

TSI TECHNICAL NOTE 42584

ANALYSIS OF

THE THERMAL RESPONSE OF THE JUNCTION BETWEEN A

PARTIALLY PROTECTED MEMBER WHICH PROTRUDES

THE THERMO-LAG 330 FIRE BARRIER AND A CABLE TRAY

APRIL 1984

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THE THERMAL RESPONSE OF THE JUNCTION BETWEEN A
PARTIALLY PROTECTED MEMBER WHICH PROTRUDES
THE THERMO-LAG 330 FIRE BARRIER AND A CABLE TRAY

TSI performed a thermal analysis in support of its recommendation that unprotected members penetrating the THERMO-LAG 330 Fire Barrier be fire protected for a distance of at least 18", as measured from their entry into the Fire Barrier.

For the purpose of this analysis, it was assumed that the penetrating member is in intimate contact with the protected entity. The higher the cross-sectional area of the unprotected penetrating member in proportion to the specific mass of the protected entity - the more critical the incipient condition.

A square tube, having 0.25 wall and an outside diameter of 4", is considered in the performance of this analysis. The square tube is penetrating into a 12"x4" steel cable tray, having a nominal wall thickness of 0.1 inches. The length of the square tube is considered to be infinite. There is no direct penetration of flames into the interior of the square tube.

The square tube is protected with the THERMO-LAG 330 Subliming Coating Material, in a dry film thickness of 0.550 inches minimum. This thickness is based on the data contained in:

"Engineering Report On The THERMO-LAG 330-1 Fireproofing Coating Thicknesses Required For 1 And 3 Hour Fire Ratings For Various Structural Steel Members.

The data contained therein was empirically obtained and analytically correlated to facilitate interpolation of thickness as a function of time, heat flux, member, mass, and duration of exposure within the limits of available independent laboratory experimental test data.

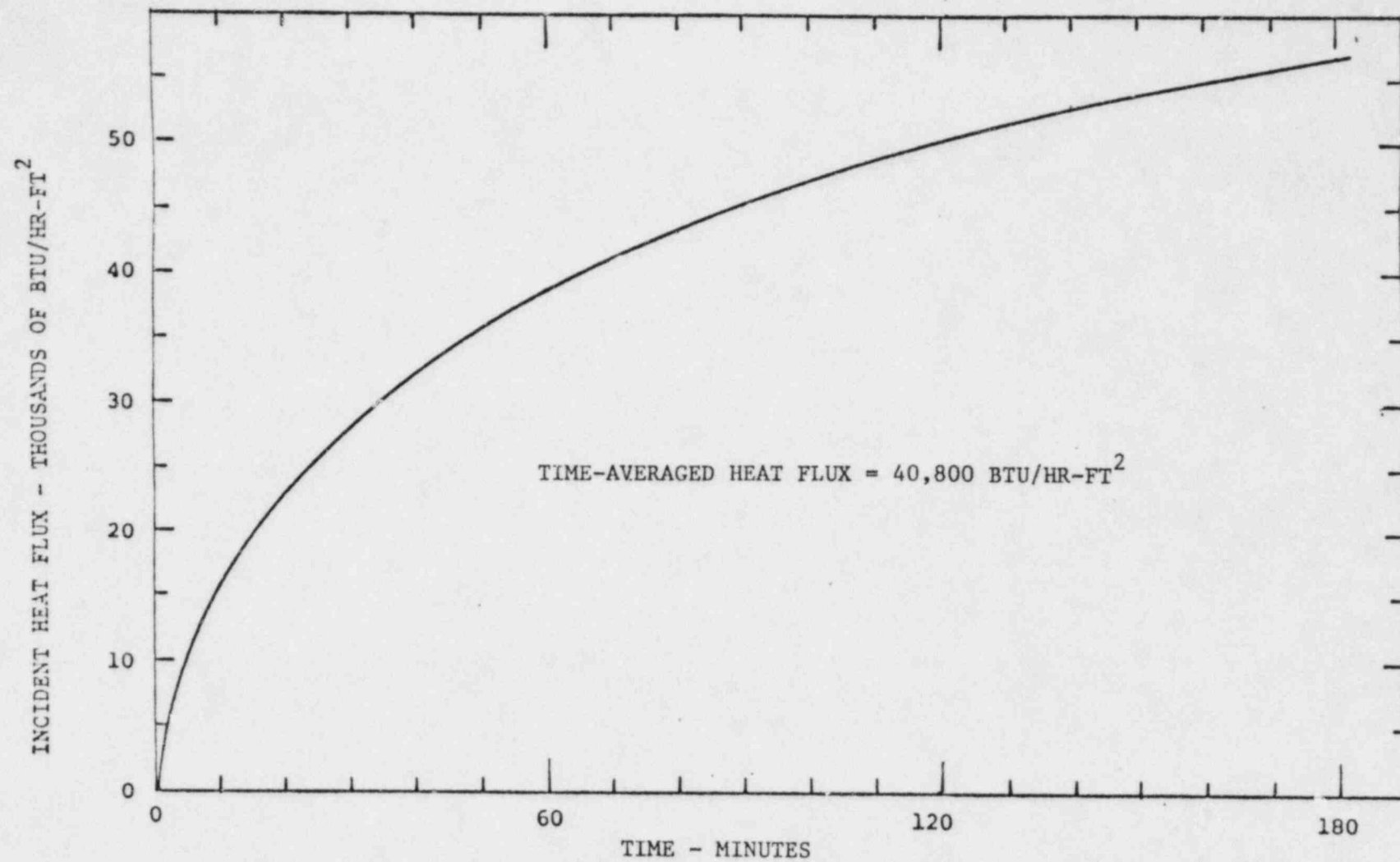
The cable tray is protected with the THERMO-LAG 330 Subliming Coating Material in a dry film thickness of 1.00 inches minimum.

The maximum limiting average temperature rise above ambient is 250°F. The maximum permissible temperature rise at any location is 300°F. For 75°F, the maximum average temperature is 325°F. The maximum individual temperature is 375°F.

This was obtained by considering the ASTM E119 guidelines for a maximum temperature rise on the unexposed side of a fire wall assembly. The fire environment used in this analysis is delineated in the ASTM E119 test method. The heat flux and flame temperature, as a function of time, is depicted in Figure 1. TSI's multi-layer ablation, numerical analysis program is utilized in this analysis.

The thermal environment around the thermally protected section of the protruding square tube member was integrated to facilitate its use with the uni-dimensional energy balances. For conservatism, the analysis utilized the more critical path, which is obtained when the conditions present at the junction between the penetrate and the cable tray fire barrier are considered.

FIGURE 1: ASTM E119 INCIDENT HEAT FLUX AS A FUNCTION OF TIME



The following material properties were used in this analysis:

For Steel:

Specific Heat	0.1 Btu/ ^o F/lbm
Thermal Conductivity	360 Btu-Ft/Hr/Ft ² / ^o F
Density	490 lbs/cu ft

For THERMO-LAG 330 Fire Barrier Material:

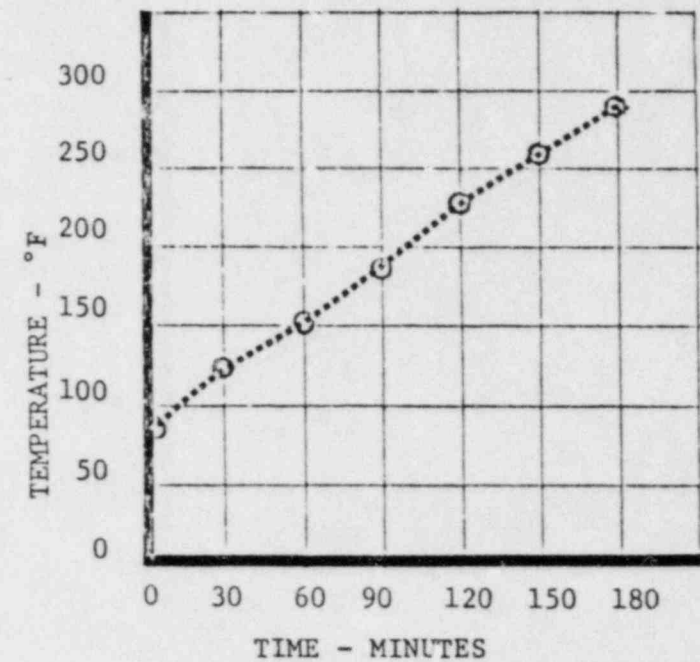
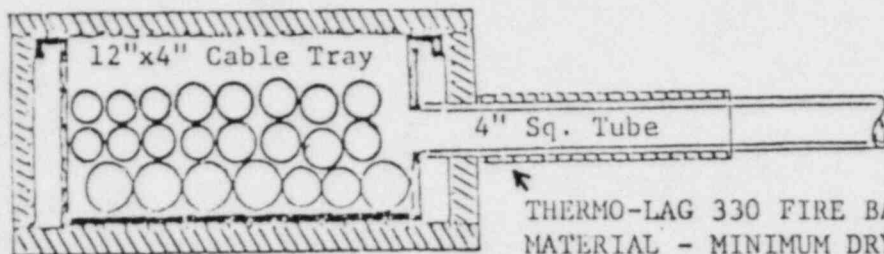
Specific Heat	0.3 Btu/ ^o F/lb
Integrated Thermal Conductivity	0.10 Btu-Ft/Hr/Ft ² / ^o F
Density	78 lbs/cu ft
Emissivity During Fire	0.9
Thermal Performance:	$t = 23.002 (T) (T)^{0.7} (W)^{0.5} / (F) \quad 1.3356$

The results of the analysis are shown in Figure 2. The maximum temperature attained at the junction between a partially protected member which protrudes the THERMO-LAG 330 Fire Barrier and a cable tray, at the end of the three hour fire exposure, is 295⁰F.

FIGURE 2

THERMAL RESPONSE OF THE JUNCTURE BETWEEN
A PARTIALLY PROTECTED MEMBER WHICH PROTRUDES
THE THERMO-LAG 330 FIRE BARRIER AND A CABLE TRAY

THERMO-LAG 330 FIRE BARRIER MATERIAL
MINIMUM DRY FILM THICKNESS = 1.00"



SUMMARIES OF THE TEST RESULTS FOR FERMI 2
CONFIGURATIONS OF THE 3M FIRE PROTECTION ENVELOPE

The attached five summaries provide information relevant to test results applicable to all the basic configurations of the 3M fire protection envelope design at Fermi 2.

Four of the summary sheets provide a roadmap for defining those sections of the generic UL Test Report that applies to the fire wrap design that Detroit Edison is currently using. The fifth summary is of a test 3M has conducted on their new junction box design. We currently expect to have UL certification of this junction box design by the week of July 30, 1984.

The overall conclusion for the four tests UL has performed of our design is:

"The electrical protection system(s) are judged to achieve a 1-hour fire rating".

The test data from the 3M tests indicates that the new junction box design has a 1-hour fire rating.

REPORT SUMMARY 1

PROTECTIVE ENVELOPE FOR CLASS 1E CIRCUITS

Based upon U. L. Test Report File R10125-1, 2 Project 82NK21937
(Dated October 19, 1983).

Electrical Protection System CS-195/M on Trays

Material: 3M Fire Barrier Mat M20A, Scotch Brand Electrical Tape #49, Aluminum Tape #49, (alternate #425 tape), special staples Fire Barrier Cord #34 and/or 5/8" steel strapping, 1/2" hardward cloth and Fire Barrier Caulk CP-25 and/or Putty 303, Fire Barrier Composite Sheet CS-195, and Unistrut Framing System.

	<u>Result</u>	<u>Page In U. L. Test Report</u>
1.0 Fire Prot. Rating	One hour	C-1
1.1 ASTM-E119	Fire Conforms	T2-2
1.2 Circuit Integrity	Pass	C-1
1.3 Temperatures on Cables	*	Appendix B
1.4 Cables Generic	XLPE-PVC	6 & 7
1.5 Hose Stream Test	Pass	T2-3
1.6 Furnace Size	22' 10" x 14' 2" x 7'	

*Temperatures on Cables at 60 Minutes (°F)
Minimum Fill of Cables in Open Ladder Tray

	300 Ave.	MCM Max.	7/C-#12 Ave.	Max.	2/C-#16 Ave.	Max.
U. L. Test 2-System 1	284	332	399	414	385	468

U. L. Test 2 - System 1 was a 4" x 24" tray

NOTE: Attached are temperature summaries and graphs for this test.

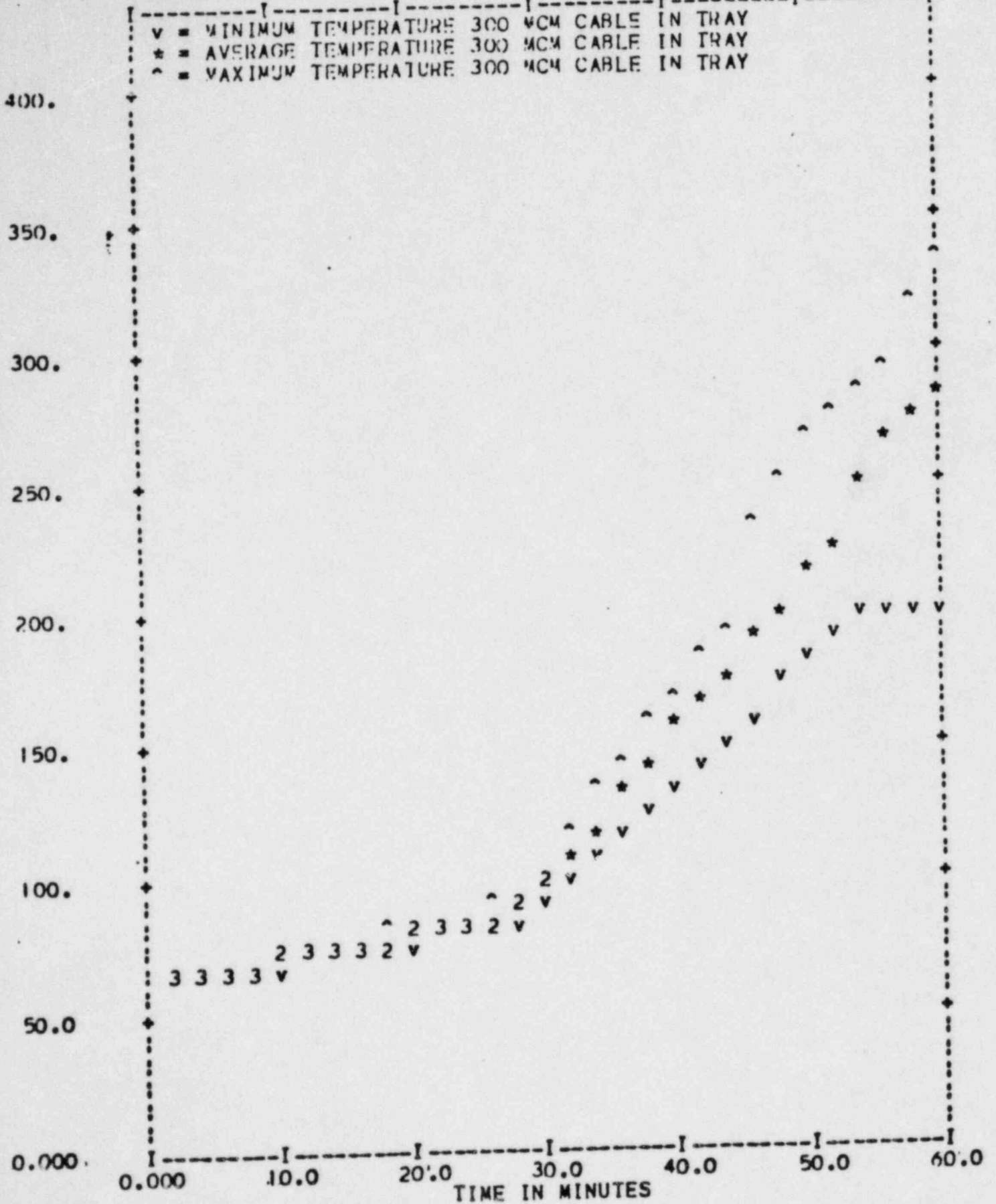
REPORT #3410539909-15A

TEMPERATURES ON CABLES VS TIME

The attached graphs show the specific data that is detailed in the U. L. report for the test on cable trays. The format gives the specific thermocouples, the minimum value at the that time, the average of the thermocouples, the maximum, statistical data, and the number of thermocouples used in the specific average.

The graphs and that data use the same data name.

