NASA Contractor Report 166418

Final Report

Study for the Optimization of Aircraft Seat Cushion Fire-Blocking Layers — Full Scale — Test Description and Results

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McDonnell Douglas Corporation
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16. Abstract

This report describes the work done by Douglas Aircraft Company under contract to the National Aeronautic and Space Agency, Ames Research Center (NASA ARC) to determine the burn characteristics of presently used and proposed seat cushion materials and types of constructions. These tests were conducted in the Douglas Cabin Fire Simulator (CFS) at the Space Simulation Laboratory, Huntington Beach, California. Thirteen different seat cushion configurations were subjected to full-scale burn tests. The fire source used was a quartz lamp radiant energy panel with a propane pilot flame. During each test, data were recorded for cushion temperatures, radiant heat flux, rate of weight loss of test specimens, and cabin temperatures. When compared to existing passenger aircraft seat cushions, the test specimens incorporating a fire barrier and those fabricated from advance materials, using improved construction methods, exhibited significantly greater fire resistance. Results of these tests were similar to those obtained from tests conducted by Douglas Aircraft Company under contract to NASA Johnson Space Center, Contract NAS9-16062.

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SECTION I
INTRODUCTION

Aircraft passenger seats represent a high percentage of the organic materials used in a passenger cabin. These organics can contribute to a cabin fire if subjected to a severe ignition source such as post-crash fuel fire. Since 1976, programs funded by NASA have been conducted at Douglas Aircraft Company to study and develop a more fire-resistant passenger seat. The first program dealt with laboratory screening of individual materials (Report No. NASA CR-152056, Contract No. NAS 2-9337). The second program continued laboratory screening of individual materials, conducted laboratory burn tests of multilayer materials, developed a full-scale standard fire source and prepared a preliminary fire-hardened passenger seat guideline (Report No. NASA CR-152184, Contract No. NAS 2-9337). The third program consisted of additional laboratory burn testing of multi-layer materials, fabricating a fire-hardened three-abreast tourist class passenger seat, and a design guideline for fire-resistant seats (Contract No. NASA 2-9337, Report No. NASA CR-152408). The fourth program fabricated and burn tested full-scale seat cushions utilizing the fire blocking concept for protecting the inner cushion (Contract No. NASA 9-16026).

The tests documented in this report involve a continuation of full-scale burning of seat cushions utilizing the fire-blocking concept.

SECTION 2
SYMBOLS AND ABBREVIATIONS

Btu	British thermal unit
°C	Degrees Celsius (centigrade)
cm	Centimeter
cm^2	Square centimeter
DAC	Douglas Aircraft Company
°F	Degrees Fahrenheit
ft	Feet
hr	Hour
in.	Inch
kg	Kilogram
kg/m^2	Kilogram per square meter
kw	Kilowatt
lb	Pound
lb/ft^2	Pounds per square foot
lb/ft^3	Pounds per cubic foot
m	Meter
mm	Millimeter
min	Minutes
NASA	National Aeronautics and Space Administration
PCT, %	Percent
psi	Pounds per square inch
sec	Second
T	Thermocouple
W	Watt

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SECTION 3
TEST ARTICLES

3.1 Test Specimens

Thirteen different seat cushion constructions were tested (Table 1). Fire blocking, when incorporated, covered all sides of the cushion. All seams were sewn with nylon thread. The overall dimensions for the back cushions were 43 by 61 by 5 centimeters (17 by 24 by 2 inches). The bottom cushions dimensions were 46 by 50 by 8 centimeters (18 by 20 by 3 inches).

3.2 Materials

The 13 test specimens were fabricated using a combination of materials shown in Table 2. These materials were selected and supplied for use in this program by NASA-AMES Research Center.

All cushions were fabricated by Expanded Rubber and Plastics Corporation in Gardena, California.

TABLE 1
SEAT CONSTRUCTIONS

Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
1	Wool-Nylon	None	None	F. R. Urethane*
2	Wool-Nylon	Cotton-Muslin	Vonar-3	F. R. Urethane
3	Wool-Nylon	Cotton-Muslin	Vonar-2	F. R. Urethane
4	Wool-Nylon	None	3/8 LS 200	F. R. Urethane
5	Wool-Nylon	None	Celiox 101	F. R. Urethane
6	Wool-Nylon	None	Norfab 11 HT-26-AL	F. R. Urethane
7	Wool-Nylon	Cotton-Muslin	Vonar-3	N. F. Urethane*
8	Wool-Nylon	None	Norfab 11 HT-26-AL	N. F. Urethane
9	Wool-Nylon	None	None	LS 200 Neoprene
10	Wool-Nylon	None	None	Polyimide
11	Polyester	None	None	Polyimide
12	Wool-Nylon	None	Norfab 11 HT-26	F. R. Urethane
13	Wool-Nylon	None	PBI	F. R. Urethane

*F. R. Urethane (Fire Retarded Urethane)
N. F. Urethane (Non-Fire Retarded Urethane)

TABLE 2
MATERIAL

Material	Source
#2043 urethane foam, fire-retardant (FR), 0.032 g/cm^3 (2.0 lb/ft^3) 43 ILD	North Carolina Foam Ind. Mount Airy, NC
Urethane foam, non-fire retardant (NF), 0.022 g/cm^3 (1.4 lb/ft^3) 24-35 ILD	CPR Division of Upjohn Torrance, Ca.
Vonar-3, 3/16-inch thick with Osnaburg cotton scrim (23.5 oz/yd^2) .079 g/cm^2	Chris Craft Industries Trenton, NJ
Norfab 11HT26-aluminized (12.9 oz/yd^2) .044 g/cm^2, aluminized one side only	Amatex Corporation Norristown, Pa
Gentex preox (celiox) (10.9 oz/yd^2) .037 g/cm^2, aluminized one side only	Gentex Corporation Carbondale, Pa
Wool nylon (0.0972 lb/ft^2) .0474 g/cm^2, 90% wool/100% nylon, R76423 sun eclipse, azure blue 78-3080 (ST7427-115, color 73/3252)	Collins and Aikem Albermarle, NC
Vonar 2, 2/16 inch thick, .068 g/cm^2, (19.9 oz/yd^2) osnaburg cotton scrim	Chris Craft Industries Trenton, NJ
LS-200 foam, 3/8" thick (33.7 oz/yd^2) .115 g/cm^2 LS-200 foam, 3-4 inches thick (7.5 lb/ft^3) 0.12 g/cm^3	Toyad Corporation Latrobe, Pa
Polyimide Foam (1.05 lb/ft^3) .017 g/cm^3	Solar San Diego, Ca
100% polyester (10.8 oz/yd^2) .037 g/cm^2 4073/26	Langenthal Corporation Bellevue, Wa
Norfab 11HT26 Approximately (11.3 oz/yd^2) .038 g/cm^2	Gentex Corporation Carbondale, Pa
PBI Woven Cloth Approximately (10.8 oz/yd^2) .037 g/cm^2	Calanese Plastic Company Charlette, NC

SECTION 4
TEST PROGRAM

4.1 Test Setup

All tests were conducted within the Cabin Fire Simulator (CFS). The CFS is a double-walled steel cylinder 12 feet in diameter and 40 feet long, with a double-door entry airlock at one end and a full-diameter door at the other. It is equipped with a simulated ventilation system and, for environmental reasons, all exhaust products are routed through an air scrubber and filter system. A view port in the airlock door allows the tests to be monitored visually. The radiant heat panels used in these tests were positioned as shown in Figures 1 and 2.

The radiant panels consisted of 46 quartz lamps producing a 10 watt/square centimeter heat flux at 6 inches from the surface of the panels. Prior to testing, the heat flux upon the cushion surface was mapped using calorimeters. Figure 3 shows the positions at which heat flux measurements were taken and their recorded values.

4.2 Instrumentation

The relative location of instrumentation for the tests is shown in Figure 4.

4.2.1

Post test still photographs were taken for each seat construction. These photographs are located in Appendix A. In addition, a video recording was made during each test.

4.2.2 Thermal Instrumentation

Temperatures were obtained using chromel-alumel thermocouples placed within the seat constructions. The number of thermocouples varied between 2 and 3 per cushion depending on whether or not a fire blocking layer was used (Figure 5). In the CFS, chromel-alumel thermocouples were located along the ceiling and at the cabin air exhaust outlet. Two heat flux sensors were installed facing the seat assembly. The upper calorimeter was used to monitor the heat flux given off by the radiant panels to insure consistency among tests. The thermocouple and calorimeter signals were fed through a Hewlett-Packard 3052A Automatic Data Acquisition System which provided a real-time printout of data (Figure 6).

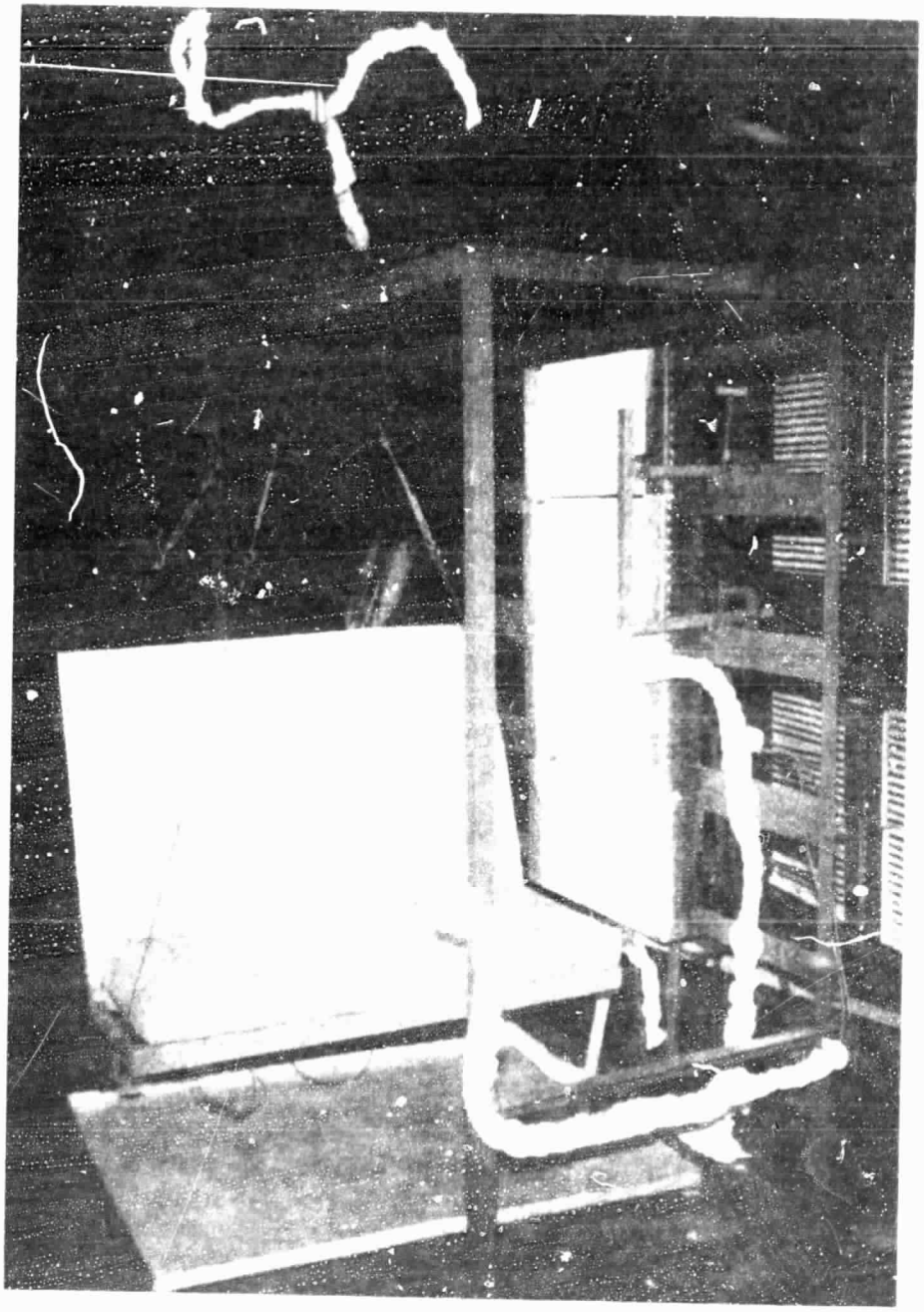

FIGURE 1. TEST STEUP

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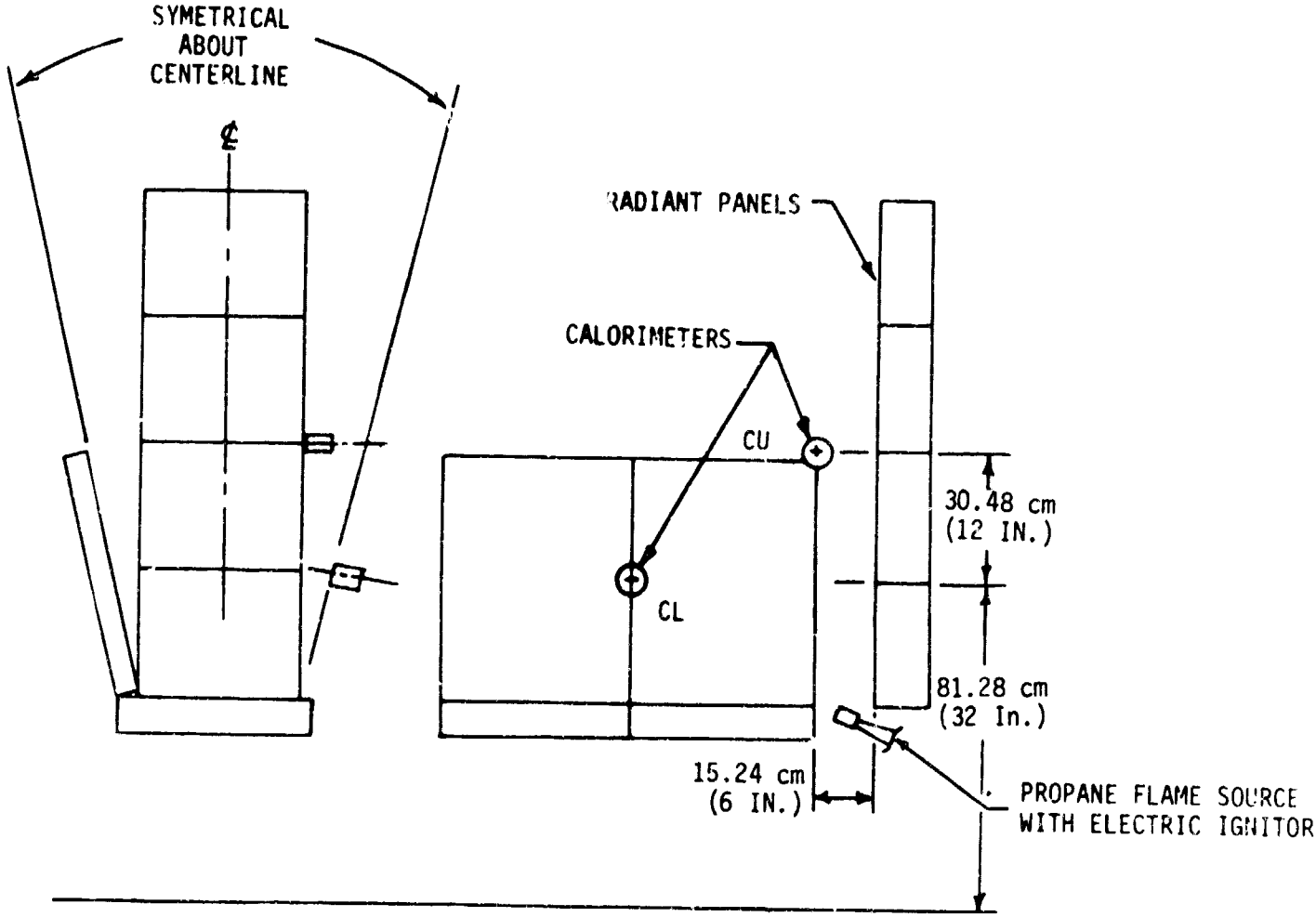


FIGURE 2. FUEL SOURCE AND CALORIMETER LOCATION

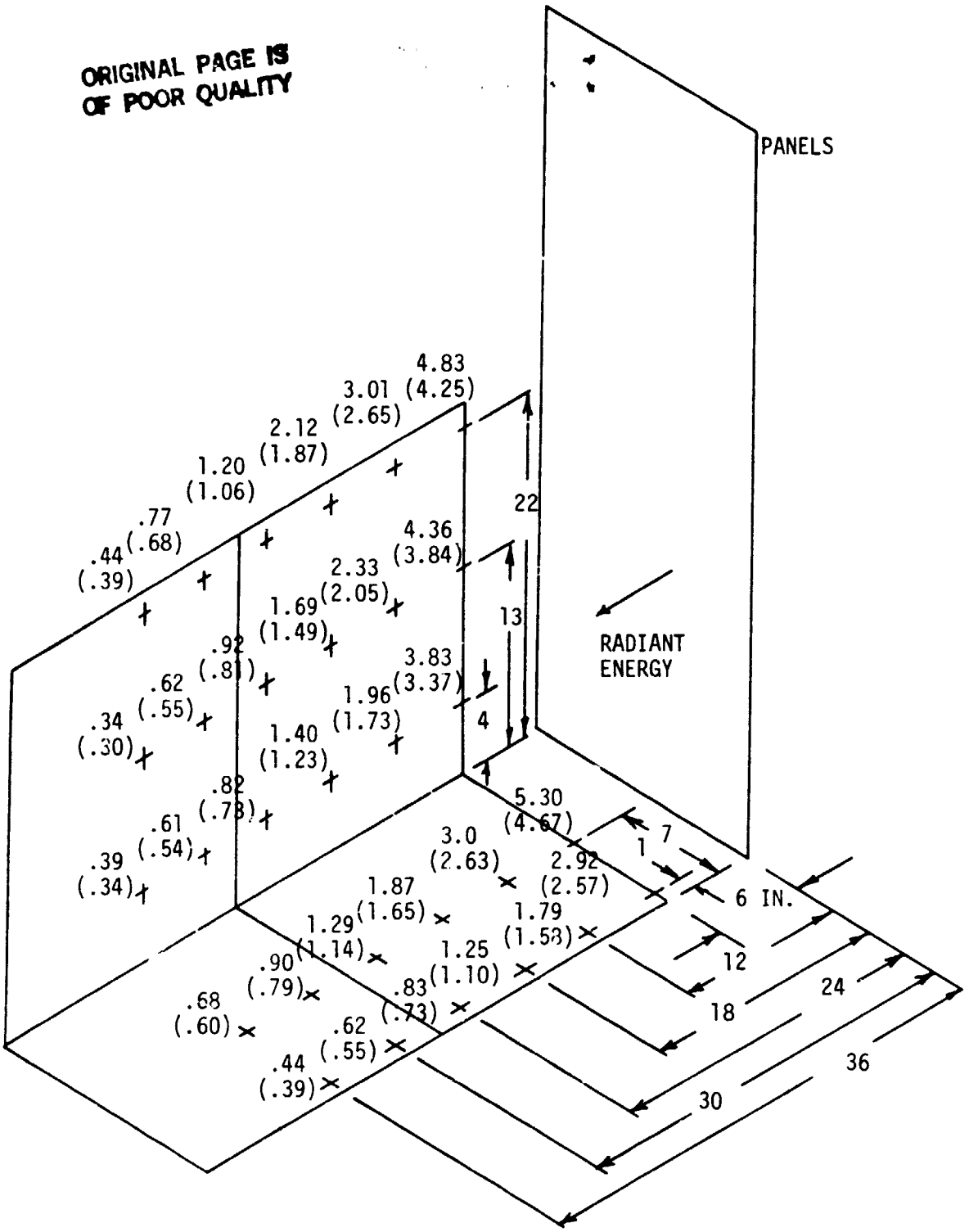
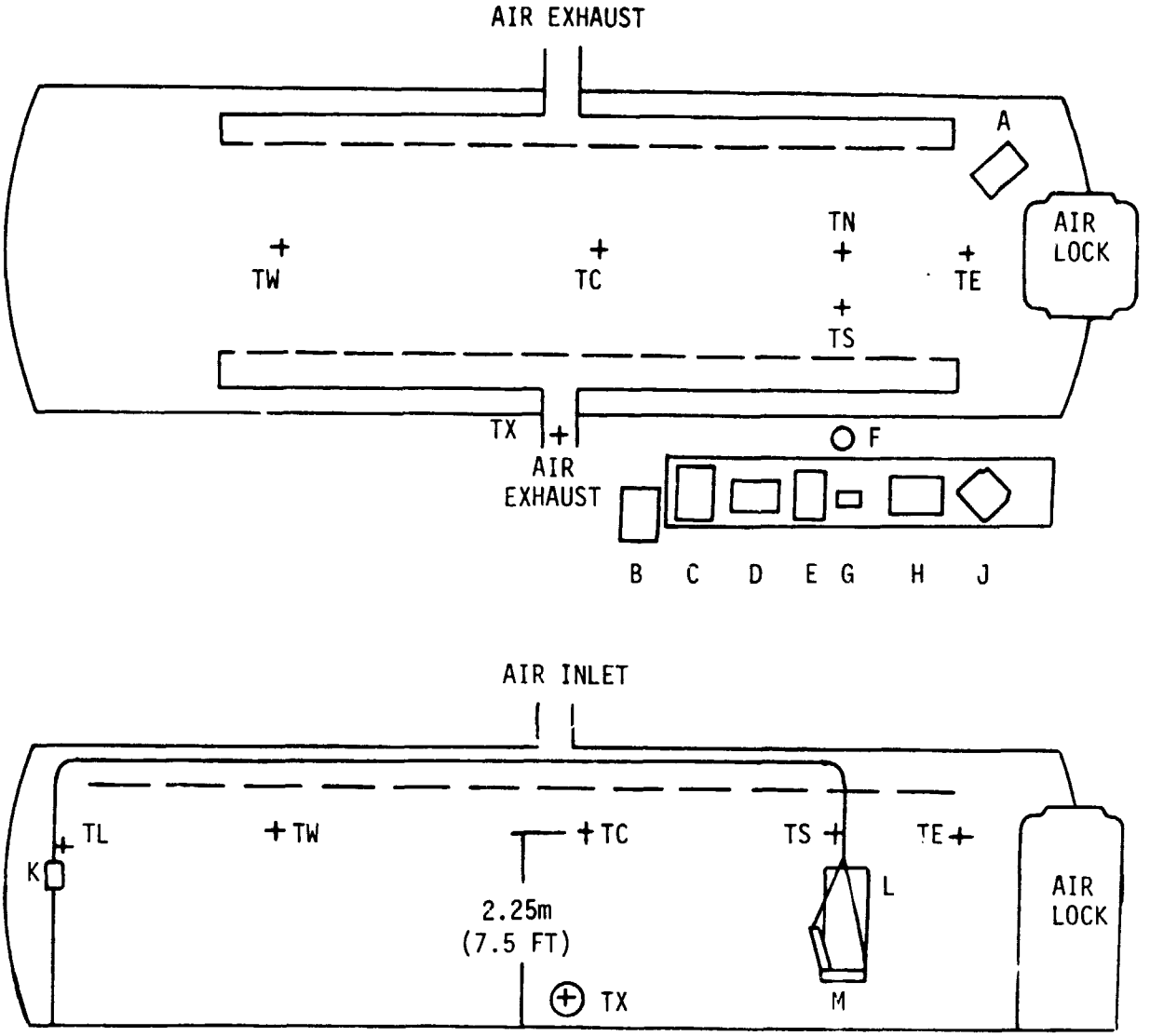


FIGURE 3. HEAT FLUX MAPPING w/cm^2 (Btu/FT^2-SEC)



LEGEND:
A = VIDEO CAMERA
B = HEWLETT PACKARD SCANNER AND DIGITAL VOLTMETER
C = HEWLETT PACKARD CALCULATOR
D = HEWLETT PACKARD PLOTTER
E = HEWLETT PACKARD PRINTER
F = PROPANE ON/OFF VALVE
G = VARIABLE TRANSFORMER
H = VIDEO CASSETTE RECORDER
J = VIDEO MONITOR
K = 100 LB. LOAD CELL
L = RADIANT ENERGY PANELS
M = SEAT FRAME
T = THERMOCOUPLE

FIGURE 4. CFS INSTRUMENTATION

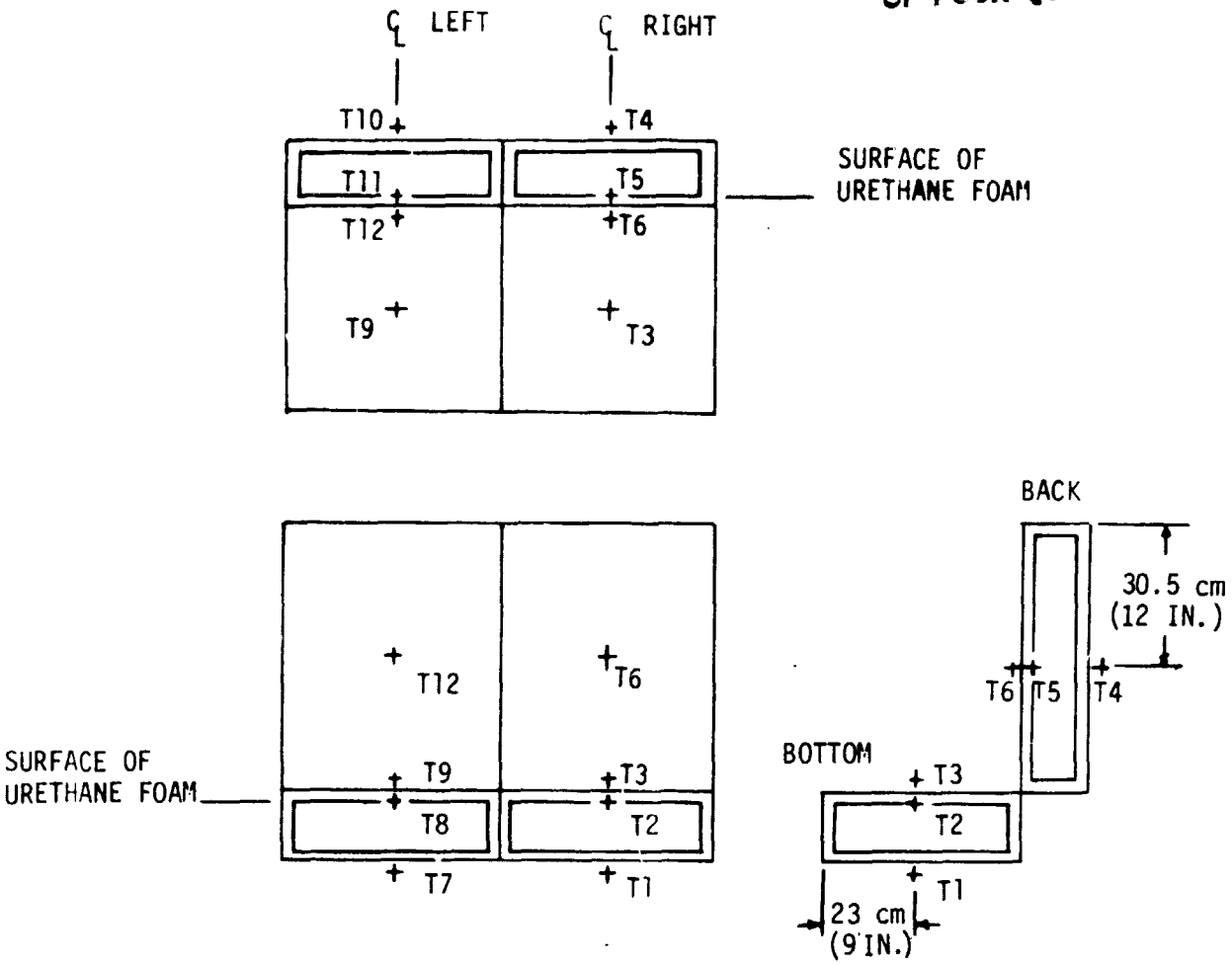


FIGURE 5. CUSHION THERMOCOUPLES (LOCATION AND IDENTIFICATION)

4.3 Test Procedures

Cushions instrumented with thermocouples were weighed, then positioned on the seat frame. The seat frame was rigged with suspension cables and hung from one end of a cable located in the ceiling of the CFS. The other end of the ceiling cable was attached to a load cell. Thermocouples, heat flux sensors, and load cells were checked for proper operation and calibration. The computer and video were started, the propane gas was ignited, and then the radiant panel was switched on. The radiant panels remained on for five minutes. After fifteen minutes, the tests were complete and post-test photos were taken of the cushion residue. The residue was removed from the seat frame and weighed.

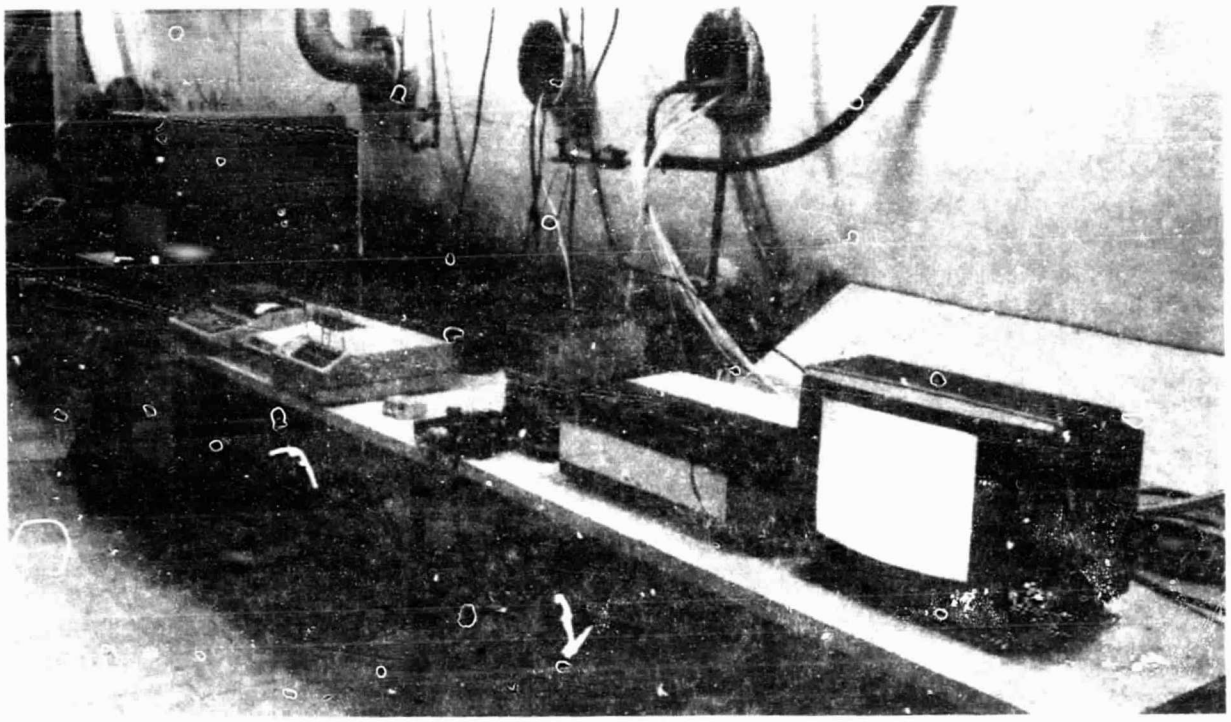


FIGURE 6. DATA ACQUISITION

SECTION 5
TEST RESULTS

A total of 23 full-scale cushion burn tests were conducted. Each seat construction listed in Table 1 was tested twice with the exception of constructions 8, 11, 12 and 13. For these constructions, only enough material for one test was available. However, when two tests of the same construction were made, the results were identical and therefore a third test was considered unnecessary.

The purpose of these tests was to investigate the burning characteristics of cushion employing fire resistant designs. It was the peculiar designs and how the materials were used which were evaluated and not so much the individual materials themselves. To give an example, construction number 2 was designed to employ one layer of Vonar-3 as a fire blocking layer. The evaluation of the performance of this cushion was not so much decided on what material was used, Vonar-3, as the way in which it was used, one layer as fire blocking.

5.1 General

The constructions tested can be classified in four groups. These groups are standard cushion construction, standard cushion construction with a protective covering enveloping the urethane foam core, standard cushion construction with a protective covering enveloping non-fire retarded urethane foam core and standard cushion construction with the urethane foam core replaced by an advance fire resistant foam.

The test results of these constructions is graphically provided in plots presented in Appendix B. To aid in comparison of these constructions, the peak values for each test and the time at which they occurred were taken from the respective plots and are presented in Table 3. The weight loss results are in Table 4. Post-test photographs for each construction are located in Appendix B.

5.2 Standard Seat Construction

Construction number 1 is representative of the type of materials most commonly used in the construction of aircraft passenger seat cushions. These cushions were totally consumed by the fire in a matter of minutes.

Characteristically, the fire-retarded urethane foam thermally decomposes under the extreme heat into a fluid form and subsequently to a gas. In the fluid form, the urethane drips from the seat cushion onto the floor forming a puddle or pool. This pool of urethane fluid gives off gases which are ignited by burning debris falling from the seat. This results in a very hot pool fire engulfing the seat in a matter of minutes.

TABLE 3
TEST DATA PEAK VALUES

C = CALORIMETER T = THERMOCOUPLE S = SECONDS

CUSHION CONSTRUCTION	CL BTU/FT2-SEC	T1 °F	T2 °F	T3 °F	T4 °F	T5 °F	T6 °F	T7 °F	T8 °F	T9 °F	T10 °F	T11 °F	T12 °F	TS °F	TN °F	BEFORE LB	AFTER LB	DELTA LB	TX °F	TC °F	TE °F	DP IN H2O
1 TEST 1	4.0	1494		1666	1309		1218	1526		1690	912		1341	747	750	7.4	0	7.4	293	308	388	11.11
	200S	150S		150S	164S		162S	202S		222S	322S		228S	222S	180S				240S	232S	234S	160S
1 TEST 17	3.40	1779		1303	1376		1652	1762		1800	1111		1491	943	1216	7.5	0	7.5	181	359	386	15.77
	152S	134S		126S	122S		118S	176S		174S	226S		178S	172S	126S				216S	180S	186S	124S
2 TEST 2	1.40	652	820	1284	1319	1368	1388	108	199	372	98	155	384	254	379	12.75	8.20	4.55	156	163	187	5.24
	106S	898S	304S	122S	654S	508S	512S	336S	482S	318S	852S	602S	316S	164S	314S				324S	318S	300S	70S
2 TEST 4	1.62	517	800	1505	1008	724	1170	157	170	418	102	204	384	261	392	11.97	8.3	3.67	111	172	191	3.01
	102S	398S	314S	126S	476S	280S	118S	898S	526S	322S	872S	478S	320S	120S	308S				316S	318S	298S	634S
3 TEST 11	1.64	917	964	1380	1531	1213	1231	234	188	391	114	326	232	268	437	11.5	7.2	4.3	121	183	216	5.72
	112S	540S	282S	98S	570S	544S	104S	890S	548S	320S	888S	320S	396S	262S	208S				324S	282S	314S	64S
3 TEST 12	1.66	991	872	1399	1372	1157	1231	233	245	407	112	232	367	282	496	11.5	7.2	4.3	126	196	229	6.0
	102S	384S	310S	102S	716S	258S	156S	836S	470S	318S	846S	406S	318S	318S	308S				318S	318S	312S	64S
4 TEST 3	1.54	329	1327	1242	1038	1647	1448	235	265	398	108	129	460	302	414	11.65	7.65	4.0	111	183	214	5.3
	60S	460S	394S	130S	330S	318S	172S	686S	4 5S	316S	860S	884S	314S	286S	318S				316S	322S	326S	60S
4 TEST 10	1.50	1106	1310	1682	1225	1461	1294	180	264	432	129	244	428	265	472	11.95	7.8	4.15	115	186	206	5.43
	114S	360S	310S	120S	582S	360S	122S	874S	388S	316S	898S	420S	314S	316S	312S				320S	320S	320S	56S
5 TEST 7	1.57	375	958	1314	711	1209	1230	143	375	406	130	409	419	267	439	9.05	6.62	2.23	122	190	209	5.76
	104S	374S	316S	92S	372S	306S	164S	346S	326S	318S	582S	330S	318S	216S	194S				330S	326S	270S	56S
5 TEST 13	1.65	1098	975	1425	767	1070	1165	150	323	415	122	306	401	272	477	9.20	6.50	2.70	118	191	222	626
	96S	346S	150S	128S	344S	242S	112S	364S	350S	316S	568S	344S	316S	288S	210S				330S	298S	310S	64S
6 TEST 6	1.70	660	1034	1495	867	979	1599	127	331	458	113	239	388	274	498	9.4	7.13	2.27		194	217	5.81
	100S	422S	278S	98S	386S	228S	104S	446S	352S	316S	616S	370S	322S	306S	276S				320S	304S	318S	60S

TABLE 3
TEST DATA PEAK VALUES (CONTINUED)

C = CALORIMETER T = THERMOCOUPLE S = SECONDS

CUSHION CONSTRUCTION	CL BTU/FT2-SEC	T1 °F	T2 °F	T3 °F	T4 °F	T5 °F	T6 °F	T7 °F	T8 °F	T9 °F	T10 °F	T11 °F	T12 °F	TS	TN	BEFORE LB	AFTER LB	DELTA LB	TX °F	TC °F	TE °F	DP IN.H2O
6 TEST 14	1.74	705	1002	1012	890	807	1352	307	120	469	127	254	490	274	473	9.32	7.0	2.32	117	185	211	6.64
	100S	356S	316S	112S	476S	188S	166S	380S	376S	318S	616S	378S	316S	312S	256S				316S	314S	318S	58S
7 TEST 15	1.39	793	782	1366	201	1031	1115	135	198	412	110	176	382	277	405	11.2$	8.45	2.8	115	171	204	5.64
	96S	918S	308S	94S	296S	336S	120S	660S	556S	320S	892S	604S	322S	298S	310S				326S	312S	302S	66S
7 TEST 16	1.54	950	778	1156	983	945	1165	148	229	400	101	175	350	269	396	11.03	8.10	2.93	108	160	200	6.03
	106S	850S	316S	126S	696S	314S	136S	894S	464S	318S	882S	526S	318S	318S	314S				326S	318S	318S	66S
8 TEST 18	1.54	783	1020	1180	1198	880	1133	142	334	459	146	285	393	310	507	8.47	6.05	2.42	126	206	229	6.08
	96S	366S	308S	104S	342S	236S	130S	382S	352S	318S	402S	370S	318S	286S	296S				330S	314S	318S	64S
9 TEST 8	1.51	132		1026	168		968	100		280	94		323	270	333	19.6			104	143	171	5.34
	114S	322S		318S	360S		322S	394S		328S	848S		318S	224S	234S				310S	266S	292S	62S
9 TEST 19	1.46	145		988	161		916	95		308	92		318	264	329	19.01	17.65	1.36	98	137	169	5.43
	118S	324S		318S	418S		322S	464S		340S	882S		320S	224S	250S				306S	310S	310S	64S
10 TEST 9	1.60	774		1393	1335		1029	411		1061	161		729	290	350	5.05	3.60	1.45	113	162	185	5.81
	86S	176S		108S	334S		124S	368S		290S	458S		332S	236S	306S				318S	230S	272S	52S
10 TEST 6	1.67	1153		1425	1794		1141	556		895	152		373	302	346	6.48	3.70	2.78	111	166	194	5.76
	102S	258S		98S	242S		134S	476S		326S	524S		388S	260S	310S				316S	274S	320S	54S
11 TEST 20	1.46	588		1100	886		1252	134		436	176		368	261	353	4.20	3.67	0.53	104	150	184	5.18
	108S	368S		110S	228S		154S	358S		324S	450S		322S	266S	302S				318S	324S	320S	68S
12 TEST 21	1.63	1504	1231	1414	1091	1204	1450	1268	783	1039	1185	628	772	324	392	9.1	3.66	5.54	137	214	238	6.02
	114S	340S	322S	120S	396S	300S	238S	346S	394S	380S	792S	400S	320S	320S	210S				396S	332S	320S	66S
13 TEST 22	1.81	1259	1059	1331	698	1052	1462	497	405	457	131	338	452	305	432	9.8	6.0	3.8	122	182	223	6.53
	100S	322S	320S	112S	344S	174S	156S	506S	326S	318S	678S	342S	316S	300S	212S				312S	280S	252S	74S

TABLE 4
WEIGHT DATA

Cushion Construction		Weight Before kg	(LB)	Weight After kg	(LB)	Weight Loss kg	(LB)
1	Test 1	3.36	(7.4)	0	(0)	3.36	(7.4)
1	Test 17	3.40	(7.5)	0	(0)	3.40	(7.5)
2	Test 2	5.78	(12.75)	3.72	(8.20)	2.06	(4.55)
2	Test 4	5.43	(11.97)	3.76	(8.3)	1.67	(3.67)
3	Test 11	5.22	(11.5)	3.27	(7.2)	1.95	(4.3)
3	Test 12	5.22	(11.5)	3.27	(7.2)	1.95	(4.3)
4	Test 3	5.28	(11.65)	3.47	(7.65)	1.81	(4.0)
4	Test 10	5.42	(11.95)	3.54	(7.8)	1.88	(4.15)
5	Test 7	4.11	(9.05)	3.00	(6.62)	1.11	(2.23)
5	Test 13	4.17	(9.20)	2.95	(6.50)	1.22	(2.70)
6	Test 5	4.26	(9.40)	3.23	(7.13)	1.03	(2.27)
6	Test 14	4.23	(9.32)	3.18	(7.0)	1.05	(2.32)
7	Test 15	5.10	(11.25)	3.8	(8.45)	1.30	(2.80)
7	Test 16	5.00	(11.03)	3.67	(8.10)	1.33	(2.93)
8	Test 18	3.84	(8.47)	2.74	(6.05)	1.10	(2.42)
9	Test 8	8.89	(19.6)	N/A		--	
9	Test 19	8.62	(19.01)	8.0	(17.65)	.62	(1.36)
10	Test 9	2.29	(5.05)	1.63	(3.60)	.66	(1.45)
10	Test 6	2.94	(6.48)	1.68	(3.70)	1.26	(2.78)
11	Test 20	1.91	(4.20)	1.66	(3.67)	.25	(.53)
12	Test 21	4.13	(9.10)	1.66	(3.66)	2.47	(5.54)
13	Test 22	4.45	(9.80)	2.72	(6.00)	1.73	(3.80)

5.3 Protected Fire-Blocked Standard Cushions

The purpose of the fire-blocking layer surrounding the urethane foam core is to thermally isolate the foam from the heat source by either conducting the heat laterally away and by providing an insulative char layer.

5.3.1 Aluminized Fabric

The celiox and norfab fire blocking constructions employed a reflective aluminum coating bonded to their outer surface.

All three constructions resulted in identical test results. These constructions were unable to protect the urethane foam in the cushions closest to the radiant heat source. They were able to slow down the burn rate of the urethane thus producing a less severe fire. This fire was unable to penetrate the adjacent cushions also protected by these materials.

Characteristically, in these constructions the urethane thermally decomposes within the fire-blocking layer and produces fluids and gases. The gas leaks through the cushion seams, ignites, burn and continues to open the seams. This results in a small controlled pool fire burning within the fire-blocking envelope with flames reaching through the seam areas. The radiant heat source in combination with the controlled pool fire, is adequate to thermally decompose the urethane foam on the closest side of the adjacent cushions. The heat source is not adequate to ignite these gases.

Reversing the edges at which the seams were located, i.e, placing the seams at the bottom edge instead of the top edge of the cushion, made no appreciable difference for the cushions adjacent to the fire source. Placing the seam on the bottom edge of the cushions farthest from the radiant panel helped to prevent the escaping gases from igniting, and the seam from opening. All cushions using this fire-blocking material were vented in the back to prevent ballooning of the cushions by the gas generated within them. However, the decomposed urethane tended to plug the vent and restrict the out-gasing. The overall final appearance of the cushion closest to the radiant panels showed a fragile, charred, empty fire-blocking envelope with its seams burned open.

The final appearance of the cushions farthest from the radiant panels showed a partially charred upholstery cover. The urethane cushion had some minor hollow spots. When the seams were placed on the bottom edge of the cushion, a fully intact fire-blocking envelope remained.

The percent weight loss between the fire and non-fire retarded urethane cushions was small, as shown by Figure 7.

5.3.2 Non-Aluminized Fire Blocking

Constructions 2, 3 and 7 used Vonar foam, construction 4 used LS-200 foam, construction 12 used non-aluminized norfab fabric and construction 13 used PBI fabric.

The constructions were unable to protect the urethane foams in the cushions closest to the radiant panels. However, they did slow down the burn rate of the urethane thus subjecting the adjacent cushion to a less intense fire.

The fire-blocking foams performed much like the aluminized fabric fire-blocking in that even though the heat was intense enough to thermally decompose the urethane into a fluid and gas, the fire blocking layer was able to contain and subdue the burning urethane. Flames exited where the fire-blocking char layer had fallen away.

The non-aluminized norfab fabrics were unable to contain the decomposed urethane. The urethane fluid dripped onto the floor where it pooled and ignited. The cushions were completely consumed when this floor fire engulfed it. The overall final appearance of the cushion remains closest to the radiant panels for foam fire blocking constructions 2, 3, 4 and 7 was thoroughly charred fire-blocking material void of all urethane foam.

The final appearance of the cushions farthest from the radiant panels were very similar. They varied in the amount of thermal decomposition of the urethane foam core, i.e., the size of the void or hollowing of the urethane. Construction number 2 using Vonar-3 material produced the smallest amount of urethane decomposition. It was followed by construction number 4, 3/8 LS 200 neoprene, and construction number 3, Vonar-2. Construction number 7 used a non-fire retarded urethane with Vonar-3. It did not fair as well as construction number 2 employing fire retarded urethane.

Typically, the foam fire-blocking layer adjacent to the urethane hollow spots were completely charred but intact.

5.4 Advanced Foam

Construction numbers 9, 10 and 11 used advanced foams in place of the urethane foam.

Construction number 9, LS 200 neoprene, produced a deep seated fire which did not produce a significant amount of heat or flames. It smoldered long after the test was completed and required total emersion in water to extinguish. This cushion had the lowest weight loss as shown by Figure 7. However, an all LS-200 neoprene seat cushion would result in a large aircraft weight impact because of its high density.

The foam in the seat cushion closest to the radiant panels was completely charred with the upholstery burned off of all surfaces except the bottom and back.

The foam in the seat cushions farthest from the radiant panels had a thick char on the edge closest to the heat source. This char gradually diminished halfway across the cushions. The upholstery on the back and bottom of these cushions was not burned.

Constructions 10 and 11, polyimide foam, had different upholstery materials. Construction 10, 90/10 wool-nylon upholstery, performed identically to a previous test program. The cushions closest to the radiant panels shrunk to one-half inch in thickness or less with a char of one-quarter inch or greater.

The cushion farthest from the radiant panels shrank to within one-half inch thickness with a char of one-quarter inch or less.

Characteristically, the polyimide foam thermally decomposes by giving off gases, and produces a char layer as it decreases in size.

The decomposing of the foam beneath the upholstery on the seat farthest from the radiant panel creates a pocket or void where the gases generated by the foam accumulates. When these trapped gases burn, the foam further thermally decomposes. Construction number 11, polyester upholstery, reacted differently from that characteristic of construction number 10. When the radiant panel was turned on, the polyester upholstery on the cushion farthest from the heat source rapidly decomposed into a liquid which dripped off the seat cushions.

With the upholstery gone, the majority of the gas from the decomposing polyimide foam escaped without igniting. These cushions decomposed less as exemplified by the small weight loss and a thinner char layer.

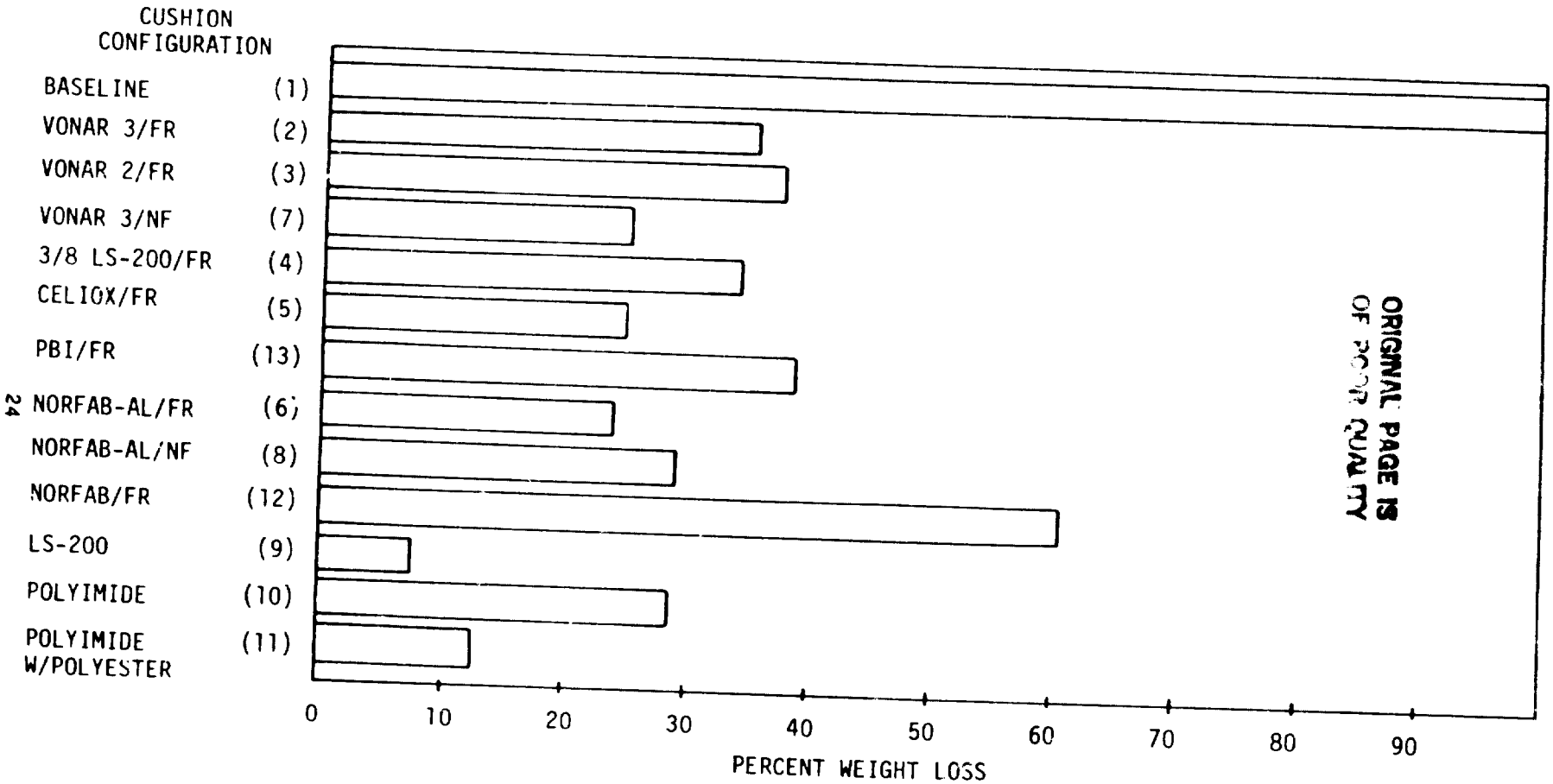


FIGURE 7. PERCENT WEIGHT LOSS

SECTION 6
CONCLUSIONS

Urethane foam decomposes into a volitile gas when exposed to a severe heat source. If this generated gas can be contained in such a manner as to prevent its igniting or to control the rate at which it burns, the severity of the fire will be reduced. This was clearly shown in the testing of standard cushion constructions with a protective covering, "fire-blocking", enveloping the urethane foam.

When the fire blocking was able to contain the decomposing urethane by-products, i.e., fluid and gas, the cushions closest to the heat source burned with less intensity, generated a minimum of heat and were unable to ignite the adjacent cushions. However, when the decomposing urethane fluid was able to escape from the fire-blocking envelope and pool on the floor, an uncontrolled fire erupted which resulted in total burning of all cushion materials.

Some of the Norfab and Celiox materials utilized aluminum coatings. It was not the aluminums reflecting properties which made the cushions perform well as it was its non-permeable properties. This coating helped contain the decomposed by-products and prevented propagation to the adjacent cushion.

Had the seams held and all the gases vented out the back of the cushions and away from the heat, the decomposing of the cushions may have been even less severe. Undoubtedly, the reflective properties had an effect in slowing down the decomposing of the urethane, but only by a few seconds. The reason being the emissivity and thermal conductivity of the aluminum coating was inadequate to resist the severe radiant energy being applied to the surfaces.

The charred foam fire-blocking layers did not act primarily as a heat barrier as they did a liquid and gas barrier. In the cushions farthest from the radiant source, the urethane foam still thermally decomposed. It formed a pocket of gas behind the intact charred envelope. This was verified in post test inspection. However, the gas escaped slowly and only created a small pilot flame. The flame extinguished itself when the radiant energy source was switched off.

The polyimide cushions are examples of a foam which thermally decomposes at high temperatures and generates gas and char but no noticeable liquids. The wool-nylon upholstery trapped gases between itself and the foam. When these gases ignited, the foam decomposed rapidly. The polyester upholstery decomposed from the cushions fast enough to prevent the trapping of these gases. Subsequently, the foam in the cushions decomposed at a slower rate. From these tests, it is concluded that no matter the foam used as a core for the cushion, if the gases generated by the foam can be expelled or contained in such a manner as to prevent their burning or reduce the rate at which they burn, a severe fire can be avoided or delayed. It is further concluded that if the thermal decomposition characteristics can be altered so as to slow down the generation of gas, the time before a fire becomes severe can be extended to the point where appropriate extinguishment of the fire may be possible.

SECTION 7

RECOMMENDATIONS

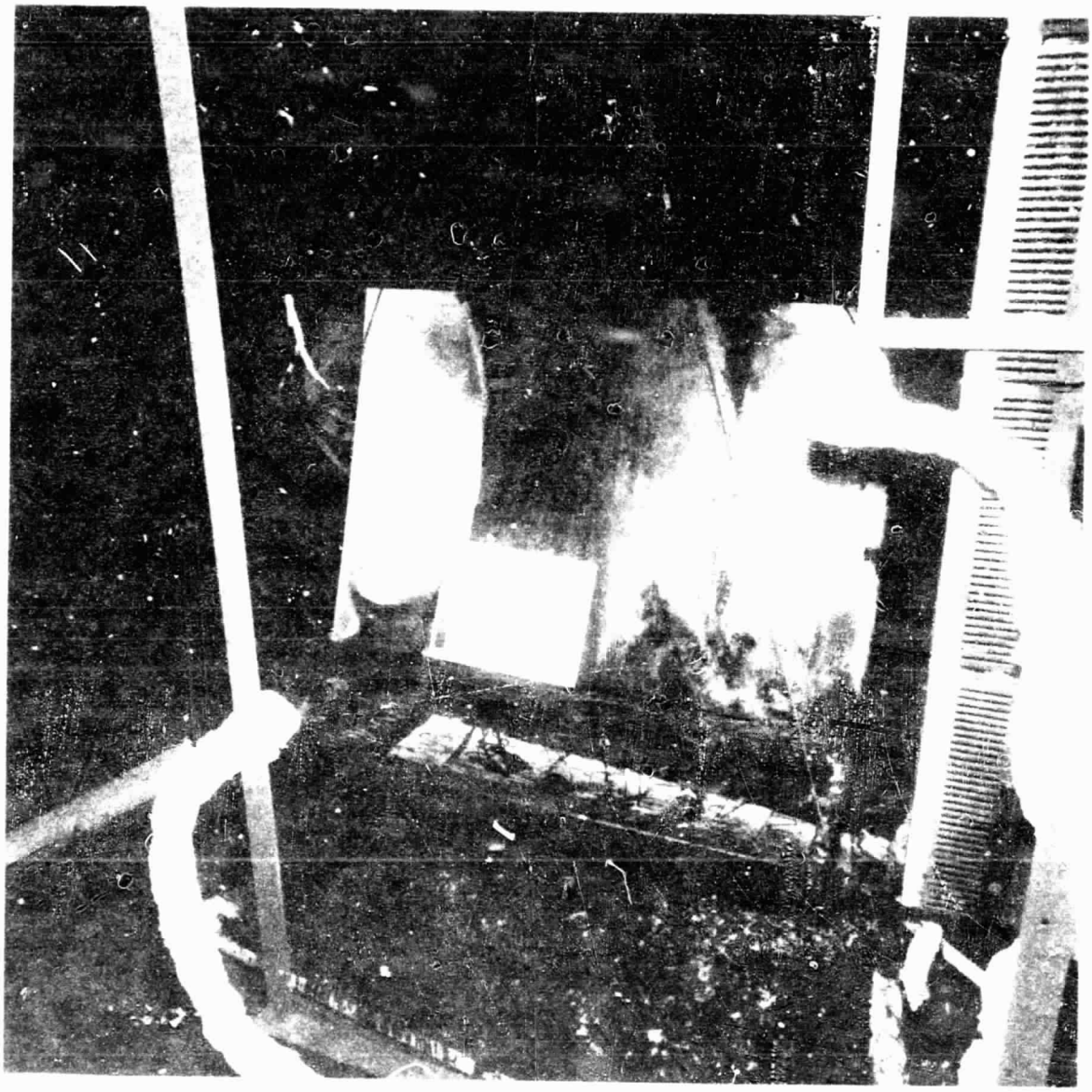
It is recommended that a study be made to incorporate cushion designs and fire-blocking materials which are thermally stable and nonpermeable to urethane fluids and gases to prevent or reduce the rate at which a seat cushion burns.

This study should include considerations for wearability of fire blocking layers, fatigue life of cushion foams and methods of venting decomposition gases from the cushion assembly. Test results from this program have shown that seam constructions significantly affect cushion burn performance. Therefore, seam constructions previously studied by the NASA seat program should be reconsidered in future cushion designs.

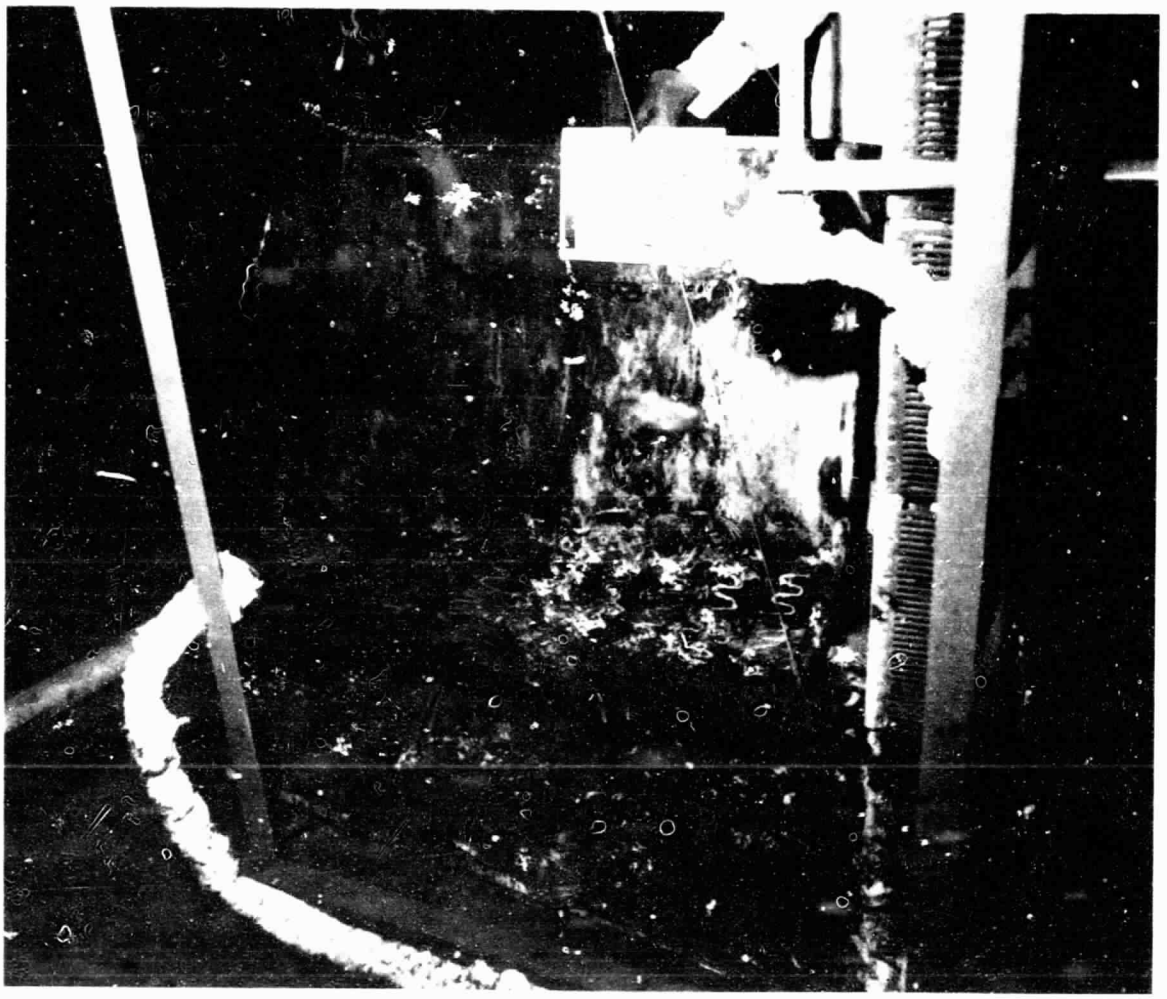
It is also recommended to use these studies as a basis to develop a design standard for a fire resistant passenger seat. This standard must be supported by inexpensive laboratory burn test methods that can verify these standards are being met.

APPENDIX A

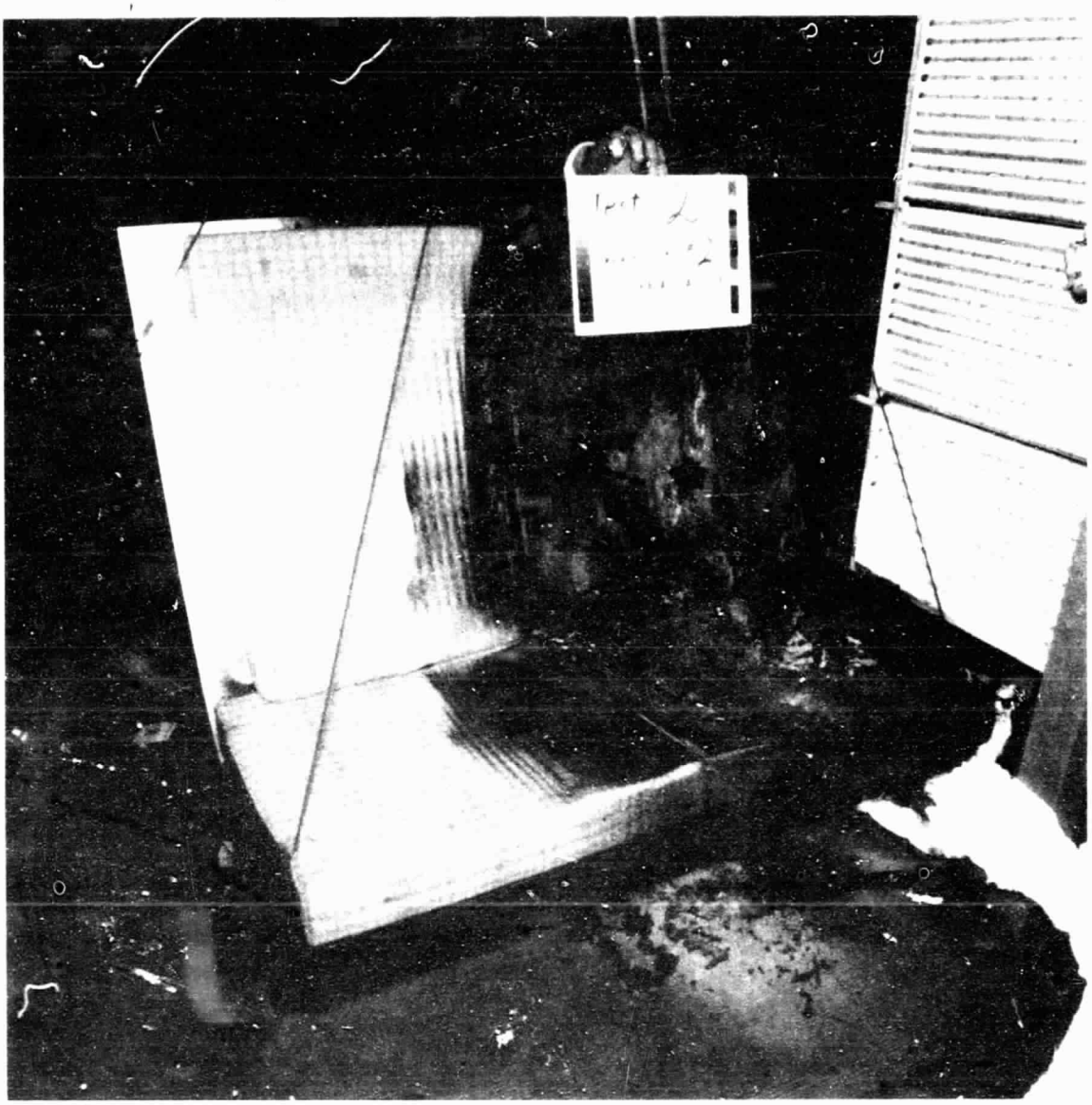
Posttest Photographs



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
1	Wool-Nylon	None	None	F. R. Urethane

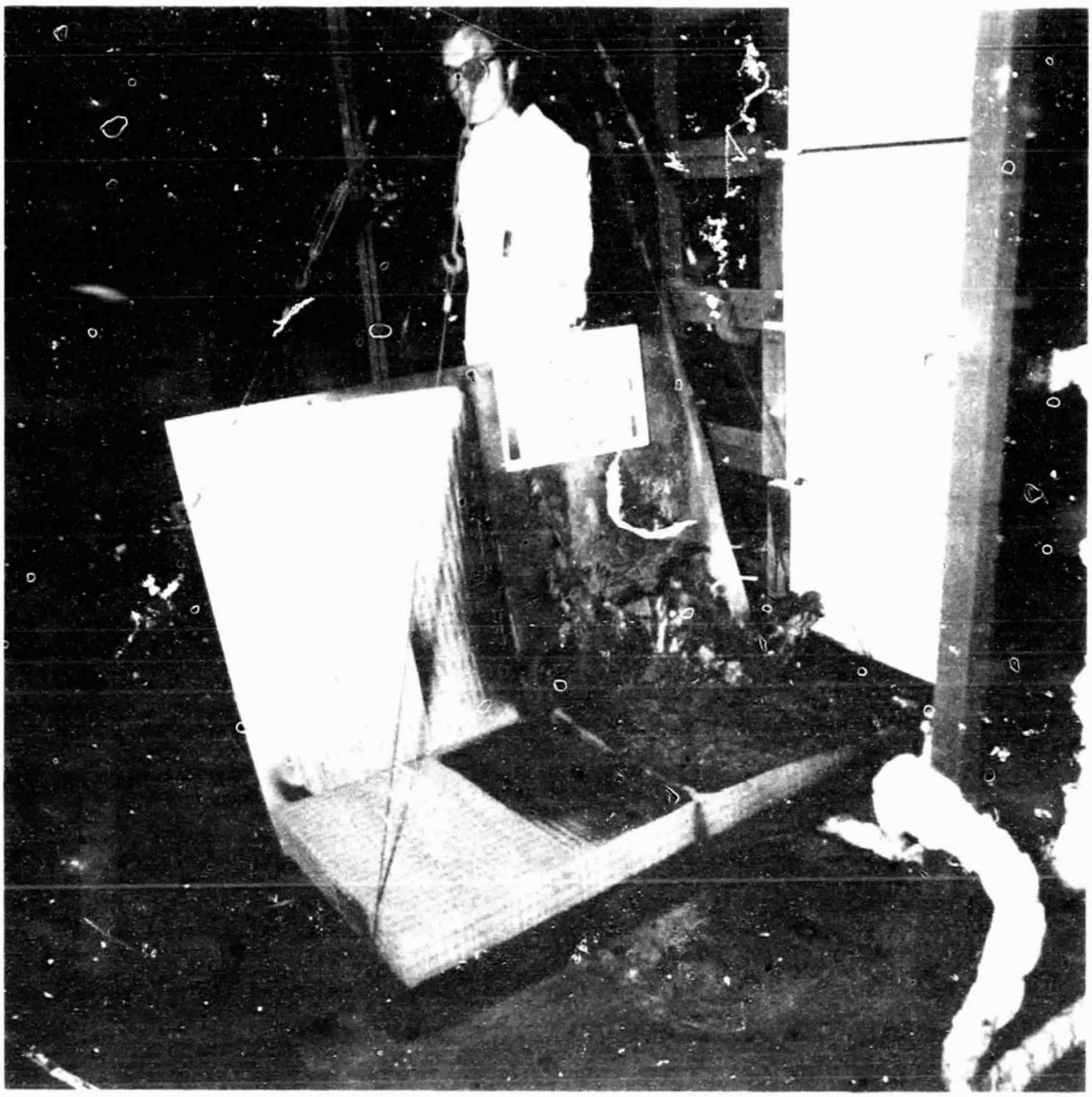


Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
1	Wool-Nylon	None	None	F. R. Urethane



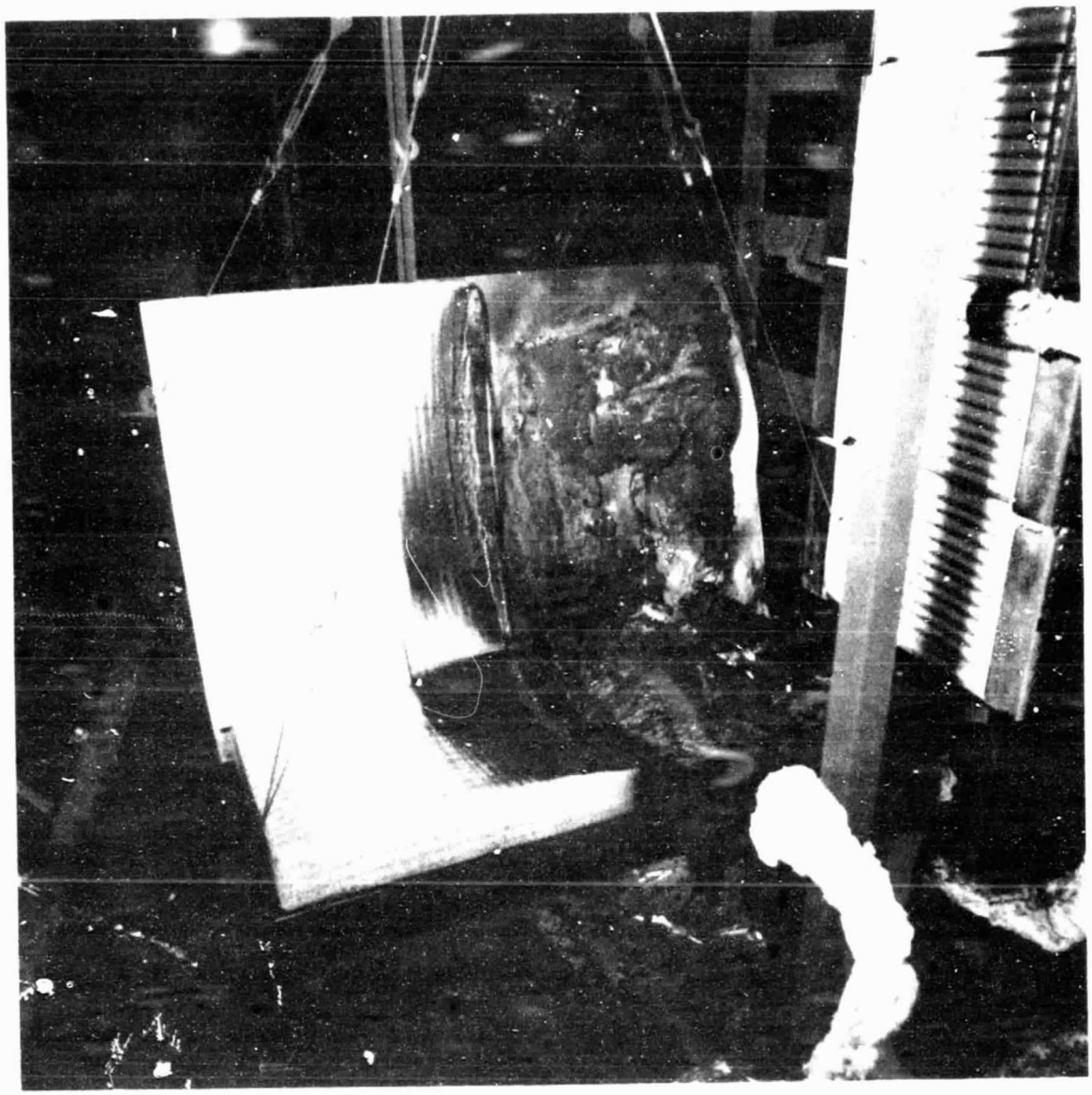
Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
2	Wool-Nylon	Cotton-Muslin	Vonar-3	F. R. Urethane

PAGE
BLACK AND WHITE PHOTOGRAPH

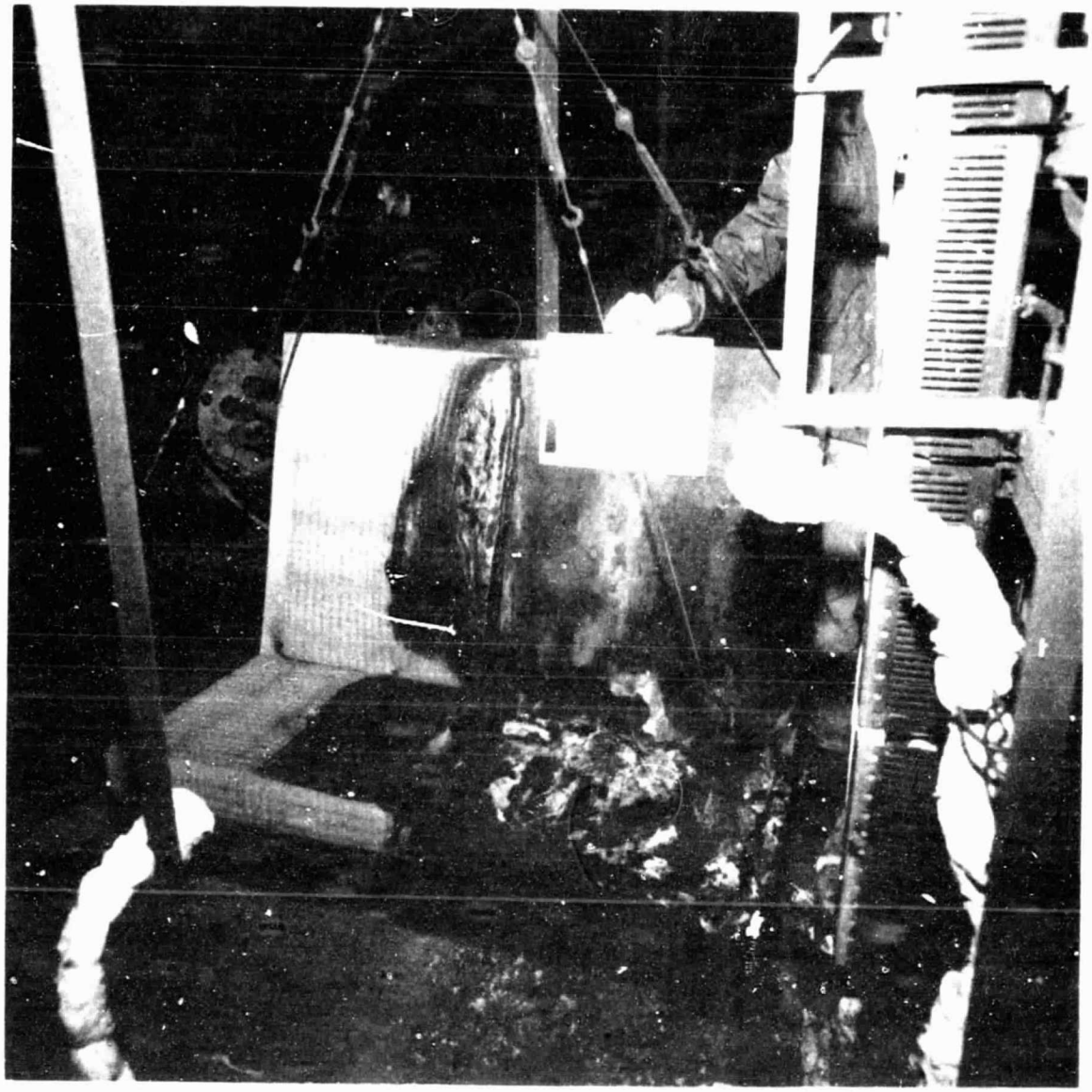


Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
2	Wool-Nylon	Cotton-Muslin	Vonar-3	F. R. Urethane

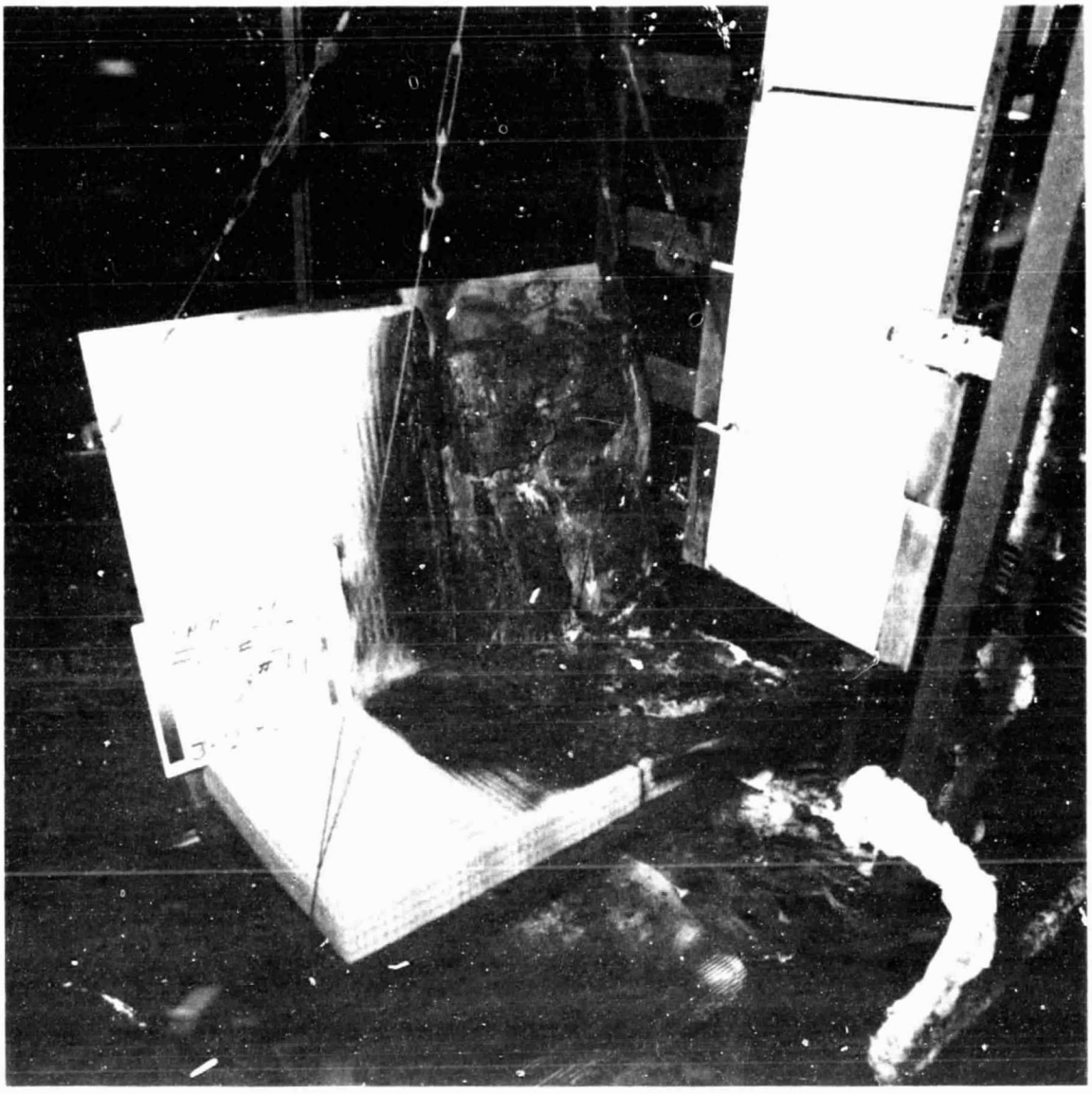
Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
3	Wool-Nylon	Cotton-Muslin	Vonar-2	F. R. Urethane



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
3	Wool-Nylon	Cotton-Muslin	Vonar-2	F. R. Urethane



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
4	Wool-Nylon	None	3/8 LS 200	F. R. Urethane



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
4	Wool-Nylon	None	3/8 LS 200	F. R. Urethane

