress for 1 minute, samples TP-4804-B1,B4,D4, and D5 modified as noted, have passed the test requirements as outlined.

Sample TP-4804-C2 performed satisfactorily for the 105 Day term with rated voltage applied. With the exception of the Insulation Resistance on the Red conductor, the above discussion is valid for this sample also. It is noteworthy that the Red conductor held voltage through the profile, which demonstrates functionability, even though Insulation Resistance measurements in the later stages of the profile were less than the yellow conductor. The Insulation Resistance during the other stages appears to be indicative of the incipient problem. While the cause of the fault was not determined, the fact of the fault cannot be reconciled except by concluding an anomaly existed. All samples were insulated with the same material. The yellow conductor was subject to the identical physical, electrical and environmental parameters without incident. Once the fault was removed, the remaining sections withstood the more than required voltage proof test, with Insultion Resistance measurements comparable to other samples including those which passed POST LOCA without incident.

It is concluded therefore, that the fault which occurred during the first attempted POST LOCA test sequence was either a random fault or the result of undetected mechanical damage.

It is further concluded that having successfully completed two 40 X Bends followed by 80 v/mil average stress for 5 minutes, 100 v/mil average stress for 1 minute, sample TP-4804-C2 has passed the test requirements as outlined.

F. Preliminary Sample Evaluation:

The test plan delineated a conductor resistance measurement at this point. Inadvertantly, it was not accomplished.

Conductor resistance was measured after sample conditioning was complete i.e. post irradiation.

Conductor resistance (metal) is unaffected by either thermal or irradiation conditioning. The point in time of the measurement is therefore insignificant.

G. A condensate drain malfunction occurred during the second day which resulted in a partial vessel fill of liquid. The level was such that the supporting grate was submerged, and was in partial contact with some of the samples. Samples were not completely submerged. The problem was corrected and no further incident occurred.

Under saturated steam conditions, 100% RH exists with either steam or liquid and pressure within the vessel is universal.

The effect of this incident is insignificant.

H. The test plan delineated a change in environmental vessels with an intermediate post LOCA test sequence, at the 30 Day point. Neither was accomplished.

IEEE-323,383 do not require testing at 30 Days. The vessel change was anticipated as a matter of convenience for other tests. Elimination of said activity has no affect upon the test program.

I. The test plan delineated a temperature of 200 degrees F at 0 psig from the 4 Day point to completion. To insure 100% RH and maintain adequate system control, a nominal temperature of 220 degrees F @ 2.7 psig was adopted for this time period. This represents a more severe condition than was required.

J. The schematic for Electrical Connections delineated in the test plan was modified based upon equipment limitations for current sources. The number of samples connected in series for current flow was reduced and additional current sources were incorporated to provide necessary current loads.

The test plan indicated 20 amps for the A and B samples. This was predicated upon the derived requirement for the single conductor A and B samples, which were in series with the multiconductor A sample. As a multiconductor, the derived requirement is 16 amps. The same situation existed for the D samples with appropriate currents of 14 amps and 10 amps.

Schematic revision and the additional current sources allowed appropriate sample loads and, therefore no effect upon the test program.

K. Chemical Spray pH measurements - Refer to discussion of Data Section 6.

L. Sample Electrical Loads - Refer to discussion of Data Section 7.

M. POST LOCA TEST - Refer to discussion of variations at end of POST LOCA TESTS.

Margin

1. Temperature - As described in IEEE Std.-323-1974 Appendix A, the suggested profile, which was adopted, includes margin. The actual profile achieved included further margin by:

   A. Extension to 105 Days.
   B. Nominal Temperature of 220 degrees F after 4 Days.
   C. Thermal excursions as noted.

2. Pressure - The test vessel was charged with saturated steam and followed the pressures and temperatures associated as such. For temperatures above 240 degrees F, pressure was greater than indicated in IEEE Std.-323-1974.

3. Radiation - As described in IEEE Std.-323-1974 Appendix A, the suggested dose for condition testing is 150 megrads which includes the margin. The assumed addition of 50 megrads normal exposure, results in a total dose of 200 megrads which was accomplished.

4. Voltage - Average recorded voltage applied to the samples, exceeds nominal values.

5. Frequency - Voltage and current supplies were derived from local utility power. Nominal 60 Hz.

6. Time - Postulated life of subject cables is 40 years. From Arrhenius data, 941 hours @ 150 degrees C represents 47 year thermal life at a continuous temperature of 90 degrees C.

7. Environmental Transients - In addition to the planned dual transients, several unplanned excursions took place. Their range was not as broad, but represent minor positive margin nonetheless.

8. Vibration - Seismic effects are beyond the scope of this test. The 40 X diameter bend conducted at completion of the profile is intended to demonstrate adequate flexibility. Some samples, as discussed in "Unanticipated Variations," were subjected to two 40 X bends with satisfactory results.

9. POST LOCA Test - In addition to multiple 40 X bends, samples were subjected to dielectric integrity tests beyond a single 80volt/mil 5 minute proof test. As noted, various samples were tested twice, and/or at higher than 80v/mil.

SECTION 1

Q.C. PRODUCTION TESTS

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER TP4804 PURCHASE ORDER N/A SPECIFICATION IEEE-323-1974,IEEE-383-19

SHOP ORDER/ITEM NO 92401-07 PRODUCT CODE E41-0114 CONSTRUCTION 7/C #14 XLPE/NEOPRENE JKT

Cable "A" Samples TP 4804-A1,A2,A3,A4,A5,A6

Insulated Wire — Physical Properties

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min.		1800	2969
Elongation Unaged (%) Min.		250	465
Vertical Flame-Out (Secs.) Max.		60	0
Burning of Indicator (%) Max.		25	0
Air Oven: 168 Hrs. @ 158°C	Tensile % of Unaged Min.	90	93
	Elongation % of Unaged Min.	90	96
Heat Distortion (%) Max.		30	21.9
EM-60 Dielectric Constant Max.		3.5	2.8
1-14 Day SIC Increase (%) Max.		2.5	-.5
7-14 Day SIC Increase (%) Max.		1.5	-1.3
Stability Factor Max.		0.5	.08
Alternate Stability Factor Max.		0.5	.01

Outer Jacket

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min.		1800	2531
Elongation Unaged (%) Min.		300	368
Set (%) Max.		10	6
Air Oven: 168 Hrs. @ 100°C	Tensile % of Unaged Min.	80	99
	Elongation % of Unaged Min.	50	97
Oil Immer: 18 Hrs. @ 121°C	Tensile % of Unaged Min.	75	82
	Elongation % of Unaged Min.	65	114
Tensile Stress 200% Elongation		750	1430
Tear Strength (Lbs./In.) Min.		25	42.8

Cable:
Complies fully with IEEE 383 Class IE as applicable.

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS.

WITNESS Dane Lyn AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM #1

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER: TP 4804 PURCHASE ORDER: N/A SPECIFICATION: IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO: 92401-07 PRODUCT CODE: E41-0114 CONSTRUCTION: 7/C #14 XLPE/NEOPRENE JKT

Cable "A" Samples TP 4804-A1,A2,A3,A4,A5,A6

REEL NUMBER	LENGTH	DIELECTRIC	INSULATION RESISTANCE MIN MEGS/M'	CONDUCTOR RESISTANCE MAX Ohms/M'	MAX O.D	INSULATION		JACKET	
						MIN. WALL	MIN. AVG. WALL	MIN. WALL	MIN. AVG. WALL
REQUIREMENTS	FT.	4.0 kv/ 5 min. c/c c/c	5452	2.78	.509 IN	.027 IN	.030 IN	.036 IN	.045 IN
D40681	1,044 FT	PASSED	33,032	2,67	.545	.030	.033	.043	.061
4A1027									
T-00026	B-01070								

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE AND TYPICAL TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS

WITNESS Diane Lyle AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM 1059

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER TP4804 PURCHASE ORDER N/A SPECIFICATION IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO 92407-06 PRODUCT CODE E41-0112 CONSTRUCTION 7/C #14 XLPE/HYPALON JKT

Cable "B" Samples TP 4804-B1,B2,B3,B4

Insulated Wire — Physical Properties

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min		1800	2786
Elongation Unaged (%) Min		250	447
Vertical Flame-Out (Secs) Max		60	0
Burning of Indicator (%) Max		25	0
Air Oven: 168 Hrs @ 158°C	Tensile % of Unaged Min	90	103
	Elongation % of Unaged Min	90	99
Heat Distortion (%) Max		30	20.7
EM-60 Dielectric Constant Max		3.5	2.8
1-14 Day SIC Increase (%) Max		2.5	-.8
7-14 Day SIC Increase (%) Max		1.5	-.5
Stability Factor Max		0.5	.06
Alternate Stability Factor Max		0.5	.03

Outer Jacket

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min		1800	1983
Elongation Unaged (%) Min		300	313
Set (%) Max		20	10
Air Oven: 168 Hrs @ 100°C	Tensile % of Unaged Min	85	113
	Elongation % of Unaged Min	65	94
Oil Immer: 18 Hrs @ 121°C	Tensile % of Unaged Min.	75	113
	Elongation % of Unaged Min.	75	94
Tensile Stress 200% Elongation		.1000	1585
Tear Strength (Lbs /In) Min		25	30

Cable
Complies fully with IEEE 383 Class IE as applicable.

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS.

WITNESS Diane Lyle AUTHORIZED SIGNATURE P.A. Shaw DATE 4/22/85

FORM --

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER: TP4804 PURCHASE ORDER: N/A SPECIFICATION: IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO: 92407-06 PRODUCT CODE: E41-0112 CONSTRUCTION: 7/C #14 XLPE/HYPALON JKT

Cable "B" Samples TP 4804- B1,B2,B3,B4

REEL NUMBER	LENGTH	DIELECTRIC (AC)	INSULATION RESISTANCE MIN. MEGS/M'	CONDUCTOR RESISTANCE MAX. Ohms/M'	O D	INSULATION		JACKET	
						MIN. WALL	MIN. AVG. WALL	MIN. WALL	MIN. AVG. WALL
REQUIREMENTS	FT	2.5kv/ 5 min.	4788	2.78	.479 IN	.023 IN	.025 IN	.036 IN	.045 IN
D40525	1,346 FT	PASSED	12,168	2.66	.514	.023	.026	.049	.067
4A1026									
T-00104	B-01450								

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE AND TYPICAL TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS

WITNESS Diane Lyn AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM 1252

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER: TP4804 PURCHASE ORDER: N/A SPECIFICATION: IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO: 92401-02 PRODUCT CODE: E41-0102 CONSTRUCTION: 2/C #20 Solid CHrome /Alumel Type KX XLPE/HYPALON JKT

Cable "C" Samples TP 4804-C1, C2

REEL NUMBER	LENGTH	DIELECTRIC (AC)	INSULATION RESISTANCE MIN. MEGS/M'	CONDUCTOR RESISTANCE MAX. Ohms-M'	O D NOM.	INSULATION		JACKET	
						MIN. WALL	MIN. AVG. WALL	MIN. WALL	MIN AVG WALL
REQUIREMENTS	FT.	2.0 kvac 5 min.	7739	N/A	.275 IN	.018 IN	.020 IN	.036 IN	.045 IN
D40526	1,718 FT	PASSED	31,061	N/A	.280	.018	.021	.036	.048
4A1036									
T-00022	B-01740								

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE AND TYPICAL TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS

WITNESS: Diane Lyle AUTHORIZED SIGNATURE: Emily Terry DATE: 4/22/85

FORM 1059

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER TP4804 PURCHASE ORDER N/A SPECIFICATION IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO 92401-02 PRODUCT CODE E41-0102 CONSTRUCTION 1/C #20 Yellow Solid Chrome /Alumel Type KX XLPE/HYPALON JKT

Cable "C" Samples TP4804-C1,C2

Insulated Wire		Physical Properties		Outer Jacket			
		REQUIRED	ACTUAL			REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min.		1800	2678	Tensile Strength Unaged (PSI) Min.		N/A	N/A
Elongation Unaged (%) Min.		250	452	Elongation Unaged (%) Min.			
Vertical Flame-Out (Secs.) Max.		60	0	Set (%) Max.			
Burning of Indicator (%) Max.		25	0	Air Oven:	Tensile % of Unaged Min.		
Air Oven	Tensile % of Unaged Min.	90	112	___Hrs @ ___°C	Elongation % of Unaged Min.		
168 Hrs @ 158°C	Elongation % of Unaged Min.	90	104	Oil Immer:	Tensile % of Unaged Min.		
Heat Distortion (%) Max		30	13.4	___Hrs @ ___°C	Elongation % of Unaged Min.		
EM-60 Dielectric Constant Max.		3.5	2.9	Tensile Stress 200% Elongation			
1-14 Day SIC Increase (%) Max.		2.5	-.6	Tear Strength (Lbs /In.) Min.			
7-14 Day SIC Increase (%) Max.		1.5	-1.6	Cable: Complies fully with IEEE 383 Class IE as applicable.			
Stability Factor Max.		0.5	.03				
Alternate Stability Factor Max.		0.5	.04				

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE AND TYPICAL TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS

WITNESS Diane Tyler AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM 6

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER TP4804 PURCHASE ORDER N/A SPECIFICATION IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO 92401-02 PRODUCT CODE E41-0102 CONSTRUCTION 2/C #20 Solid Chrome /Alumel (RED) Type KX XLPE/HYPALON JKT

Cable "C" Samples TP 4804-C1,C2

Insulated Wire — Physical Properties — Outer Jacket

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min.		1800	2308
Elongation Unaged (%) Min.		250	412
Vertical Flame-Out (Secs) Max.		60	0
Burning of Indicator (%) Max.		25	0
Air Oven: 168 Hrs @ 158°C	Tensile % of Unaged Min.	90	120
	Elongation % of Unaged Min.	90	107
Heat Distortion (%) Max.		30	10,9
EM-60 Dielectric Constant Max.		3.5	3.1
1-14 Day SIC Increase (%) Max.		2.5	1.8
7-14 Day SIC Increase (%) Max.		1.5	.9
Stability Factor Max.		0.5	0.03
Alternate Stability Factor Max.		0.5	0.12

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min.		1800	2550
Elongation Unaged (%) Min.		300	412
Set (%) Max.		20	7
Air Oven: 168 Hrs @ 100°C	Tensile % of Unaged Min.	[illegible]	88
	Elongation % of Unaged Min.	65	93
Oil Immer: 4 Hrs @ 121°C	Tensile % of Unaged Min.	75	94
	Elongation % of Unaged Min.	75	84
Tensile Stress 200% Elongation		1000	1599
Tear Strength (Lbs /In.) Min.		25	36.8

Cable:
Complies fully with IEEE 383 Class IE as applicable.

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE AND TYPICAL TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS

WITNESS Diane Tyler AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM 67

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2148

CERTIFIED TEST REPORT

CUSTOMER: TP4804 PURCHASE ORDER: N/A SPECIFICATION: IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO: 92401-04 PRODUCT CODE: E41-0108 CONSTRUCTION: 2/C #16 XLPE/NEOPRENE JKT

Cable "D" Samlpes TP-4804-D1,D2,D3,D4,D5,D6

REEL NUMBER	LENGTH	DIELECTRIC (AC)	INSULATION RESISTANCE MIN MEGS/M'	CONDUCTOR RESISTANCE MAX Ohms/M'	O D	INSULATION		JACKET	
						MIN WALL	MIN AVG WALL	MIN WALL	MIN AVG WALL
REQUIREMENTS	FT	2.0 kv/ 5 min	4878	4.52	.309 IN	.018 IN	.020 IN	.036 IN	.045 IN
D40558	1,880 FT	PASSED	31,866	4.12	.320	.019	.022	.046	.056
4A1029									
T-00024	B-01904								

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE AND TYPICAL TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS

WITNESS Diane Lyle AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM 1059

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER TP4804 PURCHASE ORDER N/A SPECIFICATION IEEE-323-1974 IEEE-383-1974

SHOP ORDER/ITEM NO 92401-04 PRODUCT CODE E41-0108 CONSTRUCTION 2/C #16 XLPE/NEOPRENE JKT

Cable "D" Samples TP-4804 D1,D2,D3,D4,D5,D6

Insulated Wire		Physical Properties		Outer Jacket			
		REQUIRED	ACTUAL			REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min		1800	2381	Tensile Strength Unaged (PSI) Min		1800	2387
Elongation Unaged (%) Min		250	450	Elongation Unaged (%) Min		300	362
Vertical Flame Out (Secs) Max		60	0	Set (%) Max		10	7.3
Burning of Indicator (%) Max		25	0	Air Oven	Tensile % of Unaged Min	80	98
Air Oven	Tensile % of Unaged Min	90	109	168 Hrs @ 100 °C	Elongation % of Unaged Min	50	74
168 Hrs @ 158°C	Elongation % of Unaged Min	90	100	Oil Immer	Tensile % of Unaged Min	75	86
Heat Distortion (%) Max		30	4.3	10 Hrs @ 121 °C	Elongation % of Unaged Min	65	111
EM-60 Dielectric Constant Max		3.5	2.9	Tensile Stress 200% Elongation		750	1347
1-14 Day SIC Increase (%) Max		2.5	2.2	Tear Strength (Lbs /In) Min		25	43.0
7-14 Day SIC Increase (%) Max		1.5	1.5	Cable			
Stability Factor Max		0.5	0.1	Complies fully with IEEE 383 Class IE as applicable			
Alternate Stability Factor Max		0.5	0.12				

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS.

WITNESS Diane Lyer AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM

THE ROCKBESTOS COMPANY

NEW HAVEN CONNECTICUT 06504 TELEPHONE (203) 772-2250 TELEX 710-465-2149

CERTIFIED TEST REPORT

CUSTOMER TP4804 PURCHASE ORDER N/A SPECIFICATION IEEE-323-1974 IEEE-383-1974

SHOP ORDER ITEM NO 92401-08 PRODUCT CODE E41-0115 CONSTRUCTION 1/C #6 XLPE/FWL III

Cable "E" Samples TP 4804- E1,E2,E3,E4

Insulated Wire — Physical Properties

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min		1800	2251
Elongation Unaged (%) Min		250	378
Air Oven 168 Hrs @ 158°C	Tensile % of Unaged Min	90	99
	Elongation % of Unaged Min	90	93
Heat Distortion (%) Max		30	6.8
EM-60 Dielectric Constant Max		3.5	2.7
1-14 Day SIC Increase (%) Max		2.5	.3
7-14 Day SIC Increase (%) Max		1.5	.3
Stability Factor Max		0.5	.09
Alternate Stability Factor Max		0.5	.01

Outer Jacket

		REQUIRED	ACTUAL
Tensile Strength Unaged (PSI) Min		N/A	N/A
Elongation Unaged (%) Min			
Set (%) Max			
Air Oven ___ Hrs @ ___°C	Tensile % of Unaged Min		
	Elongation % of Unaged Min		
Oil Immer ___ Hrs @ ___°C	Tensile % of Unaged Min		
	Elongation % of Unaged Min		
Tensile Stress 200% Elongation			
Tear Strength (Lbs/In) Min			

Cable
Complies fully with IEEE 383 Class IE as applicable

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS.