UL Test 2
System 1



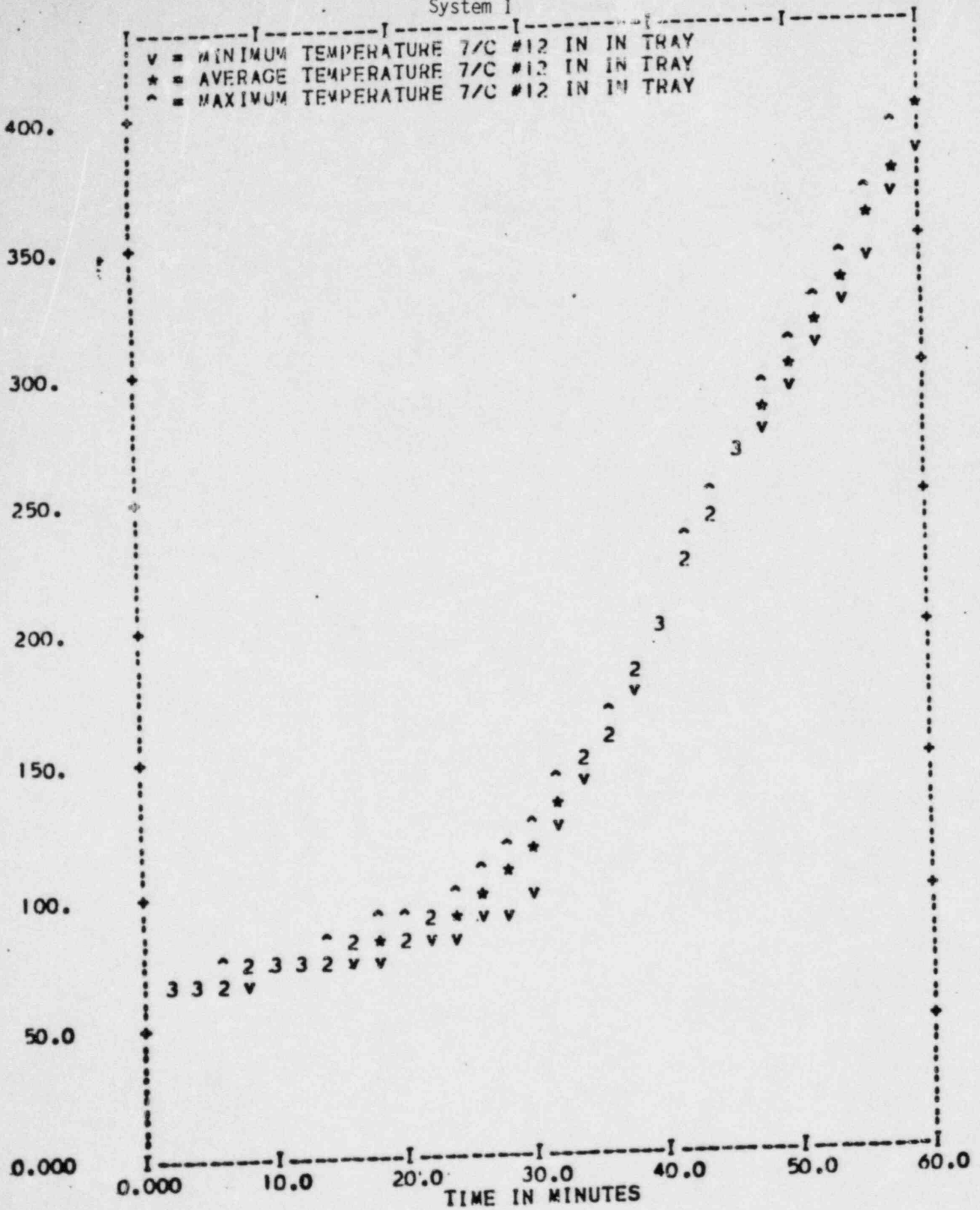
(NUMERALS INDICATE # OF COINCIDENT POINTS)

FILE NAME: CSM300.TR2

TC# 14 17 20

DEG F	T-MIN	T-AVG	T-MAX	T+1SIG	T-1SIG	#
2	67.900	68.367	68.700	68.782	67.951	3
4	68.000	68.533	68.800	68.995	68.071	3
6	68.700	69.067	69.300	69.388	68.746	3
8	69.500	69.833	70.000	70.122	69.544	3
10	70.600	71.067	71.300	71.471	70.663	3
12	71.700	72.267	72.900	72.869	71.664	3
14	73.100	74.433	76.600	76.326	72.540	3
16	75.100	76.100	77.800	77.580	74.620	3
18	75.900	78.300	81.300	81.049	75.551	3
20	77.900	79.167	80.300	80.372	77.961	3
22	80.100	81.633	84.000	83.712	79.554	3
24	80.100	83.033	86.300	86.147	79.920	3
26	82.600	86.167	89.800	89.767	82.566	3
28	85.900	90.200	92.500	93.927	86.473	3
30	90.200	97.167	102.60	103.51	90.826	3
32	98.800	111.53	118.20	122.56	100.50	3
34	106.60	120.13	130.00	132.26	108.01	3
36	117.70	130.70	142.10	142.98	118.42	3
38	124.60	142.33	155.10	158.18	126.49	3
40	132.30	156.77	170.00	177.98	135.55	3
42	143.70	166.03	185.60	187.12	144.95	3
44	152.00	175.00	193.50	196.11	153.89	3
46	160.50	193.43	233.50	230.45	156.41	3
48	172.70	203.03	247.90	242.68	163.38	3
50	185.90	216.60	264.10	258.32	174.88	3
52	194.60	226.33	276.20	270.05	182.62	3
54	199.00	248.23	286.60	293.03	203.43	3
56	201.00	263.00	295.10	316.70	209.30	3
58	201.90	273.47	313.80	335.61	211.32	3
60	203.70	283.83	332.40	353.75	213.92	3

UL Test 2
System 1

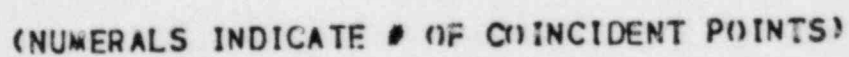


(NUMERALS INDICATE # OF COINCIDENT POINTS)

DATA FILE NAME: CM7C12.TR2

FILE NAME: CM7C12.TR2

TC#	5	16				
DEG F	T-MIN	T-AVG	T-MAX	T+ISIG	T-ISIG	#
2	68.400	69.000	69.600	69.848	68.152	2
4	68.600	69.250	69.900	70.170	68.330	2
6	69.100	70.000	70.900	71.273	68.727	2
8	70.000	71.050	72.100	72.535	69.565	2
10	71.200	72.750	74.300	74.942	70.558	2
12	72.700	74.900	77.100	78.011	71.789	2
14	74.400	77.250	80.100	81.281	73.219	2
16	76.400	80.200	84.000	85.574	74.826	2
18	79.000	83.550	88.100	89.985	77.115	2
20	81.700	86.800	91.900	94.012	79.588	2
22	84.000	89.900	95.800	98.244	81.556	2
24	86.700	93.750	100.80	103.72	83.780	2
26	89.000	97.100	105.20	108.56	85.645	2
28	93.400	105.80	118.20	123.34	88.264	2
30	97.700	112.55	127.40	133.55	91.549	2
32	125.30	131.95	138.60	141.35	122.55	2
34	143.70	146.30	148.90	149.98	142.62	2
36	161.30	161.95	162.60	162.87	161.03	2
38	178.50	180.90	183.30	184.29	177.51	2
40	198.50	199.85	201.20	201.76	197.94	2
42	222.40	225.95	229.50	230.97	220.93	2
44	244.00	245.60	247.20	247.86	243.34	2
46	262.60	264.05	265.50	266.10	262.00	2
48	278.90	284.40	289.90	292.18	276.62	2
50	291.80	301.20	310.60	314.49	287.91	2
52	308.00	317.05	326.10	329.85	304.25	2
54	325.30	333.80	342.30	345.82	321.78	2
56	342.30	354.35	366.40	371.39	337.31	2
58	364.40	376.75	389.10	394.22	359.28	2
60	384.70	399.30	413.90	419.95	378.65	2



7 of 12

FILE NAME: CM2C16.TR2

TC#	4	6	7	10	11	15	23	26	27	30	#
DEG F	T-MIN	T-AVG	T-MAX	T+1SIG	T-1SIG						
2	68.400	68.960	69.400	69.313	68.607						10
4	68.400	69.160	69.500	69.556	68.764						10
6	68.600	69.870	70.900	70.598	69.142						10
8	69.000	71.190	73.400	72.649	69.731						10
10	69.900	73.120	77.800	75.524	70.716						10
12	71.100	75.840	83.400	79.575	72.105						10
14	72.800	79.190	91.600	84.831	73.549						10
16	75.100	83.320	101.90	91.429	75.211						10
18	76.600	88.610	120.50	101.72	75.499						10
20	78.400	94.090	134.20	111.35	76.833						10
22	80.400	98.980	140.80	118.39	79.570						10
24	82.800	103.83	145.20	124.30	83.360						10
26	85.500	108.81	144.90	128.54	89.080						10
28	88.700	112.39	141.90	130.44	95.340						10
30	92.800	118.54	141.00	134.35	102.73						10
32	107.40	136.28	159.10	153.29	119.27						10
34	119.80	146.56	169.30	163.12	130.00						10
36	132.90	159.02	186.70	175.61	142.43						10
38	146.90	172.49	210.20	191.29	153.69						10
40	155.30	187.34	243.00	212.82	161.86						10
42	168.40	204.85	267.50	235.97	173.73						10
44	176.50	223.03	282.80	259.62	186.44						10
46	180.40	243.16	303.40	287.34	198.98						10
48	183.40	262.86	323.70	314.49	211.23						10
50	188.70	280.87	345.60	339.88	211.86						10
52	188.90	300.13	367.30	367.09	233.17						10
54	189.90	318.77	394.30	394.33	243.21						10
56	197.90	339.26	418.20	420.16	258.36						10
58	198.90	362.62	443.00	443.41	281.83						10
60	214.50	385.31	468.40	469.00	301.62						10

REPORT #3410539909-15A

INSTALLATION INSTRUCTIONS

CONTENTS:

5300-T1

5300-T1-1

5300-T9

10 of 12

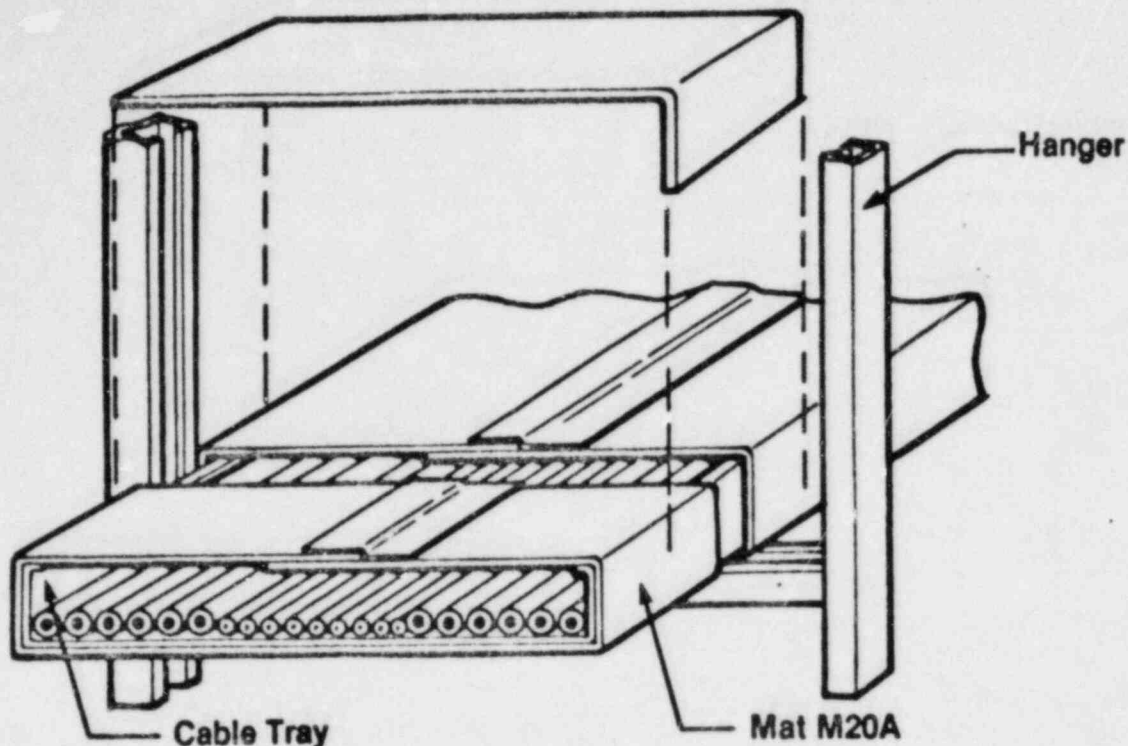
INSTALLATION DETAILS

Installation Instructions

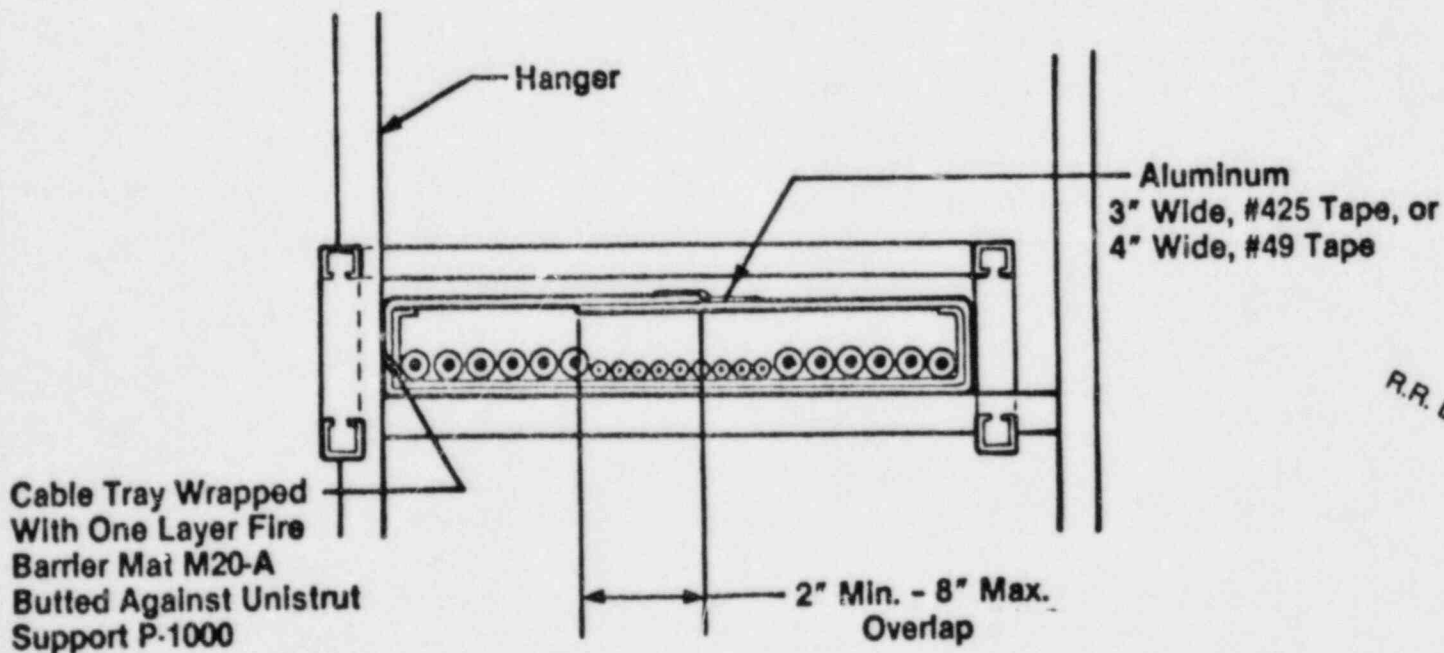
1. (Wrap tray with one layer of 49" wide mat M20A as detailed in 5300-T9 and described in 5300-H1)
2. Insure a minimum 2" overlap of each layer. When placing the next 49" wide section of mat M20A, butt seams. (See 5300-H1) cover seams with either 3" wide, 3M #425 tape or 4" wide, 3M #49 tape.
3. Assemble Unistrut or engineering approved equivalent box frame on cable tray (see 5300-T1 and 5300-U1-1).
4. Cut Fire Barrier Composite Sheet to fit onto exterior of box frame. All corner seams must be constructed so that one Fire Barrier Sheet overlaps the other sheet (reference drawing 5300-S2).
5. Attach Fire Barrier Composite Sheet to box frame. Use 3/4" bit tip screws with washers; use only enough screws to hold sheets in place.
6. Cover all seams and edges with Fire Barrier Mat M20A 4" wide as described in details 5300-S1-1, 5300-S2-1, and 5300-S1A-1.

NOTE: An option to using self-drilling screws is banding seams on the box system.
See Detail 5300-T1A.

<small>All statements, technical information and recommendations contained herein are based on tests we believe to be reliable. However, since the conditions of use and application are beyond our control, 3M shall not be liable for any damage, direct or consequential, resulting from the use of this material or design. 3M's only warranty shall be to replace any of our products found to be defective.</small>	ISSUE	DATE	REV.	CH.	Fire Barrier Cable Tray Protection System
	NOT TO SCALE		CH		
	DR		APP		
Electro-Products Division 3M	5300-T1-1				



Detail A
Mat Application With Hanger Interface
 (See Also 5300)



R.R. LIC

All statements, technical information and recommendations contained herein are based on tests we believe to be reliable. However, since the conditions of use and application are beyond our control, 3M shall not be liable for any damage, direct or consequential, resulting from the use of this material or design. 3M's only warranty shall be to replace any of our products found to be defective.

ISSUE	DATE	REV.	CH.
1	12 APR. 83		
NOT TO SCALE		CH	
DR J.F.KRENIK		APP	

Cable Tray Protection System with Inner Layer of Mat M20A

Electro-Products Division **3M**

5300-T9

REPORT SUMMARY 2

PROTECTIVE ENVELOPE FOR CLASS 1E CIRCUITS

Based upon U. L. Test Report File R10125 Project 82NK21937 dated November 2, 1983

Electrical Protection System M20A on Cable Trays

Material: 3M Fire Barrier Mat M20A, Scotch Brand Electrical Tape #49, aluminum tape (alternate #425 tape), special staples, Fire Barrier Cord #34 and/or 5/8" steel strapping, 1/2" hardward cloth and Fire Barrier Caulk CP-25 and/or Putty 303.