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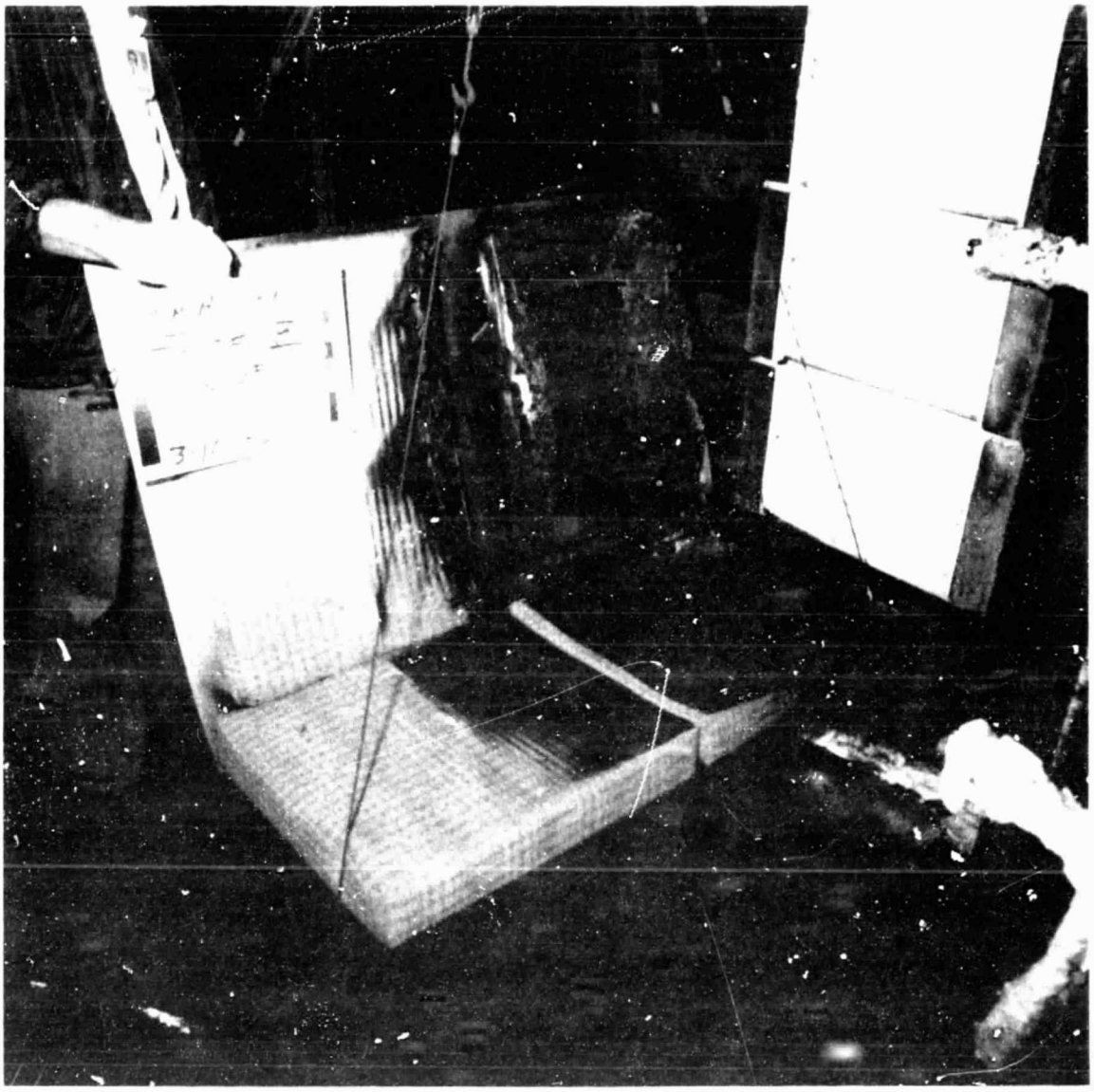
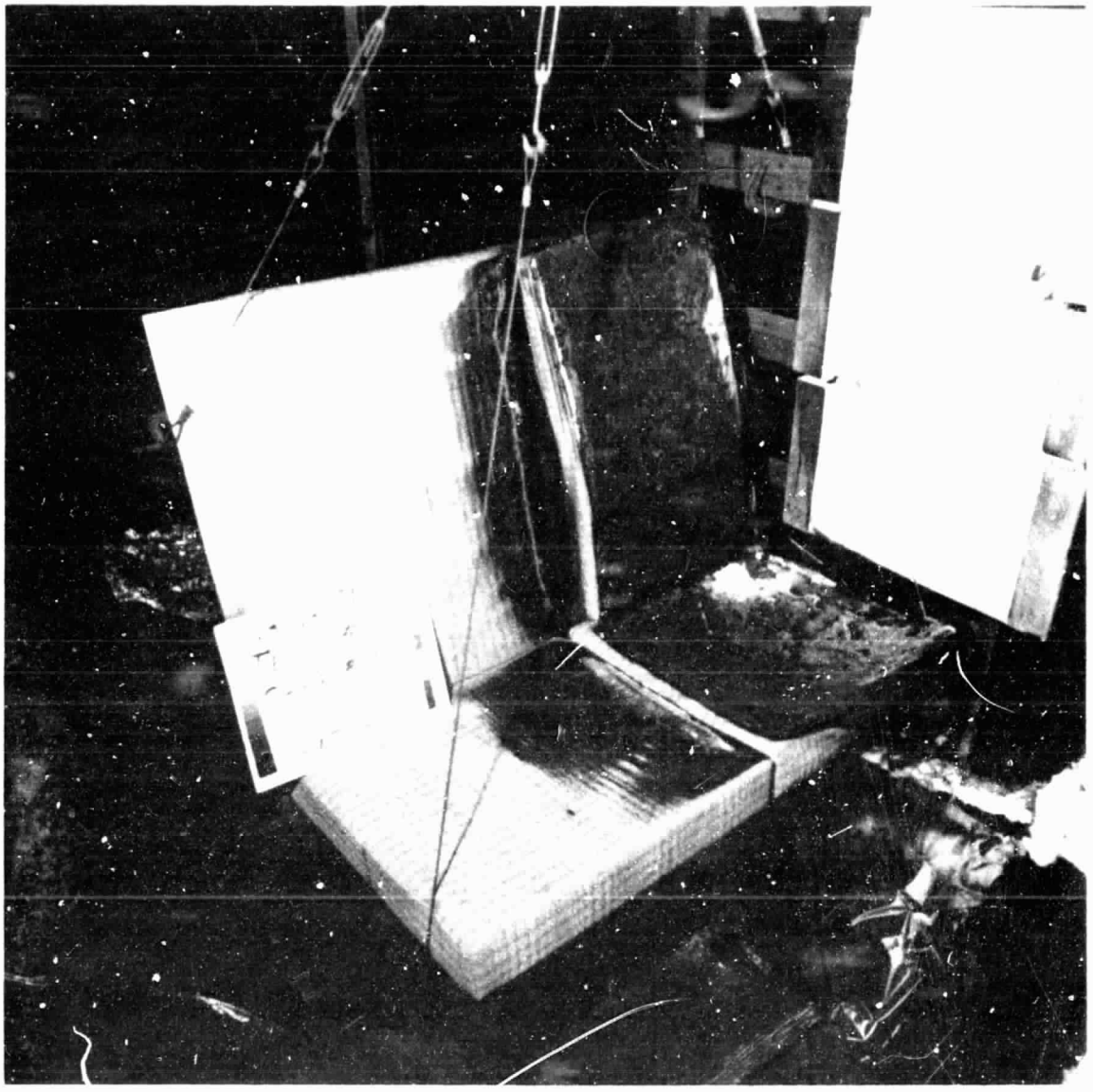


Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
5	Wool-Nylon	None	Celiox 101	F. R. Urethane



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
5	Wool-Nylon	None	Celiox 101	F. R. Urethane

BLACK AND WHITE

Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
6	Wool-Nylon	None	Norfab 11 HT-26-AL	F. R. Urethane

Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
6	Wool-Nylon	None	Norfab 11 HT-26-AL	F. R. Urethane

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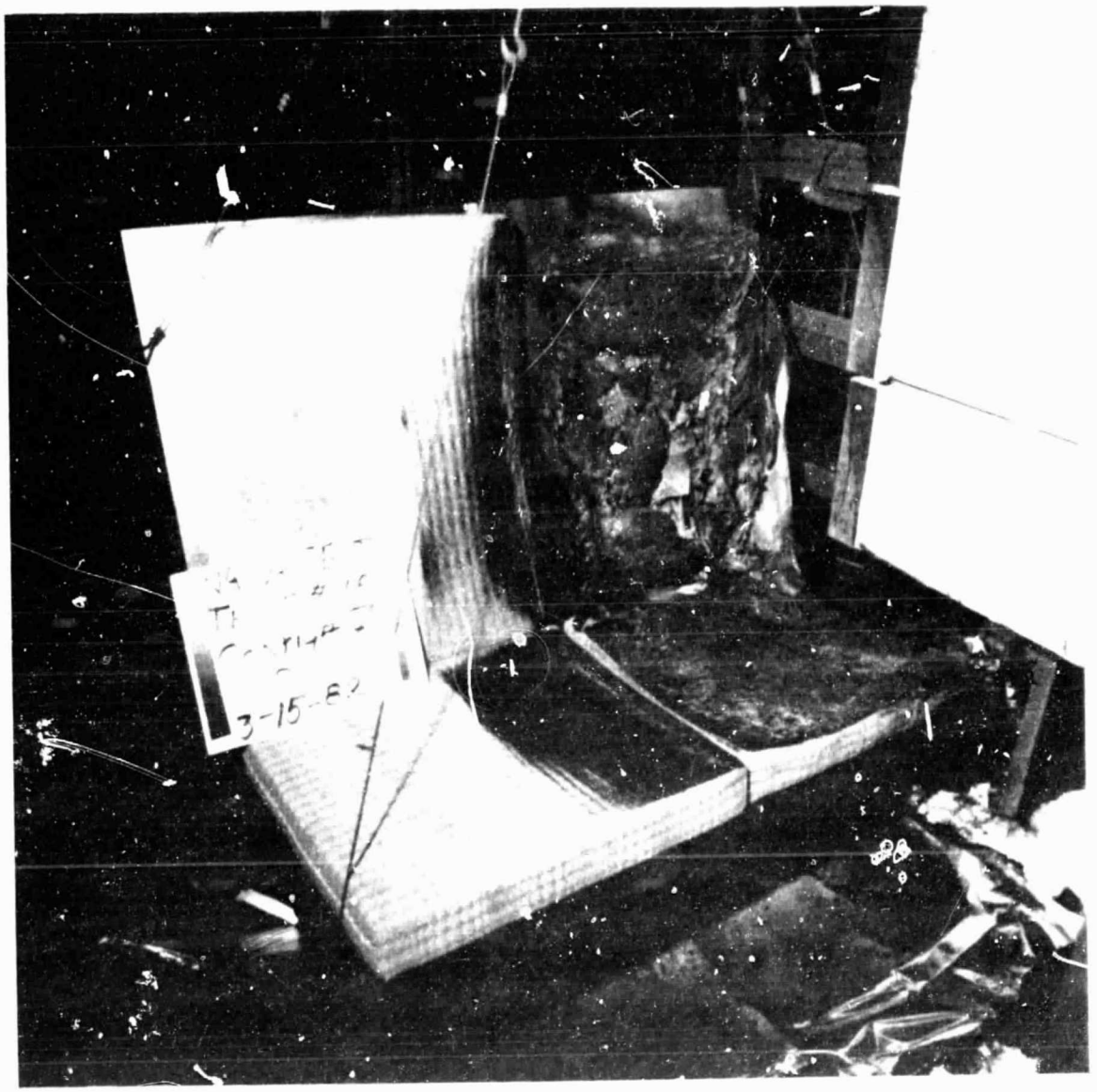
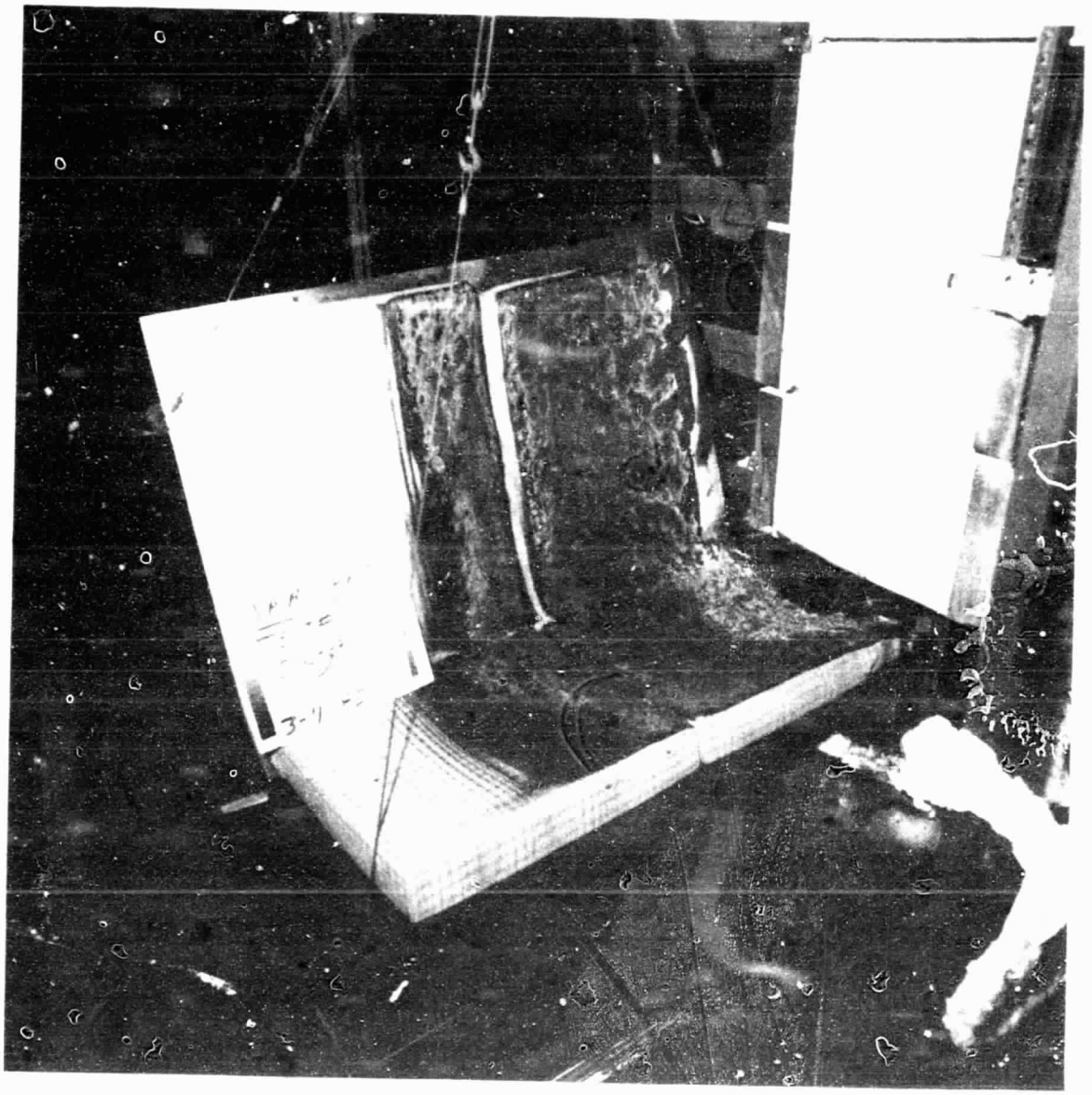
BLACK AND WHITE PHOTOGRAPH



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
7	Wool-Nylon	Cotton-Muslin	Vonar-3	N. F. Uretnane

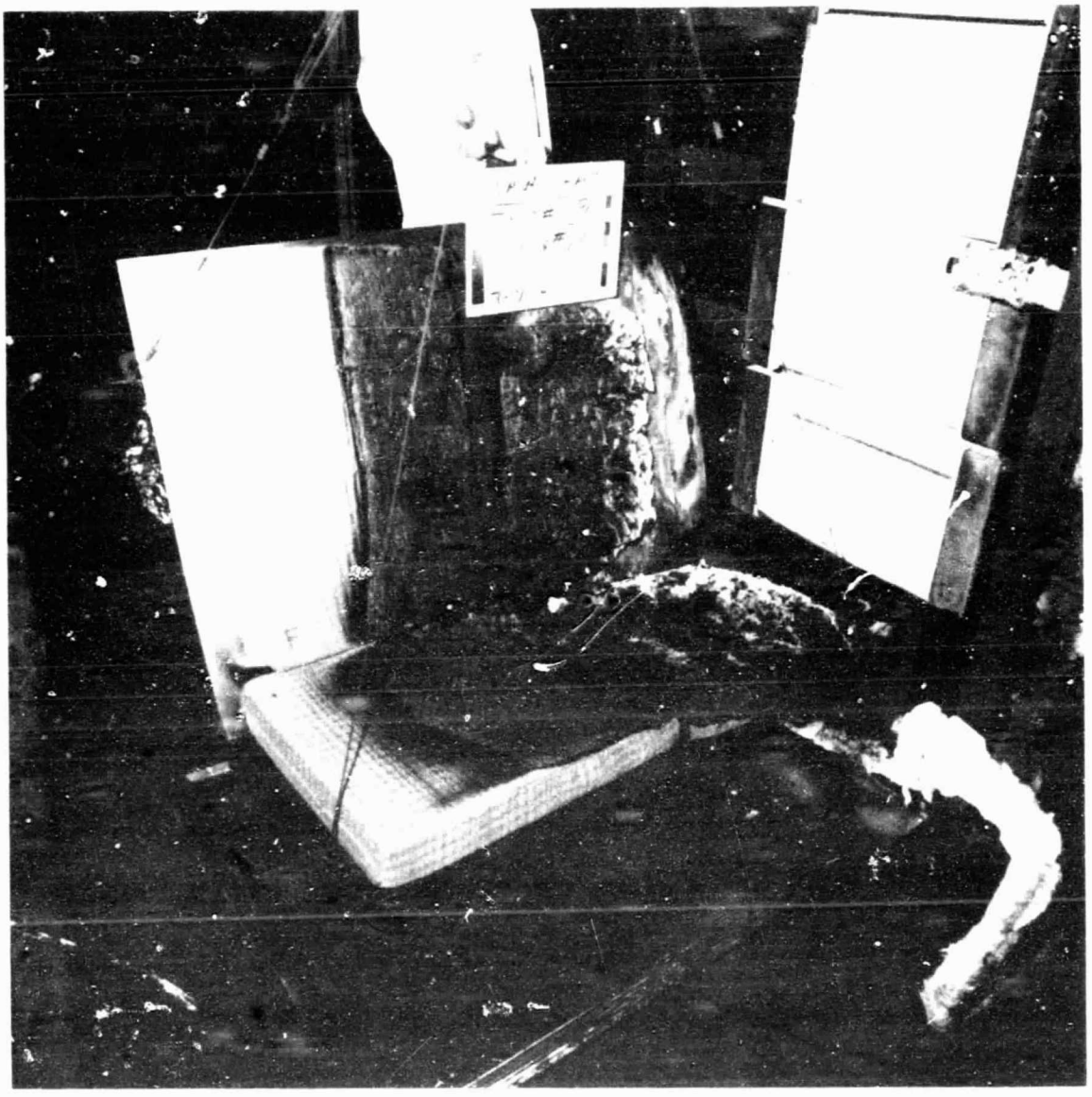
Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
7	Wool-Nylon	Cotton-Muslin	Vonar-3	N. F. Urethane

Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
8	Wool-Nylon	None	Norfab 11 HT-26-AL	N. F. Urethane



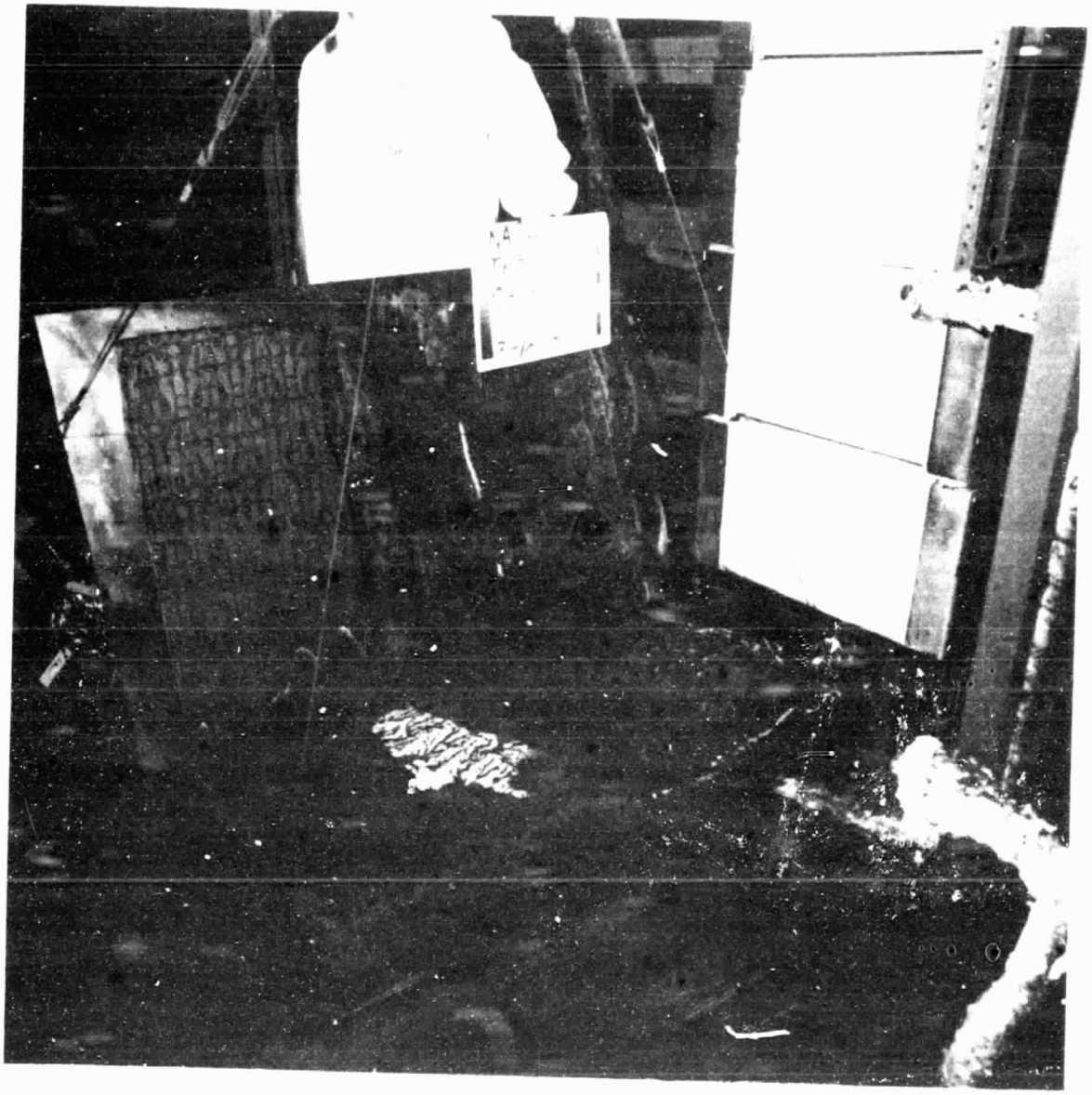
Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
9	Wool-Nylon	None	None	LS 200 Neoprene

Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
8	Wool-Nylon	None	Norfab 11 HT-26-AL	N. F. Urethane

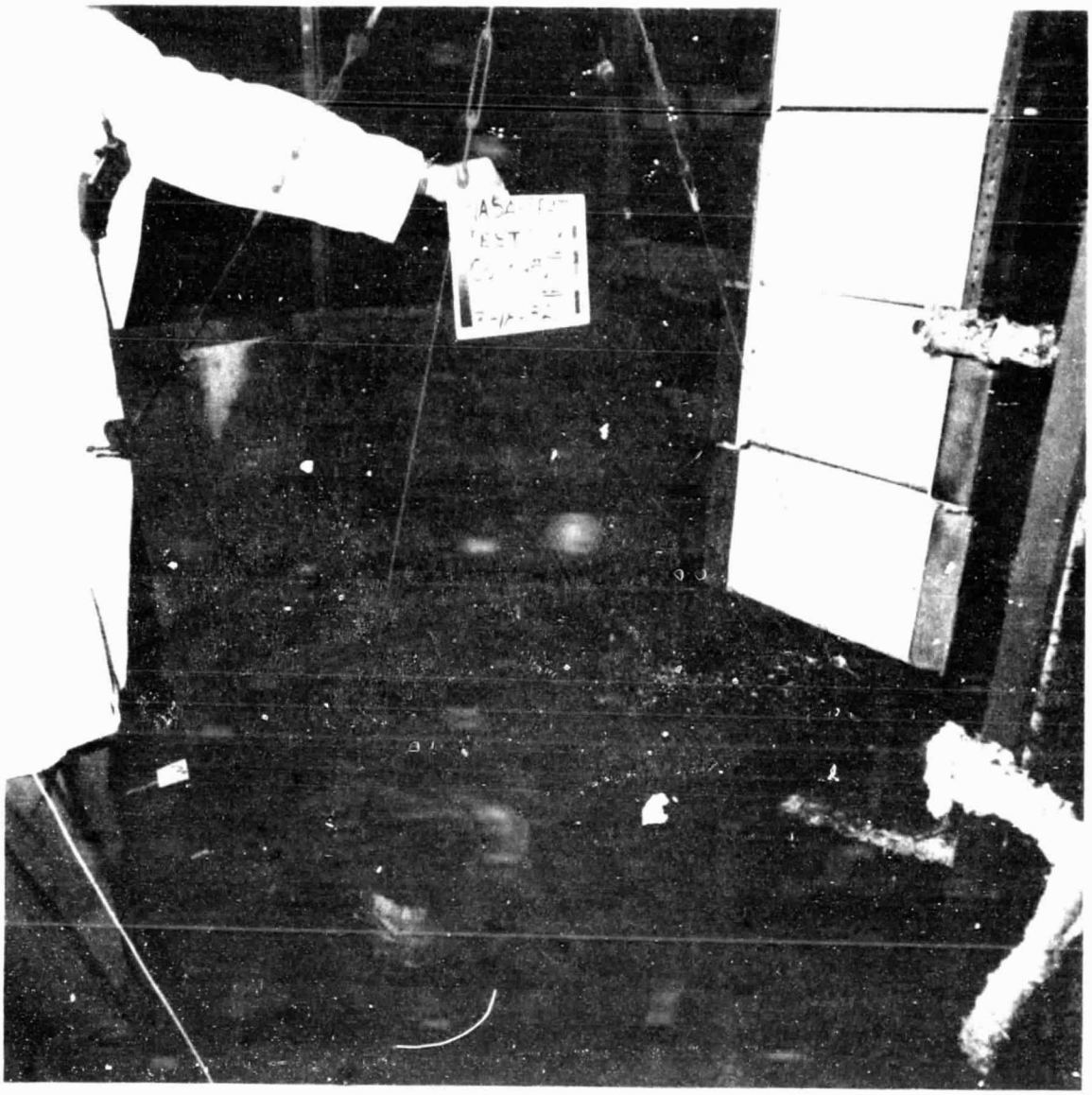


Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
10	Wool-Nylon	None	None	Polyimide

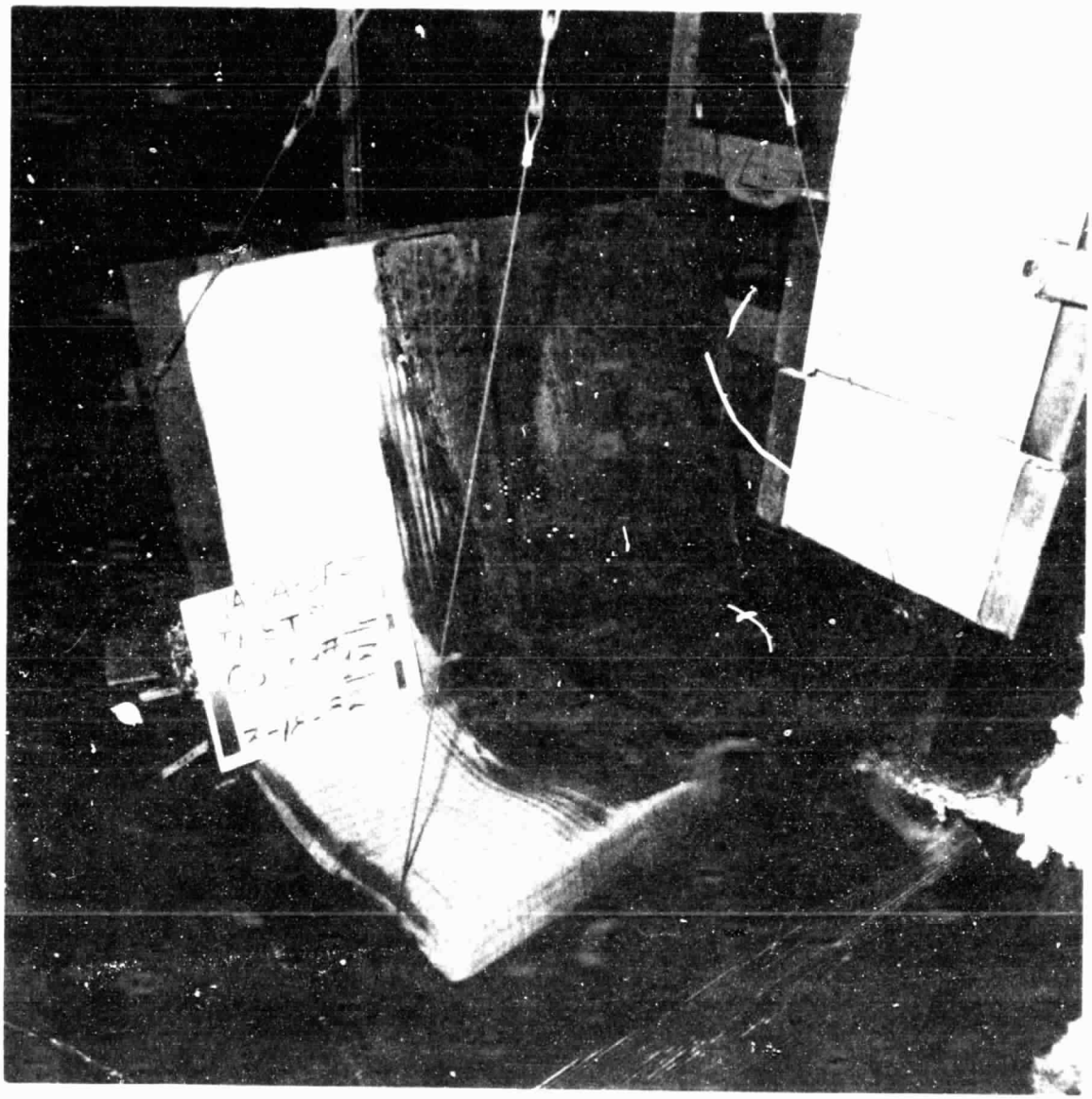
Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
10	Wool-Nylon	None	None	Polyimide



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
11	Polyester	None	None	Polyimide



Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
12	Wool-Nylon	None	Norfab 11 HT-26	F. R. Urethane

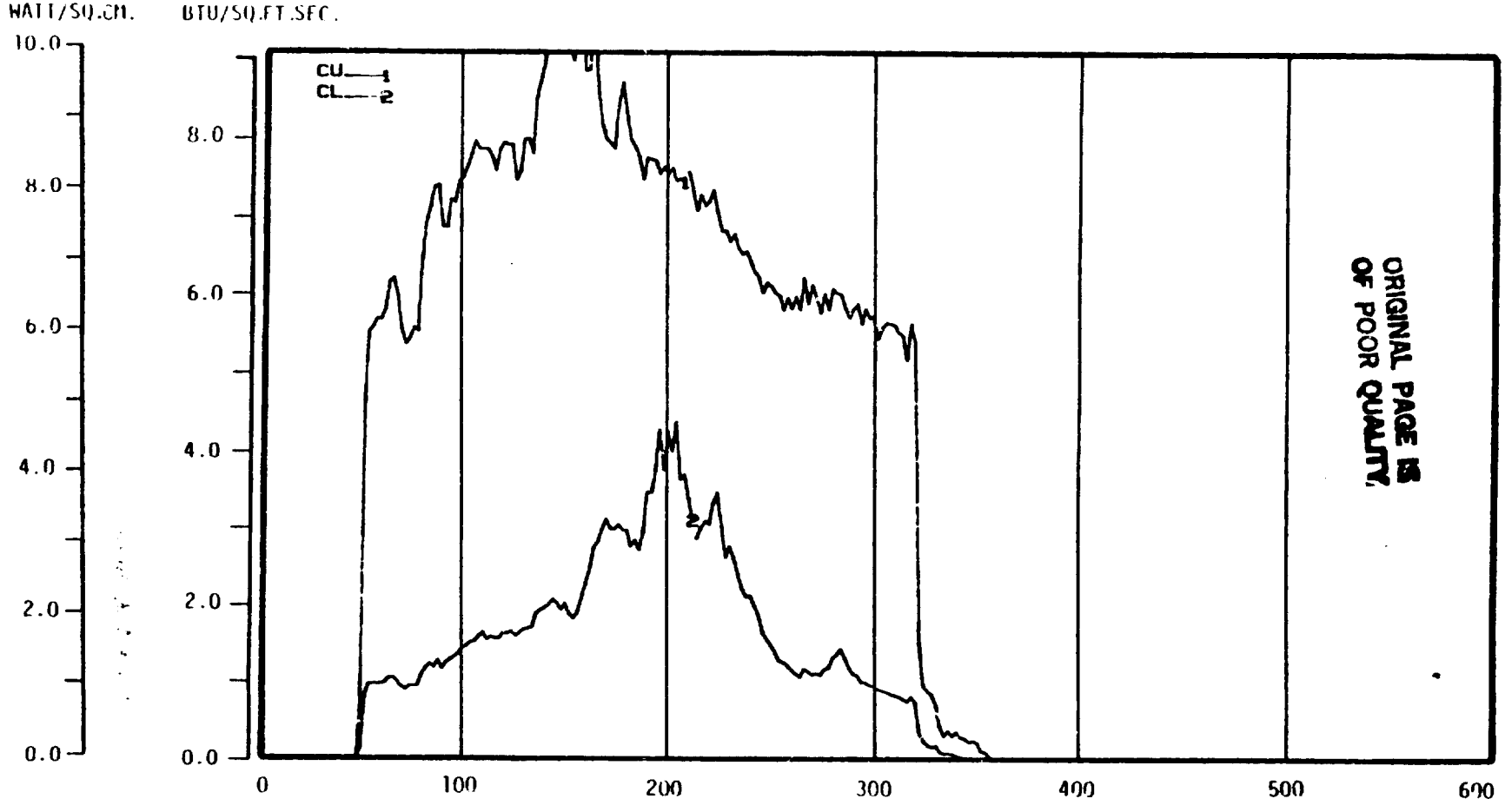


Construction Number	Decorative Upholstery	Slip Cover	Fire Blocking	Foam
13	Wool-Nylon	None	PBI	F. R. Urethane

APPENDIX B

Test Plots

HEAT FLUX

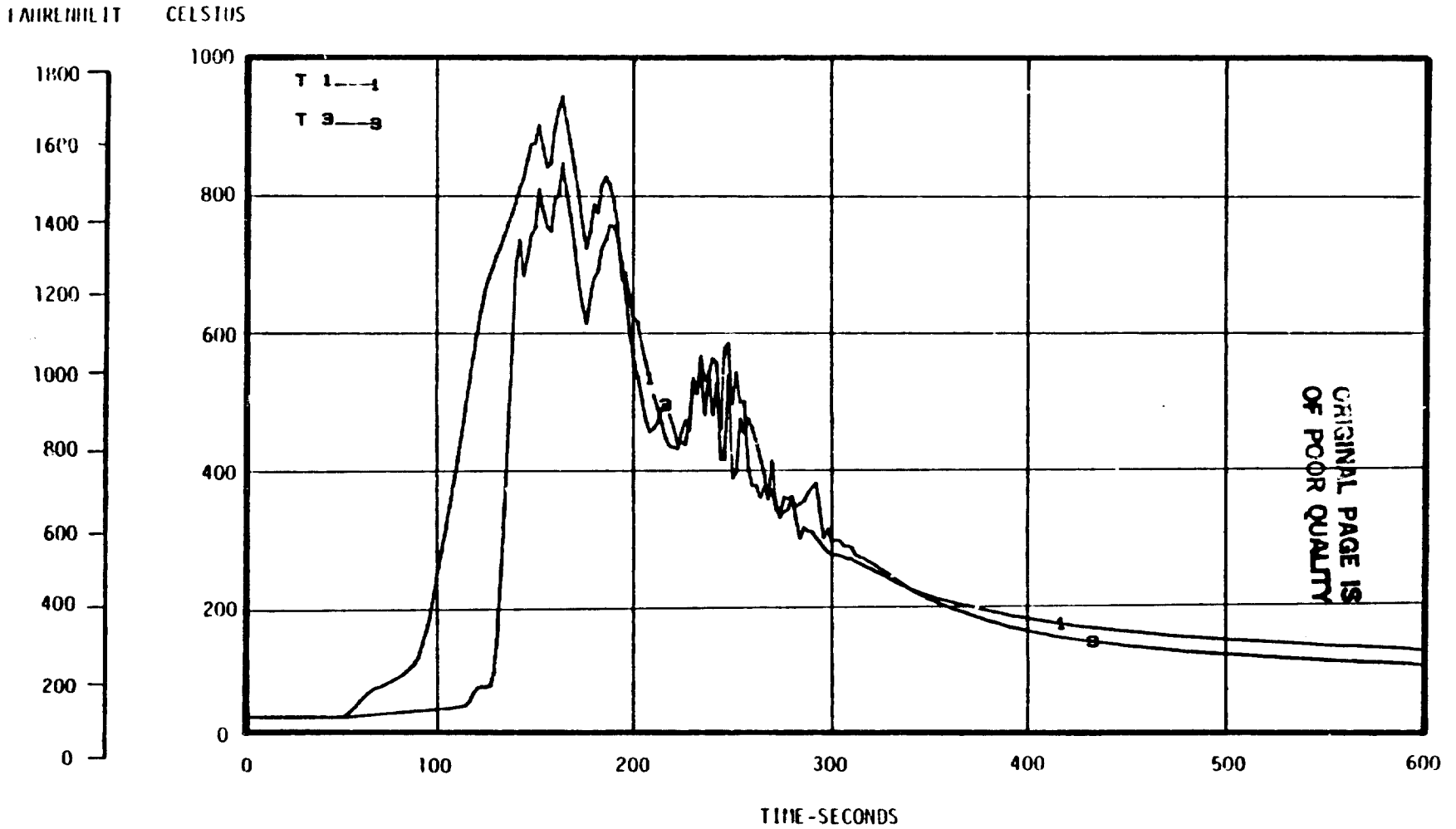


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 08.38

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 1

CUSHION CONSTRUCTION NUMBER 1.0

SEAT CUSHION TEMPERATURES



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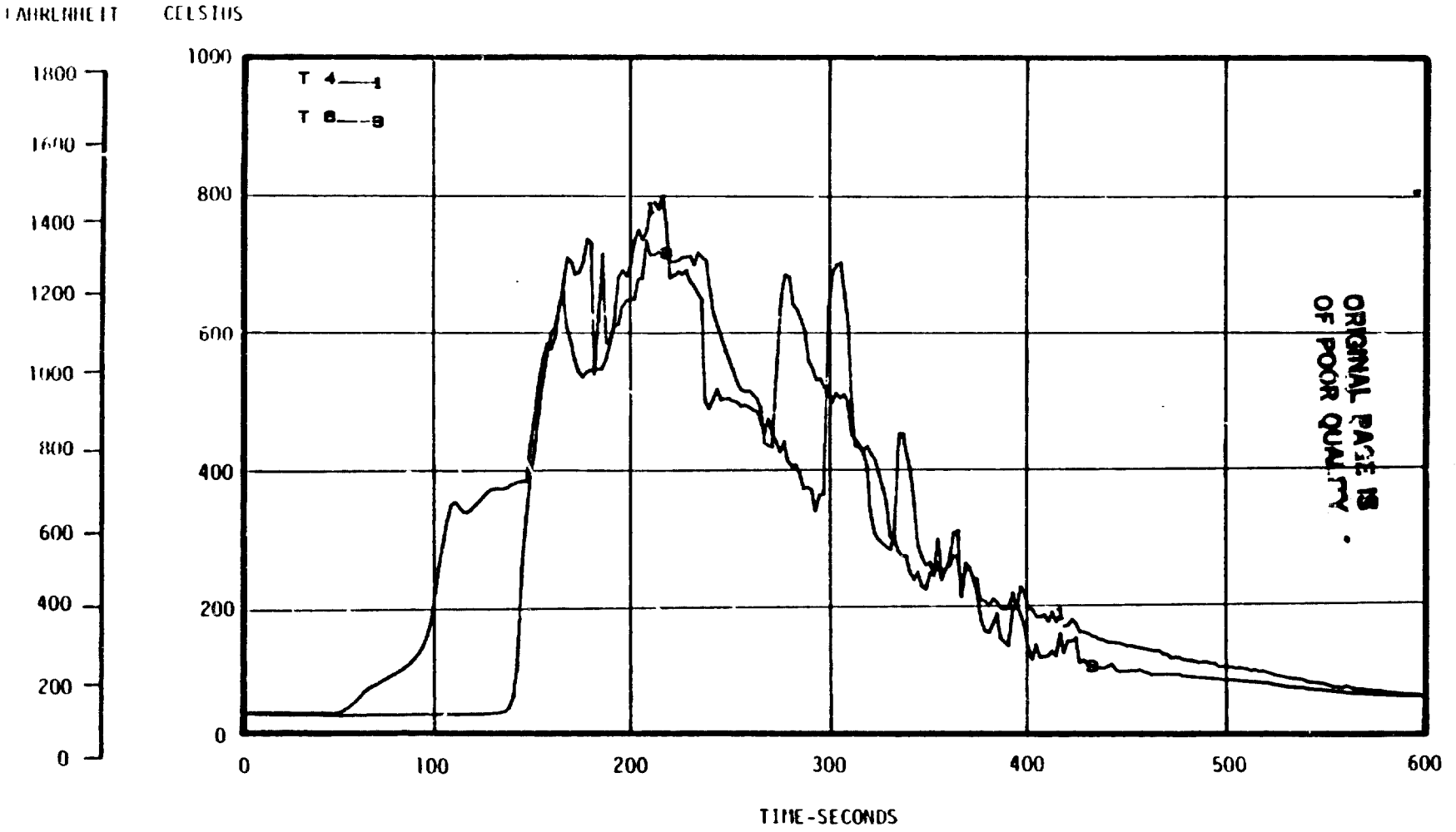
SEAT CUSHION TEMPERATURES



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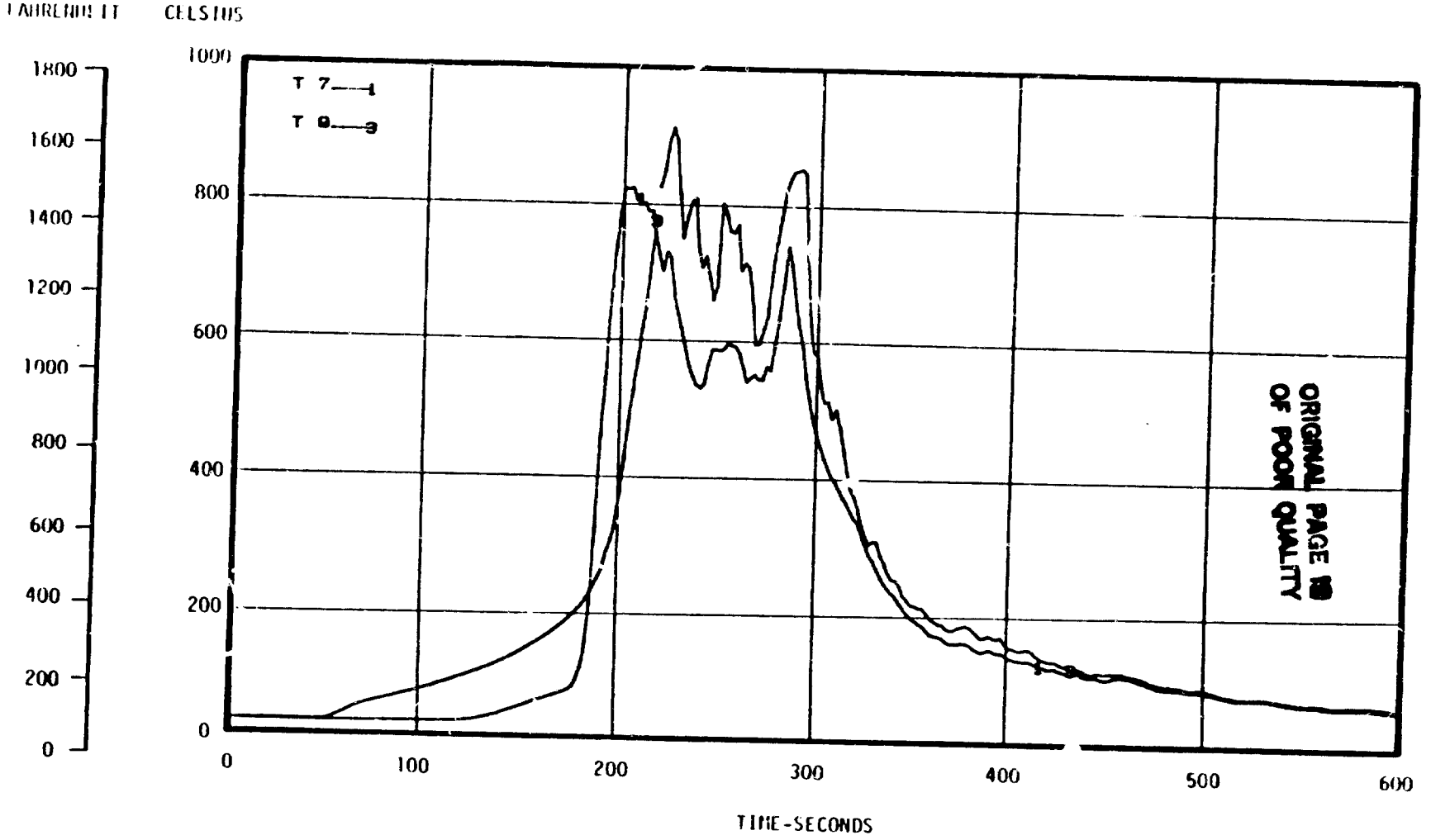
SEAT CUSHION TEMPERATURES



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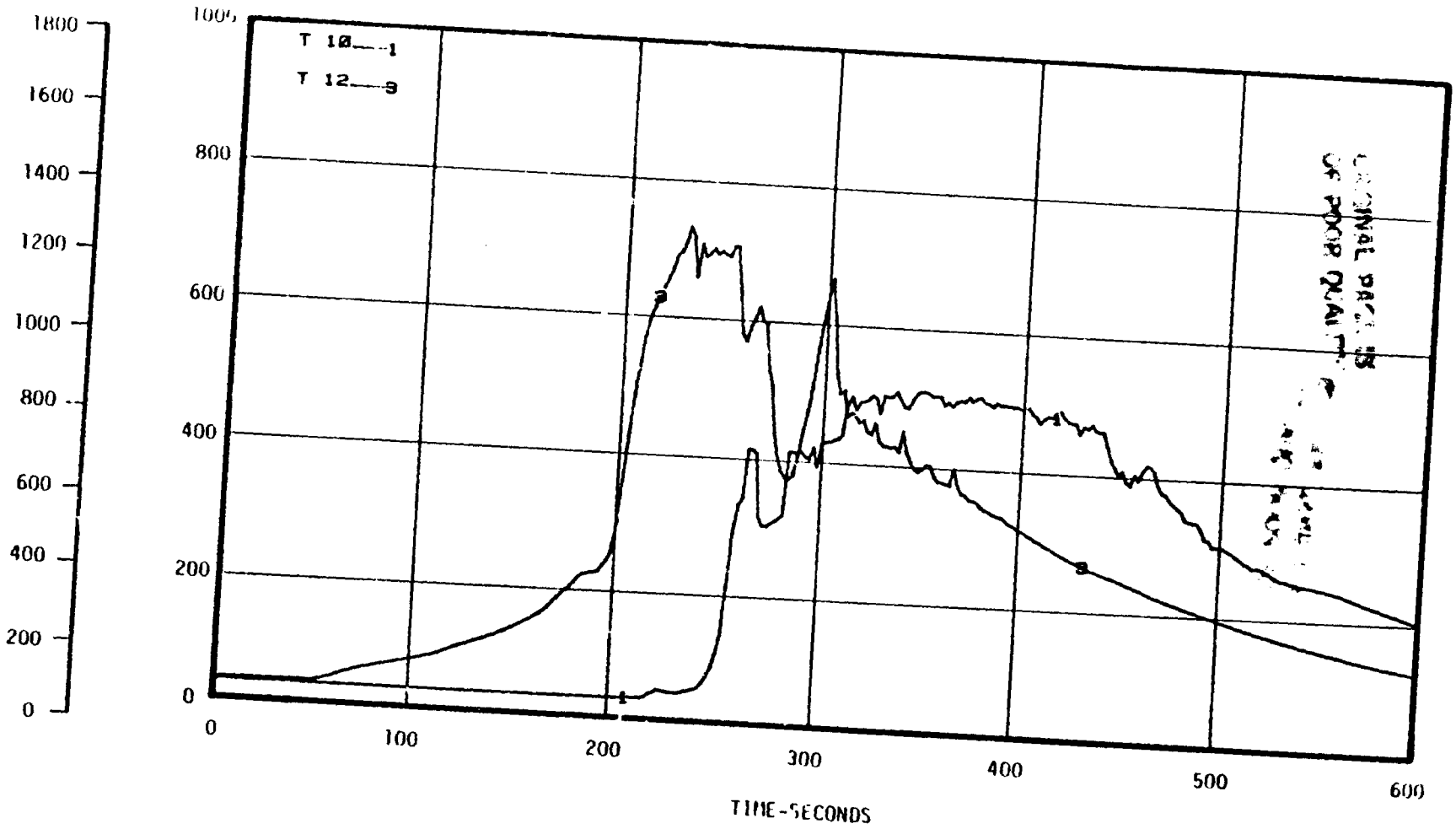
CUSHION CONSTRUCTION NUMBER 1.0

SEAT CUSHION TEMPERATURES



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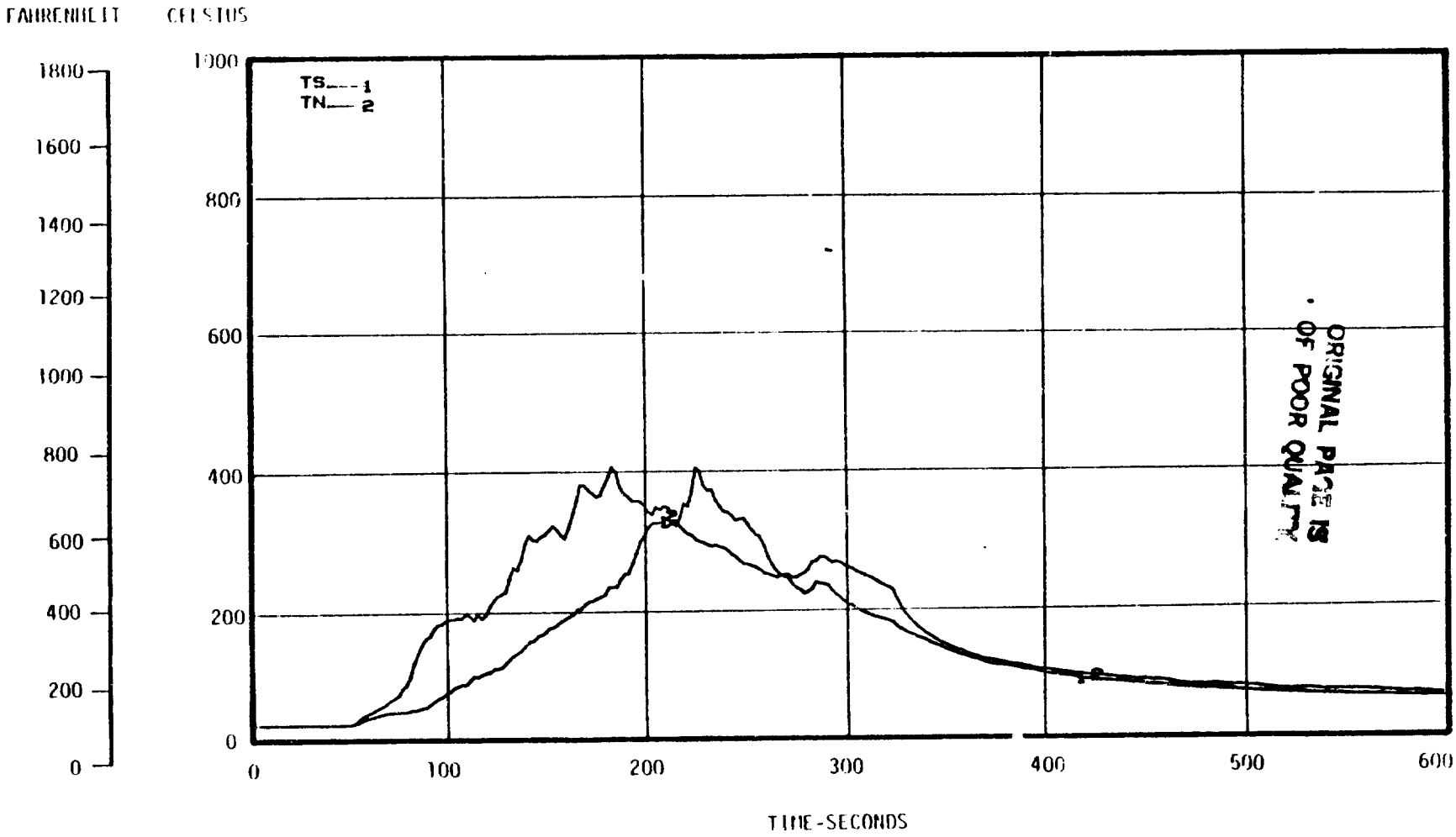
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 1
CUSHION CONSTRUCTION NUMBER 1.0

CEILING TEMPERATURE

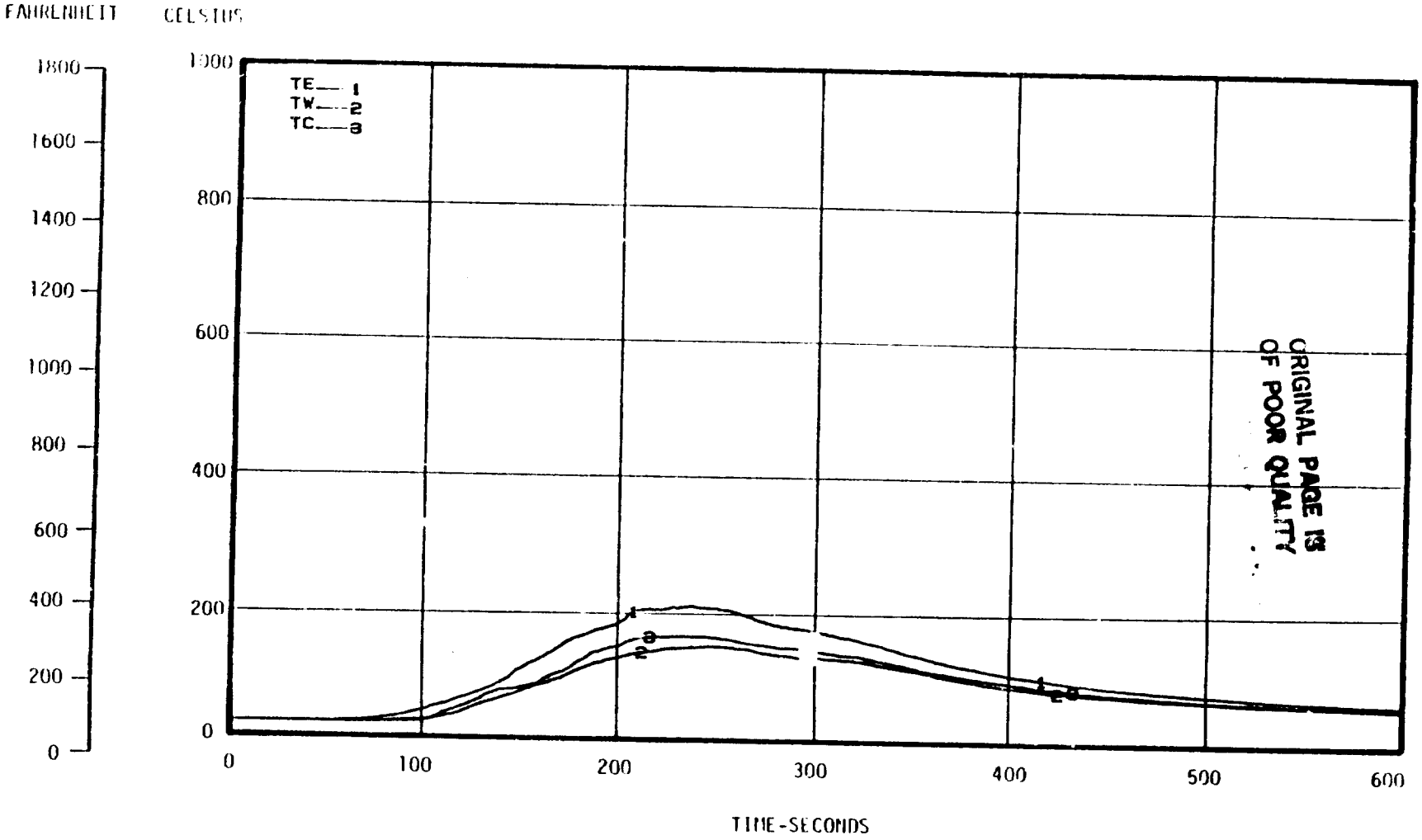


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 08:38

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 1

CUSHION CONSTRUCTION NUMBER 1.0

CEILING TEMPERATURE



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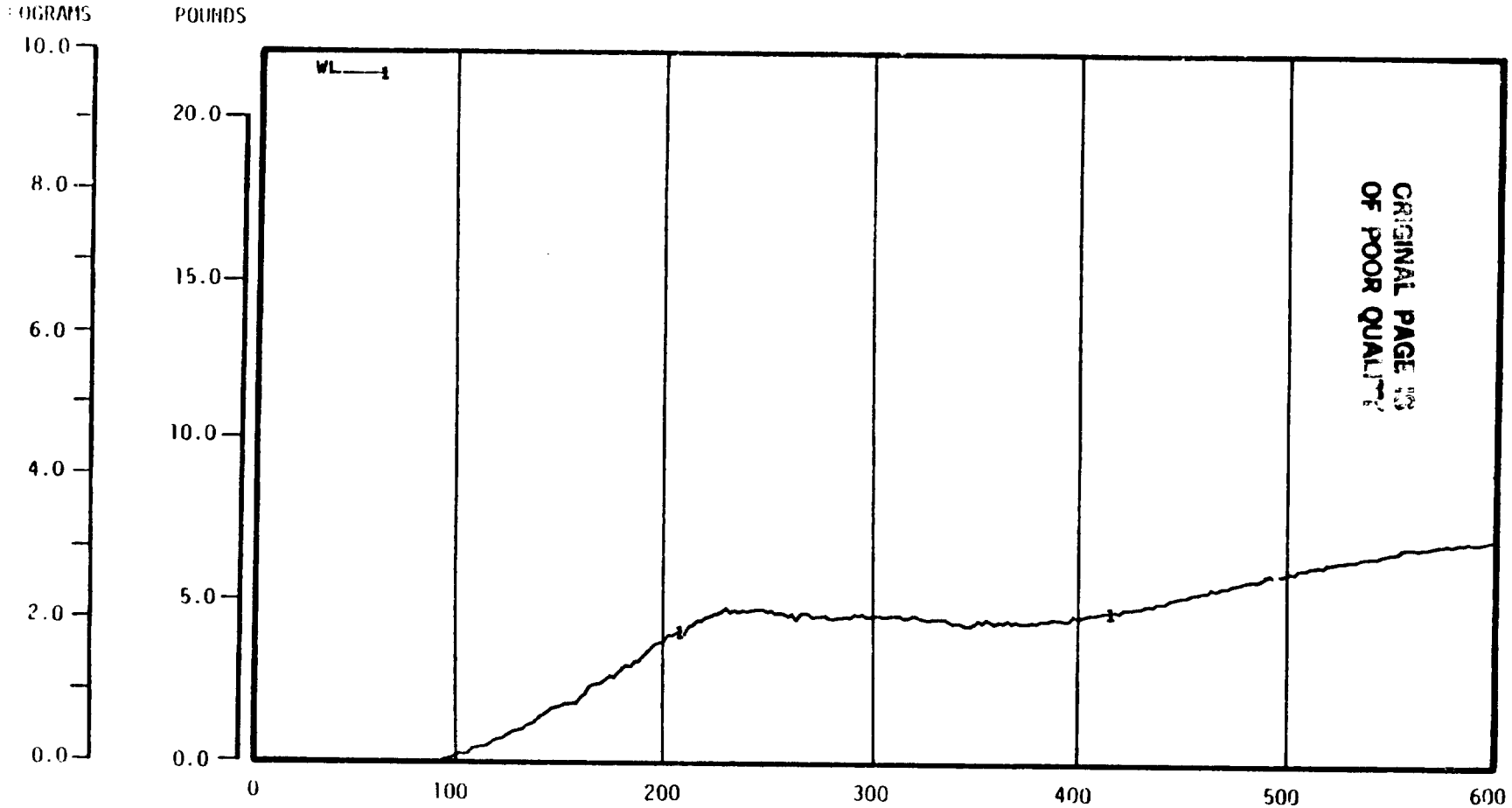
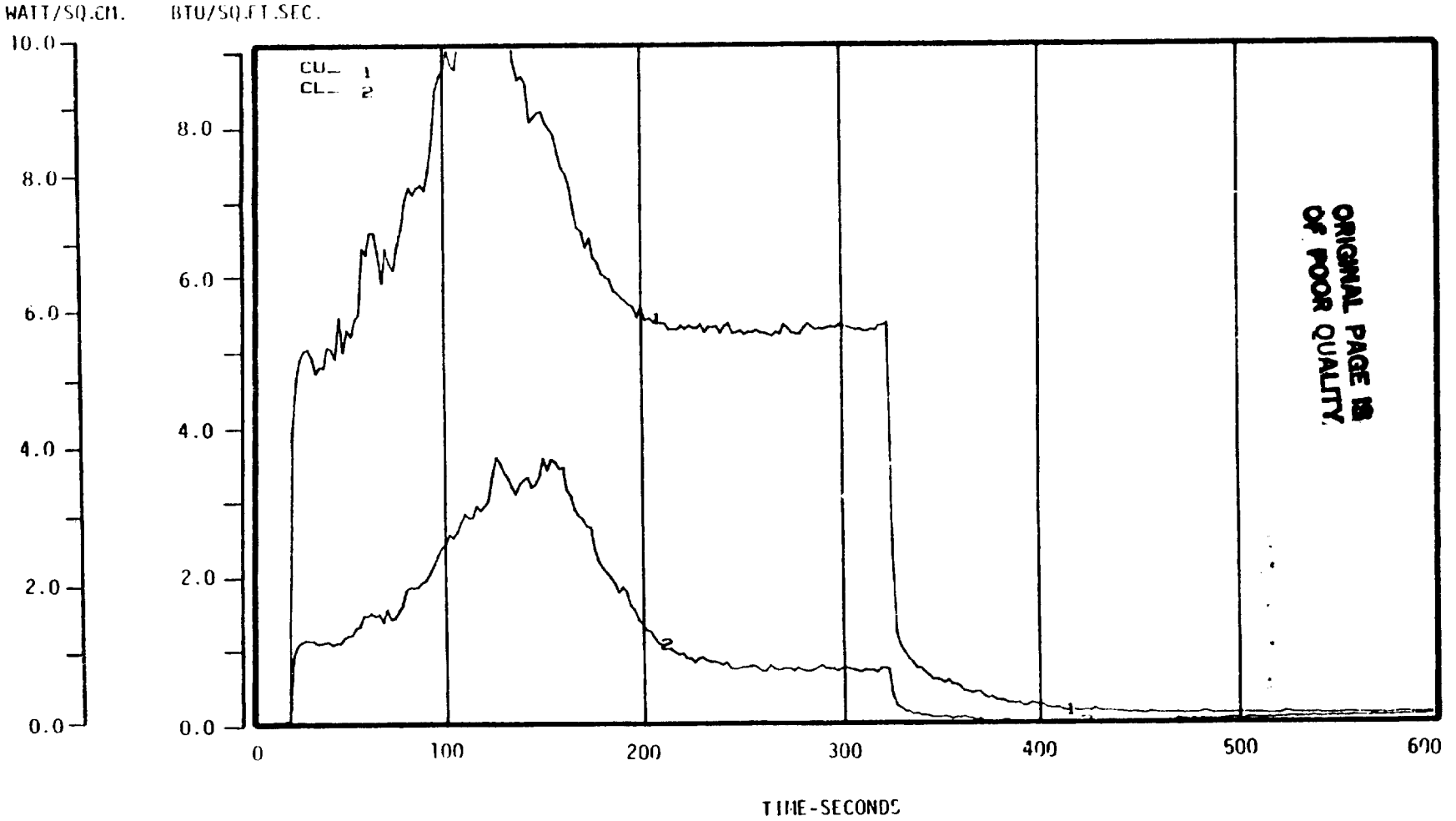
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 1
CUSHION CONSTRUCTION NUMBER 1.0

WEIGHT LOSS



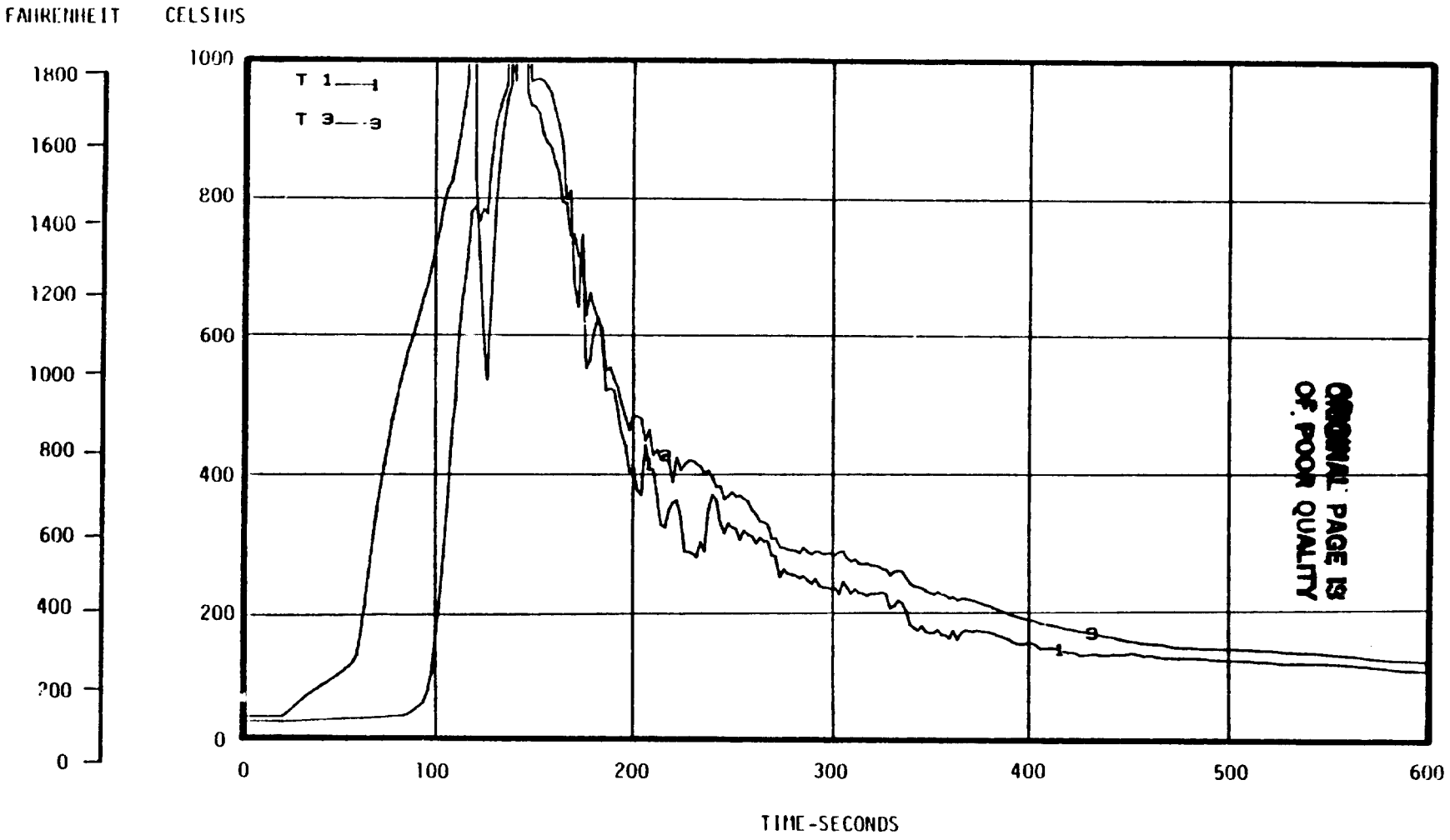
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 08.38
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 1
CUSHION CONSTRUCTION NUMBER 1.0

HEAT FLUX



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR03/16/82 11:11
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17
CUSHION CONSTRUCTION NUMBER 1.0

SEAT CUSHION TEMPERATURES

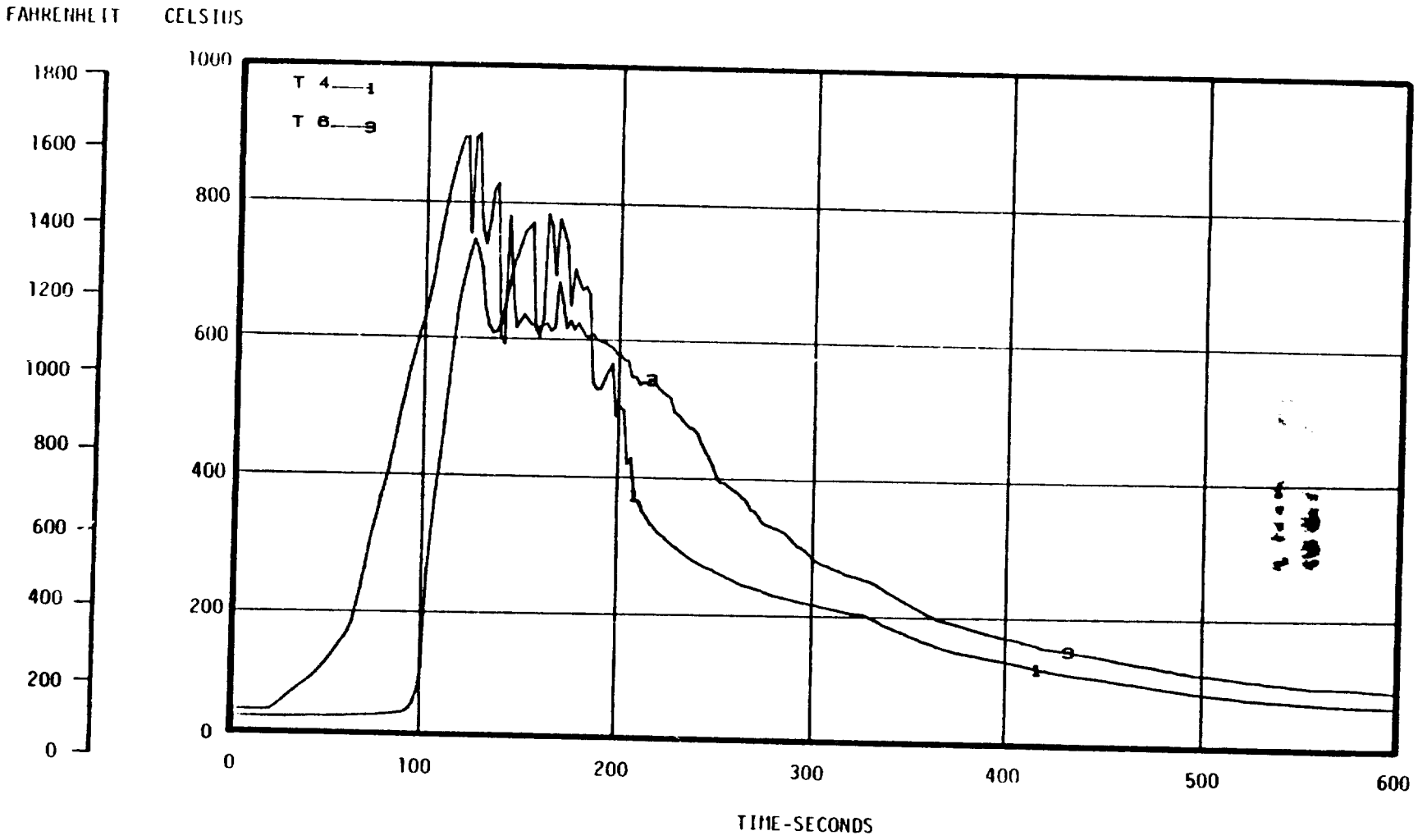


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 11.11

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17

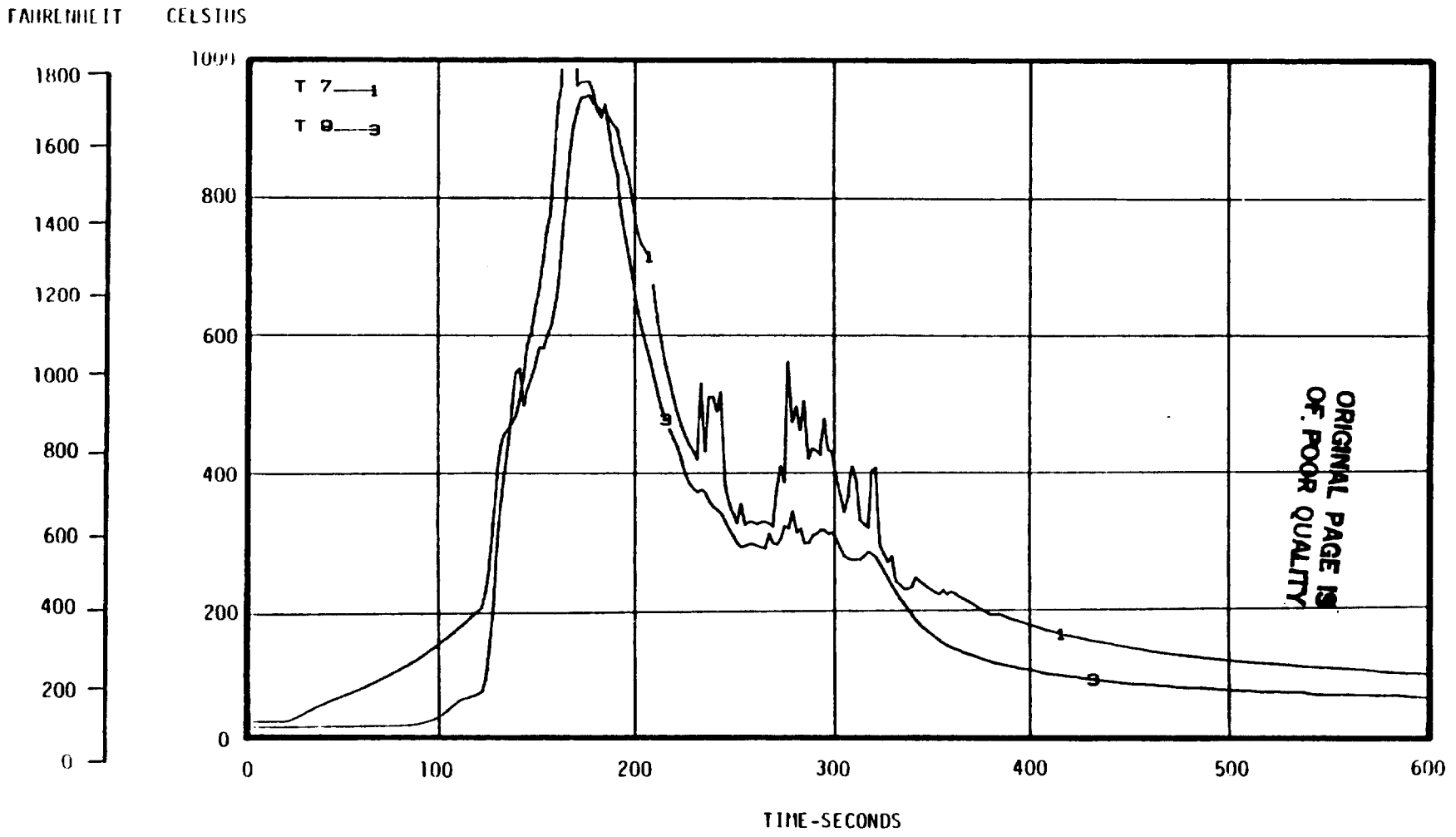
CUSHION CONSTRUCTION NUMBER 1.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 11.11
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17
CUSHION CONSTRUCTION NUMBER 1.0