WITNESS Dane Lyon AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM ...

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Cable "E" Samples TP 4804-E1,E2,E3,E4

REEL NUMBER	LENGTH	DIELECTRIC (AC)	INSULATION RESISTANCE MIN. MEGS/M'	CONDUCTOR RESISTANCE MAX. Ohms-M'	O.D. NOM	INSULATION		JACKET	
						MIN. WALL	MIN. AVG. WALL	MIN. WALL	MIN. AVG. WALL
REQUIREMENTS	FT.	5.5 kv/ 5 min.	3553	N/A	.283 IN	.041 IN	.045 IN	N/A IN	N/A IN
54566	3,300 FT	PASSED	10,461	N/A	.287	.044	.049	N/A	N/A

IT IS HEREBY CERTIFIED THAT THE FOREGOING IS TRUE AND TYPICAL TEST DATA AND THAT THE ABOVE CABLE MEETS APPLICABLE REQUIREMENTS OF PROCUREMENT DOCUMENTS

WITNESS Diane Tyler AUTHORIZED SIGNATURE Emily Terry DATE 4/22/85

FORM 1059

DATA SECTION 2

12.1 PRELIMINARY SAMPLE EVALUATION

All samples were examined visually with no apparent anomalies.

After completion of the visual examination, the samples were subjected to an electrical evaluation which included:

A. Measurement of conductor continuity.

B. Measurement of Insulation Resistance. This test was conducted per ICEA S-66-524. For single conductor samples, the procedure was as follows:

1. Place specimens in room temperature water with 10 feet of wire submerged.

2. Allow to soak for a minimum of 1 hour.

3. Measure Insulation Resistance at 500 Vdc negative, the conductor energized, and the water at ground potential.

4. Measurements were recorded after the sample was energized for one minute.

For thermocouple and Instrumentation cable the procedure was as follows:

1. Measure Insulation Resistance at 500 Vdc negative on a full length.

2. Each insulated conductor was measured individually.

3. The other insulated conductor and shield drain wire at ground potential.

4. Measurements recorded after insulated conductor was energized for one minute.

For multi-conductor jacketed cable the procedure was as follows:

1. Measure Insulation Resistance at 500 Vdc negative on a full length.

2. Each insulated conductor was measured individually.

3. All other insulated conductors were at ground potential during measurement.

4. Measurements after each insulated conductor was energized for one minute.

12.2 Criteria

As a minimum, the measurements when converted, shall exceed the Insulation Resistance Constant required in ICEA S-66-524 for cross-linked polyethylene. Per paragraph 3.6.2.2 (Second Edition 1983), the requirement is 10,000 minimum at a temperature of 15.6 degrees C (60 degrees F). The Constant (K) is calculated as follows:

$$K = \frac{IR \text{ @ } 15.6 \text{ Degrees C}}{\text{Log (D/d)}}$$

Log (Base 10)

where K = Insulation Resistance Constant

IR = Measured Resistance converted to a 1,000 ft. basis

D = Diameter over single conductor insulation

d = Diameter over metal conductor

Sample #	Sample Length	Sample #	Sample Length
TP-4804-A1	14 Ft. 4 In.	TP-4804-C1	15 Ft. 0 In.
A2	14 Ft. 4 In.	C2	14 Ft. 7 In.
A3	14 Ft. 9 In.	D1	14 Ft. 6 In.
A4	14 Ft. 10 In.	D2	14 Ft. 6 In.
A5	14 Ft. 11 In.	D3	14 Ft. 7 In.
A6	15 Ft. 1 In.	D4	14 Ft. 7 In.
B1	14 Ft. 9 In.	D5	14 Ft. 11 In.
B2	14 Ft. 9 In.	D6	14 Ft. 11 In.
B3	15 Ft. 1 In.	E1	14 Ft. 11 In.
B4	15 Ft. 1 In.	E2	15 Ft. 0 In.
		E3	15 Ft. 0 In.
		E4	14 Ft. 11 In.

12.3 RESULTS

Sample #	Continuity	Insul. Resis. @ 70 Deg. F Measured Megohms - 1,000'	Constant (K) @ 15.6 Deg C	Sample Status
TP-4804-A1				Pass
1-One	Pass	2.5×10^6 Mohms	36,000	262,000
2-Two	Pass	3.0×10^6 Mohms	40,000	289,000
3-Three	Pass	3.0×10^6 Mohms	43,000	303,000
4-Four	Pass	2.8×10^6 Mohms	40,000	291,000
5-Five	Pass	2.9×10^6 Mohms	42,000	299,000
6-Six	Pass	2.9×10^6 Mohms	42,000	303,000
7-Seven	Pass	3.0×10^6 Mohms	43,000	303,000

Sample #	Continuity	Insul. Resis. @ 70 Deg. F Measured Megohms - 1,000'	Constant (K) @ 15.6 Deg C	Sample Status
TP-4804-A2				Pass
1-One	Pass	2.6×10^6 Mohms 37,000	269,000	
2-Two	Pass	2.6×10^6 Mohms 37,000	265,000	
3-Three	Pass	3.1×10^6 Mohms 45,000	319,000	
4-Four	Pass	2.7×10^6 Mohms 39,000	281,000	
5-Five	Pass	2.8×10^6 Mohms 40,000	291,000	
6-Six	Pass	2.6×10^6 Mohms 37,000	269,000	
7-Seven	Pass	3.0×10^6 Mohms 43,000	315,000	
TP-4804-A3	Pass	2.6×10^6 Mohms 26,000	187,000	Pass
TP-4804-A4	Pass	2.3×10^6 Mohms 23,000	167,000	Pass
TP-4804-A5	Pass	2.7×10^6 Mohms 27,000	195,000	Pass
TP-4804-A6	Pass	2.2×10^6 Mohms 22,000	159,000	Pass
TP-4804-B1	Pass	2.1×10^6 Mohms 21,000	179,000	Pass
TP-4804-B2	Pass	2.3×10^6 Mohms 23,000	189,000	Pass
TP-4804-B3	Pass	1.8×10^6 Mohms 18,000	149,000	Pass
TP-4804-B4	Pass	2.3×10^6 Mohms 23,000	197,000	Pass
TP-4804-C1				Pass
Chromel	Pass	2.2×10^6 Mohms 33,000	167,000	
Alumel	Pass	1.2×10^6 Mohms 18,000	92,000	
TP-4804-C2				Pass
Chromel	Pass	2.4×10^6 Mohms 35,000	185,000	
Alumel	Pass	1.15×10^6 Mohms 17,000	84,000	
TP-4804-D1				Pass
1-One	Pass	1.6×10^6 Mohms 23,000	177,000	
2-Two	Pass	1.8×10^6 Mohms 26,000	204,000	

Sample #	Continuity	Insul. Resis. @ 70 Deg. F Megohms - 1,000' Measured		Constant (K) @ 15.6 Deg C	Sample Status
TP-4804-D2					Pass
1-One	Pass	1.6×10^6 Mohms	23,000	177,000	
2-Two	Pass	1.7×10^6 Mohms	25,000	193,000	
TP-4804-D3	Pass	2.4×10^6 Mohms	24,000	181,000	Pass
TP-4804-D4	Pass	2.3×10^6 Mohms	23,000	179,000	Pass
TP-4804-D5	Pass	2.4×10^6 Mohms	24,000	187,000	Pass
TP-4804-D6	Pass	2.5×10^6 Mohms	25,000	191,000	Pass
TP-4804-E1	Pass	3.7×10^6 Mohms	37,000	384,000	Pass
TP-4804-E2	Pass	3.7×10^6 Mohms	37,000	368,000	Pass
TP-4804-E3	Pass	3.8×10^6 Mohms	38,000	378,000	Pass
TP-4804-E4	Pass	3.5×10^6 Mohms	35,000	360,000	Pass

NOTE: K calculated on basis of 1.97 correction factor for Insulation Resistance corrected from 70 degrees F to 60 degrees F (15.6 degrees C).

12.4 SAMPLE CONDITIONING

Data Section 3

Arrhenius Data

(Thermal Aging Characteristic)

Calcultion of Arrhenius regression line based on 60% retention of elongation after air oven aging.

The equation has the form, Ref. IEEE-101A-1974,

$$\text{Life (hours)} = A \exp B/T$$

or

$$\ln(\text{hours}) = \ln A + B/T$$

A. For FW III Chemically Cross-Linked Insulation, KXL-760D there are three data points:

Hours	Temperature Deg. C	ln Hours	Recip Abs Temp (1/Deg K x 1000)
825	150	6.7153	2.3641
4300	136	8.3663	2.4450
12600	121	9.4414	2.5381

Linear regression analysis results:

Slope (B) = 15564.38
Intercept (ln A) = 29.9439
Correlation Coefficient = .9866

Calculated regression point temp. for 40 years = 91.4 Deg. C
Calculated regression point temp. for 100 hours = 177.5 Deg. C
Activation Energy = 1.3412 eV

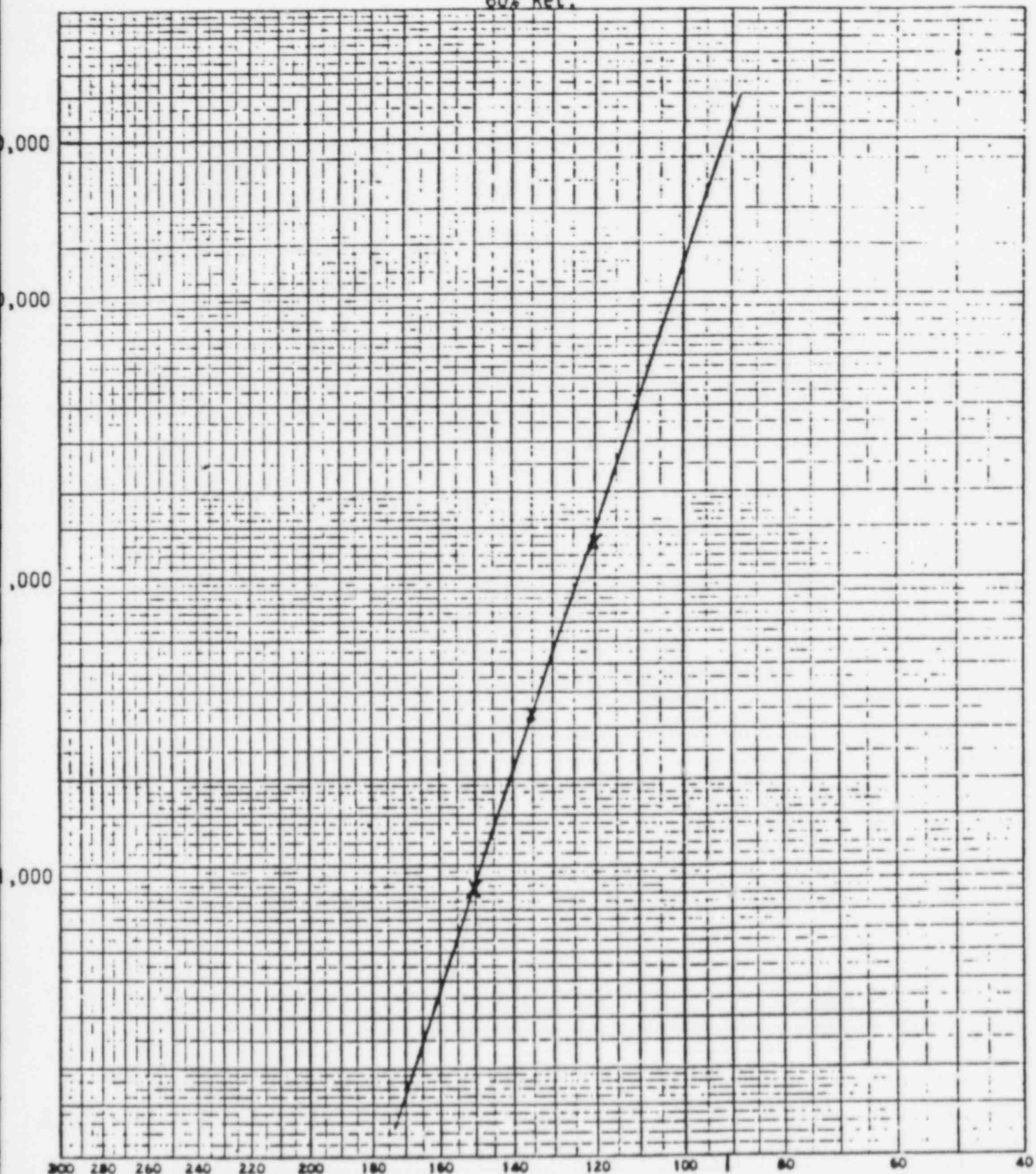
941 hours aging @ 150 Deg. C represents 412,000 hours, or 47 years at a 90 Degree C service temperature.

QR-5804

KXL-760D

$Lny = 15{,}564\ (\frac{1}{k}) - 29.9439$

60% Ret.



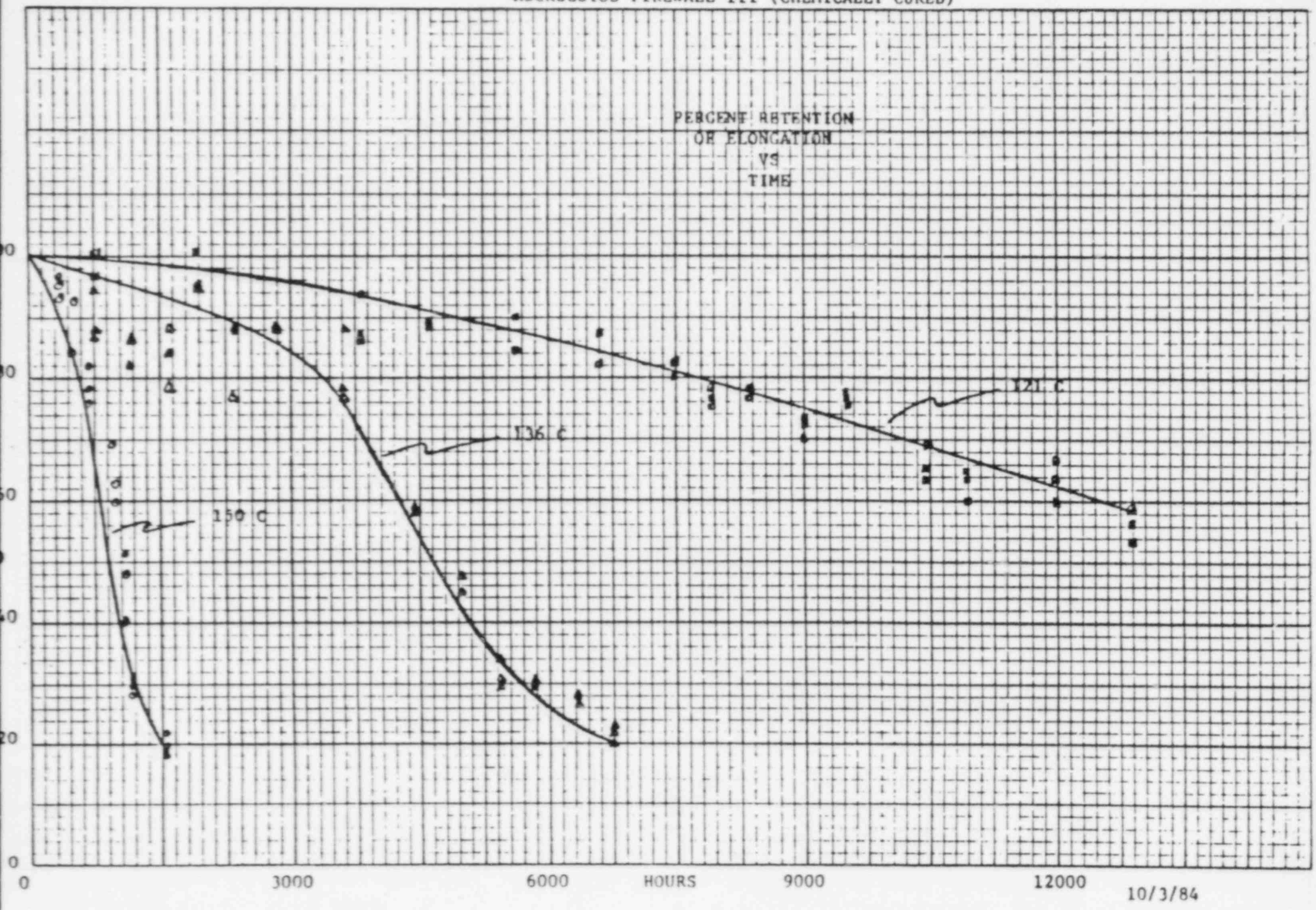
10/3/84

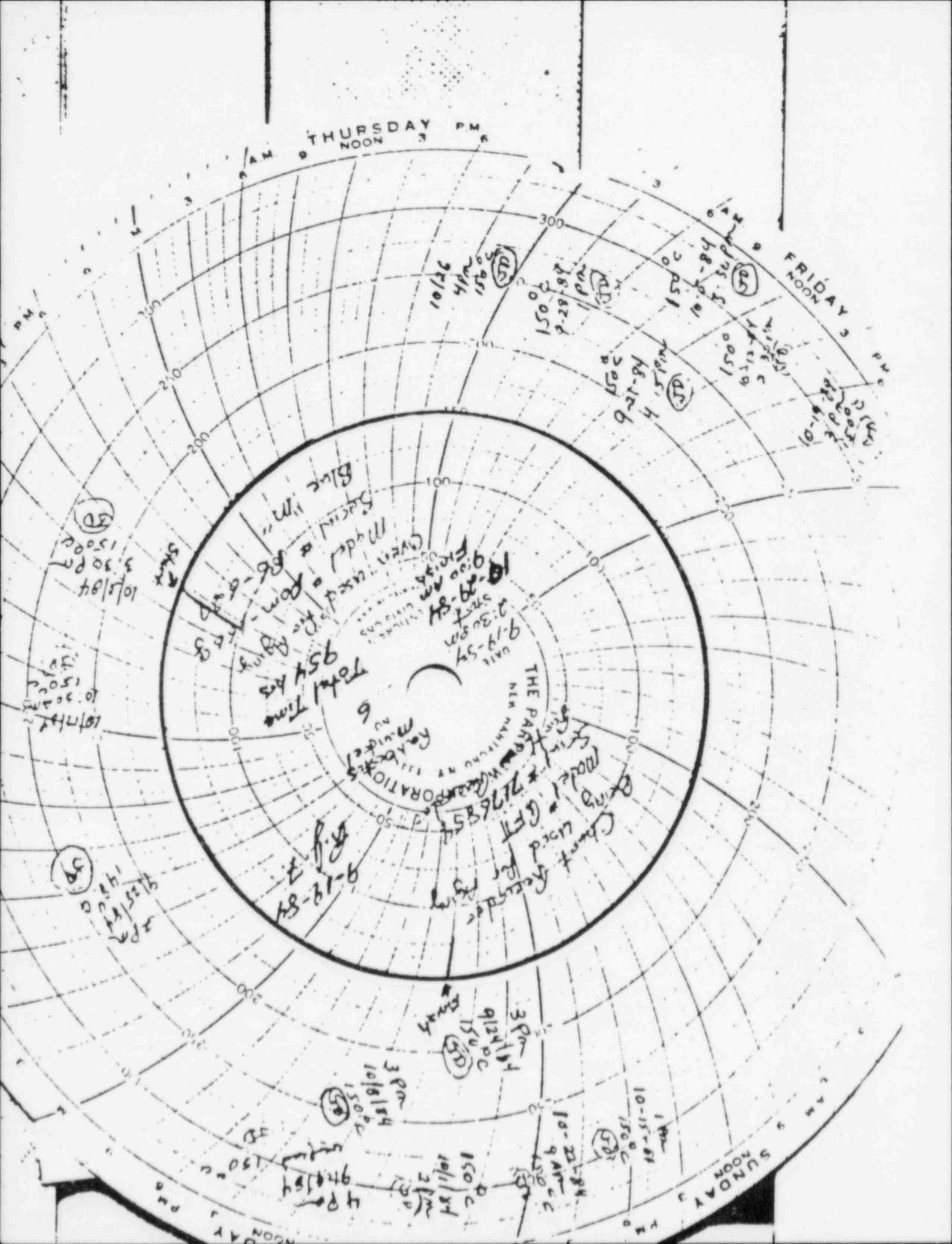
°C ($\frac{1}{K}$ SCALE)