	<u>Result</u>	<u>Page In U.L. Report</u>
1.0 Fire Prot. Rating	One hour	7
1.1 ASTM-E119	Fire Conforms	6
1.2 Temperatures on Conductors	*	Illus. 4 thru 13
1.3 Cables Generic	Bare Copper Wire	4
1.4 Hose Stream Test	Pass	6
1.5 Furnace Size	22' 10" x 14' 2" x 7'	
1.6 Temp. on Cable Tray	Tray Rung - 367°F Tray - 324°F	6 NA
1.7 Max. Edison Electrical Cable Rated Conductor (Edison Design #)	190° F	
1.8 Max. Individual Cable or Cable Tray Temp. Rise.	394°-86° = 308°F	6
1.9 Max. Cable Temp. inside System (Calculated from above)	308 + 190 = 498°F	NA
1.10 Min. Temp. for Cable Failure (UL Report 9380030601)	610°F	NA
1.11 UL Rating - Acceptable Based on 498° (1.9) being less than 610°F (1.10)		6

*Temperatures on Bare Conductors at 60 Minutes (°F)

U. L. Test	250 MCM		1/0		#8 AWG		#14 AWG	
	Ave.	Max.	Ave.	Max.	Ave.	Max.	Ave.	Max.
4" x 24" Tray	255	286	272	356	288	307	347	394

Attached are graphs and summary data

TEMPERATURES ON CABLES VS TIME

The attached graphs show the specific data that is detailed in the U. L. report for the test on cable trays. The format gives the specific thermocouples, the minimum, statistical data, and the number of thermocouples used in the specific average.

The graphs and the data use the same data name.

250 MCM Conductor

^ = MAXIMUM TEMPERATURE
* = AVERAGE TEMPERATURE #2250
v = MINIMUM TEMPERATURE

TEMPERATURE

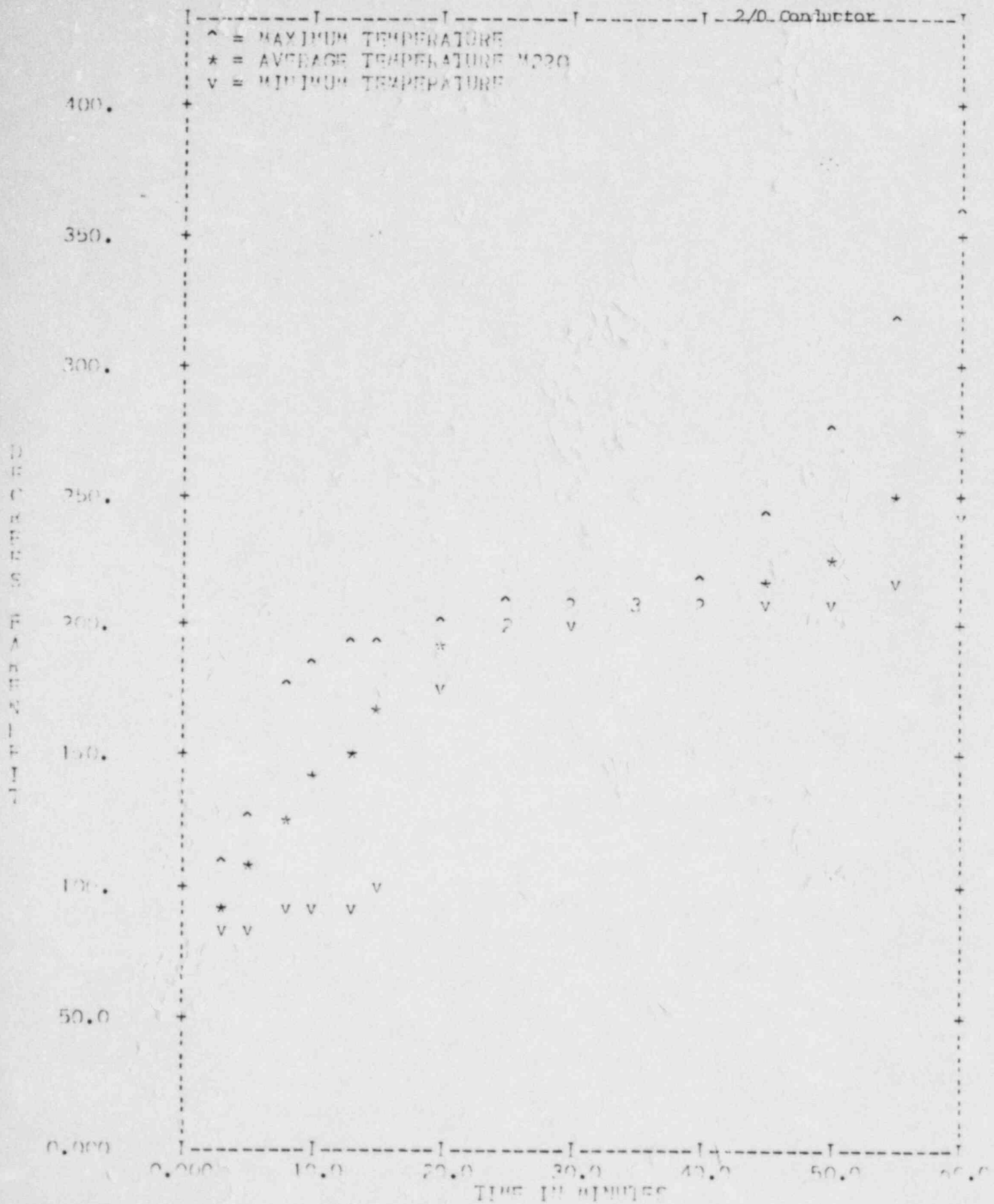


(NUMERALS INDICATE # OF COINCIDENT POINTS)

DATA FILE NAME: #2250.DAT

250 MCM Conductor

Time	Minimum	Average	Maximum	A -	A +	#
2.5.	84.2.	87.2.	96.3.	83.7.	90.7.	9
5.0.	86.5.	90.2.	108.8.	82.8.	97.6.	9
7.5.	86.7.	98.0.	129.9.	80.9.	115.2.	9
10.0.	87.3.	111.5.	172.0.	81.4.	141.7.	9
12.5.	92.5.	132.1.	182.9.	97.9.	166.3.	9
15.0.	119.9.	160.5.	188.8.	132.0.	188.9.	9
20.0.	181.2.	193.3.	199.9.	187.4.	199.3.	9
25.0.	202.3.	203.5.	204.5.	202.8.	204.3.	9
30.0.	205.3.	207.8.	208.8.	206.4.	209.1.	9
35.0.	206.4.	208.8.	209.9.	207.4.	210.2.	9
40.0.	206.6.	209.2.	210.6.	207.8.	210.6.	9
45.0.	206.4.	209.4.	210.9.	208.2.	210.7.	9
50.0.	209.9.	213.5.	227.3.	207.8.	219.2.	9
55.0.	211.6.	238.3.	354.1.	193.8.	282.9.	9
60.0.	228.4.	255.2.	285.7.	238.1.	272.3.	9



(NUMERALS INDICATE # OF COINCIDENT POINTS)

DATA FILE NAME: M220.OUT

2/0 Conductor

Time	Minimum	Average	Maximum	A -	A +	#
2.5,	86.5,	94.6,	110.0,	85.2,	104.1,	5
5.0,	86.9,	104.8,	124.2,	87.1,	122.6,	5
7.5,	87.6,	124.4,	173.0,	87.1,	161.6,	5
10.0,	88.0,	137.5,	182.3,	95.2,	179.7,	5
12.5,	91.7,	153.1,	187.8,	112.2,	194.0,	5
15.0,	103.8,	167.6,	191.5,	130.7,	204.4,	5
20.0,	174.8,	191.5,	197.4,	182.0,	201.0,	5
25.0,	199.8,	202.5,	204.4,	200.8,	204.2,	5
30.0,	204.1,	206.6,	208.7,	204.5,	208.7,	5
35.0,	206.4,	208.3,	210.2,	206.8,	209.8,	5
40.0,	206.6,	209.3,	212.5,	207.2,	211.5,	5
45.0,	206.6,	216.4,	241.4,	202.2,	230.6,	5
50.0,	209.2,	224.8,	276.8,	195.7,	254.0,	5
55.0,	217.2,	246.8,	314.8,	201.2,	292.4,	4
60.0,	239.2,	272.3,	355.8,	224.7,	320.0,	5

#8 AWG Conductor

^ = MAXIMUM TEMPERATURE
* = AVERAGE TEMPERATURE A28
v = MINIMUM TEMPERATURE

TEMPERATURE



NUMERALS INDICATE # OF COINCIDENT POINTS

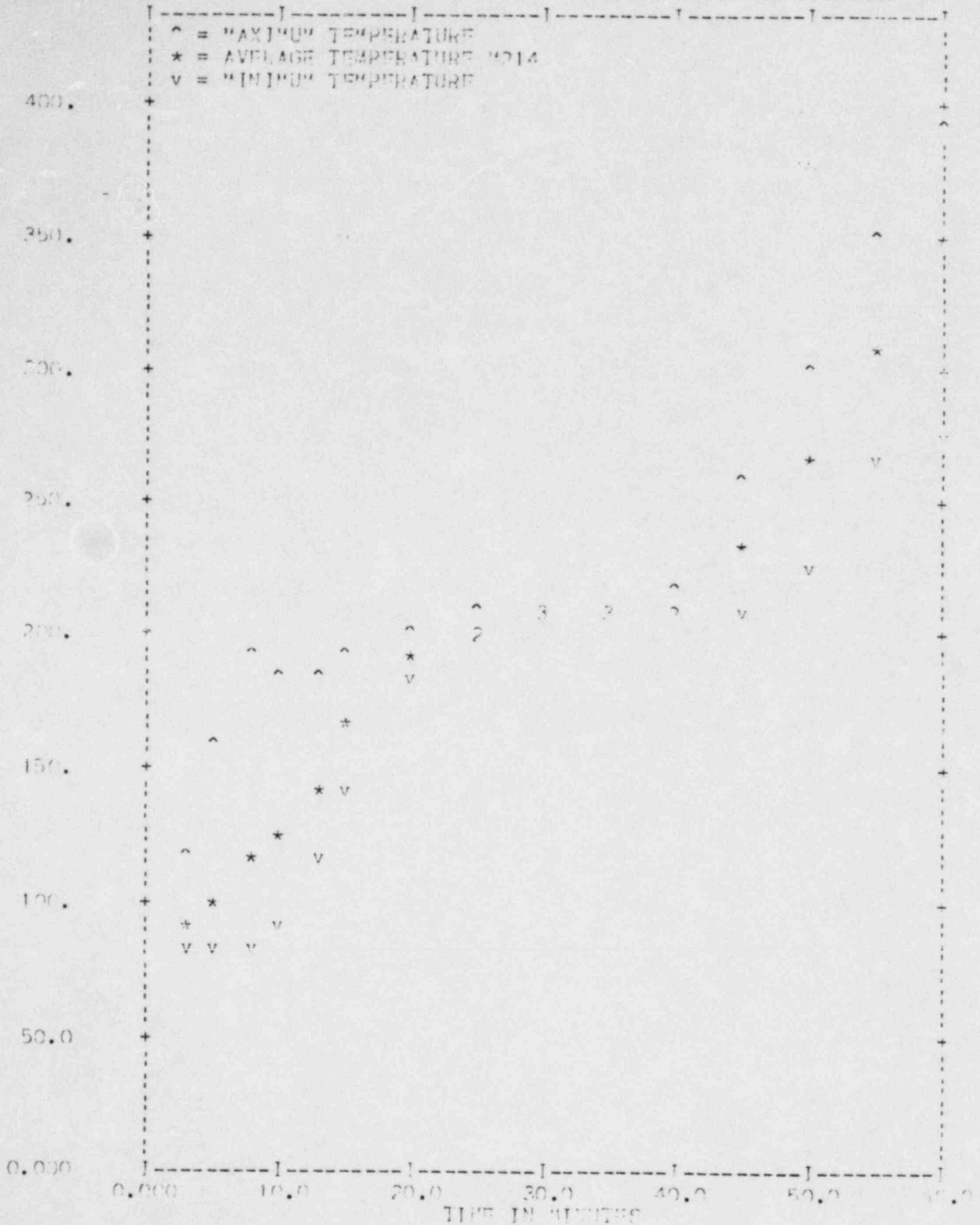
DATA FILE NAME: A08.CUT

#8 AWG Conductor

Time	Minimum	Average	Maximum	A -	A +	#
2.5.	86.9.	95.7.	106.4.	85.8.	105.6.	4
5.0.	78.7.	104.3.	129.8.	79.3.	129.4.	4
7.5.	88.4.	124.1.	176.0.	81.5.	166.7.	4
10.0.	93.6.	134.6.	179.8.	90.4.	178.7.	4
12.5.	110.4.	153.4.	186.9.	116.5.	190.4.	4
15.0.	137.8.	173.6.	192.5.	148.5.	198.7.	4
20.0.	191.1.	194.7.	198.1.	191.3.	198.1.	4
25.0.	202.7.	205.1.	207.6.	202.8.	207.4.	4
30.0.	204.3.	207.2.	208.7.	205.2.	209.2.	4
35.0.	207.1.	208.6.	209.5.	207.6.	209.7.	4
40.0.	207.3.	209.4.	210.9.	207.9.	210.9.	4
45.0.	208.5.	210.1.	212.1.	208.6.	211.6.	4
50.0.	209.9.	216.8.	226.7.	209.3.	224.3.	4
55.0.	219.2.	246.0.	263.6.	225.2.	266.7.	4
60.0.	263.2.	287.5.	306.7.	268.0.	306.9.	4

#14 AWG Conductor

CORRELATION OF TEMPERATURE



(NUMERALS INDICATE # OF COINCIDENT POINTS)

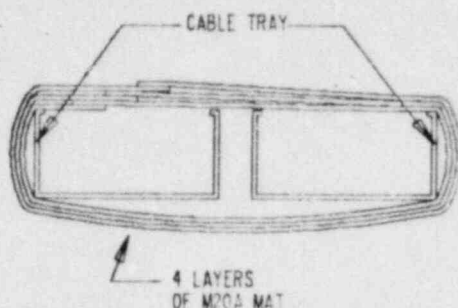
DATA FILE NAME: #214.001

#14 AWG Conductor

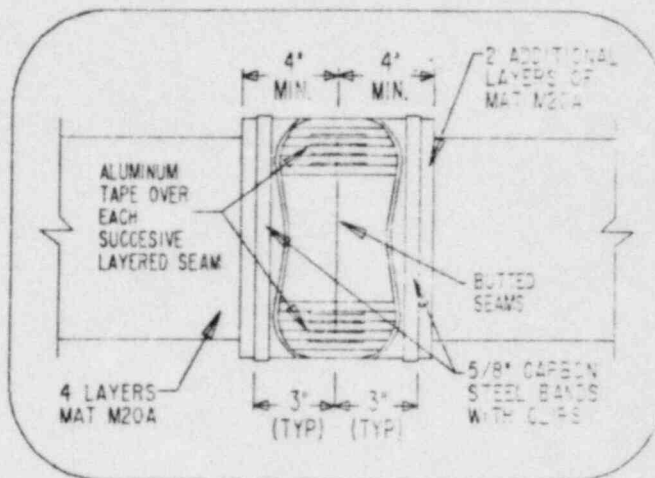
Time	Minimum	Average	Maximum	A -	A +	#
2.5,	85.0,	93.2,	114.3,	82.3,	104.0,	9
5.0,	85.6,	101.5,	154.4,	78.3,	124.8,	9
7.5,	86.2,	113.7,	188.7,	77.8,	149.6,	9
10.0,	92.7,	125.9,	184.1,	86.9,	164.9,	9
12.5,	112.7,	145.2,	186.9,	112.9,	177.5,	9
15.0,	139.1,	167.3,	193.4,	145.0,	189.6,	9
20.0,	187.3,	193.0,	199.2,	188.8,	197.3,	9
25.0,	200.0,	203.8,	208.1,	201.6,	206.0,	9
30.0,	204.6,	207.9,	210.0,	205.8,	210.0,	9
35.0,	206.7,	209.1,	211.2,	207.6,	210.6,	9
40.0,	206.4,	211.3,	219.0,	207.8,	214.7,	9
45.0,	208.0,	235.6,	256.9,	218.3,	252.9,	9
50.0,	228.0,	270.0,	298.7,	247.5,	292.5,	9
55.0,	267.3,	311.5,	347.3,	286.1,	337.0,	9
60.0,	270.3,	346.7,	393.5,	309.0,	384.4,	9

REFERENCE PRINT	REFERENCE DESCRIPTION
5300-T16-1	-- INSTALLATION INSTRUCTIONS
5300-T16-2	-- INSTALLATION INSTRUCTIONS (Cont)
5300-T16-ML	-- MATERIAL LIST

MULTIPLE CABLE TRAYS



THE SAME PROCEDURES MAY BE FOLLOWED FOR SIDE-BY-SIDE, OR STACKED TRAYS AS USED FOR SINGLE TRAYS.



Detail A

SIDE VIEW

(CUT-AWAY AT SEAMS)

THE DEPICTION AT RIGHT SHOWS TWO SEPARATE INCIDENCES OF POSSIBLE SEAM SPACING. IN THE APPLICATION OF FIRE BARRIER THERE ARE NO GAPS IN COVERAGE.

5/8" CARBON STEEL BANDS ON 6" CENTERS, OR CORD 34 SPACED 3" MAX. ICORD MUST BE COVERED WITH ALUMINUM TAPE AFTER WRAPPING

1 LAYER ALUMINUM TAPE (FOR EACH SEAM)

STAPLE ON 2" MAX. SPACING PRIOR TO APPLYING ALUMINUM TAPE

NOTE:

DO NOT STAPLE TO THE MAT M20A. STAPLES SHOULD BE APPLIED TO THE ALUMINUM TAPE.