SEAT CUSHION TEMPERATURES

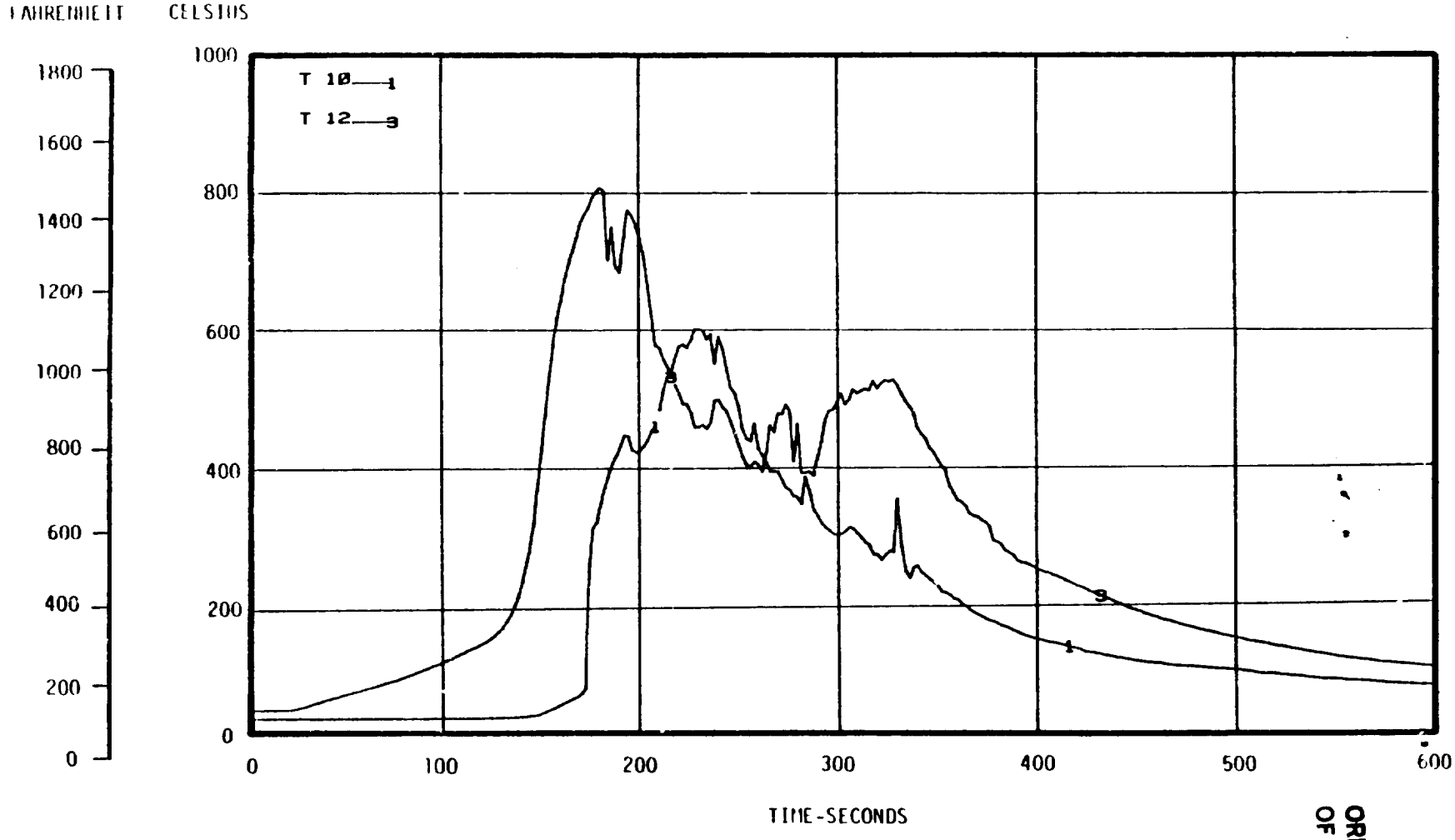


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 11.11

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17

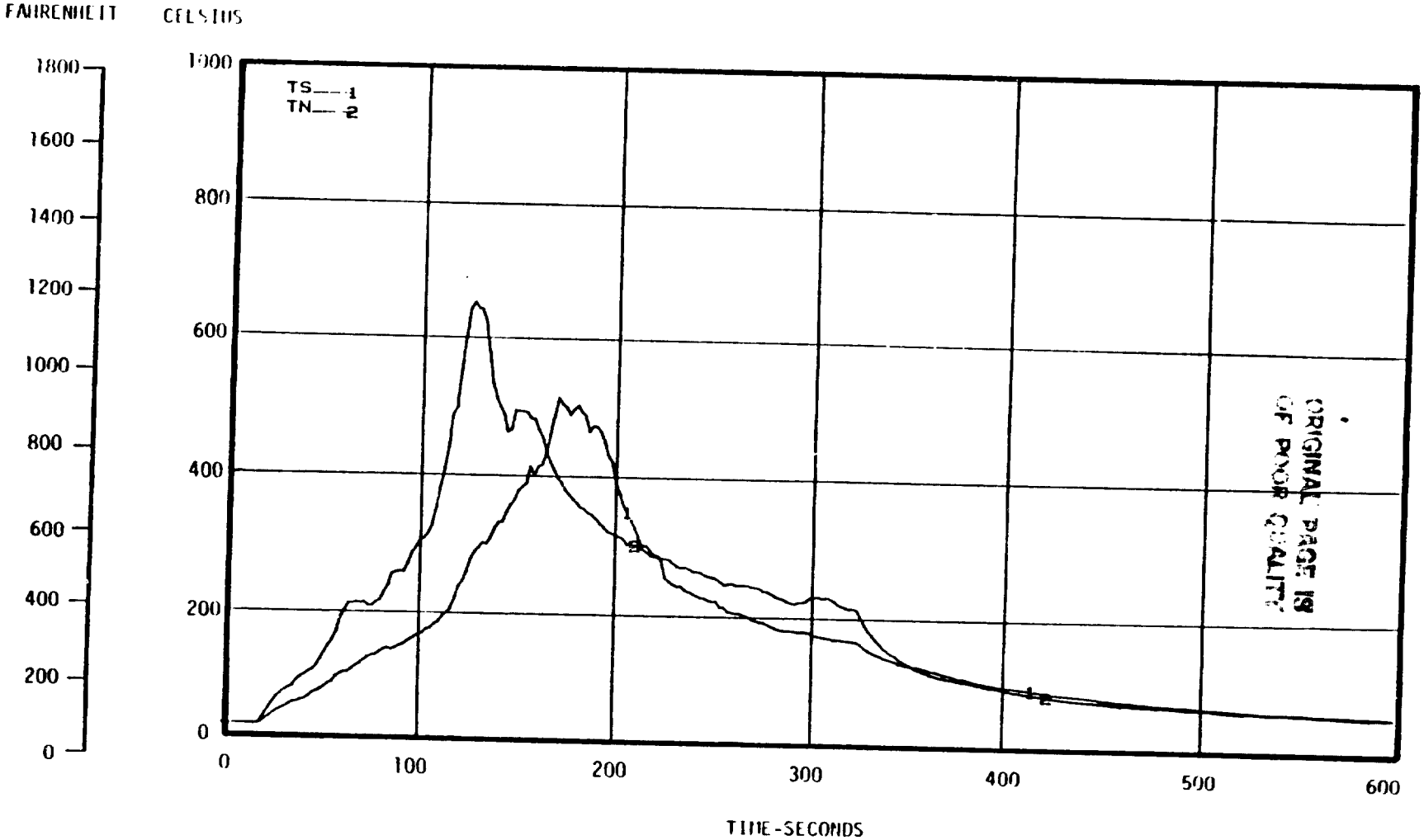
CUSHION CONSTRUCTION NUMBER 1.0

SEAT CUSHION TEMPERATURES



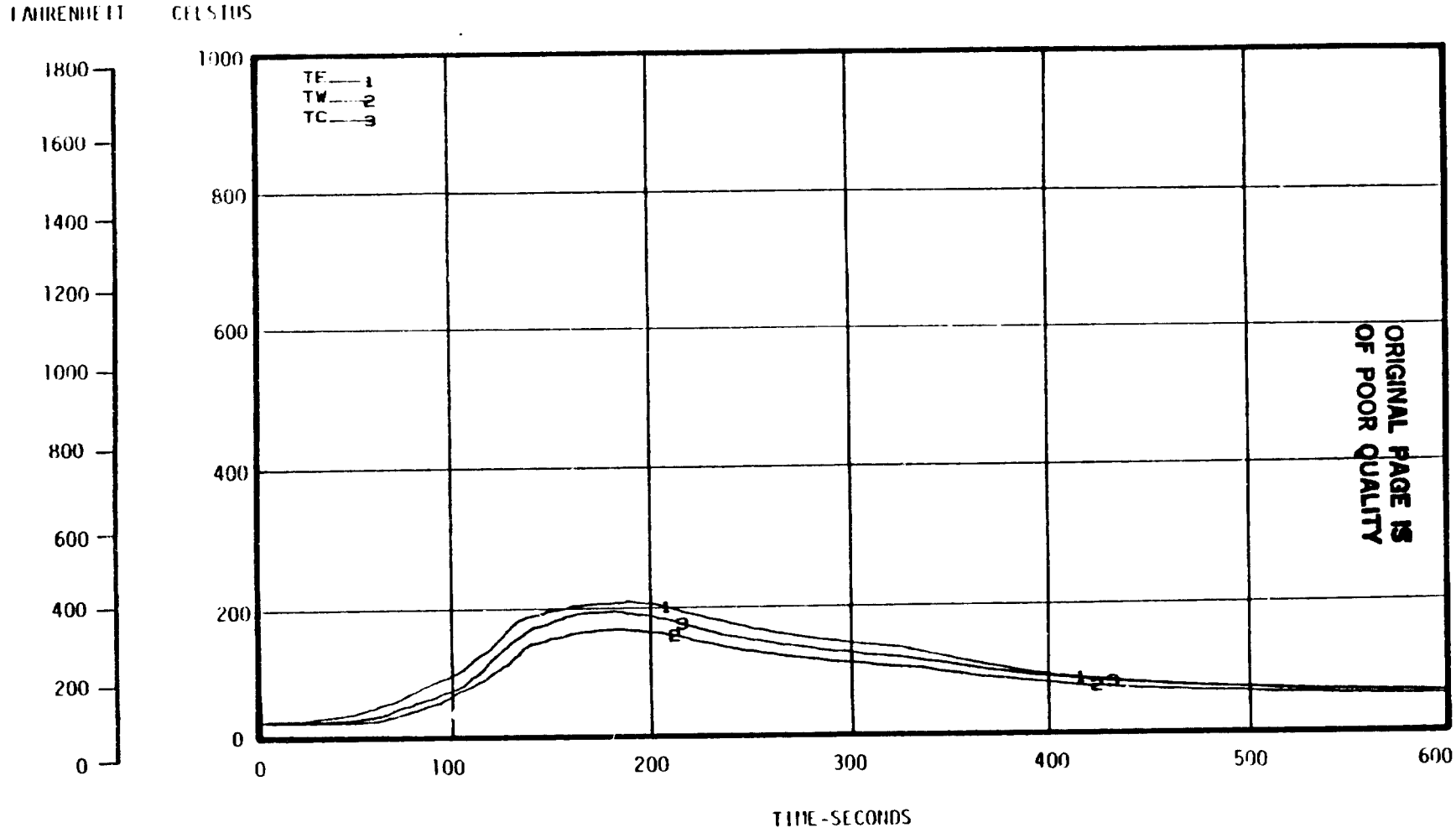
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 11.11
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17
CUSHION CONSTRUCTION NUMBER 1.0

CEILING TEMPERATURE



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 11.11
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17
CUSHION CONSTRUCTION NUMBER 1.0

CEILING TEMPERATURE

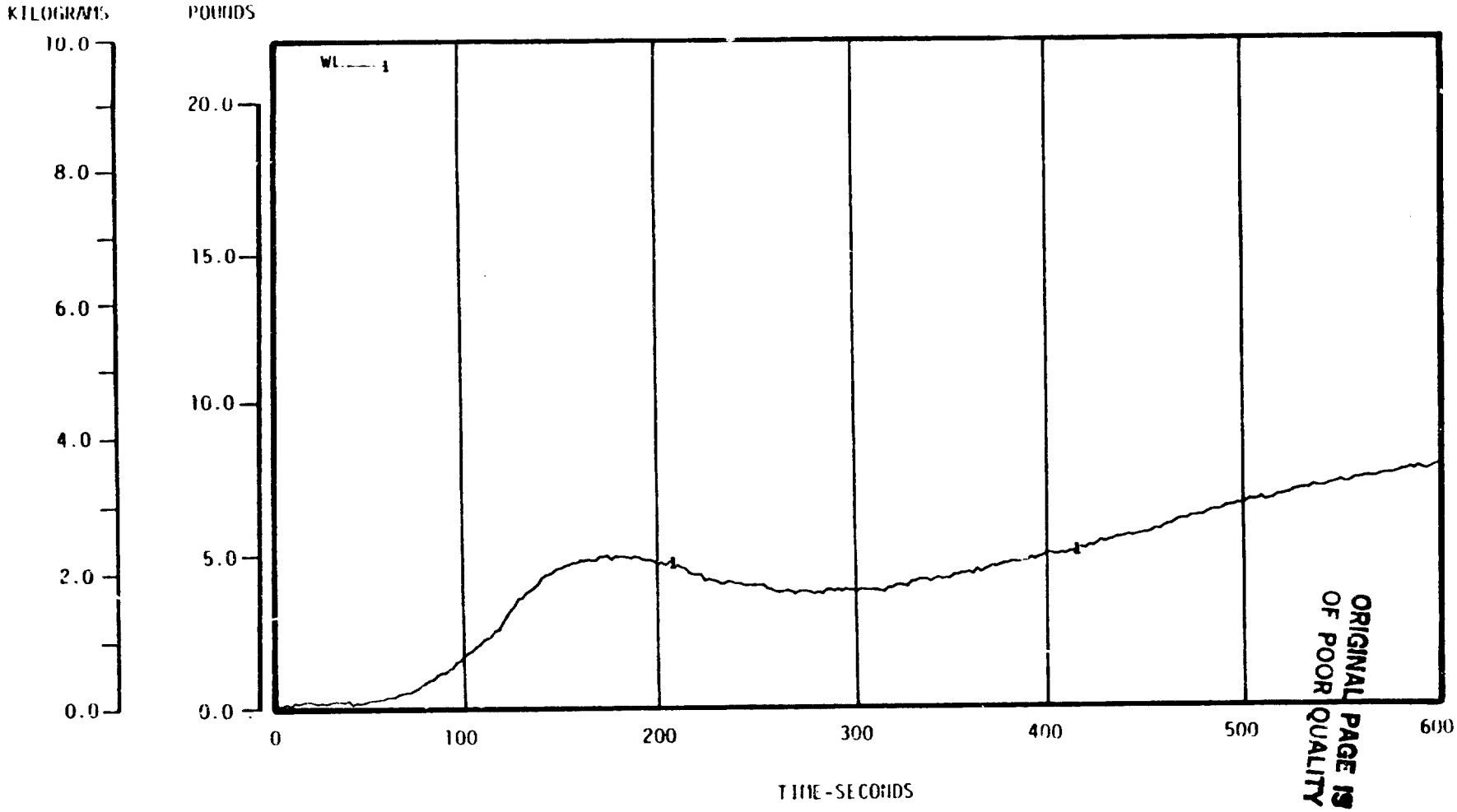


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 11.11

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17

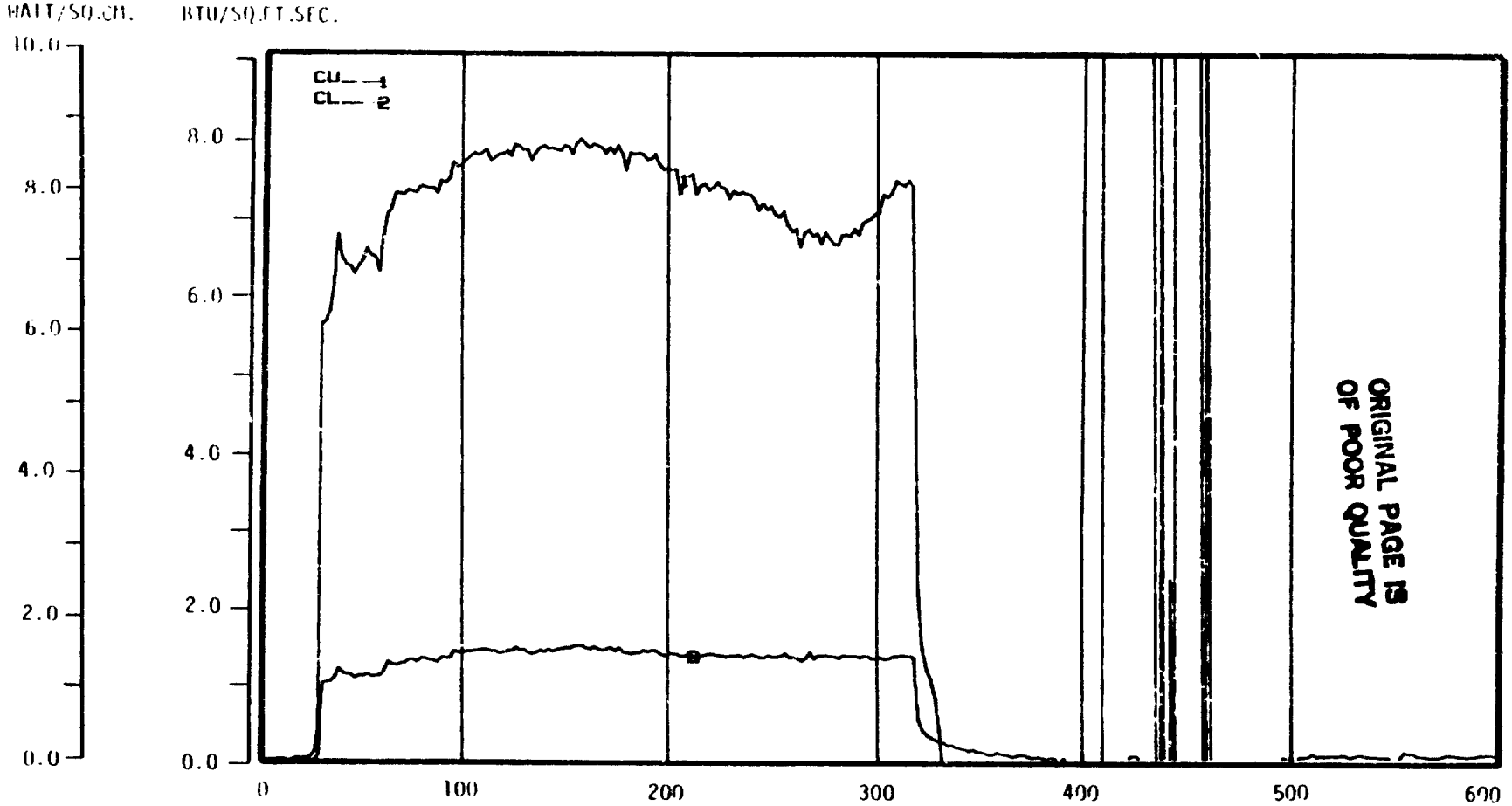
CUSHION CONSTRUCTION NUMBER 1.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 11.11
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 17
CUSHION CONSTRUCTION NUMBER 1.0

HEAT FLUX

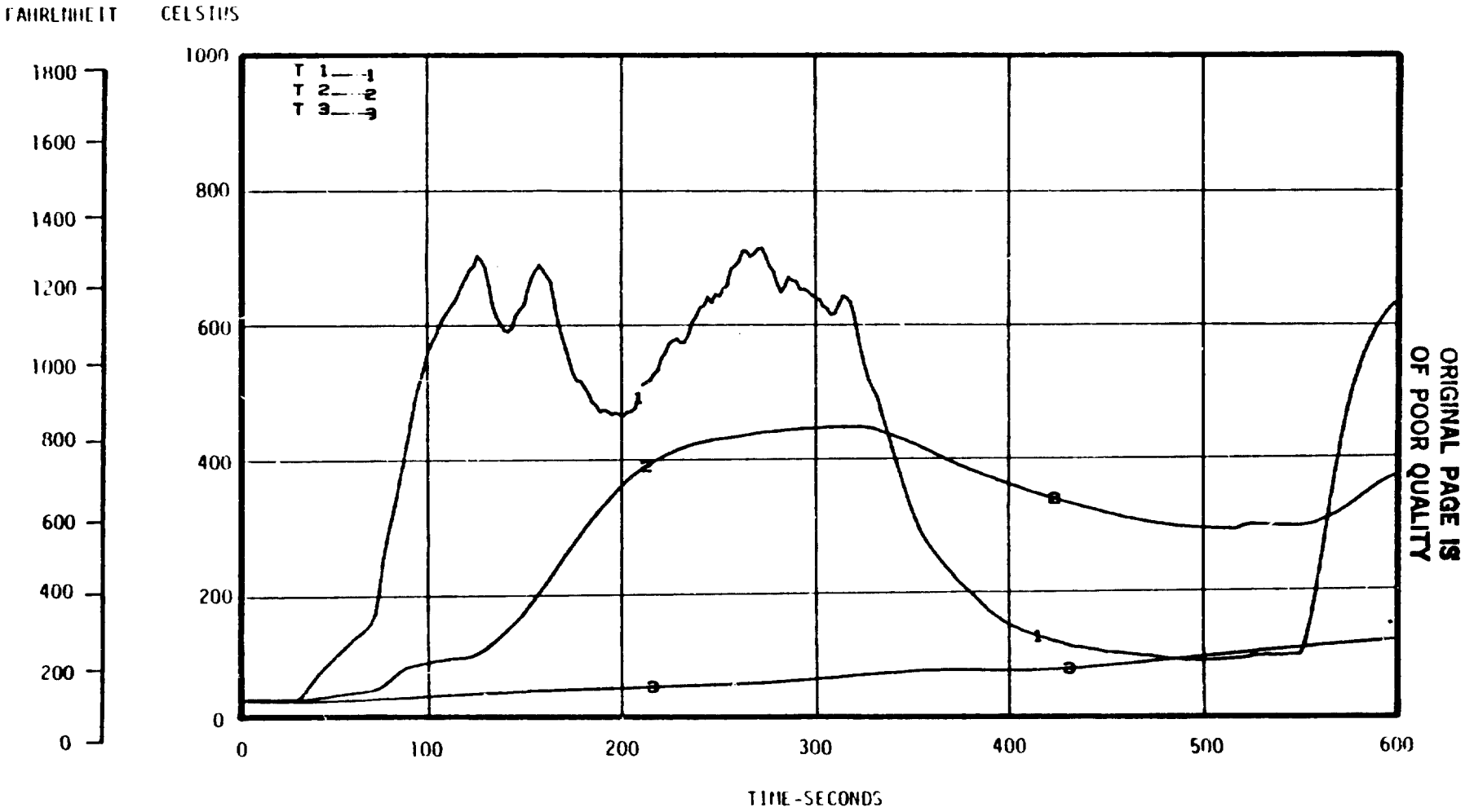


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 13.43

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 2

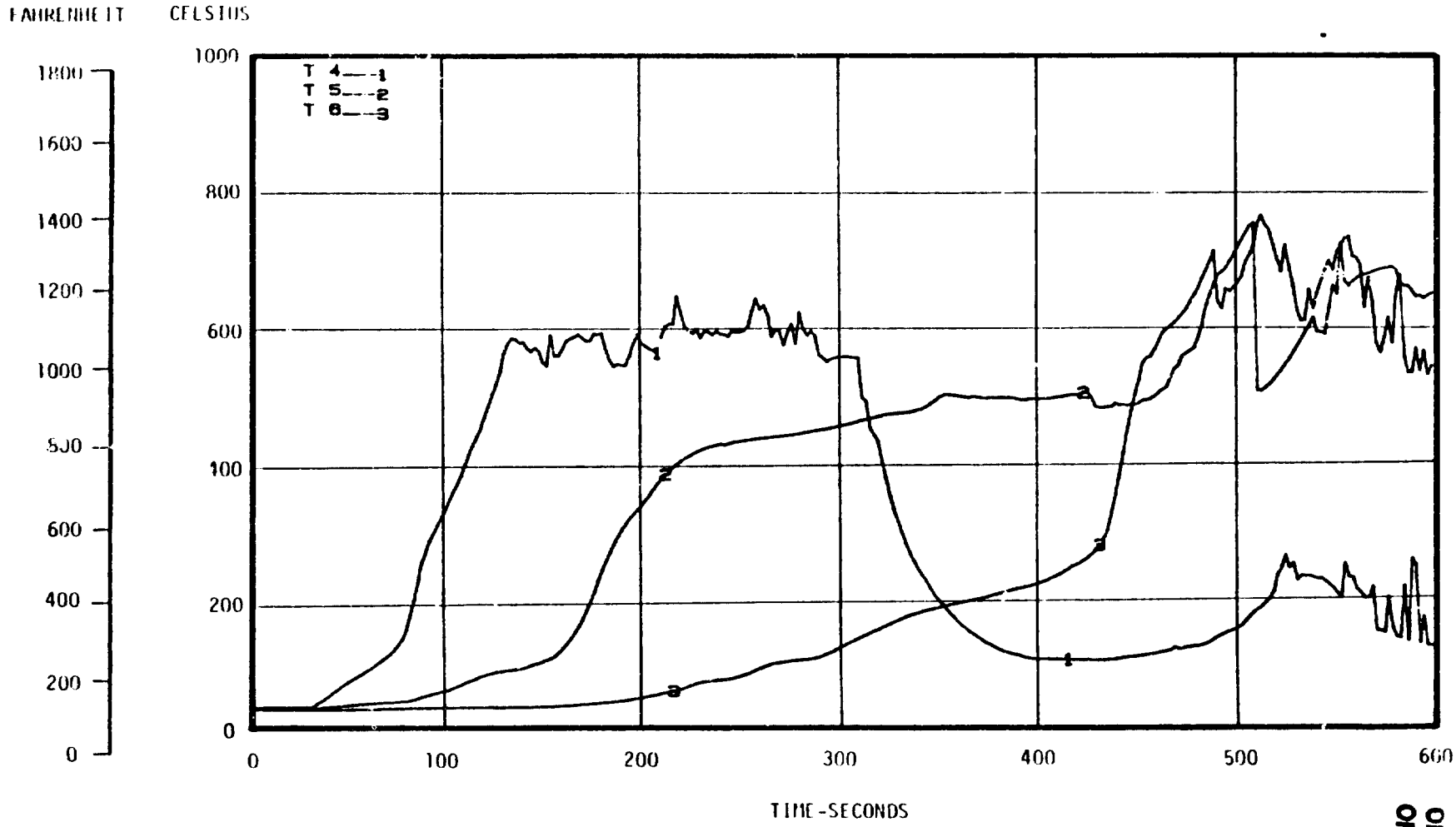
CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES



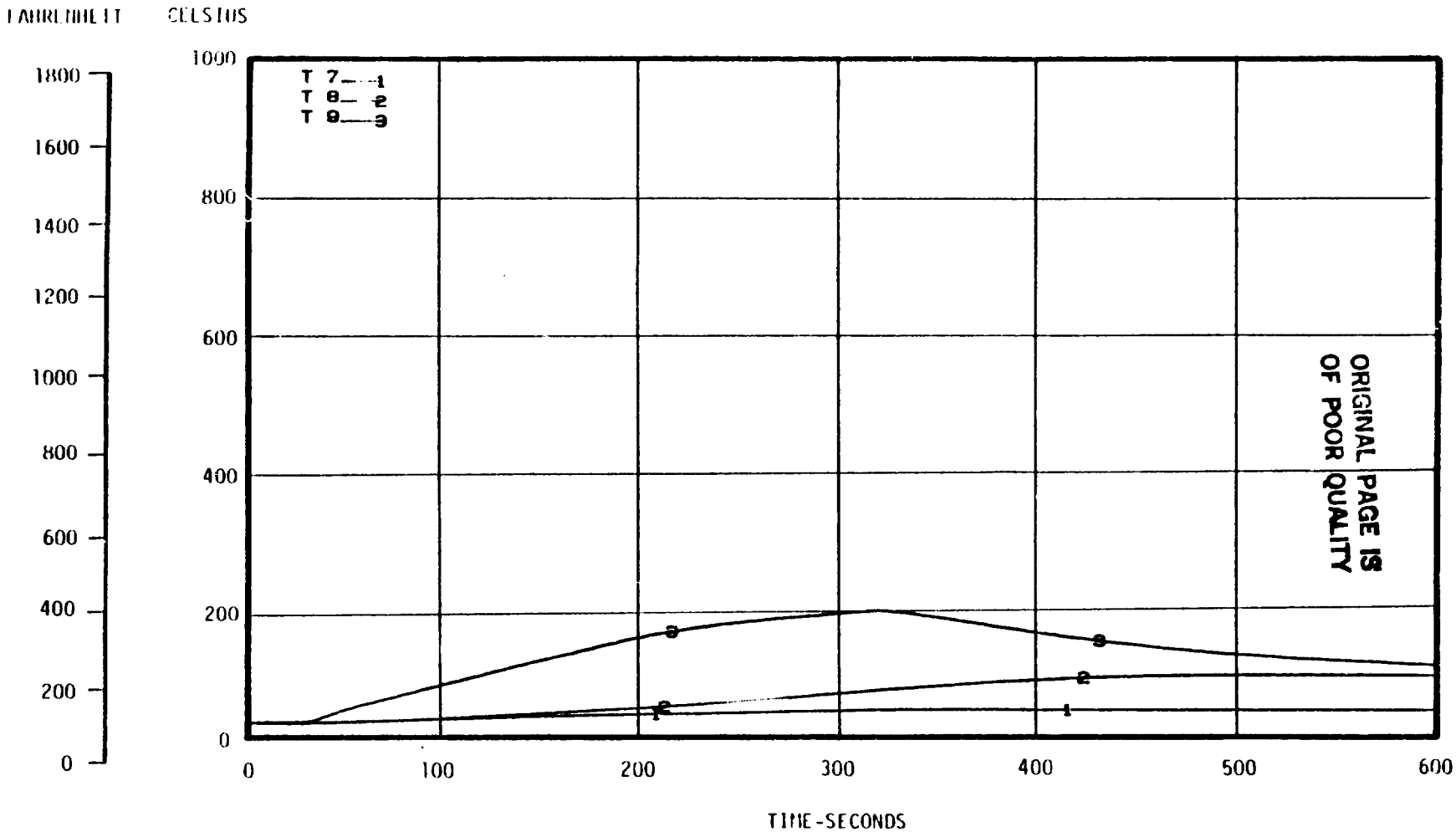
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 13:49
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 2
CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 13.49
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 2
CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES

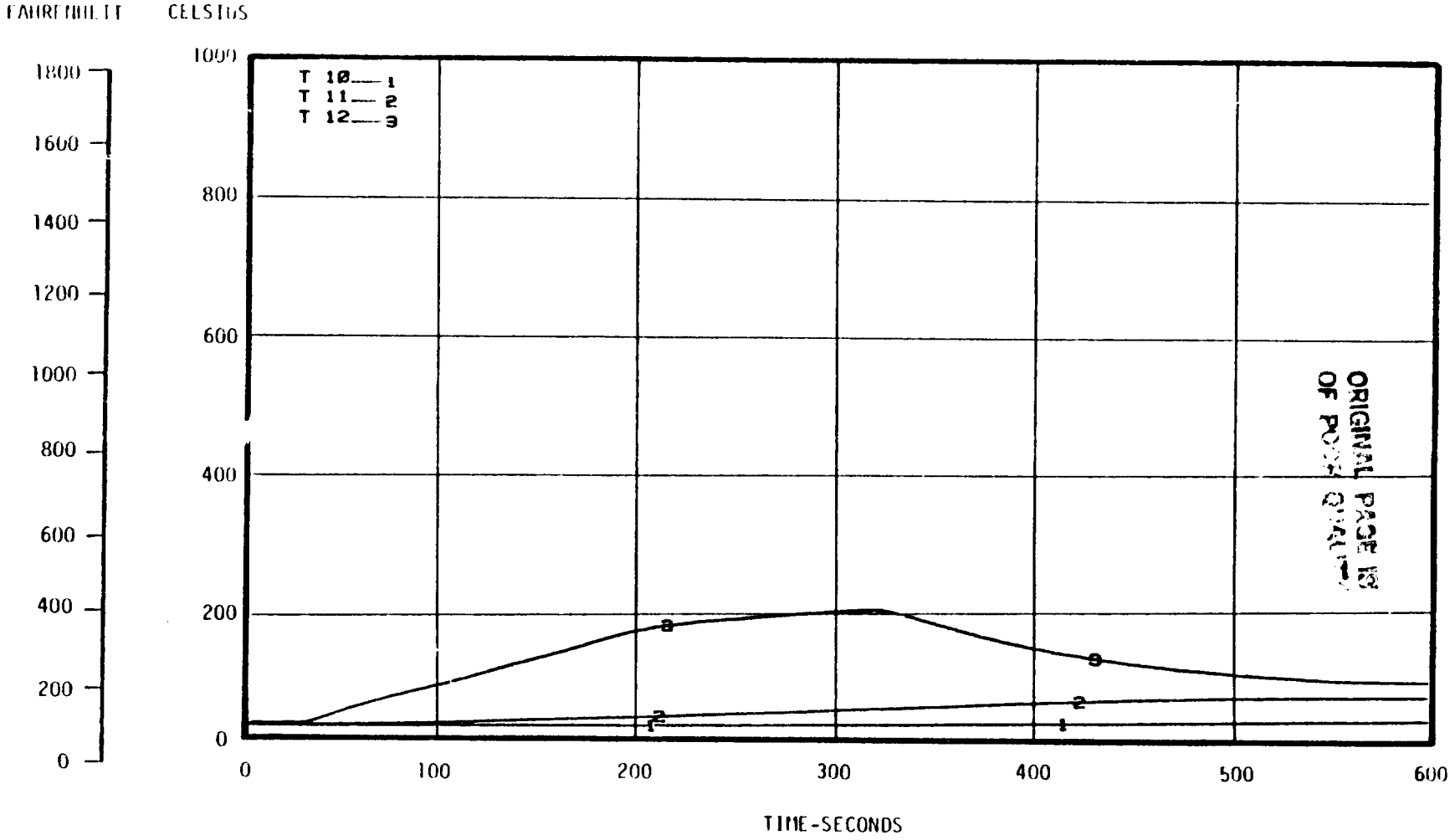


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 13:43

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 2

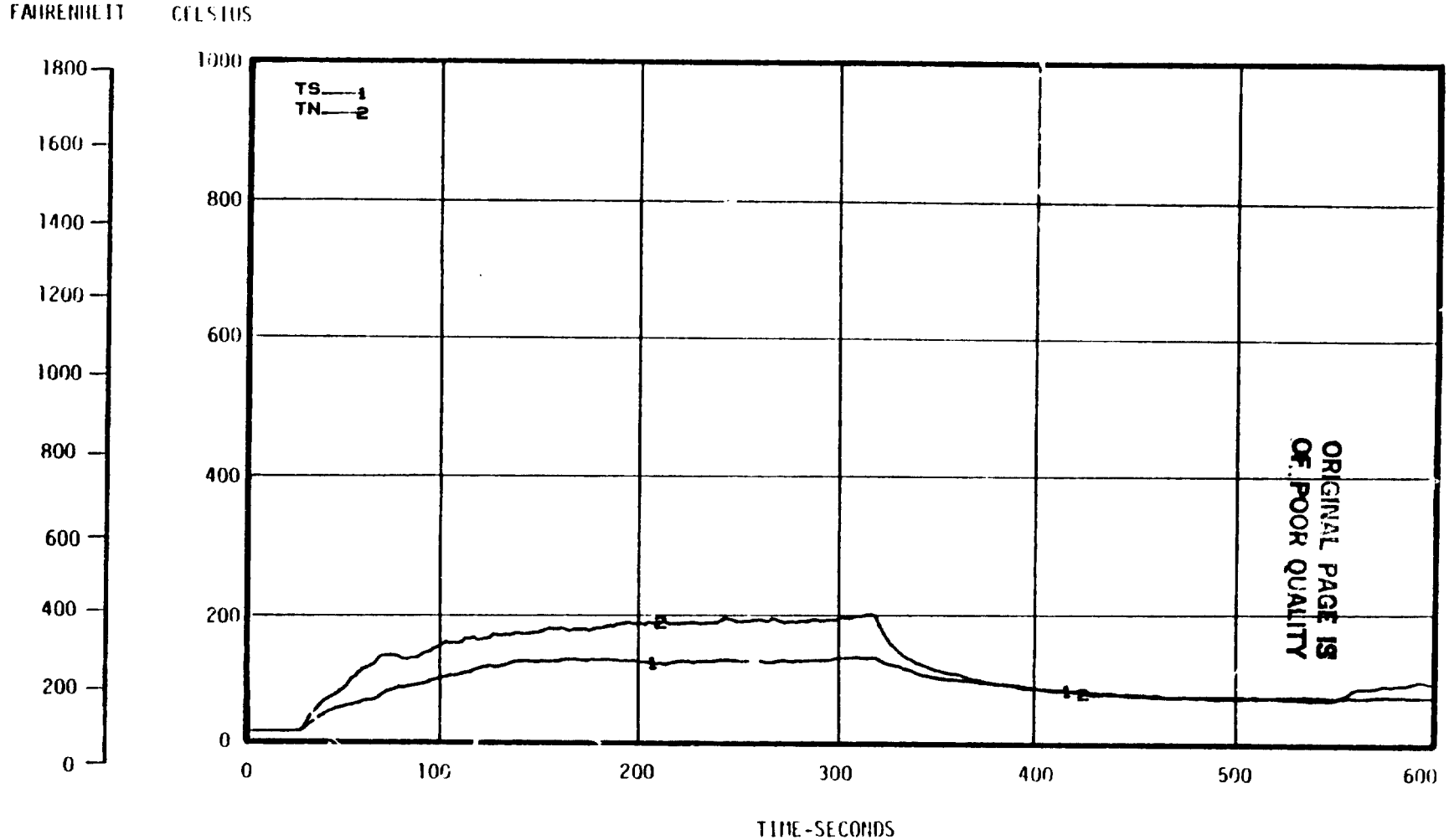
CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 13.49
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 2
CUSHION CONSTRUCTION NUMBER 2.0

CEILING TEMPERATURE



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 19.43

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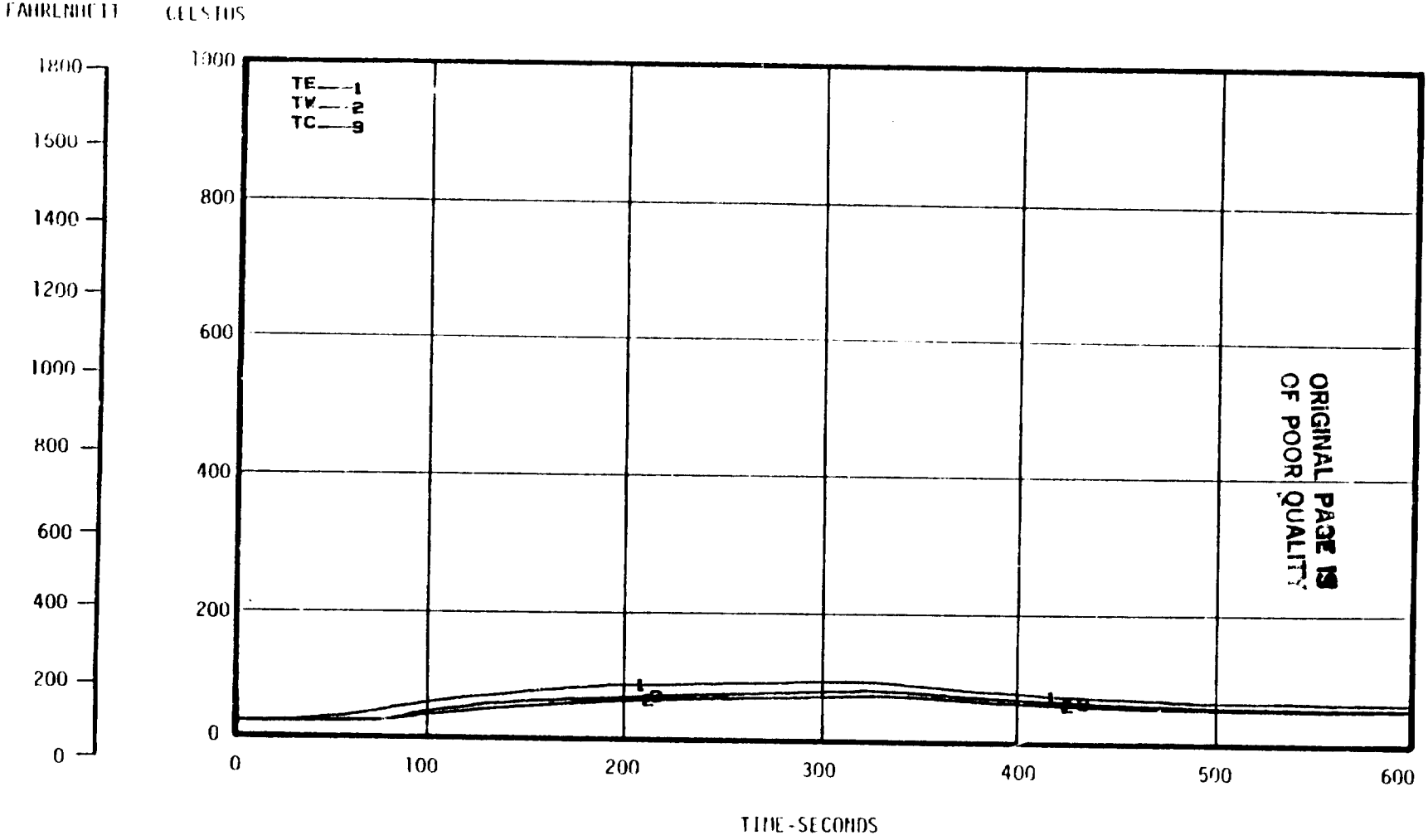
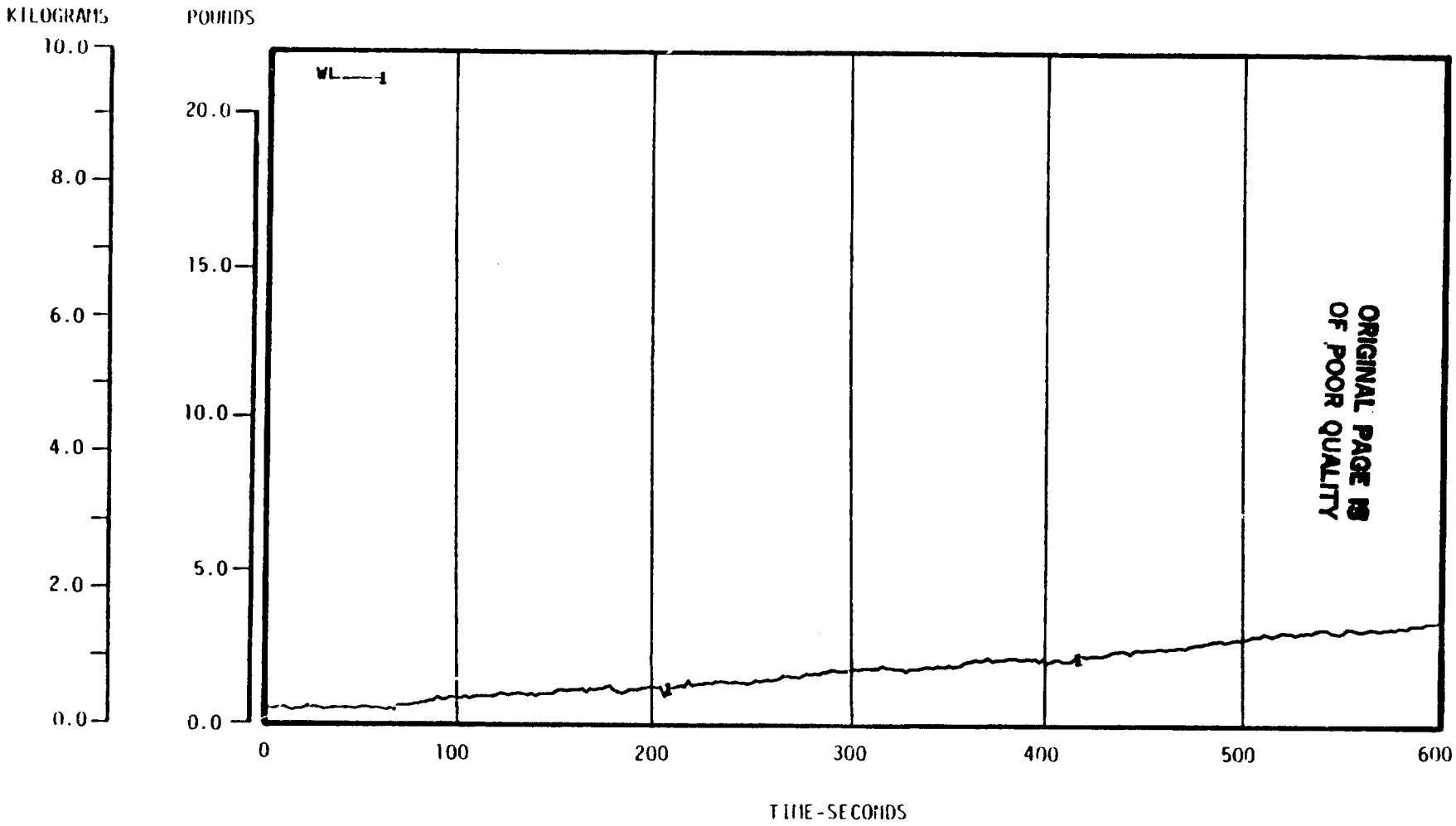
CUSHION CONSTRUCTION NUMBER 2.0

CEILING TEMPERATURE



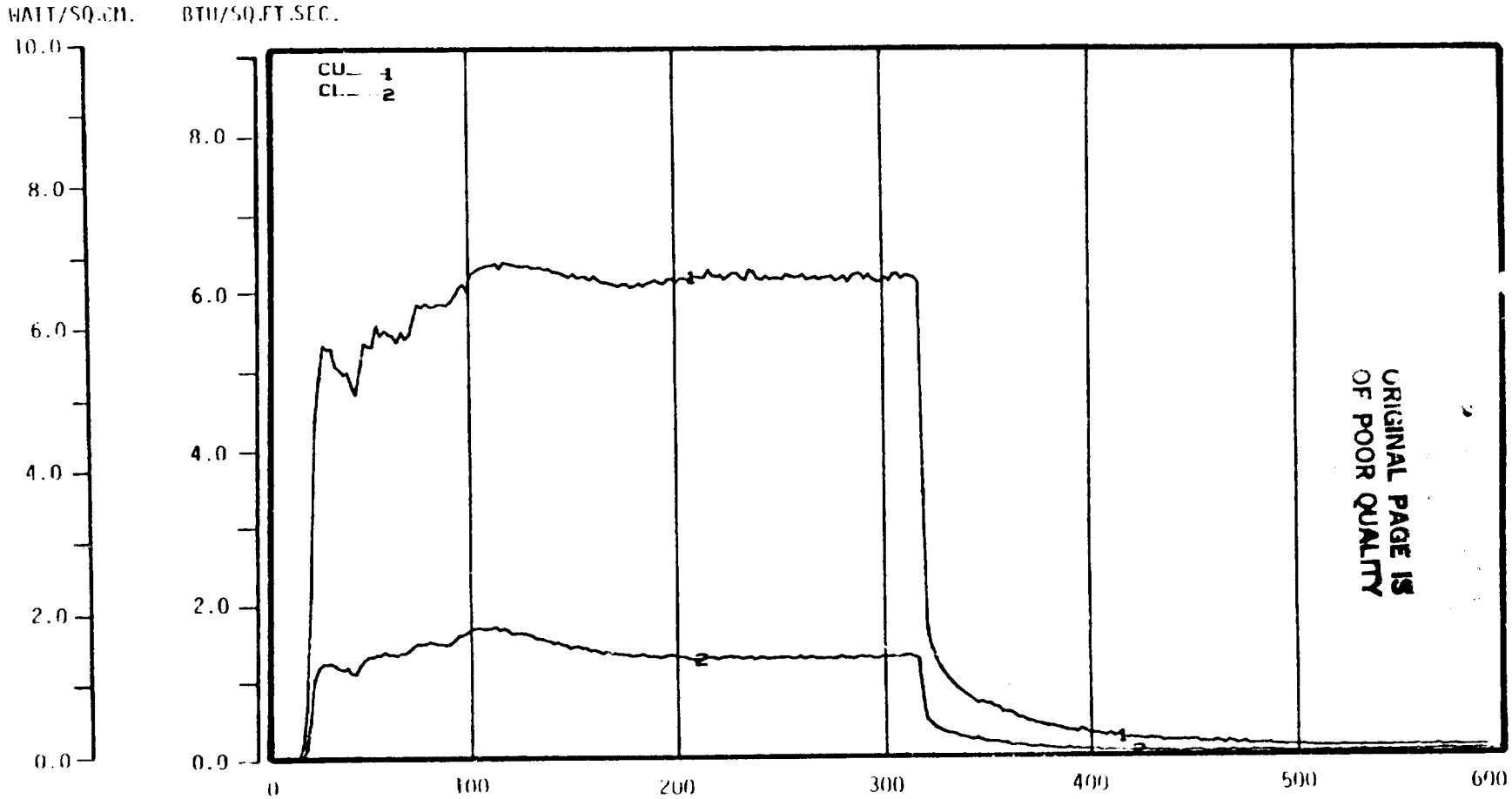
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 13.43
NASA-NIES FULL SCALE CUSHION BURN TEST NUMBER 2
CUSHION CONSTRUCTION NUMBER 2.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/05/82 13.43
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 2
CUSHION CONSTRUCTION NUMBER 2.0

HEAT FLUX

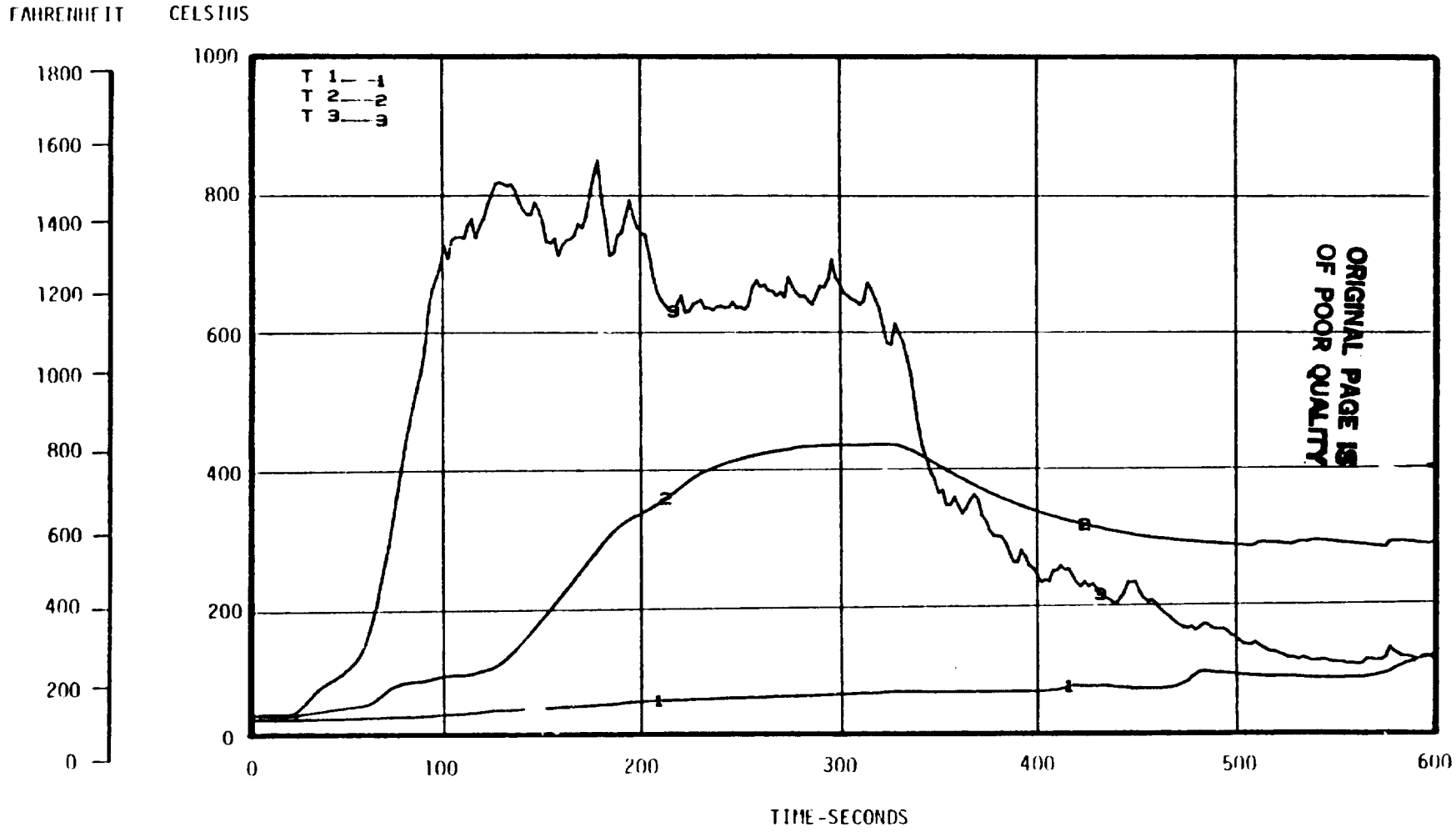


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES

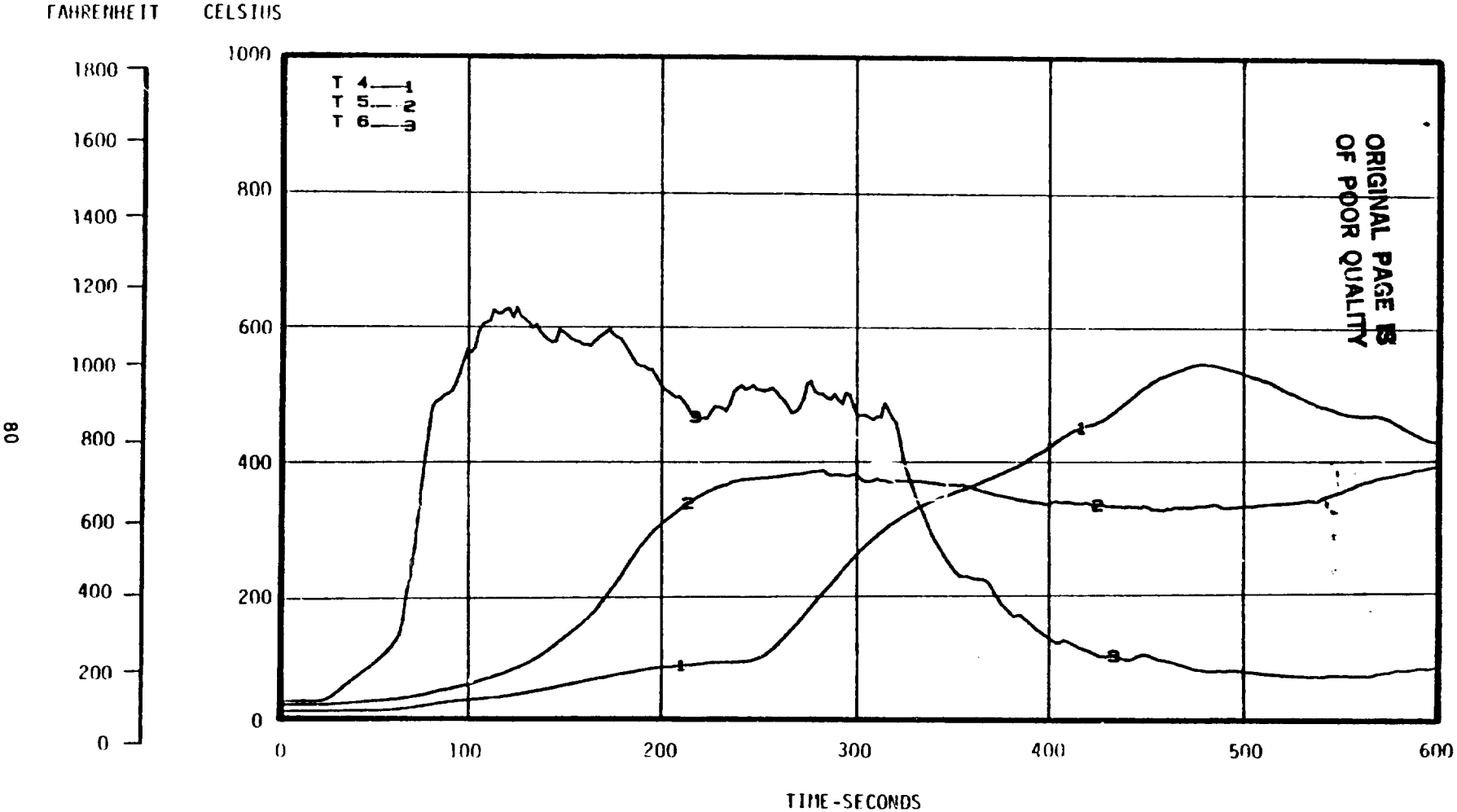


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES



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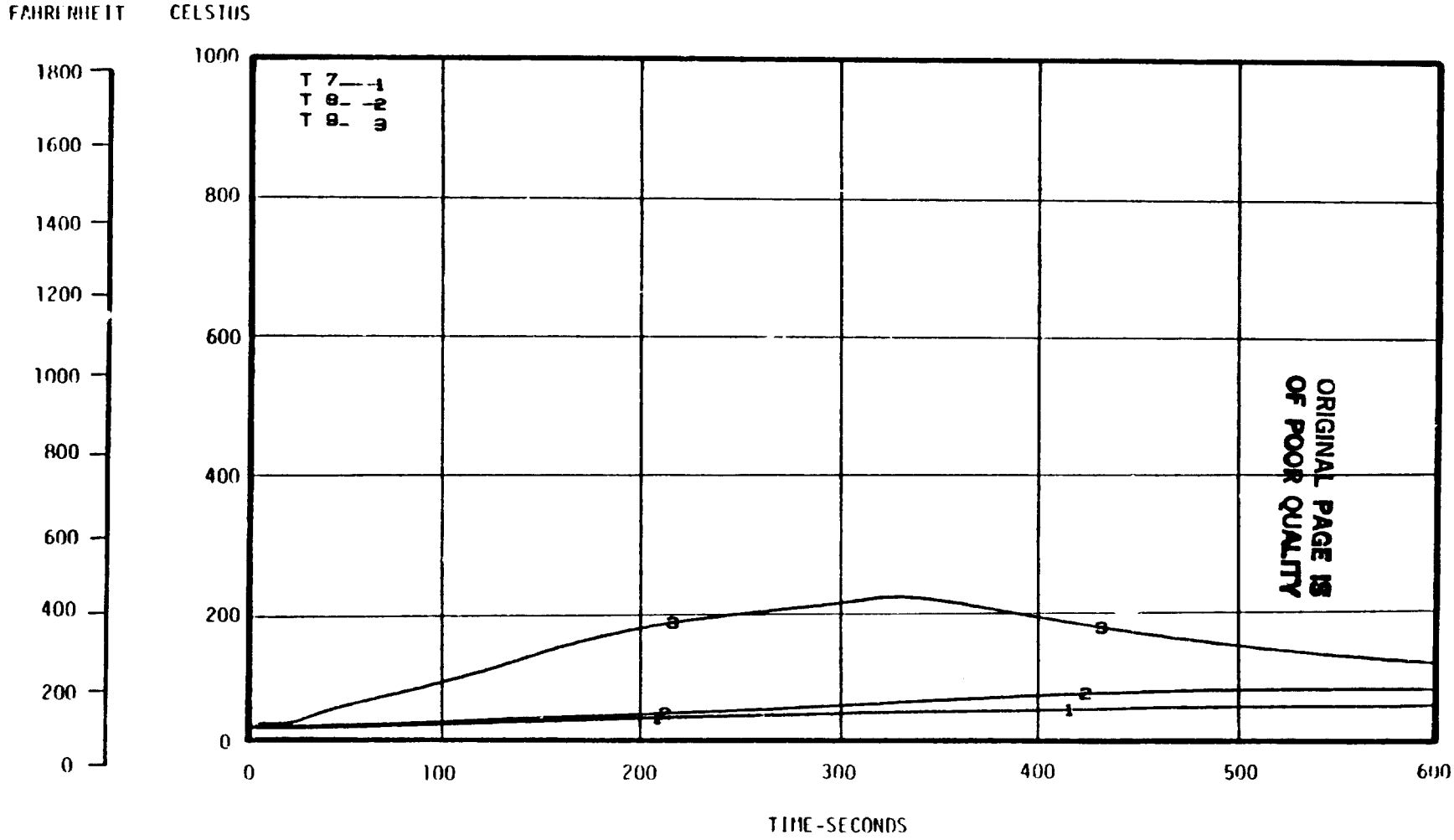
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES

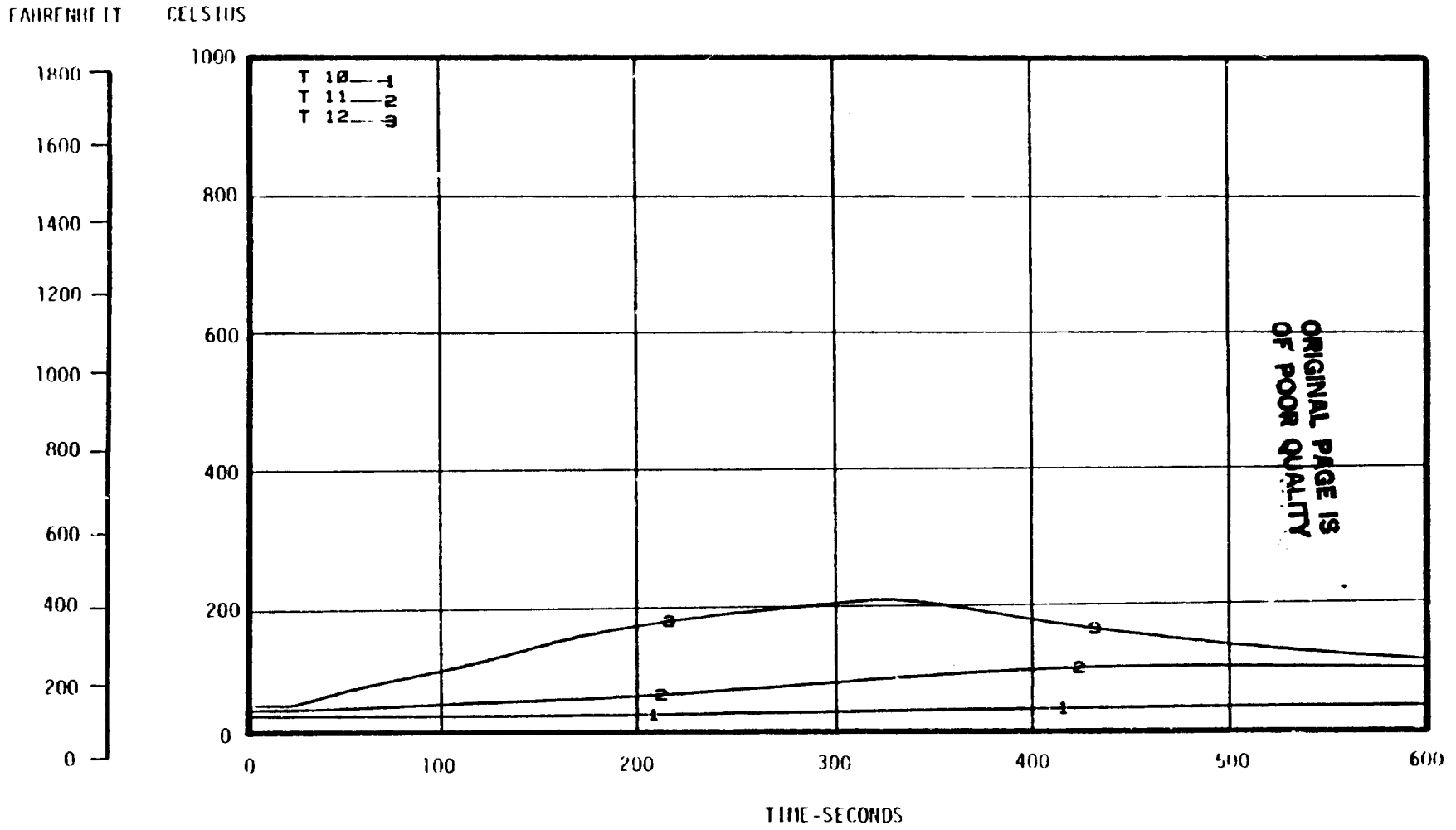


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

CUSHION CONSTRUCTION NUMBER 2.0

SEAT CUSHION TEMPERATURES

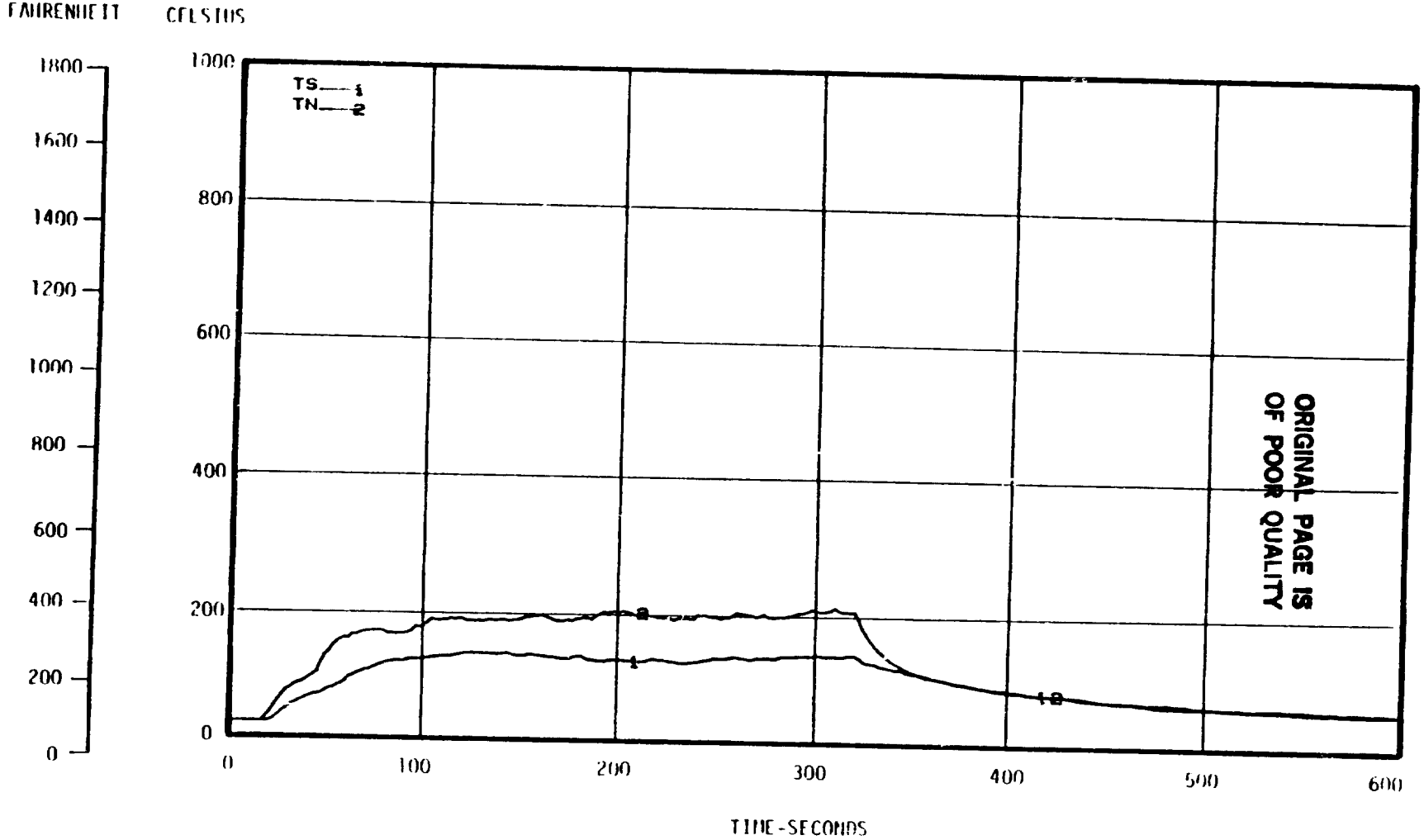


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/00/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

CUSHION CONSTRUCTION NUMBER 2.0

CEILING TEMPERATURE

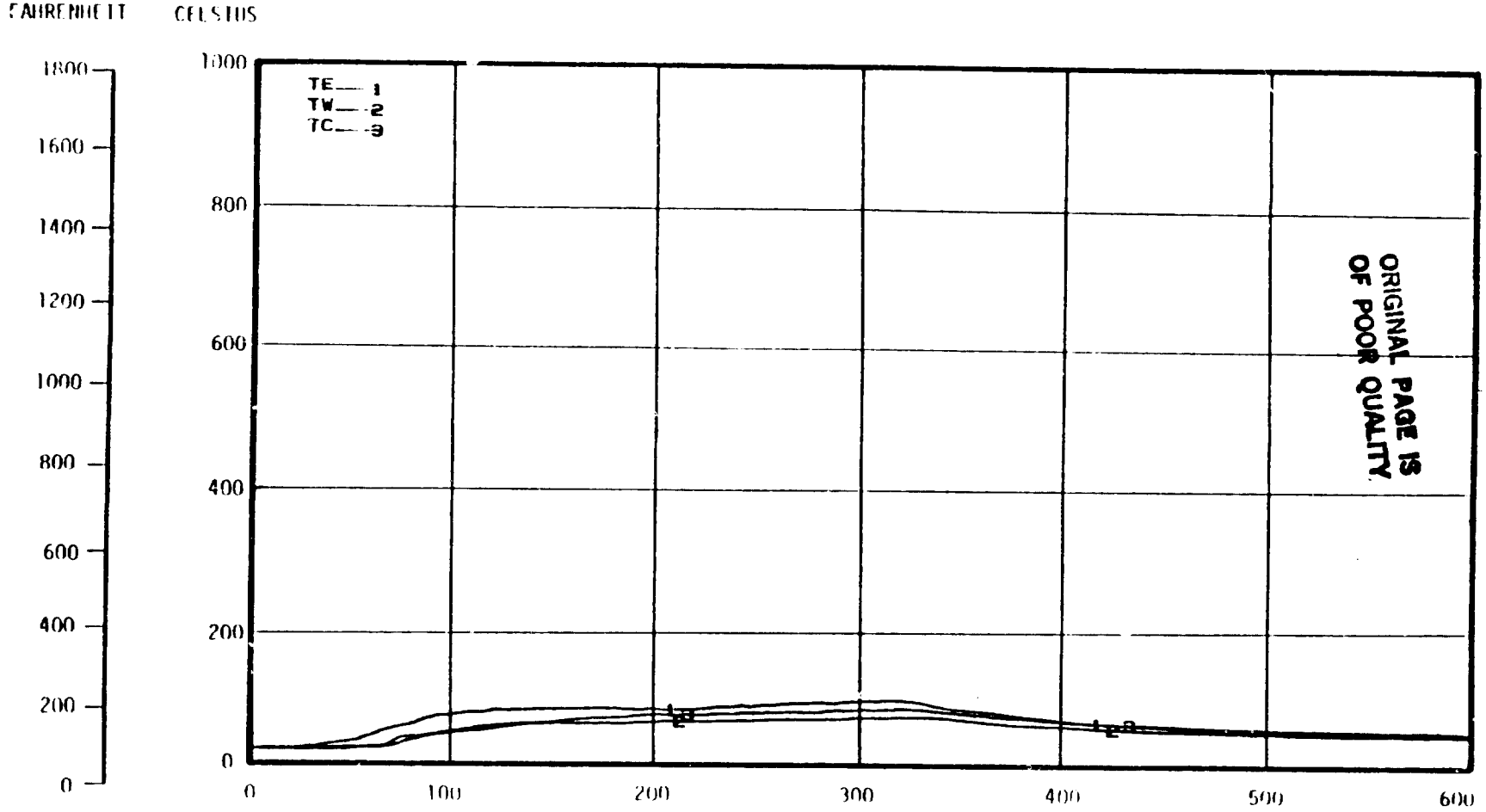


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

CUSHION CONSTRUCTION NUMBER 2.0

CEILING TEMPERATURE

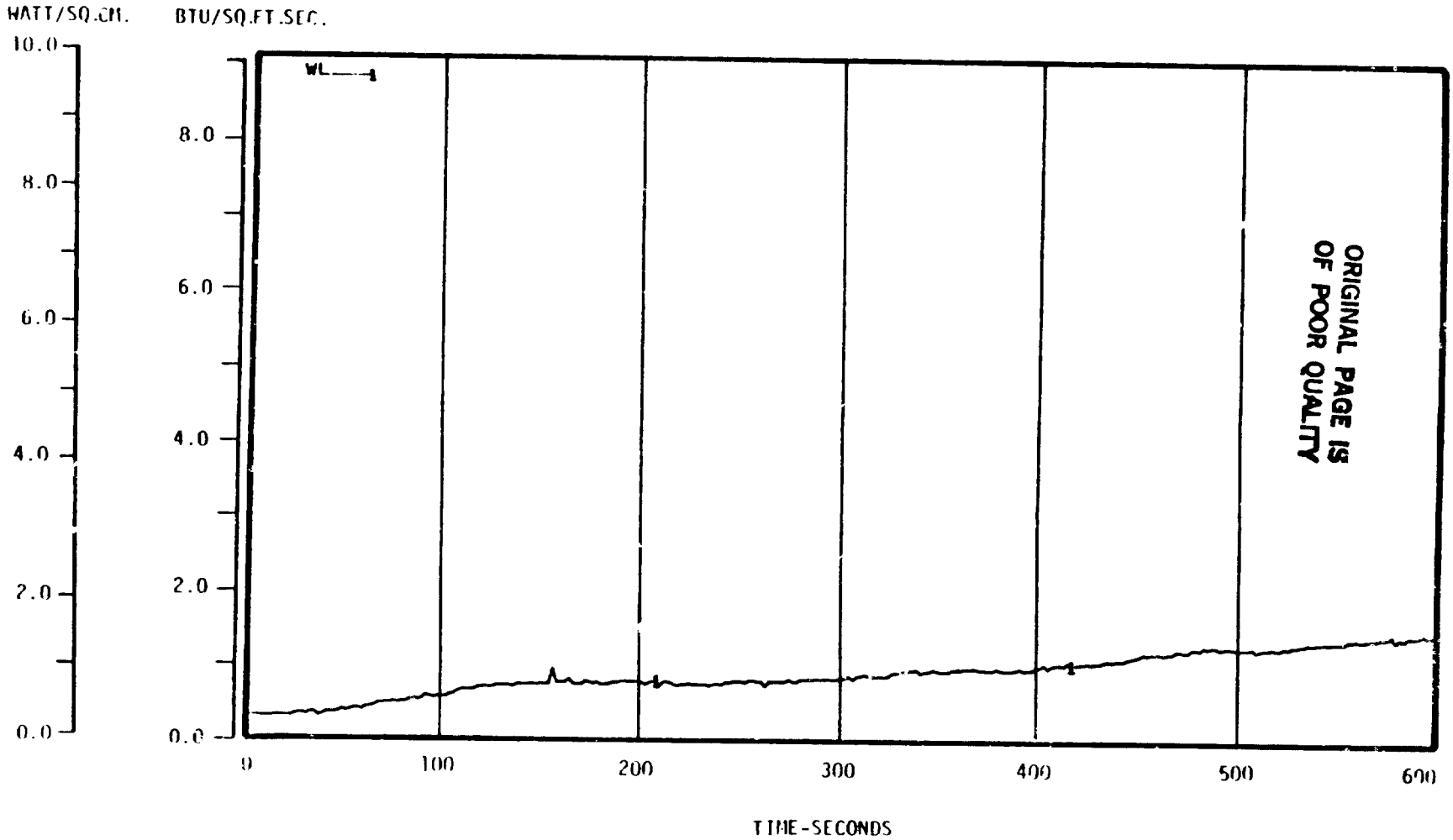


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

CUSHION CONSTRUCTION NUMBER 2.0

HEAT FLUX

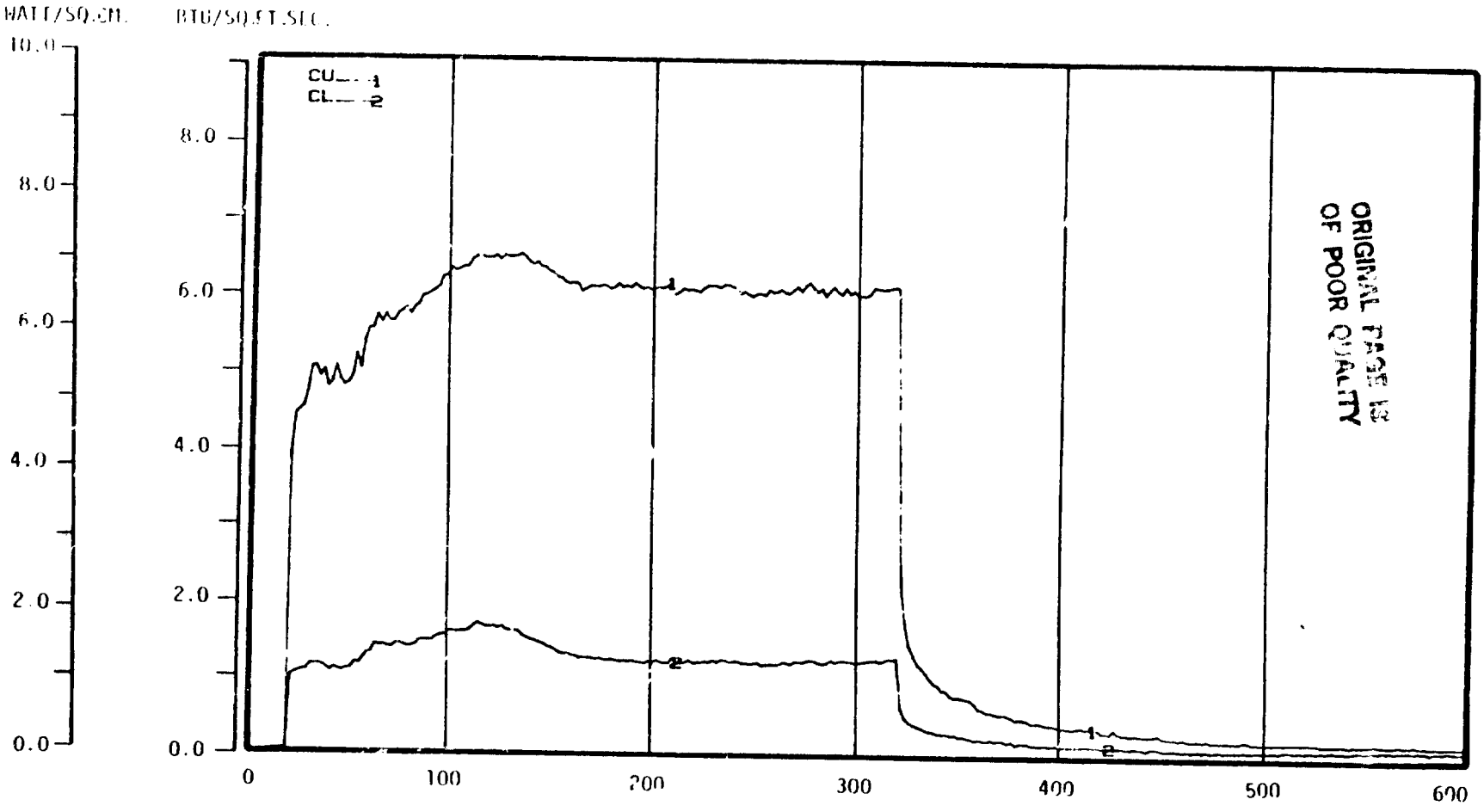


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 10.01

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 4

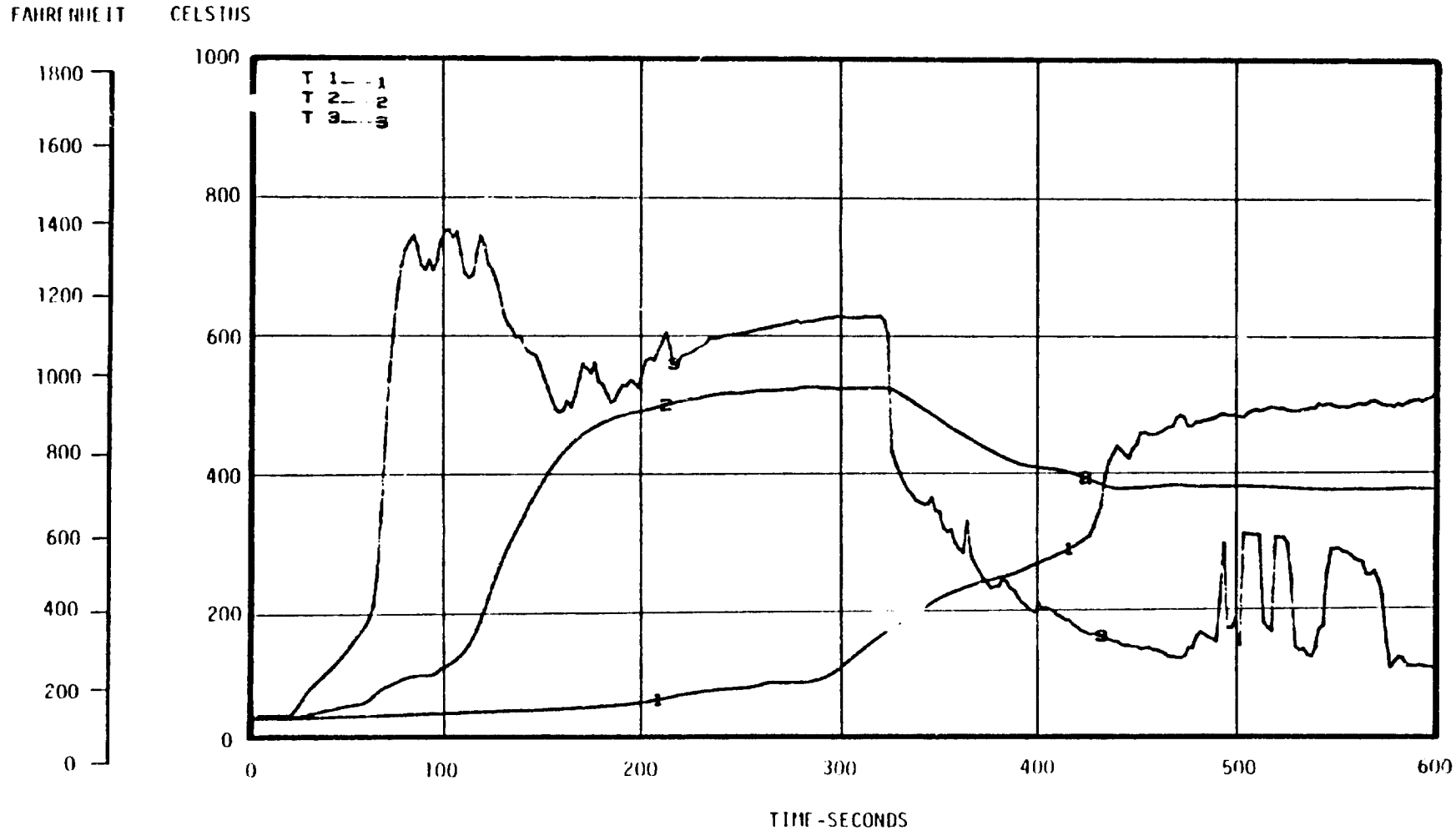
CUSHION CONSTRUCTION NUMBER 2.0

HEAT FLUX



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 10.54
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES