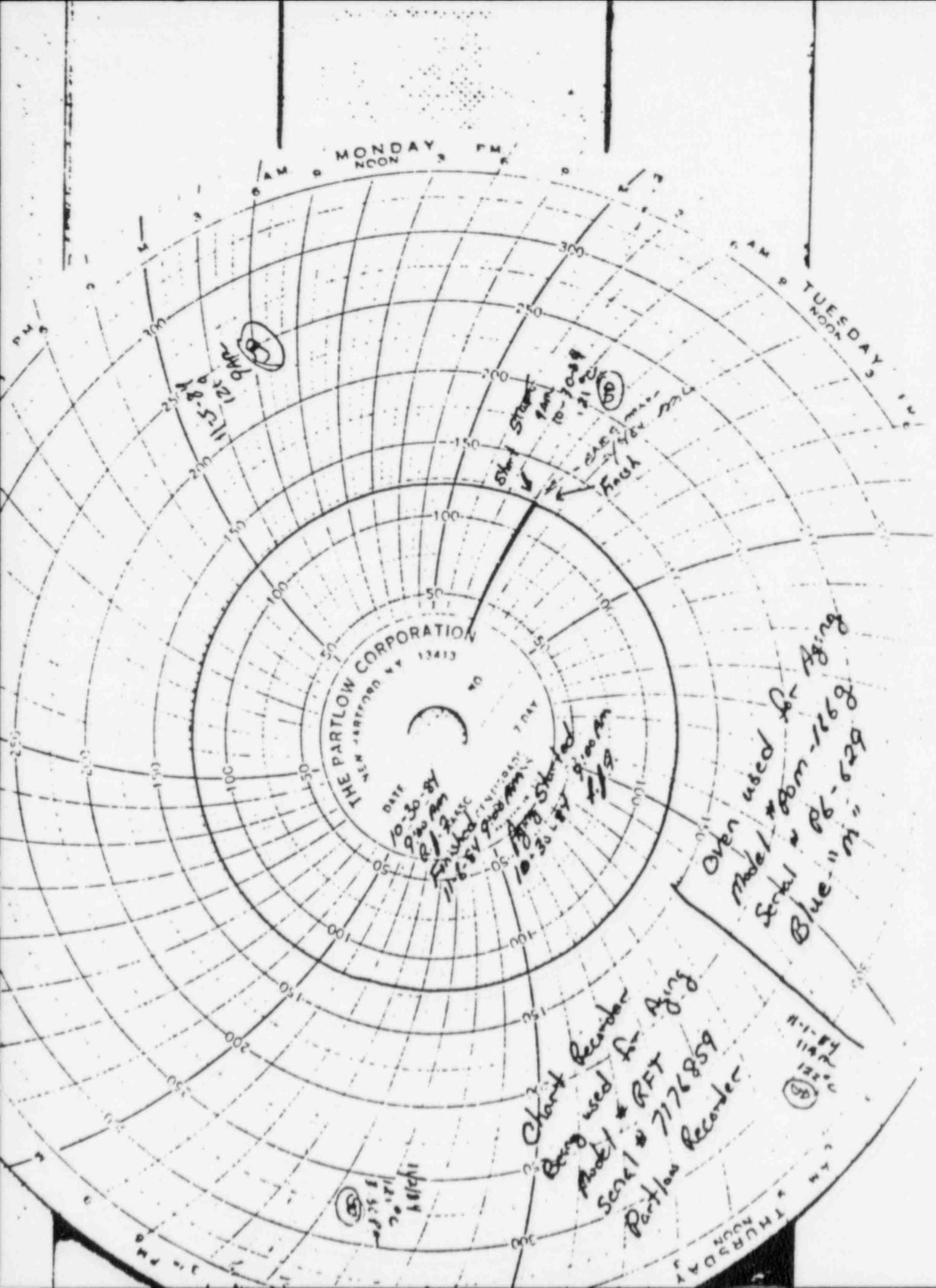
KXL-760D

QR-5804.

ROCKBESTOS FIREWALL^{R} III (CHEMICALLY CURED)




THURSDAY
NOON
A.M.
P.M.
FRIDAY
SUNDAY
300
200
100
50
THE PARTLOW CORPORATION
Total Time
954 hrs


MONDAY
NOON
TUESDAY
THURSDAY
THE PARTLOW CORPORATION
NEW HARTFORD NY 13413
DATE
7 DAY
Oven used for Aging
Model # 6am-1168
Serial # 86-629
Blue - "M"
Chart Recorder
Being used for Aging
Model # RFT
Serial # 7176859
Partlow Recorder

ISOMEDIX

Cerock Wire and Cable Group Inc
285 Nicoll St
P.O. Drawer 1102
New Haven, Conn 06504

Att: Mr Jim Morganelli

Dear Mr. Morganelli:

This will summarize parameters pertinent to the irradiation of one (1) Mandrel with Wire Samples as per your Purchase Order No. 13914 NH dated 11/7/84.

The Mandrel was exposed to a Cobalt-60 gamma field for a period of 427.6 hours at an average dose rate of .47 megarads per hour. The calculated dose based on dosimetry was 200.97 megarads.

The coils were exposed at each of four(4) quadrants. By integrating the dose rate at any point on the mandrels during the four-position exposure , an average dose rate was obtained which, when multiplied by the total exposure time, yields total dose.

Dosimetry was performed using Harwell Red 4034 Perspex dosimeters (Batch Y) utilizing a Bausch and Lomb Model 710 spectrophotometer as ~~the readout instrument. This system is calibrated~~ traceable to NBS with the last calibration date being July 10, 1984. A copy of the dosimetry correlation report is available upon request.

Irradiation was conducted in air at ambient temperature and pressure. Radiant heat from the source heated the samples somewhat, but the temperature did not exceed 110° degrees Fahrenheit as indicated by previous measurements of an oil solution in the same relative position.

Irradiaton was initiated on 11-15-~~85~~ 84 and completed on 12-12-84.

Paid 6/3/85

Very truly yours,

Eric Haft
Production Manager

SECTION 4 - LOCA CHAMBER DESCRIPTION

DATA SECTION 4

LOCA CHAMBER CONFIGURATION

The autoclave chamber is a horizontal jacketed pressure chamber 36 inches in diameter by 54 inches long at the crown.

The test sample area is controlled by a Robertshaw Controller with the sensing element located midway along the top of the vessel and penetrates approximately 12 inches. The steam inlet is at the far end of the top of the vessel and is not in direct line with the controller sensing element. The spray nozzles are arranged in two lines parallel to the lengths of the vessel and are directed downward.

Samples are supported by a perforated metal grate located approximately 1 foot from the bottom of the chamber. The grating represents a horizontal plane surface area of 8 sq. ft..

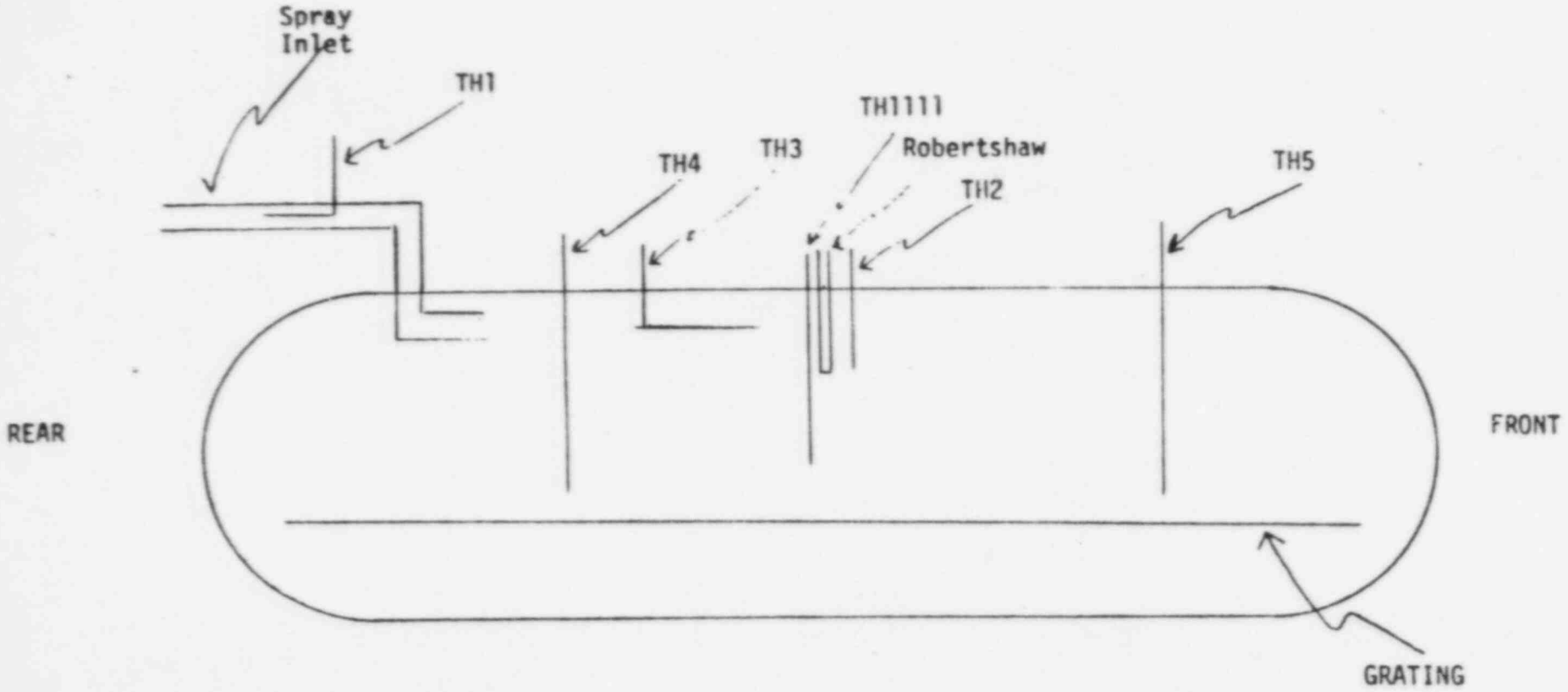
Thermocouples are positioned in the vessel to monitor temperature transients and steady state temperature.

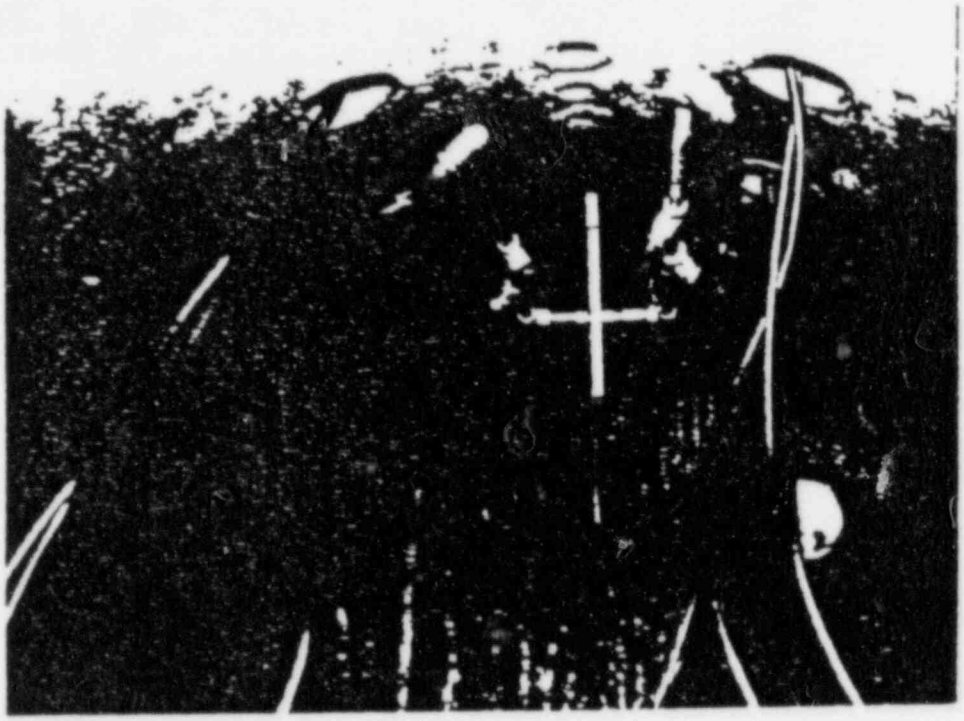
A pressure transducer is mounted in a vessel penetration to monitor pressure.

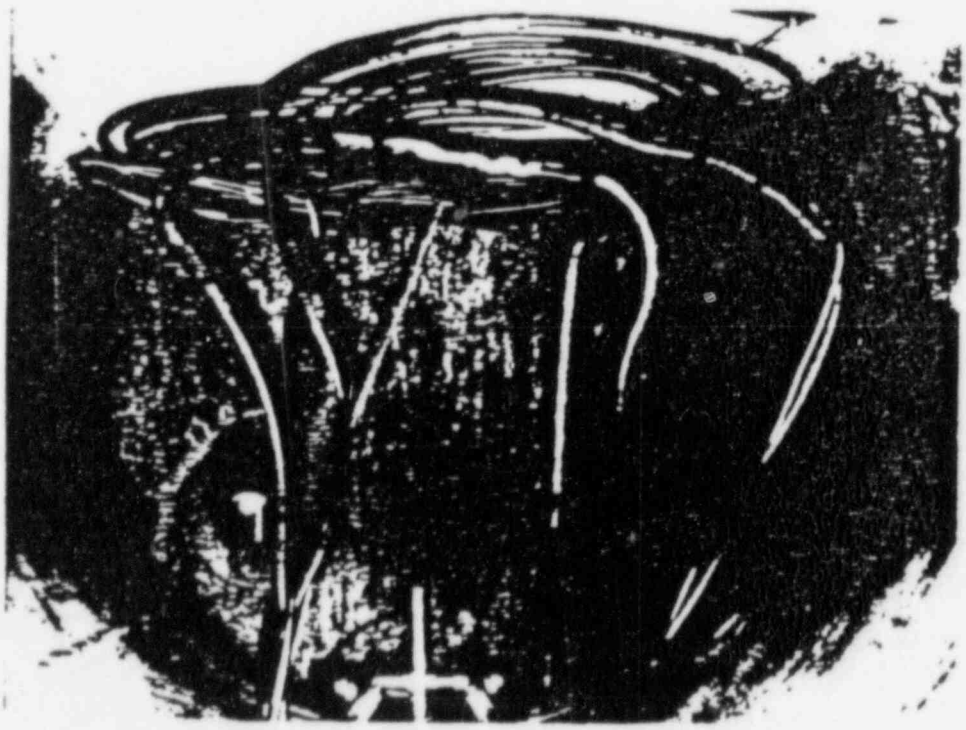
A Doppler effect ultrasonic flowmeter is attached to the input side of the spray system to monitor spray flow rate.

Channel #	Serial #	Location
1	TH1	Spray Inlet Line
2	TH2	Next to Robertshaw controlling bulb, middle, top
3	TH3	Middle, top, out of spray
4	TH4	Near Cables, rear
5	TH5	Near Cables, front
-	TH1111	Approximate Middle, separately recorded for peak transients

Robertshaw bulb is used for controlling environmental conditions within the vessel only. It is not intended to be, or used as, data aquisition instrument. However, the chart serves as a useful summary of events.







SECTION 5 - POST CONDITIONING EVALUATION

DATA SECTION 5

POST CONDITIONING EVALUATION

Upon completion of the irradiation conditioning portion of the test program, a visual and electrical evaluation was made to determine sample integrity prior to the LOCA environmental exposure.

During the visual examination, a variety of conditions were identified with different degrees. For reference, the following "Condition Code" table will be utilized. The degree of the condition will be identified as "minimal," "moderate," or "extensive".