2" MINIMUM SPACING

1/2" PLASTIC STRAPPING TO PREVENT TOP SAG

2" MINIMUM PERIMETER OVERLAP

2" MINIMUM SPACING BETWEEN SEAMS OF SUCCESSIVE LAYERS

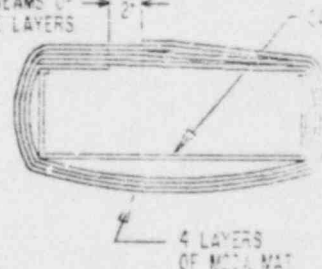
CABLE TRAY

FIRST LAYER MAT M20A

SECOND LAYER MAT M20A

THIRD LAYER MAT M20A

FOURTH LAYER MAT M20A



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ISSUE	DATE	REV	CH.
2	10-10-83		
NOT TO SCALE		CH	J.R. TUZINSKI
DR. P.A. LeTOURNEAU		APP	D.N. HUNTER

Electro-Products Division/3M

3M

5300-T16

FIRE BARRIER
Straight Run Tray
and Multiple Trays
M20A

INSTALLATION INSTRUCTIONS

Straight Run of Cable Tray (continued)

9. After the last layer has been applied, the entire system must be restrained with either 5/8 inch carbon steel bands or Cord #34. The spacing of the steel bands is 8 inches maximum and the spacing of the Cord #34 is 3 inches maximum.
10. The Cord #34 must be overwrapped with a layer of Aluminum Tape to maintain spacing and protect it from damage.

Multiple Tray

1. Multiple trays are wrapped as a single unit, using the techniques for the single trays.
2. If the mat needs support to prevent sagging, a plastic band may be applied around the trays.
3. Hangers which penetrate into the system should first be wrapped according to the appropriate hanger instruction. The intersection of the hanger and the Mat should be protected the same as the dropouts.

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ISSUE
2

DATE
10-10-93

REV CH

NOT TO SCALE

OR

RT Dripki
10/22/93
HUB

FIRE BARRIER TRAY
STRAIGHT RUN AND
MULTIPLE TRAY

Electro-Products Division/3M **3M**

5310-11-100

3M MATERIAL USED -- SEE SHEET 5300-TT-1 FOR ORDERING INFORMATION


REFERENCE NAME		TRADE NAME
MAT M20A	--	3M BRAND FIRE BARRIER MAT M20A
CORD 34	--	3M BRAND FIRE BARRIER CORD 34
ALUMINUM TAPE	--	SCOTCH BRAND ELECTRICAL TAPE #49 ALTERNATE APPROVED TAPE 3M BRAND #425

USER SUPPLIED MATERIALS

REFERENCE NAME		TRADE NAME
STAPLER	--	BOSTICH MODEL P-4 STAPLER OR EQUIVALENT
STAPLE(S)	--	BOSTICH STAPLES STCR 50A-9/16" OR EQUIVALENT
PLASTIC STRAP	--	1/2" PLASTIC STRAPPING
STEEL BANDS	--	5/8" CARBON STEEL STRAPPING BANDS

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ISSUE	DATE	REV	CH
1	10-10-83		
NOT TO SCALE	CH	JR. TUZINSKI	
DR P.A. LeTOURNEAU	APP	D.W. HUNDE	

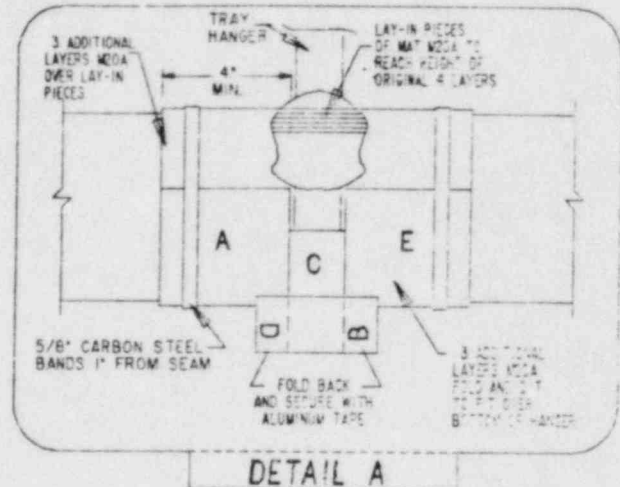
FIRE BARRIER 
Straight Run Tray
and Multiple Trays
Material List
M20A

REFERENCE PRINT •

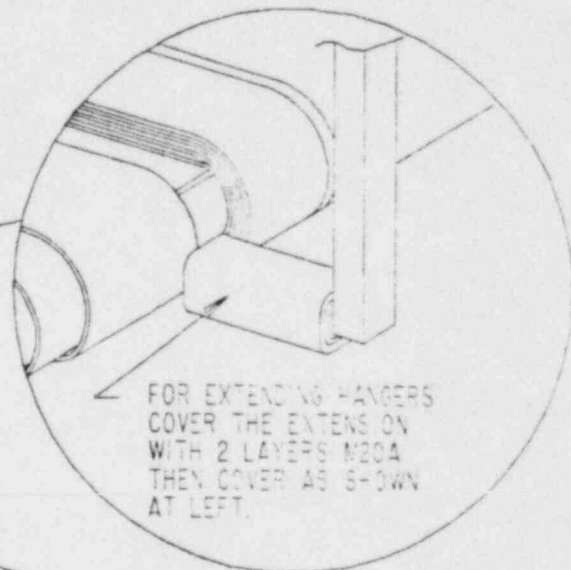
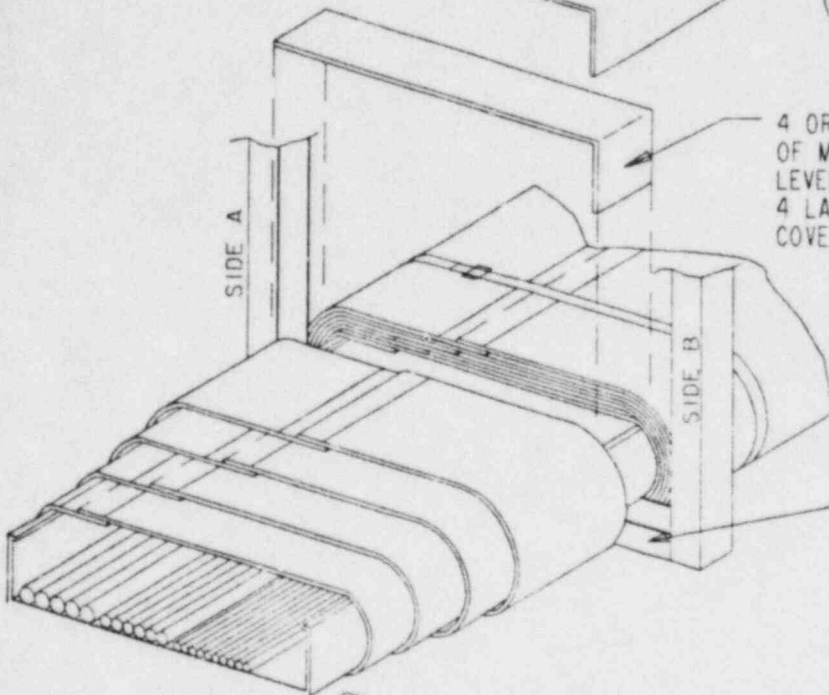
REFERENCE DESCRIPTION

5300-T17-I -- INSTALLATION INSTRUCTIONS
5300-T17-ML -- MATERIAL LIST

3 TOP LAYERS M20A TO COVER LAY-IN PIECES. TOP PIECES SHOULD BE CUT TO OVERLAP THE ORIGINAL 4 LAYERS BY AT LEAST 4" ON EACH SIDE.

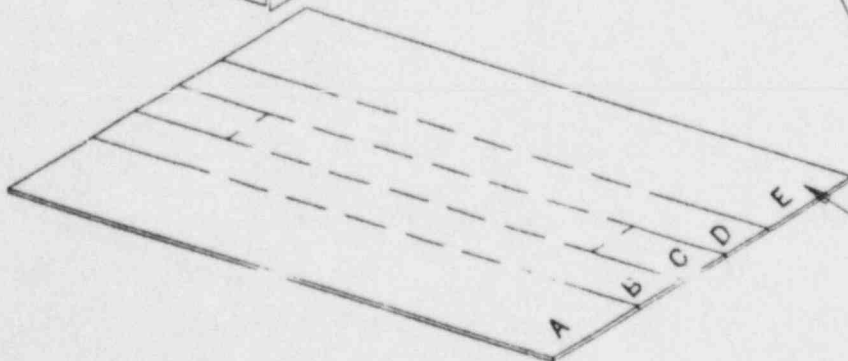


4 OR MORE LAYERS OF MAT M20A TO BRING LEVEL UP TO ORIGINAL 4 LAYERS. IF POSSIBLE COVER SIDES OF TRAY.



FOR EXTENDING HANGERS COVER THE EXTENSION WITH 2 LAYERS M20A THEN COVER AS SHOWN AT LEFT.

3 BOTTOM LAYERS M20A TO COVER THE TRAY HANGER BOTTOM OUT ON SOLID LINES. FOLD ON DOTTED LINES. FOLD TABS AS SHOWN IN DETAIL A.



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ISSUE	DATE	REV	CH.
2	10-10-83		
NOT TO SCALE		CH. J.R. TUZINSKI	
OR P.A. LeTOURNEAU		APP. D.K. HUNTER	

FIRE BARRIER
Tray - Hanger
Interface



Electro-Products Division/3M



5300-T17

M20A

REPORT SUMMARY 3

PROTECTIVE ENVELOPE FOR CLASS 1E CIRCUITS

Based upon U. L. Test Report File R10125-1, 2 Project 82NK21937.
(Dated October 19, 1983)

Electrical Protection System - 3M Mat M20A on Conduit & Air Drops

Material; 3M Fire Barrier Mat M20A, Scotch Brand Electrical Tape #49, Aluminum Tape #49 (alternate #425 tape), special staples, Fire Barrier Cord #34.

	<u>Result</u>	<u>Page In U.L. Report</u>
1.0 Fire Prot. Rating	One hour	C-1
1.1 ASTM-E119	Fire Conforms	T1-2 T2-2
1.2 Circuit Integrity	Pass	C-1
1.3 Temperatures on Cables	*	Appendix A & B
1.4 Cables Generic	XLPE-PVC	2, 3, 6 & 7
1.5 Hose Stream Test	Pass	T1-3 T2-3
1.6 Furnace Size	22' 10" x 14' 2" x 7'	

U. L. Test 1 - System 4 - 2 Inches Conduit Minimum Fill
U. L. Test 2 - System 2 - 5 Inches Conduit Minimum Fill
U. L. Test 1 - System 1 - two cables of each size

*Temperatures on Cables in Conduit at 60 Minutes (⁰F)

Minimum Cable Fill

	Layers of Mat	300 MCM		7/C-#12		2/C-#16	
		Ave.	Max.	Ave.	Max.	Ave.	Max.
U. L. Test 1-System 4	5	---	---	281	393	234	296
U. L. Test 2-System 2	2	373	397	402	436	440	521

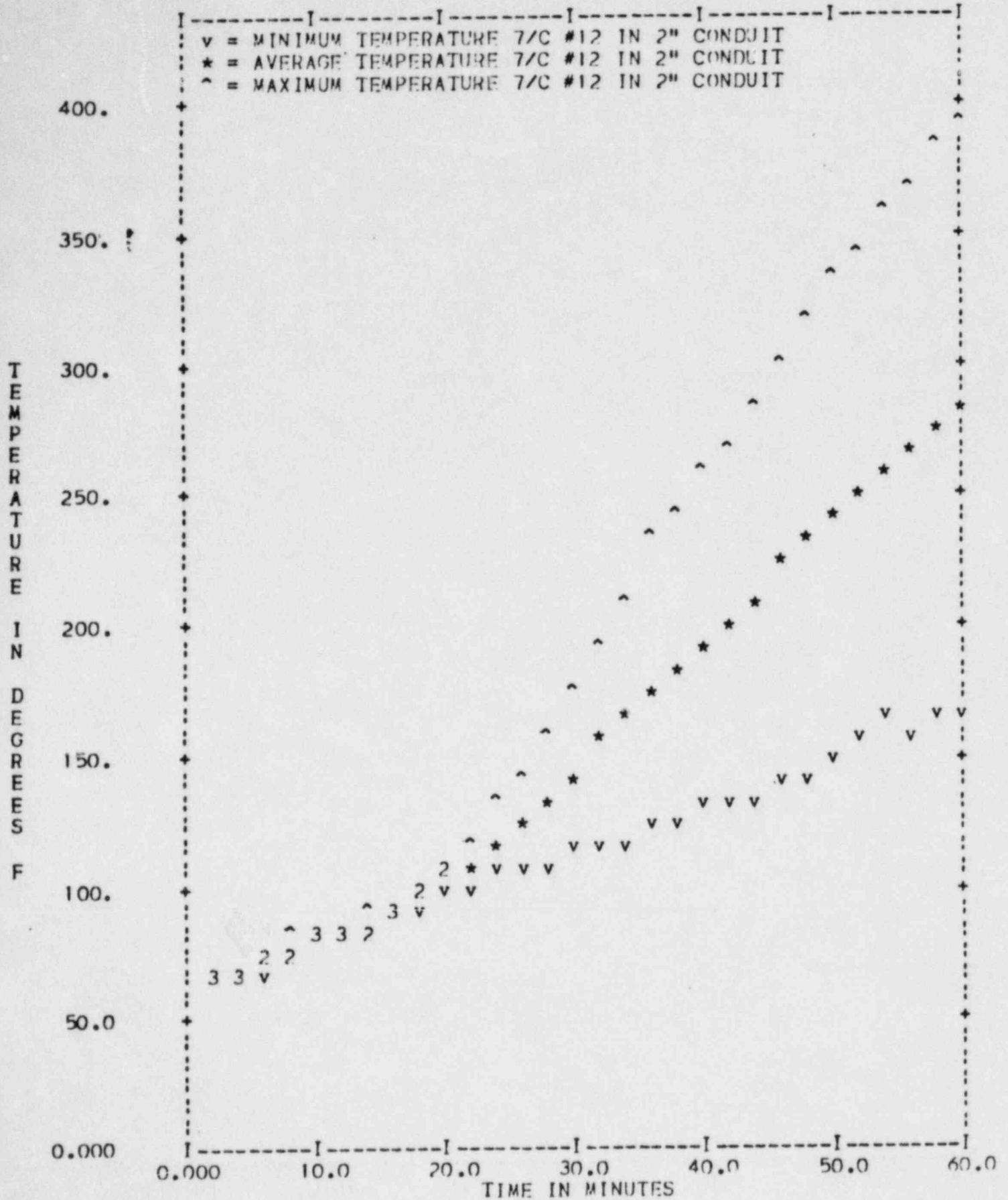
NOTE: Attached are graphs and summary data for these tests

*Temperatures on Cables in Air -Drop at 60 Minutes (⁰F)

	300 MCM		7/C-#12		2/C-#16	
	Ave.	Max.	Ave.	Max.	Ave.	Max.
U. L. Test 1-System 1	292	292	199	199	342	442

TEMPERATURES ON CABLES VS. TIME. 3M SUMMARY OF U. L. DATA

INSTALLATION INSTRUCTIONS



(NUMERALS INDICATE # OF COINCIDENT POINTS)