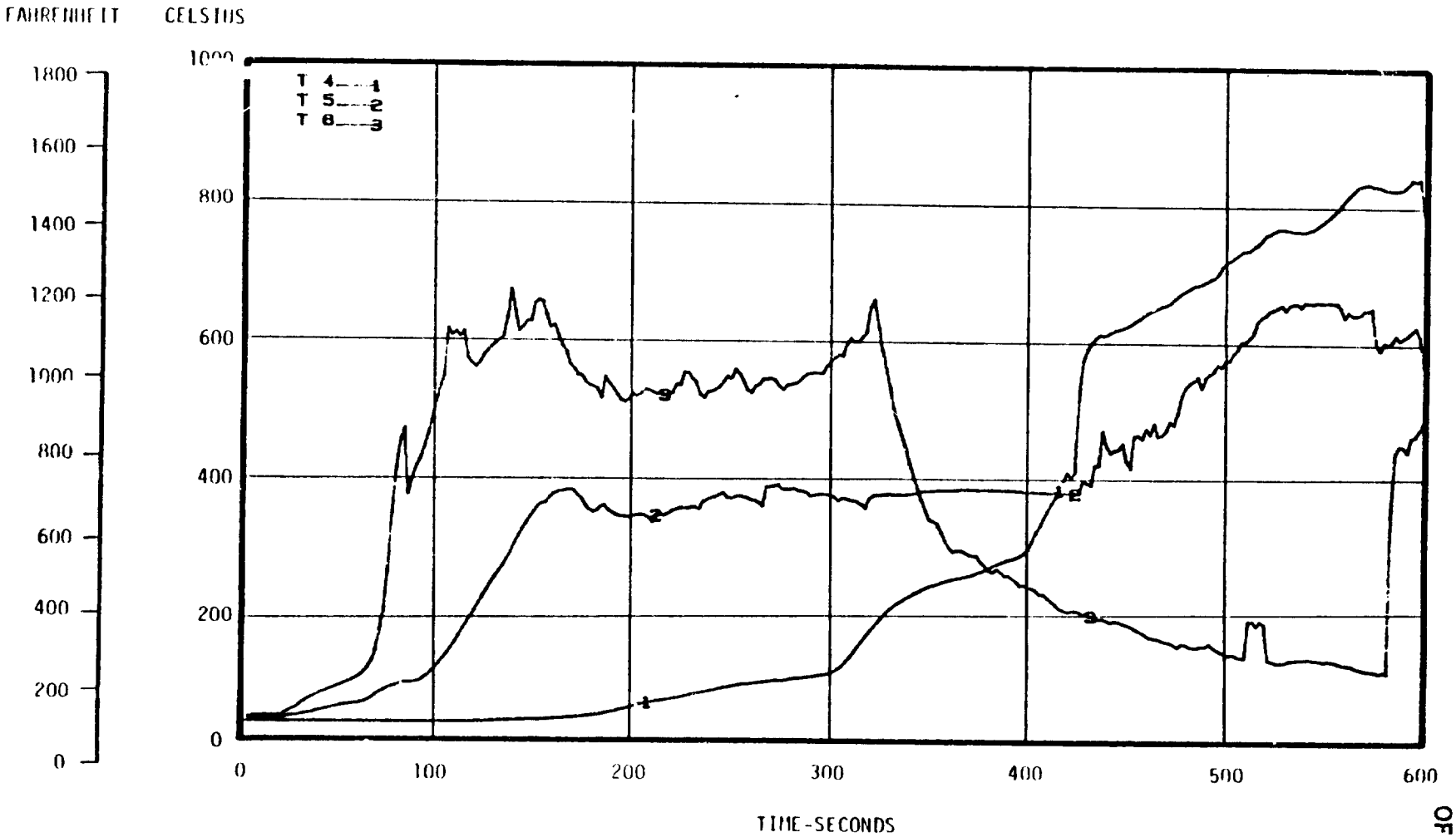


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 09/12/82 10.54

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11

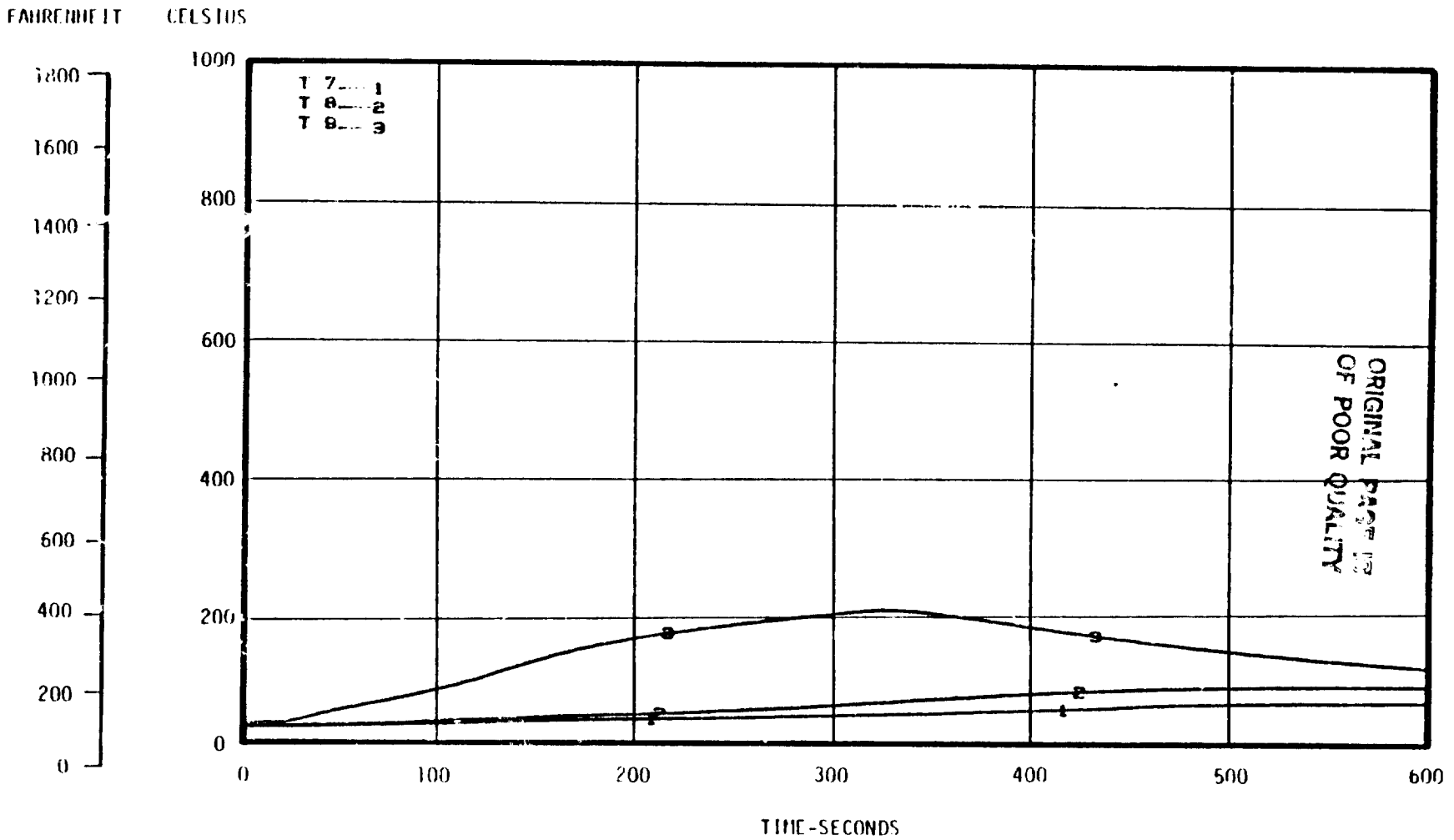
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 10.54
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES

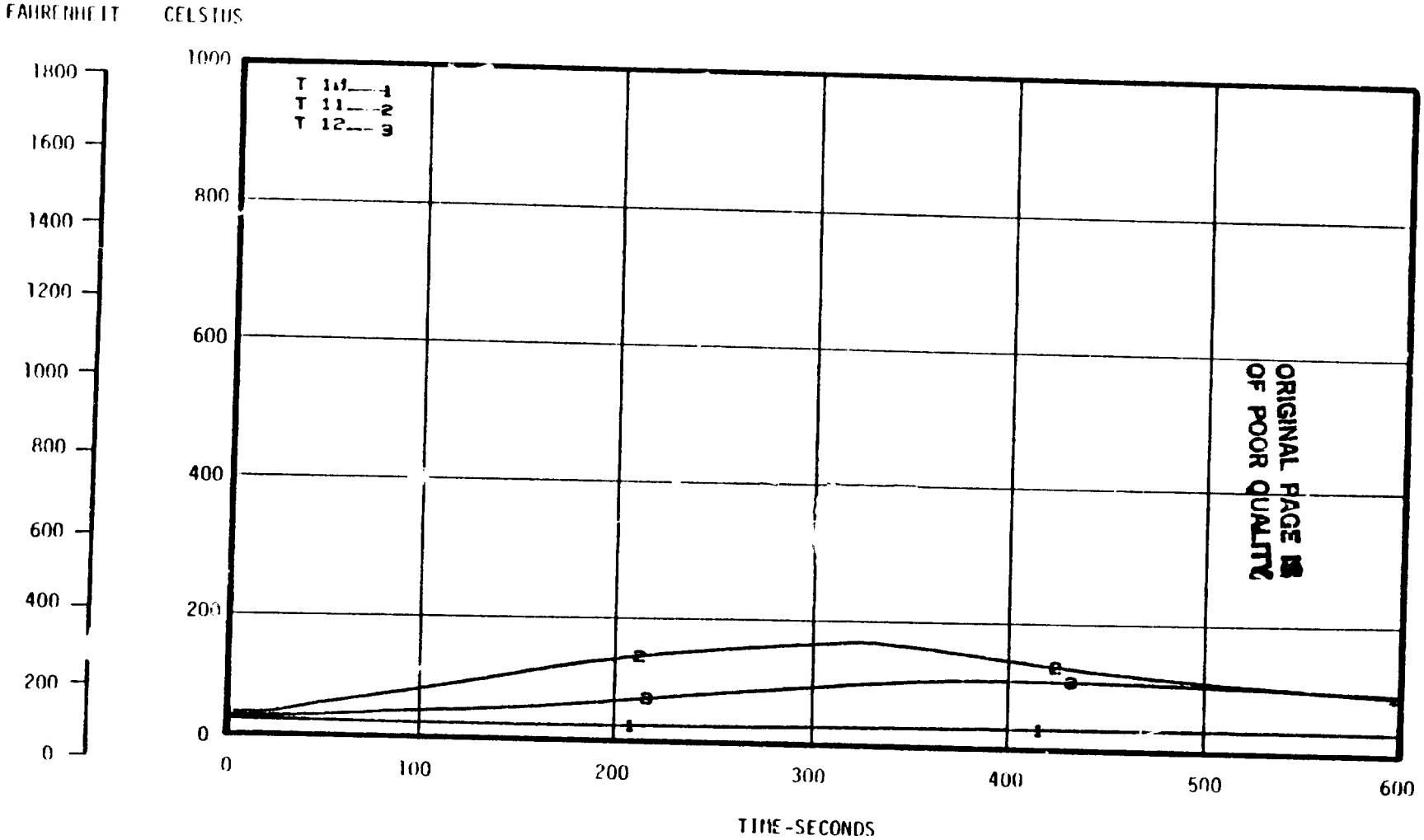


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 10:54

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11

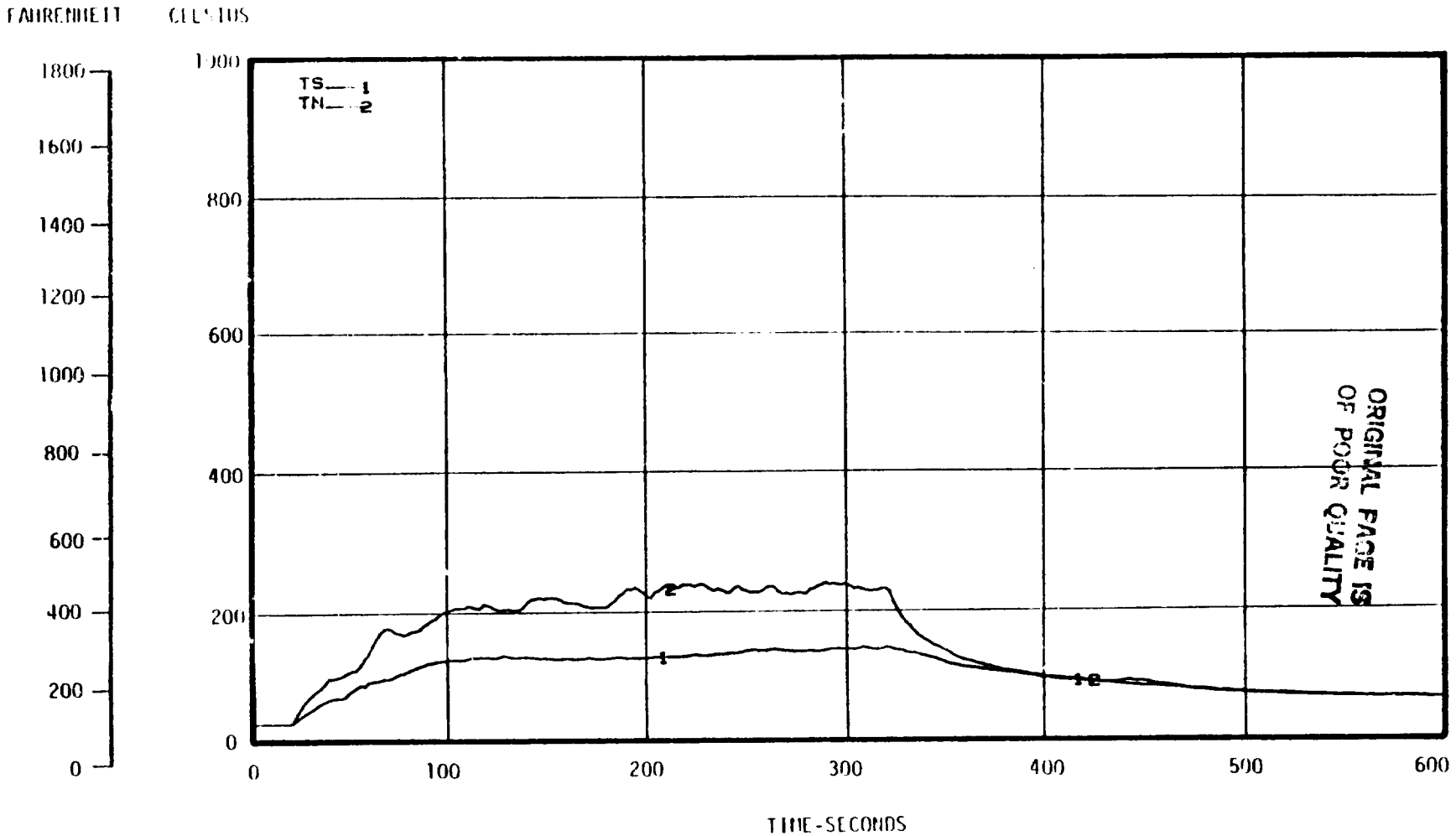
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 10.54
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11
CUSHION CONSTRUCTION NUMBER 3.0

CEILING TEMPERATURE

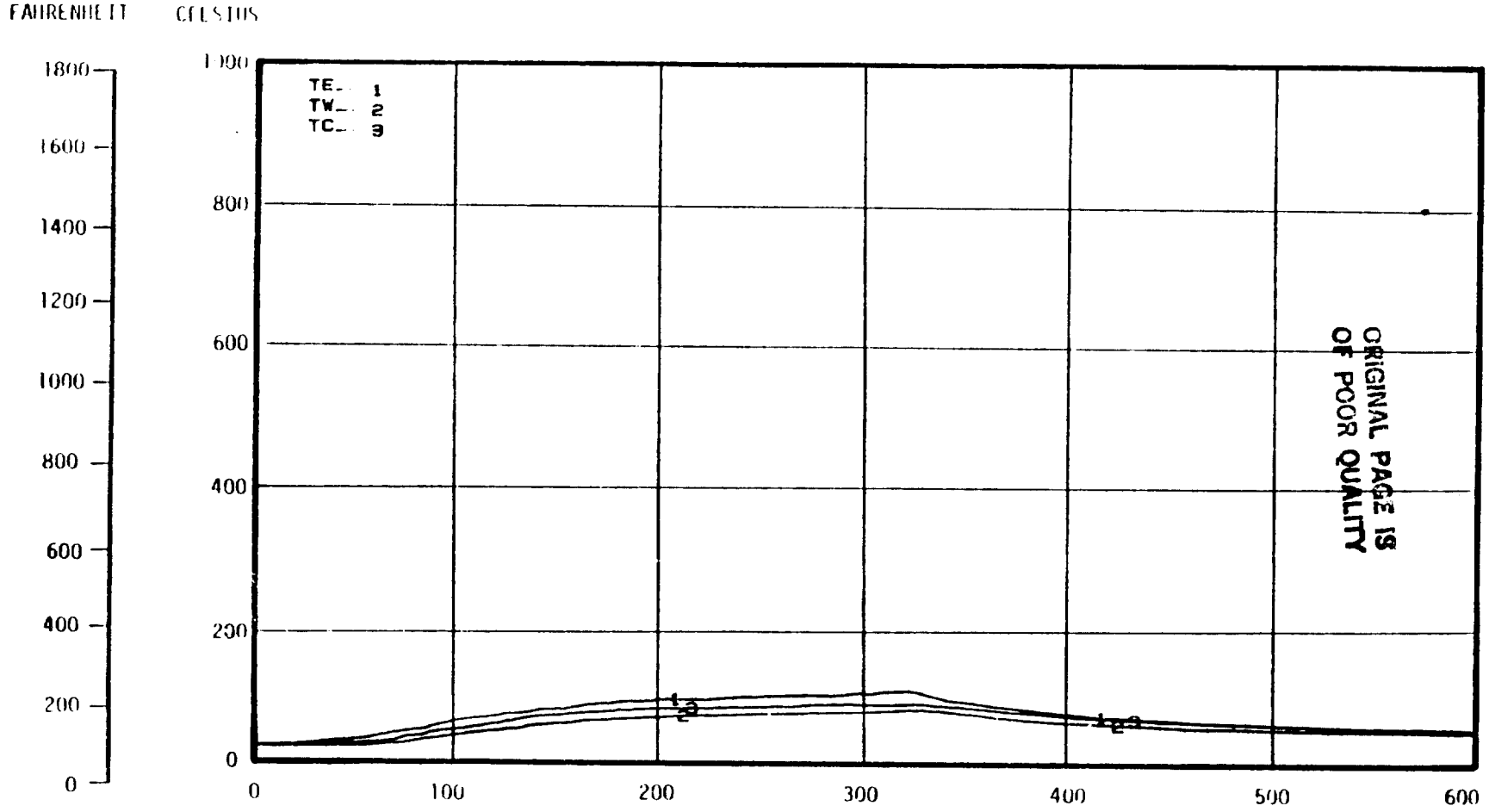


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 10.54

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11

CUSHION CONSTRUCTION NUMBER 3.0

CEILING TEMPERATURE

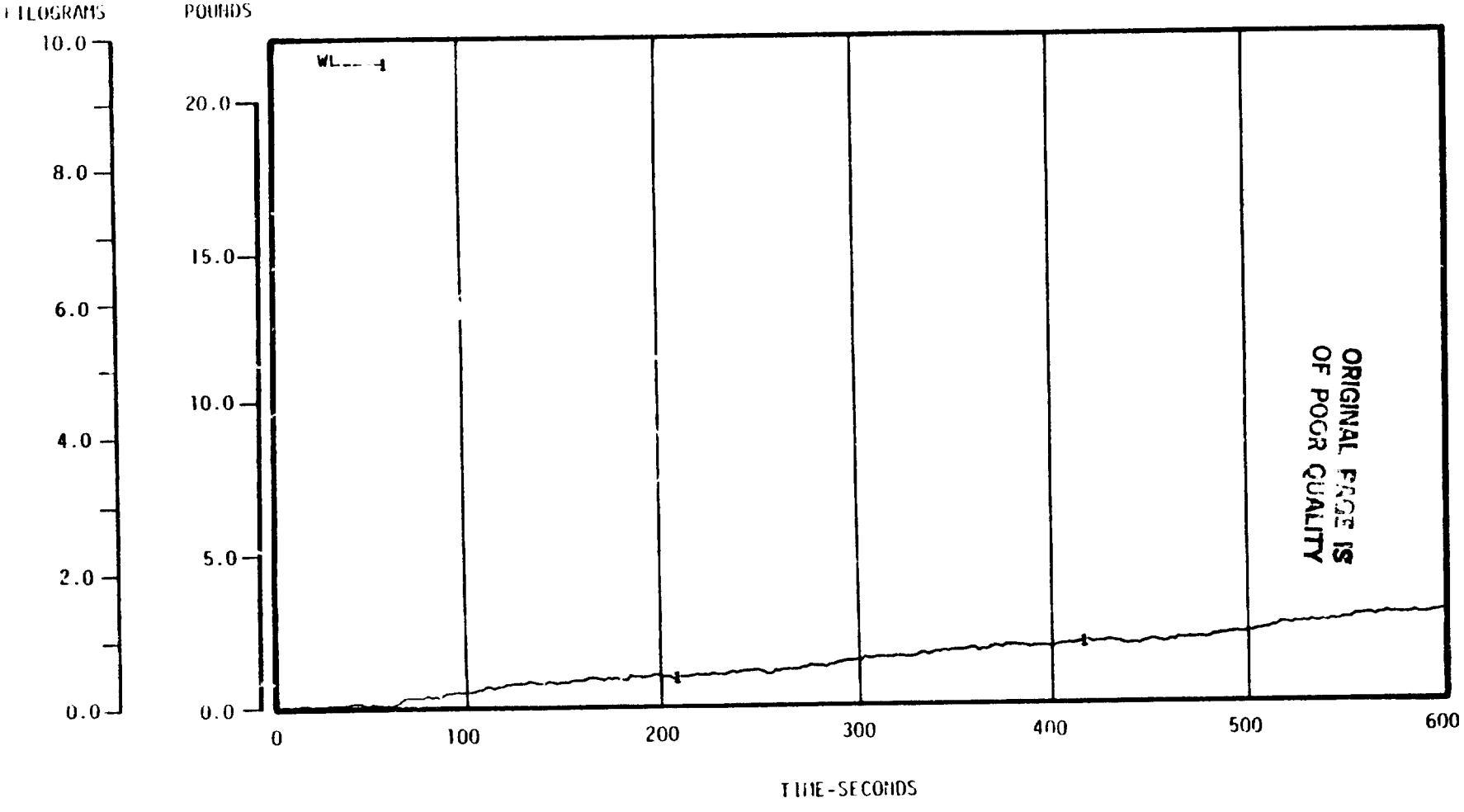


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 10.54

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11

CUSHION CONSTRUCTION NUMBER 3.0

WEIGHT LOSS

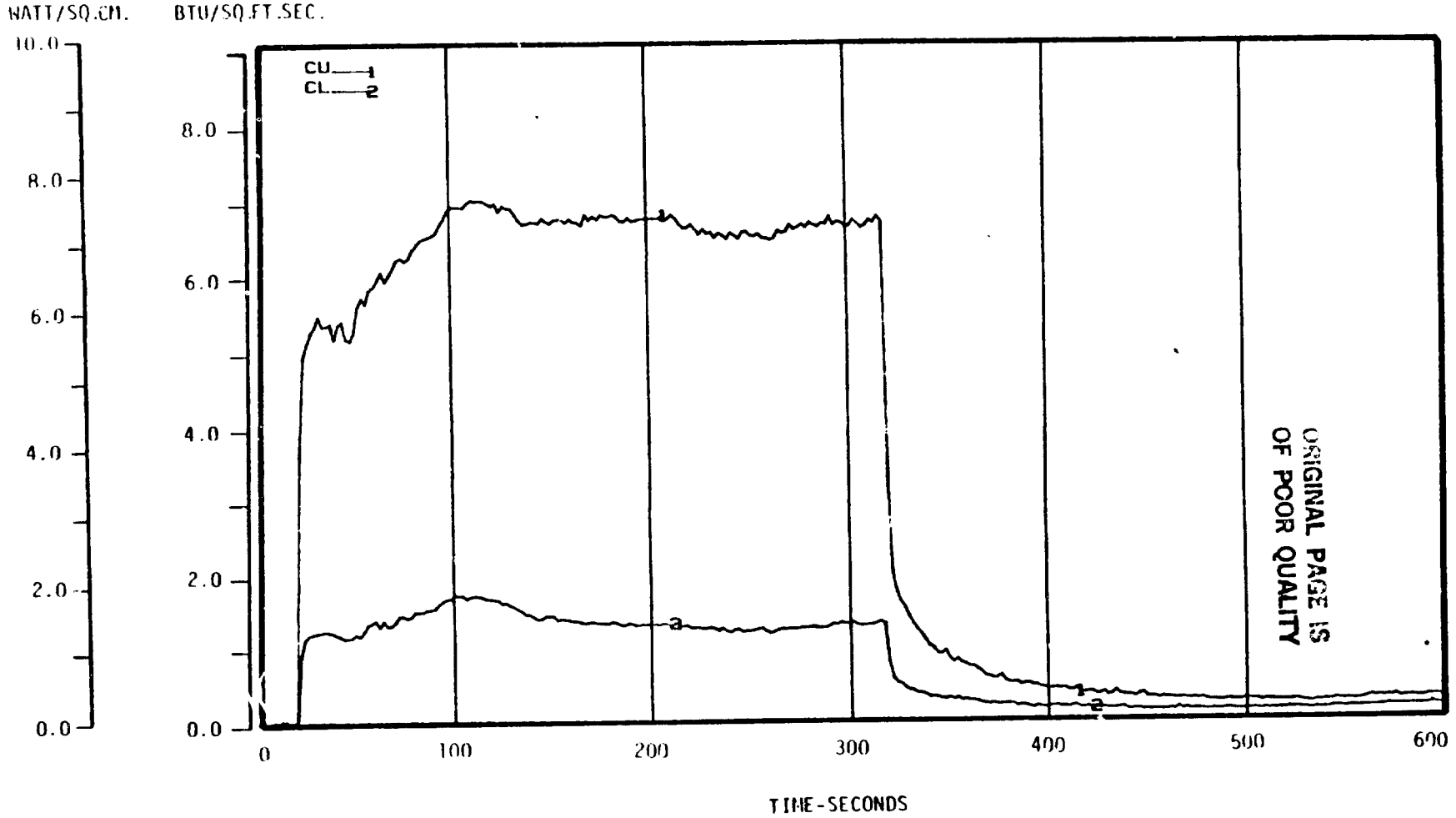


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 10.54

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 11

CUSHION CONSTRUCTION NUMBER 3.0

HEAT FLUX

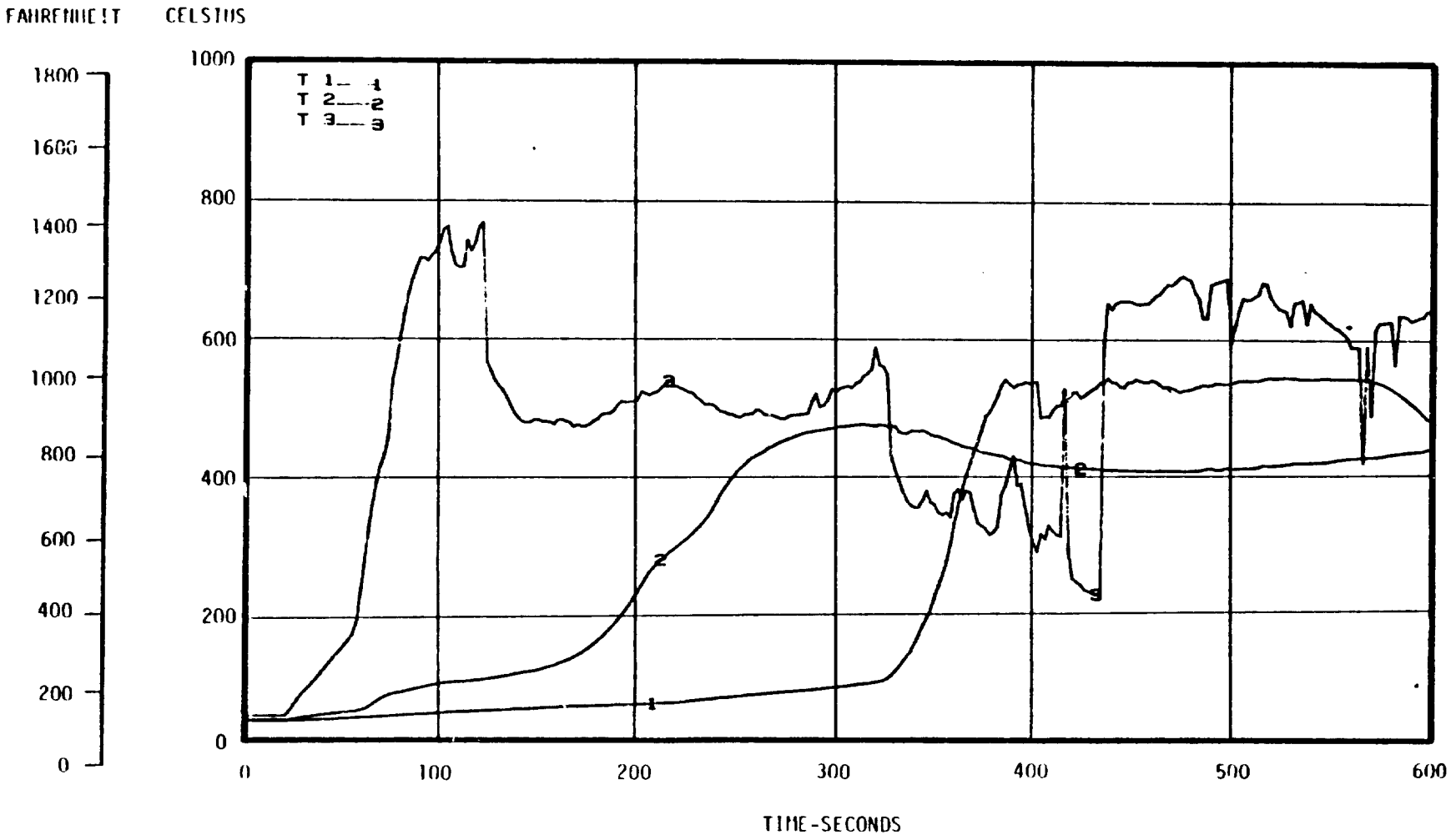


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13.51

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12

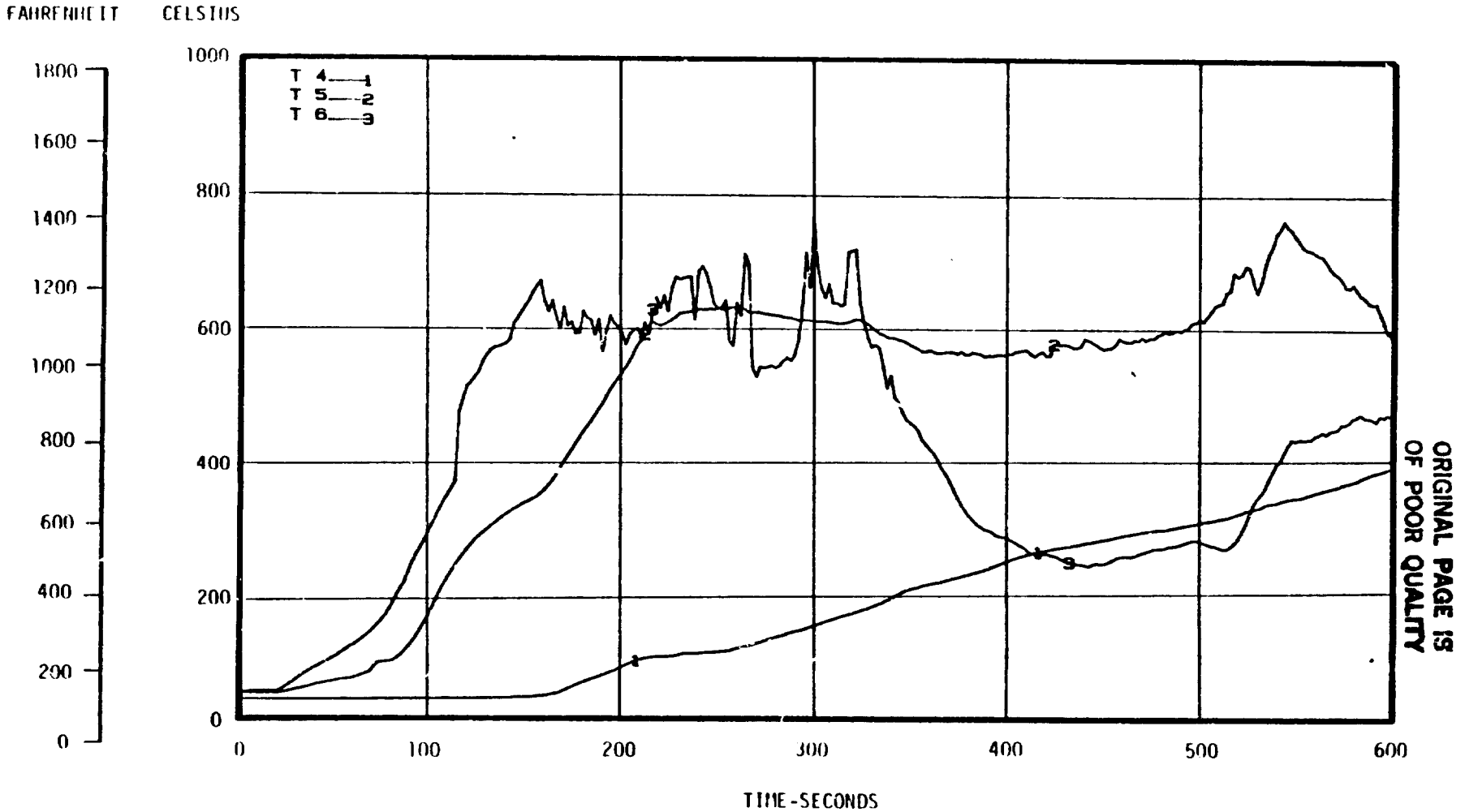
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13:51
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES

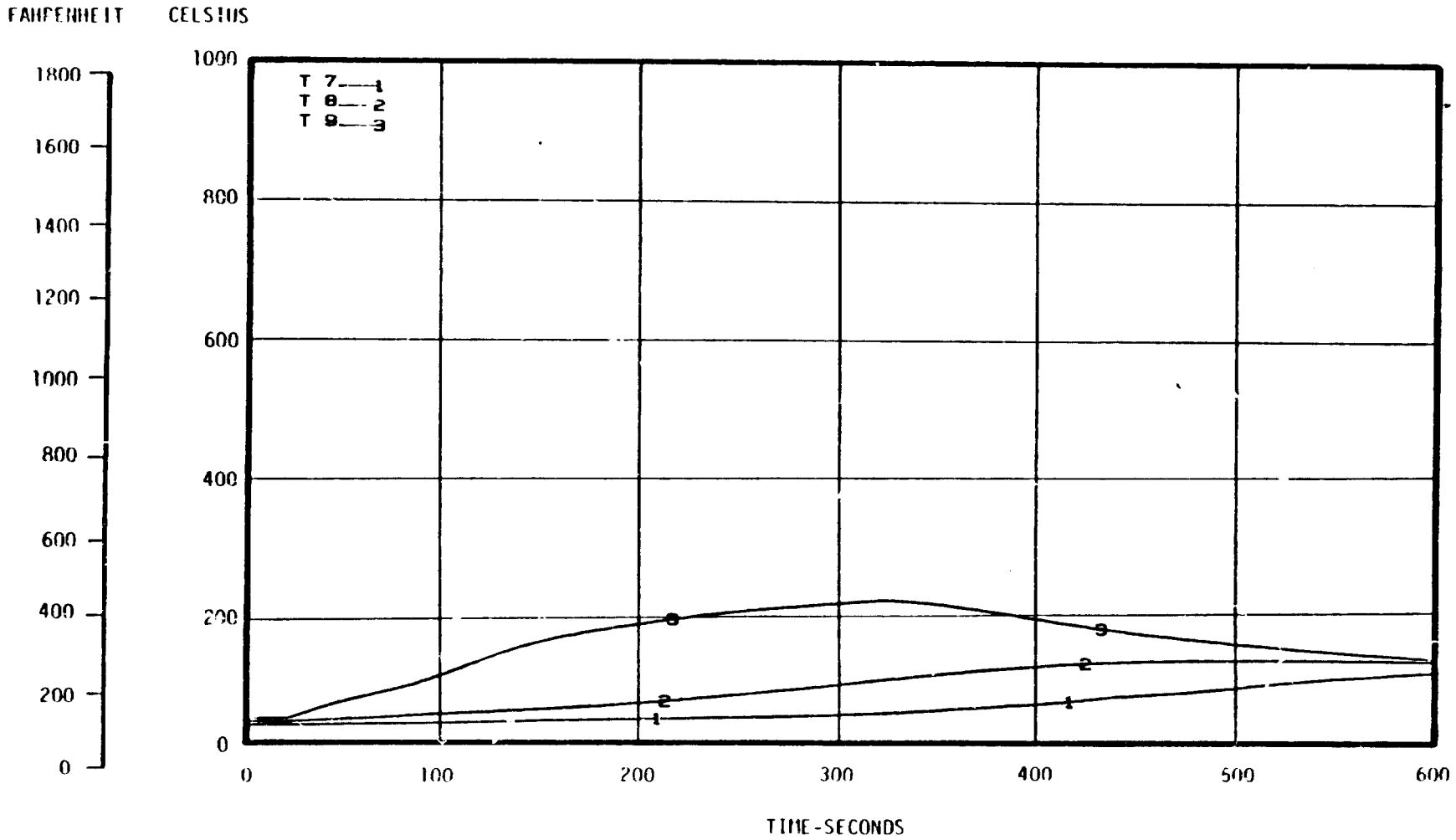


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13.51

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12

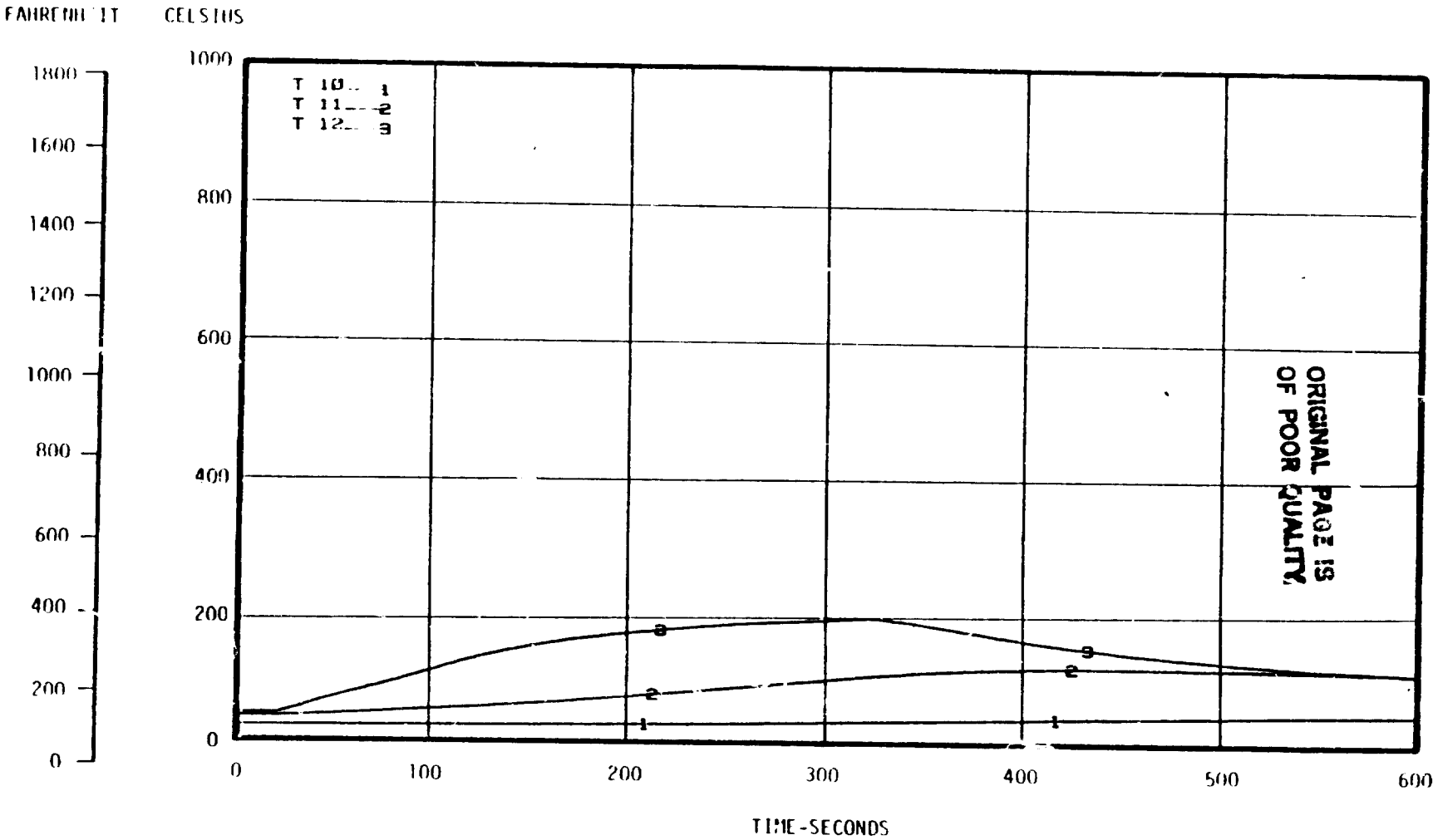
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13.51
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12
CUSHION CONSTRUCTION NUMBER 3.0

SEAT CUSHION TEMPERATURES

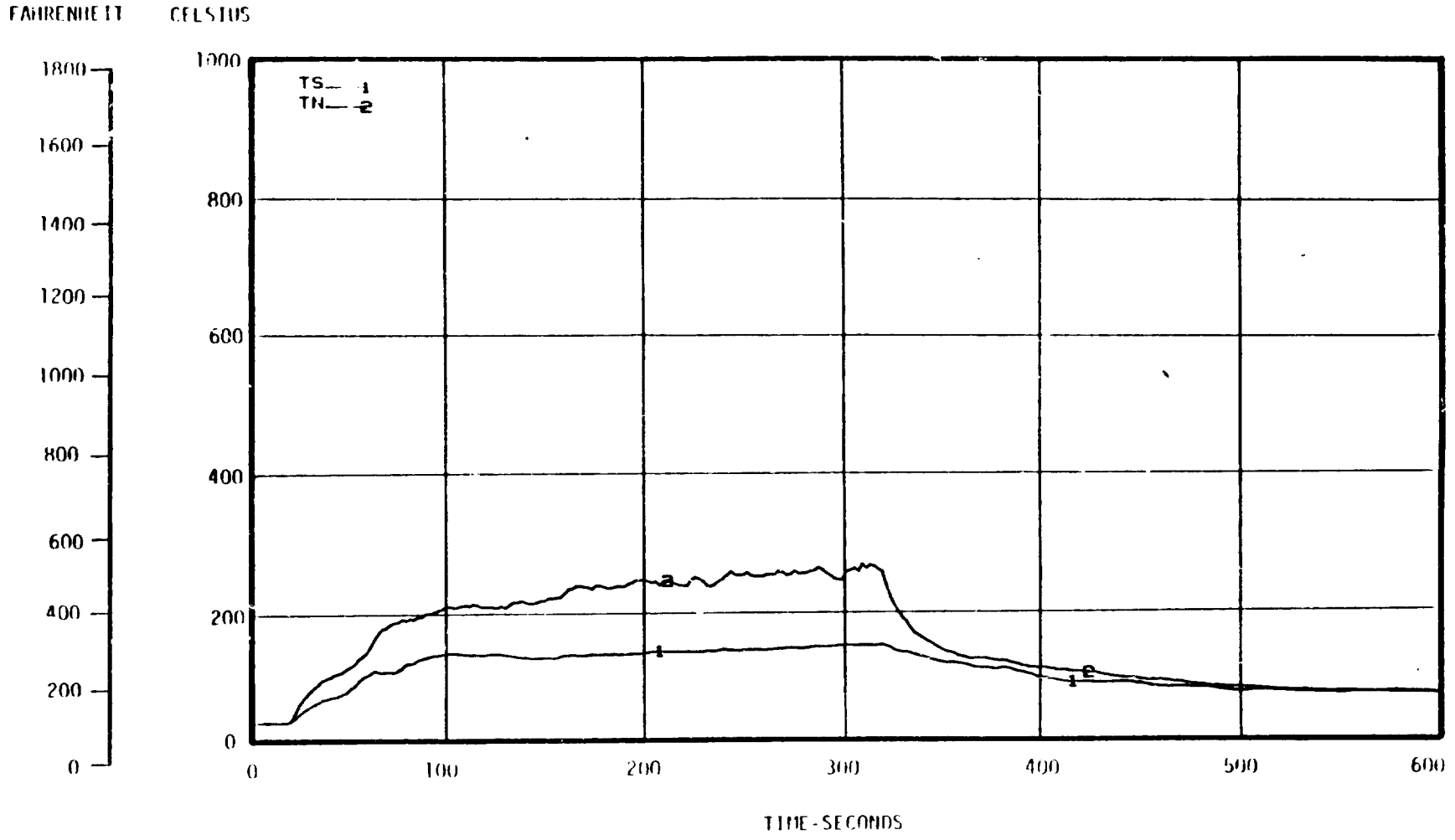


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13.51

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12

CUSHION CONSTRUCTION NUMBER 3.0

CEILING TEMPERATURE

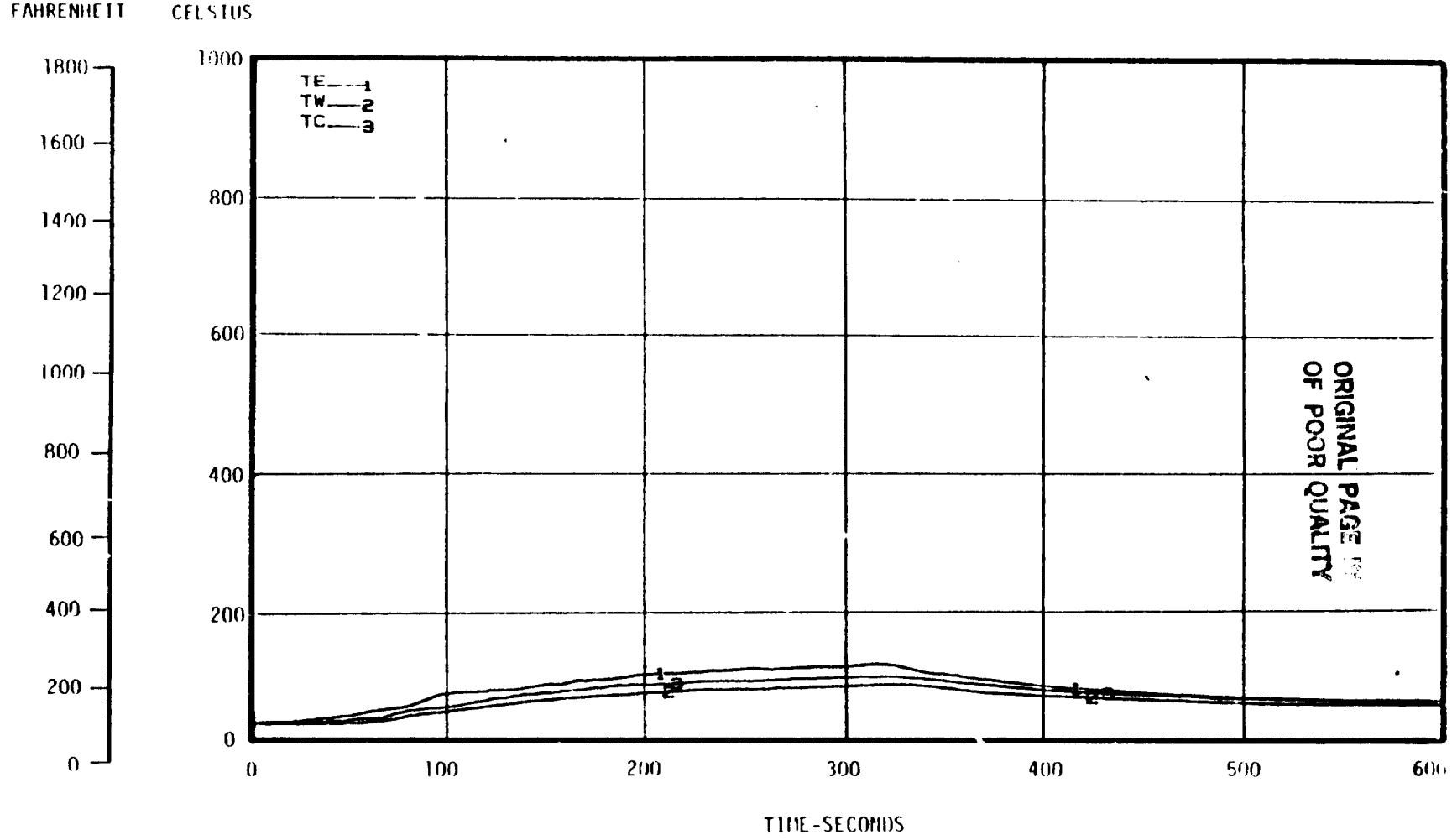


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13.51

NASA-ARES FULL SCALE CUSHION BURN TEST NUMBER 12

CUSHION CONSTRUCTION NUMBER 3.0

CEILING TEMPERATURE



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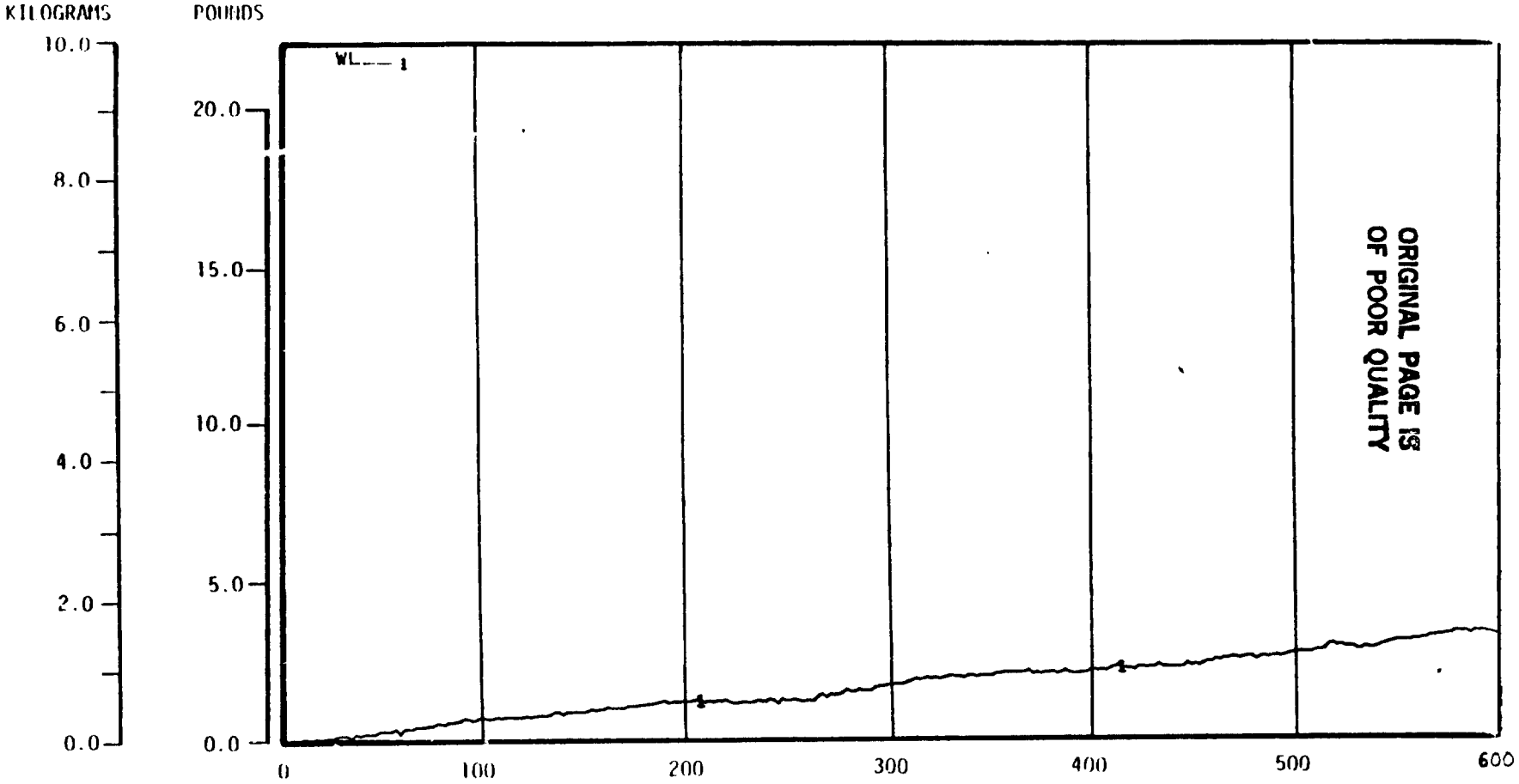
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13:51

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12

CUSHION CONSTRUCTION NUMBER 3.0

WEIGHT LOSS

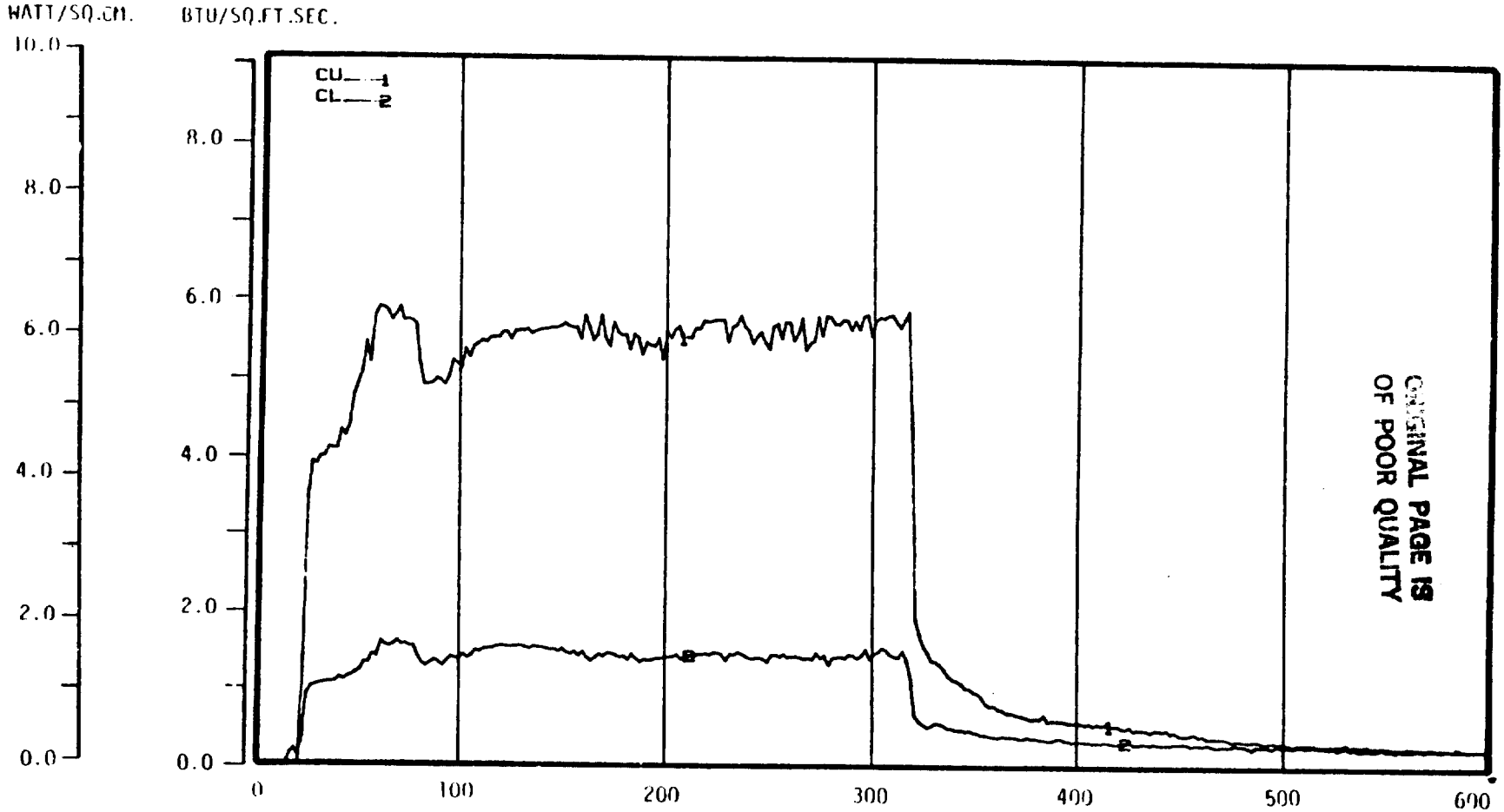


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 13.51

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12

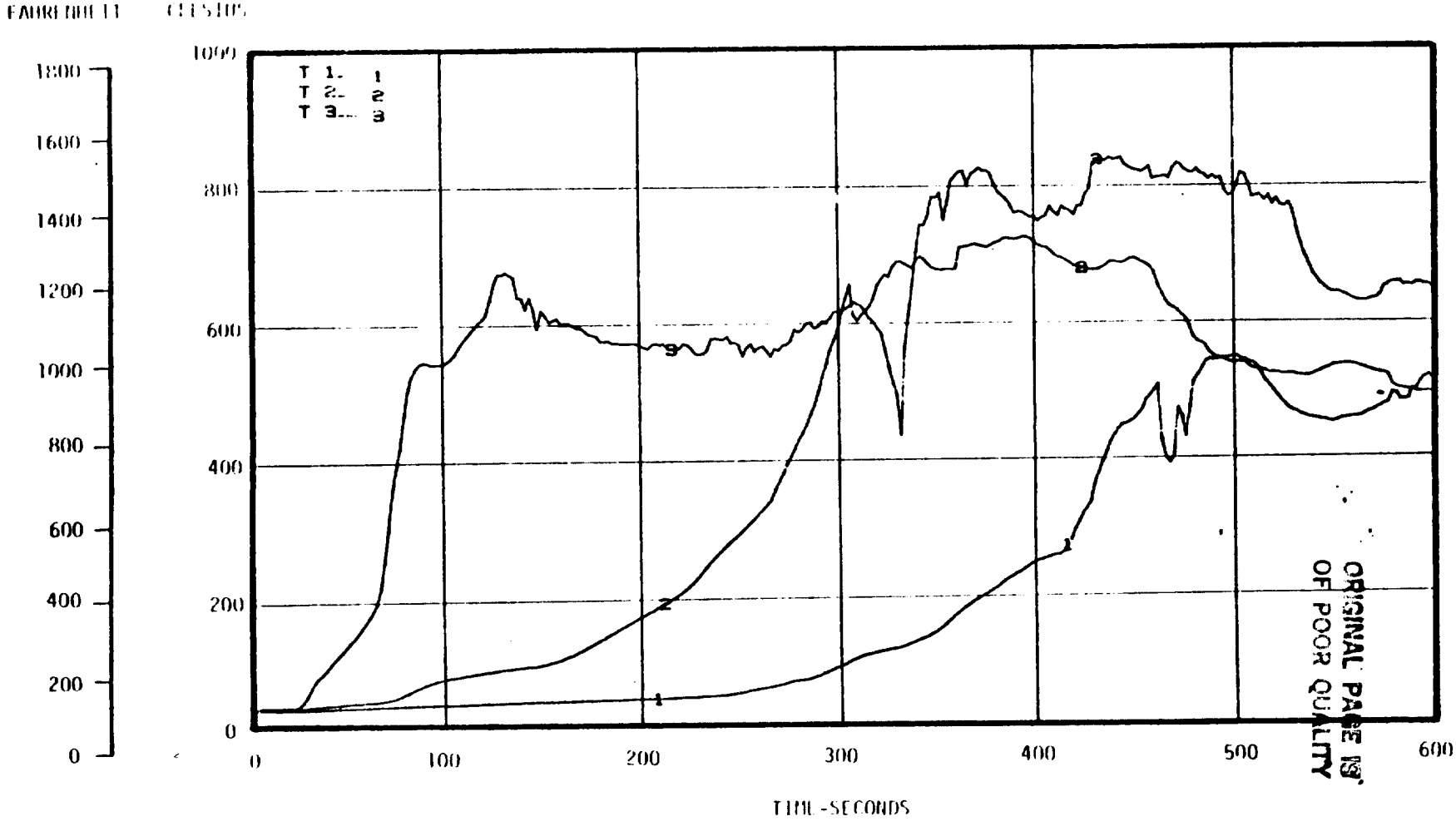
CUSHION CONSTRUCTION NUMBER 3.0

HEAT FLUX



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 13.27
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 3
CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES

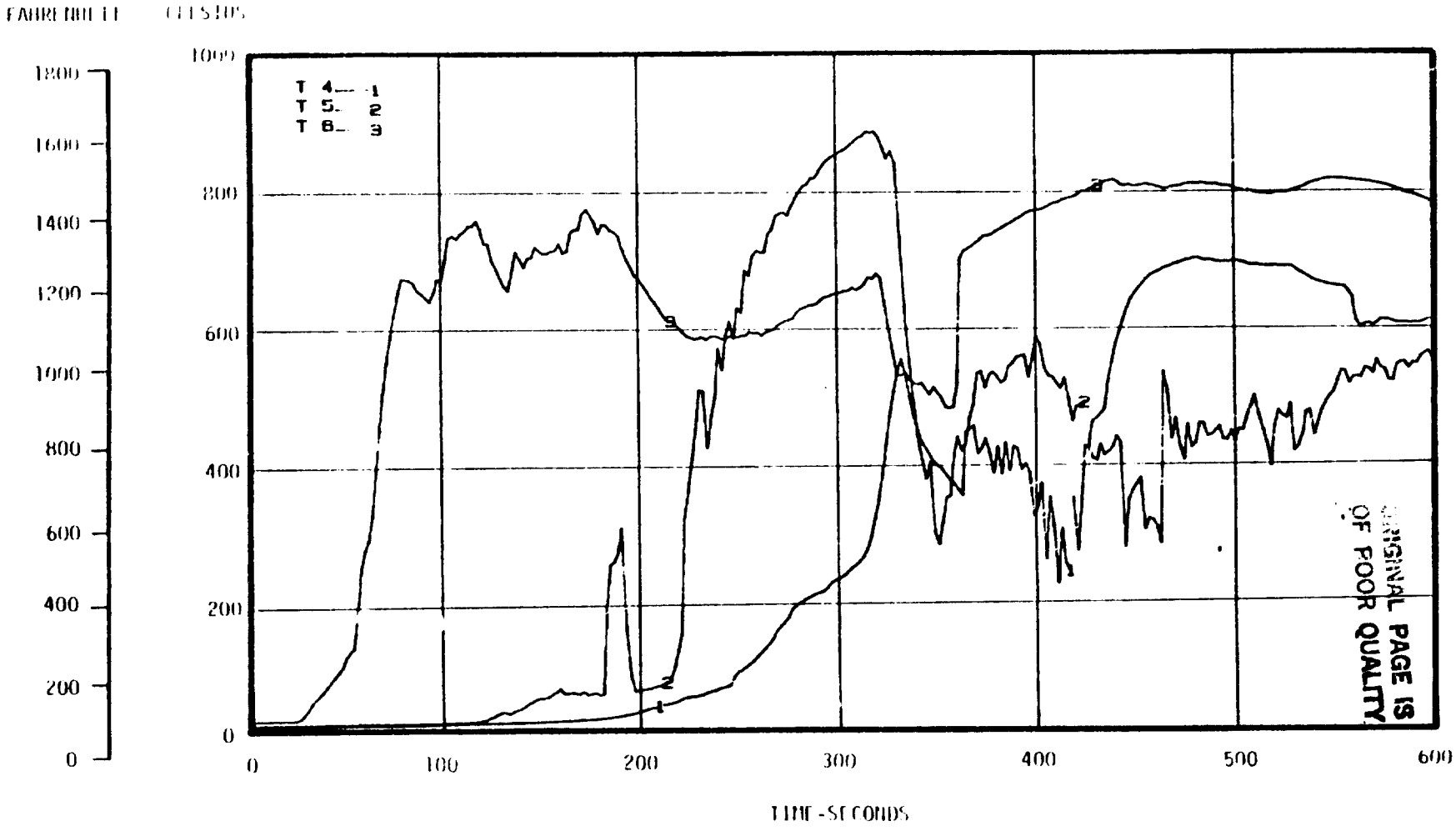


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 13.27

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 3

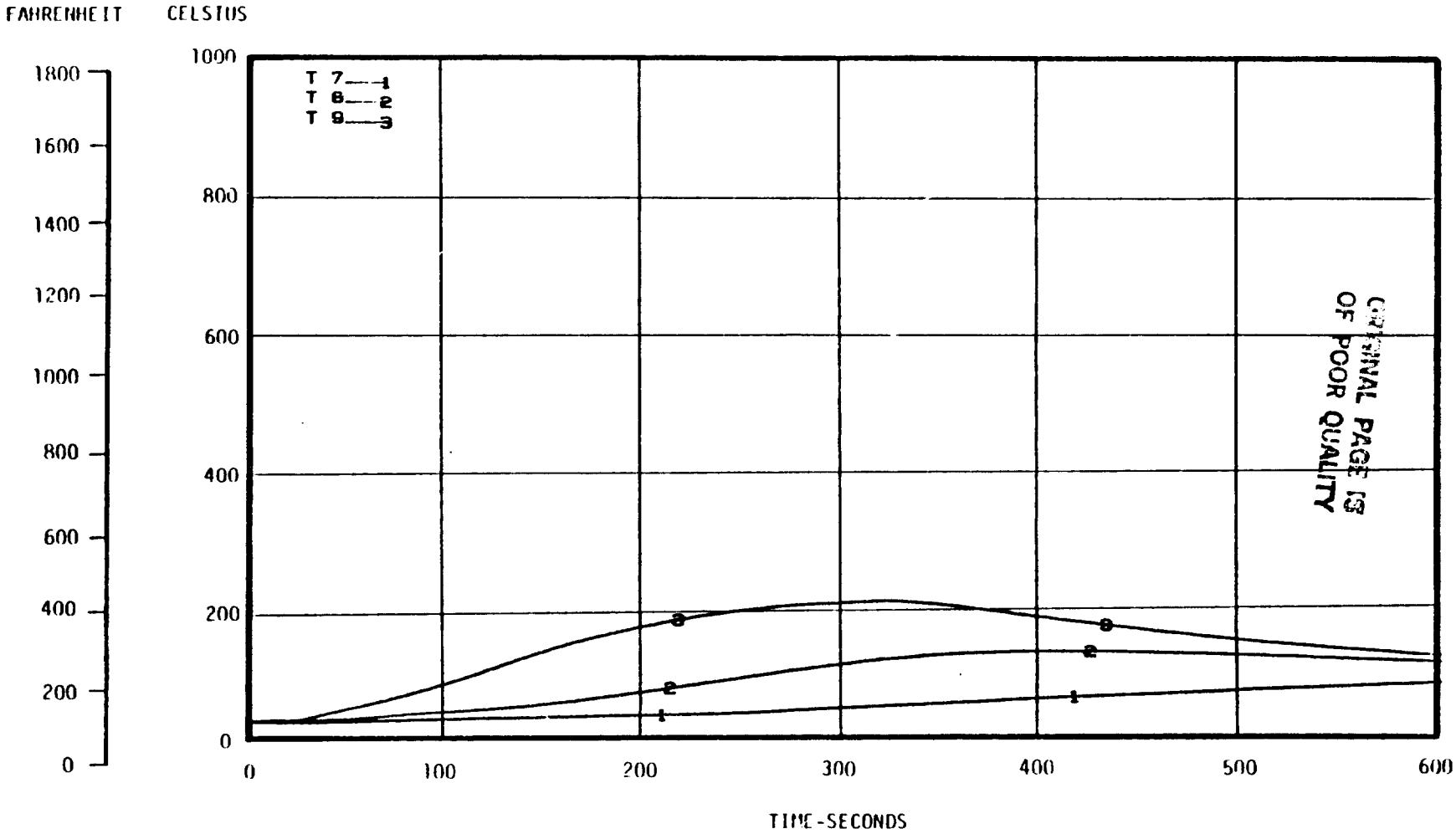
CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES



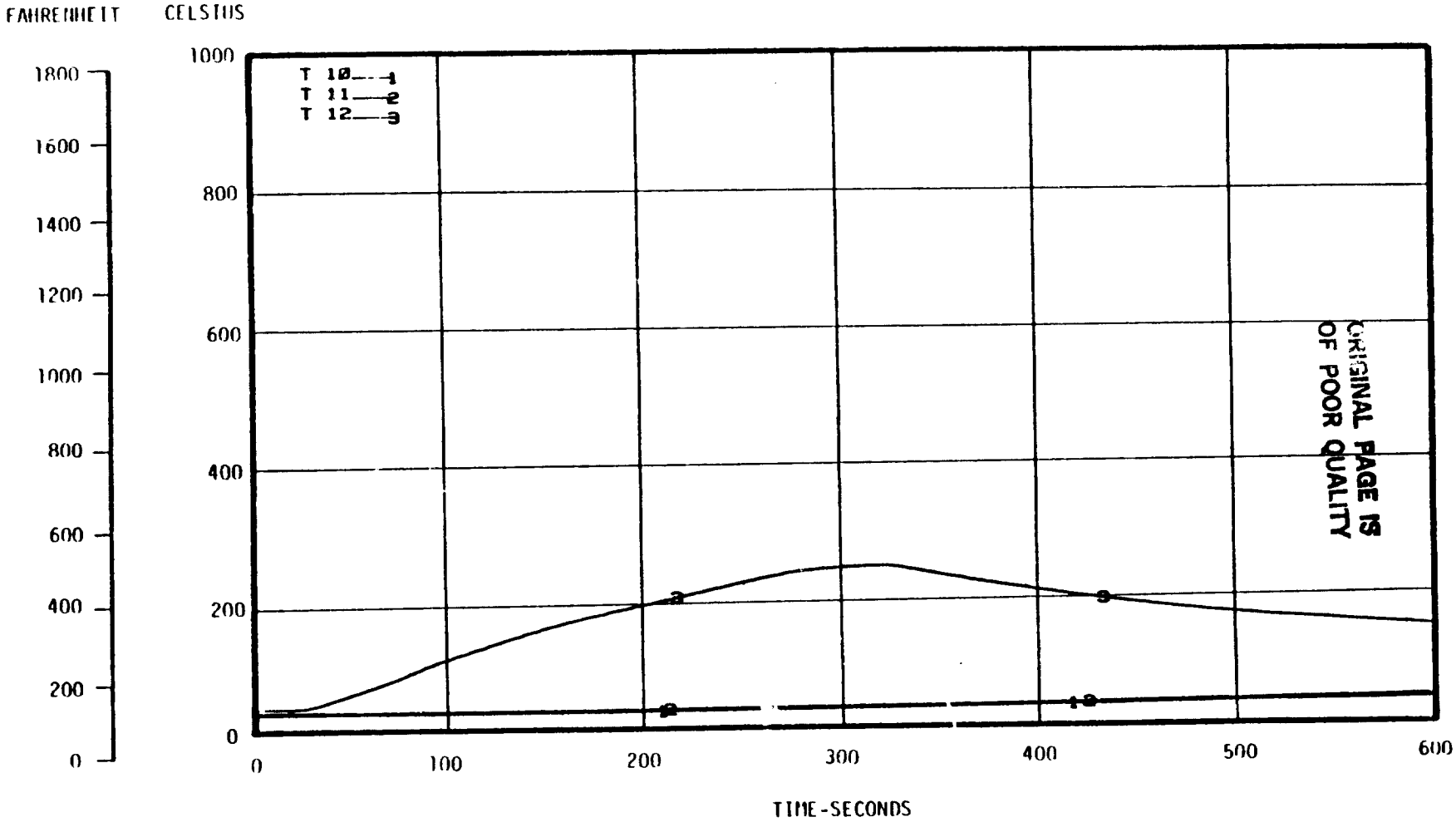
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 13.27
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 3
CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 13.27
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 3
CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES

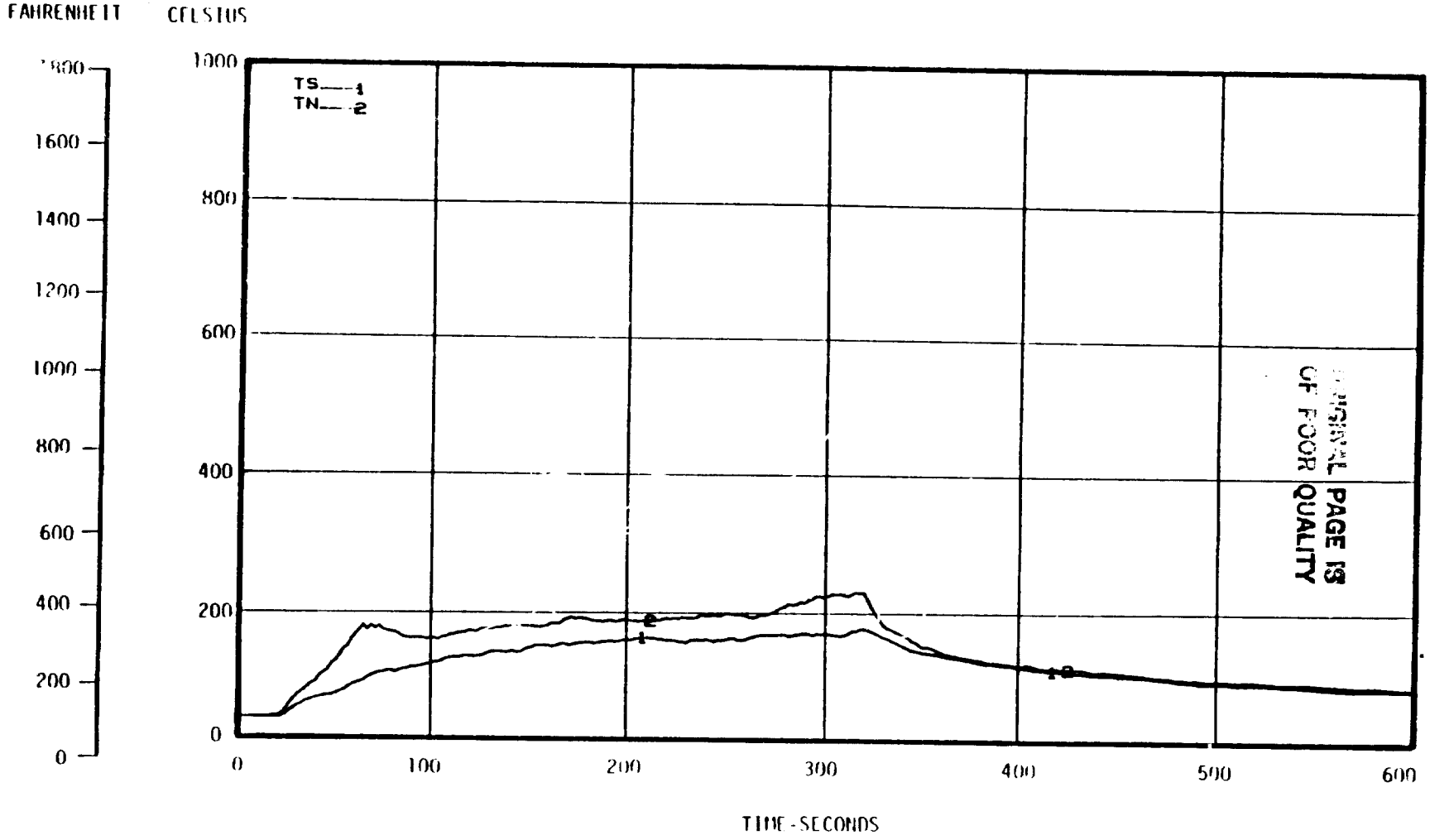


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 19.27

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 3

CUSHION CONSTRUCTION NUMBER 4.0

CEILING TEMPERATURE

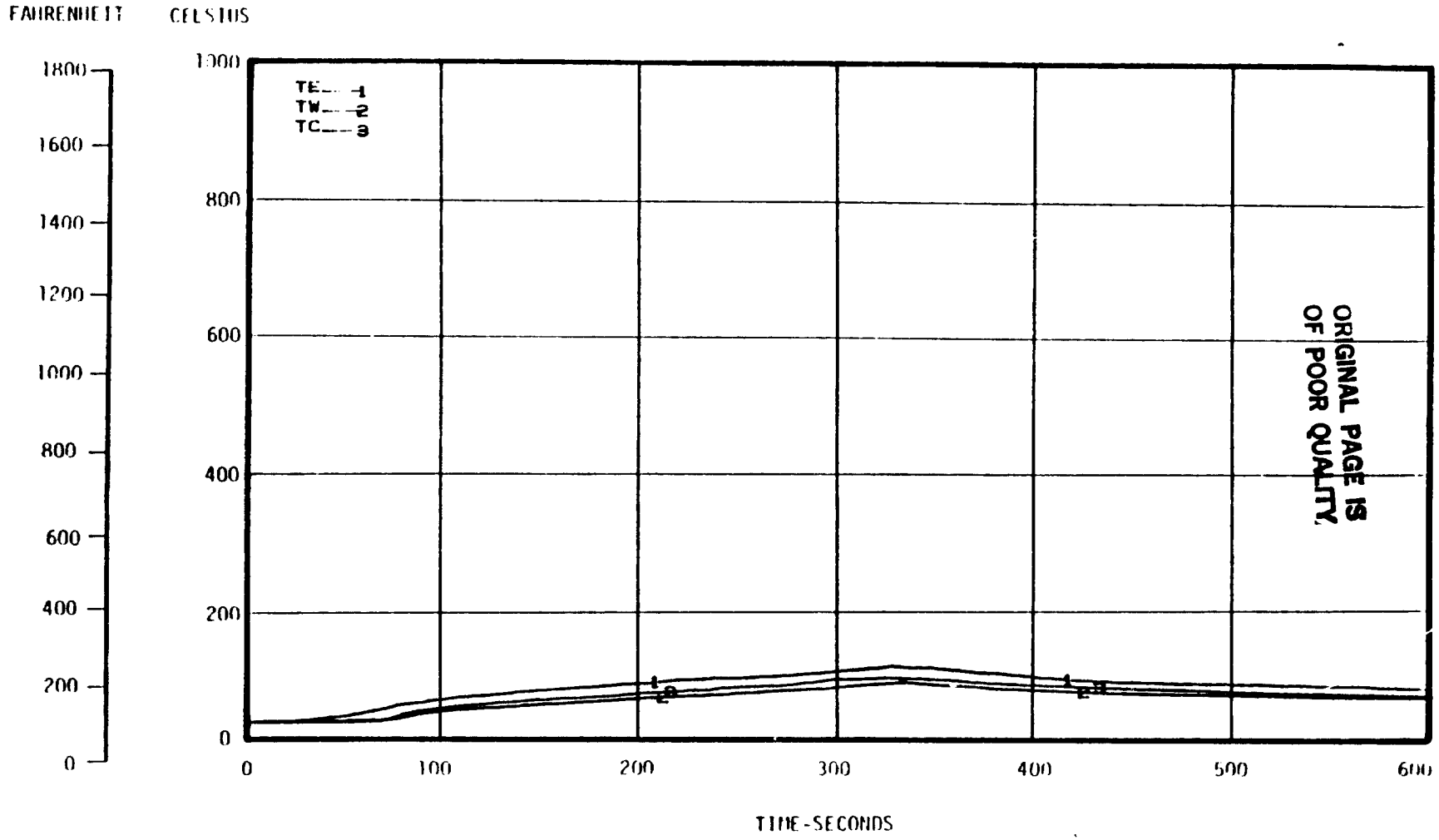


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 13.27

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 3

CUSHION CONSTRUCTION NUMBER 4.0

CEILING TEMPERATURE

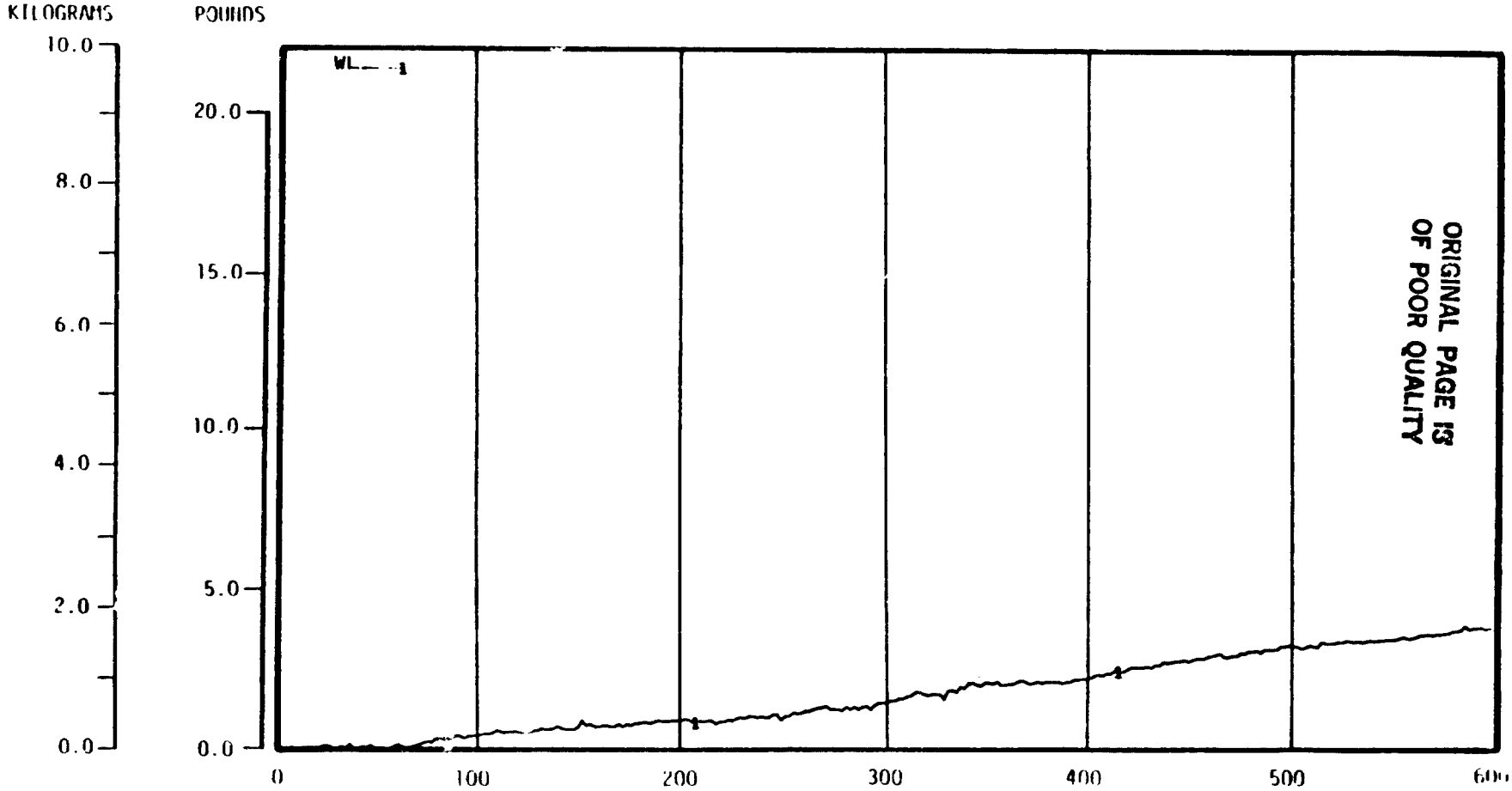


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 13.27

NASA-ARES FULL SCALE CUSHION BURN TEST NUMBER 3

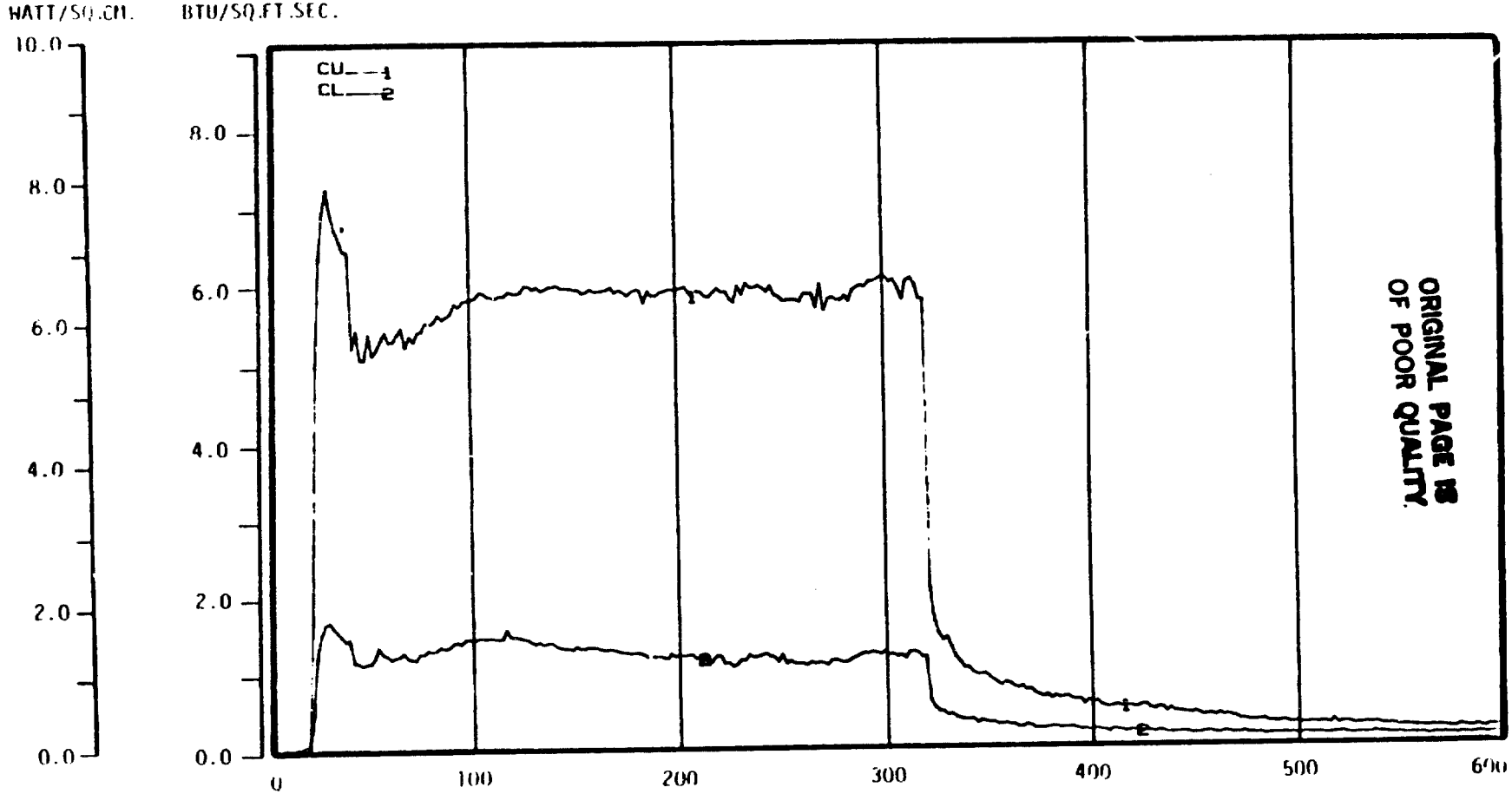
CUSHION CONSTRUCTION NUMBER 4.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 13.27
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 3
CUSHION CONSTRUCTION NUMBER 4.0