Condition Code	Description
I	Indents - A condition found on the sample surface which creates an impression toward the metal conductor and is a deformation of the material's tubular configuration by another tubular shape. The estimated dimension of the indents are 1/8" wide with a 4-8 mil penetration toward the conductor, basically perpendicular to the conductor. Probable Cause - Deformation where sample was supported on mandrel by the hooks mounted in the mandrel support rods. The heat during thermal aging, softened the insulation which then deformed due to sample weight upon individual hook supports.
C	Discoloration - Burned brown in color against the sample. Surface condition. Patch-like appearance, 1/4 -3/8", 45 degrees to 180 degrees around circumferance of sample. Close examination reveals a fabric like structure. Probable Cause - Binder tape residue which oxidized during thermal aging.
W	Water Marks - Small shiney areas. Probable Cause - Clinging water droplets during the cure process which restricts direct steam contact in that area.

F — Faded Print - Reduced print definition from normal bright contrast between print ink and insulation. Probable Cause - Degradation of ink components by aging.

D — Deformation - Similar to indents, traverses along the longitudinal axis of the sample. Appears more as flat spot 1/8" wide. Sporadic, appears for 1"-3", then disappears for 2-3". Probable Cause - Minor deformation from adjacent cabled conductors when jacket was cured. Heat of jacket cure process causes some insulation softening, with residual cable tension, develops minor axial compression.

S — Striations - A series of small, parallel, ridges spiraling in the longitudinal direction, on the insulation surface. Appear for 1-1.5", with 3-5" of unblemished length between. Probable Cause - Minor deformation from uninsulated drain wire. Jacket cure process heat causes some insulation softening with residual cable tension, develops minor axial compression.

Visual Evaluation:

Sample #	Condition Code	Degree
TP-4804-A1	I	Minimal
A2	I	Minimal
A3	F, I, C, W, D	I Moderate, others minimal
A4	F, I, C, W, D	I Extensive, others minimal
A5	D	Minimal
A6	D	Minimal
TP-4804-B1	F, I, D	Minimal
B2	F, I, D	I Moderate, others minimal
B3	I	Minimal
B4	I	Minimal
TP-480[illegible]1	I	Minimal
C2	I	Minimal
TP-4804-D1	I	Minimal
D2	I	Minimal
D3	I, S, F	Minimal
D4	I, S, F	Minimal
D5	S	Minimal
D6	S	Minimal

Sample #	Condition Code	Degree
TP-4804-E1	F, I	Minimal
E2	F, I	I Moderate
E3	None	- - - -
E4	None	- - - -

ELECTRICAL EVALUATION

This evaluation consisted of the following:

A. Measurement of Insulation Resistance conducted per ICEA S-66-524. For single conductor samples, the procedure was as follows:

1. Place specimens in room temperature tap water with 10 feet of wire submerged.

2. Allow to soak a minimum of 1 hour.

3. Measure Insulation Resistance at 500 Vdc negative. The conductor was energized and the water at ground potential.

4. Measurements were recorded after the sample had been energized for one minute.

For thermocouple and Instrumentation cable this procedure was as follows:

1. Measure Insulation Resistance at 500 Vdc negative on a nominal 15 foot length.

2. Each insulated conductor was measured individually.

3. The other insulated conductor and shield drain wire were at ground potential.

4. Measurements were recorded after insulated conductor has been energized for one minute.

For multi-conductor jacket cable the procedure was as follows:

1. Measure Insulation Resistance at 500 Vdc negative on a nominal 15 foot length.

2. Each insulated conductor was measured individually.

3. All other insulated conductors were at ground potential during measurement.

4. Measurements were recorded after each insulated conductor had been energized for one minute.

B. Dielectric Proof Test - Immediately following the Insulation Resistance measurement, all samples were subjected to 80 v/mil RMS stress for 1 minute utilizing the same electrical connection configuration as IR. Nominal thickness was utilized.

C. Conductor Resistance Measurement - Using a "Kelvin" bridge, connect leads to opposite ends of the sample metal conductor. Insure good electrical contact between metal conductor and test leads. Adjust the bridge for balance and record measured resistance. Record temperature at time of measurement.

For sample Nos. TP-4804-A1, A2, it was determined that conductor Nos. 2, 4, and 6 would be energized during the environmental exposure,with the remaining conductors at ground potential. Therefore, #2, #4, and #6 were tested in this evaluation.

Sample	Insultn. Resis. Megohms 1000 Ft.	K	80v/mil Withstand Volts	1 Min.	Conductor Resis. (@ RT) Ohms/1000'
TP-4804-A1					
#2	1230	14,300	2400	Pass	2.70
#4	1200	14,100	2400	Pass	2.71
#6	1200	13,950	2400	Pass	2.68
TP-4804-A2					
#2	940	10,800	2400	Pass	2.67
#4	970	11,280	2400	Pass	2.67
#6	1000	11,600	2400	Pass	2.65
TP-4804-A3	2200	22,200	2500	Pass	2.58
A4	2000	20,400	2500	Pass	2.57
A5	600	6,070	2500	Pass	2.56
A6	620	6,340	2500	Pass	2.57
TP-4804-B1	1700	20,490	2000	Pass	2.57
B2	1300	14,980	2000	Pass	2.60
B3	450	5,260	2000	Pass	2.58
B4	500	6,020	2000	Pass	2.58
TP-4804-C1 (Alumel)					
Red (Chromel)	540	4,420	1600	Pass	168.7
Yellow	600	4,980	1600	Pass	414.8
Red & Yellow	300	- -	- -	- -	- -
TP-4804-C2					
Red	510	4,370	1600	Pass	169.3
Yellow	580	4,750	1600	Pass	418.5
Red & Yellow	290	- -	- -	- -	- -
TP-4804-D1					
#1	370	4,570	1600	Pass	4.18
#2	400	5,100	1600	Pass	4.21
#1 & #2	220	- -	- -	- -	- -
TP-4804-D2					
#1	590	7,280	1600	Pass	4.16
#2	580	7,160	1600	Pass	4.21
#1 & #2	350	- -	- -	- -	- -

Sample	Insultn. Resis. Megohms 1000 Ft.	K	80v/mil Withstand Volts	1 Min.	Conductor Resis. (@ RT) Ohms/1000'
TP-4804-D3	1800	19,050	1600	Pass	4.10
D4	1800	19,680	1600	Pass	4.05
D5	450	4,920	1600	Pass	4.05
D6	500	5,370	1600	Pass	4.07
TP-4804-E1	940	13,690	3600	Pass	.404
E2	960	13,440	3600	Pass	.396
E3	440	6,160	3600	Pass	.400
E4	440	6,350	3600	Pass	.407

Note: Electrical measurements for single conductor samples were taken at 24 degrees C ambient. Electrical measurements for multi-conductor samples were taken at 25 degrees C ambient.

Calculation of K was based upon the correction factors of unconditioned insulation for comparison with the unconditioned results. For measurements made at 24 degrees C, K was calculated on the basis of 2.76 correction factor for Insulation Resistance corrected from 24 degrees to 15.6 degrees C. For measurements made at 25 degrees C, K was calculated on the basis of 3.17 correction factor for Insulation Resistance from 25 degrees C. to 15.6 degrees C. Refer to Unanticipated Variations, Part A. Sample Selection Based Upon Above Evaluation:

Sample TP-4804-A1 or A2 - A1 was chosen on a random basis. There was virtually no discernable difference in the visual examination. Although minor differences are apparent in the electrical evaluation, they are negligible from a practical standpoint.

Sample TP-4804-A3 or A4 - A3 was chosen on the basis of the visual examination. A3 had the larger number of minor indents, but A4 contained one indent which was considered severe, and potentially could cause a fault. Again, the minor electrical differences are not considered significant.

Sample TP-4804-A5 or A6 - A5 was chosen on a random basis. (See A1)

Sample TP-4804-B1 oR B2 - B1 was chosen on the basis of the visual examination. Indents in B2 were more severe.

Sample TP-4804-B3 or B4 - B4 was chosen on a random basis. (See A1)

Sample TP-4804-C1 or C2 - C2 was chosen on a random basis. (See A1)

Sample TP-4804-D1 or D2 - D2 was chosen on a random basis. (See A1)

Sample TP-4804-D3 or D4 - D4 was chosen on a random basis. (See A1)

Sample TP-4804-D5 or D6 - D5 was chosen on a random basis. (See A1)

Sample TP-4804-E1 or E2 - E1 was chosen on the basis of the visual examination. Indents on E2 were more severe.

Sample TP-4804-E3 or E4 - E3 was chosen on a random basis. (See A1)

SECTION 6 AND 7 DATA LOGGER CHANNEL REFERENCE

Channel No.	Measured Parameter
1	Chemical Spray Temperature (Deg. F)
2	Chamber Temperature - Center (Deg. F)
3	Chamber Temperature - Top/Center (Deg. F)
4	Chamber Temperature - Bottom/Back (Deg. F)
5	Chamber Temperature - Bottom/Front (Deg. F)
6	Average Channel 2,3,4,5 (Deg. F)
7	Nominal 300 VAC Voltage Applied - Sample TP-4804-C2,D4,D5
8	Nominal 14 AC Amperes Applied - Sample TP-4804-D4,D5
9	Not Used
10	Nominal 600VAC Voltage Applied - Sample TP-4804-A1,A3,A5, B1,B4,E1,E3
11	Nominal 20 AC Amperes Applied - Sample TP-4804-A3,A5,B1,B4
12	Not Used
13	Nominal 300VAC Voltage Applied - Sample TP-4804-D2
14	Nominal 10 AC Amperes Applied - Sample TP-4804-D2
15	Not Used
16	Not Used
17	Nominal 61 AC Amperes Applied - Sample TP-4804-E1,E3
18	Not Used
19	Not Used
20	Nominal 16 AC Amperes Applied - Sample TP-4804-A1, Cndr. #4,6
21	Not Used
22	Not Used
23	Not Used
24	Not Used
25	Nominal 1.2 Chemical Spray Flow Rate (GPM)
26	Chemical Spray pH
27	Chamber Pressure (psig)

Chart Speed 20.0 cm/hour; Initial to 27 hours

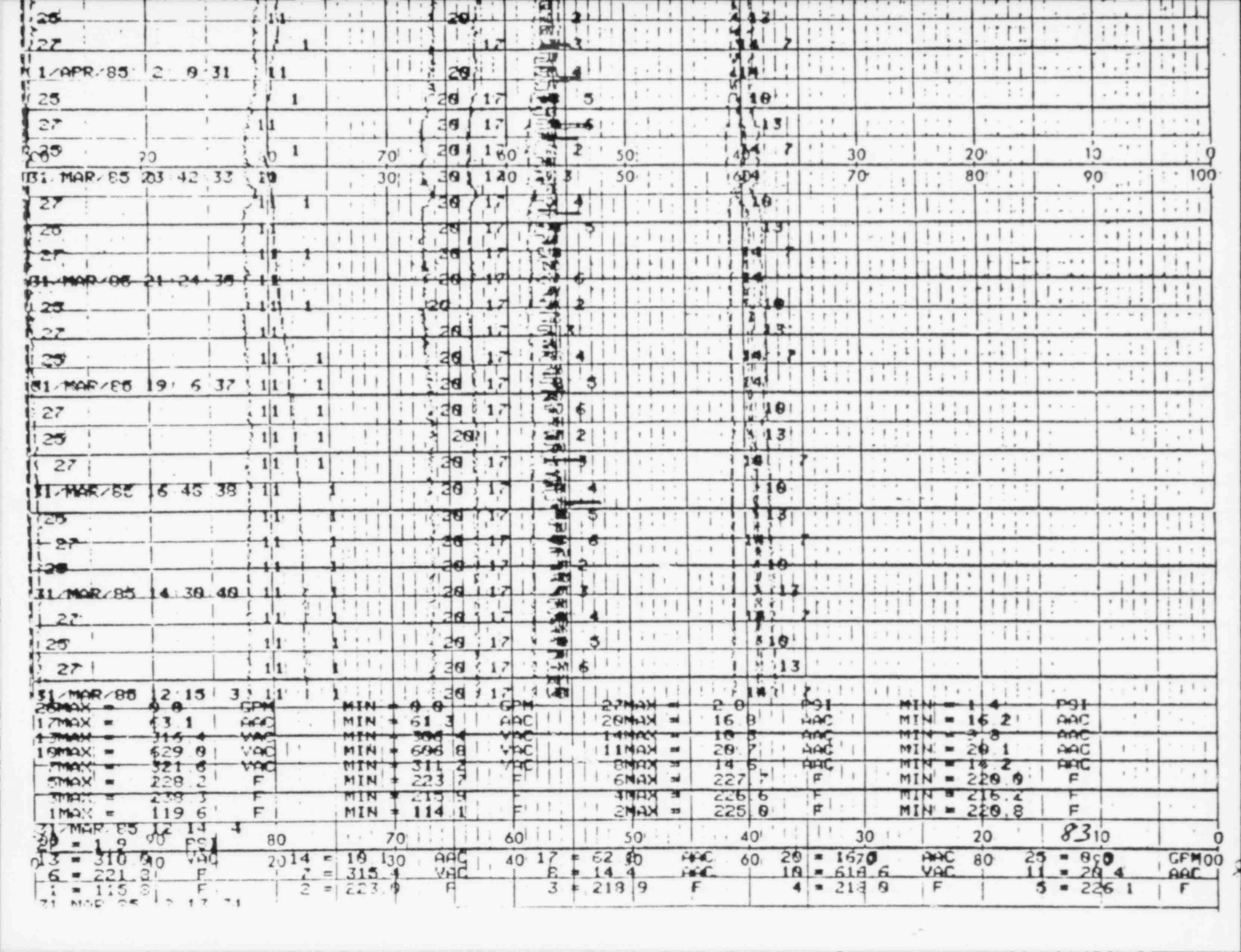
Chart Speed 5.0 cm/hour; 28 hours to 102 hours

Chart Speed 1.0 cm/hour; 103 hours to 105 Days

Instantaneous Value Print 1 cycle/hour; Initial to 102 hours

Instantaneous Value Print 1 cycle/24 hour; 103 hours to 105 Days

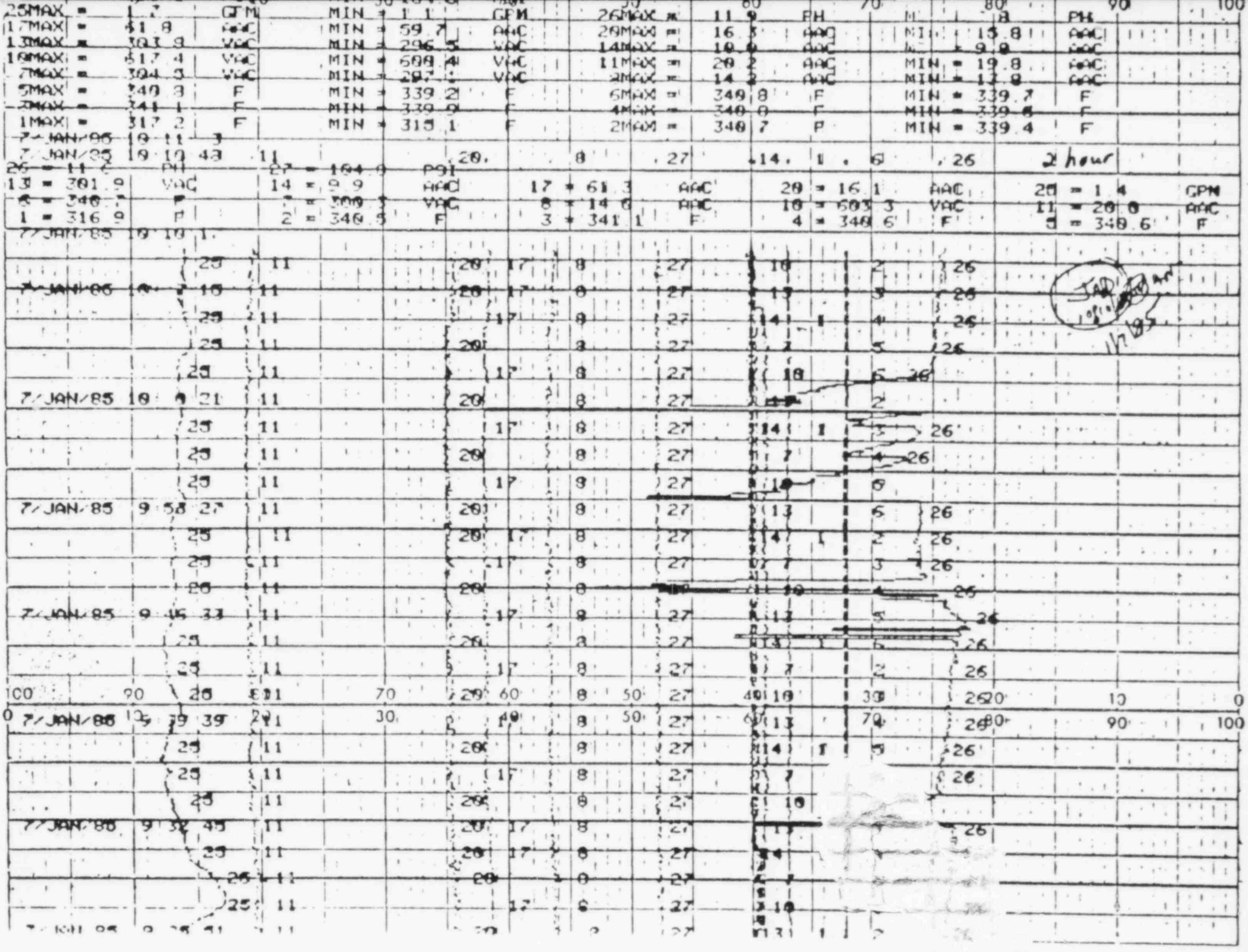
Trend line print; continuous between print cycles