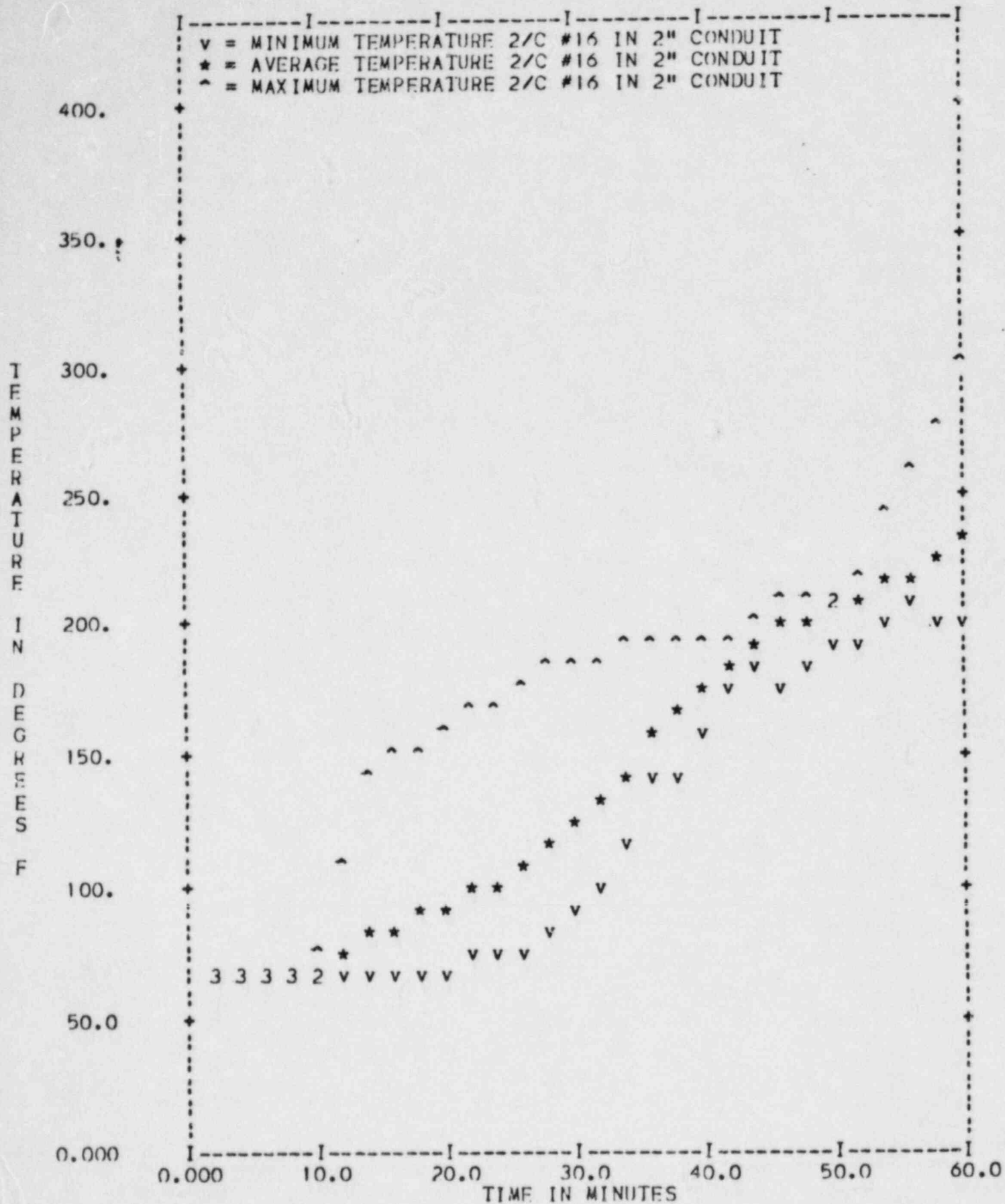
DATA FILE NAME: 2M7C12.C01

FILE NAME: 2M7C12.C01

TC#: 166 171

DEG F	T-MIN	T-AVG	T-MAX	T+1SIG	T-1SIG	# *
2	67.400	67.700	68.000	68.124	67.276	2
4	68.300	68.700	69.100	69.265	68.135	2
6	70.000	73.050	76.100	77.363	68.737	2
8	74.800	77.250	79.700	80.715	73.785	2
10	79.700	81.050	82.400	82.959	79.141	2
12	82.800	83.200	83.600	83.765	82.635	2
14	86.500	87.450	88.400	88.793	86.107	2
16	93.300	94.000	94.700	94.990	93.010	2
18	94.300	98.800	103.30	105.16	92.436	2
20	97.700	104.80	111.90	114.84	94.759	2
22	101.30	110.85	120.40	124.36	97.344	2
24	104.60	117.25	129.90	135.14	99.360	2
26	108.10	125.00	141.90	148.90	101.10	2
28	107.70	132.15	156.60	166.73	97.573	2
30	113.60	143.10	172.60	184.82	101.38	2
32	117.10	154.65	192.20	207.75	101.55	2
34	120.70	166.55	212.40	231.39	101.71	2
36	121.00	175.15	229.30	251.73	98.570	2
38	124.10	184.95	245.80	271.00	98.895	2
40	130.90	192.70	254.50	280.10	105.30	2
42	134.90	199.95	265.00	291.94	107.96	2
44	137.20	211.90	286.60	317.54	106.26	2
46	143.90	223.80	303.70	336.80	110.80	2
48	143.50	230.20	316.90	352.81	107.59	2
50	148.20	238.80	329.40	366.93	110.67	2
52	154.90	248.45	342.00	380.75	116.15	2
54	164.80	259.95	355.10	394.51	125.39	2
56	157.20	263.20	369.20	413.11	113.29	2
58	169.10	275.35	381.60	425.61	125.09	2
60	169.80	281.35	392.90	439.11	123.59	2

** = Number of thermal couples averaged on all data pages like this.



(NUMERALS INDICATE # OF COINCIDENT POINTS)

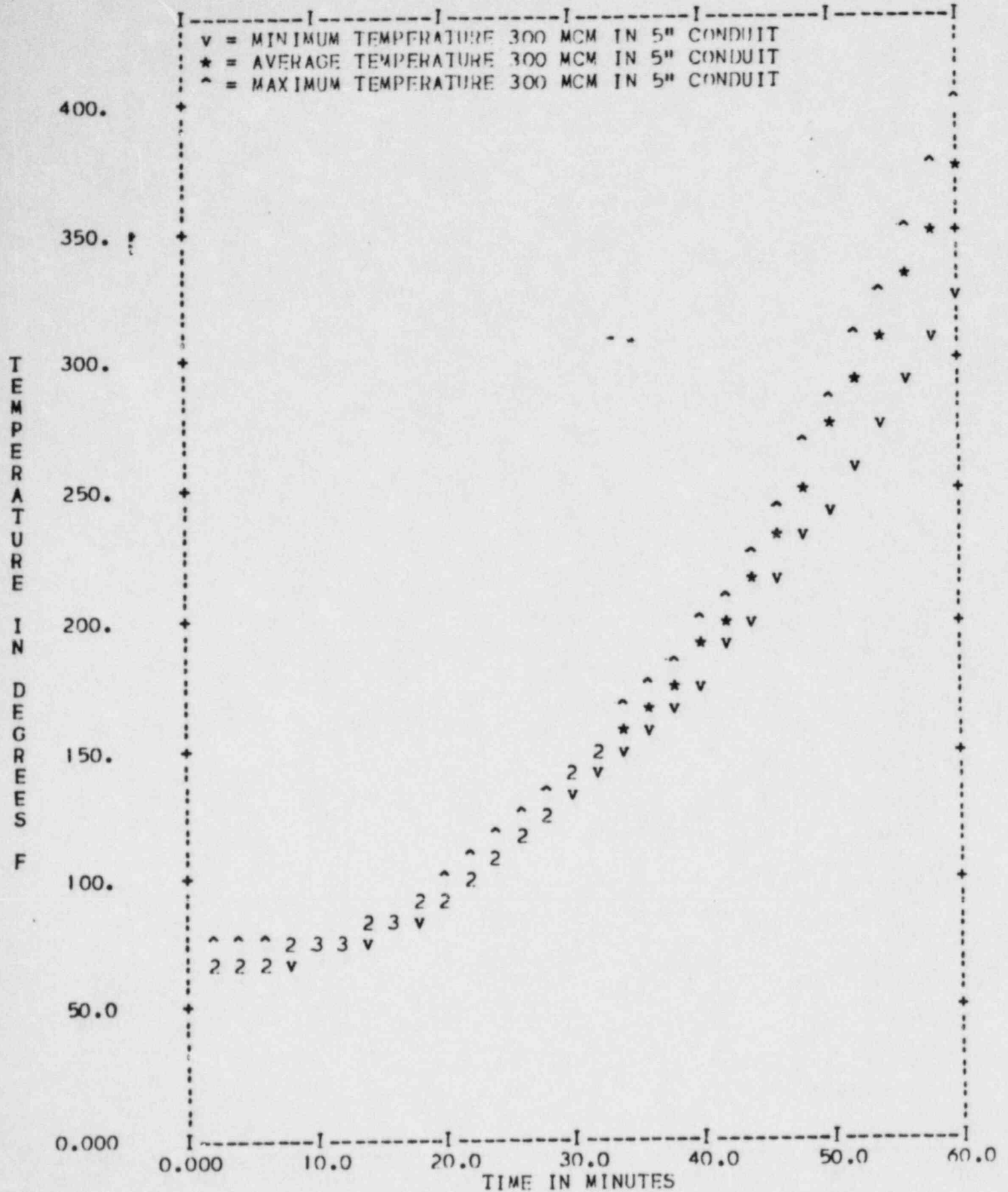
DATA FILE NAME: 2M2C16.CO1

FILE NAME: 2M2C16.C01

TC# 263 264 265 267 268 269 270 271

DEG F	T-MIN	T-AVG	T-MAX	T+1SIG	T-1SIG	# *
2	65.800	66.675	67.100	67.146	66.204	8
4	65.900	66.725	67.100	67.172	66.278	8
6	66.000	66.700	67.000	67.085	66.315	8
8	66.700	67.050	67.600	67.300	66.800	8
10	66.800	68.350	72.400	70.734	65.966	8
12	67.000	74.788	111.20	90.605	58.970	8
14	67.300	81.625	139.90	108.82	54.430	8
16	67.700	85.625	146.90	117.48	53.766	8
18	68.500	88.425	148.70	122.47	54.376	8
20	69.900	92.538	159.00	130.40	54.676	8
22	71.700	97.175	166.00	137.94	56.408	8
24	74.300	102.19	169.60	143.86	60.517	8
26	78.600	107.21	174.10	147.92	66.506	8
28	85.900	113.94	179.20	152.21	75.665	8
30	93.900	121.16	182.50	155.76	86.566	8
32	102.80	132.20	185.30	162.32	102.08	8
34	114.10	143.11	187.80	168.48	117.75	8
36	138.10	157.04	190.30	174.18	139.89	8
38	144.00	165.59	192.50	180.17	151.01	8
40	160.60	176.05	193.70	186.29	165.81	8
42	176.30	186.11	195.10	192.94	179.29	8
44	180.30	193.63	201.80	200.96	186.29	8
46	175.10	197.07	205.70	206.81	187.34	8
48	184.00	202.02	208.00	209.85	194.20	8
50	189.80	204.30	209.20	210.83	197.77	8
52	195.20	208.46	217.50	215.59	201.34	8
54	203.30	214.35	238.30	226.43	202.27	8
56	204.90	219.38	256.70	237.33	201.42	8
58	203.80	225.73	275.70	250.01	201.44	8
60	200.50	234.78	296.40	267.28	202.27	8

#* = Number of thermal couples averaged on all data pages like this.



(NUMERALS INDICATE # OF COINCIDENT POINTS)

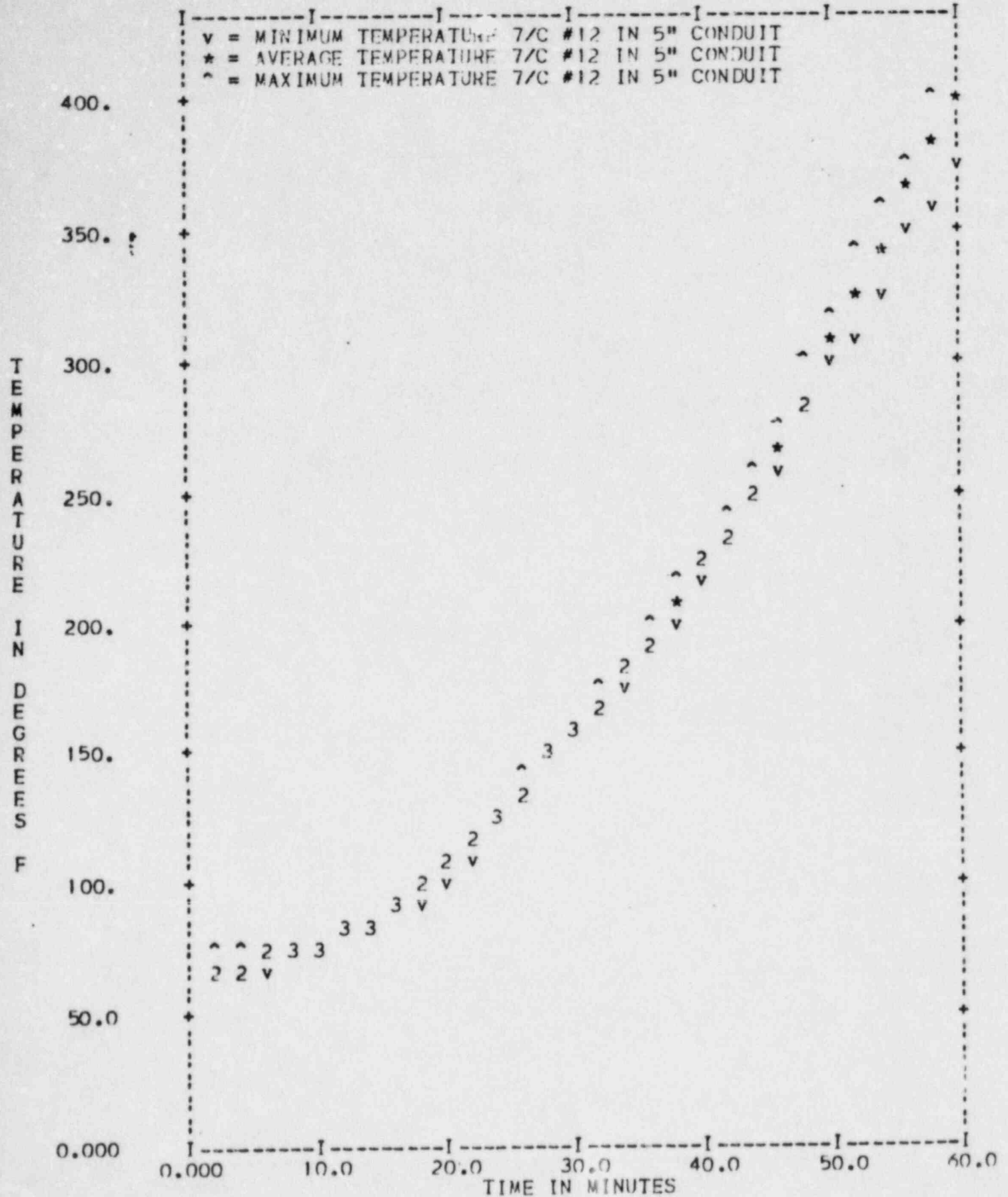
DATA FILE NAME: 5M300.C02

FILE NAME: 5M300.C02

TC# 106 111 115

DEG F	T-MIN	T-AVG	T-MAX	T+ISIG	T-ISIG	# *
2	68.600	70.167	71.000	71.524	68.809	3
4	68.700	70.367	71.300	71.813	68.920	3
6	69.100	70.833	71.800	72.337	69.329	3
8	70.100	71.867	72.900	73.404	70.330	3
10	71.900	73.567	74.500	75.013	72.120	3
12	74.400	76.033	76.900	77.448	74.618	3
14	77.600	79.267	80.600	80.794	77.739	3
16	81.900	83.567	85.500	85.381	81.752	3
18	87.000	88.800	91.500	91.181	86.419	3
20	93.100	95.167	98.600	98.161	92.173	3
22	99.800	102.47	106.60	106.10	98.837	3
24	106.70	110.57	115.30	114.93	106.20	3
26	114.10	119.63	124.60	124.91	114.36	3
28	121.70	129.00	133.80	135.43	122.57	3
30	129.60	138.17	143.30	145.63	130.70	3
32	137.80	147.43	153.40	155.85	139.01	3
34	146.90	157.37	164.10	166.55	148.18	3
36	156.70	168.00	175.60	177.98	158.02	3
38	167.40	179.10	186.90	189.42	168.78	3
40	178.90	190.63	198.30	200.95	180.31	3
42	192.60	203.43	211.30	213.13	193.74	3
44	203.10	217.90	228.10	231.02	204.78	3
46	216.20	234.43	245.80	250.38	218.48	3
48	230.30	252.13	265.00	271.14	233.12	3
50	245.80	271.27	286.10	293.42	249.11	3
52	262.00	290.83	307.10	315.87	265.79	3
54	278.30	310.87	328.70	339.11	282.62	3
56	294.60	331.40	351.20	363.30	299.50	3
58	311.10	352.27	374.00	387.94	316.60	3
60	327.50	373.73	397.30	413.77	333.69	3

#* = Number of thermal couples averaged on all data pages like this.



(NUMERALS INDICATE # OF COINCIDENT POINTS)

DATA FILE NAME: 5M7C12.C02

FILE NAME: 5M7C12.C02

TC#: 105 110 114

UL Test 2

System 2

DEG F	T-MIN	T-AVG	T-MAX	T+ISIG	T-ISIG	# *
2	68.700	69.850	71.000	71.476	68.224	2
4	69.100	70.500	71.200	71.712	69.288	3
6	70.100	71.333	72.000	72.403	70.264	3
8	72.000	73.000	73.500	73.866	72.134	3
10	75.400	75.833	76.100	76.212	75.454	3
12	79.500	79.667	79.900	79.872	79.462	3
14	83.600	84.433	85.400	85.341	83.525	3
16	88.500	90.400	92.400	92.352	88.448	3
18	94.400	97.500	100.50	100.55	94.449	3
20	101.60	105.77	109.20	109.62	101.91	3
22	110.70	115.23	118.40	119.26	111.21	3
24	121.30	125.83	128.80	129.82	121.85	3
26	133.30	136.83	138.90	139.91	133.76	3
28	146.20	148.13	150.00	150.03	146.23	3
30	156.90	158.37	160.40	160.18	156.55	3
32	166.70	169.00	171.80	171.59	166.41	3
34	177.60	181.43	184.60	184.98	177.89	3
36	189.80	194.30	198.60	198.70	189.90	3
38	202.80	208.20	213.50	213.55	202.85	3
40	216.70	222.17	228.90	228.36	215.97	3
42	231.40	236.70	244.20	243.38	230.02	3
44	246.20	251.37	259.80	258.73	244.00	3
46	262.20	266.10	277.40	276.25	259.95	3
48	280.40	286.50	297.40	295.96	277.04	3
50	297.60	306.03	317.90	316.61	295.46	3
52	312.40	324.73	338.10	337.61	311.85	3
54	328.80	344.07	358.50	358.93	329.20	3
56	346.10	363.07	378.70	379.41	346.73	3
58	358.90	380.17	400.60	401.03	359.30	3
60	375.00	402.87	436.50	434.02	371.71	3

#* = Number of thermal couples averaged on all data pages like this.