HEAT FLUX

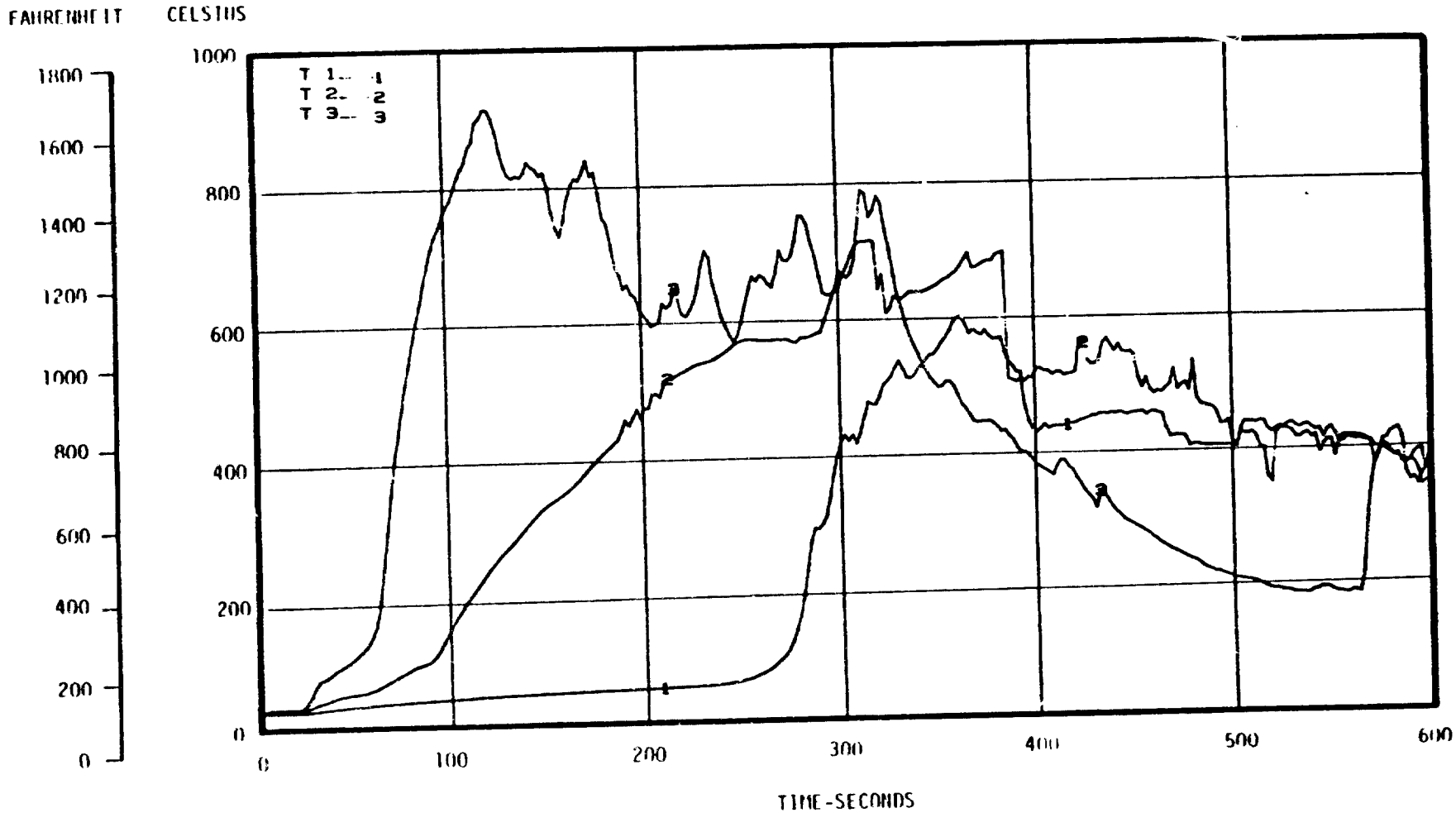


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09.02

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10

CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES

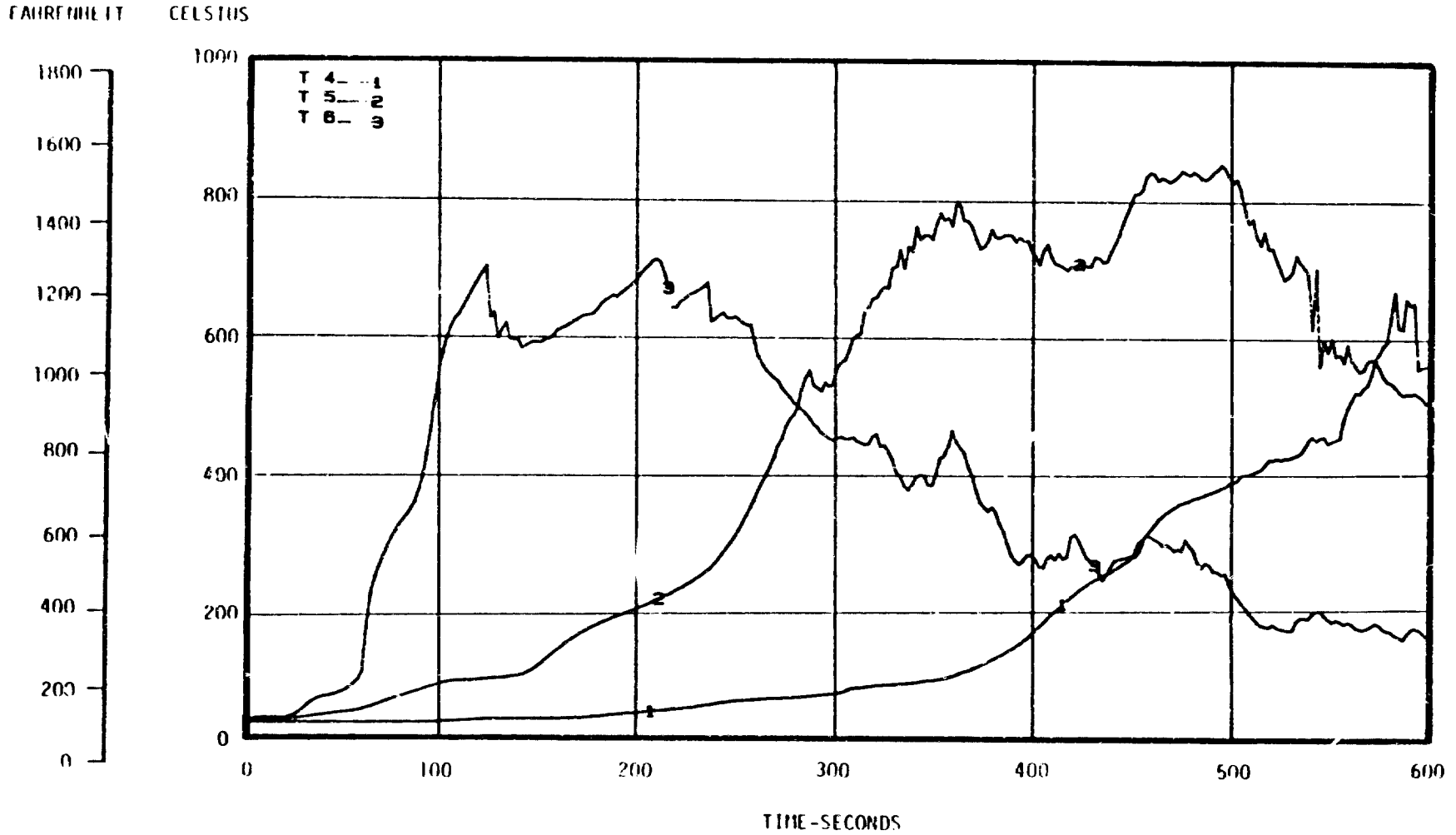


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09:02

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10

CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES

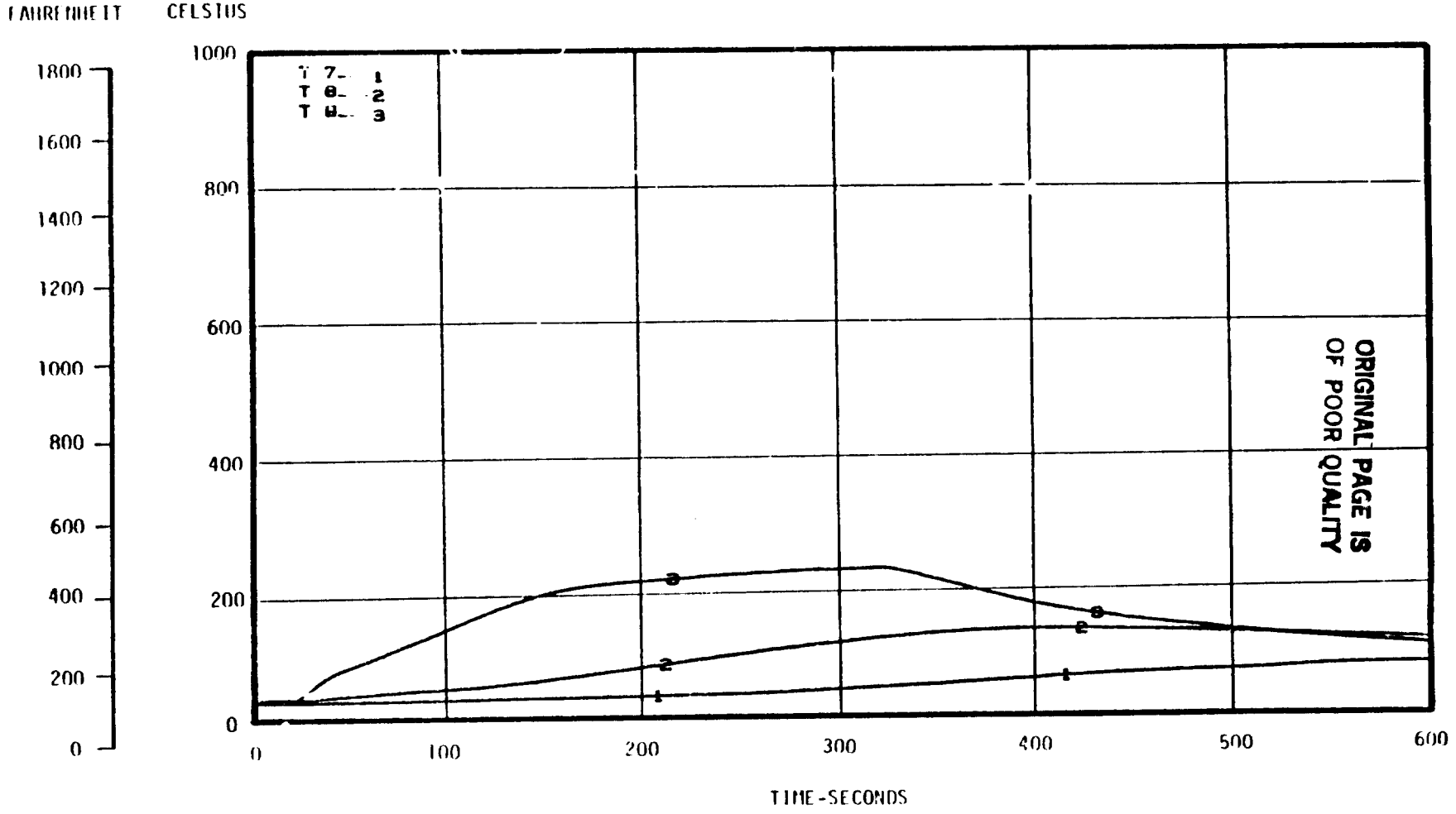


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09.02

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10

CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES

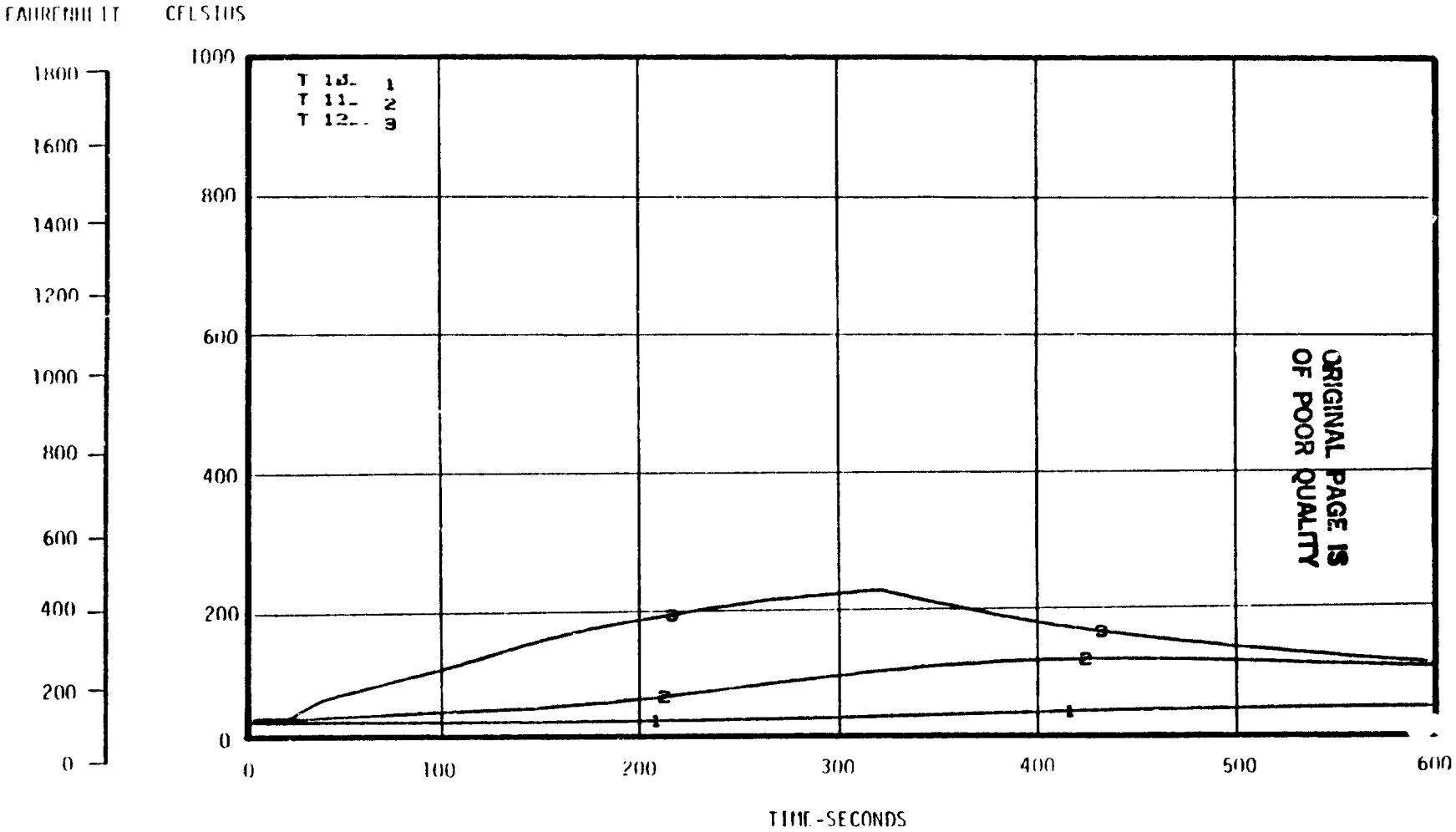


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09.02

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10

CUSHION CONSTRUCTION NUMBER 4.0

SEAT CUSHION TEMPERATURES

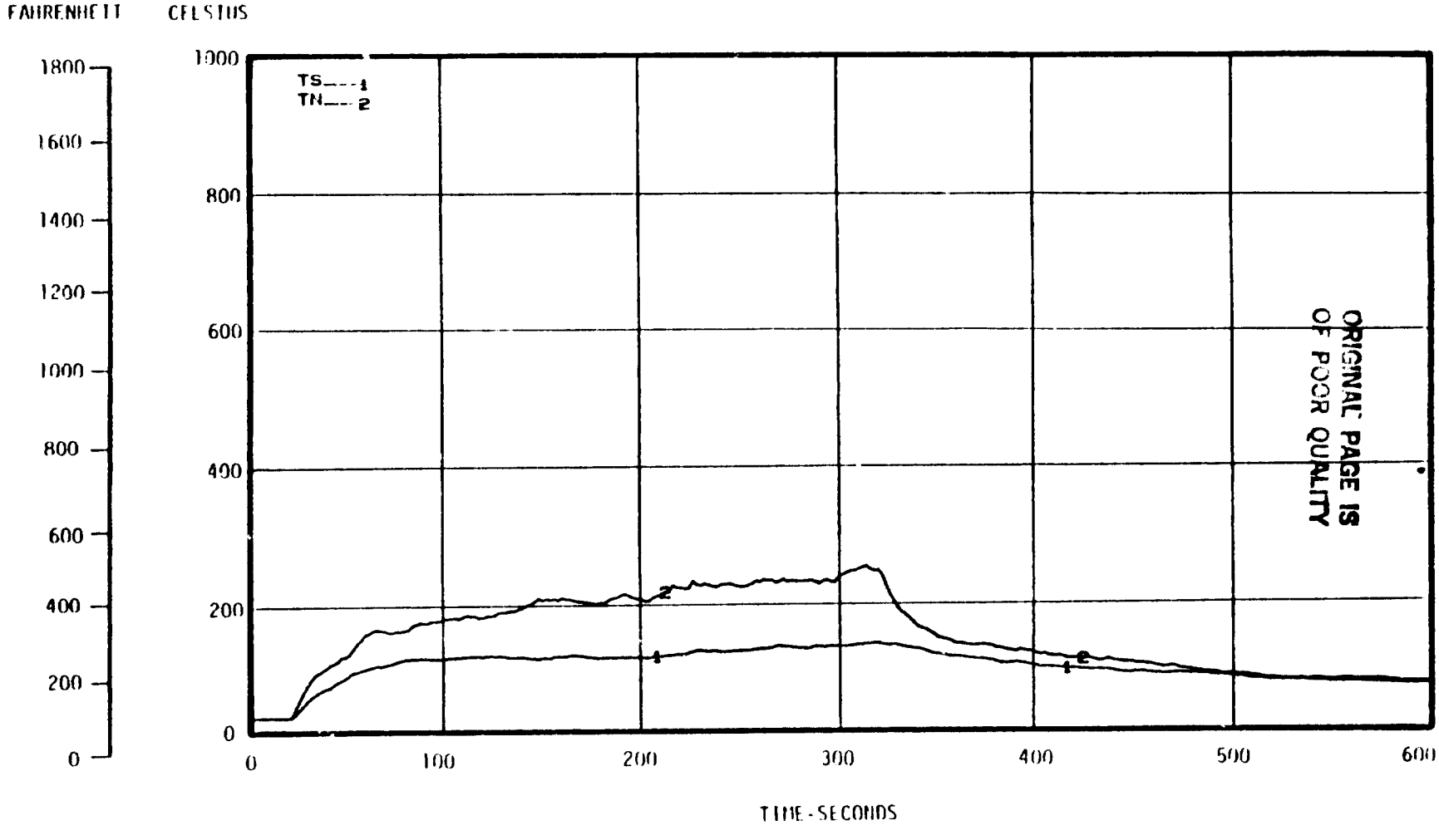


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09.02

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10

CUSHION CONSTRUCTION NUMBER 4.0

CEILING TEMPERATURE

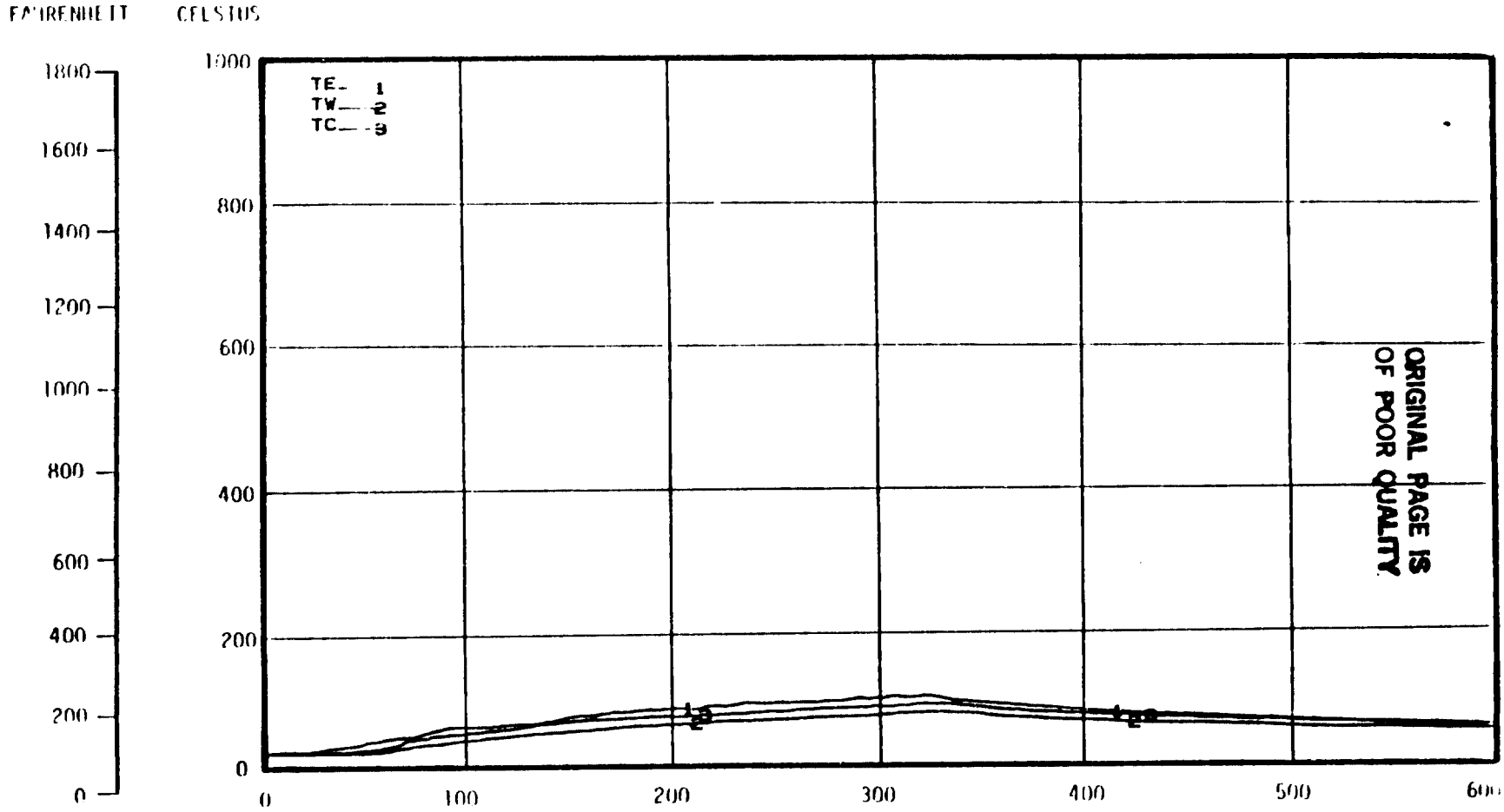


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09:02

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10

CUSHION CONSTRUCTION NUMBER 4.0

CEILING TEMPERATURE

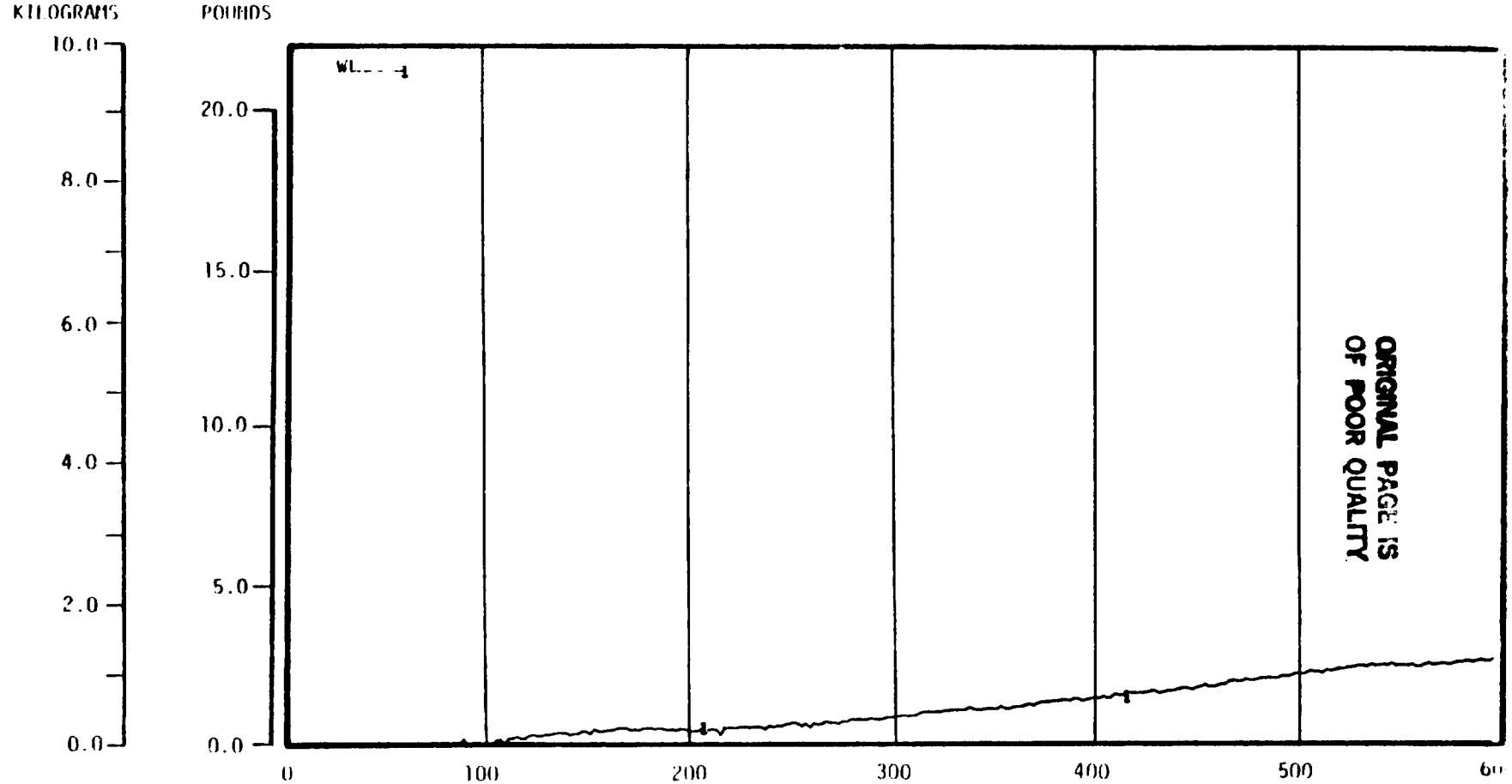


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09.02

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10

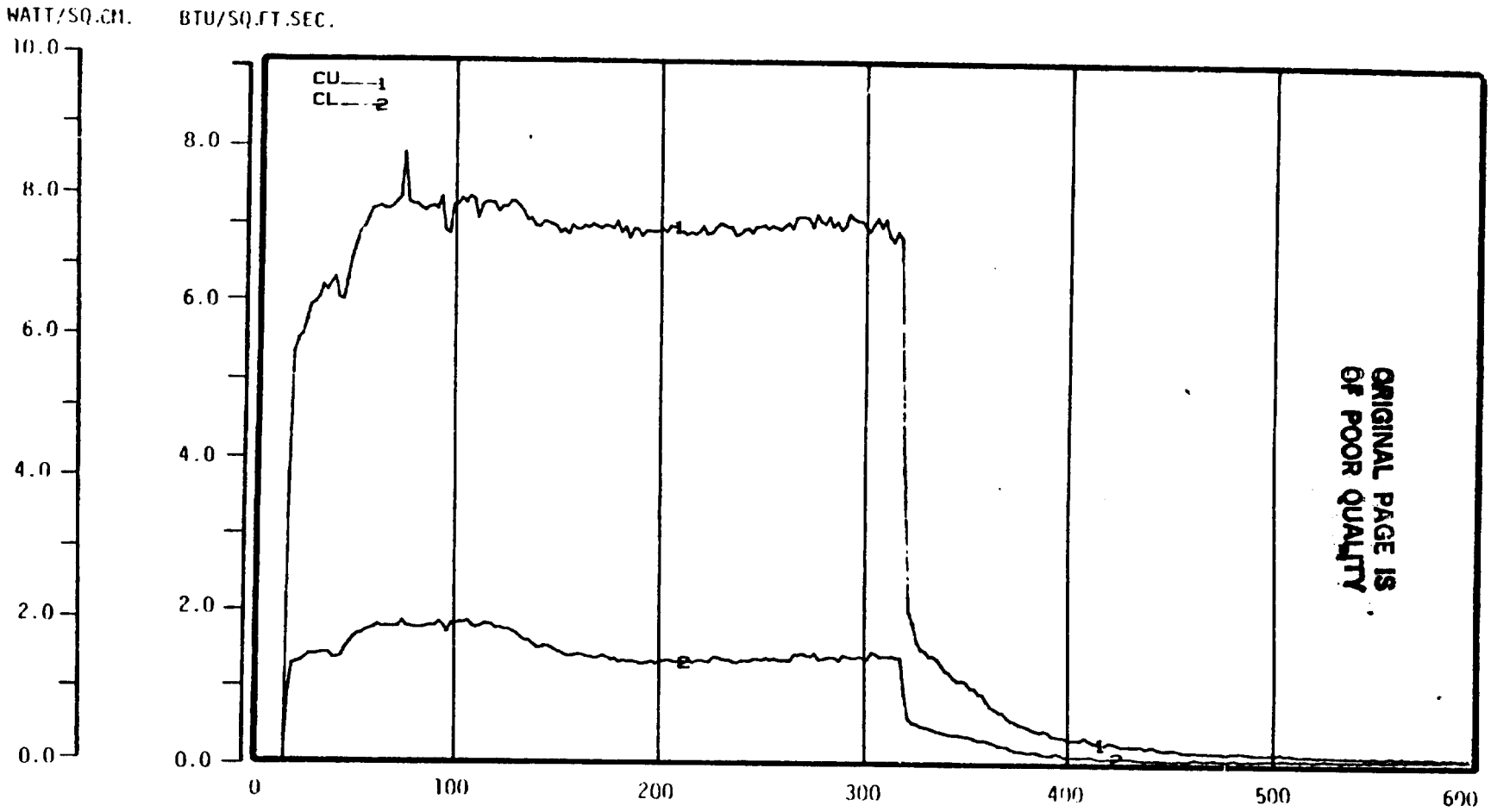
CUSHION CONSTRUCTION NUMBER 4.0

WEIGHT LOSS



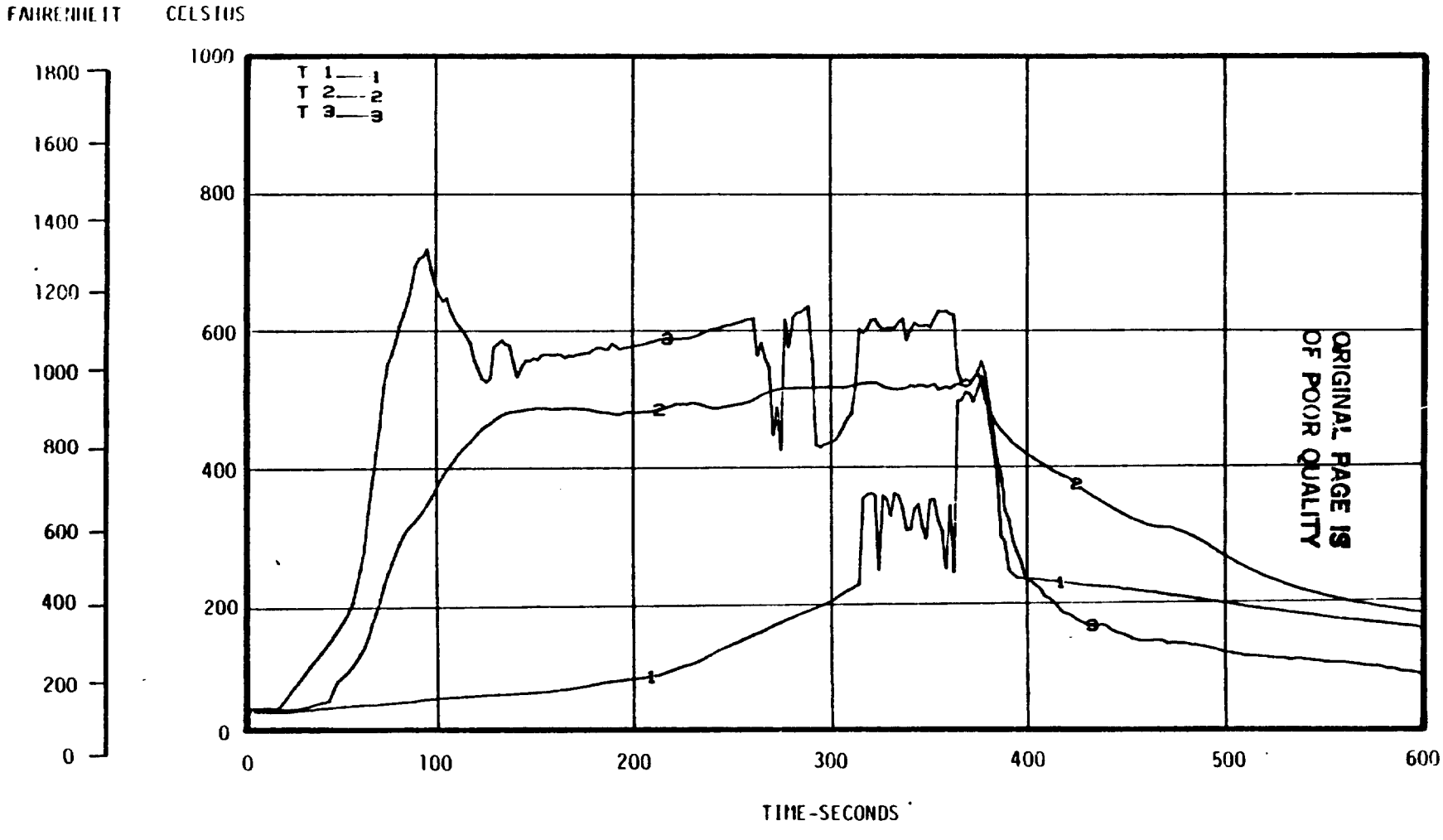
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/12/82 09.02
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10
CUSHION CONSTRUCTION NUMBER 4.0

HEAT FLUX



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.12
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7
CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES

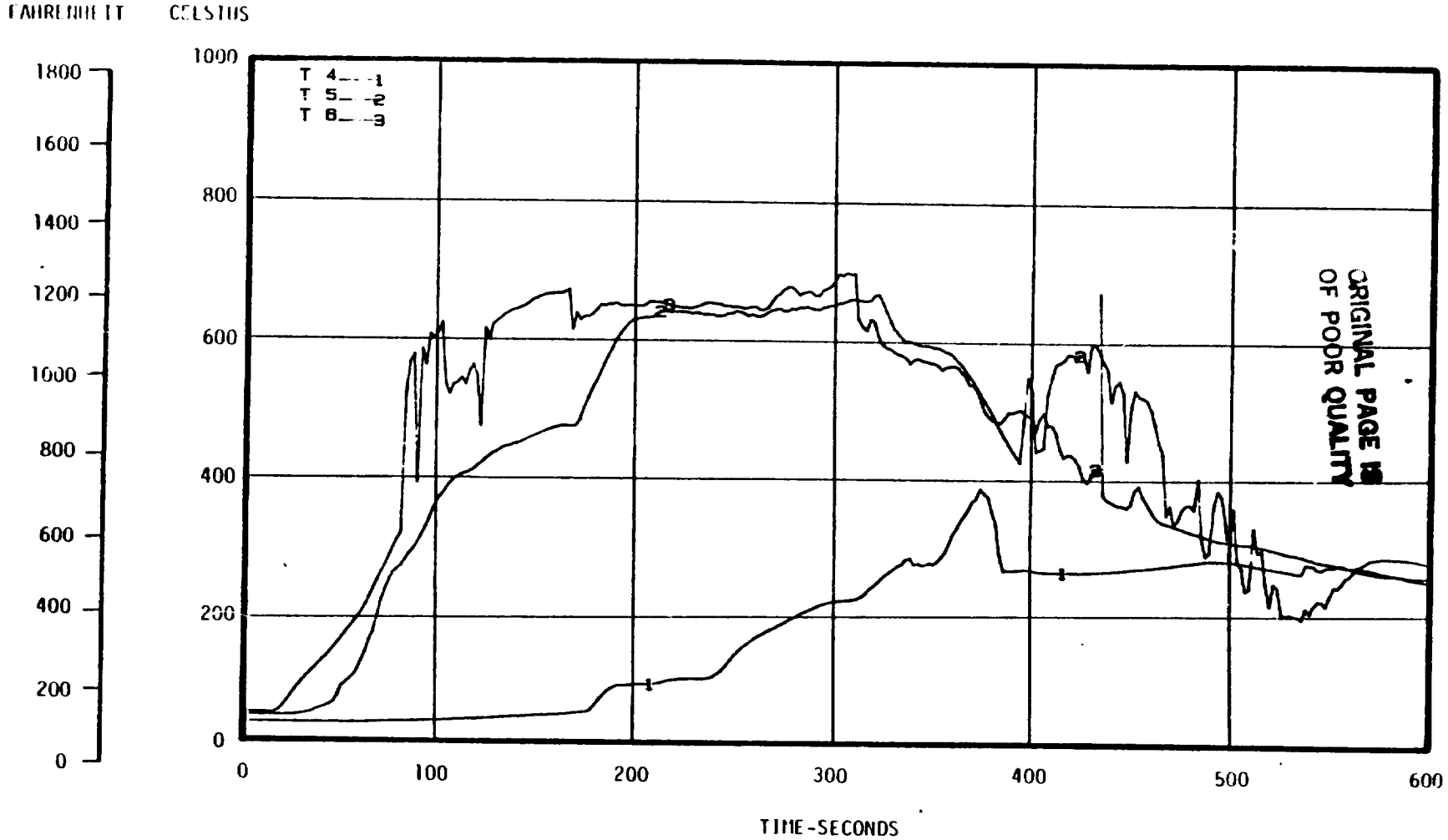


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 05/10/82 13.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7

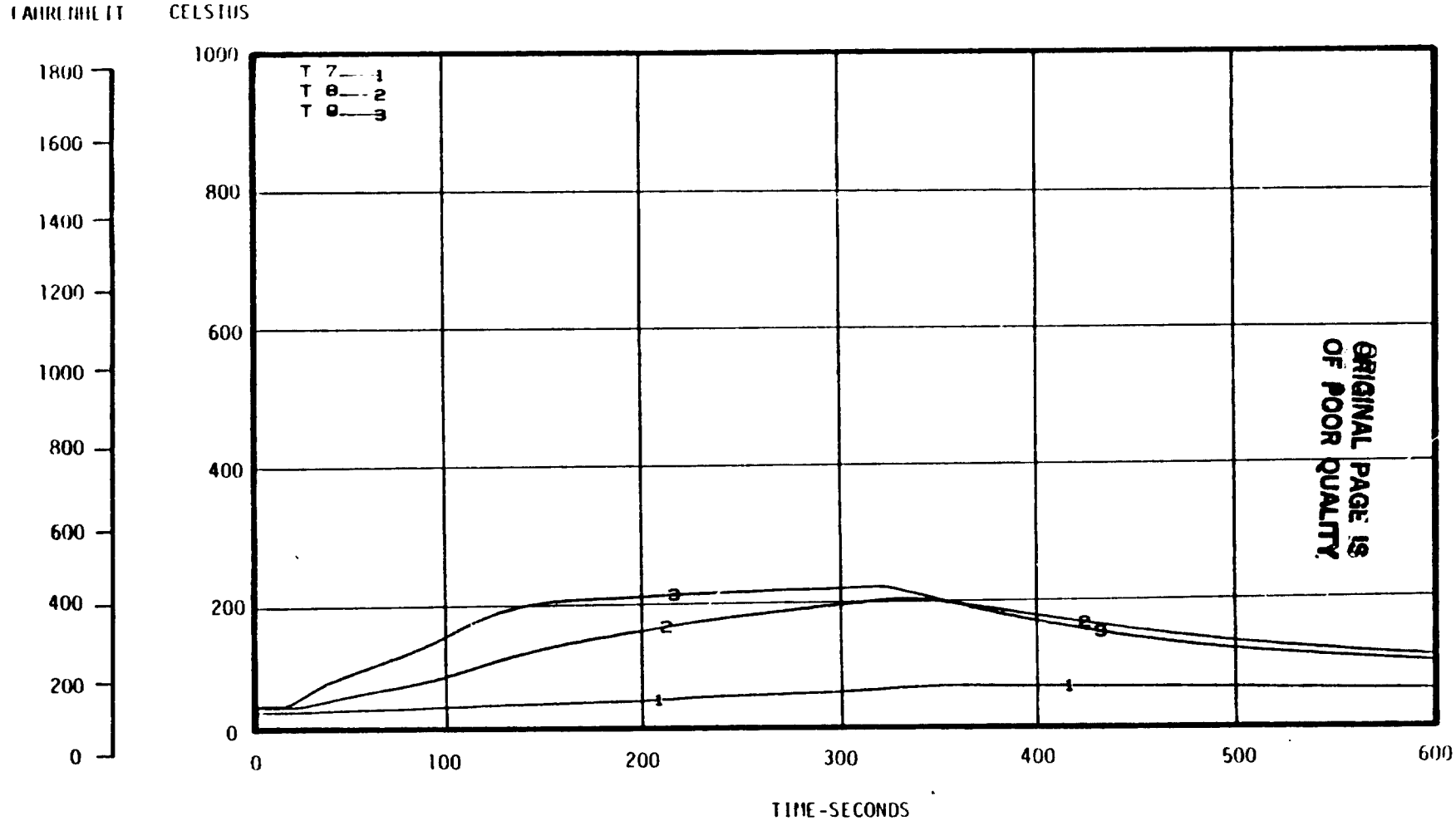
CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.12
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7
CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES

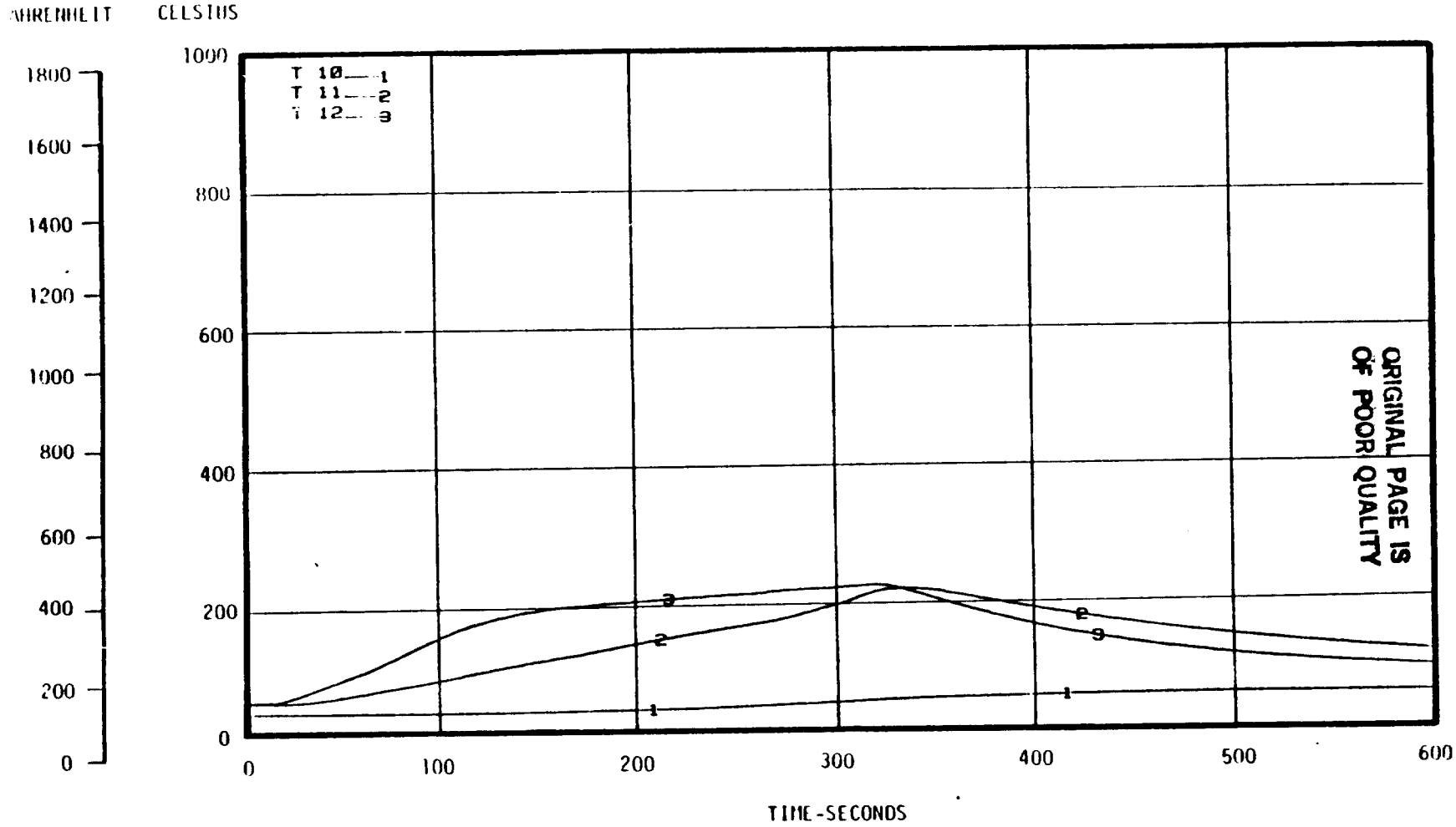


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7

CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES

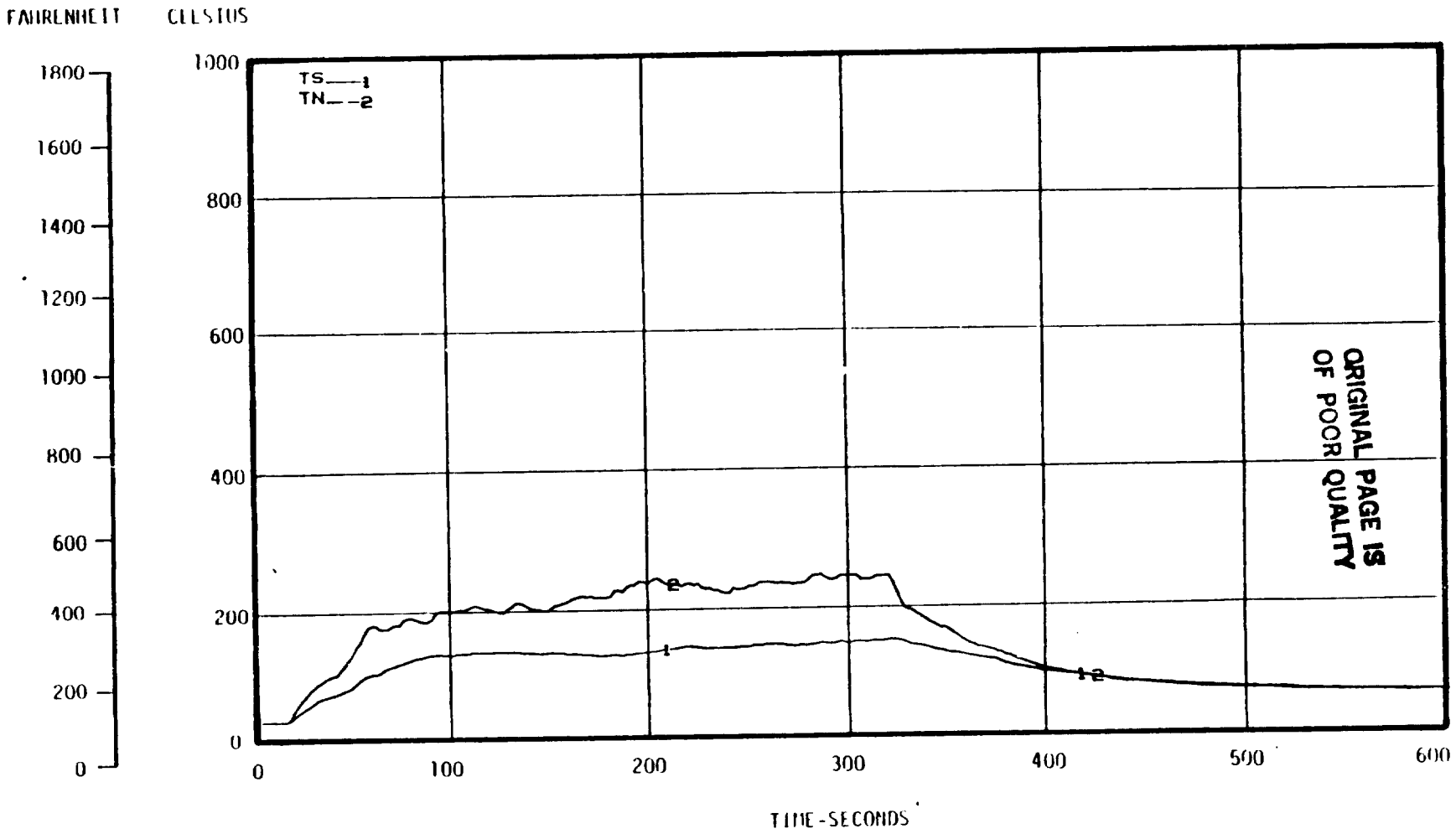


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7

CUSHION CONSTRUCTION NUMBER 5.0

CEILING TEMPERATURE

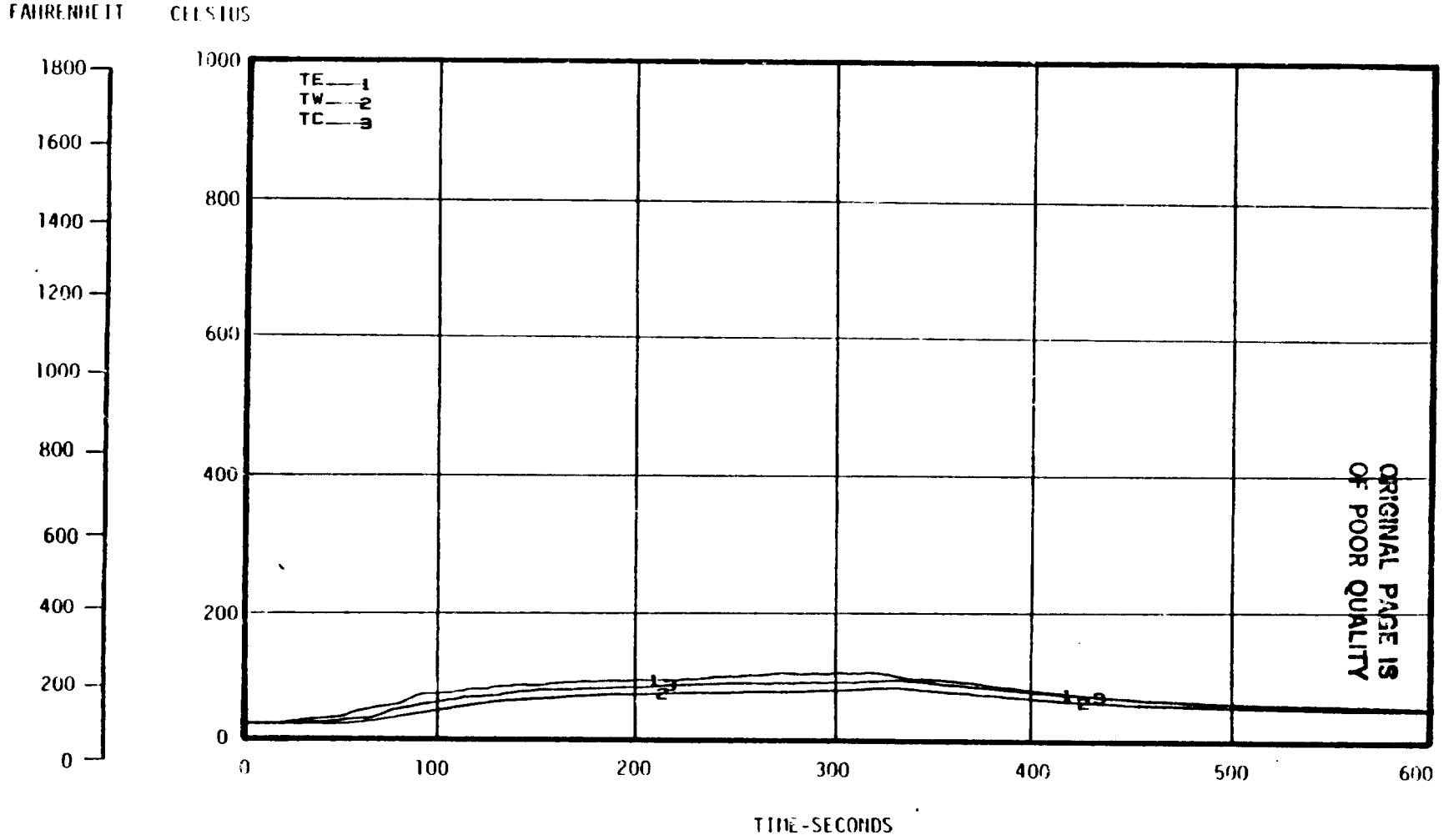


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7

CUSHION CONSTRUCTION NUMBER 5.0

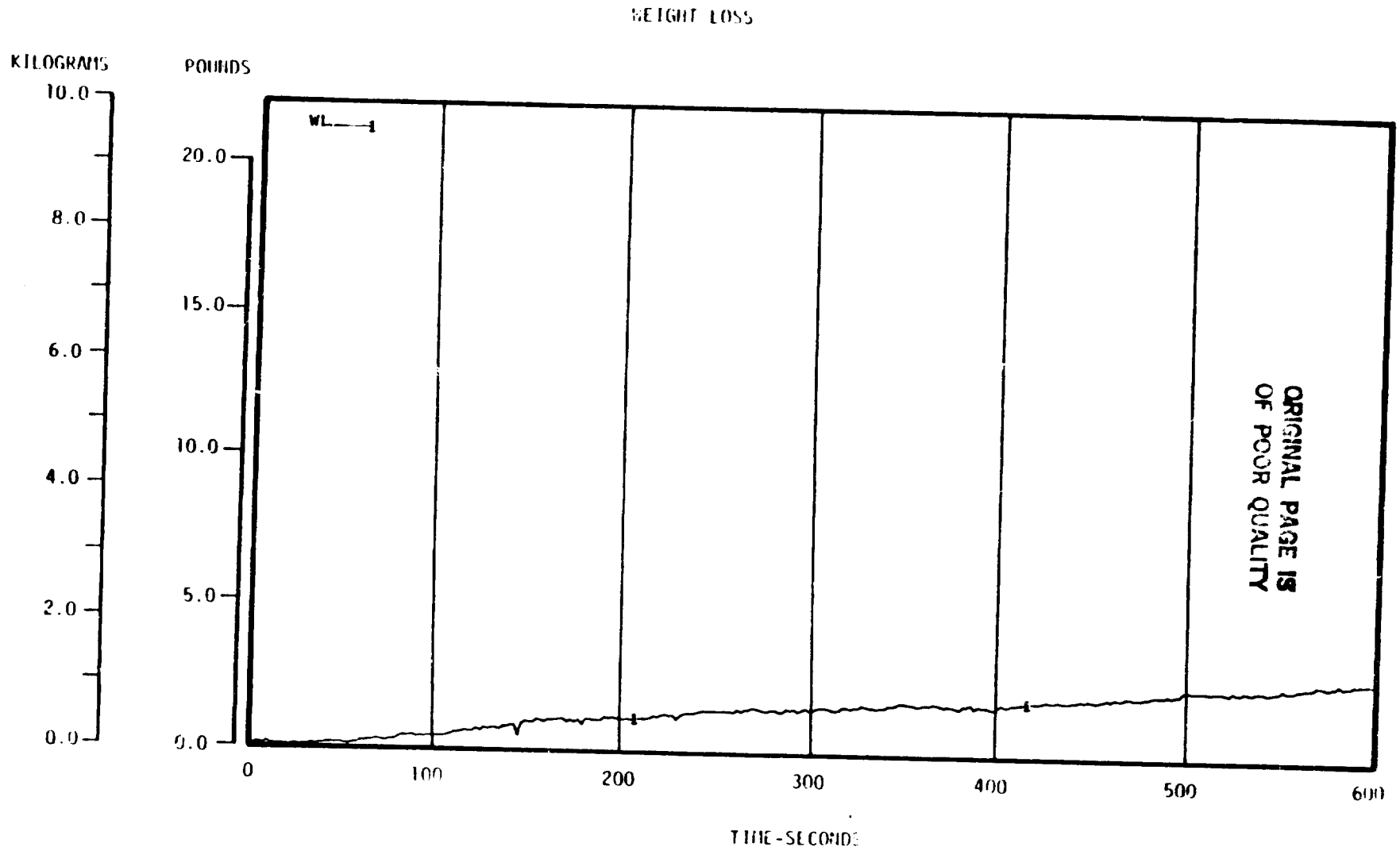
CEILING TEMPERATURE



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.12

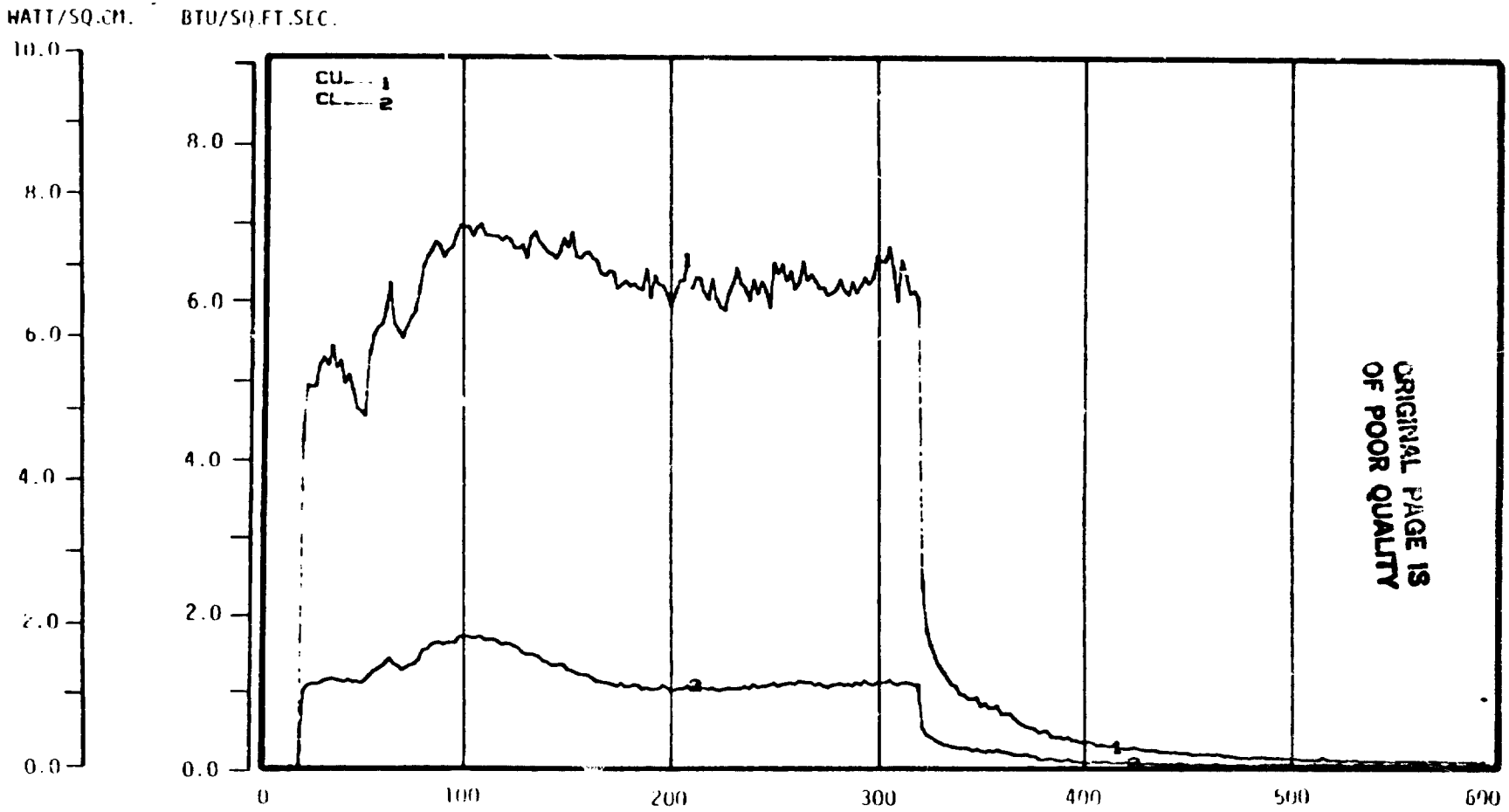
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7

CUSHION CONSTRUCTION NUMBER 5.0



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 09/10/82 13.12
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 7
CUSHION CONSTRUCTION NUMBER 5.0

HEAT FLUX

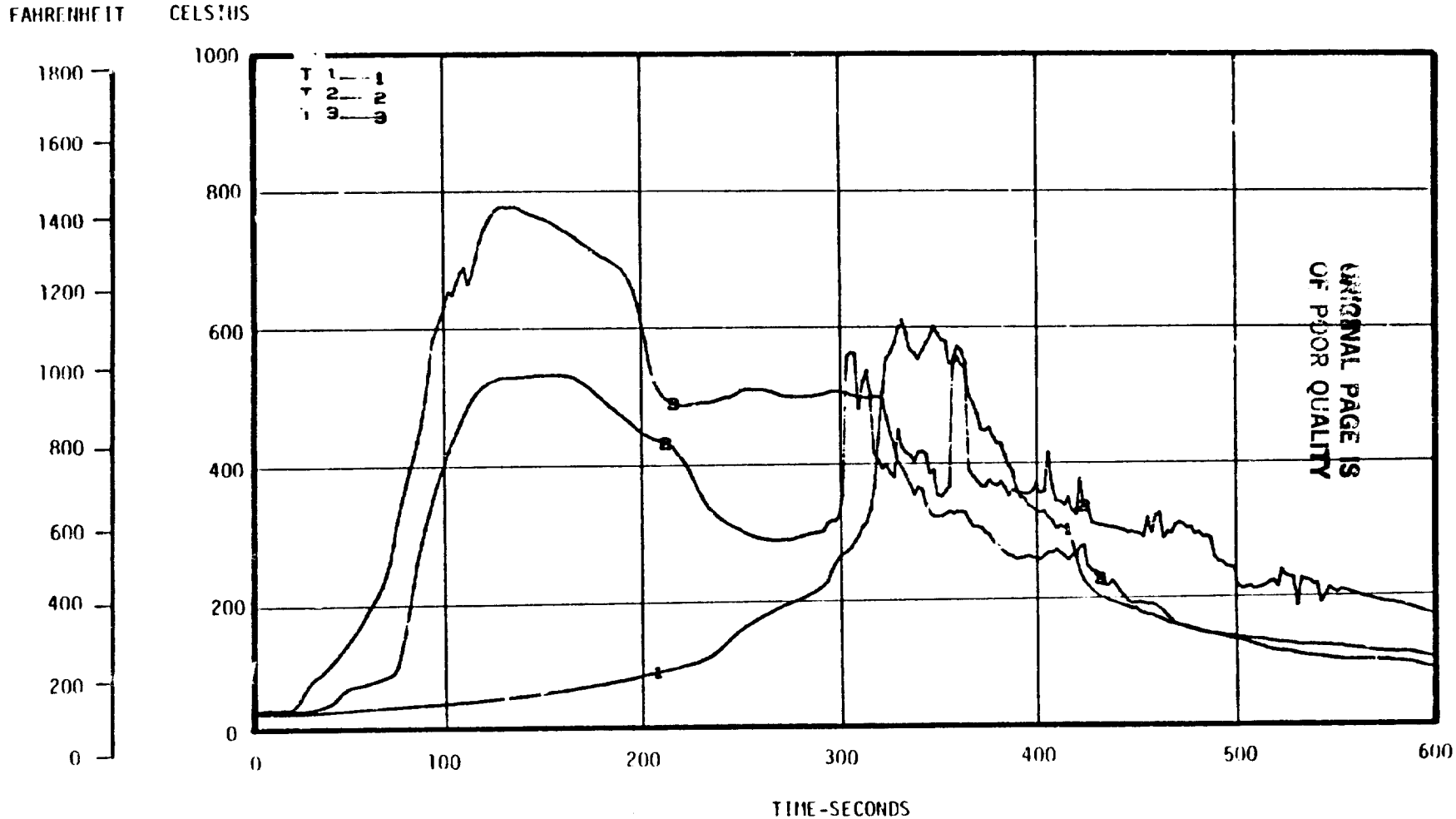


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 00: 12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 13

CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES

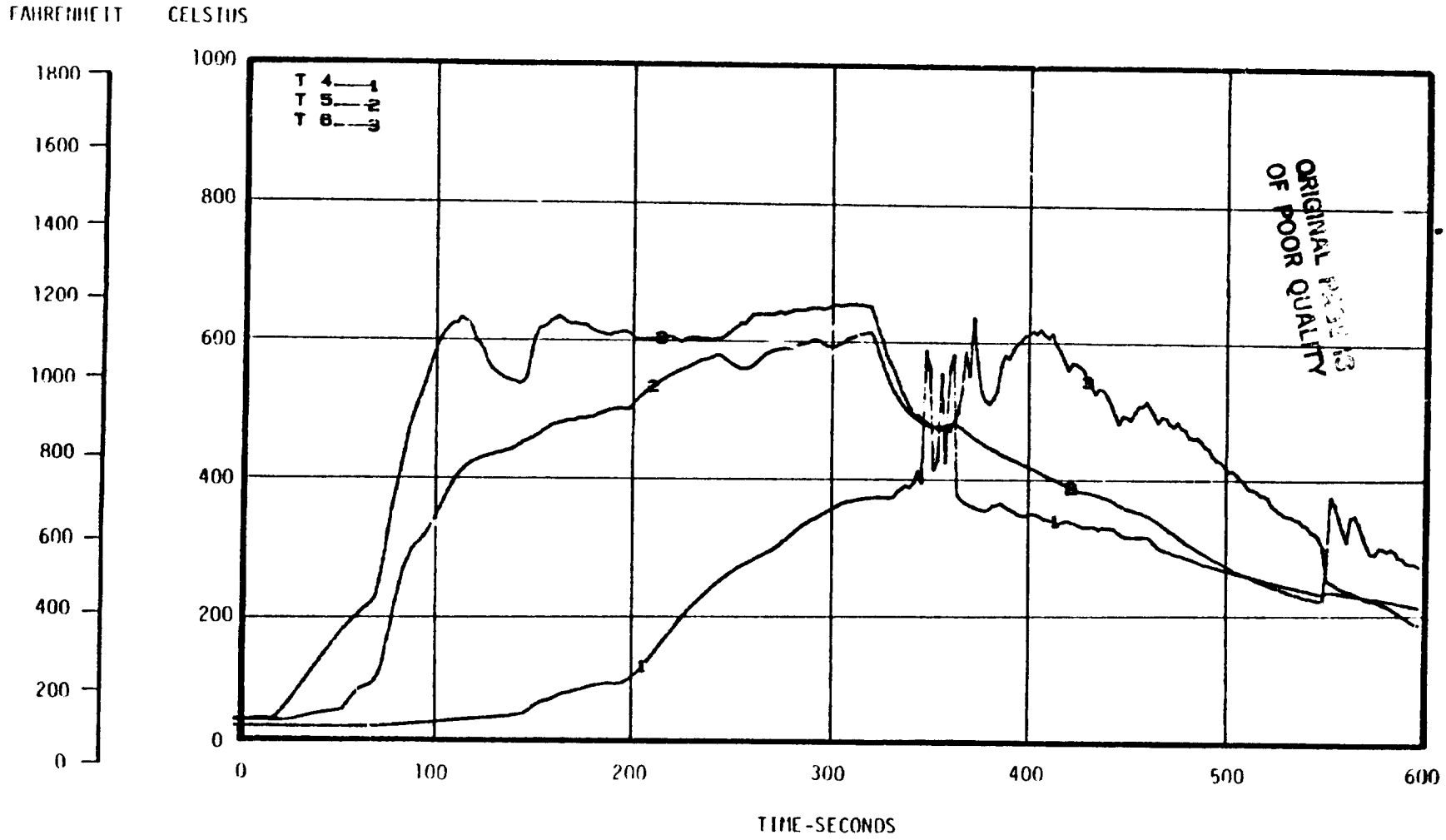


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 09.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 13

CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES

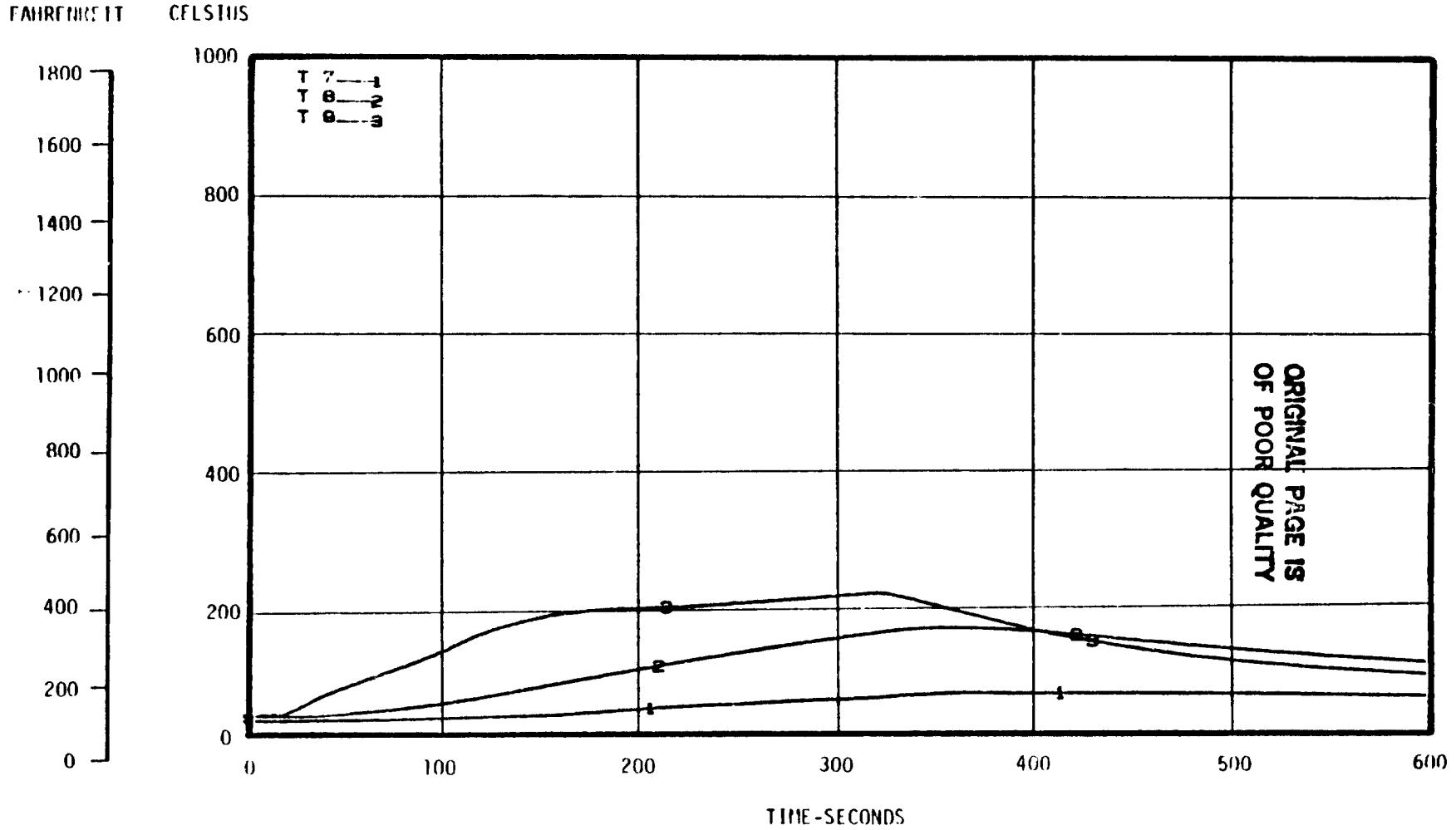


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 09.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 13

CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES

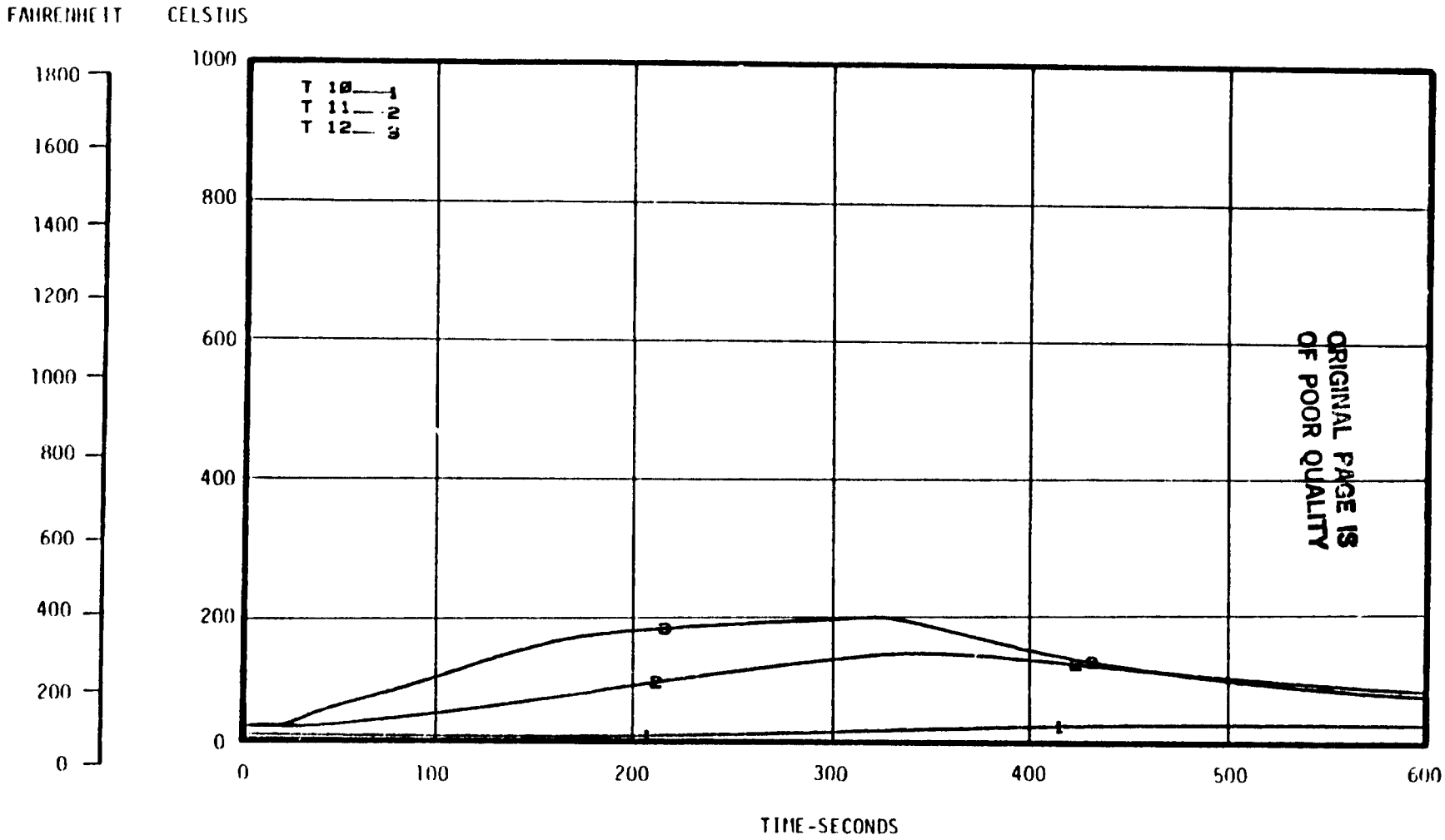


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 06.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 13

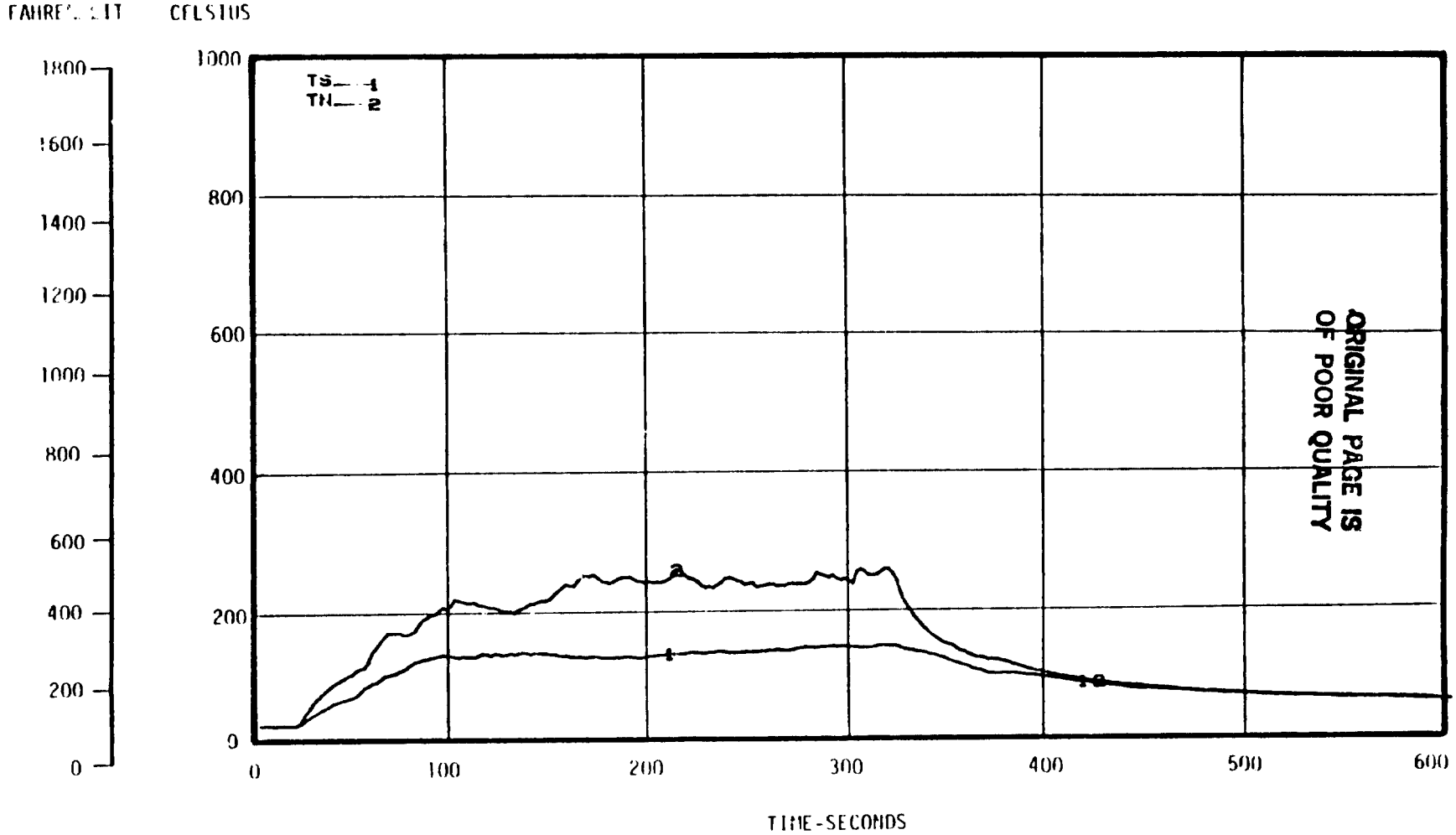
CUSHION CONSTRUCTION NUMBER 5.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 03/15/82 09.12
CUSHION CONSTRUCTION NUMBER 13
5.0