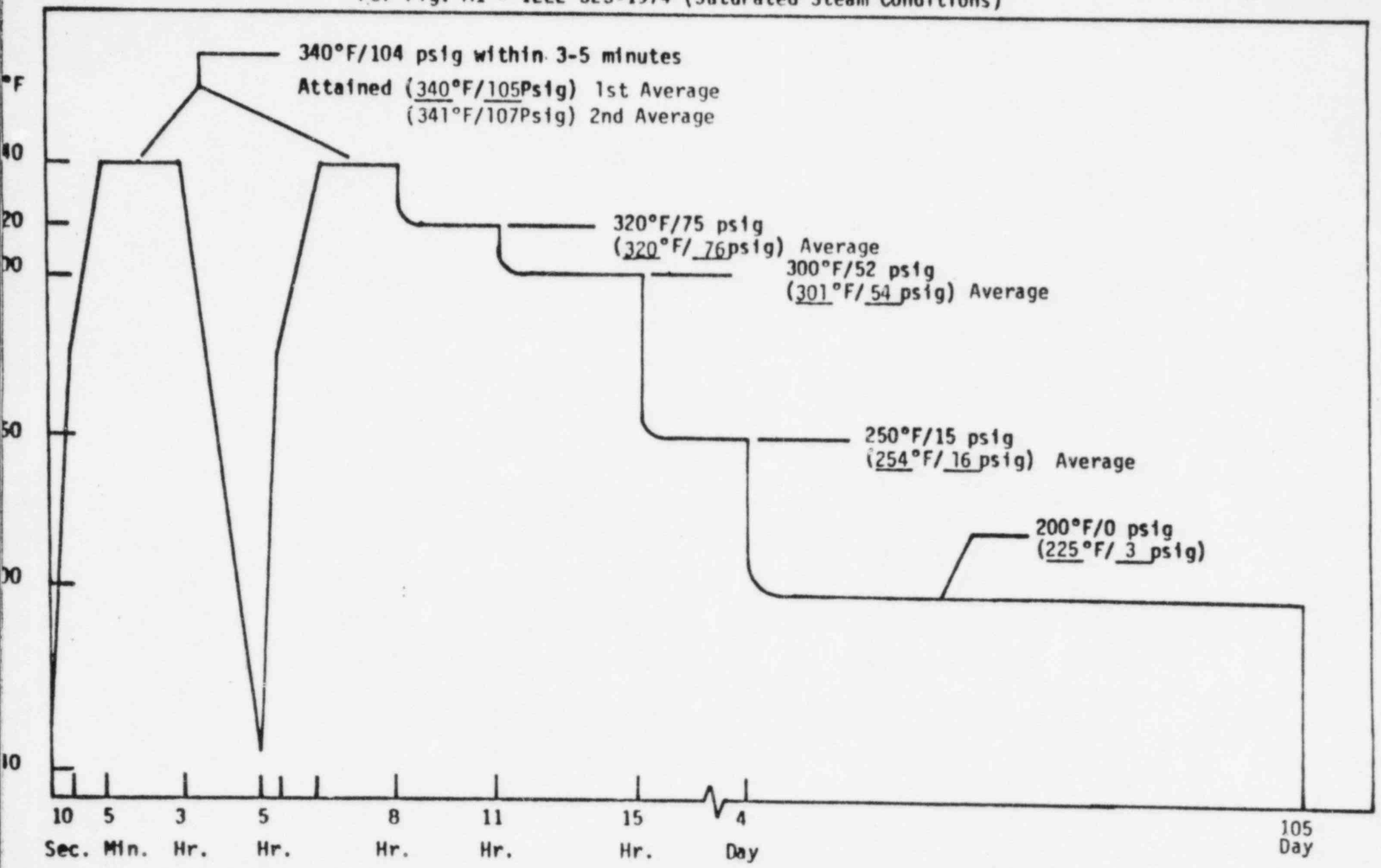
```
20    27    11    20    3    10
20    27    11    17    8    13
8/JAN/85  17 4 20    11    20    8    12    3    14
25    27    11    17    8    2    3    7
20    27    11    20    3    4    3    10
20    27    11    20    17    8    13
8/JAN/85  16:37 29    11    20    17    8    6    3    14
25MAX =    0.0    GPM    MIN = 0.0    GPM    27MAX =    16.0    PSI    MIN = 16.7    PSI
17MAX =    61.5    AAC    MIN = 60.8    AAC    20MAX =    16.3    AAC    MIN = 16.0    AAC
13MAX =    303.6    VAC    MIN = 300.3    VAC    14MAX =    10.0    AAC    MIN = 9.9    AAC
10MAX =    607.0    VAC    MIN = 598.4    VAC    11MAX =    20.1    AAC    MIN = 19.8    AAC
7MAX =    303.8    VAC    MIN = 300.1    VAC    8MAX =    14.1    AAC    MIN = 13.9    AAC
5MAX =    256.2    F    MIN = 254.6    F    6MAX =    258.2    F    MIN = 251.4    F
3MAX =    273.7    F    MIN = 254.3    F    4MAX =    250.9    F    MIN = 248.0    F
1MAX =    250.7    F    MIN = 249.0    F    2MAX =    253.8    F    MIN = 247.8    F
8/JAN/85  16:36 30
27 = 16.5    PSI
13 = 302.1    VAC    14 = 10.0    AAC    17 = 61.2    AAC    20 = 16.2    AAC    25 = 0.0    GPM
6 = 258.2    F    7 = 302.5    VAC    8 = 14.0    AAC    10 = 602.0    VAC    11 = 20.0    AAC
1 = 250.5    F    2 = 253.3    F    3 = 273.0    F    4 = 249.6    F    5 = 256.1    F
8/JAN/85  16:36  0
8/JAN/85  16:32 37    11    20    17    8    2    14
25    27    11    20    17    8    4    3    7
25    27    11    20    17    8    5    10
25    27    11    20    17    8    6    13
100    90    80    70    60    50    40    30    20    10    0
8/JAN/85  16  3  2    11    20    17    8    12    3    14
0    10    20    30    40    50    60    70    80    90    100
25    27    11    20    17    8    2    3    7
25    27    11    20    17    8    4    3    10
25    27    11    20    17    8    5    13
8/JAN/85  15:37 32    11    20    17    8    6    14
25MAX =    0.0    GPM    MIN = 0.0    GPM    27MAX =    17.8    PSI    MIN = 14.4    PSI
17MAX =    62.2    AAC    MIN = 60.8    AAC    20MAX =    16.4    AAC    MIN = 16.0    AAC
13MAX =    305.7    VAC    MIN = 300.1    VAC    14MAX =    10.2    AAC    MIN = 9.9    AAC
10MAX =    612.4    VAC    MIN = 593.0    VAC    11MAX =    20.6    AAC    MIN = 19.7    AAC
7MAX =    305.5    VAC    MIN = 299.8    VAC    8MAX =    14.5    AAC    MIN = 13.8    AAC
5MAX =    255.9    F    MIN = 251.3    F    6MAX =    257.5    F    MIN = 248.6    F
3MAX =    273.3    F    MIN = 247.7    F    4MAX =    253.6    F    MIN = 247.4    F
1MAX =    251.5    F    MIN = 246.5    F    2MAX =    251.4    F    MIN = 247.4    F
8/JAN/85  15:36 33
27 = 16.1    PSI
13 = 300.9    VAC    14 = 10.0    AAC    17 = 61.2    AAC    20 = 16.2    AAC    25 = 0.0    GPM
6 = 255.6    F    7 = 300.9    VAC    8 = 13.9    AAC    10 = 601.6    VAC    11 = 20.0    AAC
1 = 249.4    F    2 = 248.3    F    3 = 271.1    F    4 = 248.1    F    5 = 254.7    F
8/JAN/85  15:36  2
8/JAN/85  15:32 31    11    20    17    8    12    3    14
25    27    11    20    17    8    4    3    7
25    27    11    20    8    6    10
```

32 hour

31 hour


2 hour

Per Fig. A1 - IEEE 323-1974 (Saturated Steam Conditions)



SECTION 6 - DATA LOGGER ENVIRONMENTAL DATA (CONDENSED)

DATA SECTION 6

Measurements @ Time Indicated

Channel	1	2	3	4	5	6	25	26	27
Time	Deg F	Deg F	Deg F	Deg F	Deg F	Deg F	GPM	pH	psig
Initial	86.7	210.2	134.2	138.0	202.9	171.8	0.2	8.5	0.7
1 hour	315.8	340.1	340.7	340.2	339.9	340.2	1.3	11.4	105.1
2 "	316.9	340.5	341.1	340.6	340.6	340.7	1.4	11.6	104.8
3 "	315.4	339.5	340.2	339.7	339.5	339.8	1.8	11.7	105.1
4 "	172.5	186.6	186.8	186.6	187.0	186.7	1.5	10.1	0.1
5 "	166.6	166.8	166.9	166.9	167.1	166.8	1.3	-	0.4
6 "	318.8	340.1	340.7	340.3	340.7	340.5	1.1	-	107.5
7 "	322.1	341.0	341.4	341.3	340.8	341.0	1.5	-	106.7
8 "	322.2	341.7	342.0	341.5	341.6	341.8	1.8	-	106.6
9 "	302.3	320.7	321.0	320.6	320.7	320.7	1.3	-	77.4
10 "	299.8	319.2	319.6	319.1	319.3	319.3	1.7	-	75.5
11 "	299.6	319.3	319.4	319.3	319.2	319.3	1.8	-	75.6
12 "	302.9	301.9	302.3	301.8	302.8	302.2	9.6	-	55.1
13 "	284.4	300.5	301.0	300.3	300.6	300.8	0.9	-	53.9
14 "	283.7	300.7	301.1	300.7	300.6	300.8	0.9	-	53.9
15 "	282.7	300.7	301.0	300.8	300.9	300.8	0.8	-	53.7
16 "	241.4	253.0	253.3	253.1	253.0	253.1	0.5	-	17.8
17 "	238.2	249.7	250.0	249.9	249.9	250.0	1.4	-	16.1
18 "	237.4	249.2	249.6	249.4	249.6	249.5	1.4	-	15.5
19 "	237.6	249.2	249.5	249.4	249.4	249.4	1.5	-	15.5
20 "	237.2	249.1	249.5	249.5	249.6	249.4	1.5	-	15.5
21 "	237.4	249.3	249.7	249.6	249.7	249.6	1.5	-	15.8
22 "	237.4	249.4	249.7	249.6	249.7	249.7	1.4	-	15.6
23 "	237.2	249.6	250.2	249.9	250.0	250.0	1.5	-	16.0
24 "	238.0	250.0	250.3	250.1	250.0	250.0	1.4	-	16.1
25 "	249.8	249.4	249.8	249.6	249.4	249.6	2.5	-	15.4
26 "	Spray	254.0	272.6	254.2	257.9	259.8	Spray	Spray	18.9
27 "	off	253.8	277.8	256.1	256.4	261.0	off	off	17.3
28 "		250.0	275.2	251.9	252.7	257.6			14.7
32 "		253.3	273.0	249.6	256.1	258.2			16.5
36 "		251.4	264.8	247.7	254.6	254.8			15.4
40 "		256.0	266.8	257.1	258.3	259.7			18.0
44 "		255.9	270.3	255.2	258.8	260.1			18.1
48 "		253.8	262.8	250.7	256.9	256.2			16.6
52 "		254.7	269.6	256.8	257.5	259.5			16.0
56 "		253.6	250.6	253.8	256.8	253.8			15.9
60 "		252.5	253.2	254.5	255.3	253.9			15.5

Channel Time	1 Deg F	2 Deg F	3 Deg F	4 Deg F	5 Deg F	6 Deg F	25 GPM	26 pH	27 psig
64 "		252.1	255.6	254.4	255.2	254.2			5.3
68 "		252.0	252.6	254.7	255.4	253.5			5.4
72 "		252.4	255.8	250.3	256.0	253.6			5.8
76 "		253.0	257.2	255.3	256.5	255.5			6.2
80 "		258.4	264.1	255.4	258.2	259.1			8.1
84 "		253.3	250.6	255.0	252.8	253.8			5.6
88 "		252.8	250.4	255.0	255.8	253.6			5.4
92 "		252.4	250.8	254.3	255.1	253.1			5.5
96 "		253.0	250.0	254.9	256.0	253.4			6.0
100"		223.1	291.0	224.4	225.7	223.0			2.8
102"		223.2	281.7	225.0	226.4	222.5			2.0
5 days		223.0	237.5	224.5	225.5	227.8			2.8
6 "		226.8	237.6	336.0	229.4	230.0			4.1
7 "		222.6	237.3	224.1	225.7	227.9			2.5
8 "		223.6	219.8	225.4	226.4	223.7			3.0
9 "		225.2	246.3	226.6	227.6	231.4			2.9
10 "		225.1	240.3	226.7	227.8	230.4			3.3
11 "		224.6	222.3	319.6	227.0	223.7			2.9
12 "		216.5	224.3	217.2	217.2	218.9			1.9
13 "		219.2	222.0	219.4	219.8	220.1			3.1
14 "		225.0	246.2	226.7	228.0	231.4			3.0
15 "		226.8	247.2	228.3	339.6	233.1			3.9
16 "		227.1	247.8	228.6	229.4	233.1			3.8
17 "		226.2	240.4	227.4	228.6	231.0			3.3
18 "		227.1	245.2	227.9	229.6	232.4			4.1
19 "		221.9	219.1	224.5	226.2	222.8			2.6
20 "		221.7	243.0	224.3	225.7	228.8			2.6
21 "		222.5	238.4	223.9	225.6	227.7			2.6
22 "		220.4	219.2	223.9	226.3	222.5			2.8
23 "		221.7	220.4	225.4	228.0	223.8			3.2
24 "		220.8	219.6	218.3	226.0	221.5			2.2
25 "		221.9	220.9	226.6	228.3	224.3			3.3
26 "		219.7	230.8	218.7	227.6	224.7			2.6
27 "		221.8	221.8	221.2	228.7	223.4			3.2
28 "		222.3	236.0	221.7	228.9	227.4			3.1
29 "		222.1	222.5	222.2	229.6	224.0			3.5
30 "		229.6	230.0	230.3	236.8	231.7			6.3
31 "		218.1	221.4	223.1	225.9	222.5			2.6
32 "		219.1	221.2	225.0	226.7	223.2			3.0
33 "		215.8	218.6	217.4	222.6	218.9			1.9
34 "		218.4	228.1	223.7	227.2	223.7			2.6
35 "		219.6	220.7	225.8	227.9	223.6			2.9

Channel Time	1 Deg F	2 Deg F	3 Deg F	4 Deg F	5 Deg F	6 Deg F	25 GPM	26 pH	27 psig
36 "		215.7	228.8	216.7	224.7	221.8			1.9
37 "		218.2	221.7	224.9	227.0	223.0			2.9
38 "		218.2	223.1	225.2	227.3	223.5			2.4
39 "		219.1	244.9	226.7	228.1	228.0			3.0
40 "		217.6	219.4	225.3	227.1	222.3			2.4
41 "		218.2	219.1	225.4	227.2	222.5			2.8
42 "		218.6	219.3	225.5	227.6	222.7			2.5
43 "		222.3	221.6	220.6	229.3	223.4			3.3
44 "		221.8	221.3	227.1	229.1	224.9			3.4
45 "		220.4	245.6	220.9	229.2	229.1			3.4
46 "		222.4	238.3	220.6	228.6	227.5			3.1
47 "		225.0	246.4	228.0	229.8	232.5			3.5
48 "		225.0	245.5	227.2	229.1	231.4			3.6
49 "		225.3	246.1	228.0	229.7	232.3			3.3
50 "		224.4	246.5	226.6	228.7	231.4			3.0
51 "		224.7	243.7	227.0	228.9	231.1			3.2
52 "		223.6	246.5	224.9	228.3	231.0			2.5
53 "		224.7	246.8	227.0	229.0	231.9			3.2
54 "		225.2	248.2	227.9	229.9	233.0			3.2
55 "		223.8	246.7	226.4	228.3	231.2			2.6
56 "		222.2	246.9	224.9	226.7	230.6			1.9
57 "		226.7	224.2	228.5	230.5	227.4			3.7
58 "		225.0	220.6	226.8	229.0	225.3			2.7
59 "		226.0	221.3	227.2	229.6	226.0			2.9
60 "		226.0	221.8	227.8	229.9	226.3			3.3
61 "		226.2	221.6	228.2	230.3	226.6			3.4
62 "		226.2	222.3	222.3	230.5	225.3			3.3
63 "		225.7	221.7	228.0	229.9	226.4			3.4
64 "		228.6	224.7	230.4	232 8	229.0			4.8
65 "		223.7	219.6	227.2	227.2	222.6			3.0
66 "		223.8	220.2	225.2	227.5	224.1			3.2
67 "		225.7	222.6	221.6	228.9	224.5			3.3
68 "		225.9	221.1	228.0	229.7	226.3			3.4
69 "		225.6	220.9	227.7	229.3	225.9			3.4
70 "		224.8	241.7	221.2	228.7	229.3			3.4
71 "		223.4	242.3	225.0	227.1	229.5			2.4
72 "		226.2	220.1	220.6	228.2	223.9			3.3
73 "		224.6	219.2	225.6	227.3	224.3			2.4
74 "		226.4	220.9	227.0	228.5	225.8			2.9
75 "		226.7	221.0	228.1	229.5	226.2			3.3
76 "		226.1	219.7	227.3	228.6	225.5			2.9
77 "		225.2	219.8	220.3	227.8	223.4			2.8
78 "		226.2	221.0	221.7	229.7	224.6			3.0
79 "		225.2	220.1	224.8	228.5	224.7			2.8
80 "		226.1	222.0	227.9	229.7	226.4			3.4
81 "		225.4	220.3	226.7	228.5	225.2			3.1

Channel Time	1 Deg F	2 Deg F	3 Deg F	4 Deg F	5 Deg F	6 Deg F	25 GPM	26 pH	27 psig
82 "		223.3	217.7	224.6	226.4	223.0			1.9
83 "		223.0	218.9	218.0	226.1	221.8			1.9
84 "		225.0	234.6	226.2	228.2	228.8			2.9
85 "		225.0	245.3	226.7	228.2	231.7			3.1
86 "		225.2	239.0	226.8	228.5	229.9			3.1
87 "		226.8	235.9	227.6	229.3	230.3			3.2
88 "		224.6	249.1	225.0	226.9	231.5			2.3
89 "		223.4	243.7	225.2	226.5	232.5			2.2
90 "		223.7	254.2	221.2	226.0	231.0			1.7
91 "		225.7	248.3	227.0	228.2	232.1			2.8
92 "		226.8	248.6	227.7	228.9	233.3			3.2
93 "		226.5	247.6	227.9	229.3	232.8			3.1
94 "		225.3	244.0	226.5	228.0	231.0			2.4
95 "		225.3	242.8	226.4	227.9	230.3			2.3
96 "		227.3	248.1	228.8	230.2	233.6			3.3
97 "		225.8	220.4	223.5	229.3	225.1			2.8
98 "		225.8	220.7	224.7	229.3	225.3			3.1
99 "		225.9	224.1	219.5	228.7	224.8			2.8
100"		223.5	218.2	225.9	227.3	224.1			2.1
101"		224.1	239.8	222.1	226.9	227.7			2.1
102"		227.7	237.4	221.3	230.3	229.7			3.4
103"		226.1	227.7	221.6	228.6	224.8			2.3
104"		226.8	222.0	228.3	229.9	226.7			2.8
105"	Shutdown								

ANALYSIS OF DATA SECTION 6

Channel 1 - Chemical Spray Temperature
Channel 25 - Chemical Spray Flow Rate
Channel 26 - Chemical Spray pH.