UL Test 2
System 2

v = MINIMUM TEMPERATURE 2/C #16 IN 5" CONDUIT
 * = AVERAGE TEMPERATURE 2/C #16 IN 5" CONDUIT
 ^ = MAXIMUM TEMPERATURE 2/C #16 IN 5" CONDUIT

TEMPERATURE
IN
DEGREES
F

400.
350.
300.
250.
200.
150.
100.
50.0
0.000

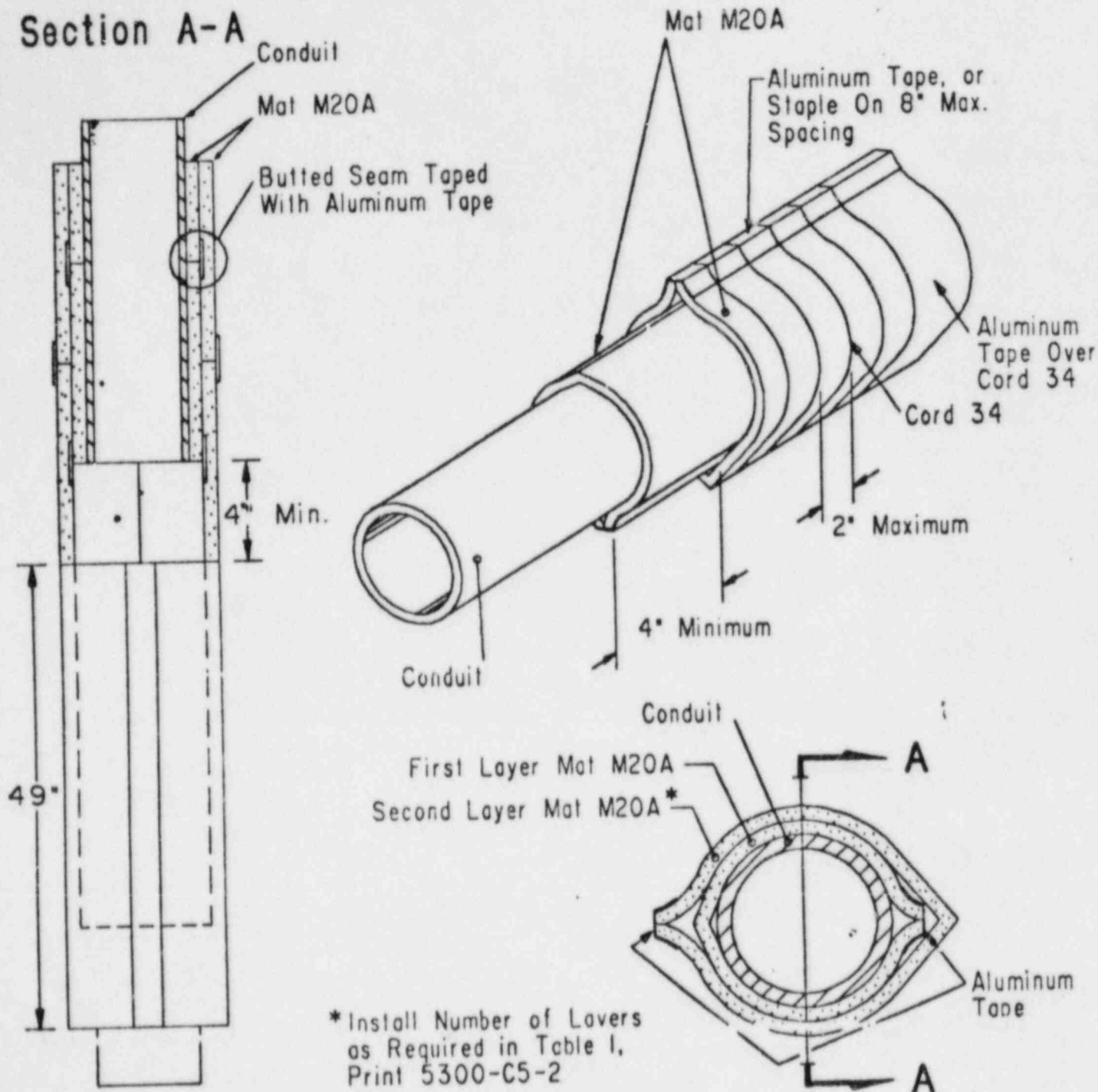
0.000 10.0 20.0 30.0 40.0 50.0 60.0
TIME IN MINUTES

(NUMERALS INDICATE # OF COINCIDENT POINTS)

DATA FILE NAME: 5M2C16.C02

REFERENCE PRINT #	REFERENCE DESCRIPTION
5300-C5-1	-- INSTALLATION INSTRUCTIONS
5300-C5-2	-- MATERIAL DIMENSIONS
5300-C5-ML	-- MATERIAL LIST

Section A-A



NOTE: Install Mat M20A With Aluminum Foil Out

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ISSUE	DATE	REV	CH.
4	10-10-83		
NOT TO SCALE		CH.	J.R. TUZINSKI
DR. P.A. L'ETOURNEAU		APP.	B.N. HUNTER

Electro-Products Division/3M

3M

5300-C5

3M
FIRE BARRIER
Conduit
Protection System
M20A

INSTALLATION INSTRUCTIONS

1. Determine the size of the conduit to be protected.
2. Refer to Table 1 (Print # 5300-C5-2) to determine the length and number of layers required for one hour protection.
3. Cut Mat M20A to proper dimension. Note: Clean hands or gloves required to keep Mat clean before applying Aluminum Tape.
4. Apply a strip of Aluminum Tape to Mat M20A edge, allowing 1/2 of the tape width to overhang the Mat. Note: Omit this step when using staples. See 7A.
5. Crease Mat in half with aluminum foil on outside surface.
6. Place Mat around conduit.
7. Fold the Mat around the conduit and seal with tape. To ensure a good bond, rub down the tape with a small rubber roller or hot iron.
- 7A. Option: The ^{MAT} ~~tape~~ may also be stapled together at 8 ± 1 inch spacing. Place staples 1/4 inch ± 1/8 inch from edges.
8. Install second and succeeding strips by butt jointing to first strip. Tape the butt joint with Aluminum Tape.
9. Install succeeding layers using above procedure, reversing direction of edge seam on each layer. The edge seam of each layer must be at least 2 inches from the seam above or below it.
10. Seal the last exposed edge of Mat with Aluminum Tape even if option 7A was used.
11. Install Cord #34 after all layers are installed by wrapping Cord diagonally down length of conduit with a maximum spacing of 2 inches between wraps (Print # 5300-C5).
12. The Cord #34 should be covered on the surface with a layer of Aluminum Tape.

<small>All statements, technical information and recommendations contained herein are based on tests we believe to be reliable. However, since the conditions of use and application are beyond our control, 3M shall not be liable for any damage, direct or consequential, resulting from the use of this material or design. 3M's only warranty shall be to replace any of our products found to be defective.</small>	ISSUE 3	DATE 10-10-93	REV	CH.	FIRE BARRIER CONDUIT SYSTEM INSTRUCTIONS
	NOT TO SCALE		<small>CH. J. R. Tizinski</small> <small>APR 1994</small> <small>D. N. Turner</small>		
	Electro-Products Division/3M		3M		
		5300-C5-1			

TABLE 1

DIMENSIONAL REQUIREMENTS OF MAT M20A*
CONDUIT SIZE VS. MAT LENGTH AND NUMBER OF LAYERS

Conduit Diameter	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5	Total Length M20A
3/4"	6.5"	9.5"	13"	16"	19"	64"
1"	7.5"	10.5"	14"	17"	20"	69"
1.25"	8.5"	11.5"	15"	18"	21"	74"
1.50"	9.5"	12.5"	16"	19"	22"	79"
2"	11"	14"	17"	20"	23"	85"
2.5"	12.5"	16"	19"	22"	25"	94.5"
3"	14.5"	18"	21"	24"	27.5"	105"
4"	18"	22.5"	25"	28.5"	32"	126"
5"	22"	25"	—	—	—	47"
6"	25"	28.5"	—	—	—	53.5"

* Per U.L. Letter dated September 27, 1983

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	NOT TO SCALE		<small>CH</small> J.R. Kozinski <small>APP</small> D.N. Hurdler		
	OR				
Electro-Products Division/3M	3M				5300-C5-2

3M MATERIAL USED -- SEE SHEET 5300-TT-1 FOR ORDERING INFORMATION

REFERENCE NAME

TRADE NAME

MAT M20A	--	3M BRAND FIRE BARRIER MAT M20A
CORD 34	--	3M BRAND FIRE BARRIER CORD 34
ALUMINUM TAPE	--	SCOTCH BRAND ELECTRICAL TAPE #49
		ALTERNATE APPROVED TAPE 3M BRAND #425

USER SUPPLIED MATERIALS


REFERENCE NAME

TRADE NAME

STAPLER	--	BOSTICH MODEL P-4 STAPLER OR EQUIVALENT
STAPLE(S)	--	BOSTICH STAPLES STCR 50A-9/16" OR EQUIVALENT

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ISSUE	DATE	REV	CH.
1	10-10-83		
NOT TO SCALE		BY J.R. TUZINSKI	
DR. P.A. LeTOURNEAU		APP. D.W. HUNTER	

FIRE BARRIER 
Conduit
Protection System
Material List
M20A

Electro-Products Division/3M



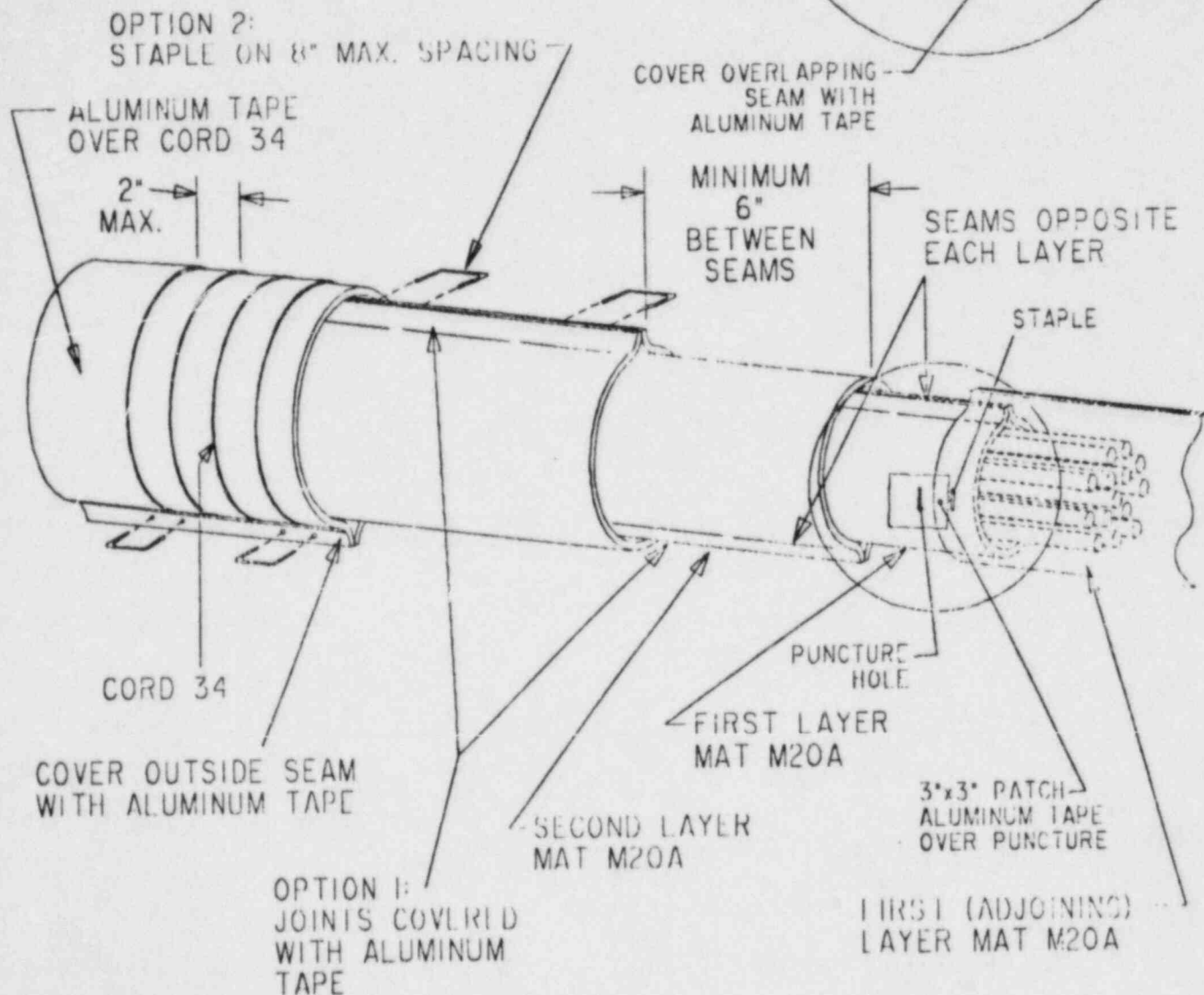
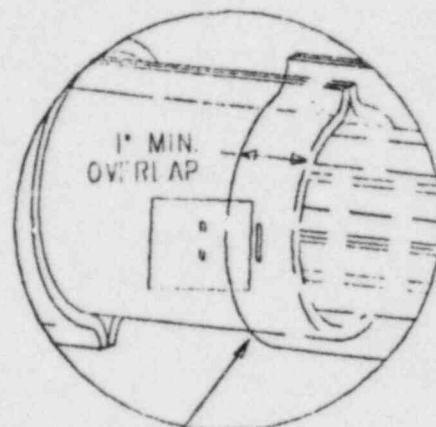
5300-C5-ML

REFERENCE PRINT

5300-AD-1
5300-AD-2
5300-AD-ML

REFERENCE DESCRIPTION

INSTALLATION INSTRUCTIONS
MATERIAL DIMENSIONS
MATERIAL LIST



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ISSUE	DATE	REV	CH.
3	10-10-83		
NOT TO SCALE		CH. J.R. TUZINSKI	
DR. P.A. LECURNEAU		APP. D.N. HUNTER	

Electro-Products Division/3M



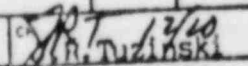
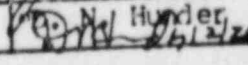
5300-AD

FIRE BARRIER
Air Drop System

M20A

INSTALLATION INSTRUCTIONS

1. Determine the size of the air drop cables to be protected by measuring the bundle perimeter with a flexible tape or cord.
2. Refer to Table 1 (5300 AD-2) to determine the length and number of layers required for one hour protection.
3. Cut Fire Barrier Mat M20A to proper dimension. Note: Clean hands or gloves required to keep mat clean before applying Scotch Brand Electrical Tape #49.
4. Apply a strip of Scotch Brand Electrical Tape #49 (or #425) to Fire Barrier Mat edge, allowing 1/2 of the tape width to overhang the Mat. Note: Omit this step when using staples. See 7A.
5. Crease Mat in half with aluminum foil on outside surface.
6. Place mat around air drop cables.
7. Fold tape edge around to contact on tape edge. Seal by pressing tape together.
- 7A. Option: The Mat may also be stapled together at 8 + 1 inch spacing. Place staples 1/4 inch + 1/8 inch from edges. Seal puncture made by stapler foot with aluminum foil tape - 3" x 3" minimum.
8. Install second and succeeding strips by butt jointing to first strip with a 1 inch minimum overlap. This seam may be stapled. The pointed foot of the stapler is used to puncture the Mat so that it may be secured. The aluminum foil tear must be less than 1 inch. The aluminum foil of the Mat must be repaired. This is done by covering with a piece of aluminum tape, 3" x 3" - minimum size. Tape the seam of the overlap with aluminum tape.
9. Install succeeding layers using above procedure, reversing direction of edge seam on each layer. The edge seam of each layer must be at least 2 inches from the seam above or below it.
10. Seal the last exposed edge of the Mat with Scotch Brand Electrical Tape #49 even if option 7A was used.
11. Install Fire Barrier Cord #34 after all layers are installed by wrapping cord diagonally down length of air drop with a maximum of 2 inches between wraps. See 5300 AD.
12. The Cord #34 should be covered on the surface with a layer of aluminum foil tape.

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	NOT TO SCALE				
	OR				
Electro-Products Division/3M 3M	5300 AD-1				

REPORT SUMMARY 4

PROTECTIVE ENVELOPE FOR CLASS 1E CIRCUITS

Based upon U. L. Test Report File R10125-1, 2 Project 82NK21937.
(Dated October 19, 1983).