CEILING TEMPERATURE

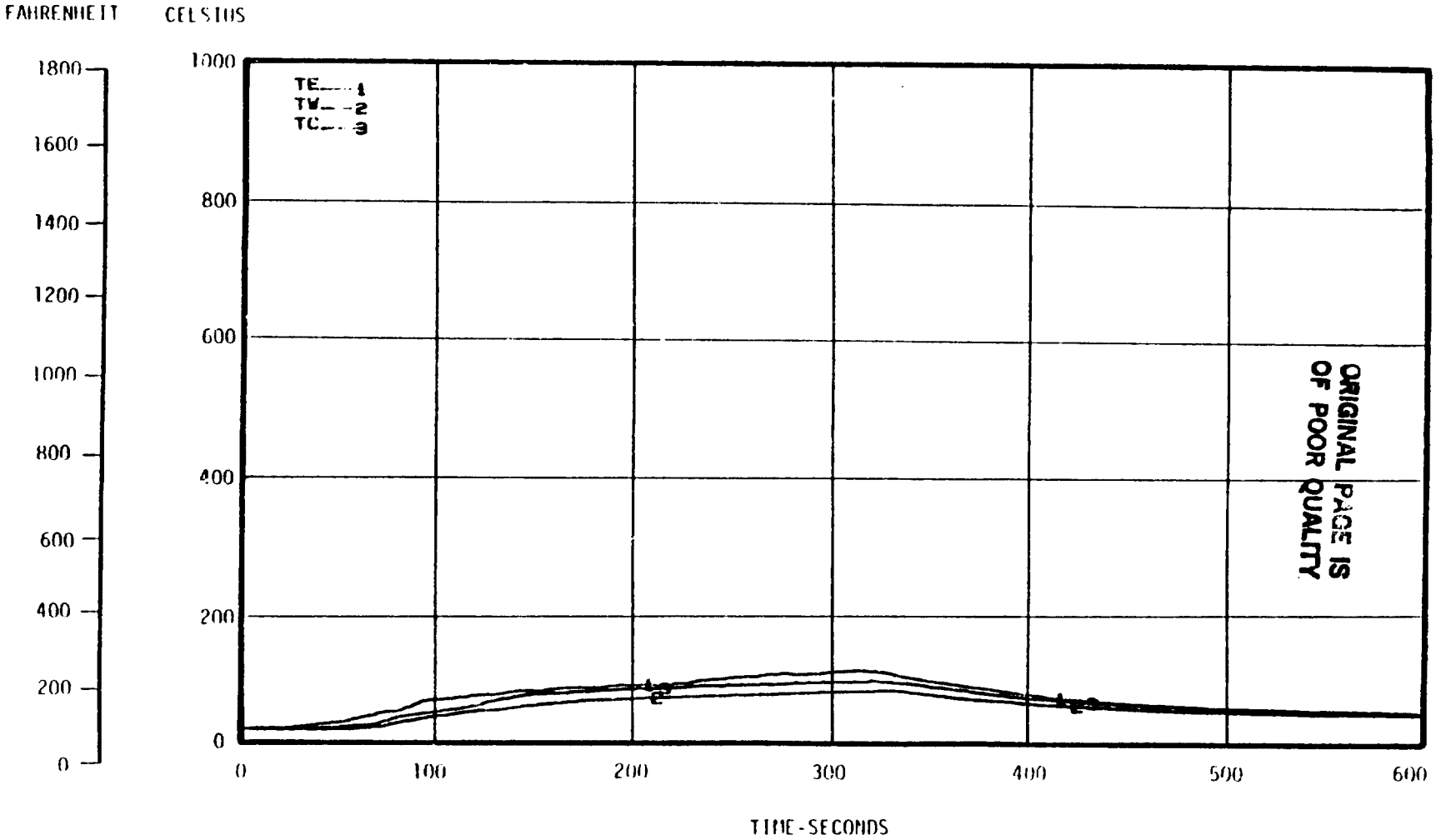


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 09:12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 13

CUSHION CONSTRUCTION NUMBER 5.0

CEILING TEMPERATURE

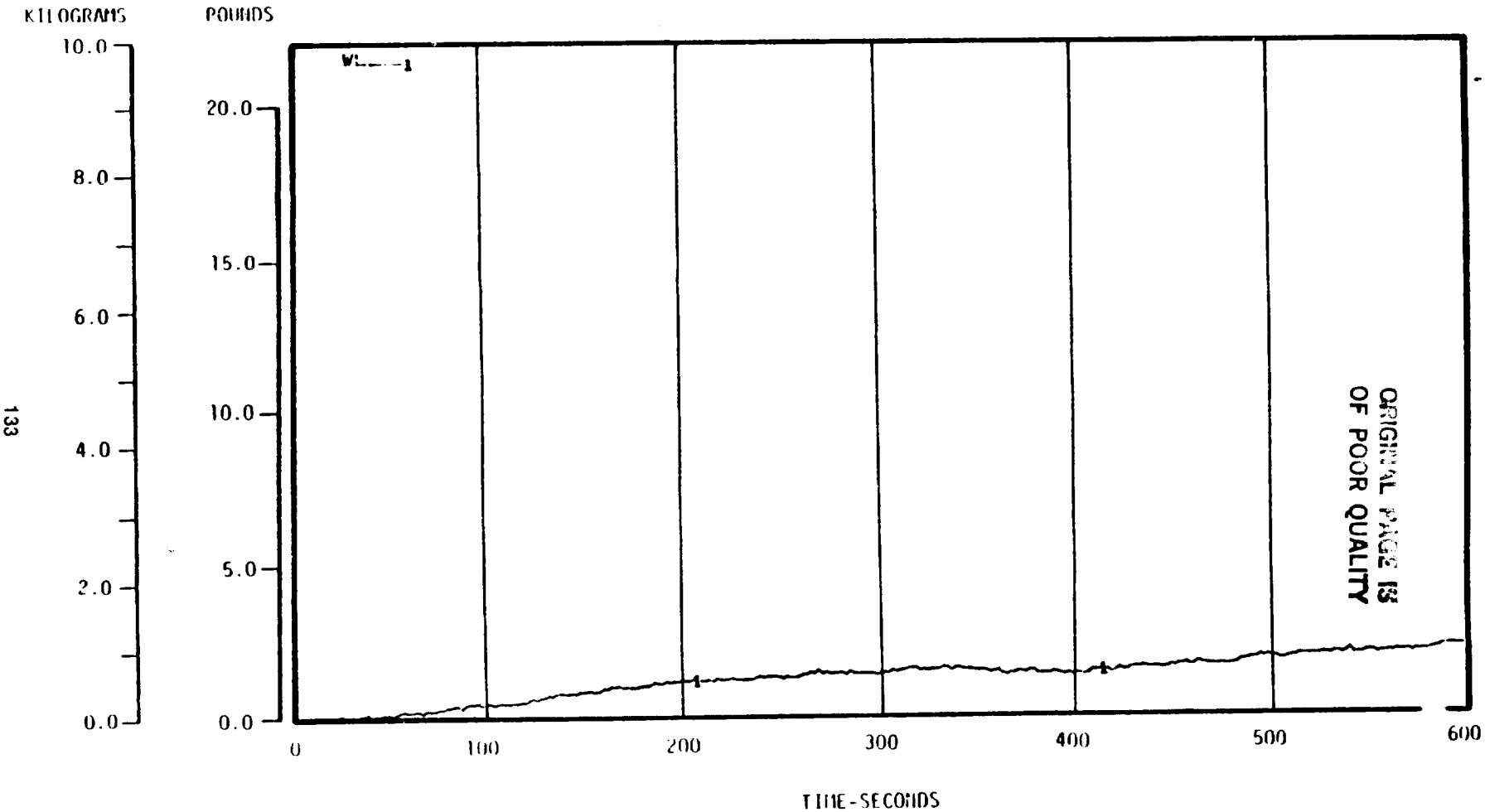


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 08.12

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 12

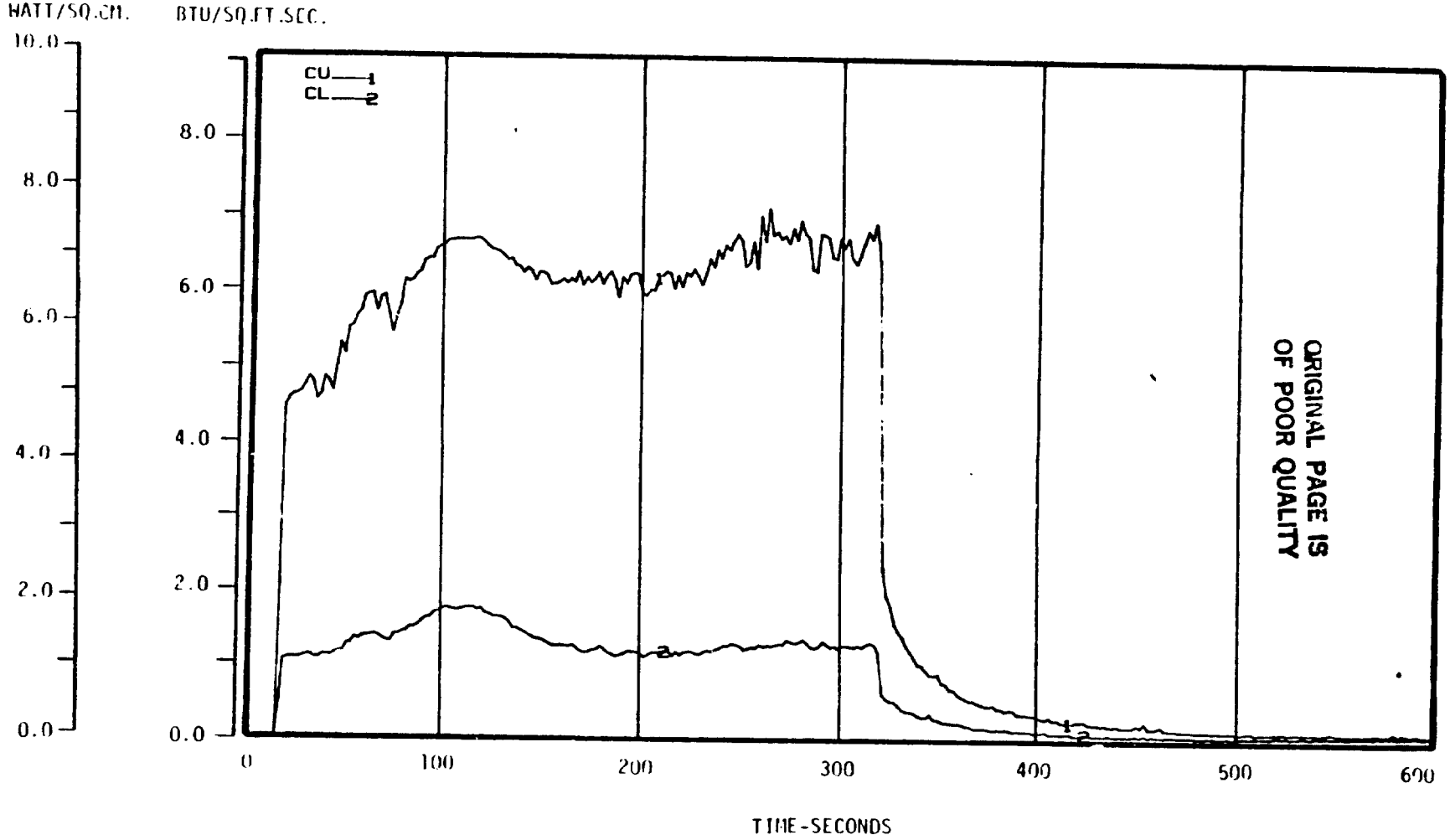
CUSHION CONSTRUCTION NUMBER 5.0

WEIGHT LOSS



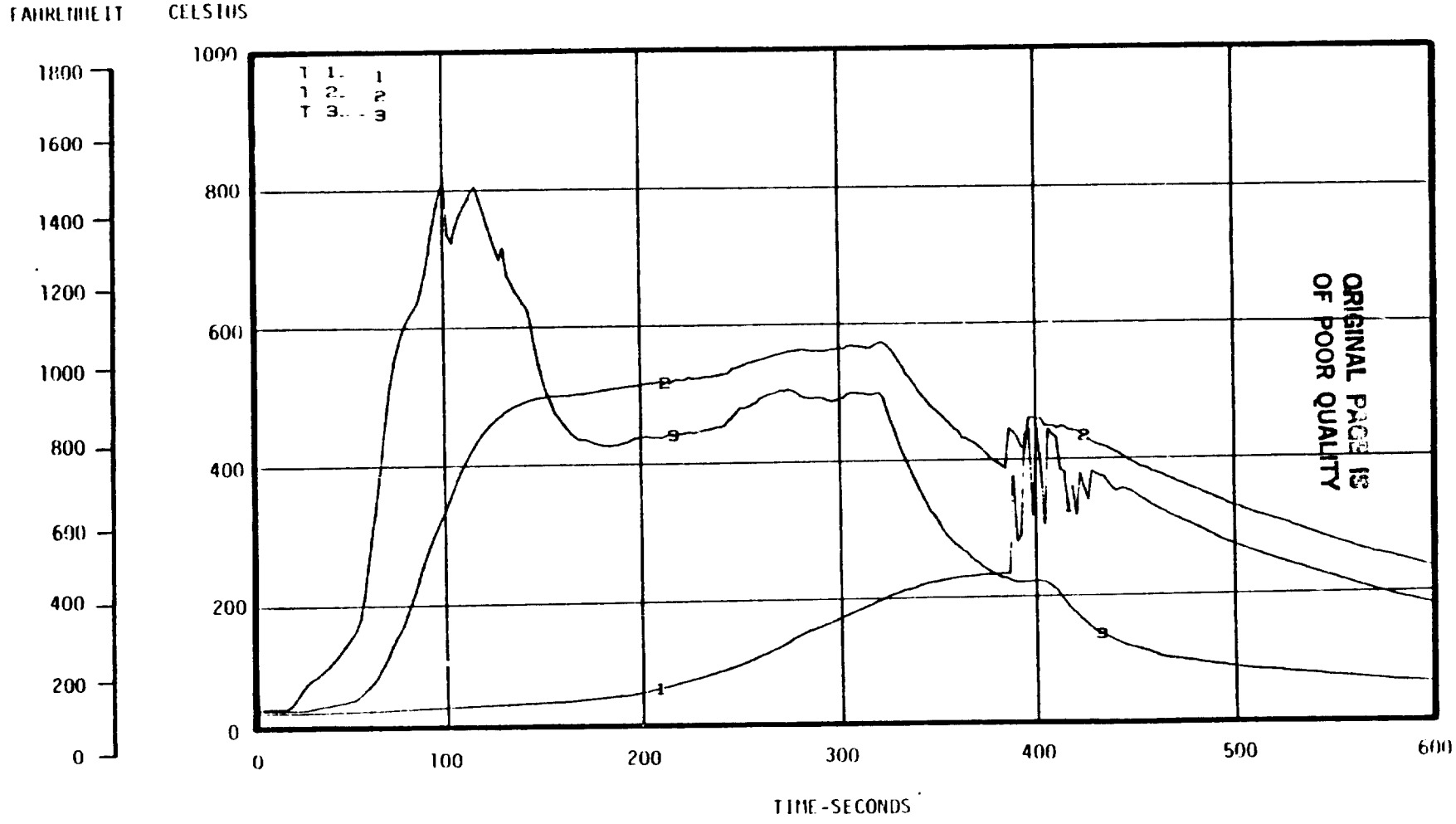
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 08:12
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 13
CUSHION CONSTRUCTION NUMBER 5.0

HEAT FLUX



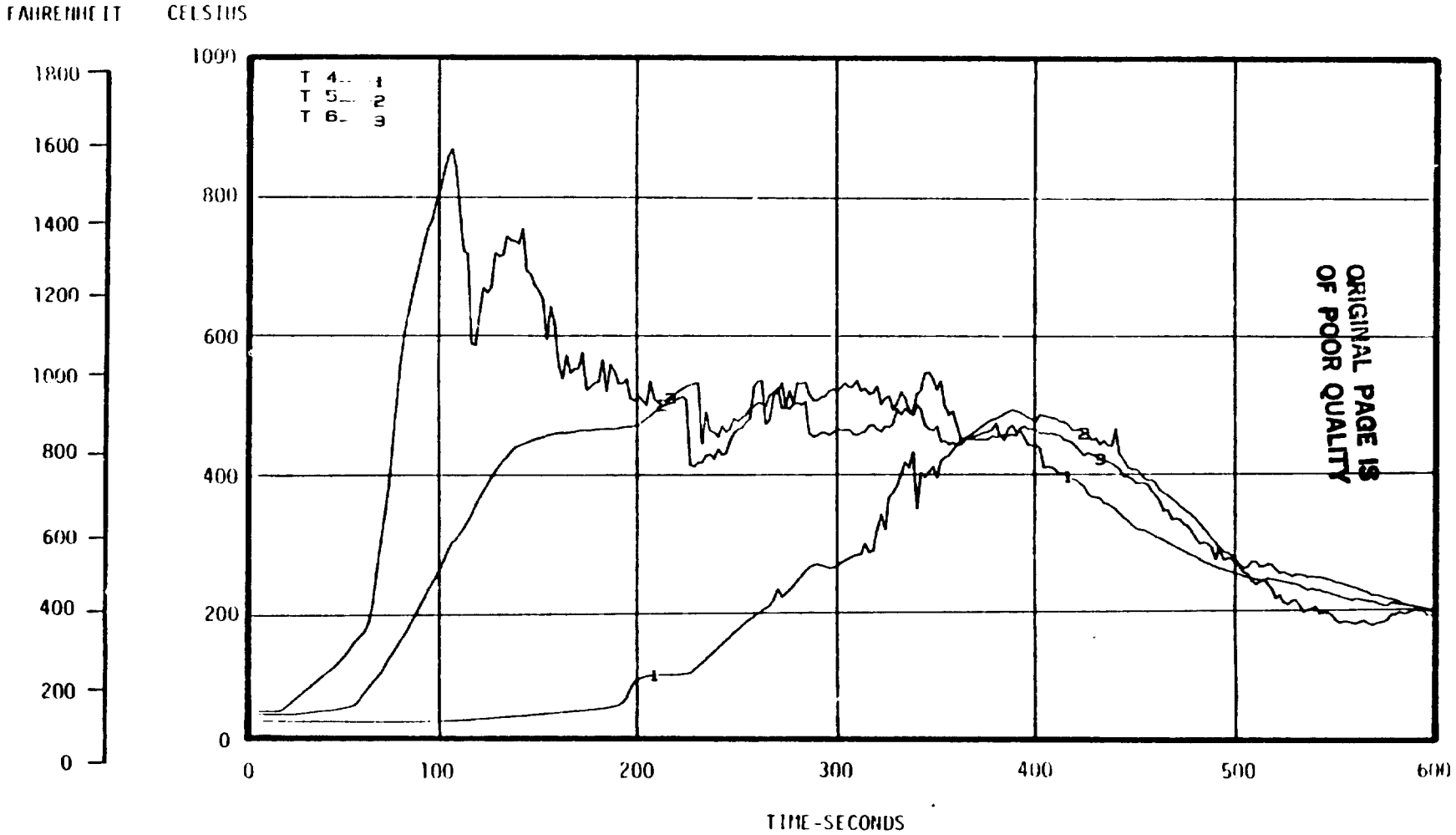
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/08/82 14:28
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 5
CUSHION CONSTRUCTION NUMBER 6.0

SEAT CUSHION TEMPERATURES



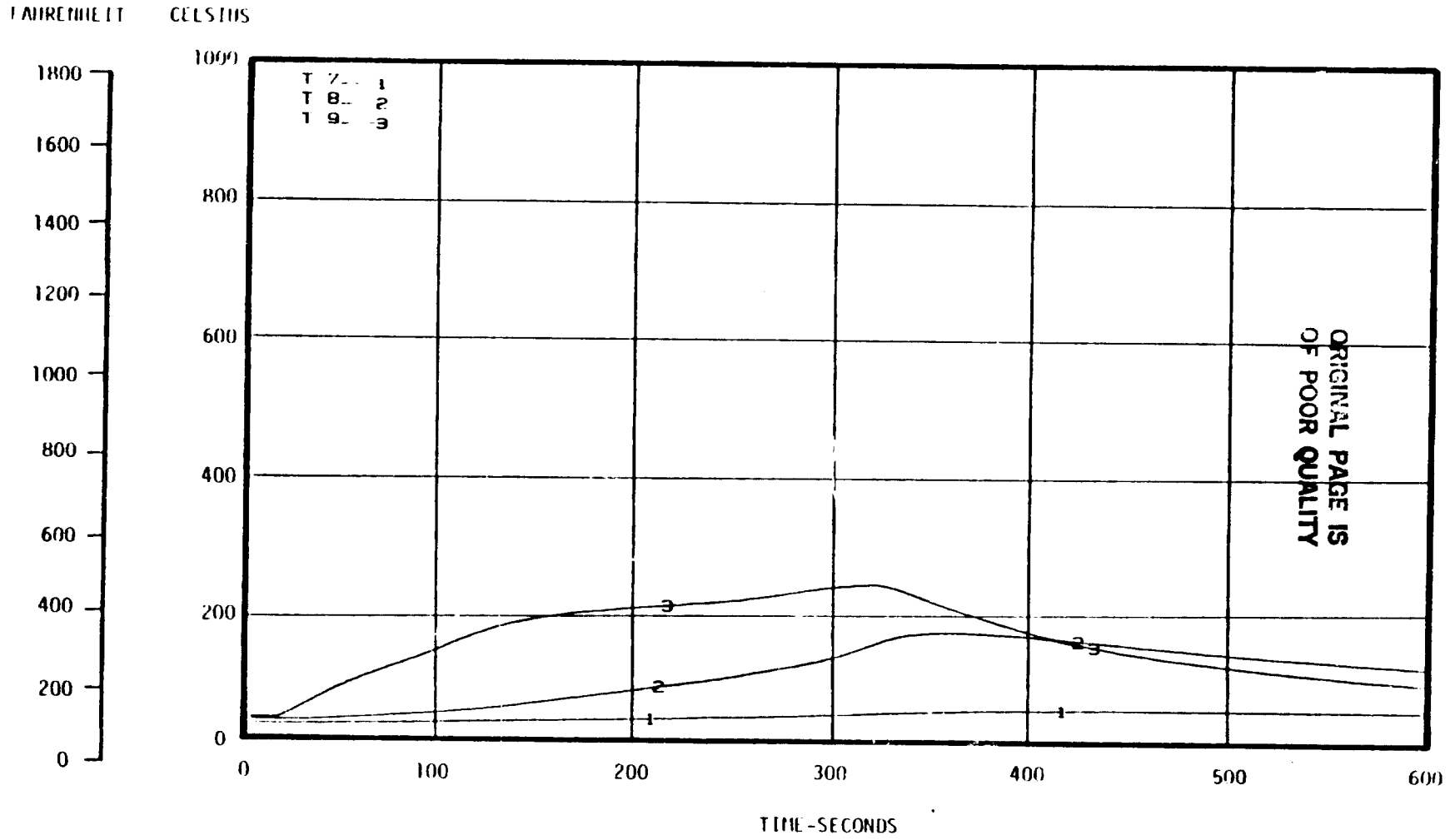
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 14:28
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 5
CUSHION CONSTRUCTION NUMBER 6.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 14:28
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 5
CUSHION CONSTRUCTION NUMBER 6.0

SEAT CUSHION TEMPERATURES

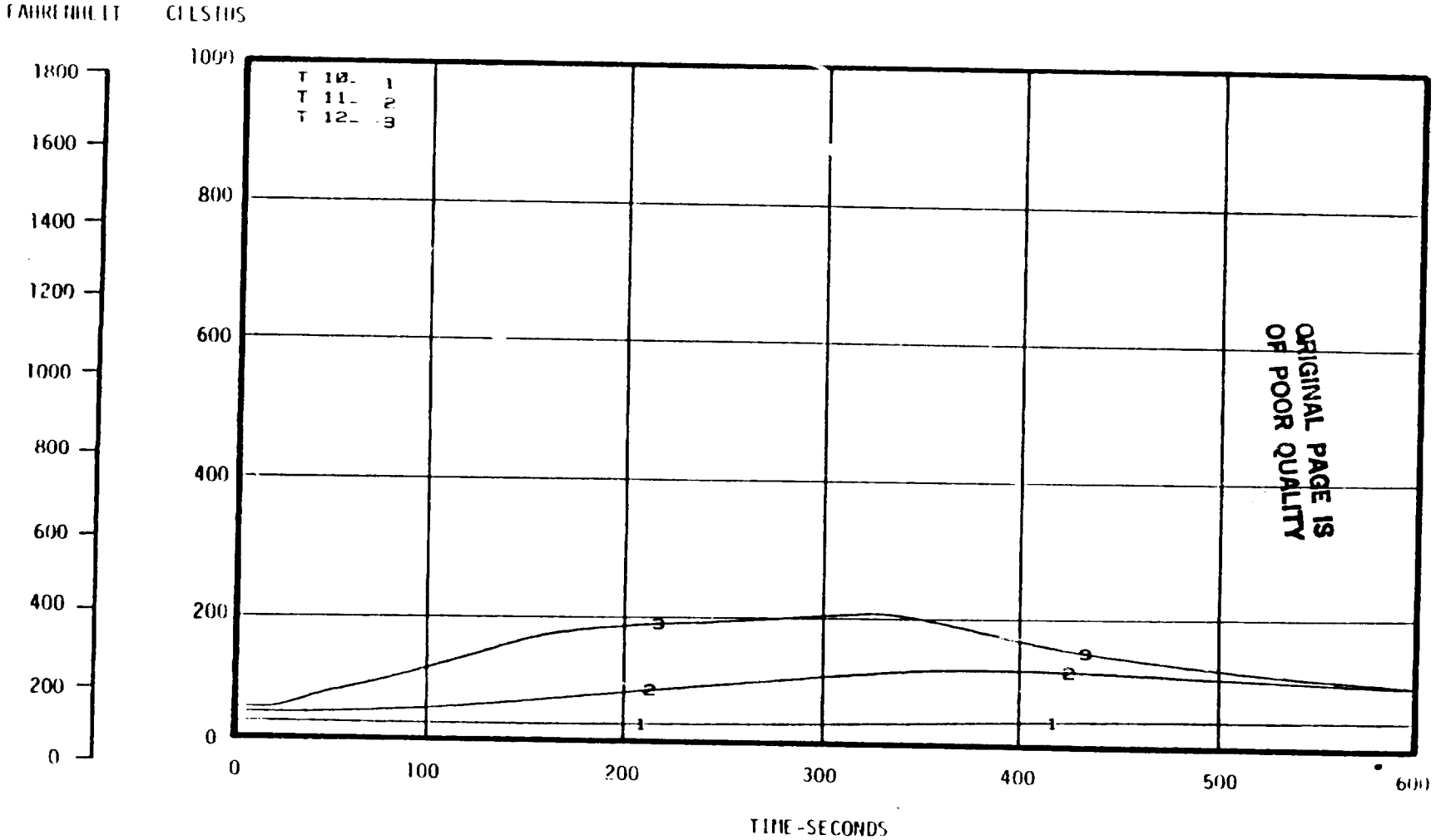


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 14:28

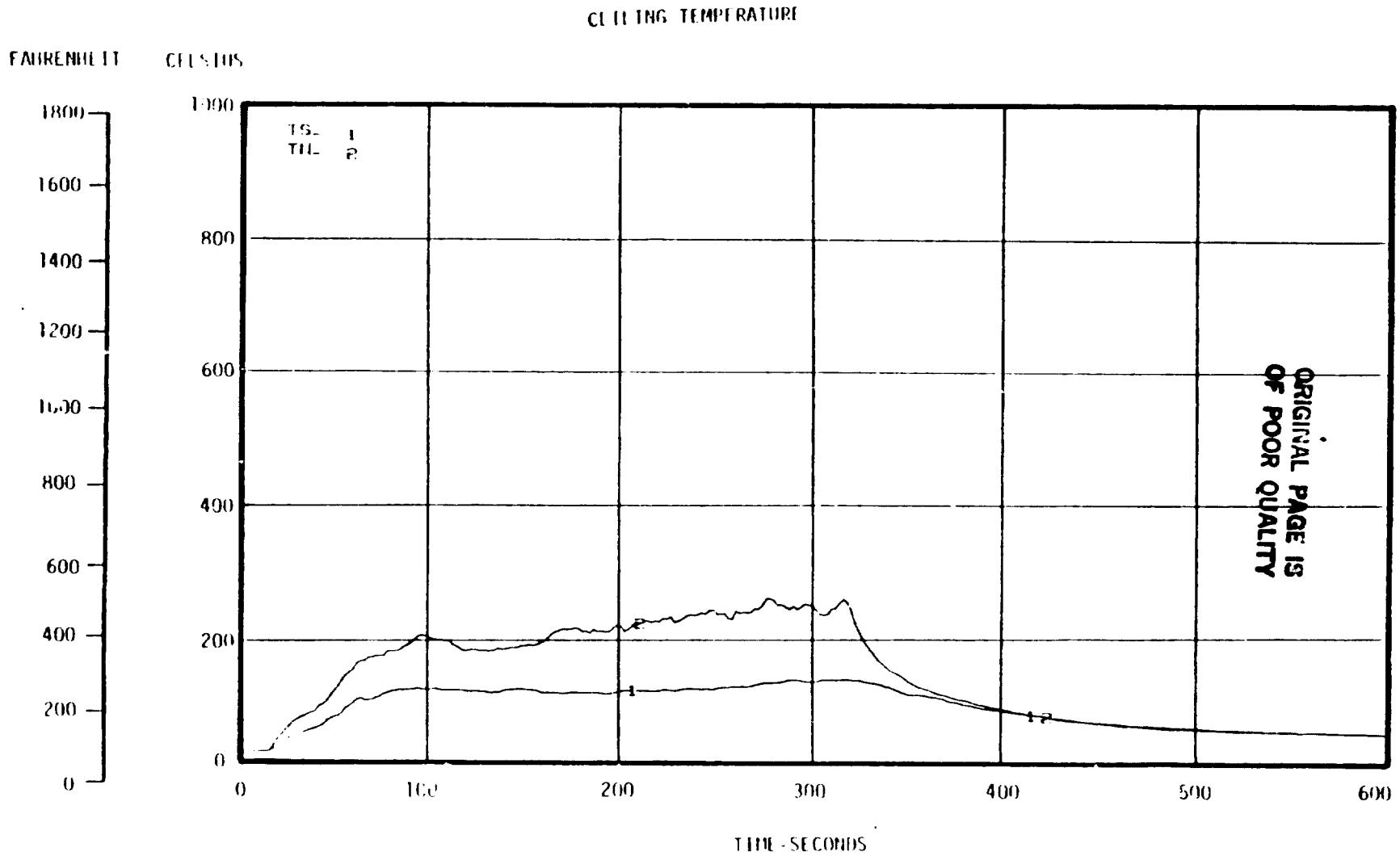
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 5

CUSHION CONSTRUCTION NUMBER 6.0

SEAT CUSHION TEMPERATURES

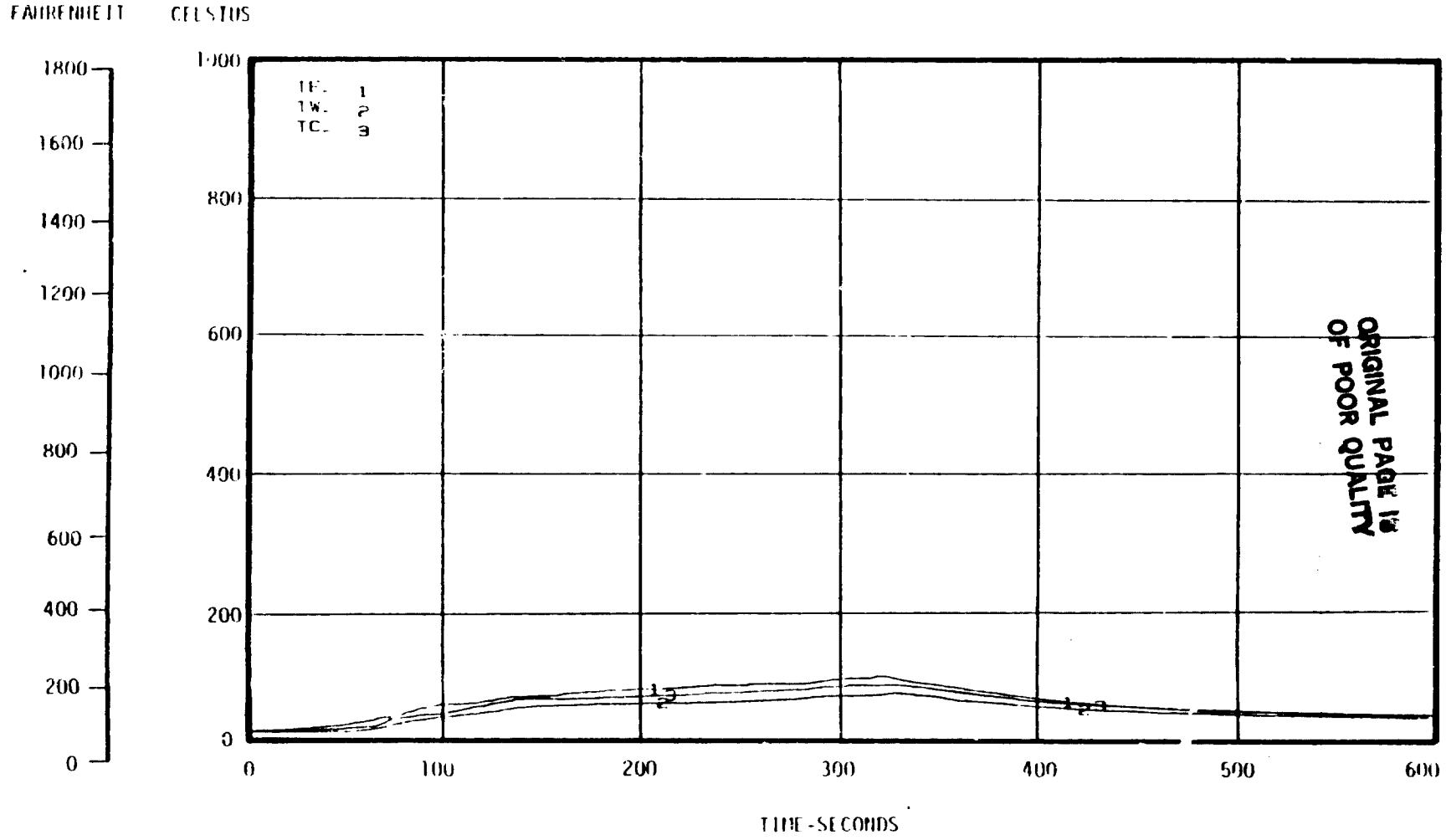


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 14:28
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 5
CUSHION CONSTRUCTION NUMBER 6.0



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 09/09/82 14:28
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 5
CUSHION CONSTRUCTION NUMBER 6.0

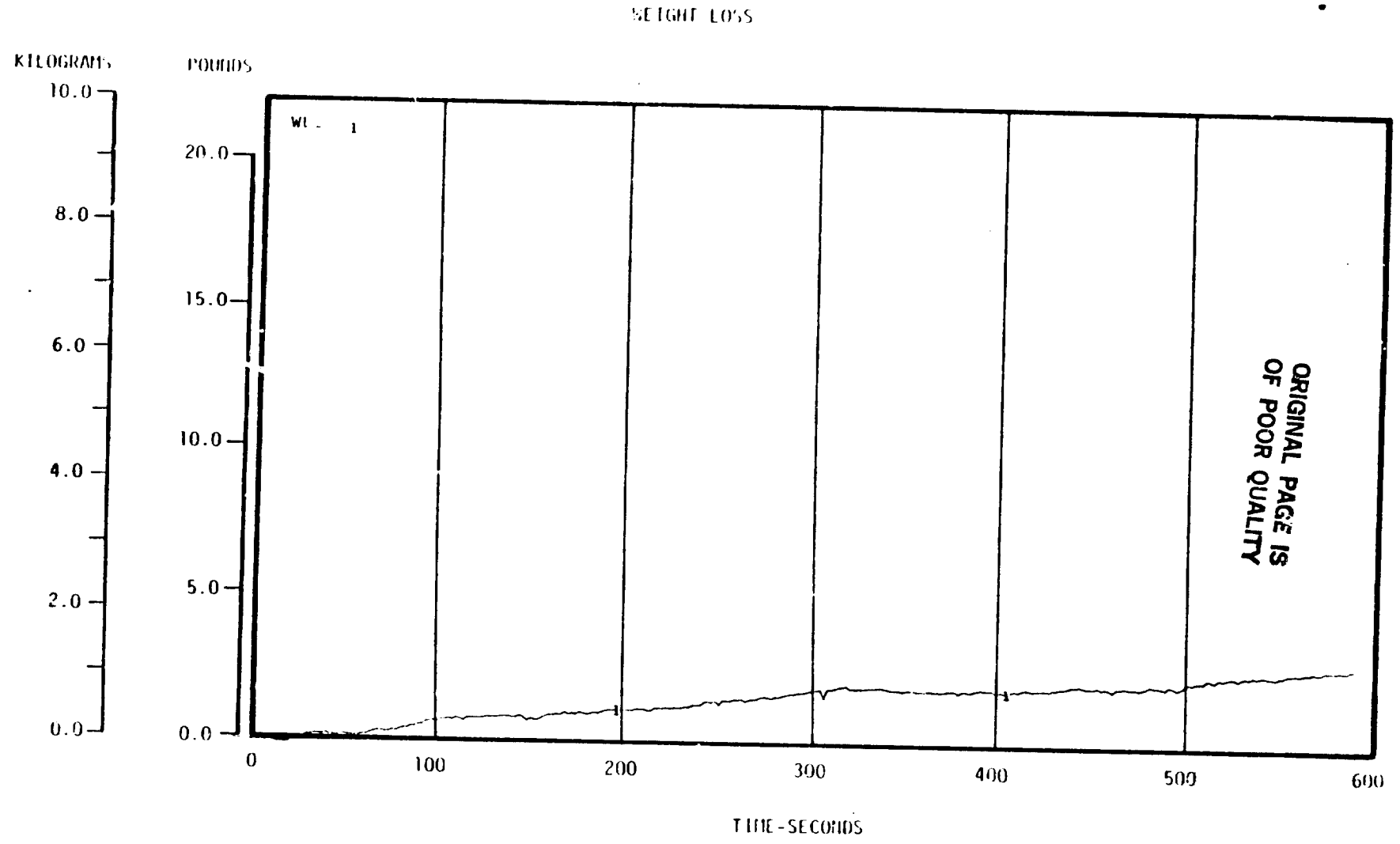
CEILING TEMPERATURE



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/09/82 14:28

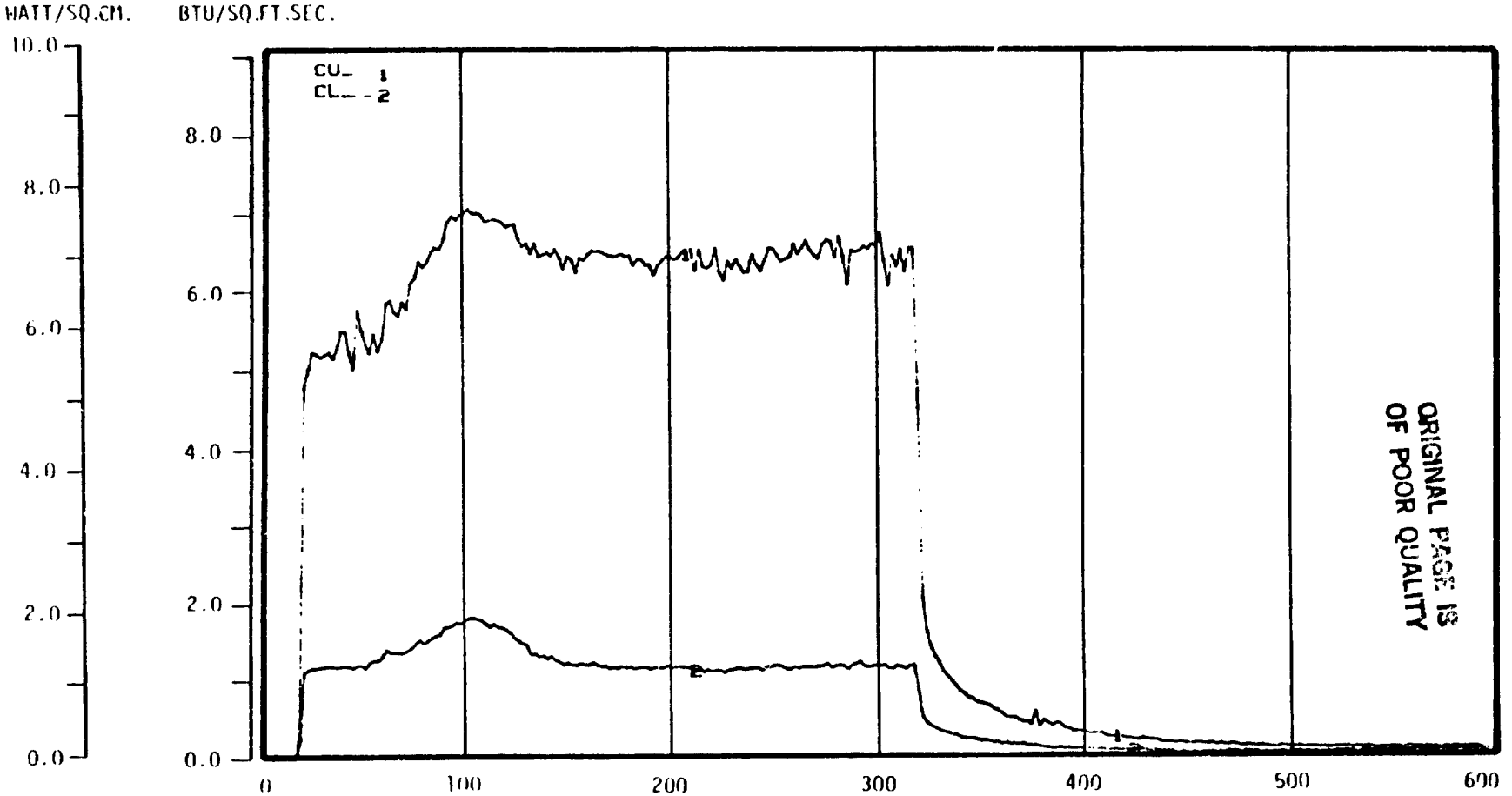
NASA-NIES FULL SCALE CUSHION BURN TEST NUMBER 5

CUSHION CONSTRUCTION NUMBER 6.0



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 09/09/82 14:28
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 5
CUSHION CONSTRUCTION NUMBER 6.0

HEAT FLUX

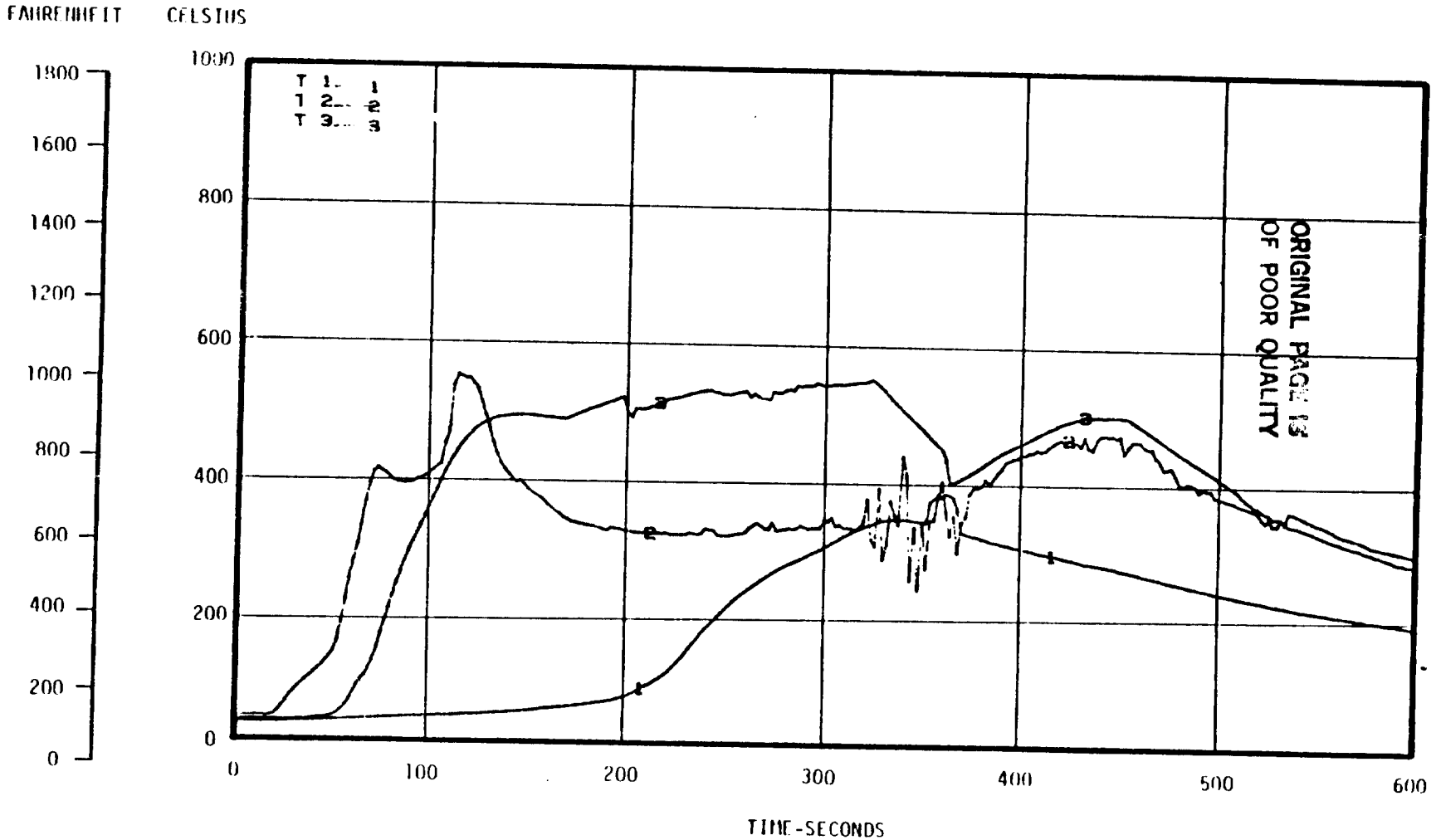


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 23/15/62 11.43

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14

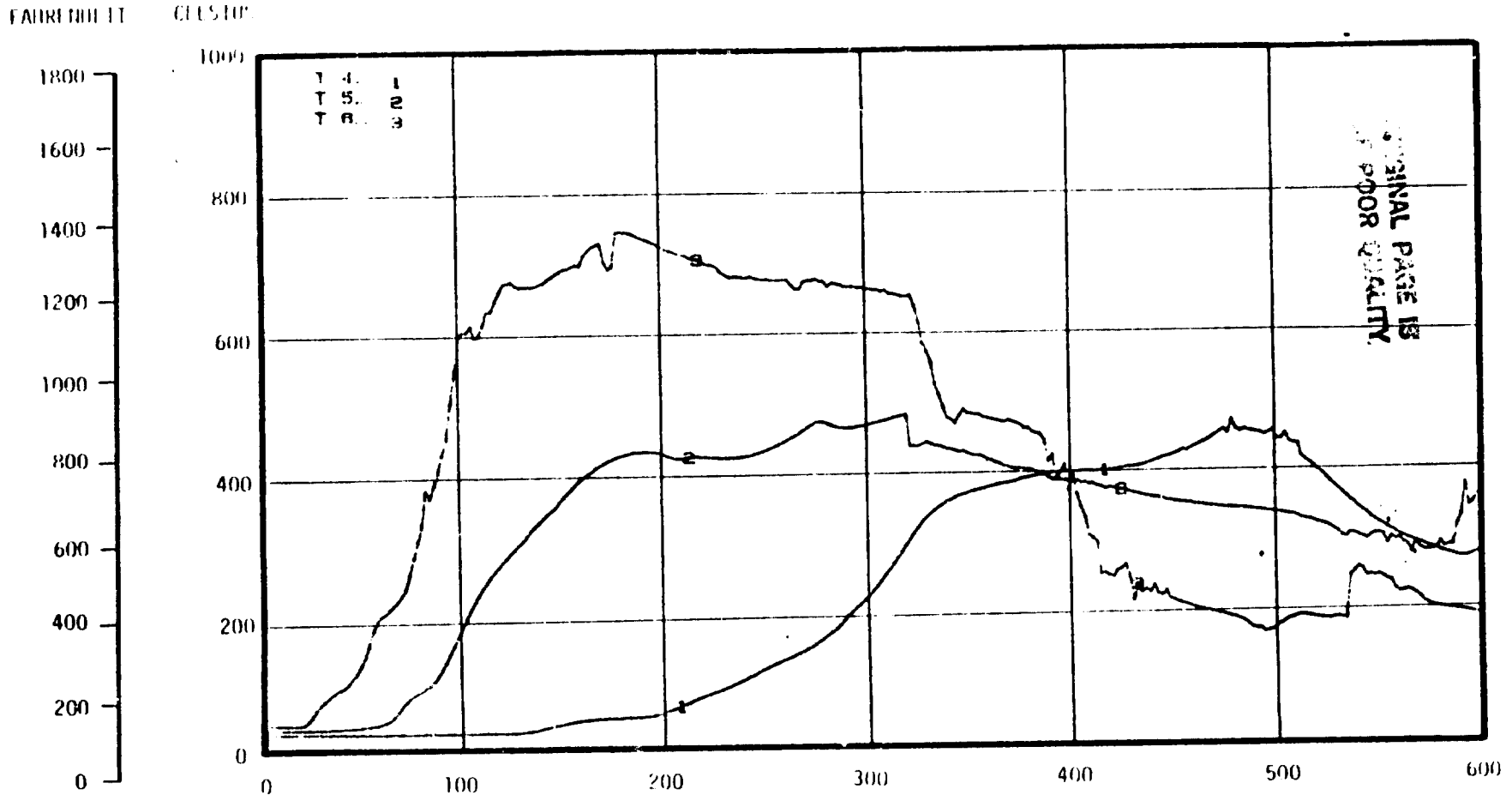
CUSHION CONSTRUCTION NUMBER 6.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 11.40
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14
CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES

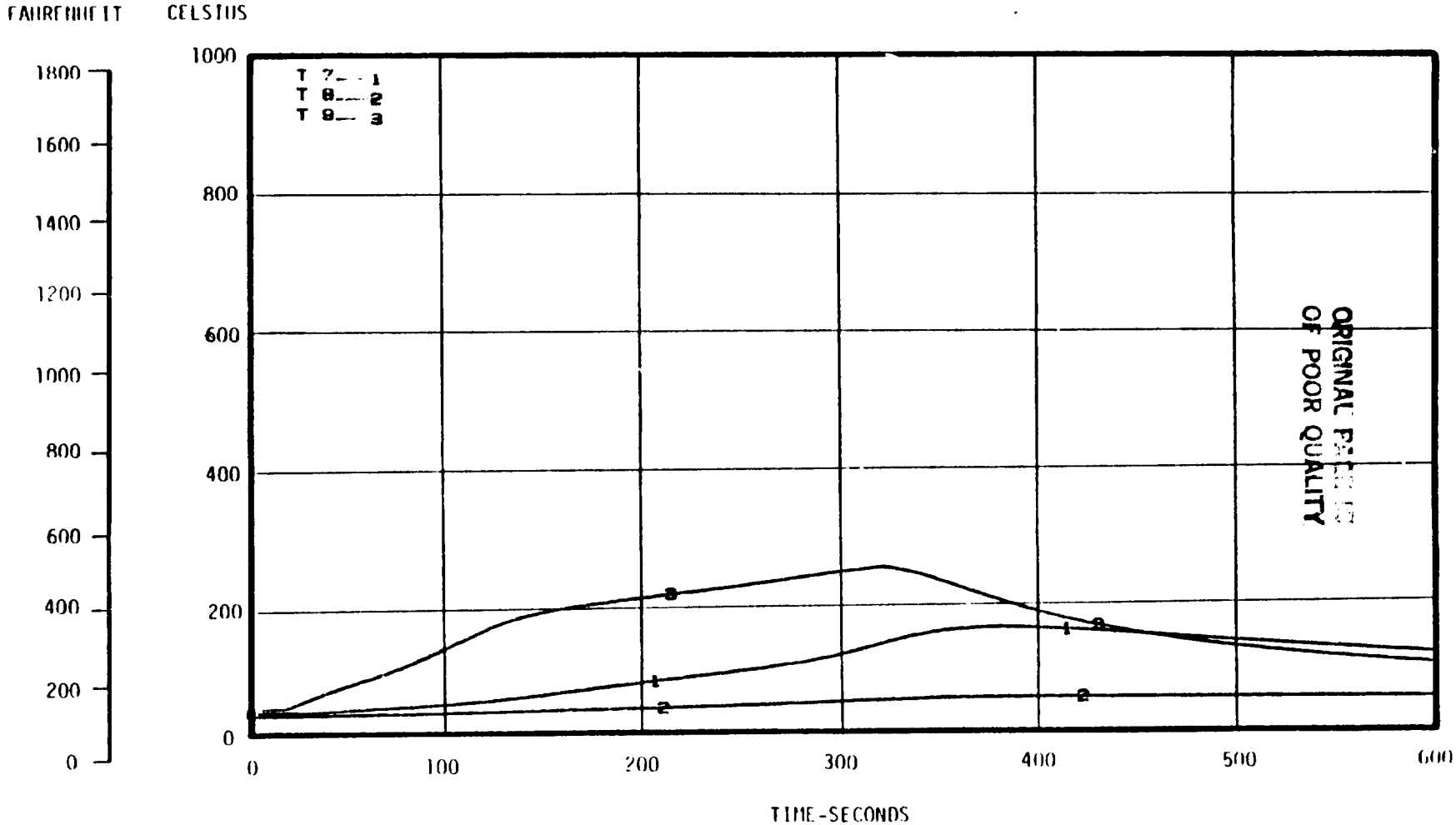


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 11:40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14

CUSHION CONSTRUCTION NUMBER A.0

SEAT CUSHION TEMPERATURES

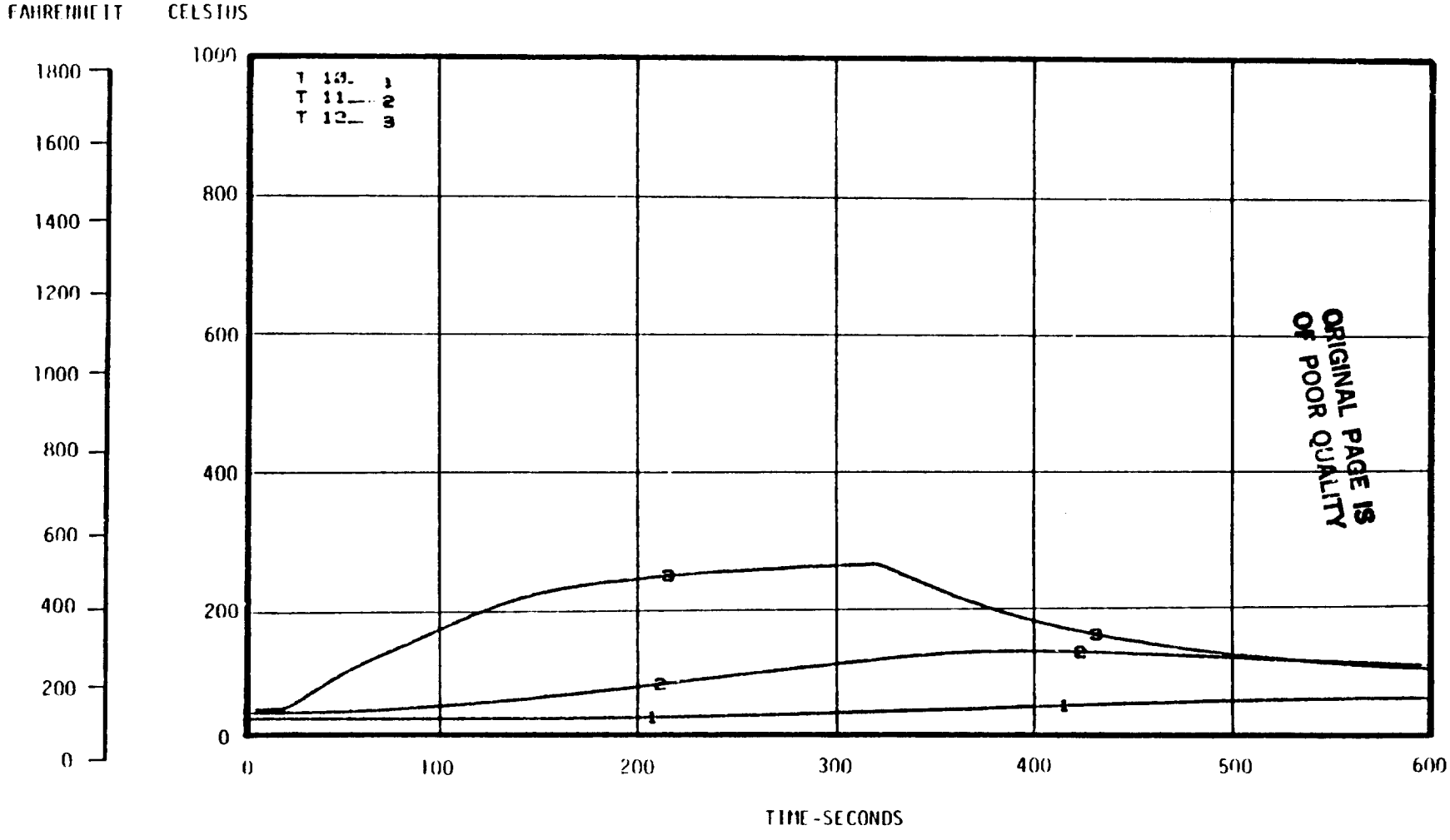


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 11.40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14

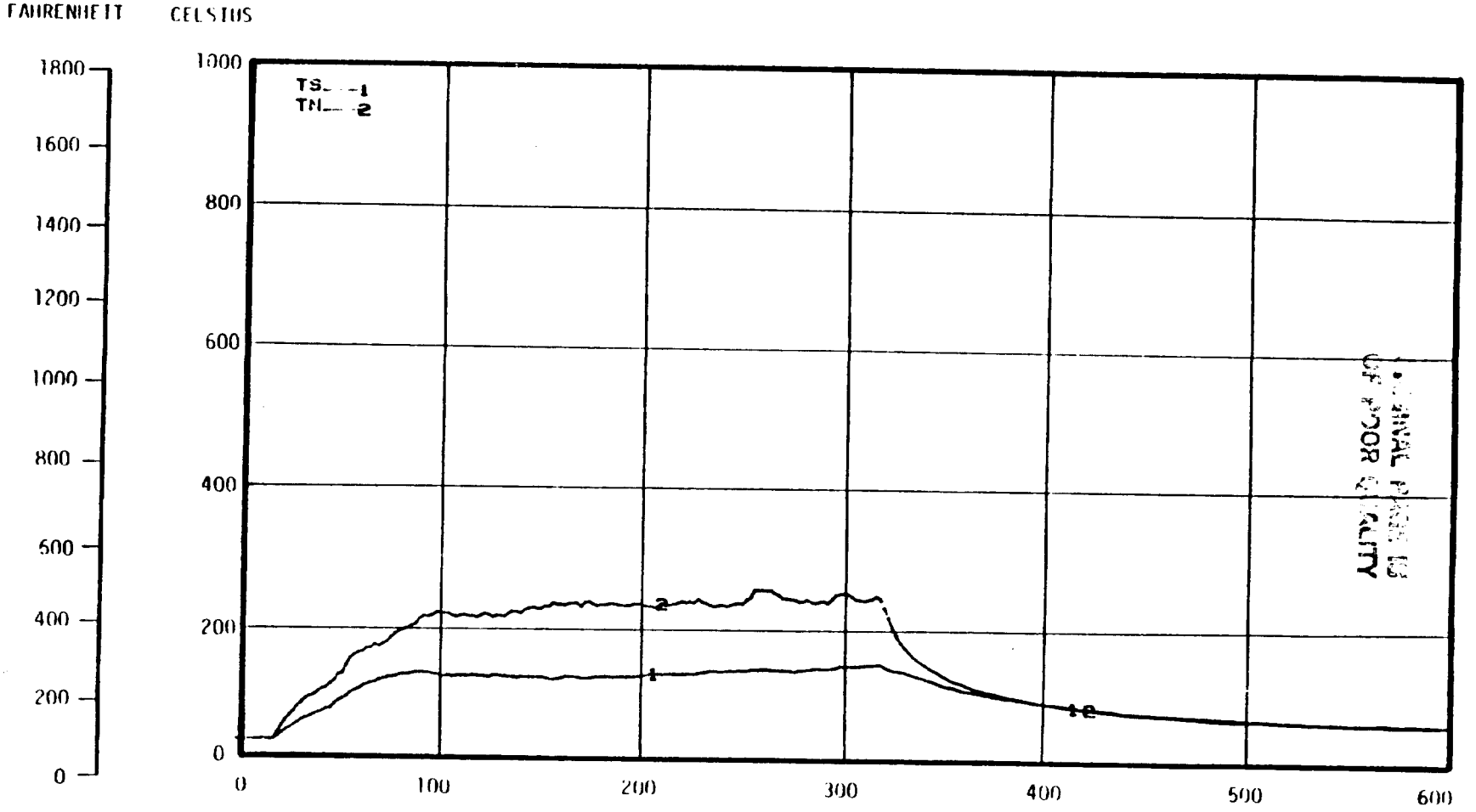
CUSHION CONSTRUCTION NUMBER 6.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/HC 11:43
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14
CUSHION CONSTRUCTION NUMBER 6.0

CEILING TEMPERATURE

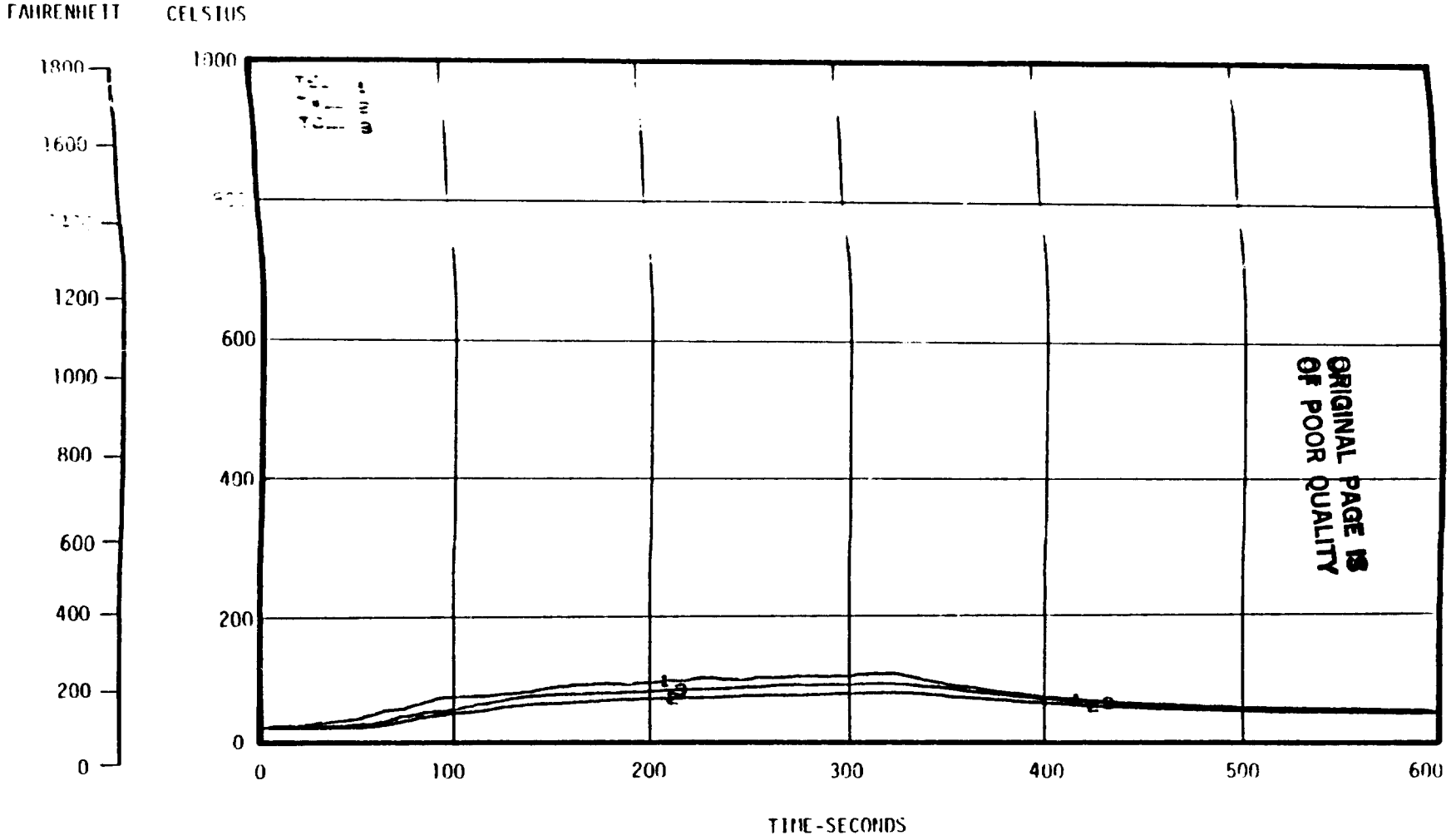


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 11.40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14

CUSHION CONSTRUCTION NUMBER 8.0

CEILING TEMPERATURE

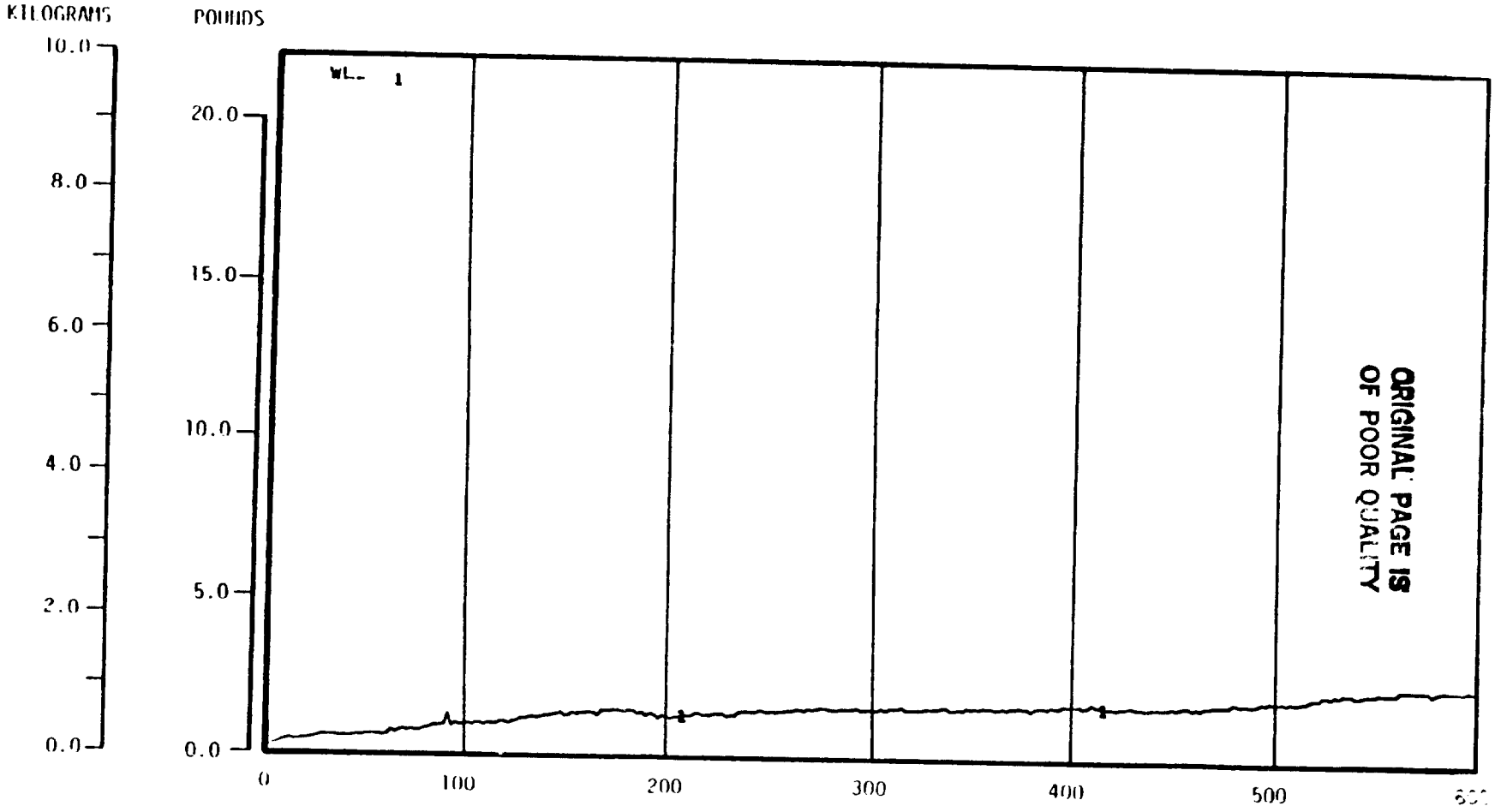


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03./15./82 11:40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14

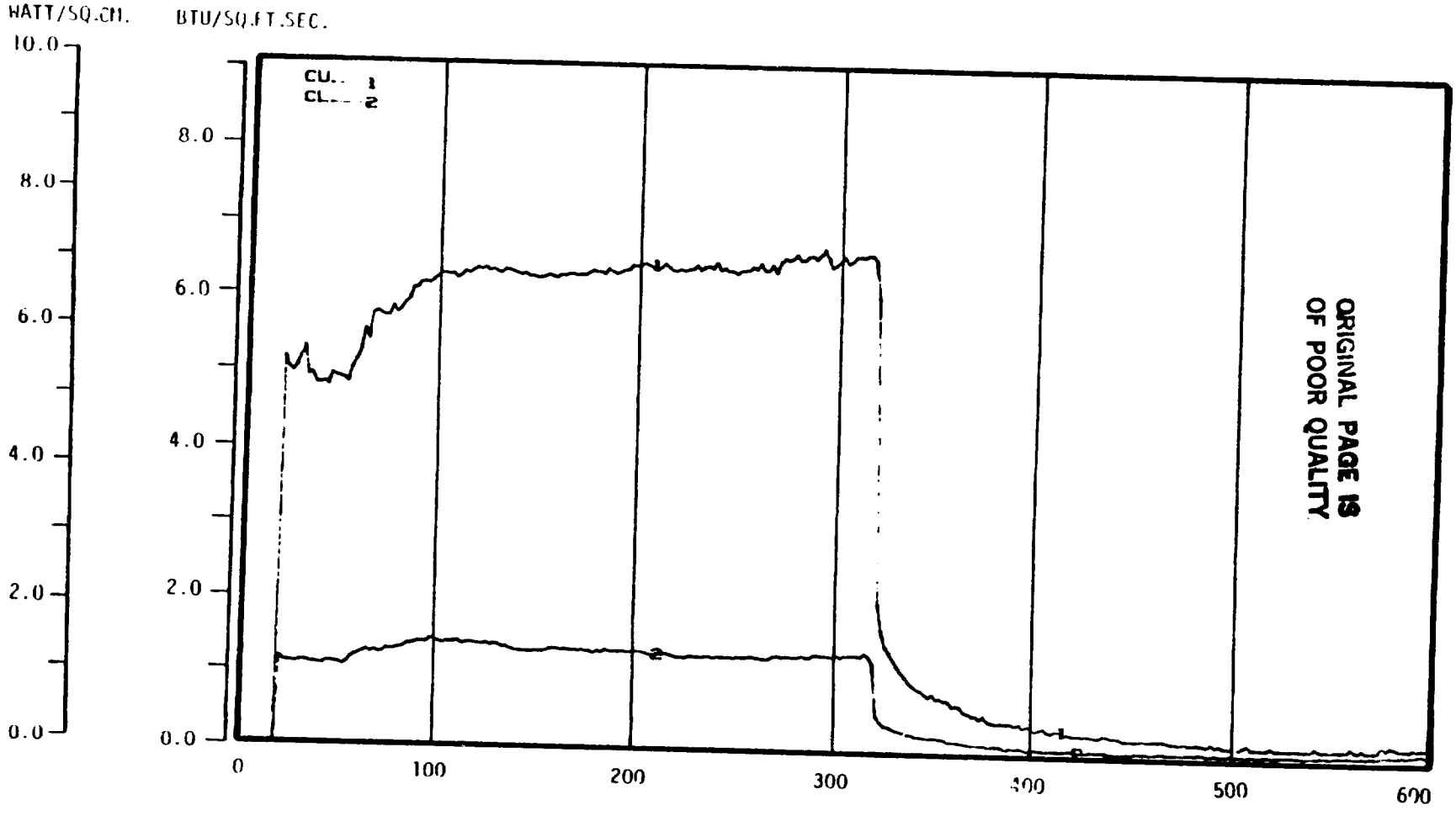
CUSHION CONSTRUCTION NUMBER 8.0

WEIGHT LOSS



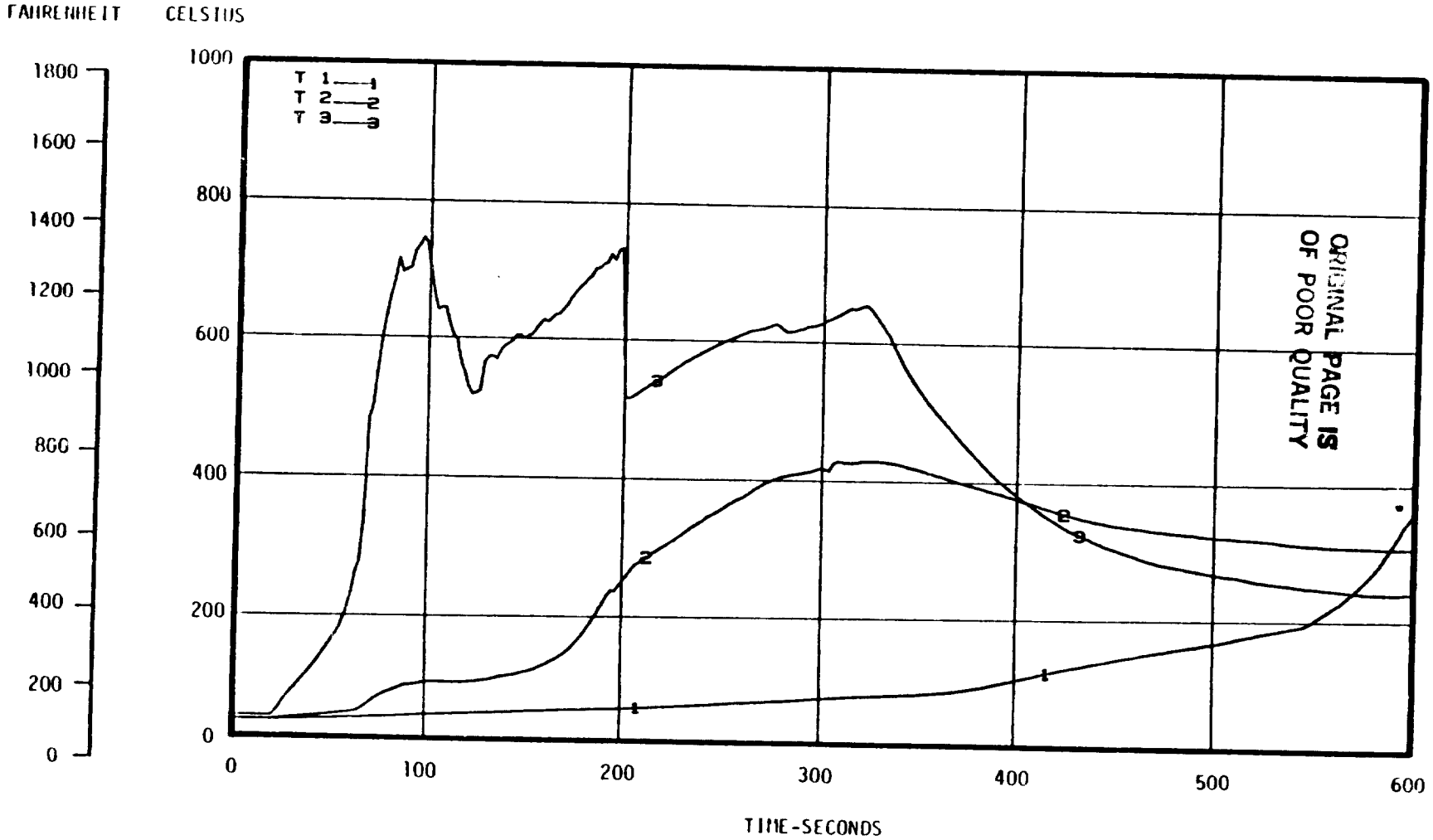
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 11.40
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 14
CUSHION CONSTRUCTION NUMBER 6.0

HEAT FLUX



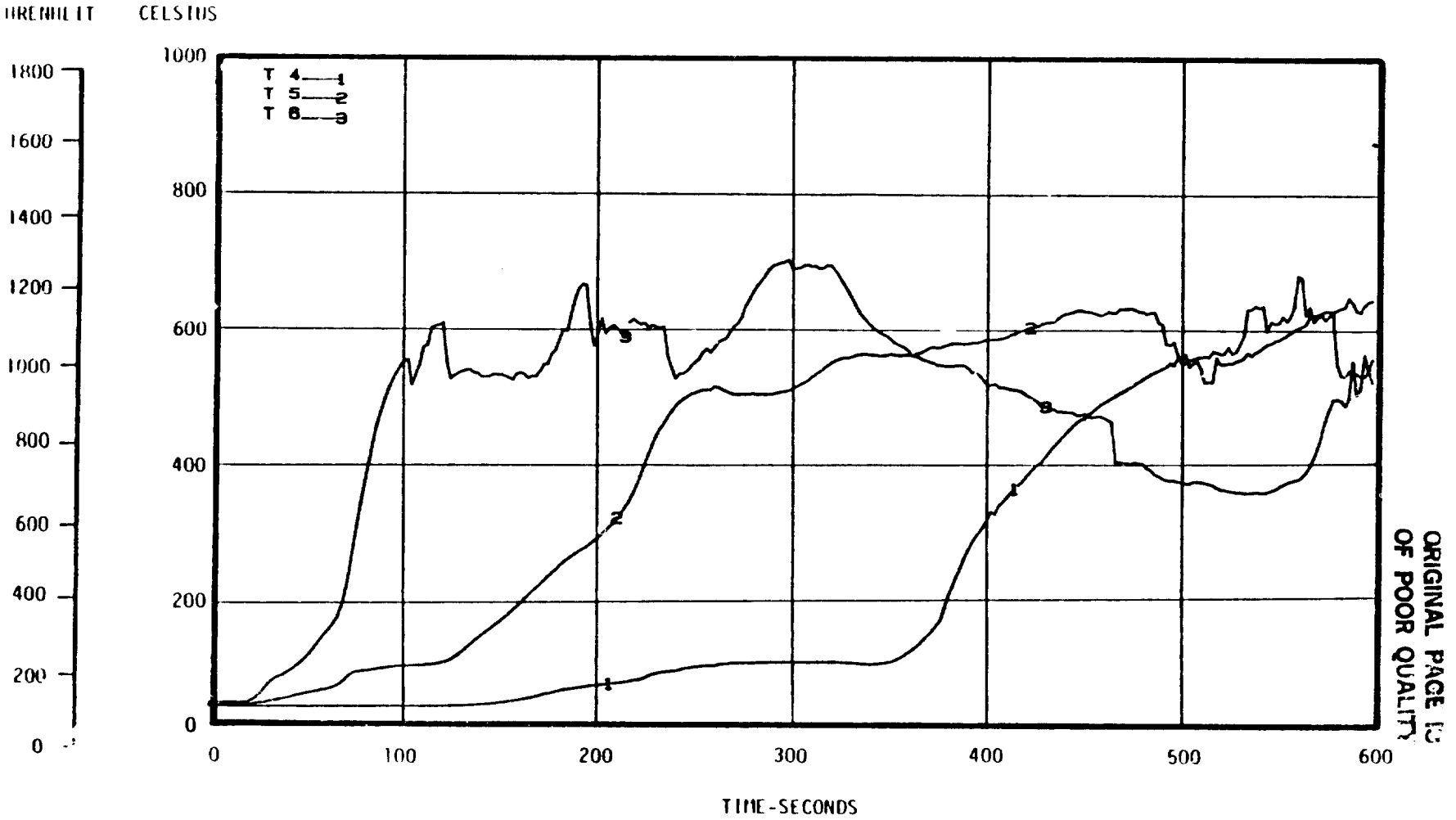
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14.33
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14.33
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES

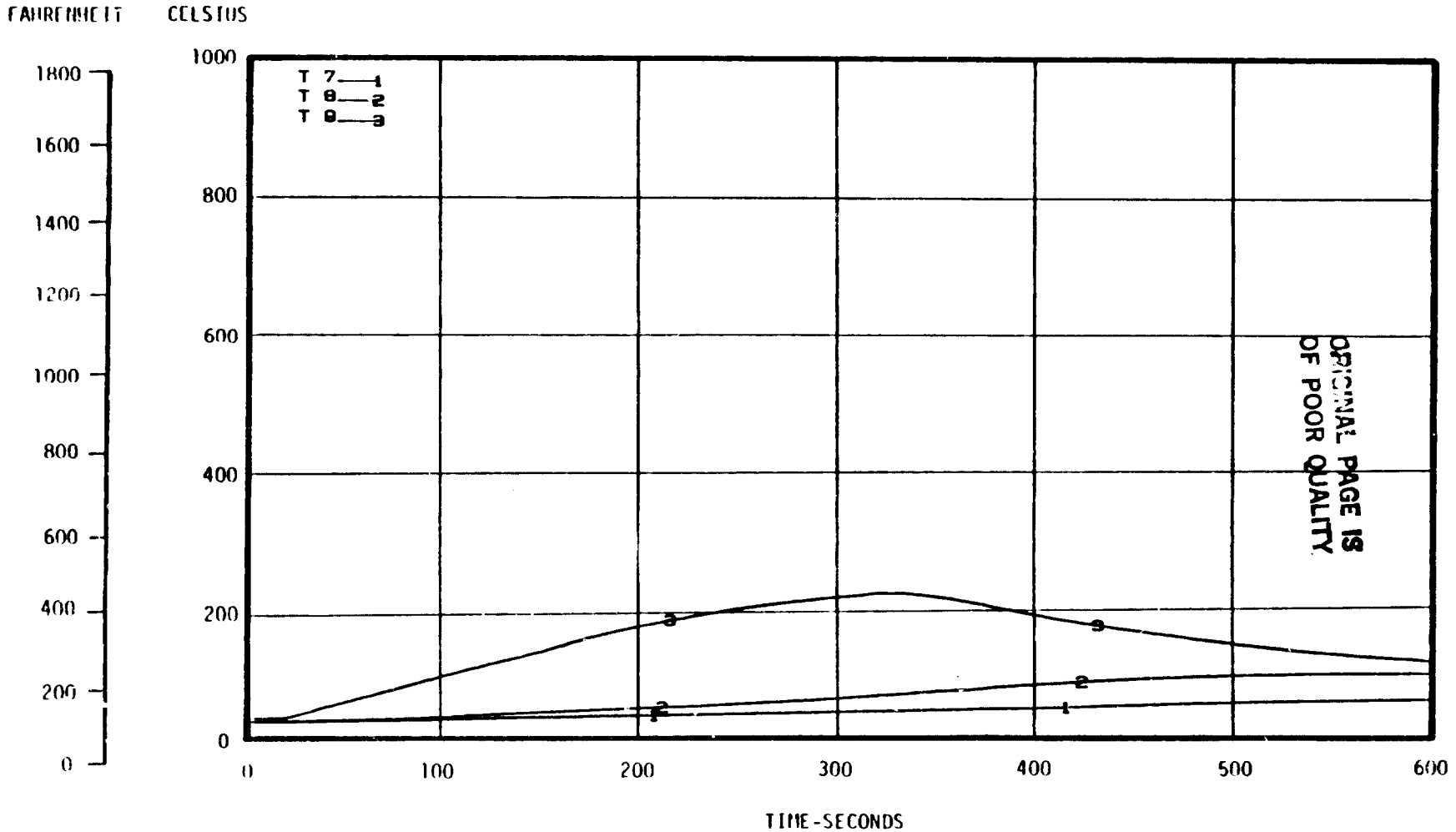


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14:33

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15

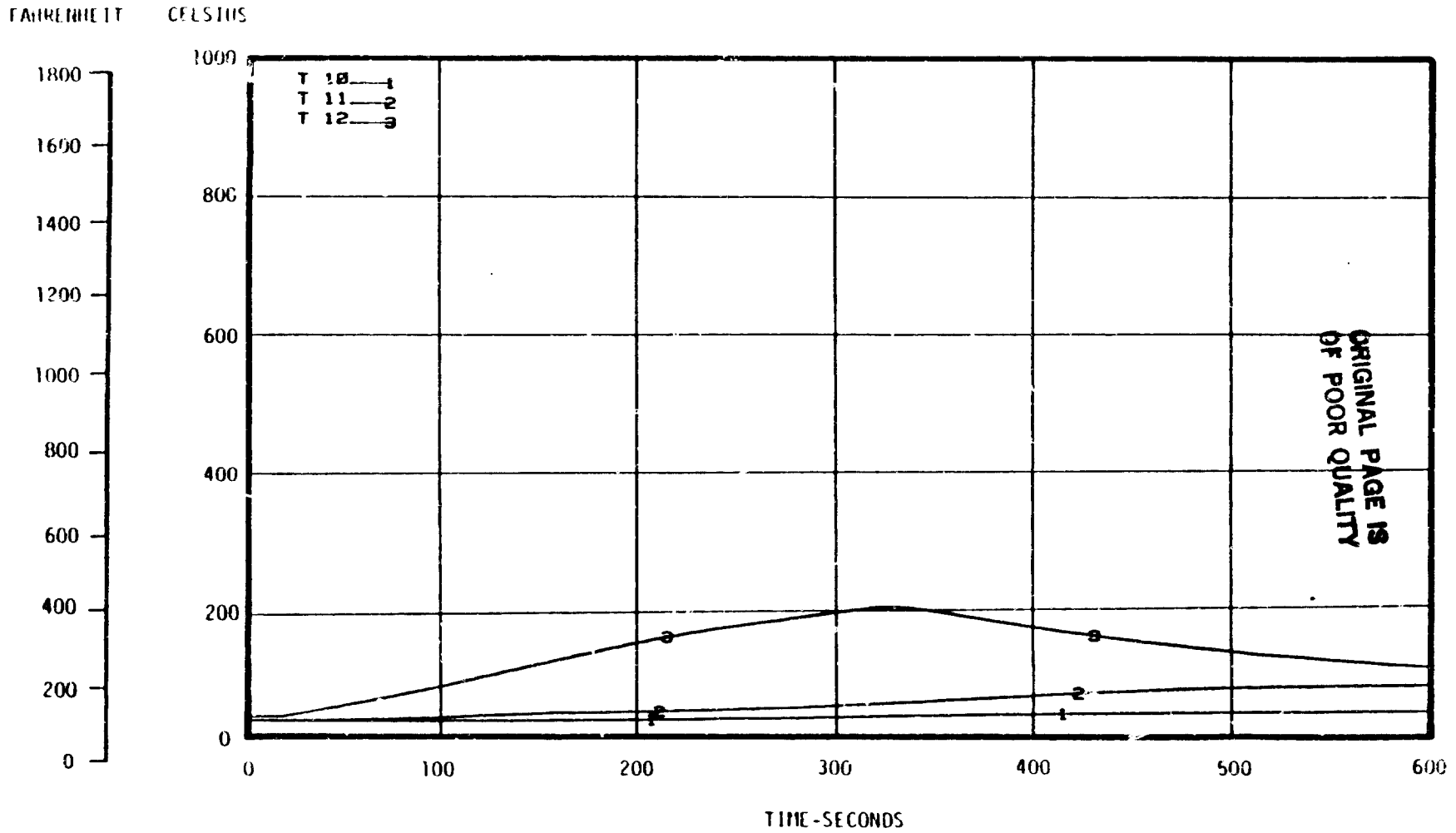
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES



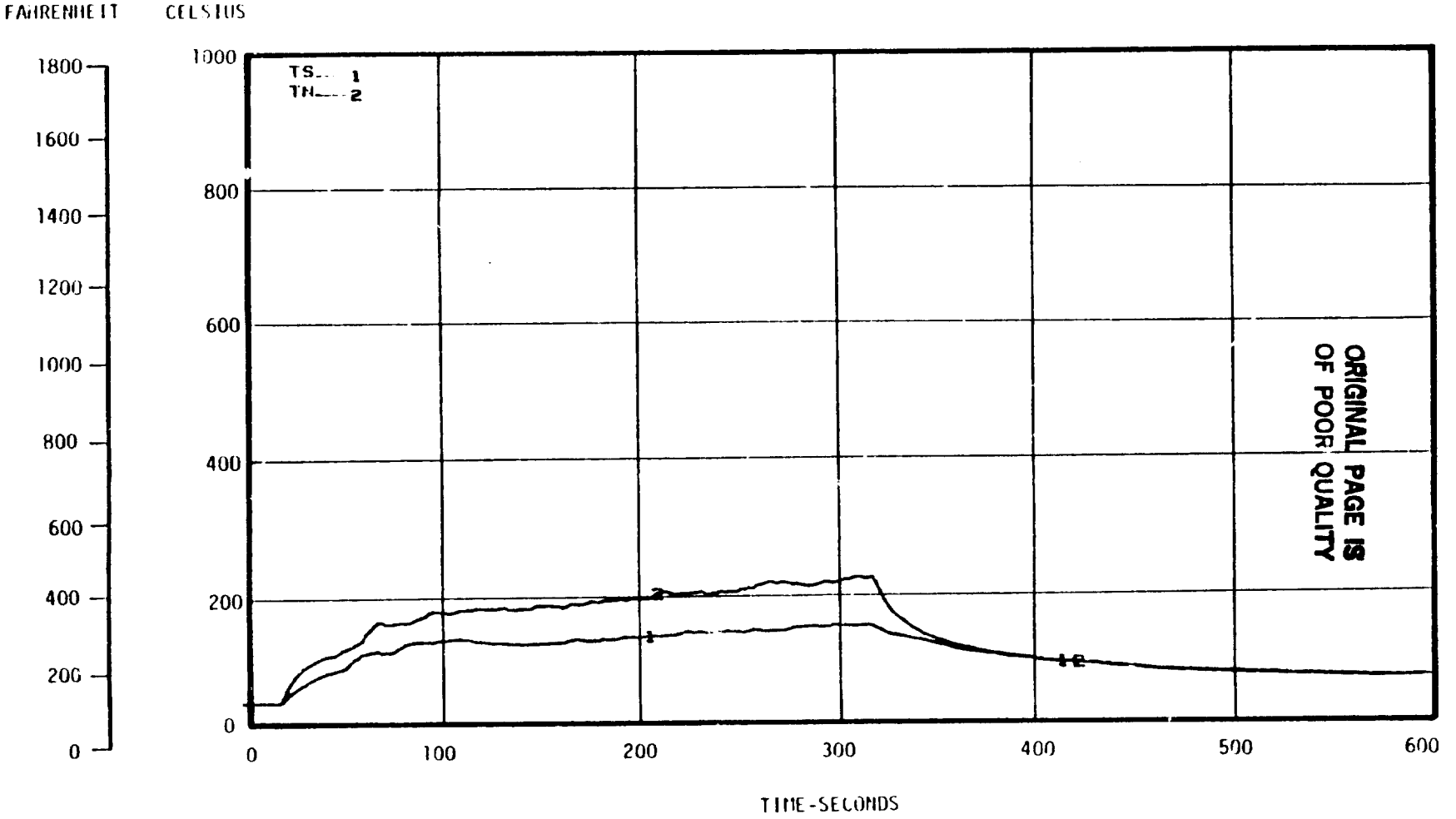
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14:33
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14.33
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15
CUSHION CONSTRUCTION NUMBER 7.0

CEILING TEMPERATURE

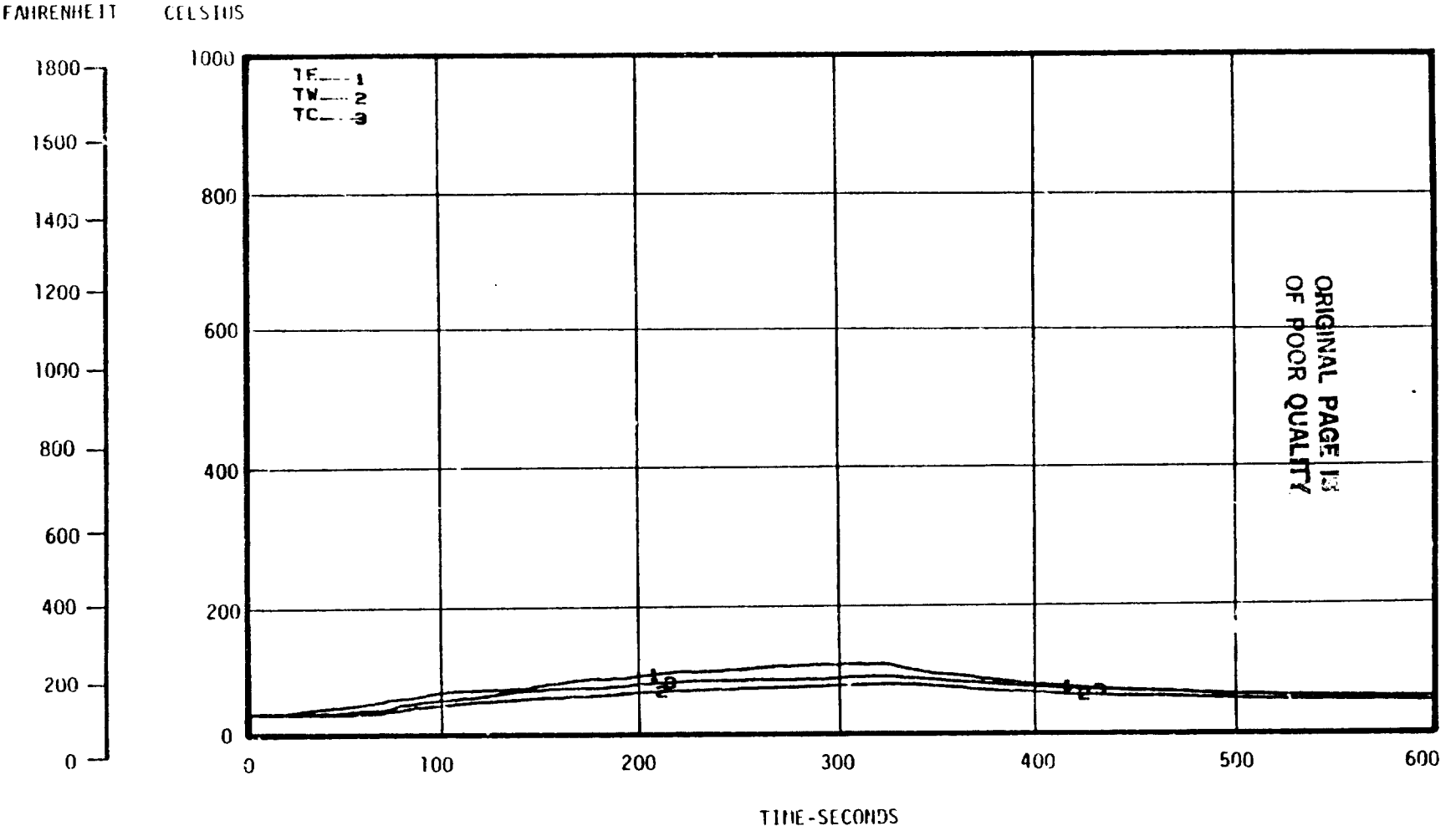


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14:33

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15

CUSHION CONSTRUCTION NUMBER 7.0

CEILING TEMPERATURE

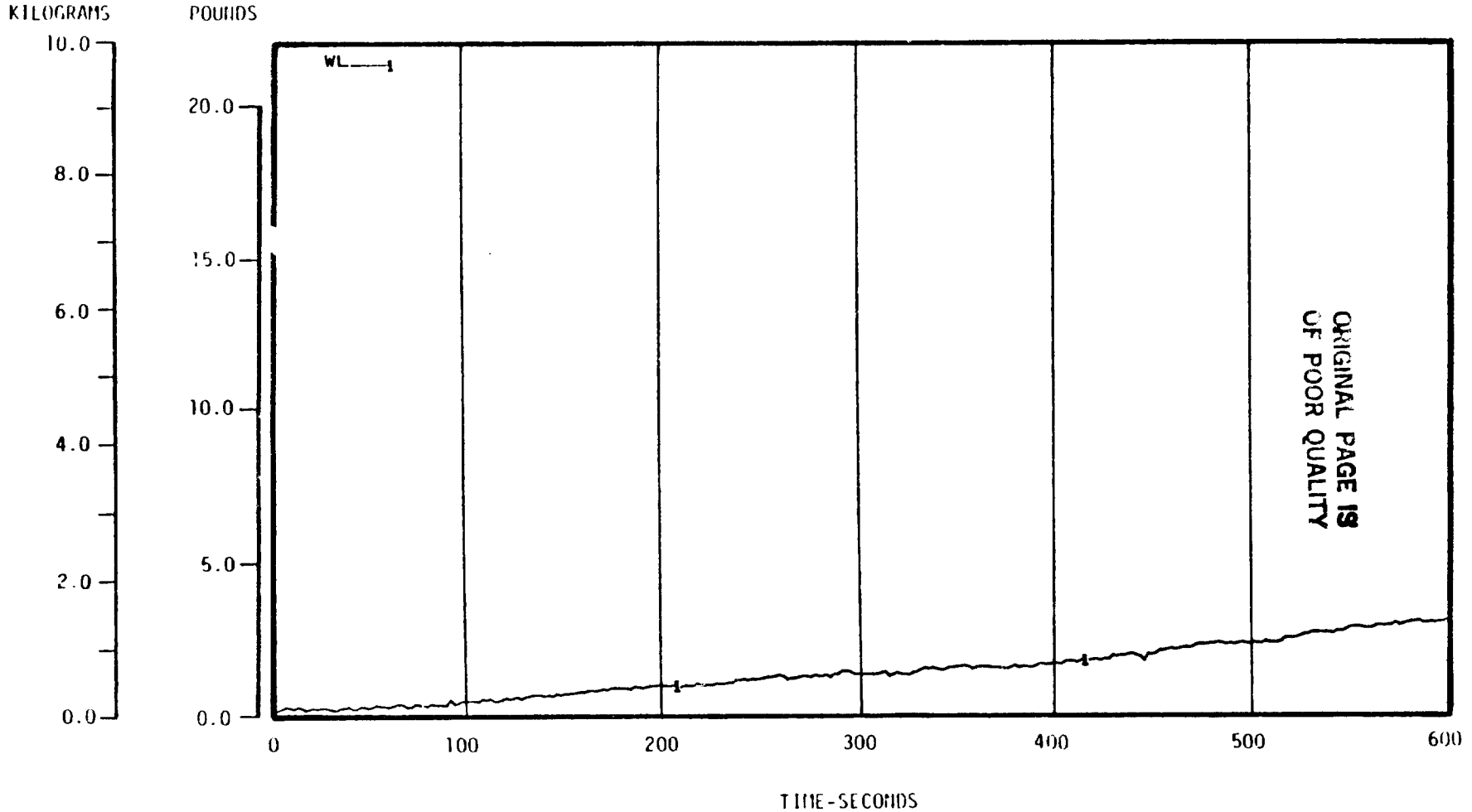


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14:33

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15

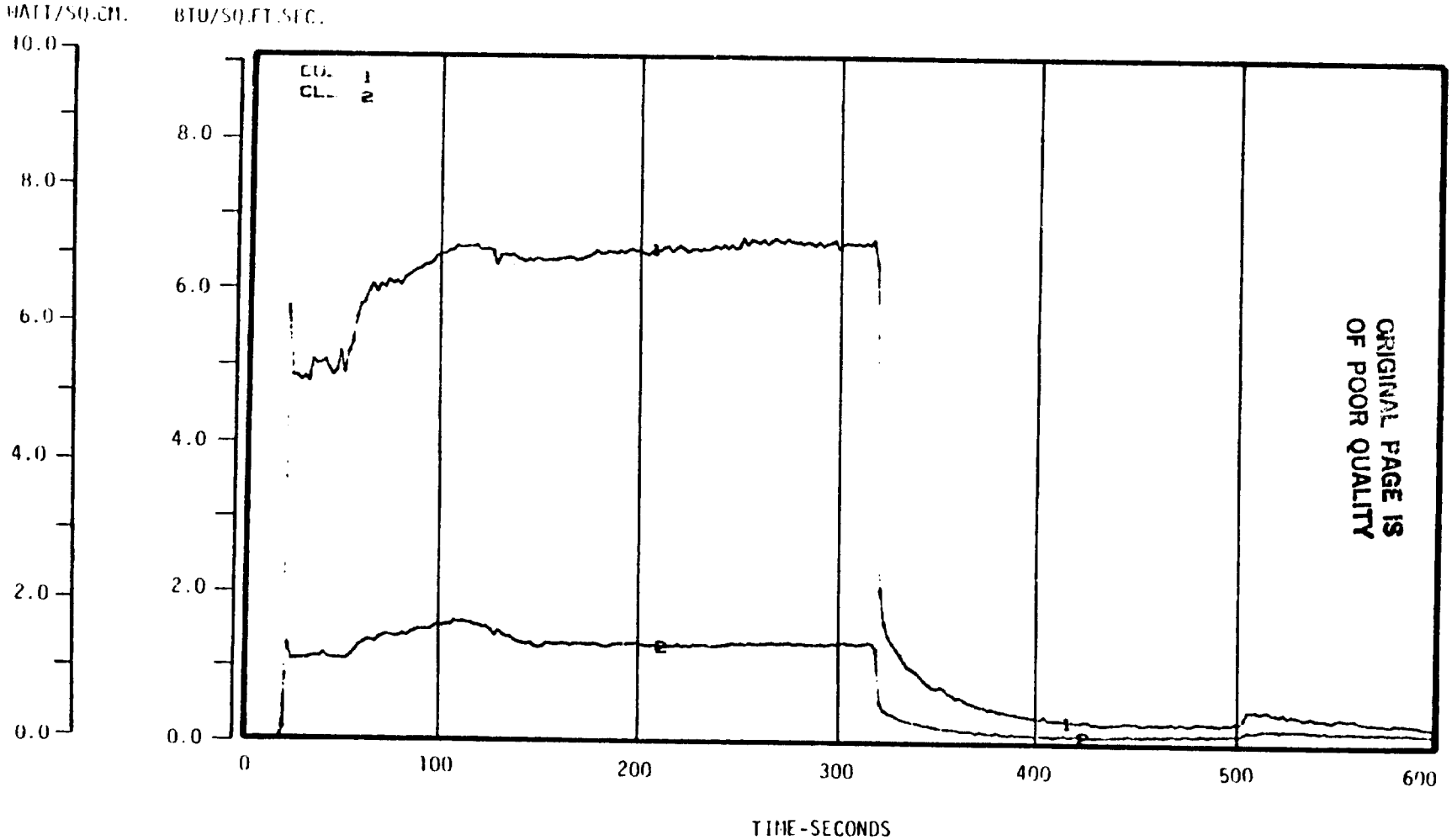
CUSHION CONSTRUCTION NUMBER 7.0

WEIGHT LOSS



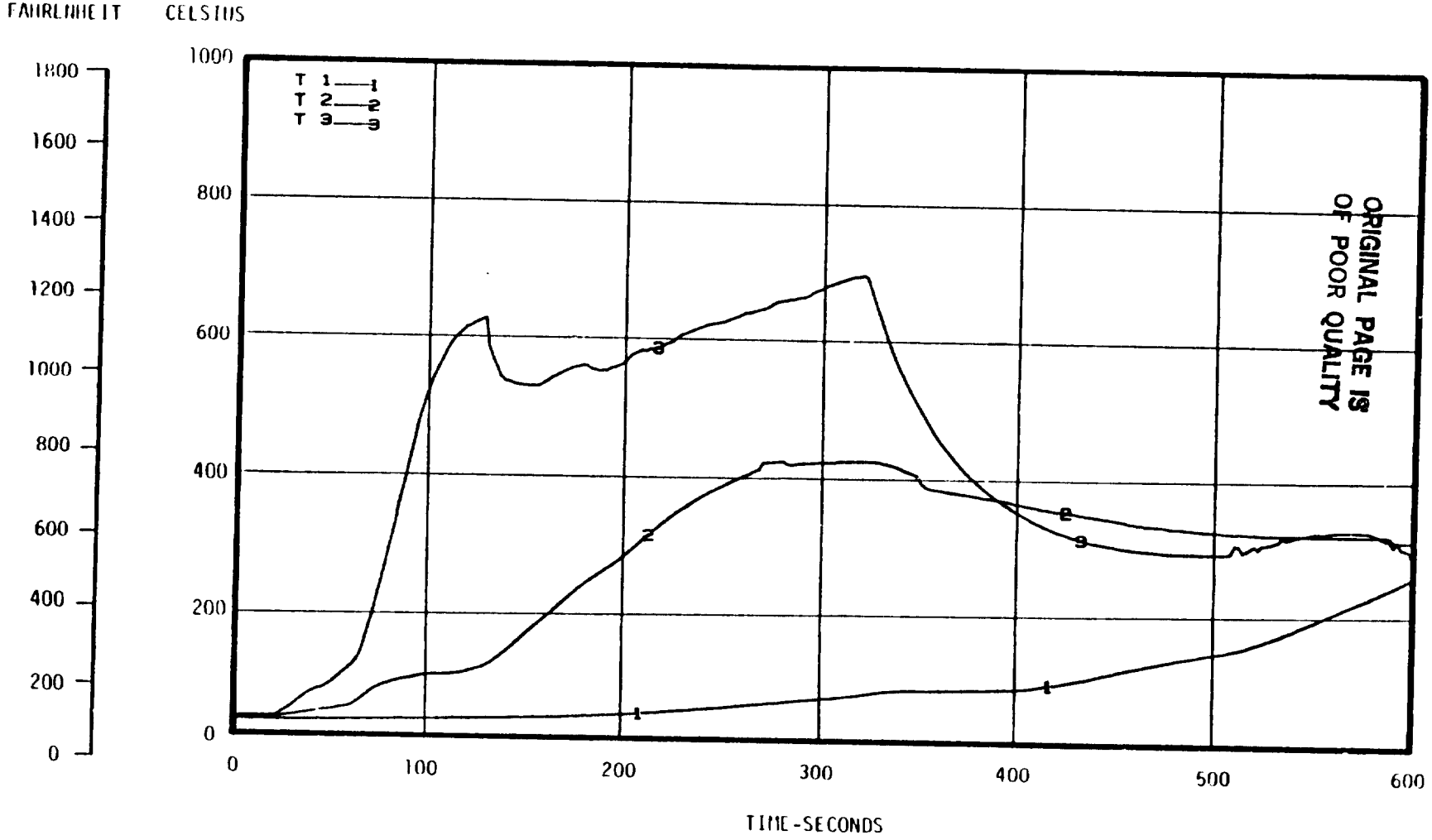
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/15/82 14.33
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 15
CUSHION CONSTRUCTION NUMBER 7.0

HEAT FLUX



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 08.59
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 16
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES

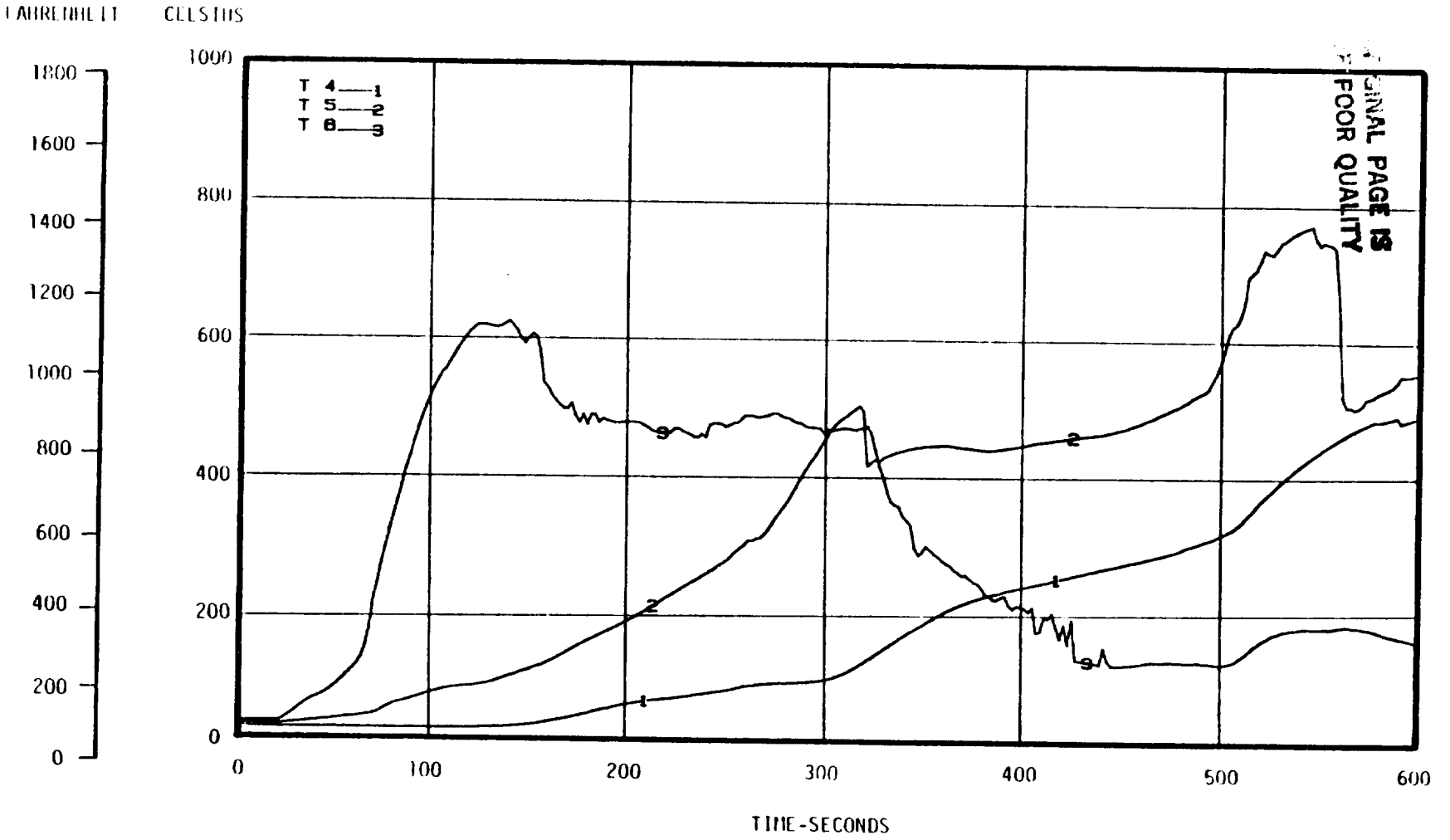


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 08:59

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

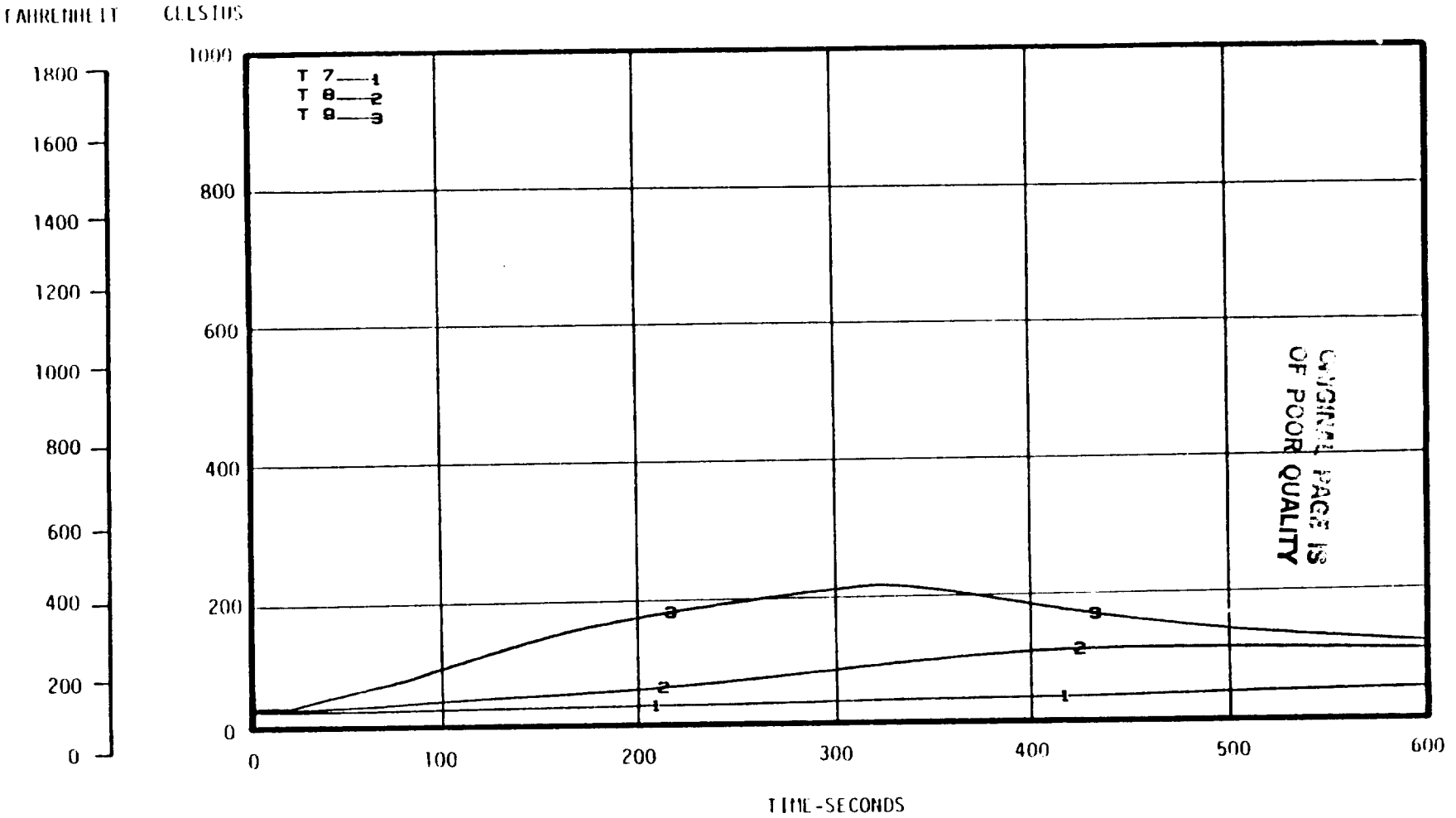
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 08:59
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES

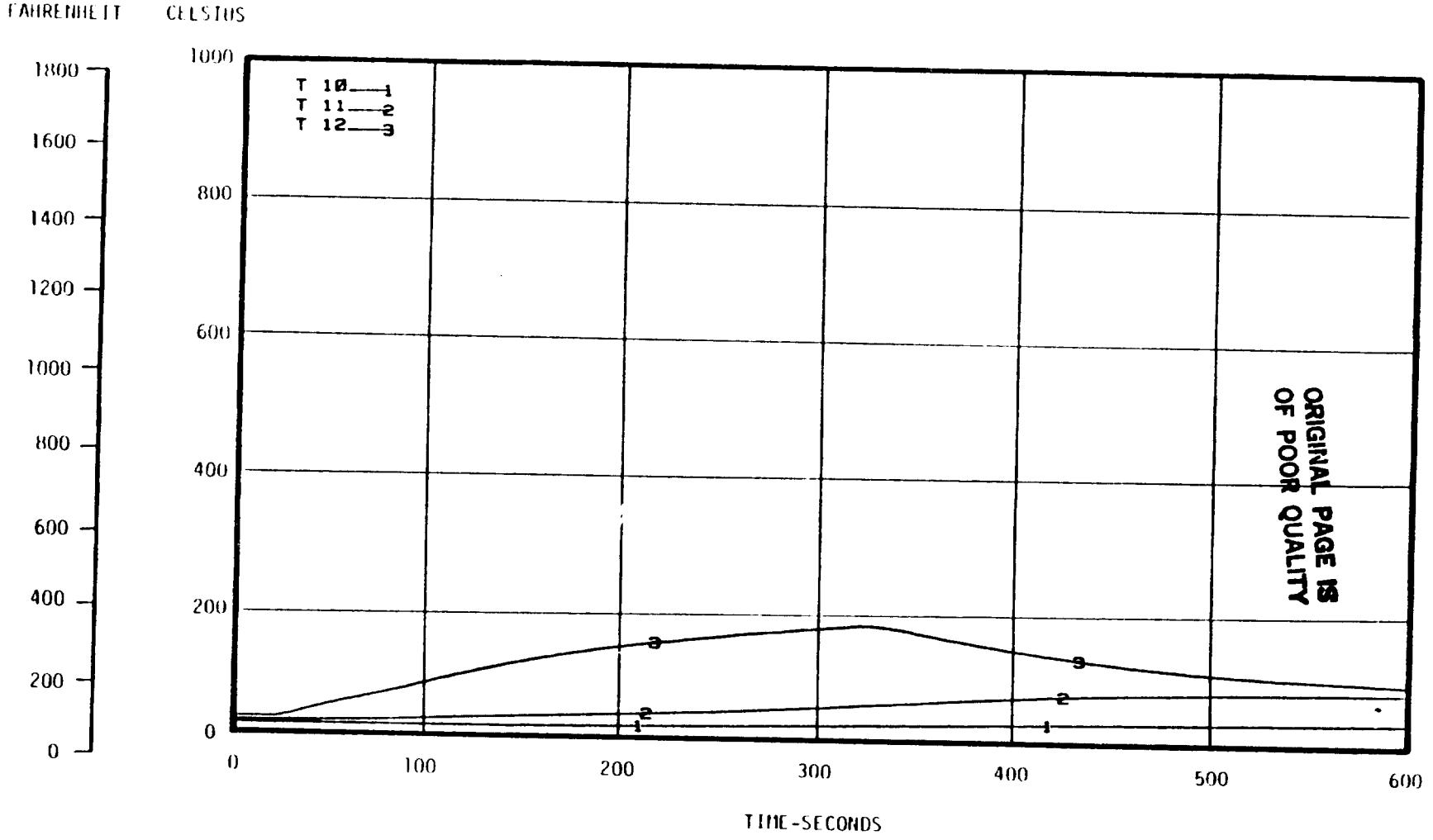


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 08:59

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 16

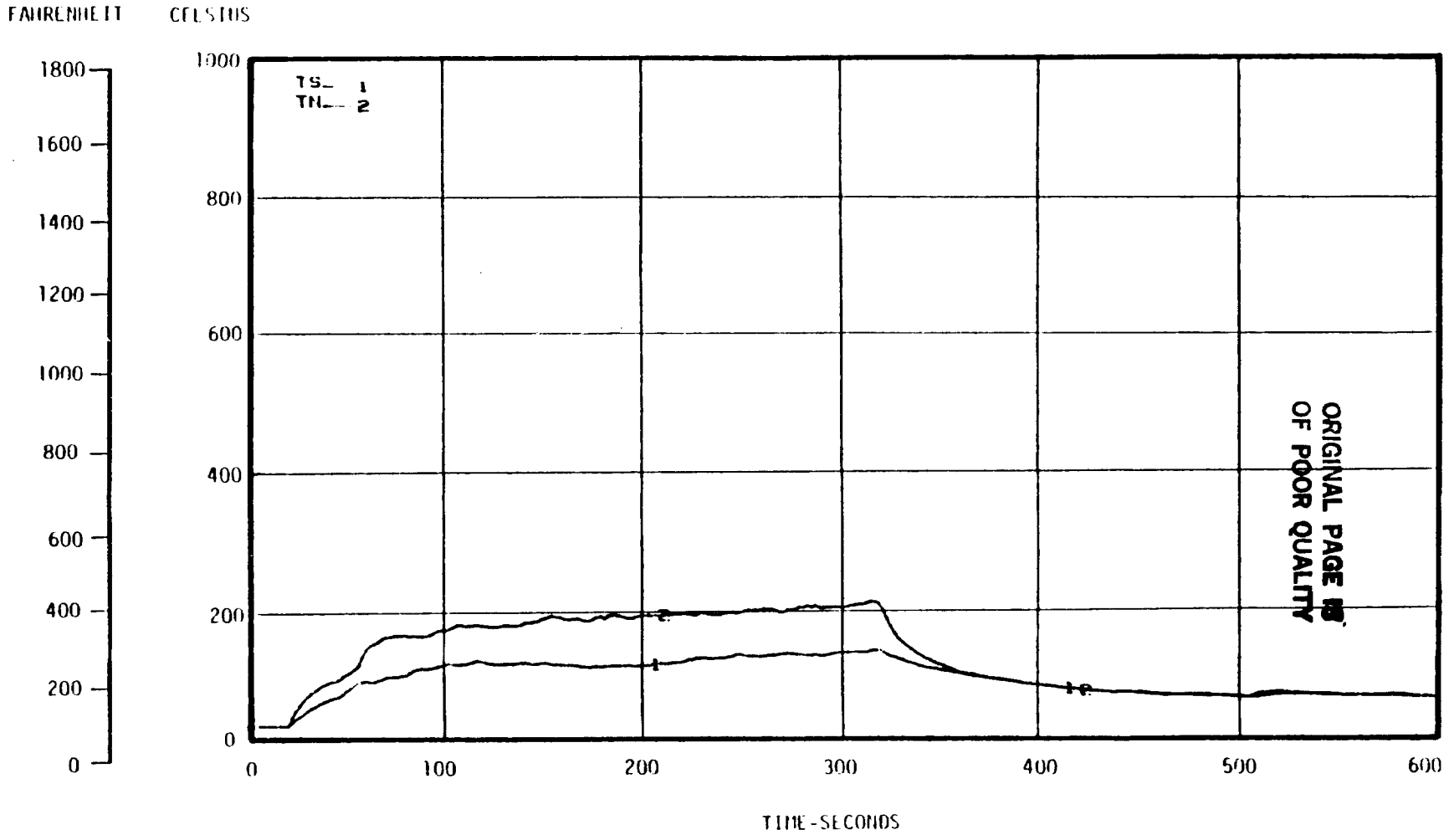
CUSHION CONSTRUCTION NUMBER 7.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 08:59
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18
CUSHION CONSTRUCTION NUMBER 7.0

CEILING TEMPERATURE

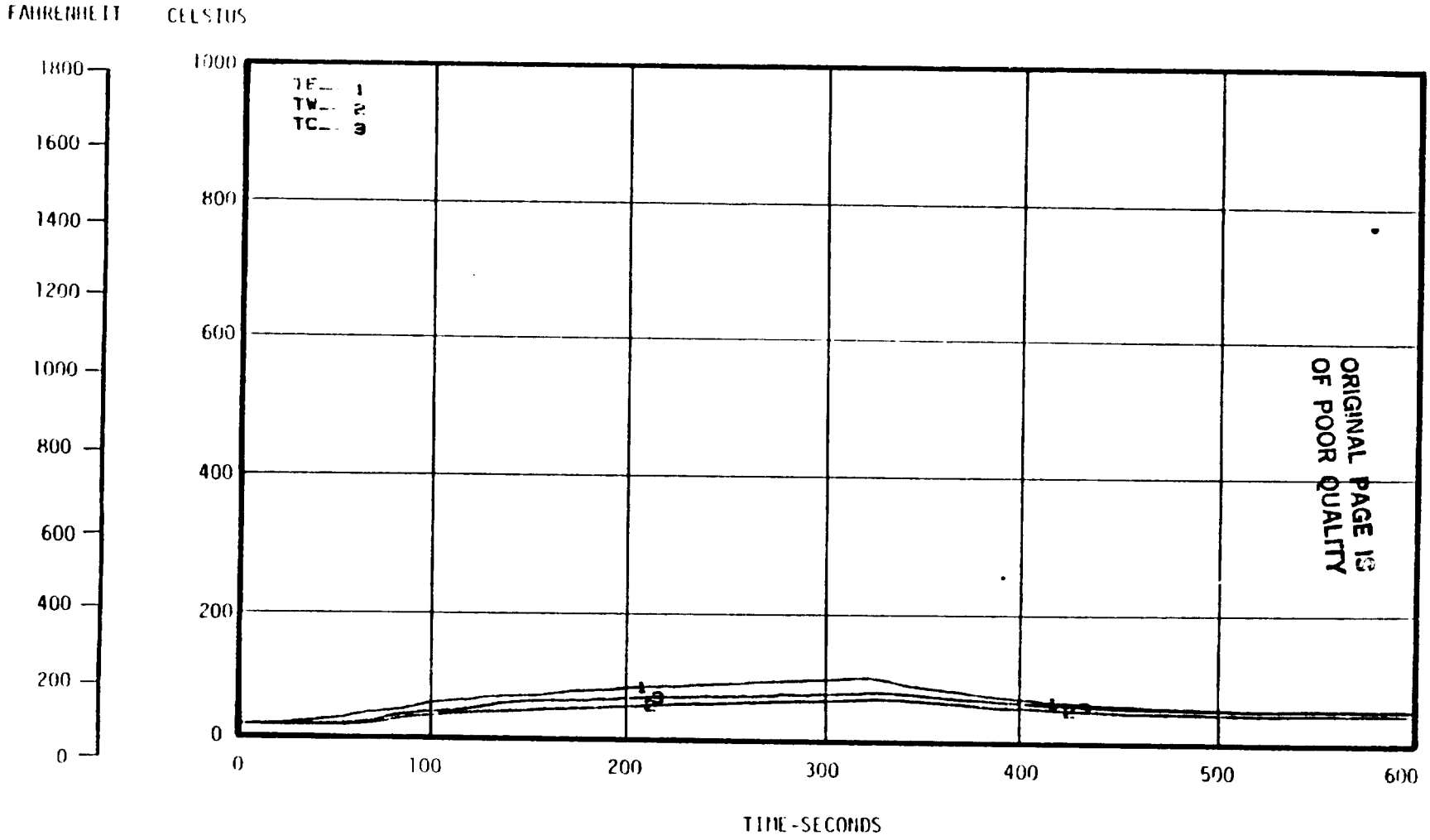


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 08.59

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 16

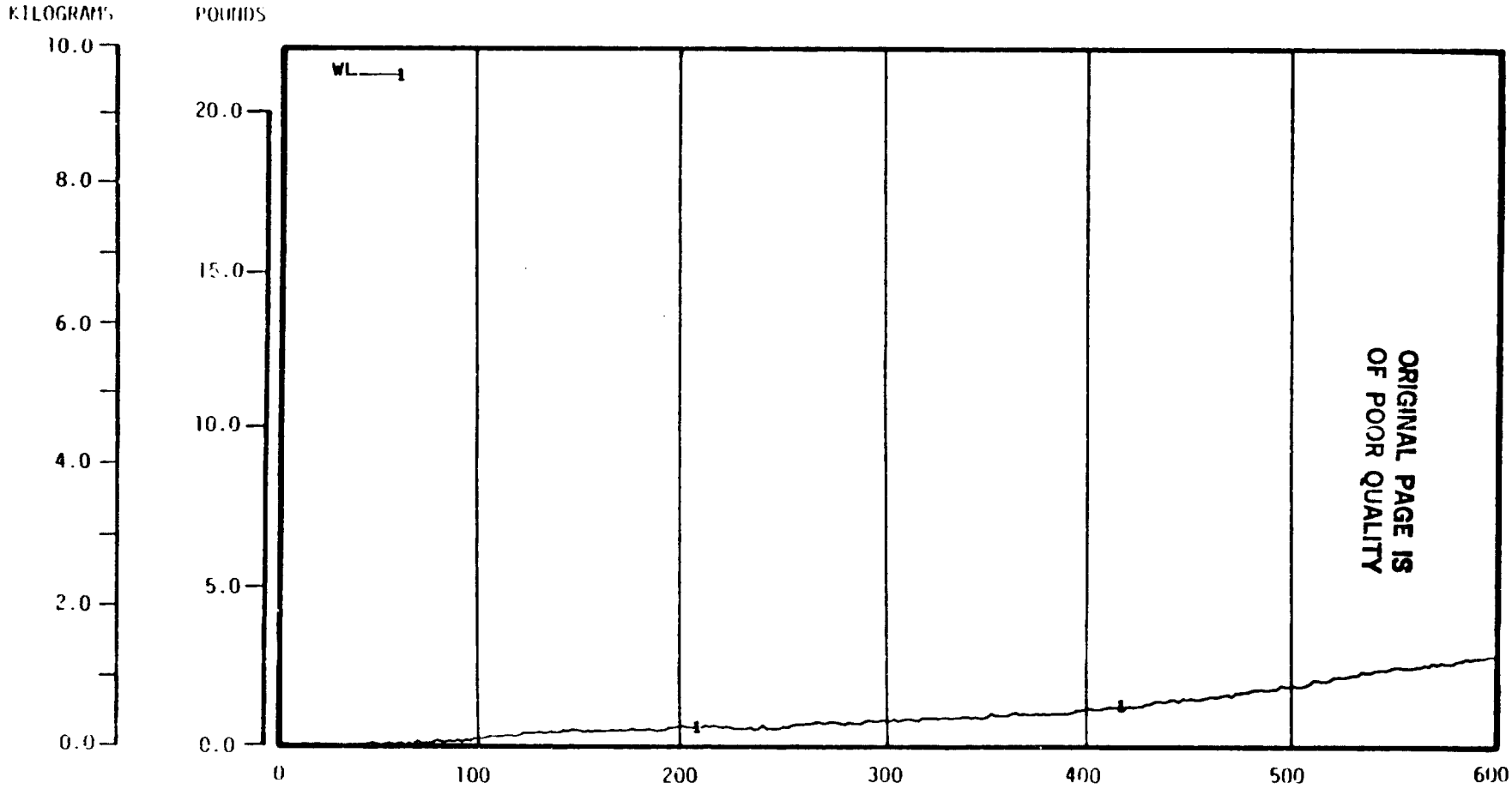
CUSHION CONSTRUCTION NUMBER 7.0

CEILING TEMPERATURE



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 08.59
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 16
CUSHION CONSTRUCTION NUMBER 7.0

WEIGHT LOSS

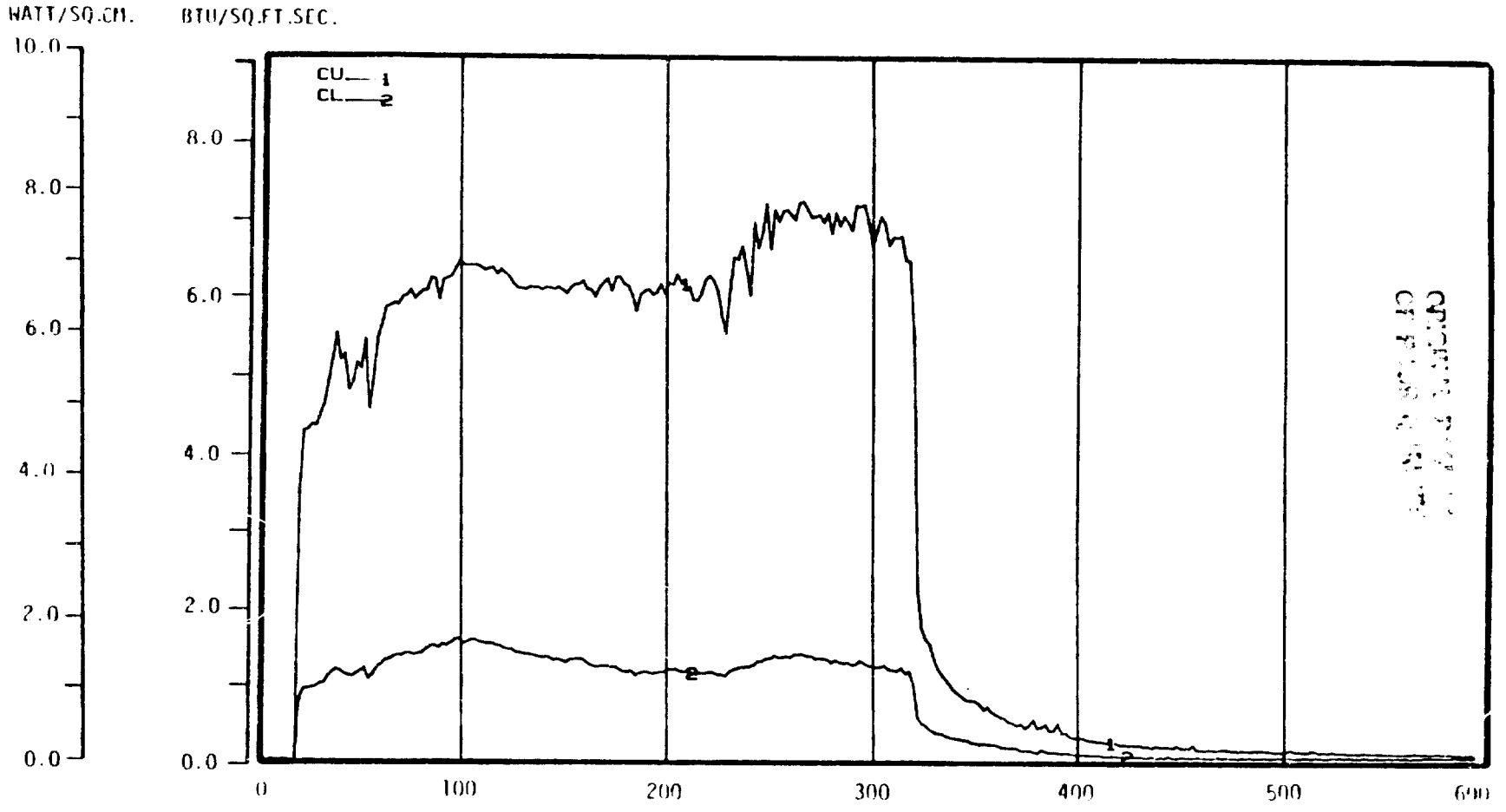


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 08.59

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

CUSHION CONSTRUCTION NUMBER 7.0

HEAT FLUX

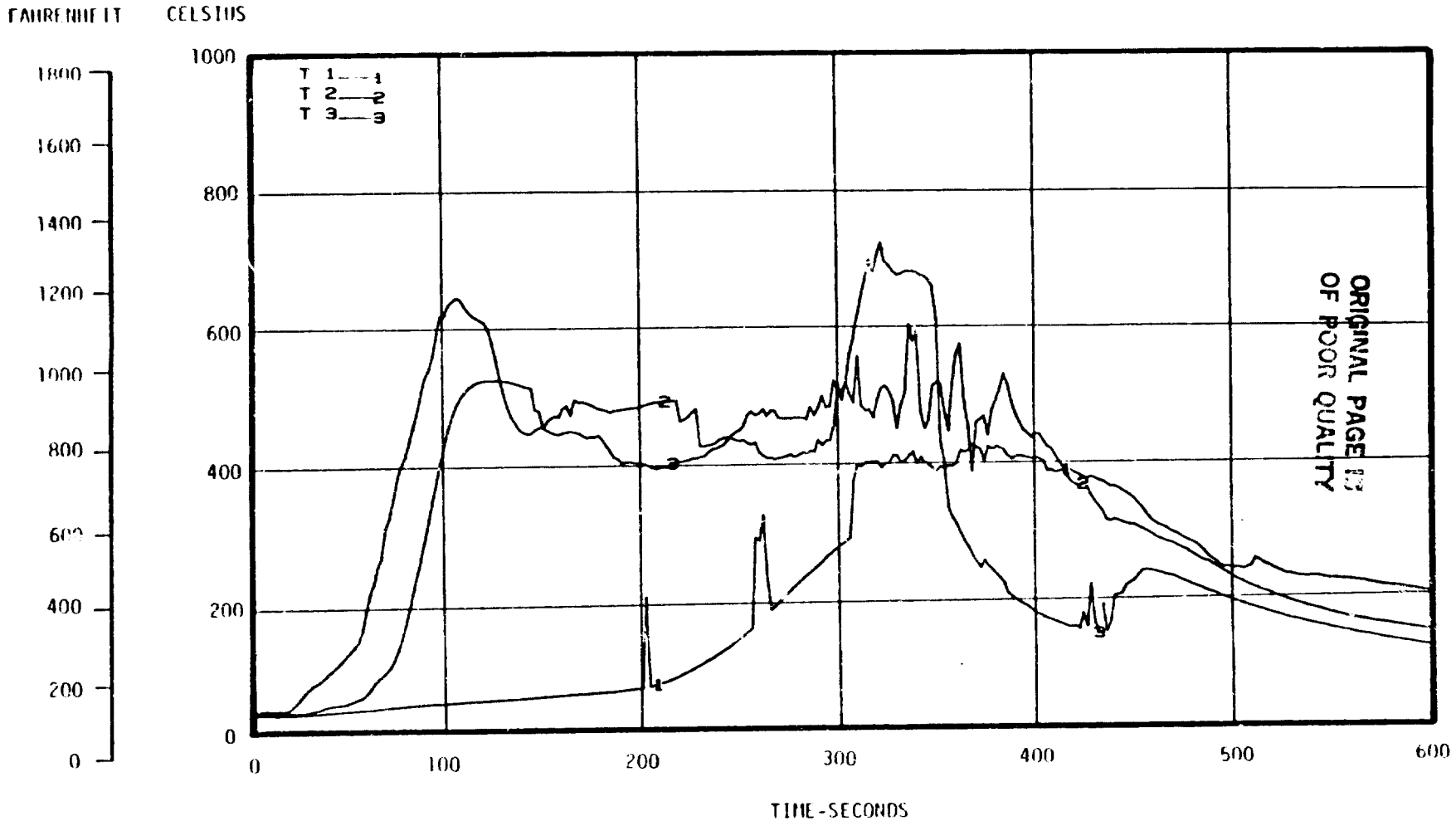


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 15.06

NASA-NIES FULL SCALE CUSHION BURN TEST NUMBER 18

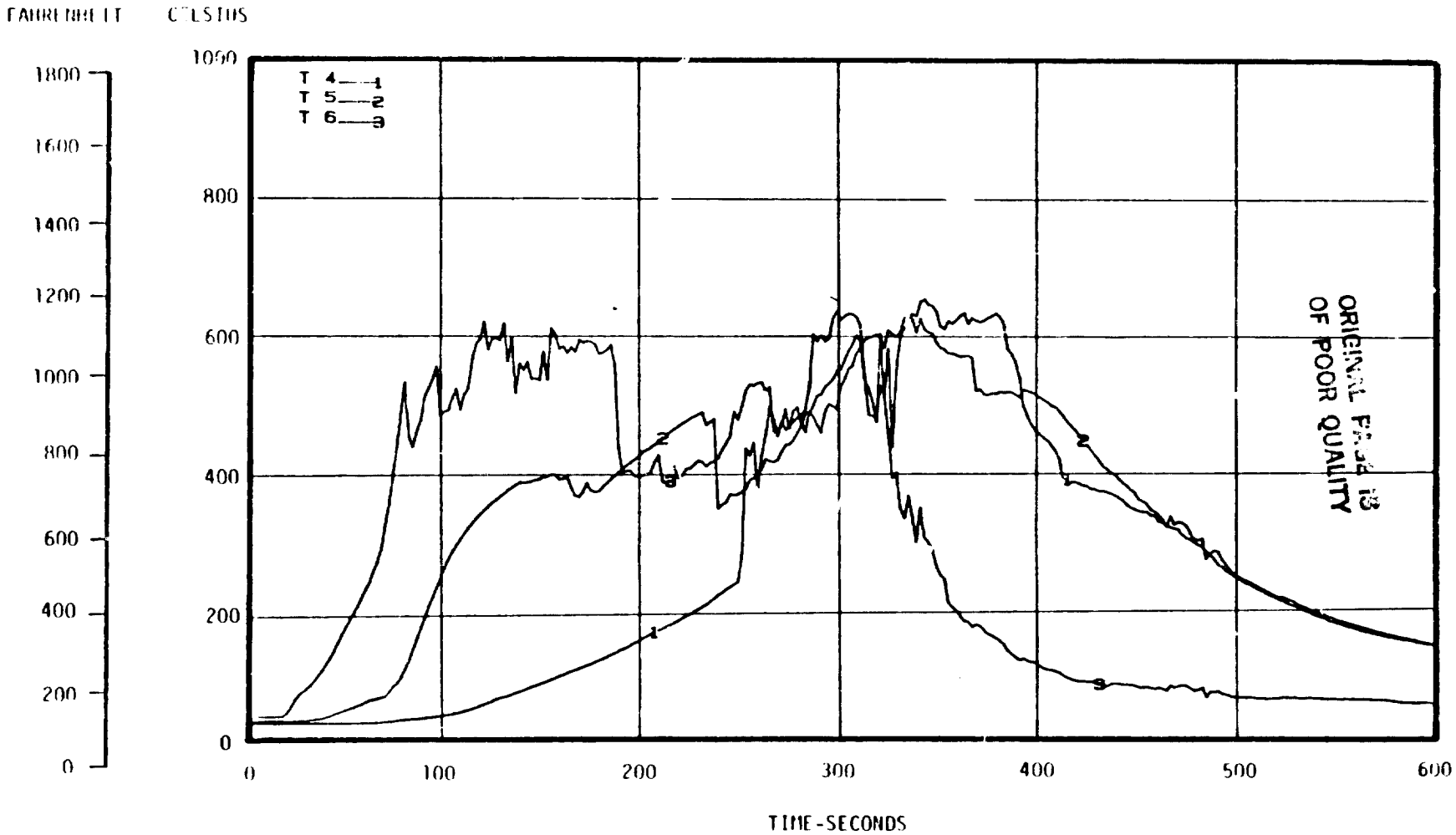
CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES



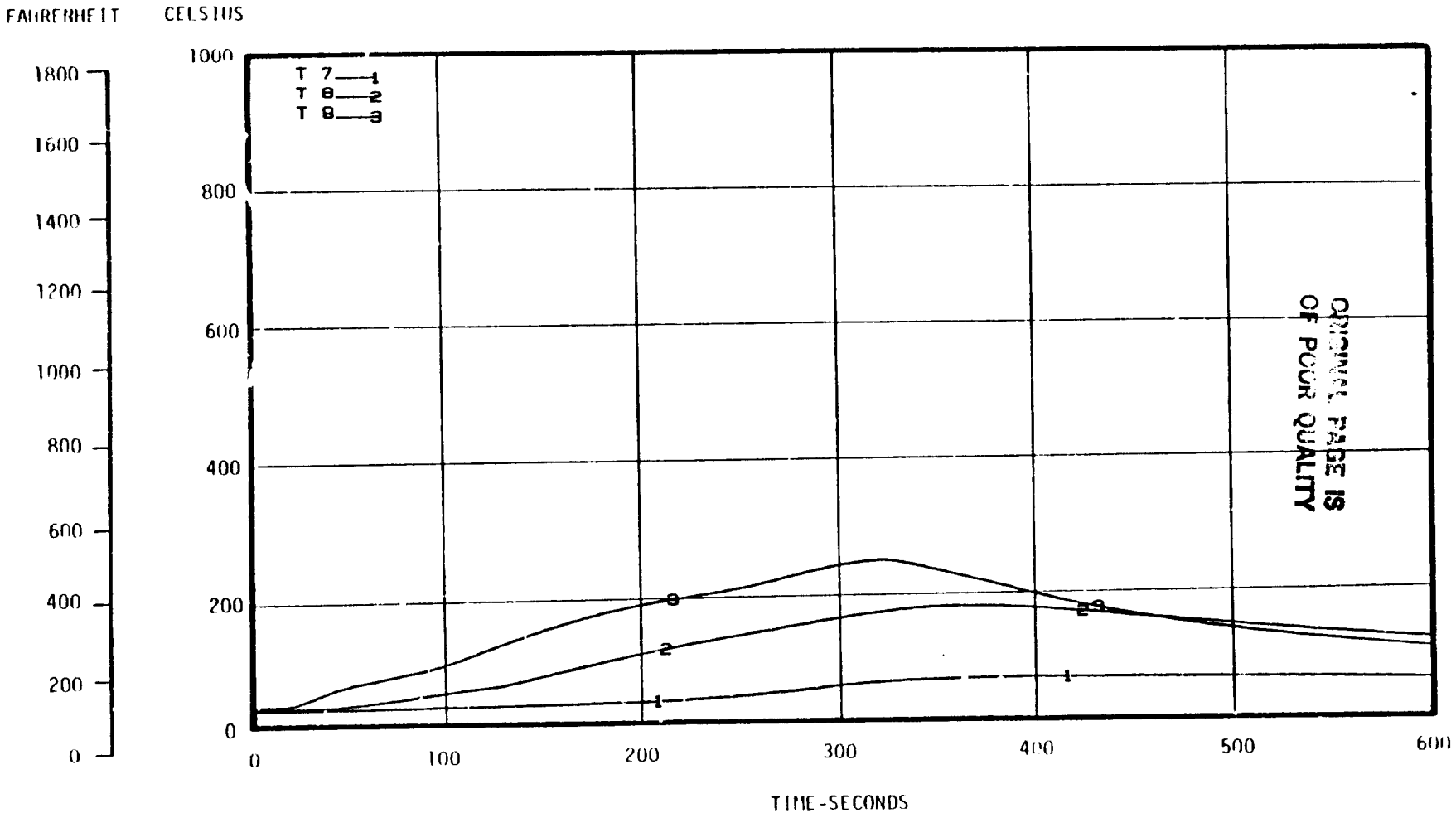
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 15.06
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18
CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 15.08
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18
CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES

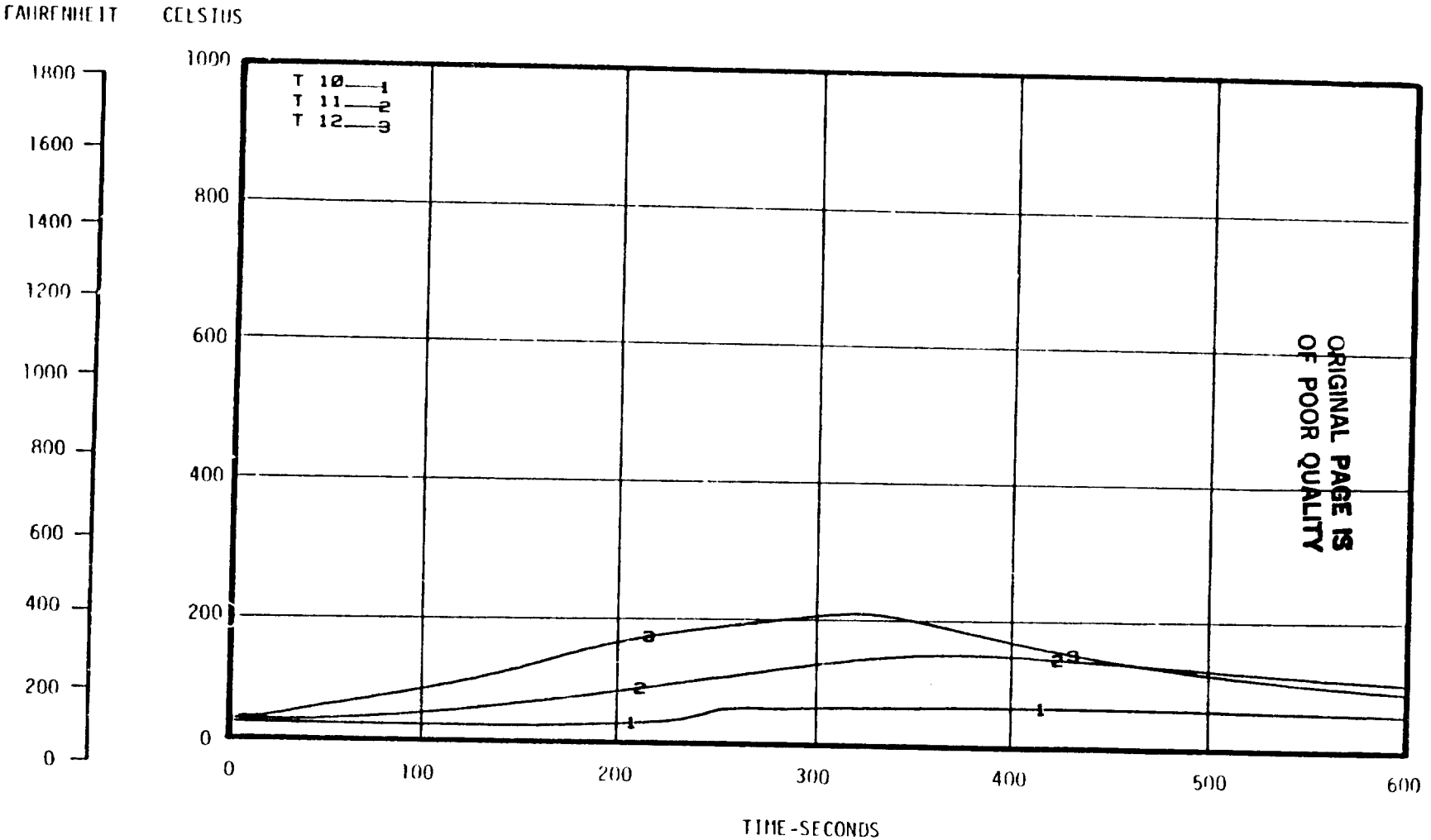


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 15:06

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES

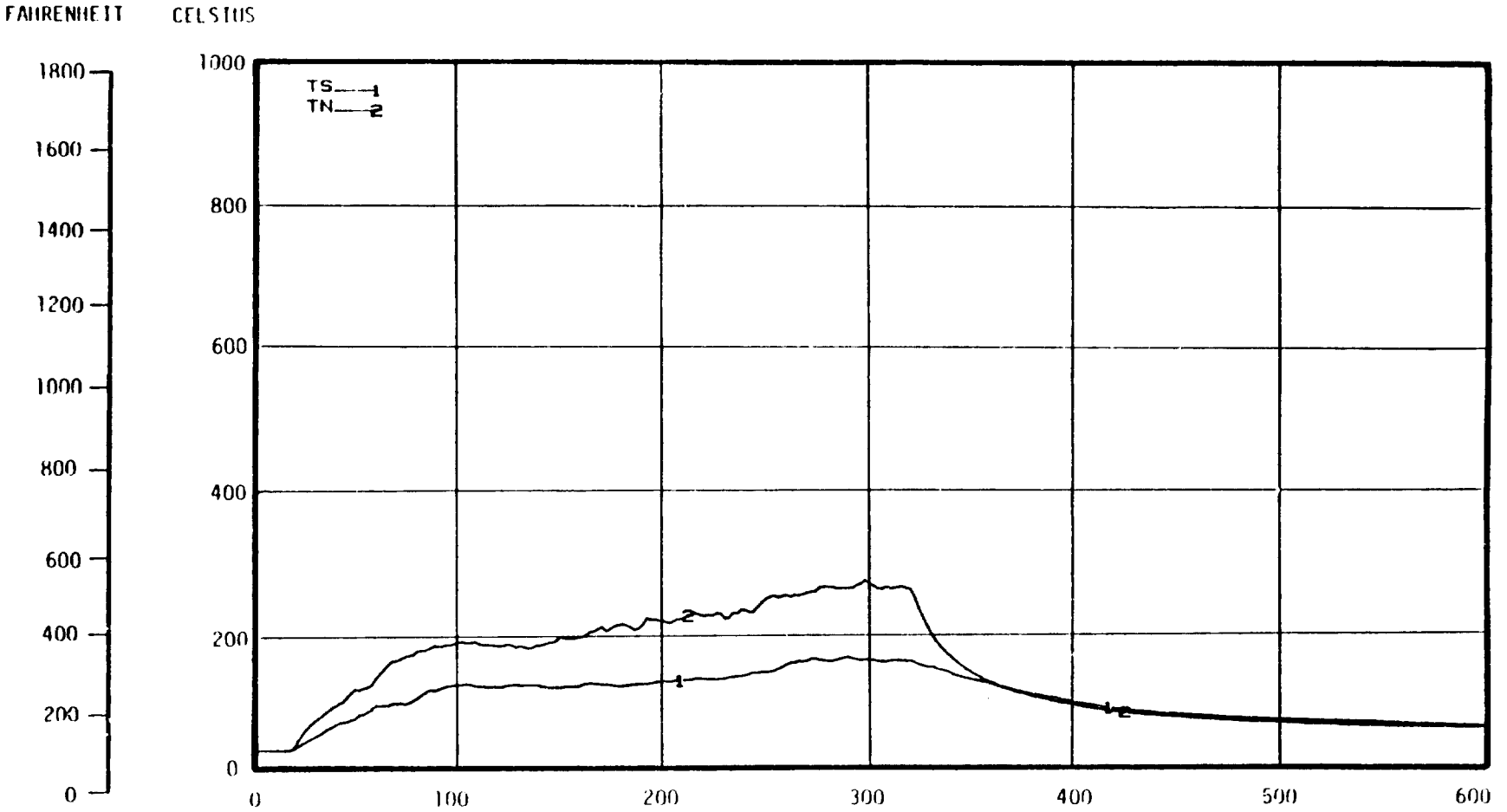


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 15:06

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

CUSHION CONSTRUCTION NUMBER 8.0

CEILING TEMPERATURE

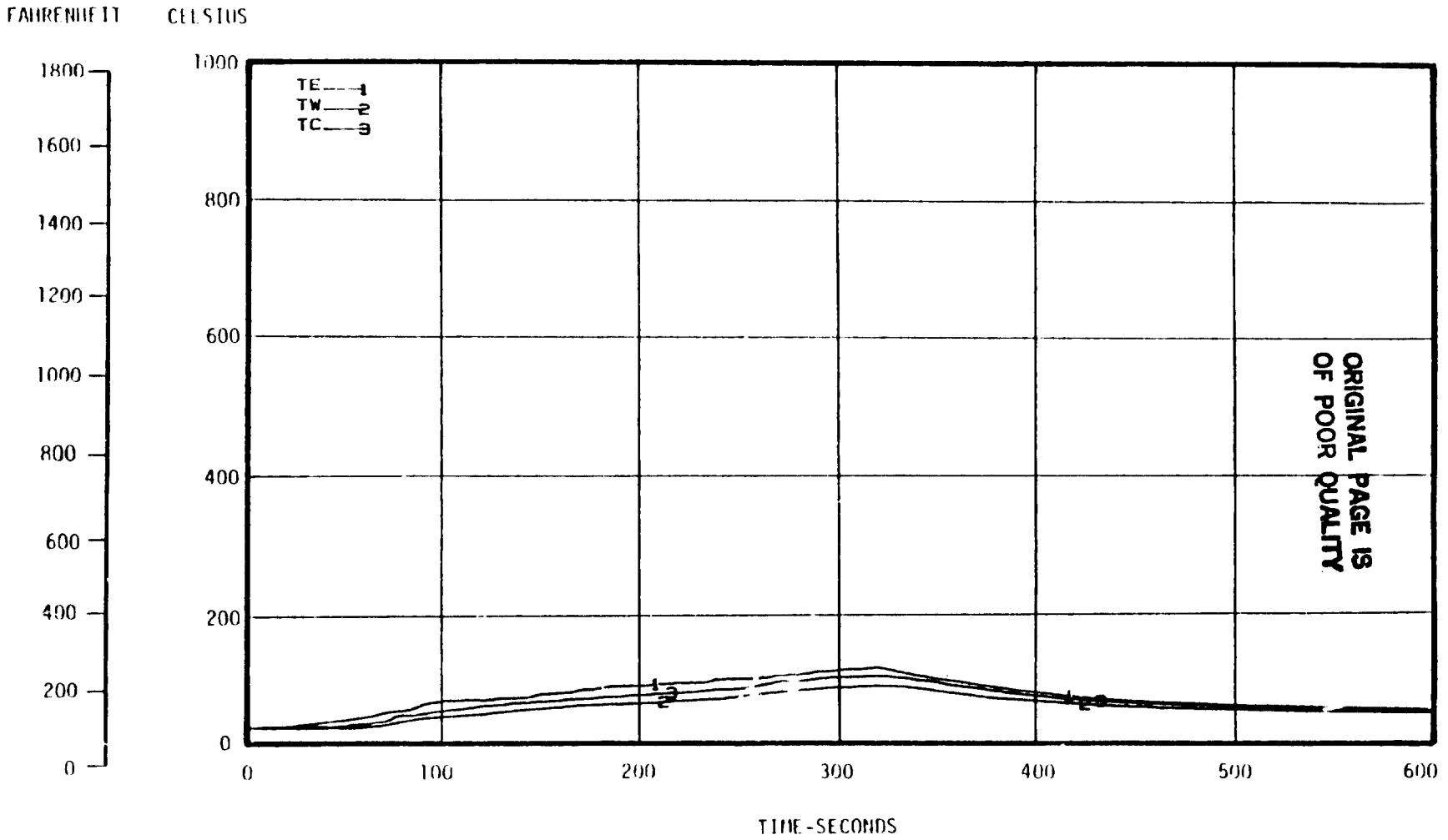


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 15.08

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

CUSHION CONSTRUCTION NUMBER 8.0

CEILING TEMPERATURE

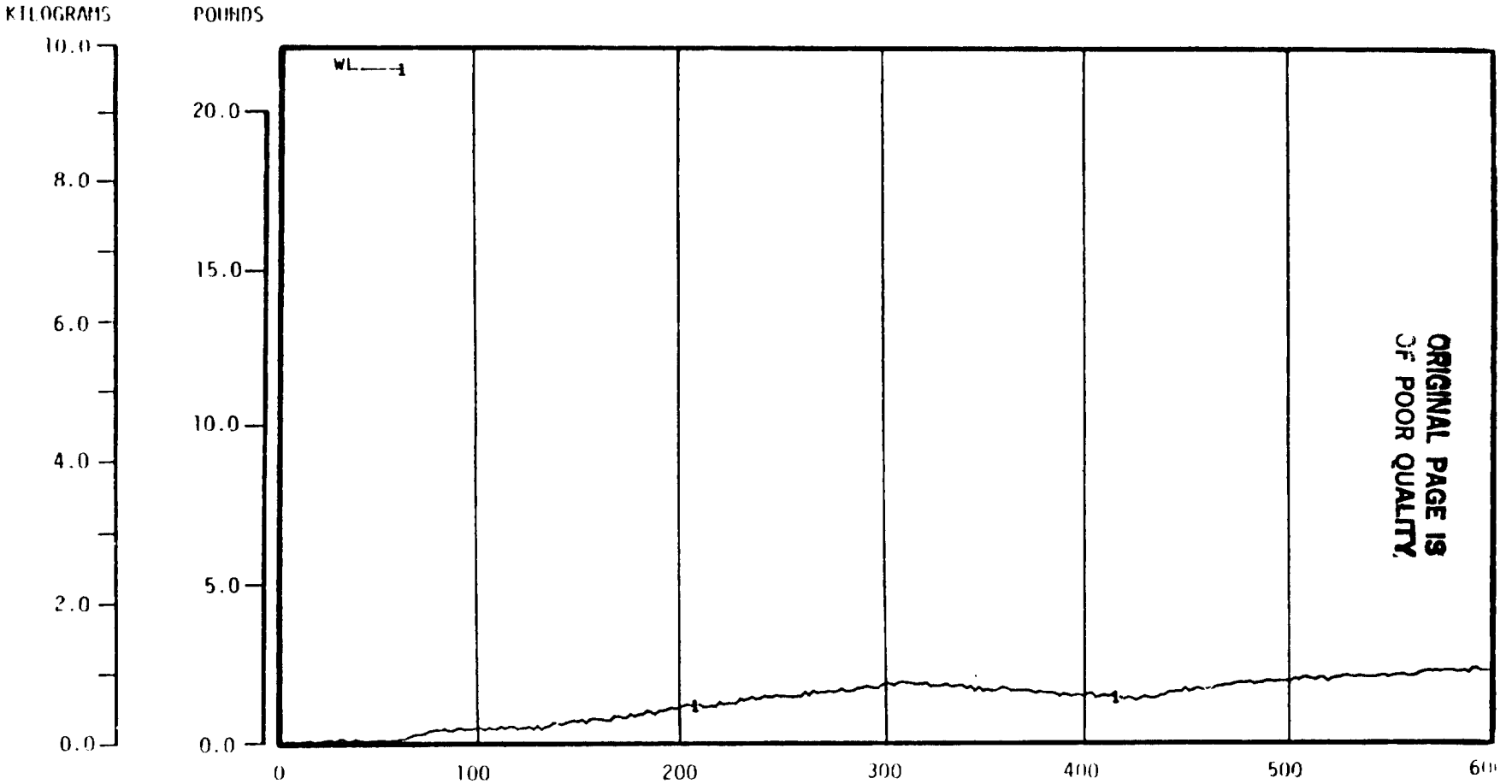


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/16/82 15.08

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

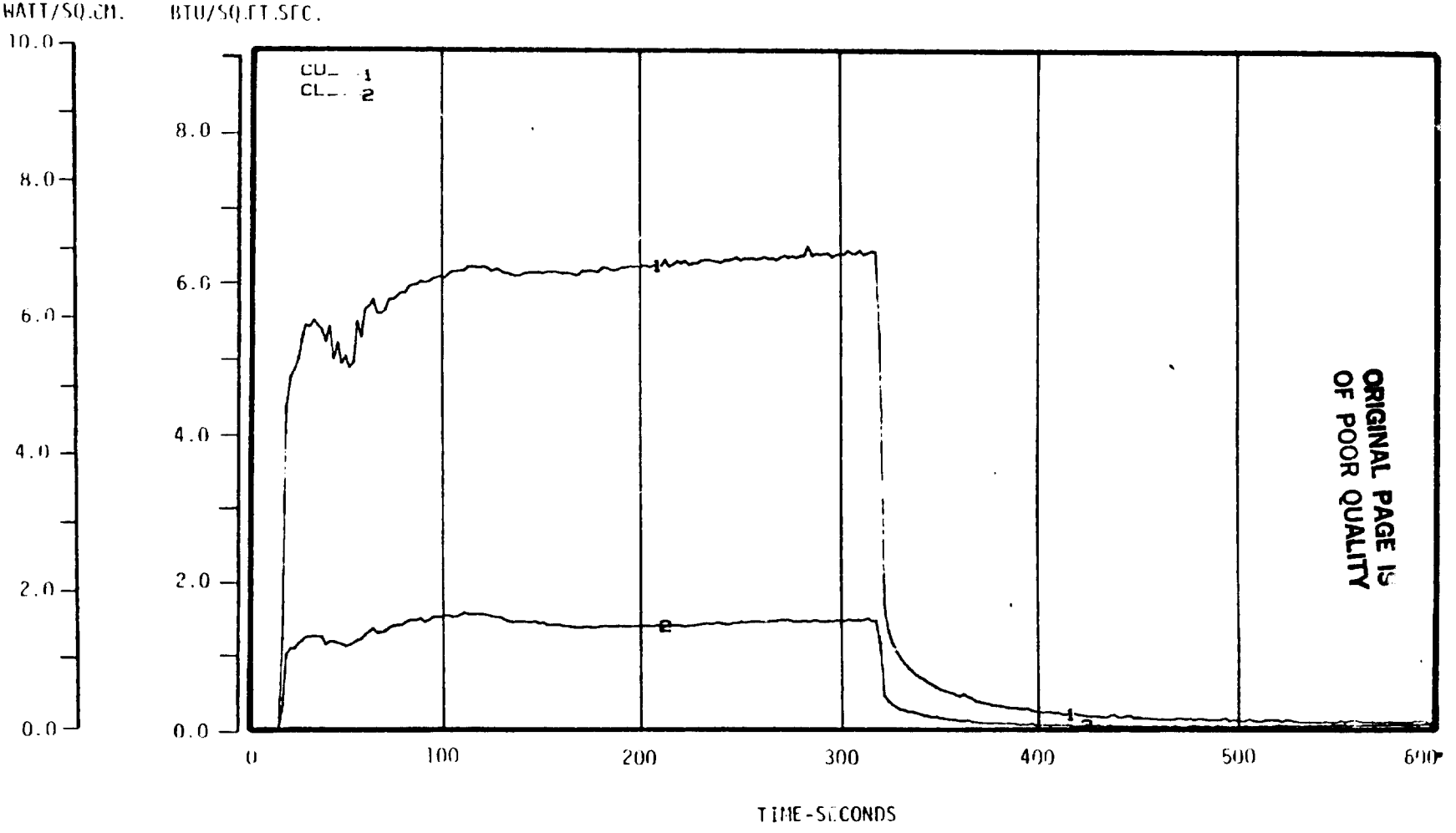
CUSHION CONSTRUCTION NUMBER 8.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 15.08
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18
CUSHION CONSTRUCTION NUMBER 8.0

HEAT FLUX

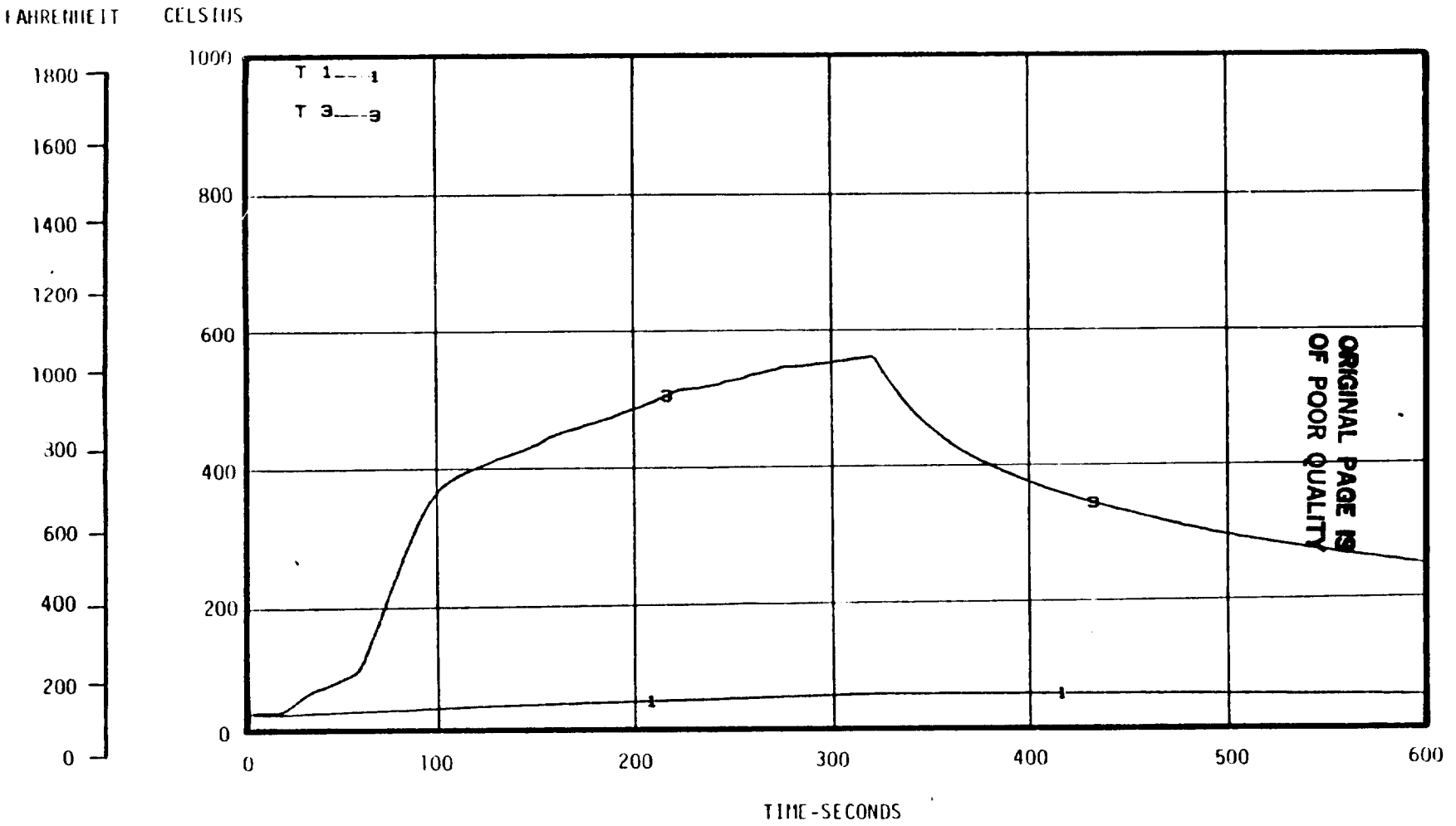


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09.15

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8

CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES

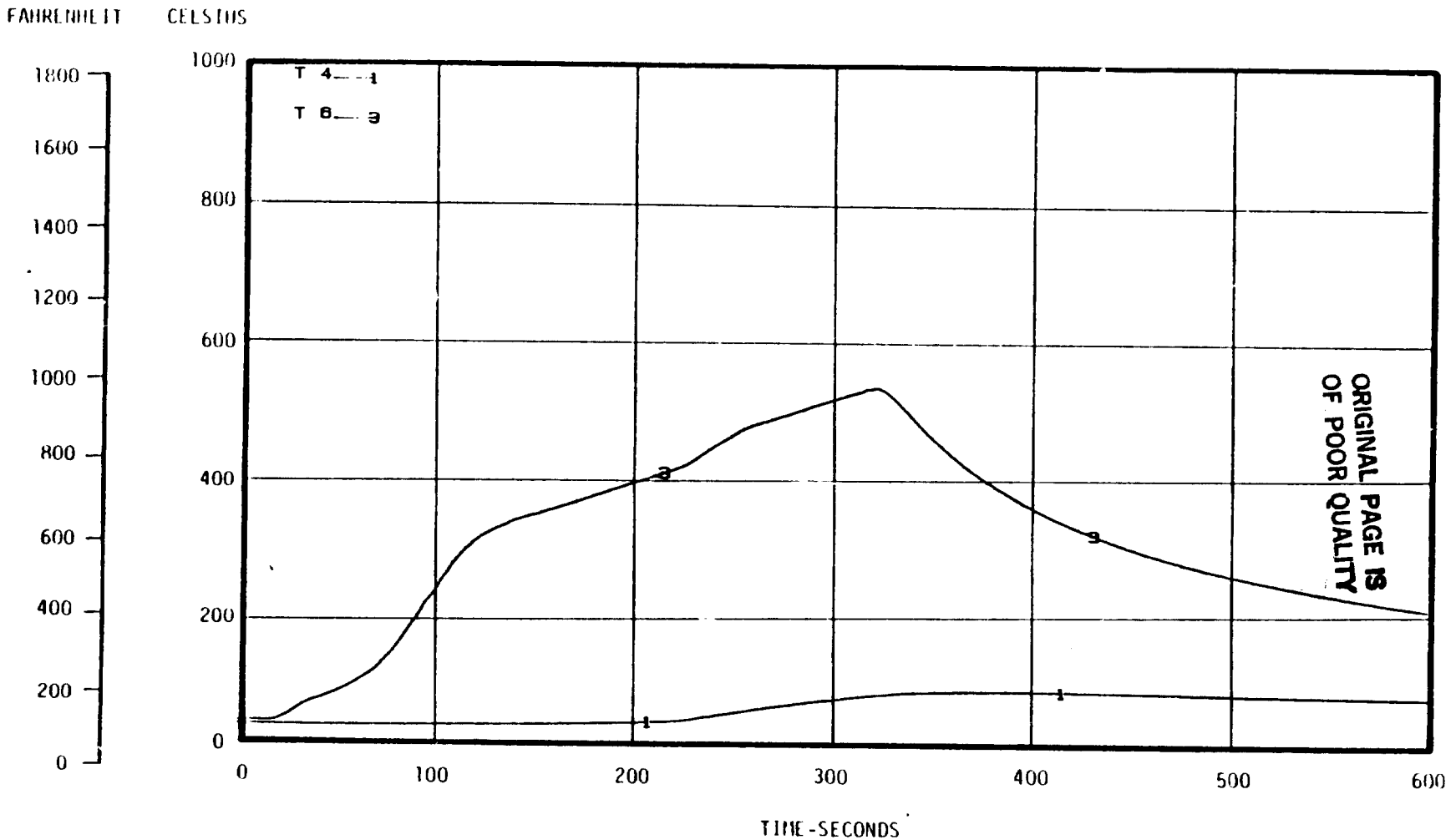


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09.40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8.