Chemical Spray Temperature and Flow Rate were measured on the input side of the spray system to the test vessel. The spray system, while externally located from the test vessel, is at vessel pressure during operation as it is a recirculating system with input and return lines.

Spray was initiated approximately 9 minutes after the start of the environmental profile, after the first transient peak temperature was stabilized.

During stable environmental conditions, spray temperature and flow rate were also reasonably stable, with the flow being slightly more variable.

During temperature transitions, both temperature and flow rate were highly variable. Temperature primarily decreased; flow rate fluctuated in both directions.

Each of these periods coincided with changes in vessel environment temperature, and pressure. It is postulated that the variations were caused by interaction of:

1. Vapor formation in the spray system.
2. Vapor condensation.
3. Reaction time of spray system to pressure changes.
4. Variation of back pressure in spray system.
5. Other similar phenomenon.

These periods of variation occurred 6 times during spray application from 10 minutes to 40 minutes.

Excluding the initial and 12 hour measurement, the average instantaneous value of Flow is 1.4 GPM or 2,000+ gallon for the 24 hour period of the spray.

Between the 4 and 5 hour instantaneous measurement, the pH value became eratic.

It was discovered that the probe had cracked. Samples of spray were taken at periodic intervals for the remainder of the spray period, by bring dripped into an uncovered glass beaker.

Collection Time	Measured pH	Solution Temperature
4 Hr. 49 Min. to 6 Hr. 39 Min.	11.7	25 Deg. C
6 Hr. 39 Min to 8 Hr. 14 Min.	11.5	23 Deg. C
8 Hr. 14 Min. to 10 Hr. 38 Min.	11.4	23 Deg. C
10 Hr. 39 Min. to 11 Hr. 53 Min.	11.1	25 Deg. C
11 Hr. 53 Min. to 1 14 Hr. 54 Min.	8.8	23 Deg. C
14 Hr. 54 Min. to 24 Hr. 19 Min.	8.2	23 Deg. C
Complete refill of Beaker @ 24 Hr. 24 Min.	7.8	23 Deg. C

Precise procedures were not utilized: 1. Measurement was not temperature compensated. 2. Probe was not rinsed between measurements.

PH itself was higher during the beginning of the spray than intended. This was an error during mixing of the spray components due to an inadvertant over buffering. The result was a more severe caustic than required.

Published data by cross-linked polyethylene suppliers indicates excellent resistance to damage from spray components in concentrations as high as 25%.

Variations withstanding, cable was subjected to a significant volume of spray solution. PH was higher than intended though not measured precisely. For the wire and cable insulation of interest, chemical composition of the spray has virtually no effect on properties due to the low concentrations utilized.

Conclusion:

Test plan variations relative to the Chemical Spray did not affect cable performance in either a positive or negative sense. Results obtained are therefore acceptable as meeting outlined parameters and criteria.
Channel 2, 3, 4, 5, - Chamber Temperature
Channel 27 - Chamber Pressure

Test vessel is charged with saturated steam. Under completely stable conditions, temperature and pressure measurements are redundant, and will follow published Steam Tables. For the period of the Chemical Spray, recorded temperatures and pressure follow Steam Table conditions within experimental error, for all channels. Of the instantaneous values recorded, the largest variance between Channels 2, 3, 4, 5 is 1 deg. F, occurred during spray.

After termination of the spray, recorded temperature of the various channels diverged. The most prominent variation occurred on Channel 3. Channels 2 and 4 remained reasonably consistant with the Steam Table values. Some variation occurred in Channel 5.

Shortly before the 56 hour point, Channel 3 was disconnected from the test vessel and evaluated for proper function, with satisfactory results. After termination of the profile, (105 days) the thermocouple and Channel 3 were evaluated using the standard calibration procedure with satisfactory results. The conclusion is that Channel 3 values are actual temperature measurements throughout the environmental profile.

It was noted that each time voltage and current to the samples was discontinued, for Insulation Resistance measurements, temperatures monitored on Channel 2, 3, 4, 5 converged to approximately equal value. Conversely, when voltage and current were reapplied after the IR measurement, temperature measurements diverged again. Further, this convergence and divergence took approximately 5 minutes to be completed, and in a smooth trend.

Shortly after completion of the environmental profile, all other Channels were subjected to the standard calibration procedure with satisfactory results, without adjustment.

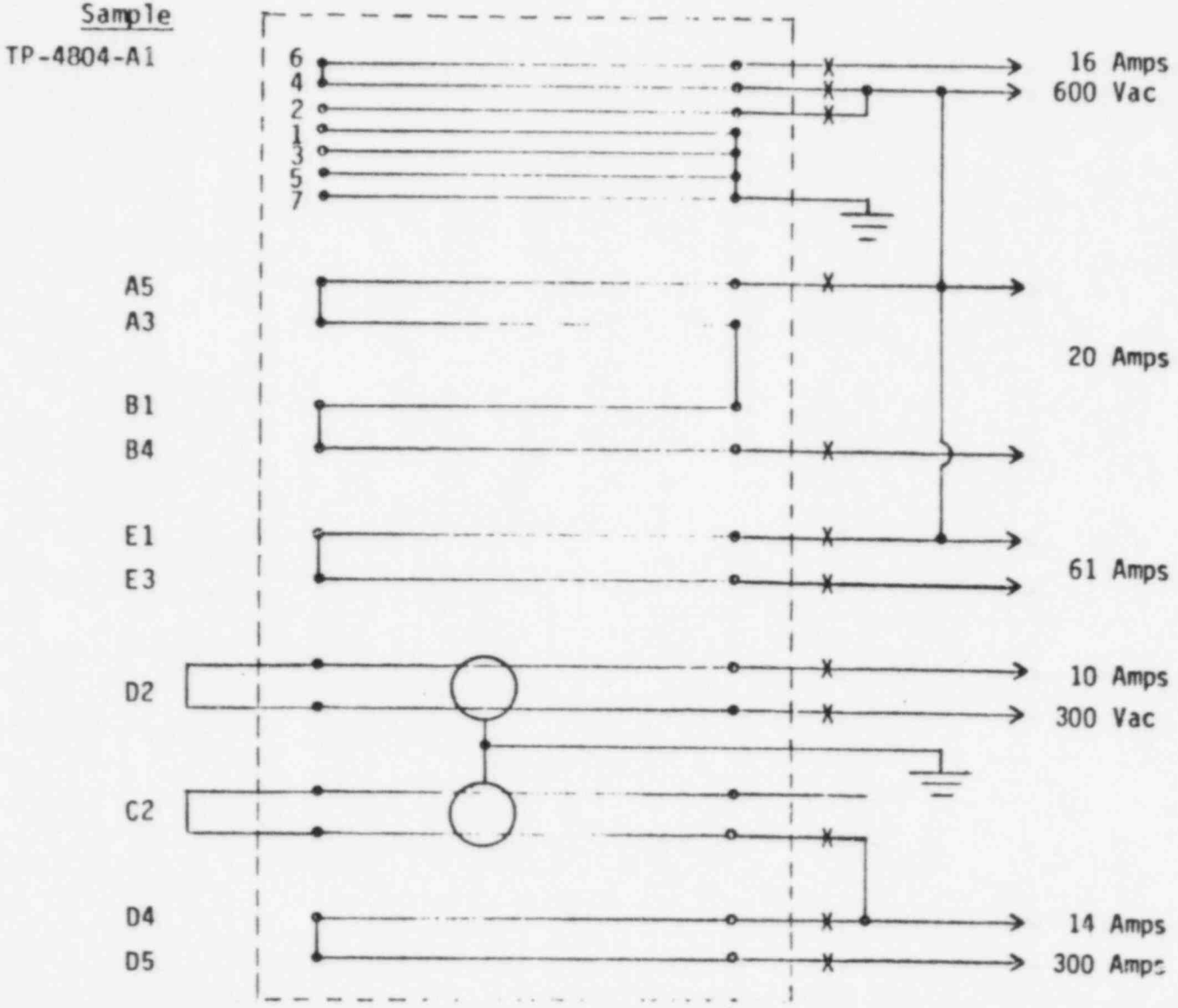
It is postulated that uniformity demonstrated during spray, was affected by the considerable circulatory effect of the spray itself, which resulted in uniform temperature throughout the test vessel. It is further postulated that the variance which occurred, post-spray, was affected by the localized heating effect of the samples due to current loading, which resulted in various thermal convection current.

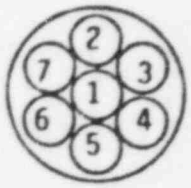
Conclusion:

Test plan variations relative to sample environmental profile temperatures, were caused by required test parameters themselves. An integrated view of these variations, results in a profile slightly more severe than intended. Results are therefore acceptable as meeting outlined parameters and criteria.

SECTION 7 - DATA LOGGER
CABLE ELECTRICAL LOAD DATA (CONDENSED)

SCHEMATIC FOR CABLE
ELECTRICAL CONNECTIONS





X - Breakpoints for Insulation Resistance Measurements

SECTION 7

DATA LOGGER CABLE ELECTRICAL LOAD DATA

Data Section 7

Voltage and Current Loading During LOCA Profile

Sample	Voltage	Current (Amps) *
TP 4804 A1	600 (3 Cndr.)	16 (2 Cndr.)
A3	600	20
A5	600	20
TP 4804 B1	600	20
TP 4804 C2	300	0
TP 4804 D2	300	10
D4	300	14
D5	300	14
TP 4805 E1	600	61
E3	600	61

* NEC ampacities based upon 30 degrees C ambient. NEC allowable correction factor for higher ambients to be applied. Typical ambient temperature for cable installed for Class 1E applications is 65 degrees C. The derating factor is .58. This is very conservative compared to the ambient temperature during the environmental profile. Current indicated is applied during environmental profile.

Time	7 Volts	8 Amps	10 Volts	11 Amps	13 Volts	14 Amps	17 Amps	20 Amps
Initial	301.3	14.5	607.3	20.1	299.0	9.9	60.6	15.8
1 hour	299.0	14.0	606.2	20.1	297.8	10.0	60.3	16.0
2 "	300.3	14.0	603.3	20.0	301.9	9.9	61.3	16.1
3 "	302.3	14.1	609.2	20.2	305.5	10.0	61.6	16.1
4 "	302.1	14.2	602.3	20.2	299.1	10.2	61.5	16.6
5 "	301.2	14.1	602.2	20.7	299.0	10.0	61.6	16.3
6 "	301.9	14.0	604.1	20.0	301.1	10.1	60.9	16.2
7 "	Insulation Resistance Measurements							
8 "	299.8	13.9	603.1	20.2	302.0	10.0	60.4	16.2
9 "	298.0	14.1	602.8	20.0	300.7	10.2	61.2	16.2
10 "	298.9	14.2	606.5	20.2	301.7	10.2	60.8	16.3
11 "	Insulation Resistance Measurements							
12 "	297.9	13.6	602.8	19.9	299.1	10.0	61.8	16.1
13 "	299.2	13.9	603.2	20.2	300.7	10.1	59.2	16.2
14 "	298.5	13.9	603.2	20.1	299.1	10.1	58.6	16.1
15 "	Insulation Resistance Measurements							
16 "	299.7	13.9	600.6	19.9	298.2	10.1	60.7	16.1
17 "	300.4	13.9	602.4	19.9	300.2	10.1	60.3	16.0
18 "	298.2	13.9	598.9	19.8	297.3	10.0	60.1	15.8
19 "	299.6	14.0	601.5	20.0	299.5	10.1	60.4	16.0
20 "	299.0	13.9	598.8	19.9	298.4	10.0	60.2	15.9
21 "	299.4	14.0	602.2	19.9	299.0	10.1	60.6	16.0
22 "	300.5	14.0	604.4	20.0	300.9	10.1	60.7	16.1
23 "	303.9	14.1	610.9	20.2	303.0	10.2	61.0	16.2
24 "	301.2	14.0	604.3	20.0	300.9	10.1	60.5	16.0
25 "	300.1	14.0	603.0	20.1	300.5	10.1	61.0	16.2
26 "	300.2	13.7	603.0	19.5	301.0	10.0	60.5	16.1
27 "	301.9	14.1	606.6	20.1	302.9	10.0	61.4	16.2
28hrs	300.2	14.1	601.6	20.1	300.1	10.1	61.2	16.2
32 "	302.4	14.0	602.8	20.0	302.1	10.0	61.2	16.2
36 "	299.3	13.8	596.5	19.7	298.2	9.9	60.2	15.9
40 "	297.4	13.7	593.1	19.6	295.4	9.8	59.9	15.8
44 "	298.2	13.8	595.3	19.7	296.5	9.8	60.2	15.8
48 "	298.7	14.1	599.3	19.8	300.3	9.9	60.6	15.9
52 "	296.8	13.7	595.7	19.6	294.1	9.9	60.3	15.9
56 "	300.3	13.9	601.0	19.9	299.9	10.0	61.0	15.9
60 "	293.1	13.6	588.4	19.5	292.4	9.7	59.6	15.6
64 "	297.1	13.8	596.2	19.7	295.7	9.9	60.2	15.8
68 "	297.1	13.8	596.2	19.7	295.7	9.9	60.2	15.8
72 "	297.1	13.8	594.7	19.8	296.7	9.9	60.6	15.8
76 "	299.6	14.0	596.7	19.8	299.8	10.0	60.9	16.0
80 "	301.7	14.1	601.7	20.0	301.3	10.0	61.5	16.1
84 "	295.8	13.8	588.1	19.6	294.1	9.8	60.1	15.7
88 "	299.2	14.0	597.7	19.8	297.2	10.0	60.7	15.9

Time	7 Volts	8 Amps	10 Volts	11 Amps	13 Volts	14 Amps	17 Amps	20 Amps
92 "	298.5	14.0	595.4	19.8	297.3	10.0	60.8	16.0
96 "	299.3	14.0	595.8	19.8	297.7	10.0	61.1	16.0
100"	299.3	13.9	596.0	20.0	297.1	9.9	60.5	16.0
102"	304.5	14.1	606.4	20.3	303.1	10.1	61.5	16.2
5 days	305.5	14.1	609.5	20.4	307.1	10.2	61.3	16.3
6 "	301.9	13.9	603.0	20.1	304.1	10.0	60.4	16.0
7 "	299.4	14.1	608.6	19.9	304.1	10.0	61.1	16.3
8 "	303.6	14.0	601.2	19.9	300.8	10.1	61.4	16.4
9 "	291.8	13.9	590.2	19.7	298.4	9.9	60.3	15.8
10 "	304.5	14.1	614.8	20.2	303.8	10.1	61.2	16.1
11 "	298.7	14.1	601.9	20.1	303.5	10.0	61.0	16.0
12 "	-	13.3	597.5	-	-	10.2	-	16.3
13 "	-	13.4	605.2	20.0	301.2	10.1	61.2	16.2
14 "	301.1	14.0	602.5	20.0	301.2	10.1	61.2	16.2
15 "	300.3	13.9	600.1	19.9	297.7	9.9	60.0	16.2
16 "	303.7	14.1	608.4	20.1	301.6	10.0	61.8	16.4
17 "	302.6	14.1	604.2	20.3	305.4	10.1	61.4	16.2
18 "	303.7	14.0	604.7	20.0	303.6	10.1	61.2	16.1
19 "	311.1	14.3	622.9	20.5	311.2	10.4	62.9	16.6
20 "	307.4	14.2	614.9	20.3	307.1	10.3	62.4	16.4
21 "	305.1	14.1	607.2	20.2	305.5	10.2	62.0	16.3
22 "	303.4	14.2	610.7	20.3	303.7	10.2	61.8	16.4
23 "	305.7	14.2	608.4	20.2	304.3	10.1	61.5	16.0
24 "	302.2	14.3	605.6	20.4	301.0	10.2	61.4	16.4
25 "	305.1	14.0	609.8	20.2	303.4	10.1	61.0	16.1
26 "	312.4	14.2	624.5	20.5	310.8	10.3	62.0	16.4
27 "	308.6	14.1	617.7	20.4	307.6	10.2	61.8	16.2
28 "	306.6	14.0	612.4	20.3	305.3	10.2	61.5	16.1
29 "	304.9	14.0	605.9	20.1	303.5	10.2	61.4	16.1
30 "	309.8	14.1	613.2	20.2	306.7	10.1	61.6	16.1
31 "	302.4	14.0	604.6	20.2	302.6	10.2	61.4	16.1
32 "	302.4	14.1	604.1	20.2	302.8	10.1	61.6	16.2
33 "	306.9	14.3	614.0	20.5	307.2	10.4	62.5	16.5
34 "	304.3	14.0	608.2	20.2	305.1	10.2	61.7	16.1
35 "	302.9	14.0	605.7	20.1	303.9	10.1	61.3	16.0
36 "	303.1	14.3	612.6	20.4	304.5	10.2	62.3	16.5
37 "	302.3	14.2	612.0	20.2	303.9	10.1	61.3	16.3
38 "	304.3	14.1	606.6	20.1	306.2	10.1	61.6	16.3
39 "	308.9	14.2	613.5	20.3	311.7	10.2	62.2	16.4
40 "	313.2	14.4	622.3	20.5	315.7	10.3	62.9	16.7
41 "	308.8	14.2	613.4	20.3	311.4	10.2	62.2	16.4
42 "	306.2	14.2	608.2	20.1	308.8	10.1	62.0	16.3