Electrical Protection System - Mat M20A/CS195

	<u>Result</u>	<u>Page In UL Report</u>
1.0 Fire Prot. Rating	One hour	C-1
1.1 ASTM-E119	Conforms	T2-2
1.2 Circuit Integrity	Pass	C-1
1.3 Temperatures on Cables	*	Appendix B
1.4 Cables Generic	XLPE-PVC	6 & 7
1.5 Hose Stream Test	Pass	T2-3
1.6 Furnace Size	22' 10" x 14' 2" x 7'	

*Temperatures on Cables at 60 Minutes (°F)

	7/C-#12		2/C-#16	
	Ave.	Max.	Ave.	Max.
U. L. Test 2-System 3	316	348	357	383

U L. Test 2 - System 3 2 inch conduit, minimum fill

NOTE: Attached are graphs and data for this test

TEST 2 - SYSTEM 3

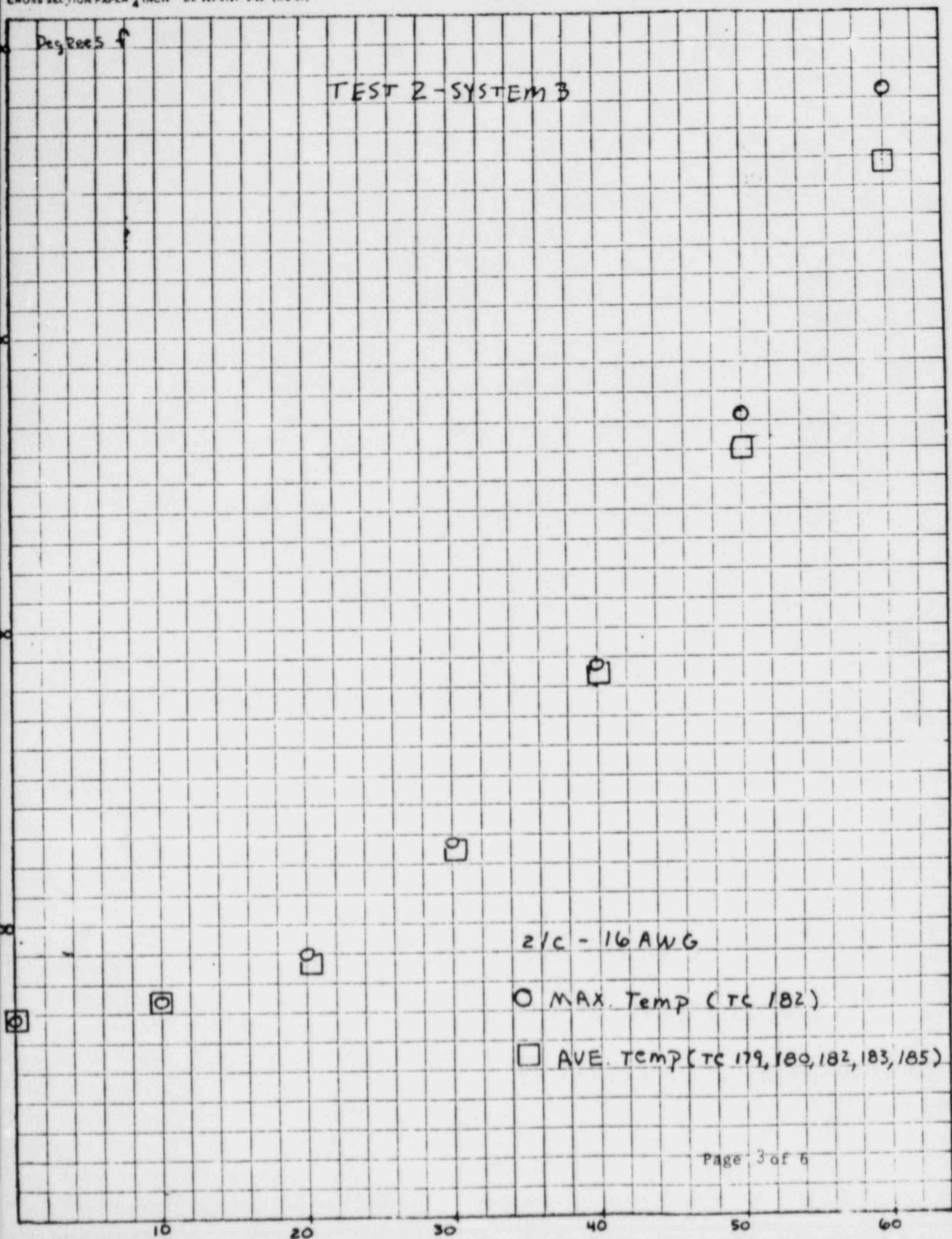
TIME - MIN	2/C - 16 AWG.		7/C - 12 AWG	
	MAX.	AVE.	MAX	AVE.
0	69	69	69	69
10	74	74	72	72
20	90	88	83	82
30	128	127	115	111
40	188	187	170	166
50	272	261	238	220
60	383	357	348	316

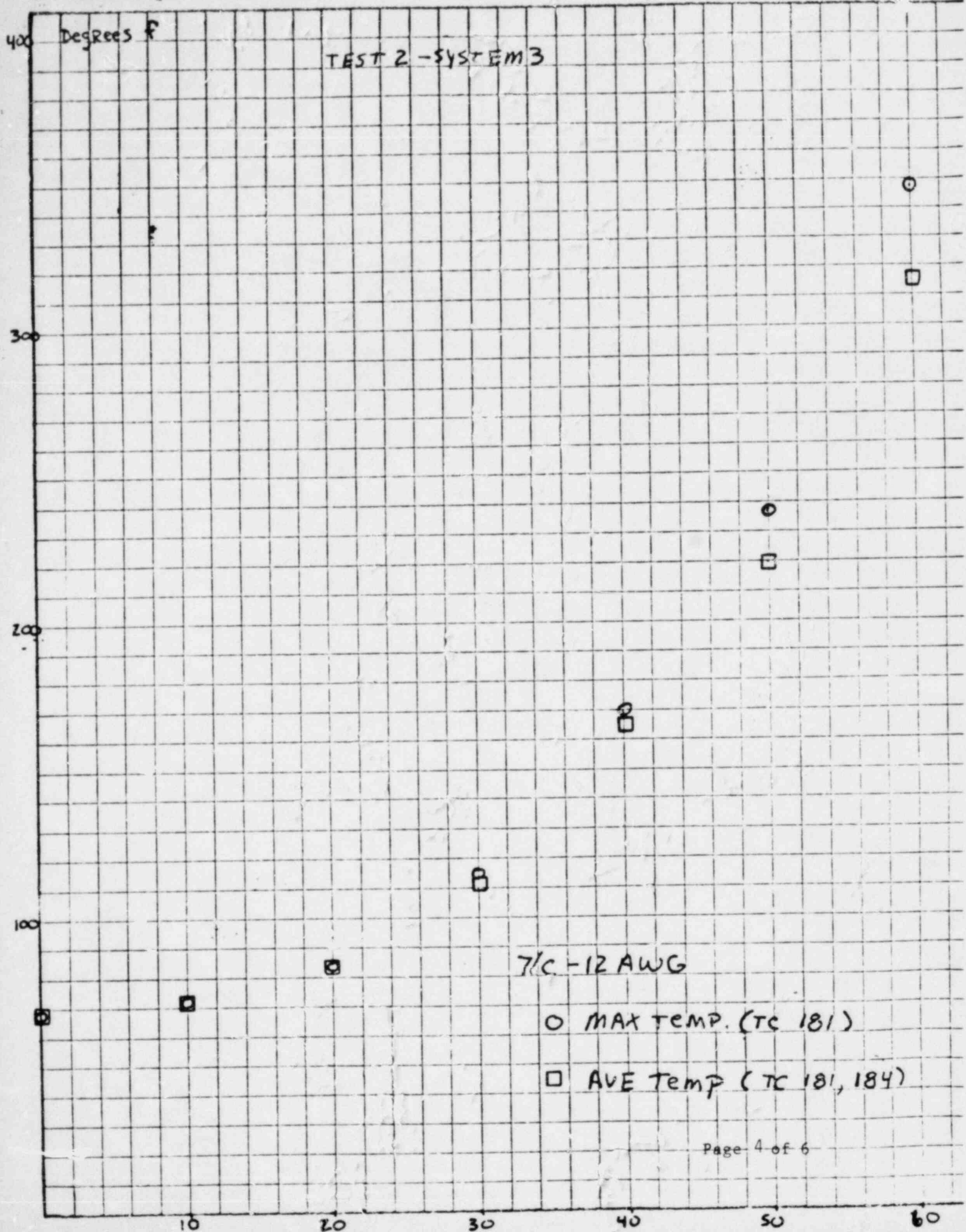
END

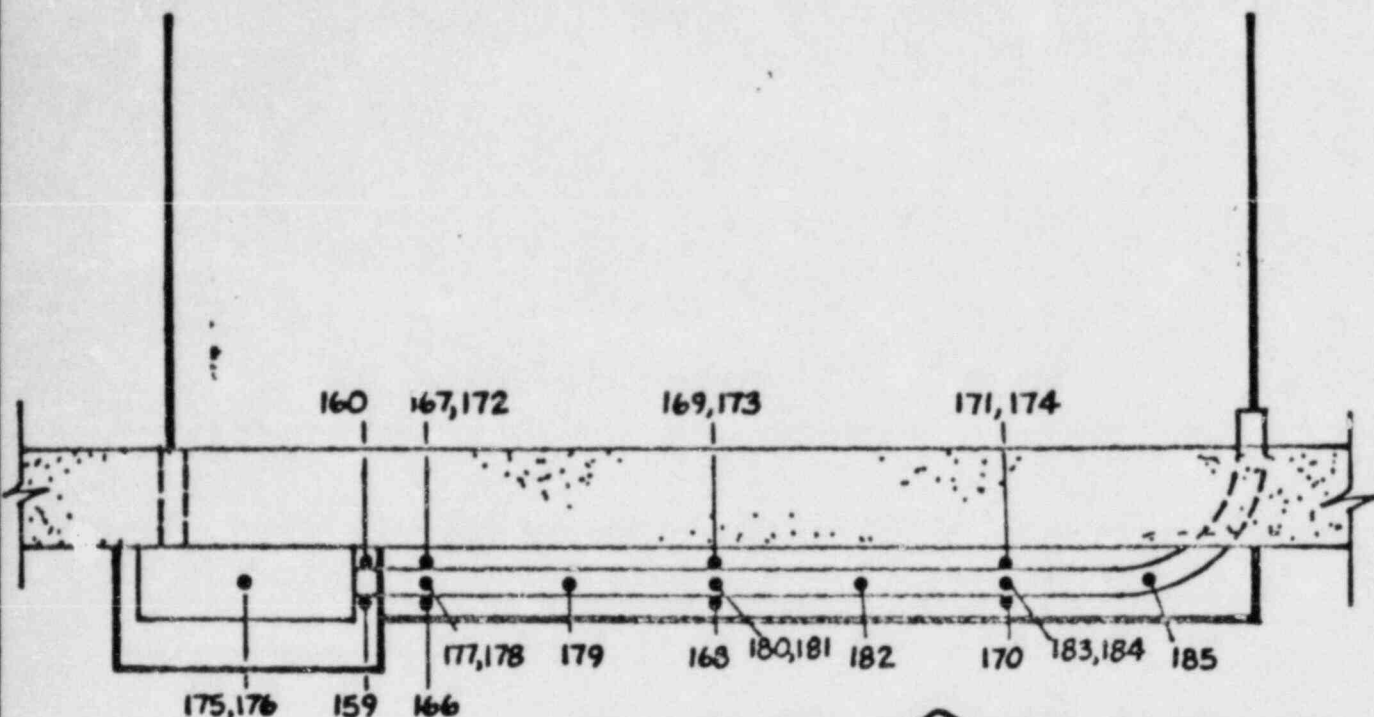
Page 2 of 6

Deg. Rees f

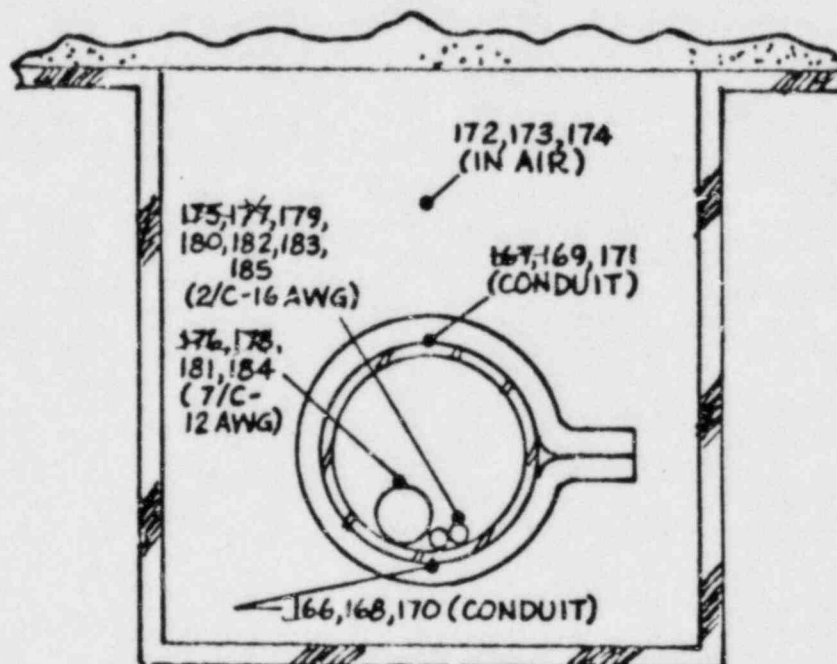
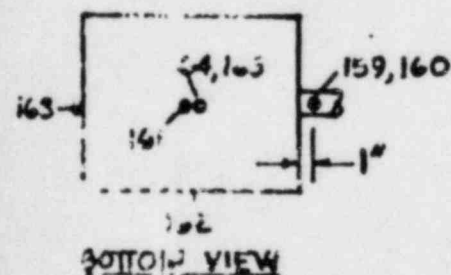
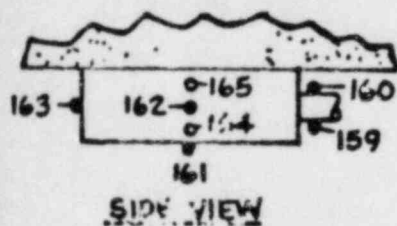
TEST 2 - SYSTEM B





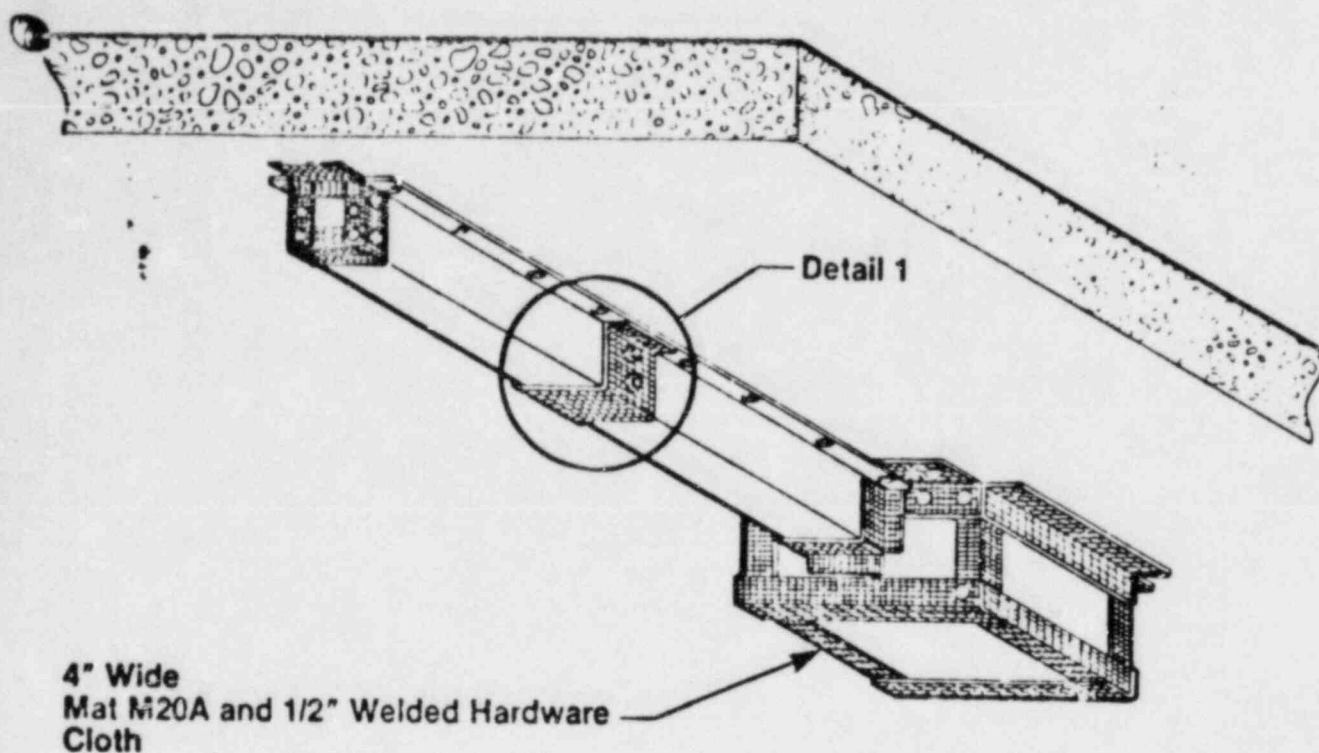


JUNCTION BOX THERMOCOUPLES

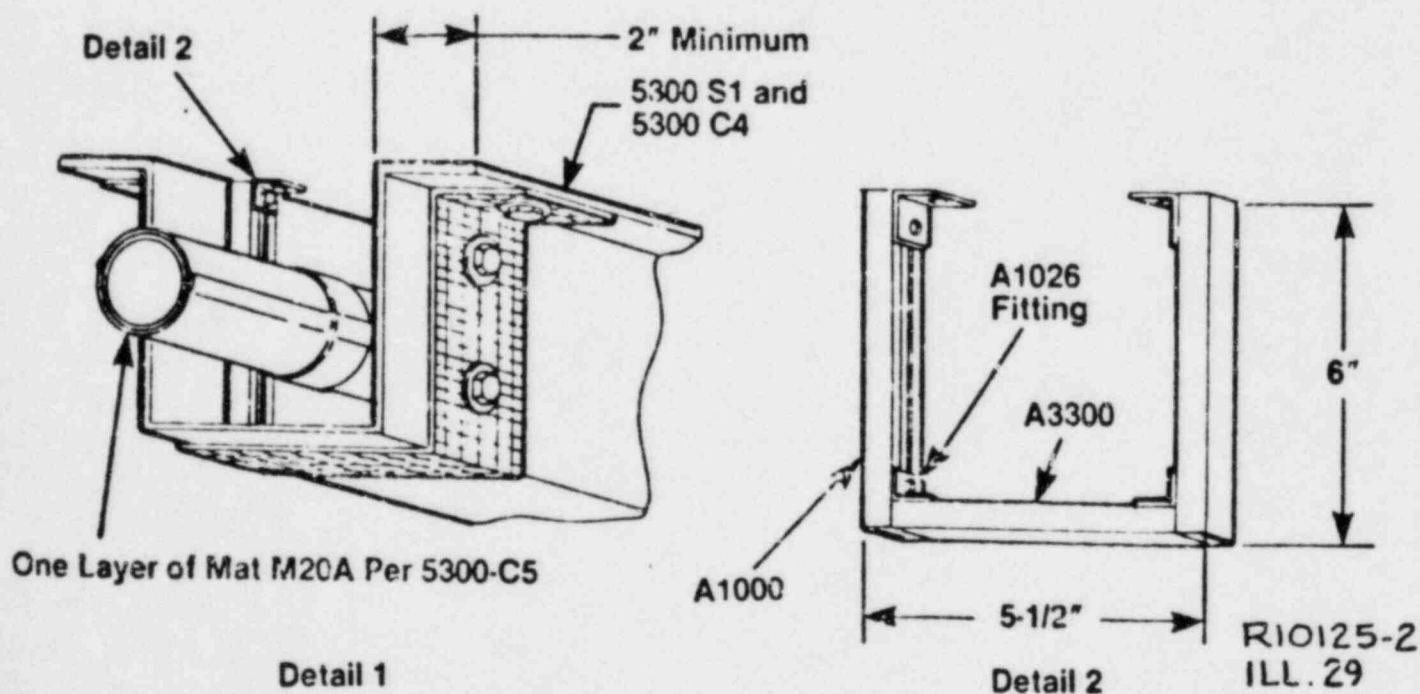


<u>T.C. NO.</u>	<u>LOCATION:</u>
159, 160	ON CONDUIT 1" FROM JUNCTION BOX W/IN ENCLOSURE
161	ON BOTTOM CENTER OF JUNCTION BOX
162	ON SIDE OF JUNCTION BOX @ CENTER
163	ON END OF JUNCTION BOX @ CENTER
164	INSIDE JUNCTION BOX, IN AIR, 1" ABOVE BOTTOM OF BOX
165	INSIDE JUNCTION BOX, IN AIR, 1" BELOW TOP OF BOX