Time	7 Volts	8 Amps	10 Volts	11 Amps	13 Volts	14 Amps	17 Amps	20 Amps
43 "	304.8	14.0	604.1	20.0	307.6	10.0	61.7	16.1
44 "	309.2	14.1	609.6	20.1	311.1	10.1	61.3	16.2
45 "	308.8	14.1	608.4	20.1	310.9	10.1	61.5	16.3
46 "	301.4	13.6	598.0	20.0	303.7	9.9	60.5	16.0
47 "	305.0	14.1	607.3	20.2	308.0	9.9	61.6	16.2
48 "	301.3	13.9	598.8	20.0	304.2	9.8	60.9	16.0
49 "	306.8	14.0	609.9	20.0	304.5	10.1	61.7	16.2
50 "	304.5	14.1	605.7	20.0	302.5	10.1	61.7	16.2
51 "	302.9	14.0	608.4	19.9	305.4	10.0	61.3	16.1
52 "	302.1	14.0	604.4	19.9	306.4	10.0	61.4	16.1
53 "	303.0	14.0	607.8	20.0	307.1	10.0	61.3	16.2
54 "	305.7	14.1	612.1	20.1	310.4	10.0	61.5	16.2
55 "	305.9	14.1	613.8	20.2	310.0	10.1	61.8	16.3
56 "	303.3	14.2	608.3	20.2	307.6	10.0	62.3	16.3
57 "	300.6	14.0	607.3	19.8	302.7	10.0	61.2	16.1
58 "	305.6	14.1	603.4	20.0	301.2	10.1	62.0	16.2
59 "	307.7	14.2	608.0	20.1	302.7	10.1	62.1	16.2
60 "	308.5	14.1	608.1	20.0	304.0	10.1	61.5	16.1
61 "	314.9	14.3	619.2	20.4	308.8	10.3	62.6	16.4
62 "	313.1	14.2	614.7	20.3	308.5	10.2	62.2	16.2
63 "	309.2	14.1	606.8	20.1	304.0	10.1	61.5	16.1
64 "	307.8	14.0	606.8	19.9	303.5	10.0	61.2	16.0
65 "	307.8	14.1	606.1	20.1	302.4	10.1	61.6	16.1
66 "	308.3	14.2	606.3	20.1	303.8	10.1	62.0	16.1
67 "	306.3	14.0	601.7	19.9	300.6	10.0	61.2	16.0
68 "	317.6	14.4	621.8	20.6	311.9	10.3	62.8	16.5
69 "	312.4	14.2	612.5	20.2	307.4	10.2	61.9	16.3
70 "	308.6	14.0	602.9	19.9	302.8	10.1	61.3	16.0
71 "	306.9	14.1	598.8	20.0	301.0	10.1	61.9	16.2
72 "	307.5	14.1	602.0	20.0	301.4	10.0	61.6	16.1
73 "	306.7	14.1	600.3	20.0	300.5	10.0	61.4	16.1
74 "	307.6	14.2	602.5	20.1	301.7	10.0	61.7	16.3
75 "	315.2	14.3	615.4	20.3	309.7	10.2	62.0	16.4
76 "	314.1	14.3	612.2	20.2	309.1	10.1	61.9	16.3
77 "	306.2	14.1	597.7	19.9	300.5	10.0	61.1	16.1
78 "	310.0	14.1	602.9	20.0	303.9	10.0	61.3	16.2
79 "	306.4	14.0	598.4	19.9	300.9	9.9	6112	16.0
80 "	306.5	14.0	600.3	19.8	302.4	9.9	61.2	16.0
81 "	307.5	14.1	603.0	19.9	303.5	9.9	60.9	16.0
82 "	319.6	14.5	625.3	20.6	314.4	10.3	63.0	16.7
83 "	315.4	14.4	616.6	20.4	310.0	10.1	62.2	16.5
84 "	306.0	14.1	598.8	19.9	300.8	9.7	61.1	16.1
85 "	308.6	14.1	600.9	20.0	303.4	9.7	61.3	16.1
86 "	305.7	14.0	598.1	19.9	301.6	9.6	61.2	16.2
87 "	307.6	14.0	601.0	19.8	301.9	10.0	60.7	16.1

Time	7 Volts	8 Amps	10 Volts	11 Amps	13 Volts	14 Amps	17 Amps	20 Amps
88 "	312.3	14.2	611.0	20.1	307.2	10.1	61.3	16.3
89 "	317.6	14.4	620.4	20.4	312.6	10.2	62.1	16.5
90 "	313.4	14.2	612.1	20.2	308.7	9.8	61.6	16.3
91 "	308.1	14.1	603.9	19.9	302.6	9.7	61.3	16.1
92 "	308.7	14.1	604.3	19.9	303.8	9.7	61.2	16.1
93 "	308.0	14.0	600.1	19.9	302.9	9.6	61.0	16.0
94 "	301.0	14.1	603.5	19.9	301.8	10.1	60.8	15.8
95 "	303.0	14.2	606.5	20.1	304.9	10.2	61.3	15.9
96 "	308.8	14.3	615.2	20.3	310.2	10.3	61.5	16.0
97 "	307.7	14.3	615.2	20.3	308.0	10.0	61.2	15.8
98 "	301.5	14.1	604.6	19.9	302.5	9.8	60.5	15.3
99 "	300.6	14.1	605.5	19.9	302.8	9.8	60.8	15.5
100"	304.7	14.2	603.1	20.0	303.3	10.2	63.0	15.9
101"	304.6	14.2	601.2	20.0	303.1	10.2	63.0	15.7
102"	300.8	14.0	592.4	19.7	300.2	10.0	61.7	15.4
103"	309.3	14.4	616.6	20.3	309.4	10.4	63.0	16.5
104"	306.9	14.3	613.9	20.1	307.3	10.4	62.6	16.4
105"	Shutdown							

13 DATA ANALYSIS:

Channel 7, 10 & 13 - Sample Voltage

Channel 8, 11, 14, 17, and 20 - Sample Current

Minor fluctuation occurred in all channels. They were the result of:

A. Instrument adjustment
B. Conductor Resistance Change - Temperature Changes
C. Building Voltage fluctuation due to plant machine loads.

Average values for the term of application for each channel exceed the nominal value outlined for the test program.

Scheduled shutdowns for Insulation Resistance measurements represent transient conditions, and are generally recognized to be more severe than steady state conditions.

Conclusion:

Test plan variations relative to sample electrical loading were the result of normal expected influences. An integrated view of these variations result in a slightly more severe condition than intended. Results are therefore acceptable as meeting outlined parameters and criteria.

DATA SECTION 8

INSULATION RESISTANCE MEASUREMENTS

500 Vdc - 1 Minute

Insulation Resistance (Megohms - 1000 ft.)

Time	Temp.	Samples (TP4804)							
	Deg. F	A1 2	A1 4	A1 6	A3	A5	B1	B4	Comments
---	RT	31000	31000	31000	31000	31000	38000	38000	Production Test
Initial	RT	40000	40000	42000	26000	27000	21000	23000	
PreLOCA	RT	1230	1200	1200	2200	600	1700	500	
7 Hrs	341	.012	.013			.013			50 Vdc
11 "	319	.021	.023			.027			A3-B4 50 Vdc
15 "	301	.042	.046			.040			
53 "	253	.27	.32			3.15			
8 Day	223	.83	.97			10.7			
45 "	220	.64	.60			6.55			
93 "	222	.57	.63			6.55			
102 "	224	.50	.52			6.55			
Final	RT	3900	4200	4400	10000	7000	7600	5600	

DATA SECTION 8

INSULATION RESISTANCE MEASUREMENTS

500 Vdc - 1 Minute

Insulation Resistance (Megohms - 1000 ft.)

Time	Temp	Samples (TP-4804)						
	Deg. F	C2 Red	C2 Yellow	D2 #1	D2 #2	D4	D5	Comments
-	RT	38,000	31,000	31,000	33,000	40,000	40,000	Prod. Test
Initial	RT	17,000	35,000	23,000	26,000	23,000	22,000	
PreLOCA	RT	510	580	590	580	1,800	450	
7 hrs.	341	.011	.012	.008	.008	.011		50 Vdc
11 hrs.	319	.020	.017	.019	.019	.016		
15 hrs.	301	.039	.034	.038	.041	.022		
53 hrs.	253	.248	.190	.218	.189	2.60		
8 days	223	.875	.700	.580	.885	9.44		
45 days	220	.029	.408	.240	.780	5.01		
93 days	222	.058	.204	.145	.653	4.13		
102days	224	-	.175	.189	.653	4.43		C2-Red Erratic
Final	RT	7,500	6,450	5,000	5,100	3,880	4,500	

		E1	E3	
-	RT	10,000	10,000	Prod. Test
Initial	RT	37,000	38,000	
PreLOCA	RT	940	440	
7 hrs.	341	.009		50 Vdc
11 hrs.	319	.017		
15 hrs.	301	.033		
53 hrs.	253	2.45		
8 days	223	9.57		
45 days	220	6.28		
93 days	222	5.68		
102days	224	7.48		
Final	RT	5,600	2,640	

Note 1 - Measurements indicated during LOCA for TP 4804-A1 conductor #4, #6; TP 4804-D4, D5; and TP 4804-E1, E3, are composite based upon overall length of series combination. These samples were connected in series for current loading.

Note 2 - Measurements indicated during LOCA are based on sample length(s). A parallel, therefore reducing resistance is included in the measurement due to extension leads. Actual values therefore, are greater than indicated during LOCA.

SECTION 9 - EQUIPMENT CALIBRATION RECORDS

NUCLEAR QUALIFICATION TEST INSTRUMENT CALIBRATION

Verification of accuracy is conducted on a routine frequency to provide assurance that equipment accuracies conform to the accepted requirements for commercial wire and cable test.

The calibration program is conducted to meet the requirements as outlined in MIL Std. 45662A with documentation traceable to NBS.

Calibration documentation is available for inspection at:

The Rockestos Company
285 Nicoll Street
New Haven, Connecticut 06511

Calibration documentation is included as part of the backup documentation maintained on file for this program.

Equipment Usage

The appropriate written procedures shall be followed relative to individual equipment operation and data acquisition. Departure from these procedures shall be noted. Said departures shall be evaluated as to effect upon parameter measured and overall test program.

Raw data sheets shall include identification of actual instrument used to acquire the data, by model and serial number.

A-C Voltage Test Sets

6. Hipotronics Set No. 8909-6

Item	Make	Serial No.	Description
AC Test Set	Hipotronics	8909-6	Model 702-.5
Voltmeter	Hipotronics	-	0.4/0.8/2 kV via HV Resistor

Voltmeter Indication, kV	True RMS Voltage, kV	True Peak Voltage, kV	Crest Factor Deviation, per cent	Correction to Indication, per cent
		0.4-kV Range		
0.100	0.100	0.100	0	0
0.200	0.202	0.202	0	+1.0
0.300	0.302	0.302	0	+0.7
0.400	0.400	0.400	0	0
		0.8-kV Range		
0.200	0.200	0.200	0	0
0.400	0.405	0.405	0	+1.3
0.600	0.605	0.605	0	+0.8
0.800	0.800	0.800	0	0
		2-kV Range		
0.50	0.51	0.51	0	+2.0
1.00	1.02	1.02	0	+2.0
1.50	1.51	1.52	+0.7	+0.7
2.00	2.01	2.02	+0.5	+0.5

A. A-C Voltage Test Sets

5. Hipotronics Set No. 8909-5

Item	Make	Serial No.	Description
AC Test Set	Hipotronics	8909-5	Model 702-.5
Voltmeter	Hipotronics	-	0.4/0.8/2 kV via HV Resistor

Voltmeter Indication, kV	True RMS Voltage, kV	True Peak Voltage, kV	Crest Factor Deviation, per cent	Correction to Indication, per cent
		0.4-kV Range		
0.100	0.100	0.100	0	0
0.200	0.202	0.202	0	+1.0
0.300	0.302	0.302	0	+0.7
0.400	0.402	0.404	+0.5	+0.5
		0.8-kV Range		
0.200	0.200	0.200	0	0
0.400	0.405	0.405	0	+1.3
0.600	0.605	0.605	0	+0.8
0.800	0.800	0.805	+0.6	0
		2-kV Range		
0.50	0.50	0.50	0	0
1.00	1.01	1.01	0	+1.0
1.50	1.52	1.53	+0.7	+1.3
2.00	2.02	2.04	+1.0	+1.0

A. A-C Voltage Test Sets

4. Hipotronics Set No. 8909-4

Item	Make	Serial No.	Description
AC Test Set	Hipotronics	8909-4	Model 702-.5
Voltmeter	Hipotronics	-	0.4/0.8/2 kV via HV Resistor

Voltmeter Indication, kV	True RMS Voltage, kV	True Peak Voltage, kV	Crest Factor Deviation, per cent	Correction to Indication, per cent
		0.4-kV Range		
0.100	0.102	0.102	0	+2.0
0.200	0.204	0.204	0	+2.0
0.300	0.306	0.306	0	+2.0
0.400	0.408	0.410	+0.5	+2.0
		0.8-kV Range		
0.200	0.205	0.205	0	+2.5
0.400	0.410	0.415	+1.2	+2.5
0.600	0.615	0.620	+0.8	+2.5
0.800	0.810	0.820	+1.2	+1.3
		2-kV Range		
0.50	0.51	0.52	+2.0	+2.0
1.00	1.02	1.04	+2.0	+2.0
1.50	1.53	1.56	+2.0	+2.0
2.00	2.03	2.06	+1.5	+1.5

E.C.L. Report No. 84008A

A. A-C Voltage Test Sets

3. Hipotronics Set No. 8909-3

Item	Make	Serial No.	Description
AC Test Set	Hipotronics	8909-3	Model 702-.5
Voltmeter	Hipotronics	-	0.4/0.8/2 kV via HV Resistor

Voltmeter Indication, kV	True RMS Voltage, kV	True Peak Voltage, kV	Crest Factor Deviation, per cent	Correction to Indication, per cent
		0.4-kV Range		
0.100	0.098	0.098	0	-2.0
0.200	0.200	0.200	0	0
0.300	0.300	0.300	0	0
0.400	0.396	0.396	0	-1.0
		0.8-kV Range		
0.200	0.195	0.195	0	-2.5
0.400	0.400	0.405	+1.3	0
0.600	0.600	0.605	+0.8	0
0.800	0.795	0.800	+0.6	-0.6
		2-kV Range		
0.50	0.49	0.50	+2.0	-2.0
1.00	1.02	1.03	+1.0	+2.0
1.50	1.52	1.53	+0.7	+1.3
2.00	2.00	2.02	+1.0	0

A. A-C Voltage Test Sets

1. Hipotronics Set No. 8909-1

Item	Make	Serial No.	Description
AC Test Set	Hipotronics	8909-1	Model 702-.5
Voltmeter	Hipotronics	-	0.4/0.8/2 kV via HV Resistor

Voltmeter Indication, kV	True RMS Voltage, kV	True Peak Voltage, kV	Crest Factor Deviation, per cent	Correction to Indication, per cent
		0.4-kV Range		
0.100	0.102	0.102	0	+2.0
0.200	0.204	0.204	0	+2.0
0.300	0.304	0.306	+0.7	+1.3
0.400	0.402	0.404	+0.5	+0.5
		0.8-kV Range		
0.200	0.200	0.200	0	0
0.400	0.400	0.400	0	0
0.600	0.600	0.605	+0.8	0
0.800	0.800	0.805	+0.6	0
		2-kV Range		
0.50	0.51	0.51	0	+2.0
1.00	1.02	1.03	+1.0	+2.0
1.50	1.52	1.53	+1.3	+1.3
2.00	2.02	2.06	+2.0	+1.0

A. A-C Voltage Test Sets

2. Hipotronics Set No. 8909-2

Item	Make	Serial No.	Description
AC Test Set	Hipotronics	8909-2	Model 702-.5
Voltmeter	Hipotronics	-	0.4/0.8/2 kV via HV Resistor

Voltmeter Indication, kV	True RMS Voltage, kV	True Peak Voltage, kV	Crest Factor Deviation, per cent	Correction to Indication, per cent
		0.4-kV Range		
0.100	0.100	0.100	0	0
0.200	0.200	0.200	0	0
0.300	0.298	0.298	0	-0.7
0.400	0.398	0.400	+0.5	-0.5
		0.8-kV Range		
0.200	0.200	0.200	0	0
0.400	0.400	0.400	0	0
0.600	0.595	0.600	+0.8	-0.8
0.800	0.790	0.795	+0.6	-1.3
		2-kV Range		
0.50	0.50	0.50	0	0
1.00	1.00	1.01	+1.0	0
1.50	1.50	1.51	+0.7	0
2.00	1.99	2.01	+1.0	-0.5

A. A-C Voltage Test Sets

3. Hipotronics Set No. 7962-00

Item	Make	Serial No.	Description
AC Test Set	Hipotronics	7962-00	Model 710-1
Voltmeter	Hipotronics	-	2.5/5/10 kV via HV Resistor

Voltmeter Indication, kV	True RMS Voltage, kV	True Peak Voltage, kV	Crest Factor Deviation, per cent	Correction to Indication, per cent
		2.5-kV Range		
0.50	0.49	0.49	0	-2.0
1.00	1.00	1.00	0	0
1.50	1.50	1.50	0	0
2.00	2.00	2.00	0	0
2.50	2.50	2.50	0	0
		5-kV Range		
1.00	0.98	0.98	0	-2.0
2.00	2.00	2.00	0	0
3.00	3.00	3.00	0	0
4.00	4.00	4.00	0	0
5.00	5.00	5.00	0	0
		10-kV Range		
2.00	1.95	1.95	0	-2.5
4.00	4.00	4.00	0	0
6.00	6.00	6.00	0	0
8.00	8.00	8.00	0	0
10.00	10.00	10.00	0	0

B. Ammeters

1. Rockbestos Set No. 740697-2

Model No. 700RAG-1 Range 25/50/150 Amps AC

Indicated Current, Amps	True Current, Amps	Correction, per cent
	25-Amp Range	
5.0	5.4	+8.0
10.0	10.6	+6.0
15.0	15.9	+6.0
20.0	21.1	+5.5
25.0	26.4	+5.6
	50-Amp Range	
10.0	10.8	+8.0
50.0	53.0	+6.0
	150-Amp Range	
30.0	31.0	+3.3
105.0	108.5	+3.3

2. Rockbestos Set No. 740697-3

Model No. 700RAG-1 Range 25/50/150 Amps

Indicated Current, Amps	True Current, Amps	Correction, per cent
	25-Amp Range	
5.0	5.2	+4.0
10.0	10.3	+3.0
15.0	15.6	+4.0
20.0	21.2	+6.0
25.0	26.8	+7.2
	50-Amp Range	
10.0	10.4	+4.0
50.0	53.8	+7.6
	150-Amp Range	
30.0	29.5	-1.7
105.0	108.0	+2.9

E.C.L. Report No. 84008A

B. Ammeters

3. Rockbestos Set No. 740697-4

Model No. 700RAG-1 Range 25/50/150 Amps AC

Indicated Current, Amps	True Current, Amps	Correction, per cent
	25-Amp Range	
5.0	5.4	+8.0
10.0	10.6	+6.0
15.0	15.7	+4.7
20.0	20.8	+4.0
25.0	25.8	+3.2
	50-Amp Range	
10.0	10.6	+6.0
50.0	52.0	+4.0
	150-Amp Range	
30.0	30.5	+1.7
105.0	108.0	+2.9

B. Ammeters

4. Amprobe Clamp-On Meter No. 833852

Model ACD-1 Range 100/1000 Amps AC

Indicated Current, Amps	True Current, Amps	Correction, per cent
10.0	10.2	+2.0
20.0	20.4	+2.0
50.0	50.7	+1.4
75.0	76.0	+1.3
99.9	101.0	+1.1

E.C.L. Report No. 84008

C. Insulation Resistance Test Sets

6. General Radio Megohmmeter 2311

Make General Radio
Serial No. 2311
Model No. 1864
Range 50 KΩ - 50 TΩ

Test Resistor	Instrument Reading	Multiplier	Derived Resistance, Megohms	True Resistance, Megohms	Correction, per cent
		Checks made at 500 volts			
0.5	0.500	1 M	0.500	0.500	0
0.7	0.700	1	0.700	0.700	0
1	0.995	1	0.995	1.000	+1
2	1.86	1	1.86	1.86	0
5	5.0	1	5.0	5.0	0
5	0.500	10	5.00	5.00	0
50	0.505	100	50.5	50.5	0
1 G	1.06	1 G	1060	1060	0
10 G	1.04	10	10400	10200	-2
100 G	0.97	100	97000	97000	0
1 T	0.82	1 T	820000	810000	-1
5 T	0.50	10	5000000	4800000	-4

Measured test voltage = 489 volts.