CONDUIT CABLE JUNCTION BOX AND AIR THERMOCOUPLES-
SYSTEM NO 2



4" Wide
Mat M20A and 1/2" Welded Hardware
Cloth



One Layer of Mat M20A Per 5300-C5

Detail 1

Detail 2

R10125-2
ILL. 29

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ISSUE	DATE	REV	CHK
1	4/13/83		
DESIGN BY		J.R. Tuzinski	
DR J.F. Krenik		M.A. O'Hara	

Electro-Products Division: 3M



5300-C6

Conduit -
Junction Box
Protection System

REPORT SUMMARY 5

PROTECTIVE ENVELOPE FOR CLASS 1E CIRCUITS

Based upon 3M Test Report #84-18.
(Dated July 18, 1984).

Electrical Protection System - Mat M20A/CS195 - Two (2) layers of Mat M20A
junction box with CS195 composite sheet attached to
unistrut frame.

	<u>Result</u>
1.0 Fire Prot. Rating	One hour
1.1 ASTM-E119	Conforms
1.2 Circuit Integrity	Pass
1.3 Temperatures on Cables	*
1.4 Cables Generic	**
1.5 Hose Stream Test	NA this test
1.6 Furnace Size	24" dia cylinder 27-1/2" height

*Temperatures at 60 Minutes (°F)

Airtemp Inside Box - 202°F
Junction Box Temp - 236°F

**Tamaqua Brand cable with the following designation: "#12 7/C THHN or THWN
Type TC 600V (UL) direct burial"

NOTE: Attached are graphs and data for this test

TWO LAYER M20A JUNCTION BOX FIRE TEST #84-18

TEMPERATURE DATA (TABLE ONE)

ANALYSIS FORM 1038A

TWO LAYER M20A JUNCTION BOX FIRE TEST #84-18										
TEMPERATURE DATA (TABLE ONE)										
ANALYSIS FORM 1038A										
Time	Hour:	Minutes	TC # ->	Inside of Junc. Box Side					Junction Box	Air Temp. Inside Junction Box
				Avg. Furnace Temp. (°F)	Closest to Slab	Center	Closest to Heat Source	Avg. Junc. Box		
1				1-4	5	6	7	5-7	9	10
2										
3										
4	0			72	72	72	72	72	72	69
5	5			1195	73	73	73	73	73	69
6	10			1345	73	73	74	73	74	70
7	15			1375	78	78	78	78	76	73
8										
9	20			1607	85	85	85	85	82	79
10	25			1455	94	94	96	94	90	87
11	30			1657	108	108	111	109	102	98
12	35			1471	123	133	143	133	127	117
13										
14	40			1531	157	165	177	166	163	151
15	45			1639	192	198	202	197	194	175
16	50			1692	213	215	215	215	205	199
17	55			1717	215	224	224	221	209	204
18										
19	1:00			1712	220	241	248	236	206	202
20	1:05			1754	236	277	294	269	215	204
21	1:10			1753	276	321	341	313	286	218
22	1:15			1754	316	363	387	355	337	237
23										
24	1:20			1761	359	409	437	402	398	330
25	1:25			1770	400	454	485	446	451	356
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										

Page 2 of 5

Page 7 of 9

JUNCTION BOX FIRE TEST #84-18 10"x10"x6" J BOX w/ 2 LAYERS M20A; CS-195

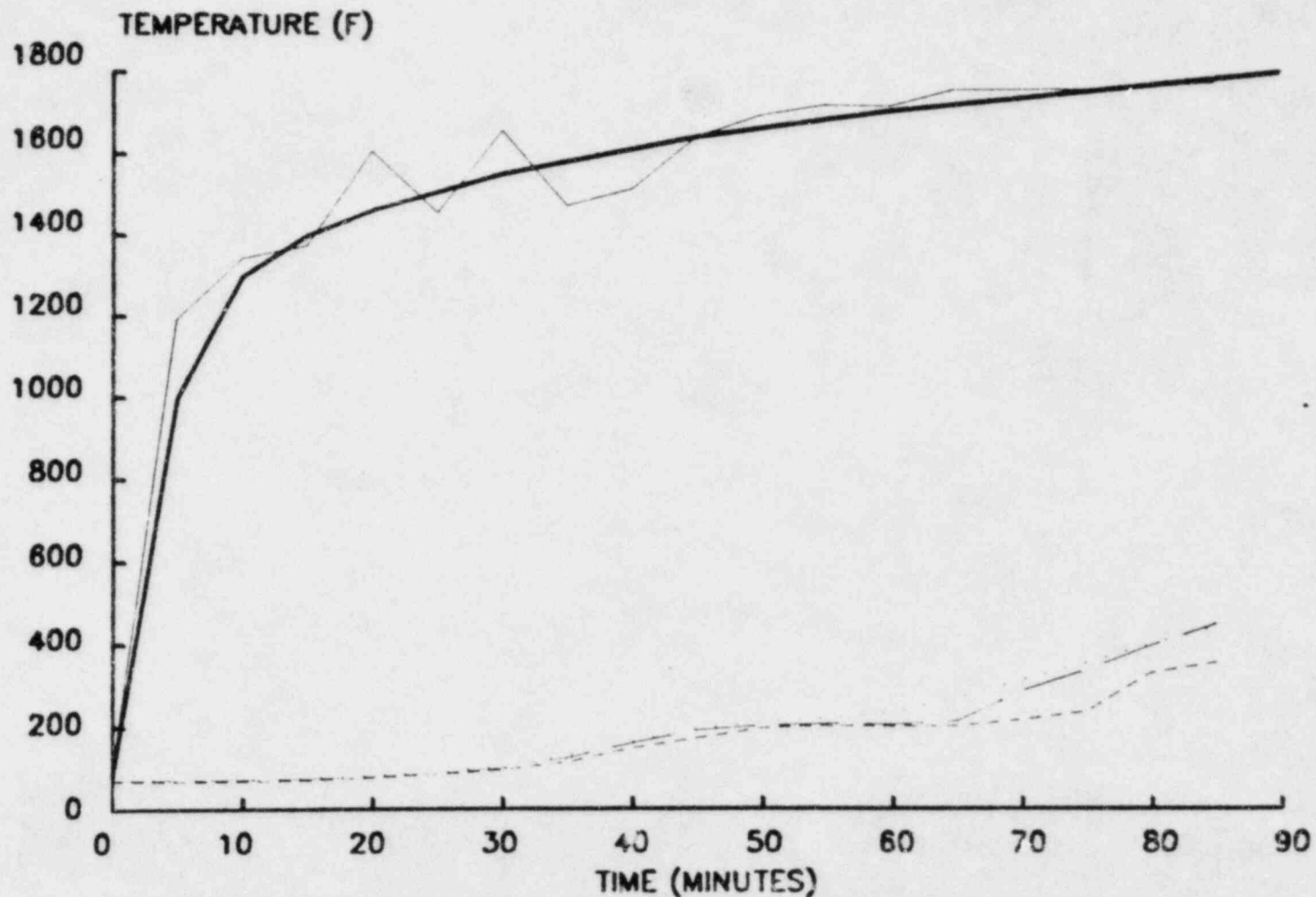
ASTM E-119
 TEMP CURVE

FURNACE
 AVG TEMP

JUNC BOX
 BOTTOM

AVG TEMP
 BOX SIDE

AIR TEMP
 INSIDE



3M BLDG 207-BSC ASTM E-119 FIRE TEST RUN ON 6-6-84

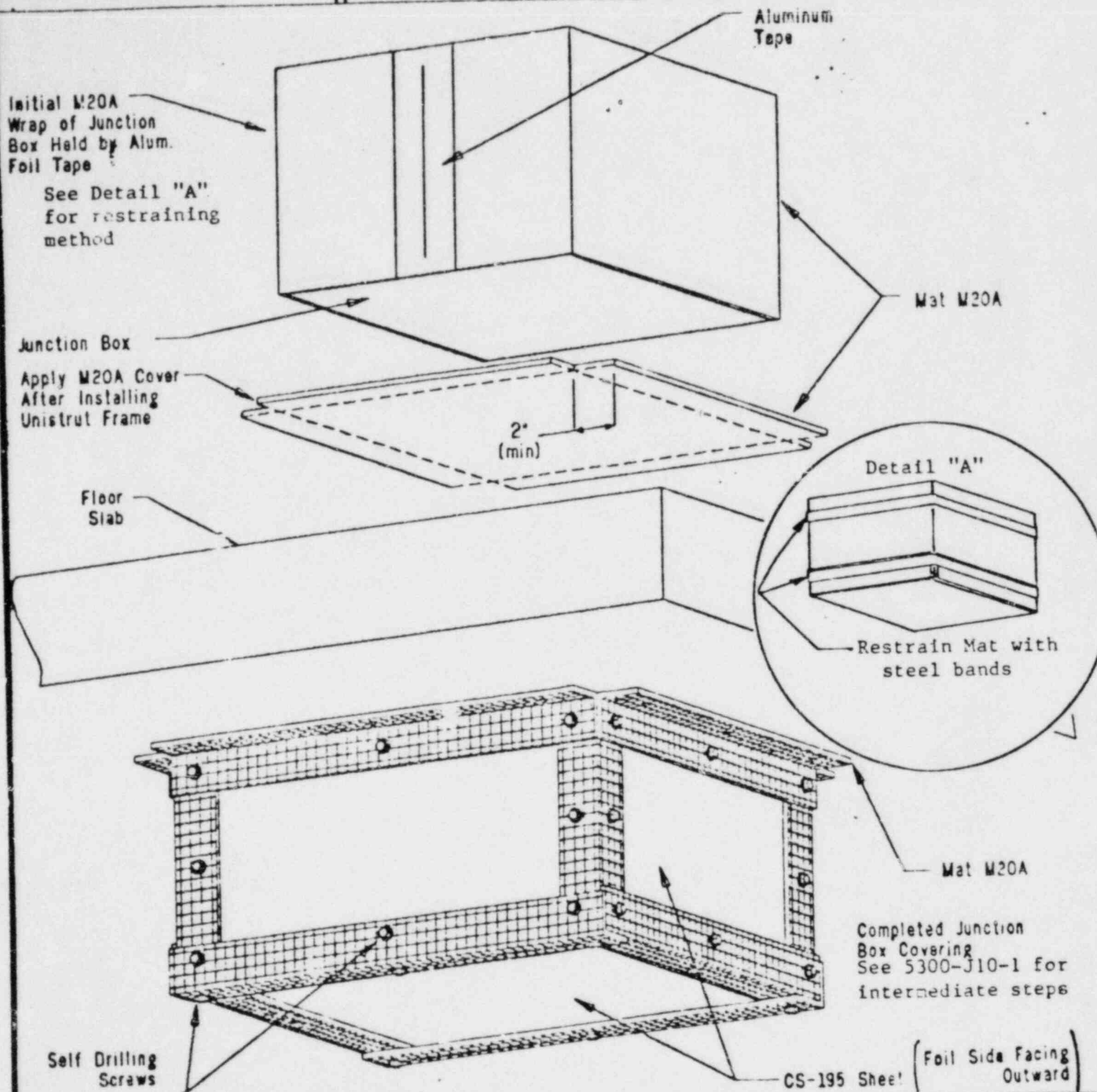
Figure Four

REFERENCE PRINT

5300-J10-1

5300-J10-2

5300-MA



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ISSUE	DATE	REV.	CH.
1	7-5-84		
NOT TO SCALE		CH	R.J. Israelson
OR K.A. Jensen		APP	R.R. Licht

FIRE BARRIER
JUNCTION BOX
CS-195/M20A

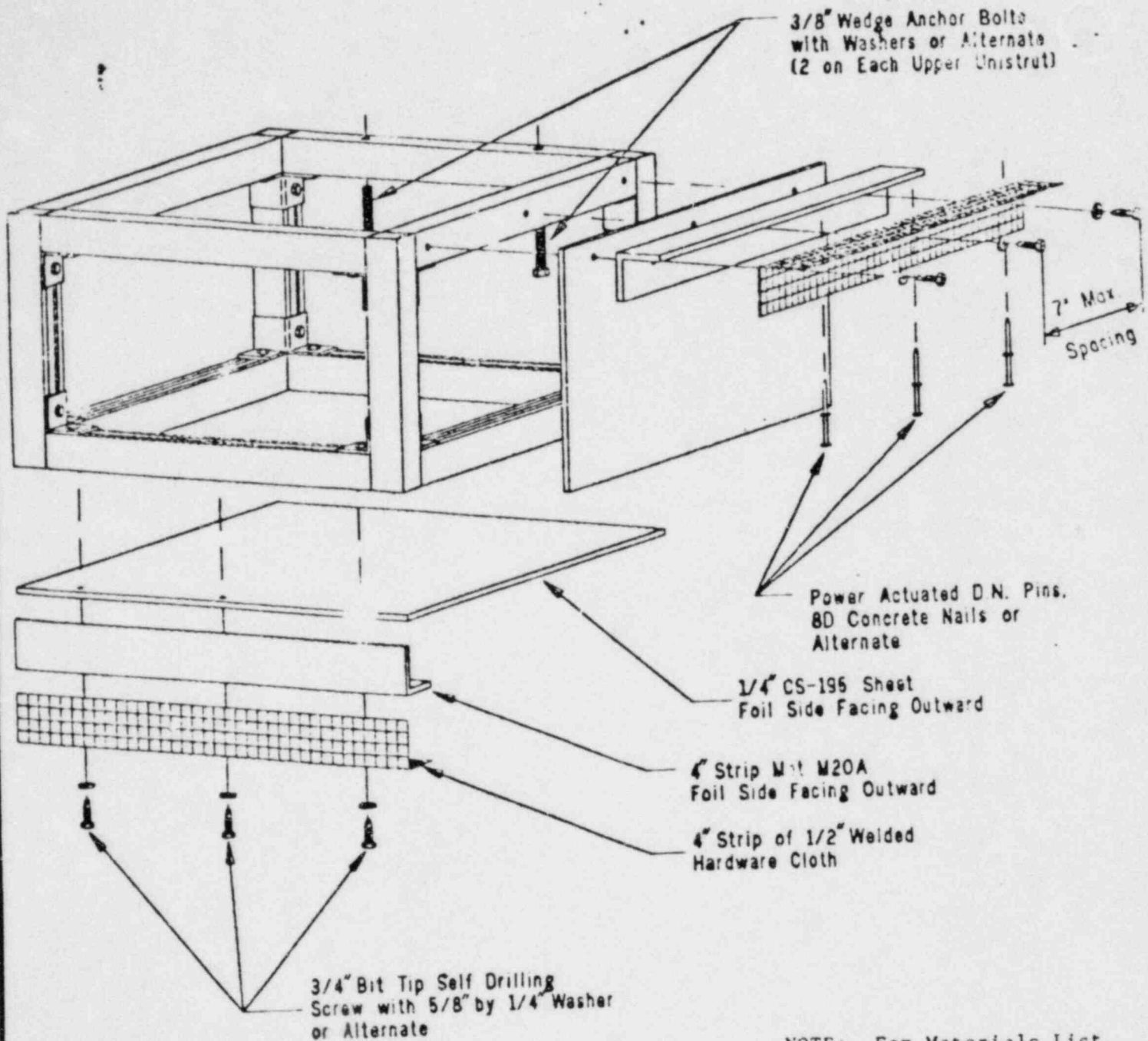
Ceramic Materials
Department 3M

3M

5300-J10

Page 1 of 3

M20A



NOTE: For Materials List, see 5300-MA

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	1	7-05-84			
	NOT TO SCALE		By R.J. Israelson App R.R. Licht		
	K.A. Jensen				
Ceramic Materials Department/3M	5300-J10-1				