C. Insulation Resistance Test Sets

3. Simpson Multimeter No. 712397 - Lab

Make Simpson
Serial No. 712397

Model No. 260-7
Range V.I.R

Test Resistor	Instrument Reading	Multiplier	Derived Resistance, Megohms	True Resistance, Megohms	Correction, per cent
1	1.00	1	1.00	1.00	0
10	10.0	1	10.0	10.0	0
100	100	1	100	100	0
100	1.00	100	100	100	0
500	4.95	100	495	500	+1
1000	9.8	100	980	1000	+2
3000	29.5	100	2950	3000	+2
10000	100	100	10000	10000	0
10000	1.00	10000	10000	10000	0
1 MΩ	99	10000	990000	1000000	+1

Note: Meter applies low voltage to test sample.

D. Kelvin Bridges

1. Leeds & Northrup Kelvin 1824344

Make L & N
Serial No. 1824344

Model No. 4287-3
Range 0.0001 - 110 Ω

Test Resistor	Bridge Setting: Variable Resistor	Bridge Setting: Multiplier	Derived Resistance, Ohms	True Resistance, Ohms	Correction, per cent
0.0001	1.0151	10^{-4}	0.00010151	0.00010157	+0.05
0.01	10.099	10^{-3}	0.010099	0.010096	-0.05
0.01	1.0097	10^{-2}	0.010097	0.010096	0
1	10.123	10^{-1}	1.0123	1.0123	0
1	1.0122	1	1.0122	1.0123	0
11	1.100	10	11.00	11.00	0
22	2.200	10	22.00	22.00	0
33	3.300	10	33.00	33.00	0
44	4.400	10	44.00	44.00	0
55	5.500	10	55.00	55.00	0
66	6.600	10	66.00	66.00	0
77	7.700	10	77.00	77.00	0
88	8.800	10	88.00	88.00	0
99	9.900	10	99.00	99.00	0
110	10.999	10	109.99	110.00	0

L. Pressure Gauges

3. Helicoid Pressure Gauge 354

Make Helicoid
Serial No. 354

Type or Model No. 2410-0
Range 160 p.s.i.

Indicated Pressure, p.s.i.	True Pressure, p.s.i.	Correction, per cent
20.5	20.0	-2.5
40.5	40.0	-1.2
79.5	80.0	+0.6
119.5	120.0	+0.4
159.0	160.0	+0.6

4. Helicoid Pressure Gauge No. 355

Make Helicoid
Serial No. 355

Type 2410-0
Range 160 psi

Indicated Pressure, p.s.i.	True Pressure, p.s.i.	Correction, per cent
19.5	20.0	+2.6
40.0	40.0	0
81.0	80.0	-1.2
121.5	120.0	-1.2
161.5	160.0	-0.9

C. Pressure Gauges

1. Molytek Digital Indicator No. 840424044

Model No. 2702S2-I-4-R Range 200 psi

Indicated Pressure, psi	True Pressure, psi	Correction, per cent
20.2	20.0	-1.0
49.6	50.0	+0.8
99.6	100.0	+0.4
149.8	150.0	+0.1
199.9	200.0	+0.1

*E. Temperature Indicators

10. ERTCO Thermometer 96576

Make ERTCO
Serial No. 96576
Type or Model No. F.C.
Range -20 to 110 °C

Indicated Temperature, °C	True Temperature, °C	Correction, °C
24.0	23.7	-0.3
60.0	59.7	-0.3
100.5	100.0	-0.5

11. National Vacuum Oven 1644-103

Make NAPCO
Serial No. 1644-103
Type or Model No. 5831
Range 40-200 °C

Indicated Temperature, °C	True Temperature, °C	Correction, °C
40	40	0
100	100	0
170	170	0

E.C.L. Report No. 84008

J. Temperature Indicators

1. Partlow Recorder No. 7176859 - Mezzanine

Make Partlow
Serial No. 7176859
Type or Model No. RFT
Range 40-340°C

Indicated Temperature, deg. C	True Temperature, deg. C	Correction, deg. C
150	149	-1

2. Partlow Recorder No. 7266667 - Mezzanine

Make Partlow
Serial No. 7266667
Type or Model No. RFT
Range 40-340°C

Indicated Temperature, deg. C	True Temperature, deg. C	Correction, deg. C
110	111	+1

3. Partlow Recorder No. 7176797 - Mezzanine

Make Partlow
Serial No. 7176797
Type or Model No. RFT
Range 40-340°C

Indicated Temperature, deg. C	True Temperature, deg. C	Correction, deg. C
121	121	0

E.C.L. Report No. 84008

J. Temperature Indicators

4. Partlow Recorder No. 7176796 - Mezzanine

Make Partlow
Serial No. 7176796
Type or Model No. RPT
Range 40 - 340 °C

Indicated Temperature, °C	True Temperature, °C	Correction, °C
136	136	0

5. Partlow Recorder No. 7176795 - Mezzanine

Make Partlow
Serial No. 7176795
Type or Model No. RPT
Range 40 - 340 °C

Indicated Temperature, °C	True Temperature, °C	Correction, °C
150	150	0

Checks made after adjustment. As found this instrument indicated 13 °C low.

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

librated
: R.A. Cz[illegible]

1/6/85 Date

ipment: A.C Current Set

ufacturer: Rockbestos

±5.0 % Maximum Allowable Error

-3.85 % Maximum Measured Error

el: 70C RAG-1

Remarks: New Equip

ial #: 740697-6

#:

le: 0-25/50/150 Amps

ation: Autoclave Meez (Chem Equip)

ndards Used:

Amp Probe Model ACD-1
Serial No 833552

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
		0-25 Amp Range					
5.1	5.0	0.1	-1.96				
10.4	10.0	0.4	-3.85				
15.2	15.0	0.2	-1.32				
20.4	20.0	0.4	-1.96				
25.4	25.0	0.4	-1.57				

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

ibrated: R.A. Gibson

ipment: A.C. Current Set

ufacturer: Rockbestos

el: 700RAG-1

ial #: 746697-5

#:

le: 0-25/50/150 Amps

ation: Autoclave Meze (Qual Equip)

ndards Used:

Amp Probe — Model ACD-1
Serial No. 833852

1/6/85 Date

±5.0 % Maximum Allowable Error

+2.34 % Maximum Measured Error

Remarks: New Equip

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
		0-150 Amp Range					
29.3	30.0	-0.7	+2.34				
60.0	60.0	0	0				
91.2	90.0	1.2	-1.32				
120.0	120.0	0	0				

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

ibrated: ZG Sh ____ 1/4/85 Date

ipment: TYPE K THERMOCOUPLES

ufacturer: OMEGA

±50 % Maximum Allowable Error

NONE % Maximum Measured Error

el: TYPE K

Remarks:

ial #: TH1 - TH5 + TH1111

#:

le:

ation: AUTOCLAVE

ndards Used:

LEEDS + NORTHRUP MILLIVOLT POTENTIOMETER
m/n 8690 s/n 1662248
ICE BATH + BOILING DISTILLED WATER

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
		TH1				TH1111	
32°F	32°F	0	0	32°F	32°F	0	0
212°F	212°F	0	0	212°F	212°F	0	0
		TH2					
32°F	32°F	0	0				
212°F	212°F	0	0				
		TH3					
32°F	32°F	0	0				
212°F	212°F	0	0				
		TH4					
32°F	32°F	0	0				
212°F	212°F	0	0				
		TH5					
32°F	32°F	0	0				
212°F	212°F	0	0				

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA   TELEPHONE (203) 772-2250   TELEX 710-465-2149

librated
: R G Gehm

uipment: Clamp-on Ultrasonic Flowmeter

nufacturer: Controlotron

del: 484N1HHT5

rial #: 21C47B

C #:

ale: -40 to +40 FT/SEC

cation: Ablcalt Meez

andards Used:

stopwatch m/n 460 s/n B39427

Jan 3, 1985 Date

20.0 % Maximum Allowable Error

+6.3 % Maximum Measured Error

Remarks: New Equipment

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
4.850 Liter/min							
↓							
1.281 Gal/min	1.2 Gal/min	0.081	+ 6.34				

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

librated : RG [signature] Aug 29, 1984 Date

±2.5 % Maximum Allowable Error

-0.1 % Maximum Measured Error

uipment: STOPWATCH (DEPARTMENT STANDARD)

nufacturer: ACCUSPLIT

del: 460

rial #: B39427

C #:

ale: 00-59999 min

cation:

Remarks: NEW DEPARTMENT STANDARD FIRST OR INITIAL CALIBRATION

andards Used:

WWV TRANSMISSION - DIRECT FROM NBS - CONTINUOUS

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
Mins	Mins						
1.0	0.999	-0.001	-0.1				
2.0	2.001	+0.001	+0.05				
3.0	3.000	0.000	0				
4.0	4.000	0.000	0				
5.0	5.001	+0.001	+0.02				
10.0	10.000	0.000	0				
15.0	14.998	-0.002	-0.013				
30.0	30.000	0.000	0				
45.0	45.001	+0.001	+0.002				
60.0	59.999	-0.001	-0.0016				

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

ibrated: P.G. [signature]

ipment: STRIP CHART RECORDER (3 PEN)

ufacturer: [illegible]

el: 575

ial #: 60301

#:

le: 0-1/2/5/10/20/50/100/200/500mV/1/2/5.

ation: LAB

ndards Used:

LEEDS + NORTHRUP POTENTIOMETER

s/n 8090 s/n 160,248

SEPT 19, 1984 Date

±5.0 % Maximum Allowable Error

1.0 % Maximum Measured Error

Remarks: NEW EQUIP - CALIBRATION WAS PERFORMED IN ACCORDANCE WITH THE [illegible] OPERATION MANUAL DATE 1983 FROM WHICH CALIBRATION PROCEDURE # 47 WAS DERIVED. P.G. [signature] 1/4/85

REWRITTEN FROM ORIGINAL TO CORRECT ERROR NOTED. [signature] 4/24/85

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
		UPPER PEN		5.0 mV	5.01 mV	0.01	0.1
0.5 mV	0.51 mV	0.01	1.0	10.0 mV	10.0 mV	0	0
1 mV	1.00 mV	0	0	10.0 mV	10.01 mV	0.01	0.05
1.0 mV	1.01 mV	0.01	0.5	20.0 mV	20.0 mV	0	0
2.0 mV	2.0 mV	0	0	25.0 mV	25.01 mV	0.01	0.02
2.5 mV	2.51 mV	0.01	0.2	50.0 mV	50.0 mV	0	0
5.0 mV	5.0 mV	0	0			LOWER PEN	
5.0 mV	5.0 mV	0	0	0.5 mV	0.51 mV	0.01	1.0
10.0 mV	10.0 mV	0	0	1.0 mV	1.0 mV	0	0
10.0 mV	10.01 mV	0.01	0.05	1.0 mV	1.0 mV	0	0
20.0 mV	20.0 mV	0	0	2.0 mV	2.0 mV	0	0
25.0 mV	25.01 mV	0.01	0.02	2.5 mV	2.51 mV	0.01	0.2
50.0 mV	50.0 mV	0	0	5.0 mV	5.0 mV	0	0
		MIDDLE PEN		5.0 mV	5.01 mV	0.01	0.1
0.5 mV	0.5 mV	0	0	10.0 mV	10.0 mV	0	0
1.0 mV	1.0 mV	0	0	10.0 mV	10.0 mV	0	0
1.0 mV	1.01 mV	0.01	0.5	20.0 mV	20.0 mV	0	0
2.0 mV	2.0 mV	0	0	25.0 mV	25.01 mV	0.01	0.02
2.5 mV	2.51 mV	0.01	0.2	50.0 mV	50.0 mV	0	0
5.0 mV	[illegible]	[illegible]	[illegible]				

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

llibrated
: R.A. [illegible]

June 6, 1984 Date

uipment: Temp Recorder

nufacturer: [illegible]

±5.0 % Maximum Allowable Error

0 % Maximum Measured Error

del: RFT

rial #: 7176859

C #:

ale:

cation: R+D Maze

Remarks:

ndards Used:

OMEGA 881C # 13910

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
121°	121°	0	0				

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

brated: [illegible signature] — Nov 10 1984 Date

pment: DataLogger (for Temp) — ±5.0 % Maximum Allowable Error

facturer: Monitor — 0.53 % Maximum Measured Error

l: 2762-S-2-I-4-R — Remarks: Low Cond

al #: 8464240-1-23 — Calibration performed in accordance with General Calibration Procedure #27 of Rockbestos Calibration Procedure Manual.

#:

e: 32°F - 500°F (Chn 1-5)

tion: AutoCal Area

dards Used:

Leeds + Northrup Millivolt Potentiometer
Mod 8690 s/n 1606248

Calibration Procedure #52 was derived from the Monitor Datalogger Calibration Manual in conjunction with General Calibration Procedure #27 of Rockbestos Calibration Procedure Manual.

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
(Low Temp)		Chn #1		200.0	200.2	0.2	0.1
32.0	32.0	0	0	300.0	299.9	-0.1	0.03
75.0	75.1	0.1	0.13	400.0	400.1	0.1	0.03
100.0	100.0	0	0	500.0	500.5	0.5	0.1
200.0	199.9	0.1	0.05	(Amb Temp)		Chn #4	
300.0	299.7	0.3	0.1	32.0	32.0	0	0
400.0	400.0	0	0	75.0	74.8	-0.2	0.27
500.0	500.2	0.2	0.04	100.0	100.0	0	0
(Amb Temp)		Chn #2		200.0	200.4	0.4	0.2
32.0	32.1	0.1	0.31	300.0	300.0	0	0
75.0	75.2	0.2	0.27	400.0	400.0	0	0
100.0	100.3	0.3	0.3	500.0	499.7	-0.3	0.06
200.0	199.8	0.2	0.1	(Amb Temp)		Chn #5	
300.0	300.0	0	0	32.0	32.0	0	0
400.0	400.1	0.1	0.03	100.0	100.2	0.2	0.2
500.0	500.0	0	0	200.0	199.5	0.5	0.25
(Amb Temp)		Chn #3		300.0	300.3	0.3	0.10
32.0	32.0	0	0	400.0	400.0	0	0
75.0	75.0	0	0	500.0	500.5	0.5	0.1
100.0	100.1	0.1	0.10	75.0	75.4	0.4	0.53

THE ROCKBESTOS COMPANY

NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE: (203) 772-2250 TELEX 710-465-2149

ibrated: R.G. [signature]

1-6-85 Date

ipment: pH METER

ufacturer: ORION RESEARCH

el: 501

ial #: 48229

#:

le: 0.0 to 14.00 pH

ation: ANTICLAIMT MEEP (RECEIVAL AGAIN)

±5.0 % Maximum Allowable Error

0.0 % Maximum Measured Error

Remarks: NEW EQUIP. - CALIBRATED BEFORE EACH USE.

dards Used:

CALIBRATION - STANDARD BUFFER SOLUTION 10.00pH @ 25°C NBS TRACEABLE

STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR	STD. VALUE	TEST VALUE	DIFFER. FROM STD.	% ERROR
		INITIAL CHECK @ 25°C					
10.00pH	10.10pH	0.10	1.0				
		CALIBRATION @ 25°C					
10.00pH	10.00pH	0.0	0.0				

pH Meter

Photovolt pH Meter 85A

Model 185

Serial No. 39585

Unit is Calibrated before each use.

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SALES AND SERVICE
SIMPSON

STANDARDIZING
LABORATORY

24 May, 1983

Subject: L & N Mod. 8690 Millivolt Potentiometer, s/n 1602248
Mfg. Rated Accuracy: Per Manual
Deviation When Tested: None
Submitted By: CEROCK WIRE & CABLE
Activity: Certification
Test No: 33952

Standard: R.F.L. Model 1605, s/n 144, certified to an accuracy of .02% of actual reading, directly traceable to N.B.S. 5 June, 1982, Due: 5 June, 1983.
Ref. N.B.S. Test Nos:
Standard Cell Test # 230273
Source: N.B.S. Date:4/12/83 Due: 4/12/84
Current Transfer: # 521/222331
Voltage: # 521/222331
Res. Standard: # 221.01/220188

Our calibration system complies with MIL-STD-45662.

Tests were conducted at an ambient temperature of 70° F. and 48% relative humidity.

The subject item was calibrated within the manufacturers specications.

By: Burton J. Warren

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