CUSHION CONSTRUCTION NUMBER 9.0

SEAT CUSHION TEMPERATURES

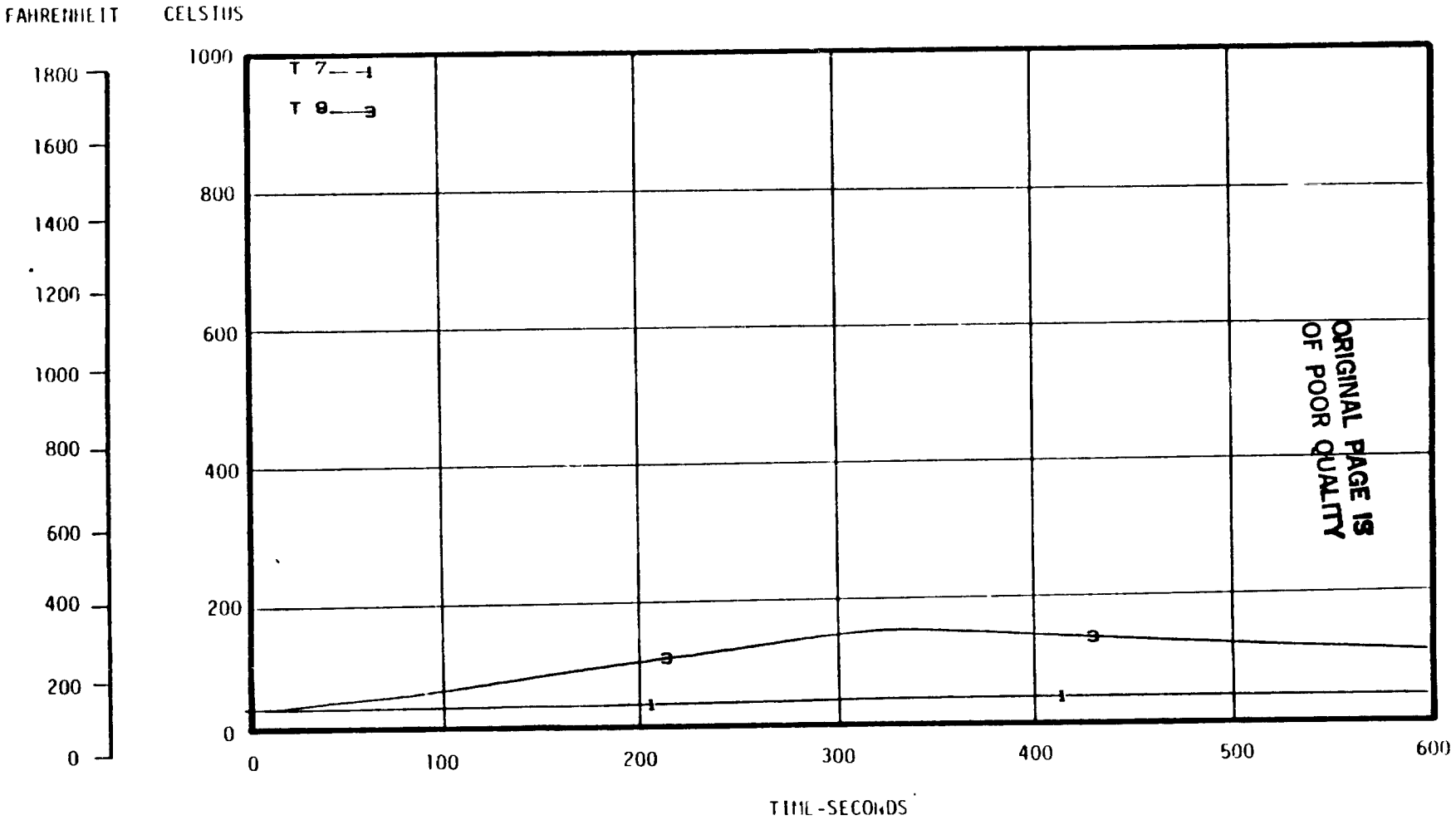


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09. 40.

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER . 8.

CUSHION CONSTRUCTION NUMBER . 8-A

SEAT CUSHION TEMPERATURES

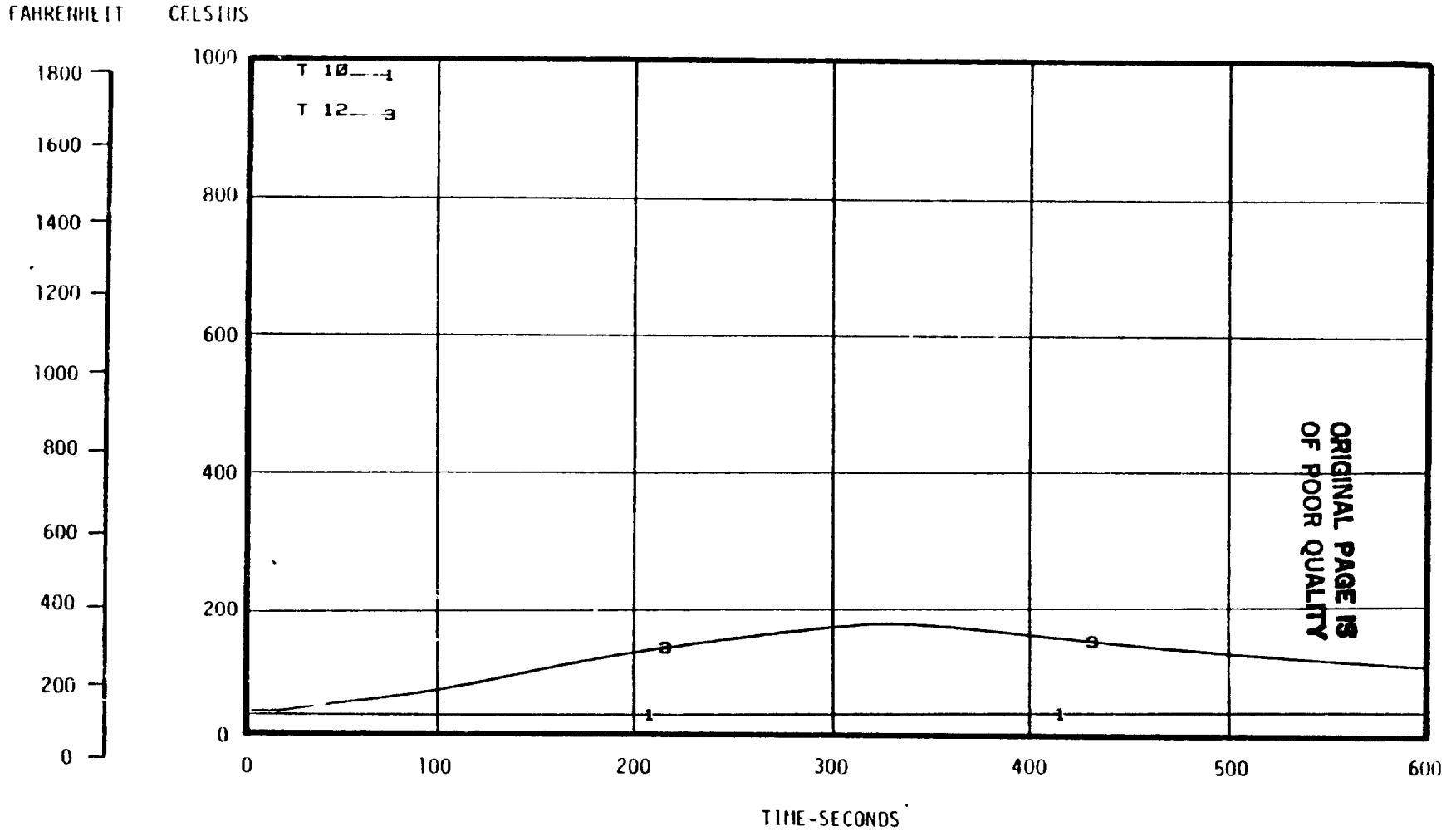


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09.40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8

CUSHION CONSTRUCTION NUMBER 9A

SEAT CUSHION TEMPERATURES

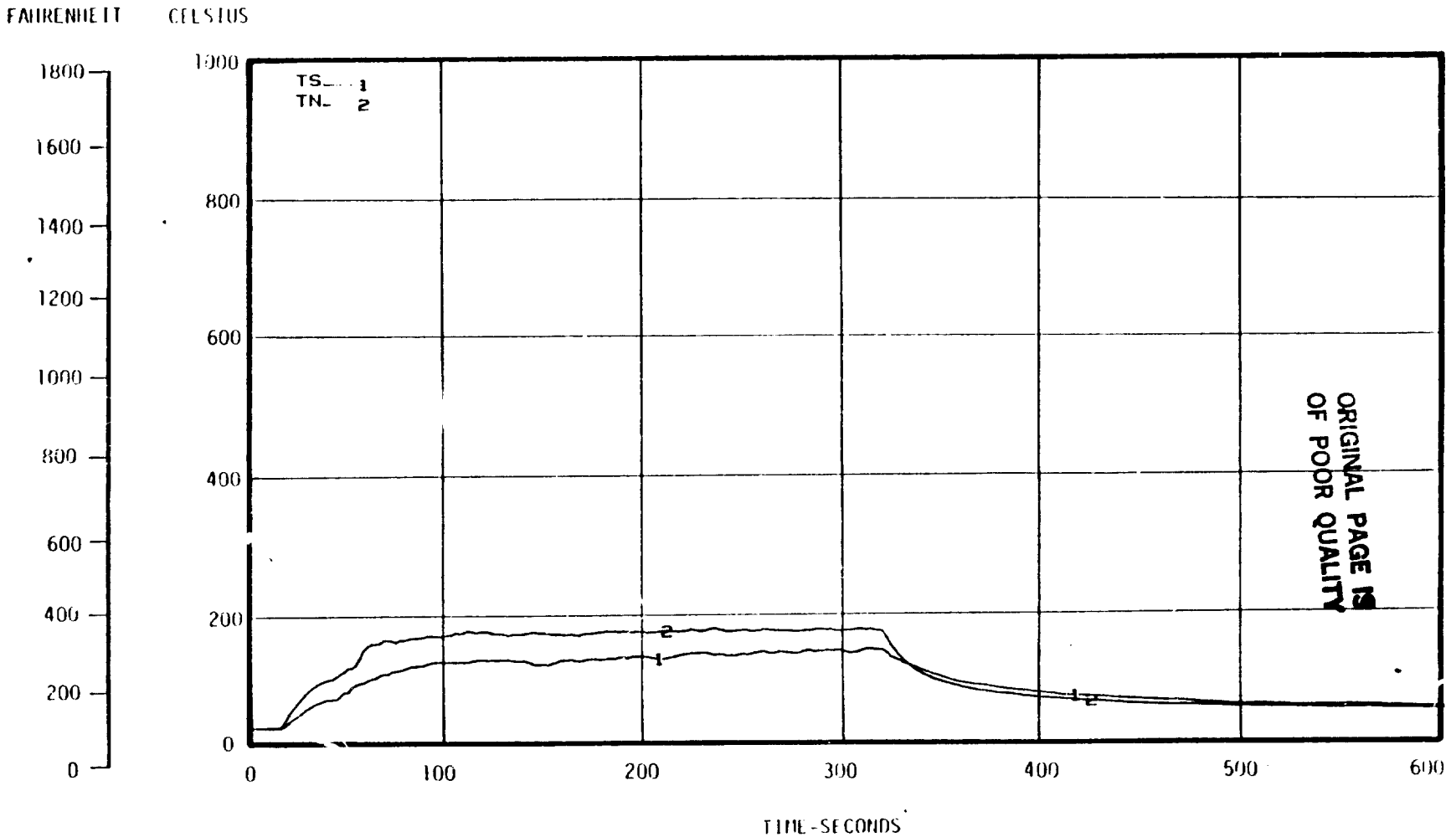


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09:40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8

CUSHION CONSTRUCTION NUMBER 9A

CEILING TEMPERATURE

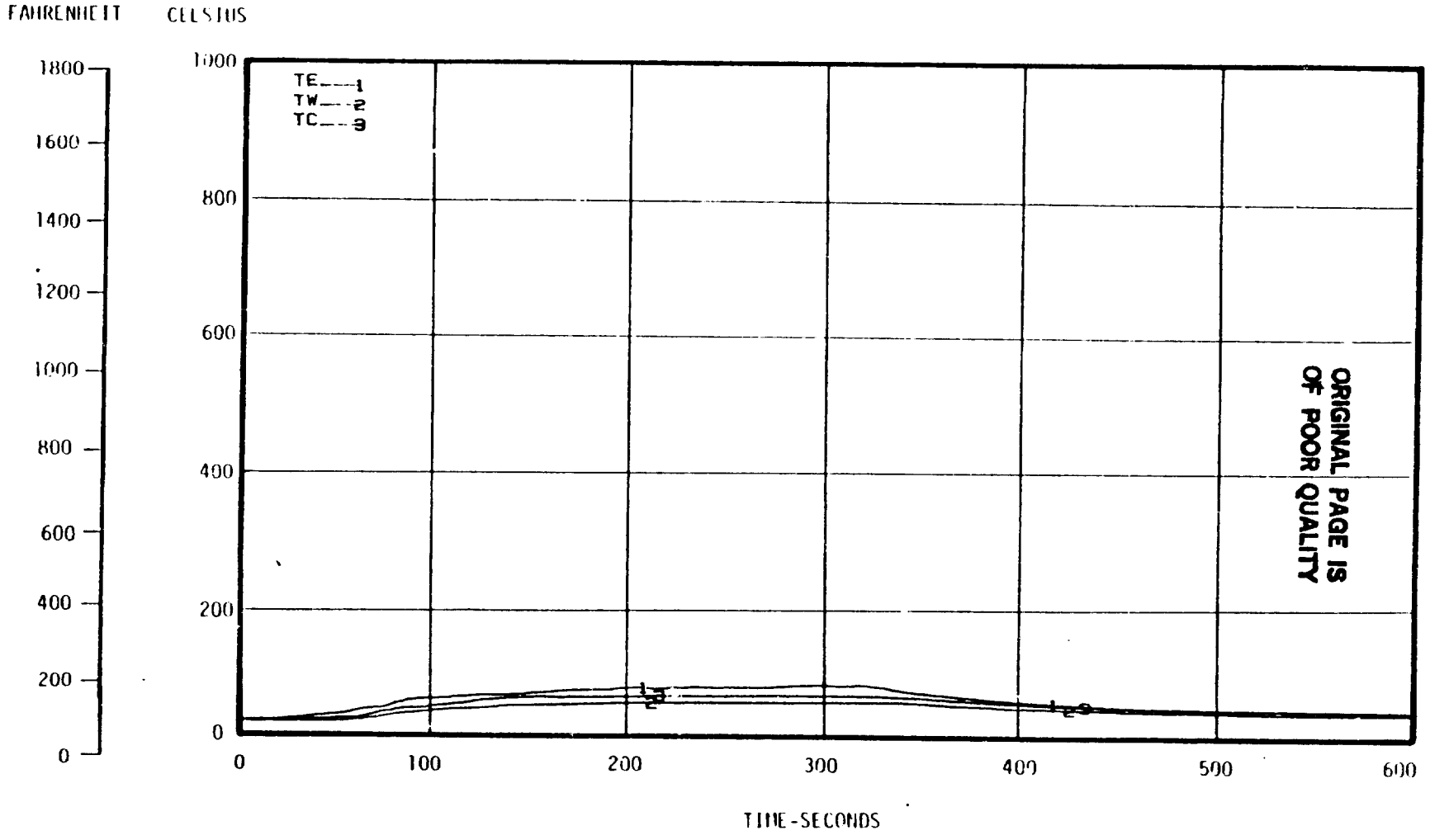


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09.40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8

CUSHION CONSTRUCTION NUMBER 9.0

CEILING TEMPERATURE

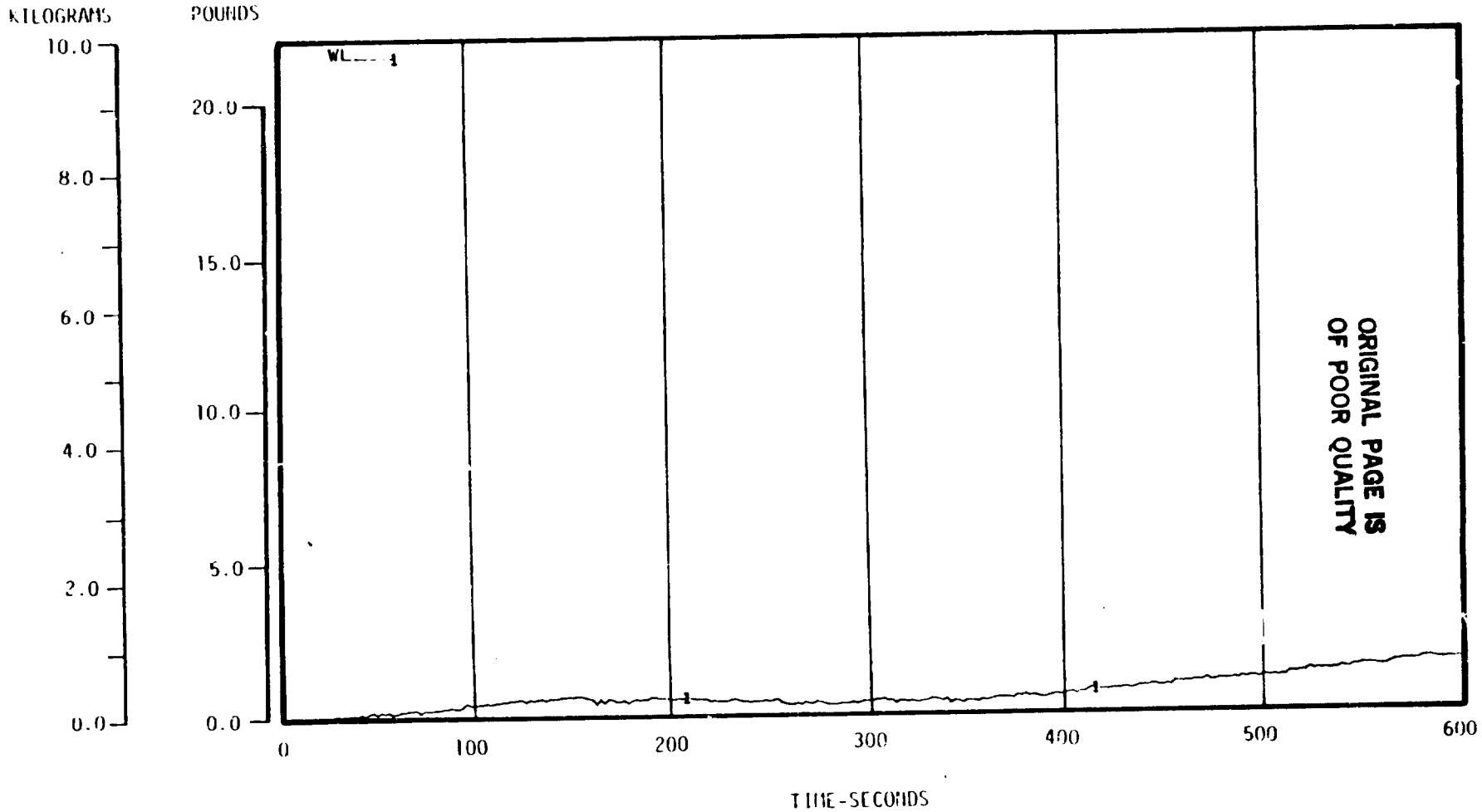


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09.40

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8

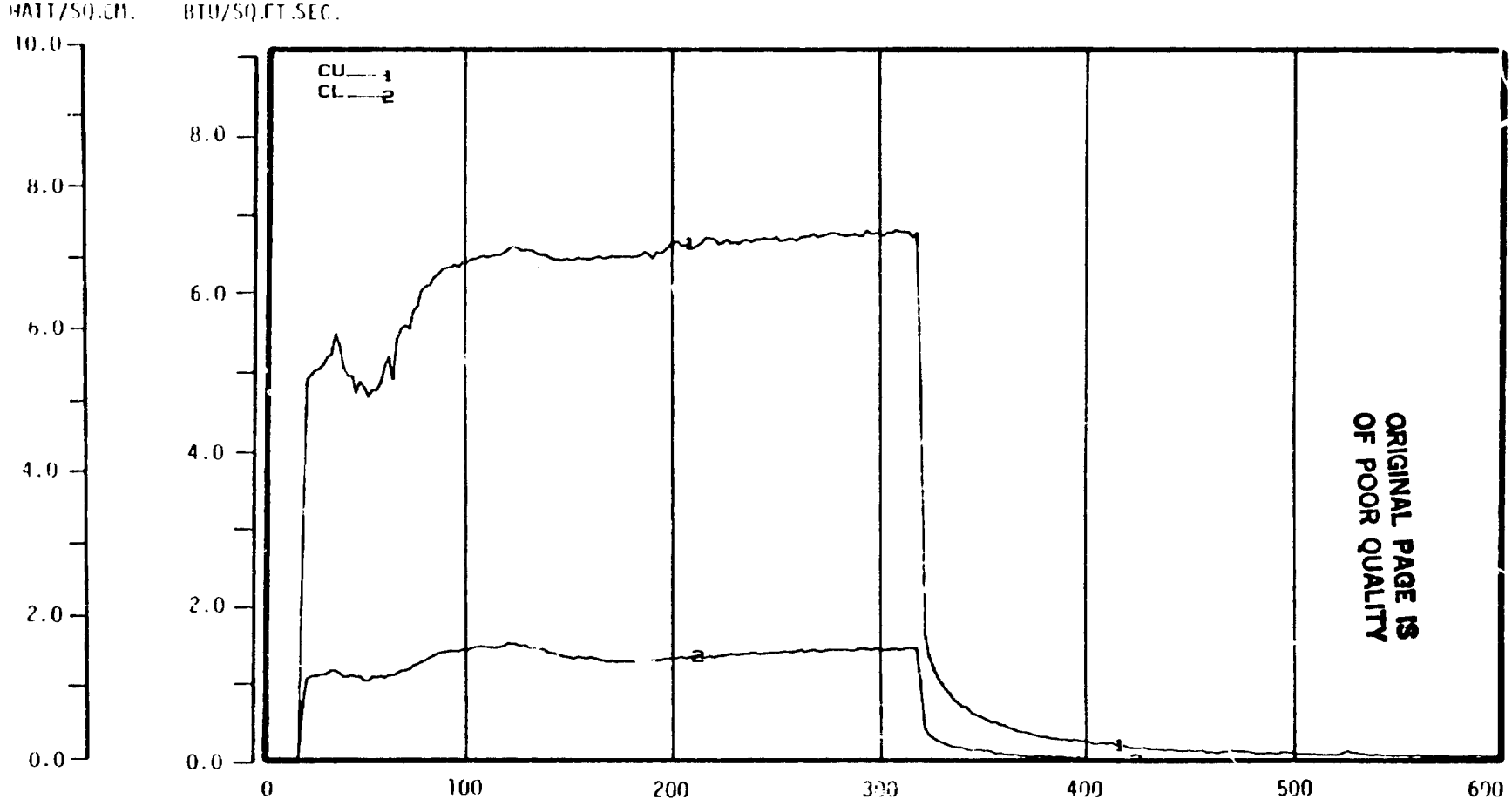
CUSHION CONSTRUCTION NUMBER 9.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 09.40
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8
CUSHION CONSTRUCTION NUMBER 8

HEAT FLUX

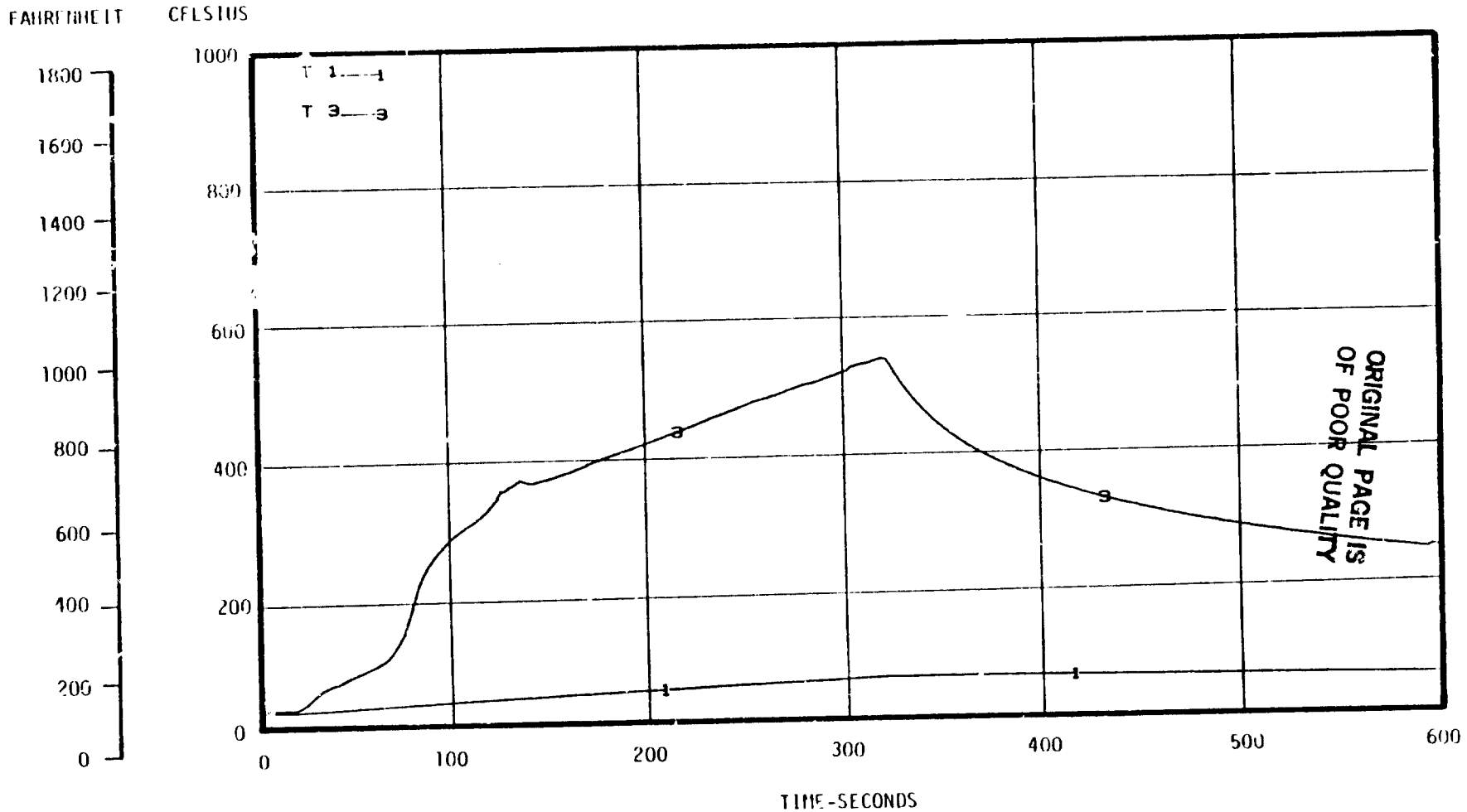


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 09.10

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 19

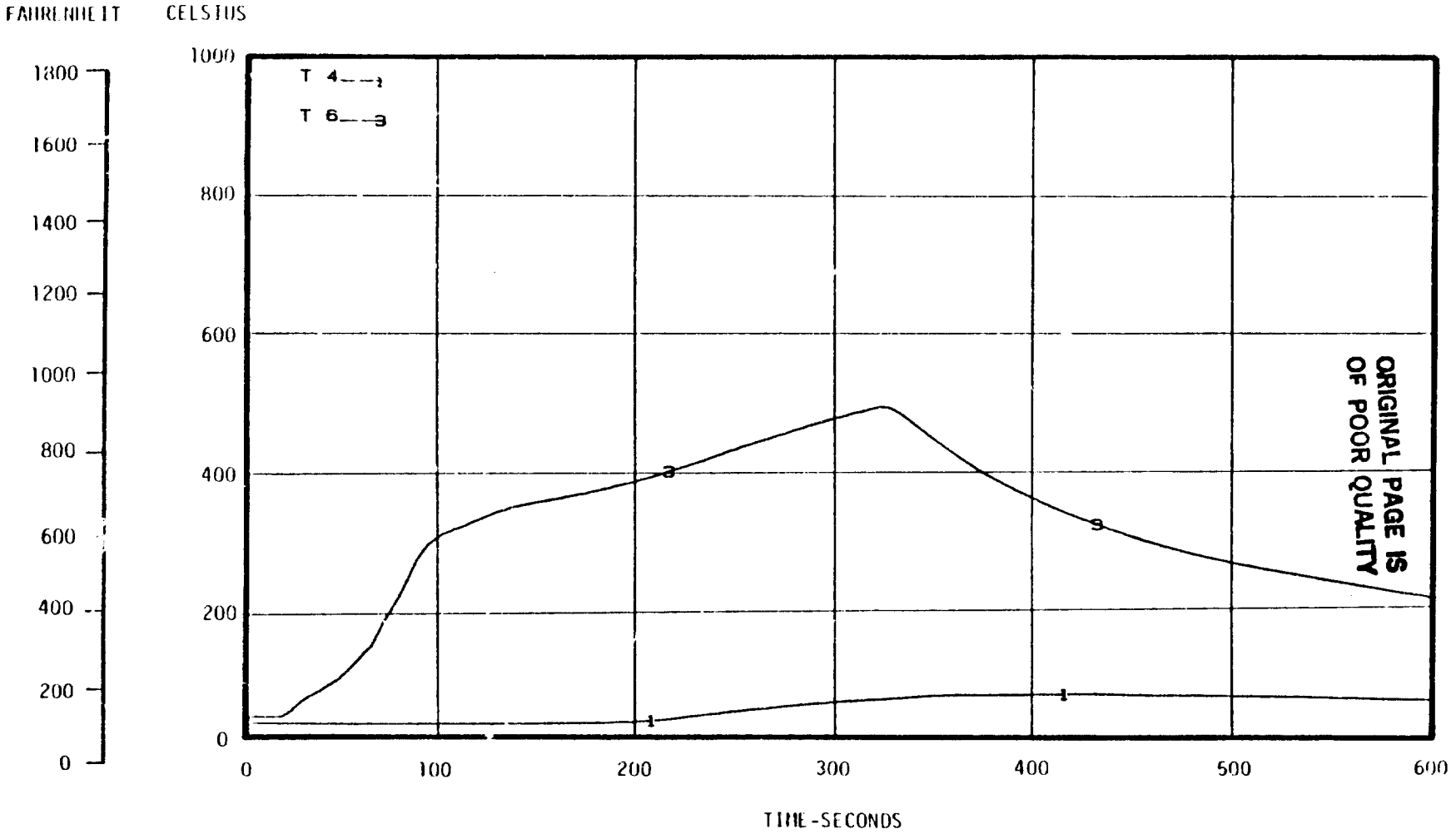
CUSHION CONSTRUCTION NUMBER 9.0

SEAT CUSHION TEMPERATURES



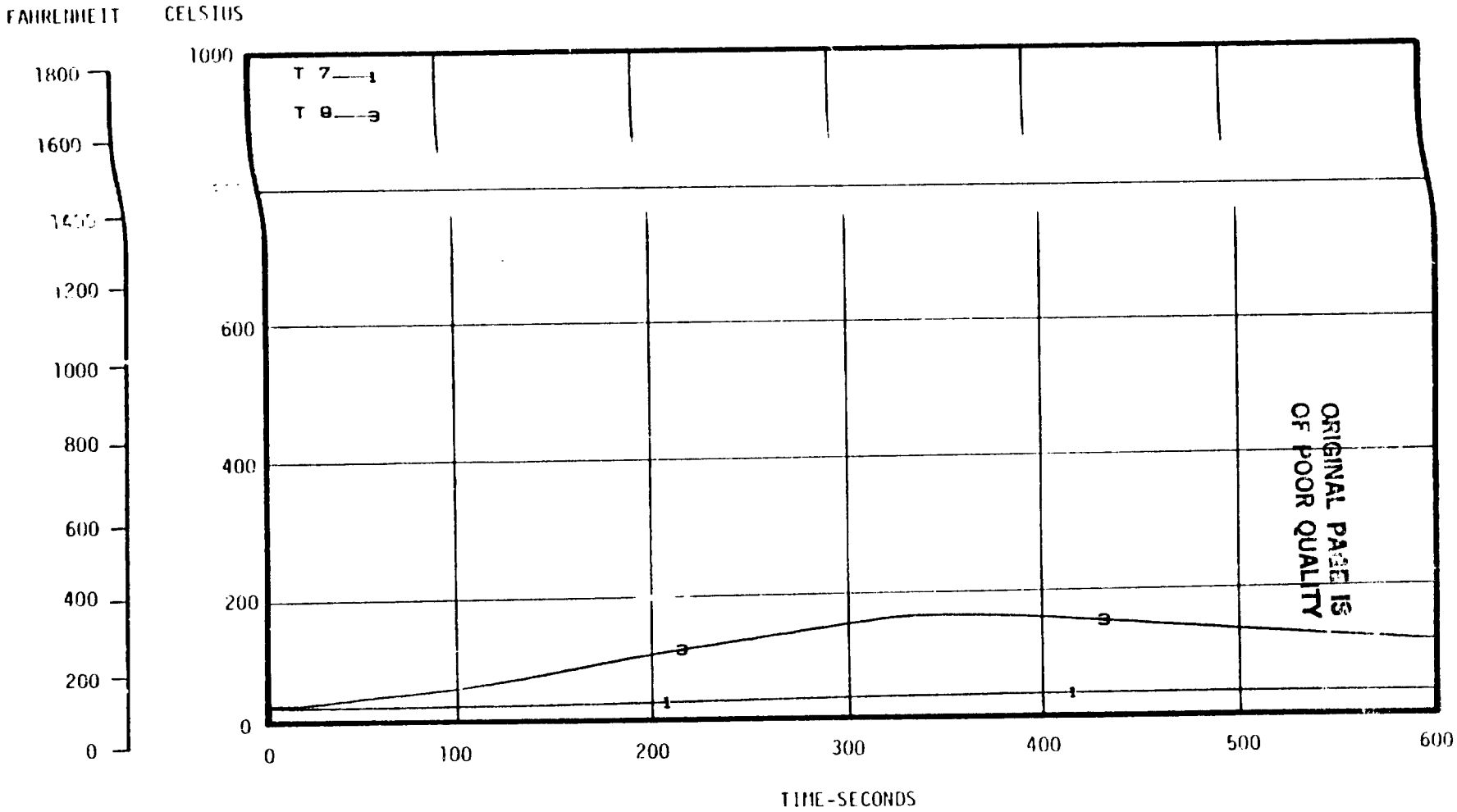
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 09.10
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10
CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 09.10
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 10
CUSHION CONSTRUCTION NUMBER 9.0

SEAT CUSHION TEMPERATURES

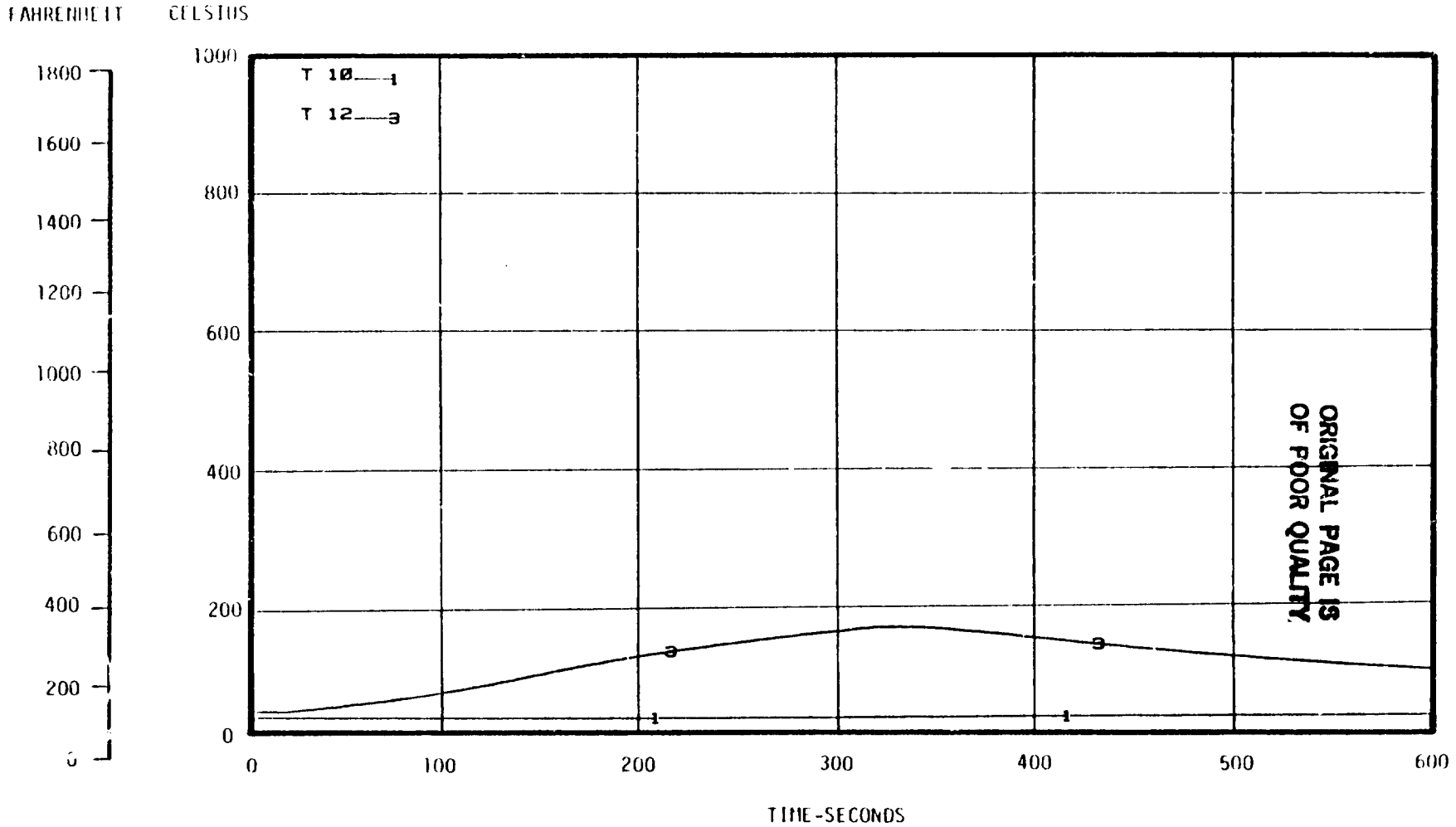


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 08.10

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

CUSHION CONSTRUCTION NUMBER 8.0

SEAT CUSHION TEMPERATURES

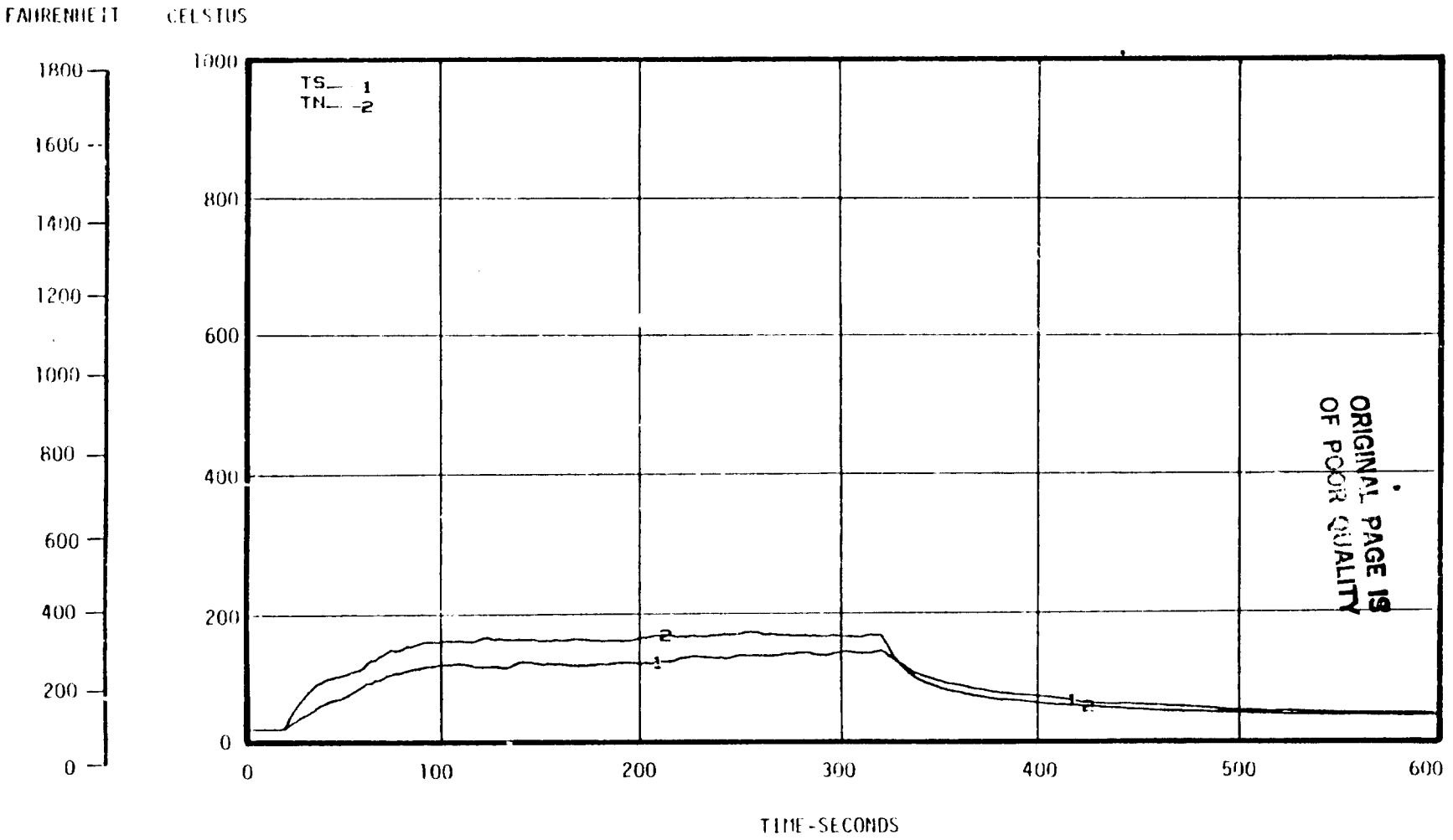


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 08.10

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

CUSHION CONSTRUCTION NUMBER 8.0

CEILING TEMPERATURE

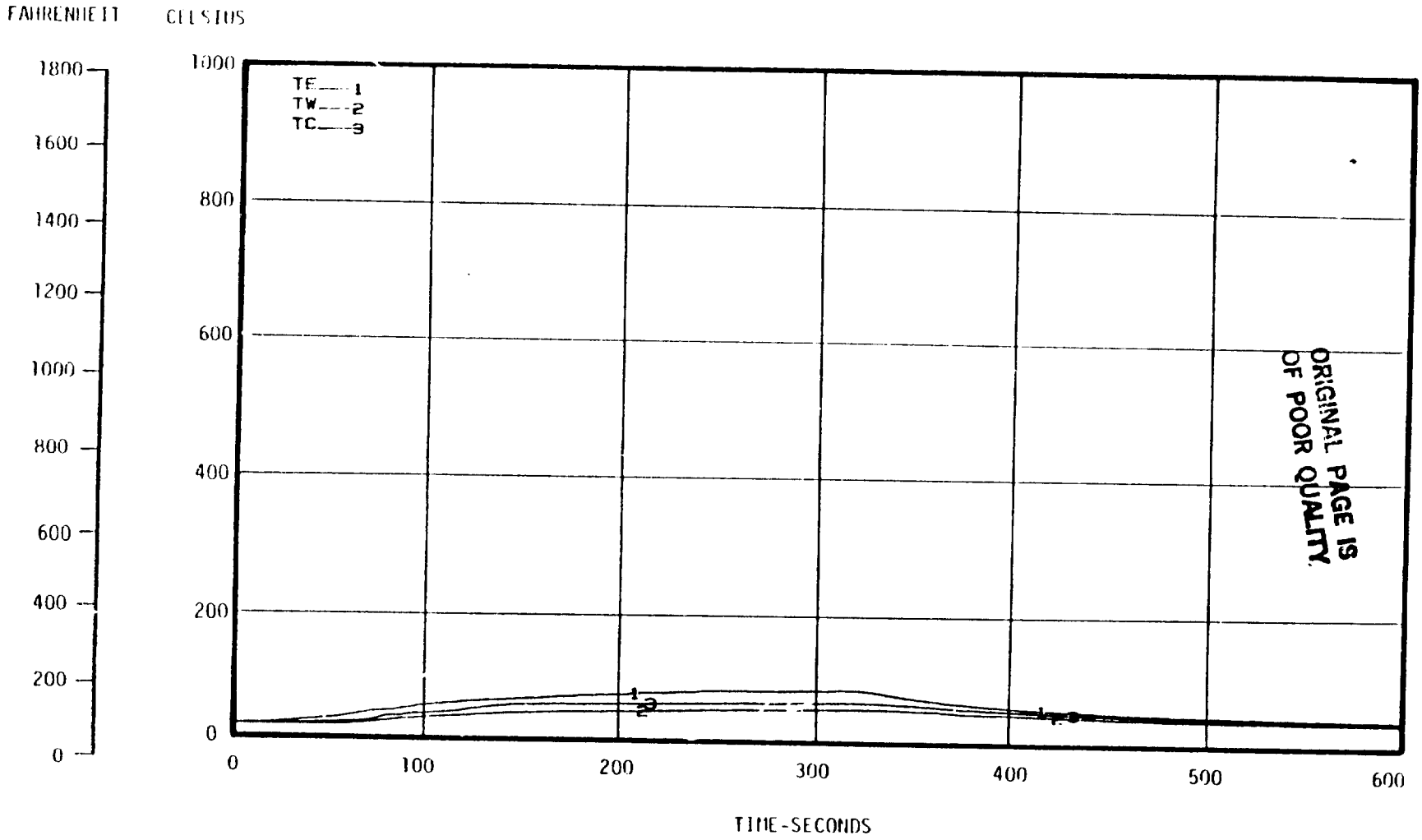


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 09.10

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

CUSHION CONSTRUCTION NUMBER 8.0

CEILING TEMPERATURE

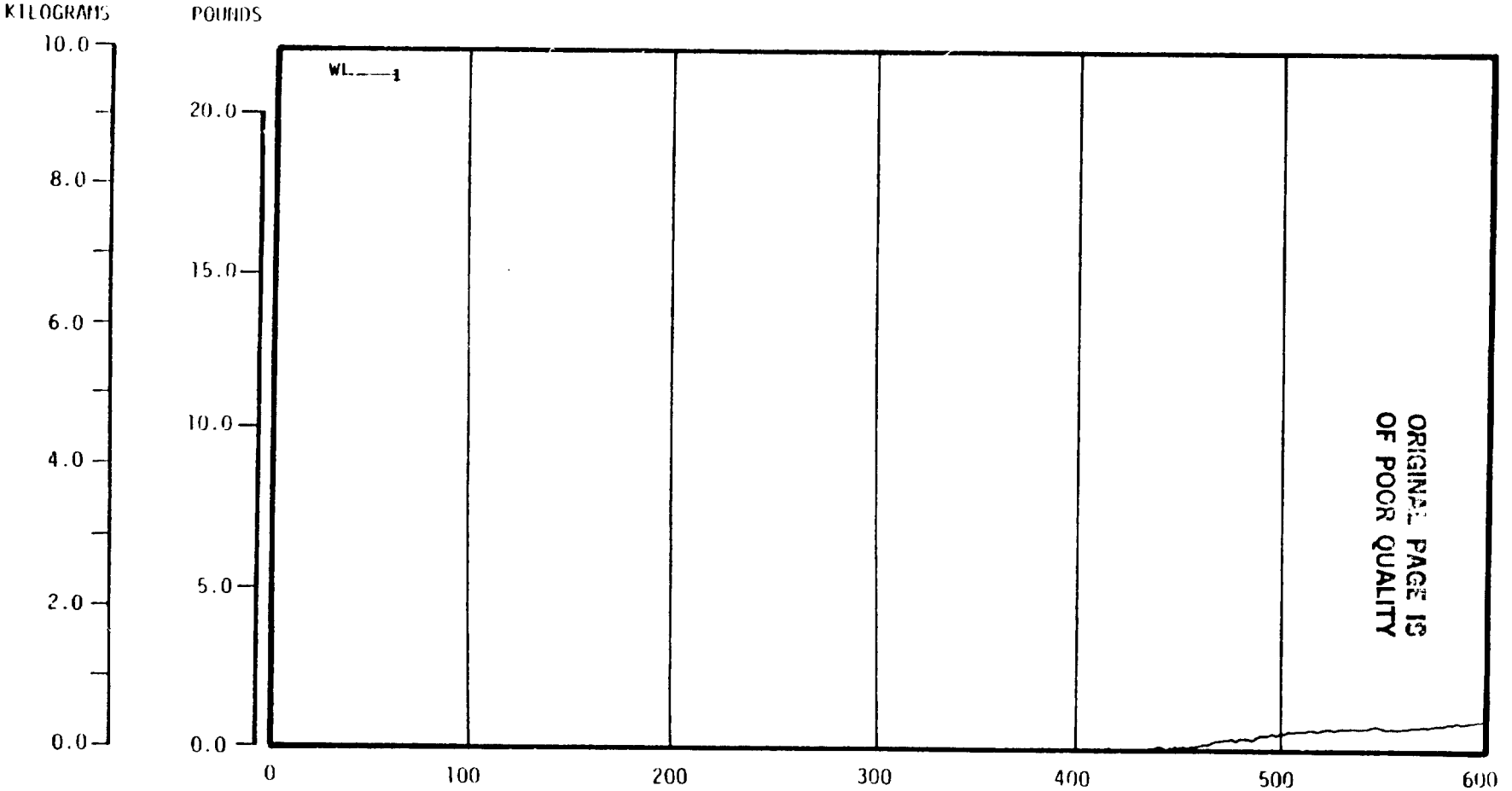


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 09.10

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 18

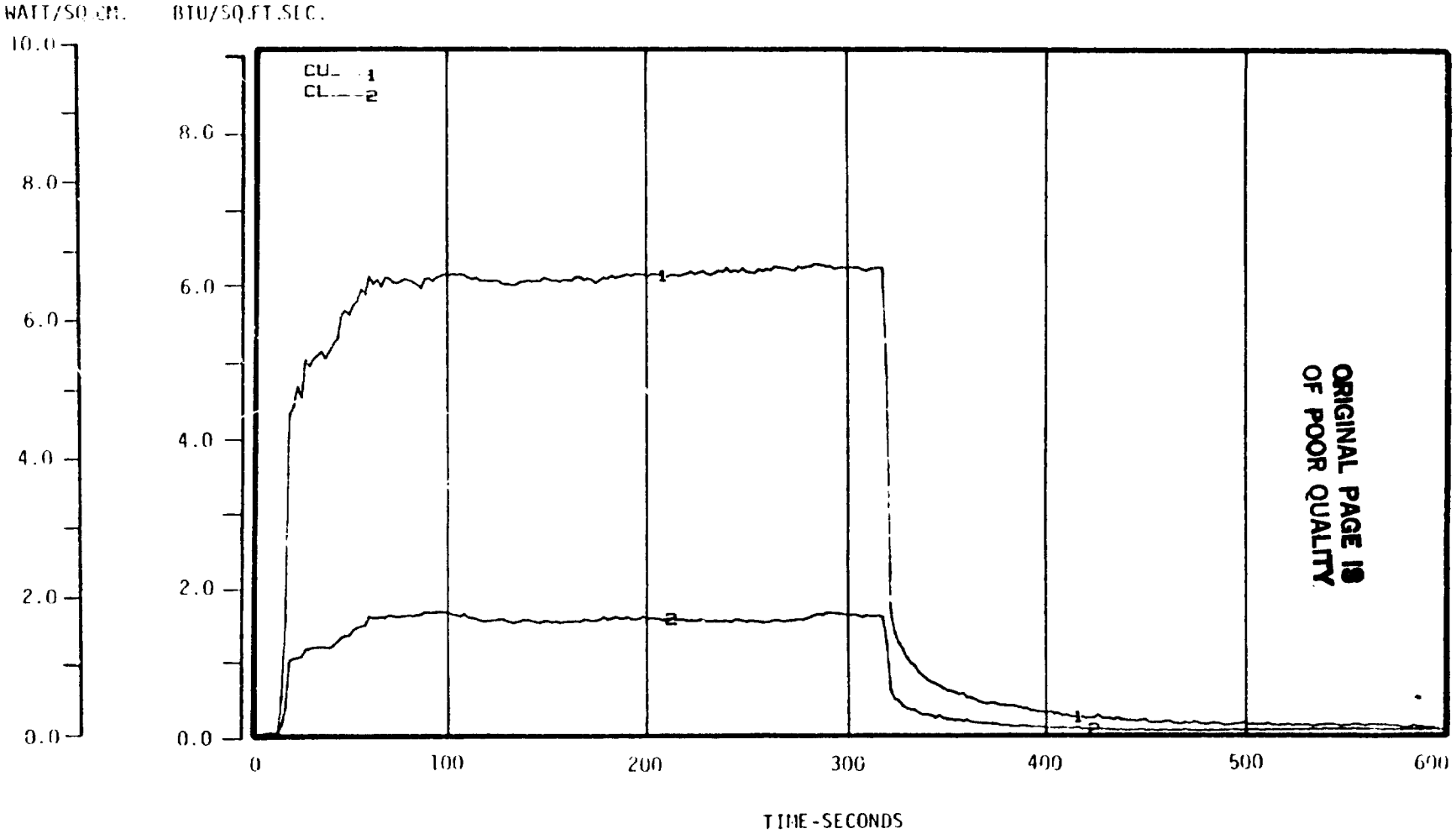
CUSHION CONSTRUCTION NUMBER 9.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/17/82 09:10
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 19
CUSHION CONSTRUCTION NUMBER 9.0

HEAT FLUX

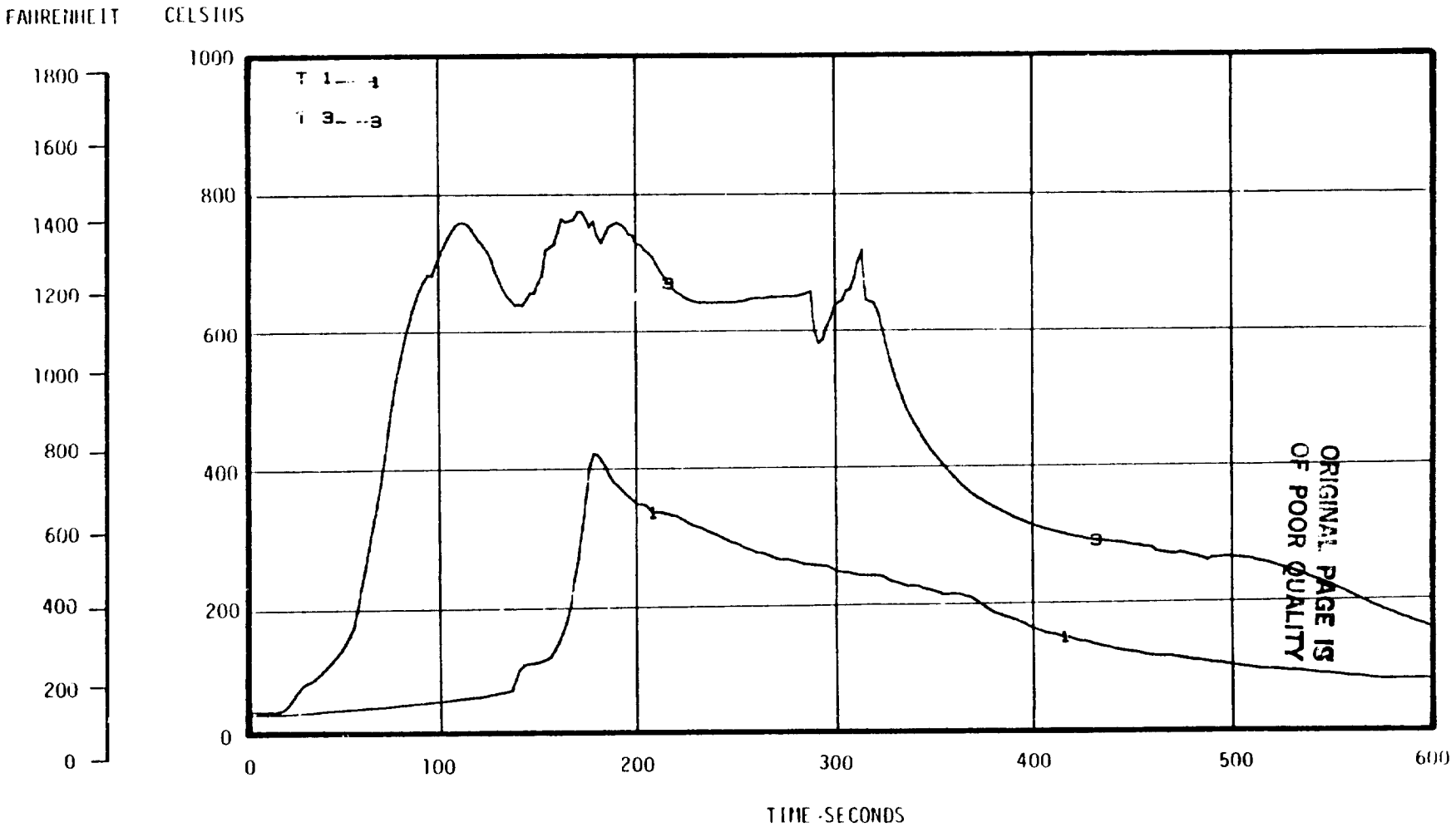


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14.31

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 9

CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES

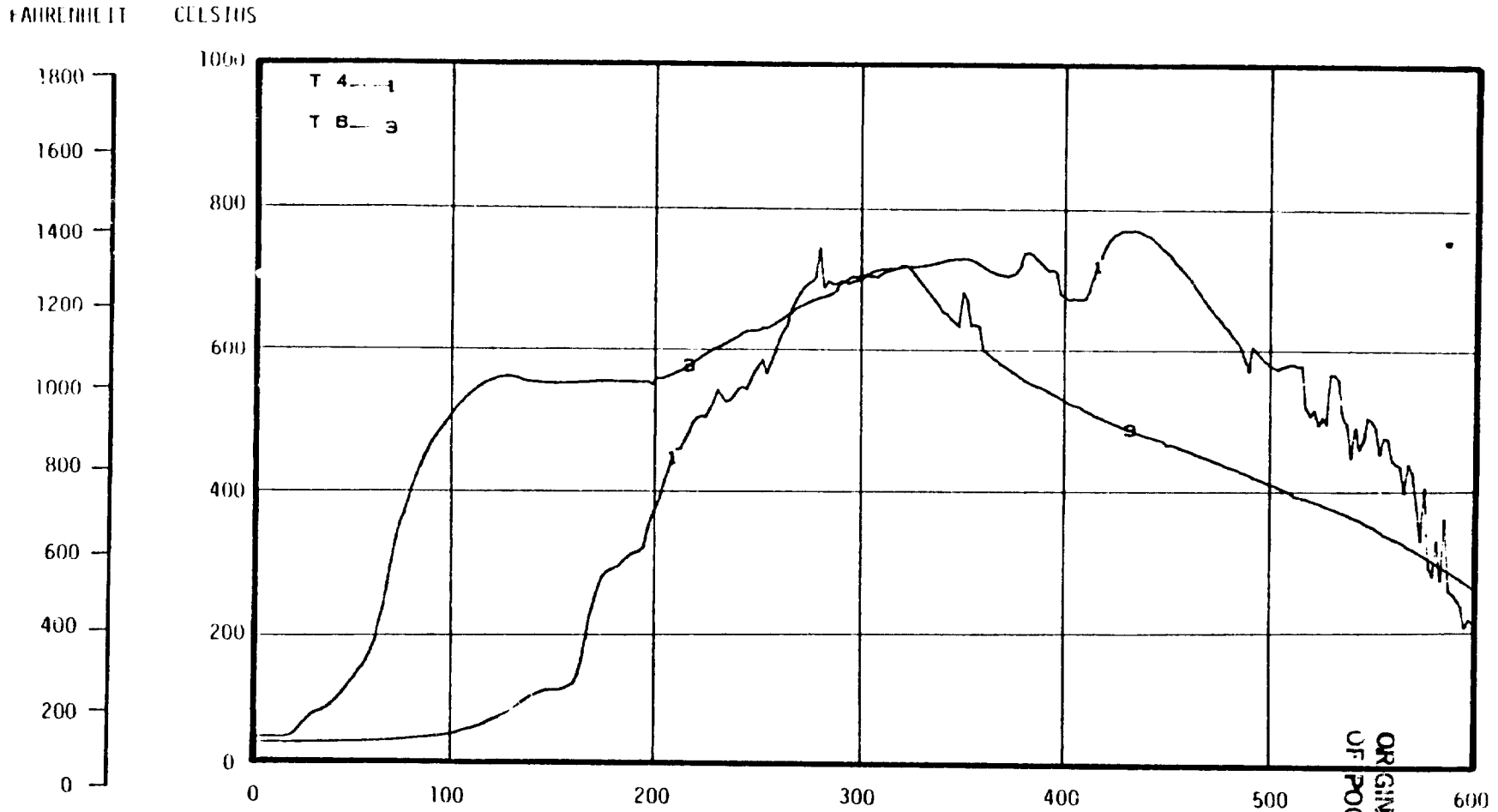


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14:31

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 0

CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES

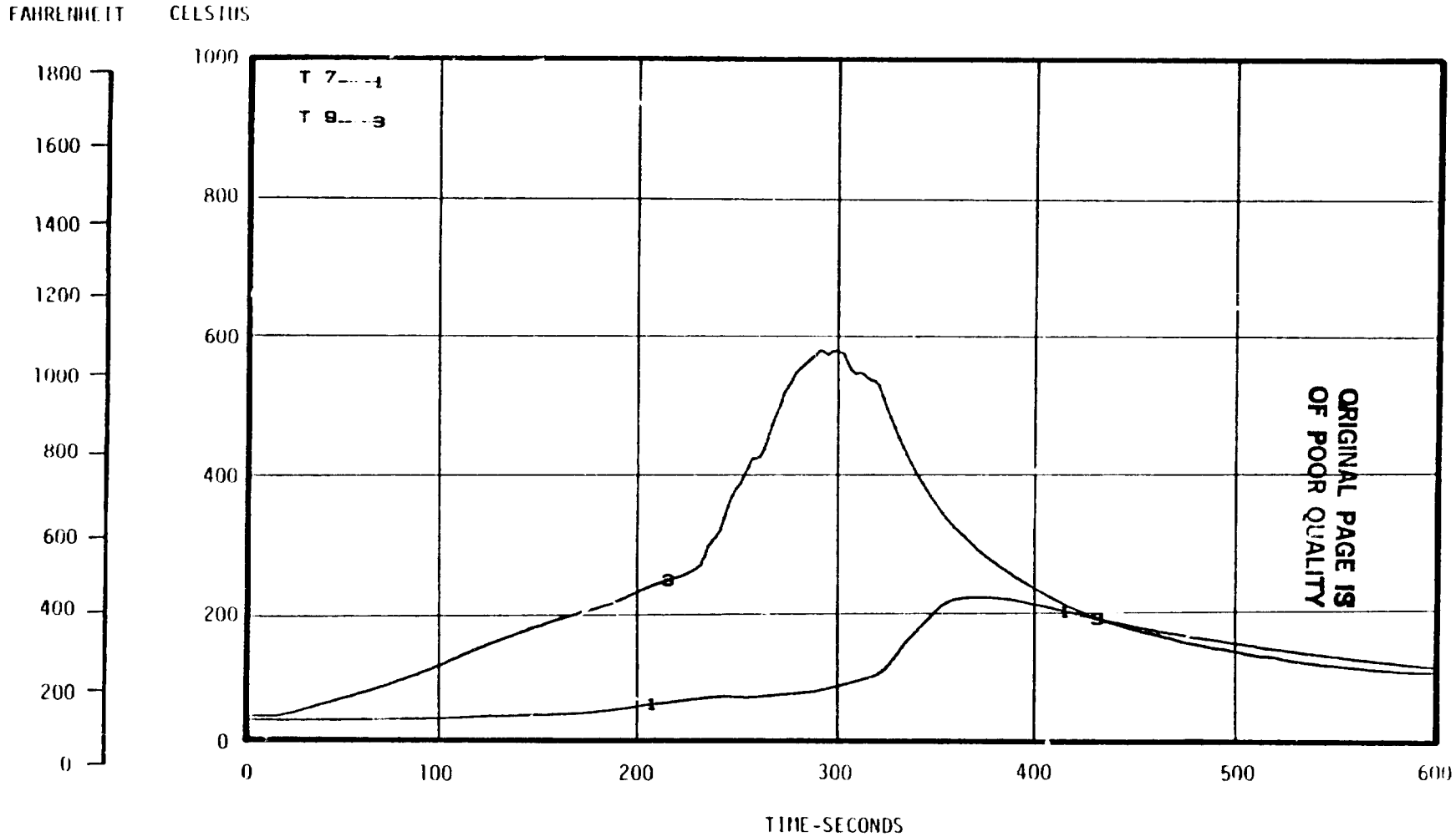


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14:31

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 9

CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES

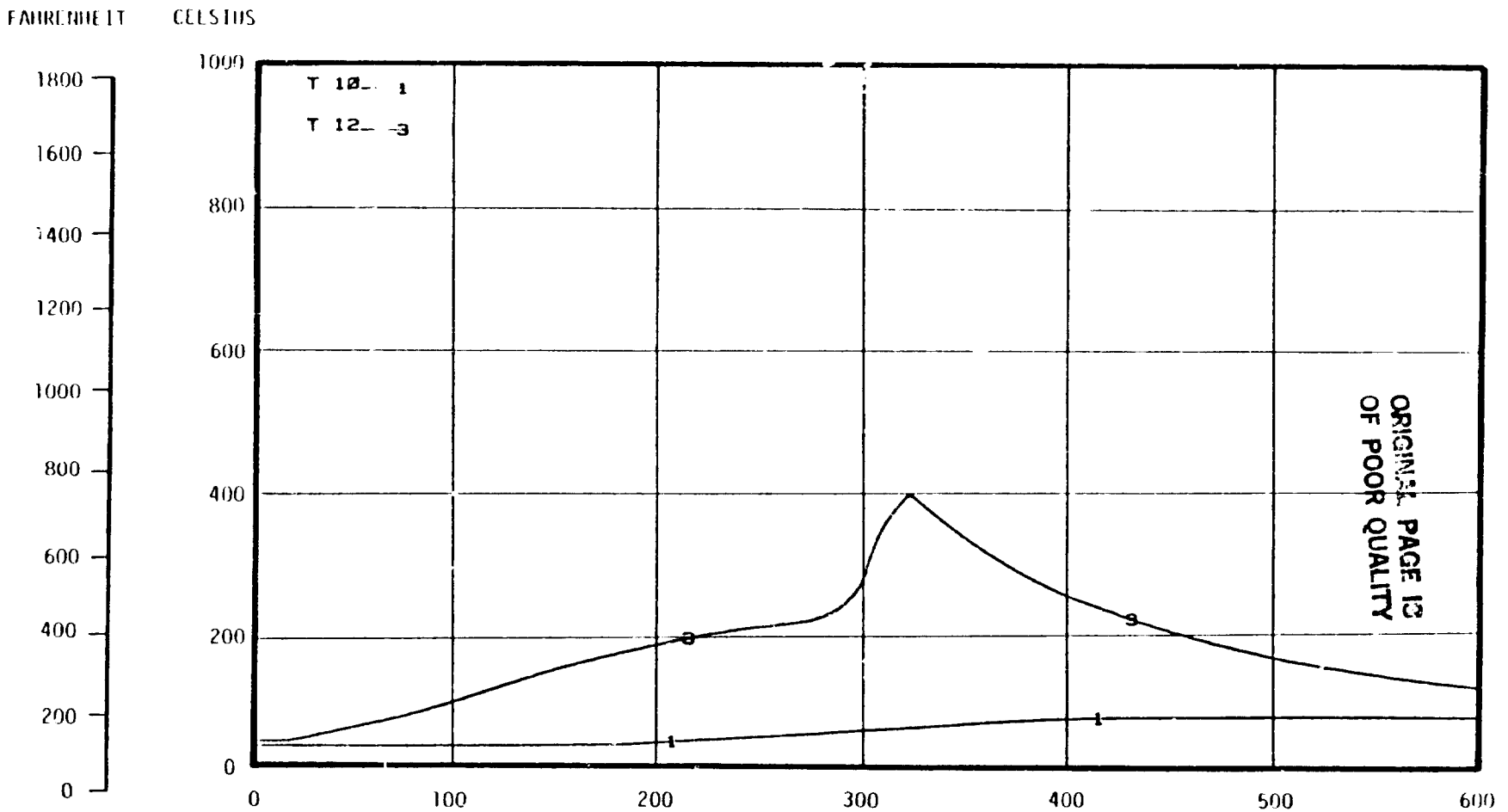


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14.31

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 9

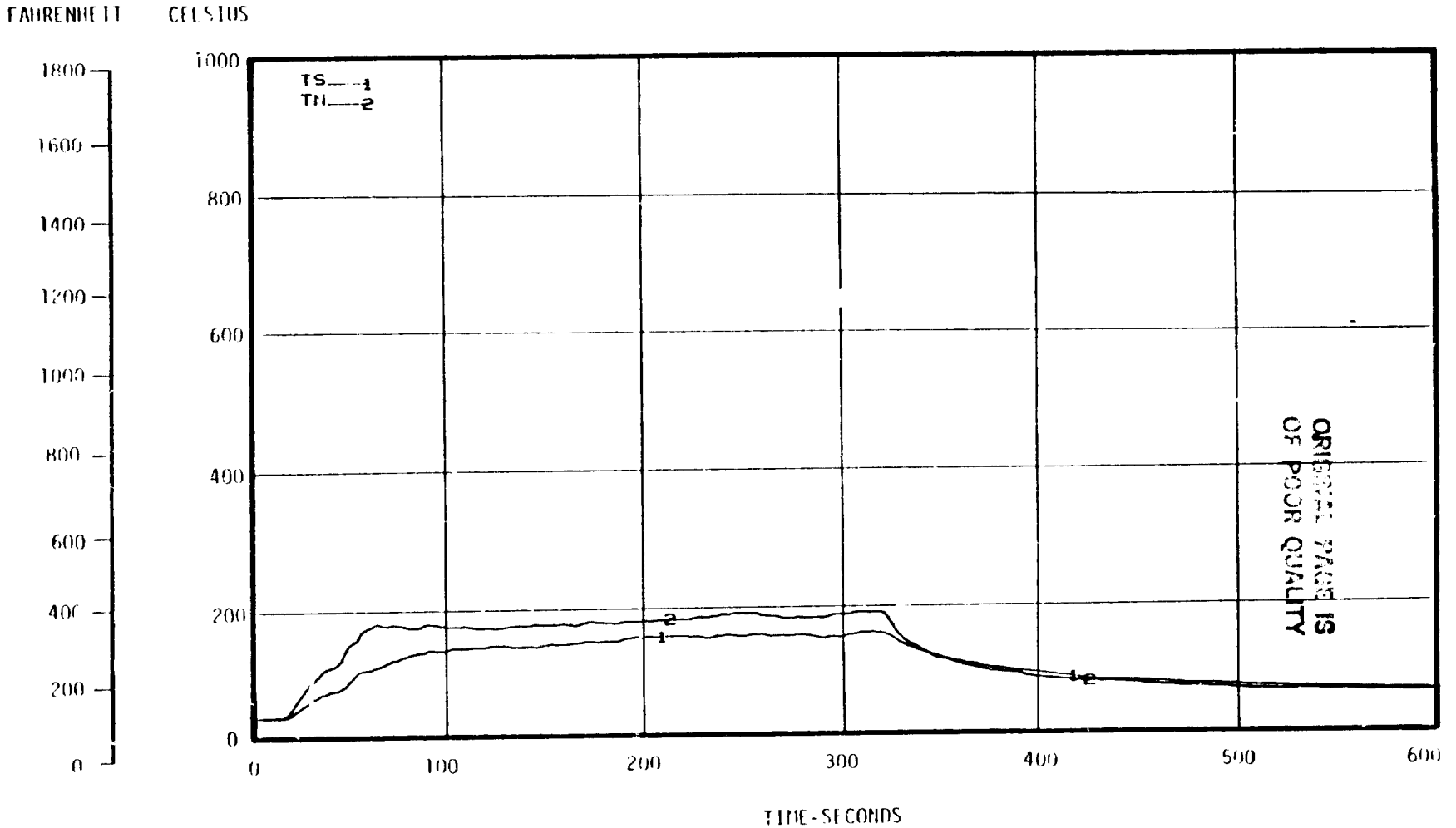
CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14.31
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 9
CUSHION CONSTRUCTION NUMBER 10.0

CEILING TEMPERATURE

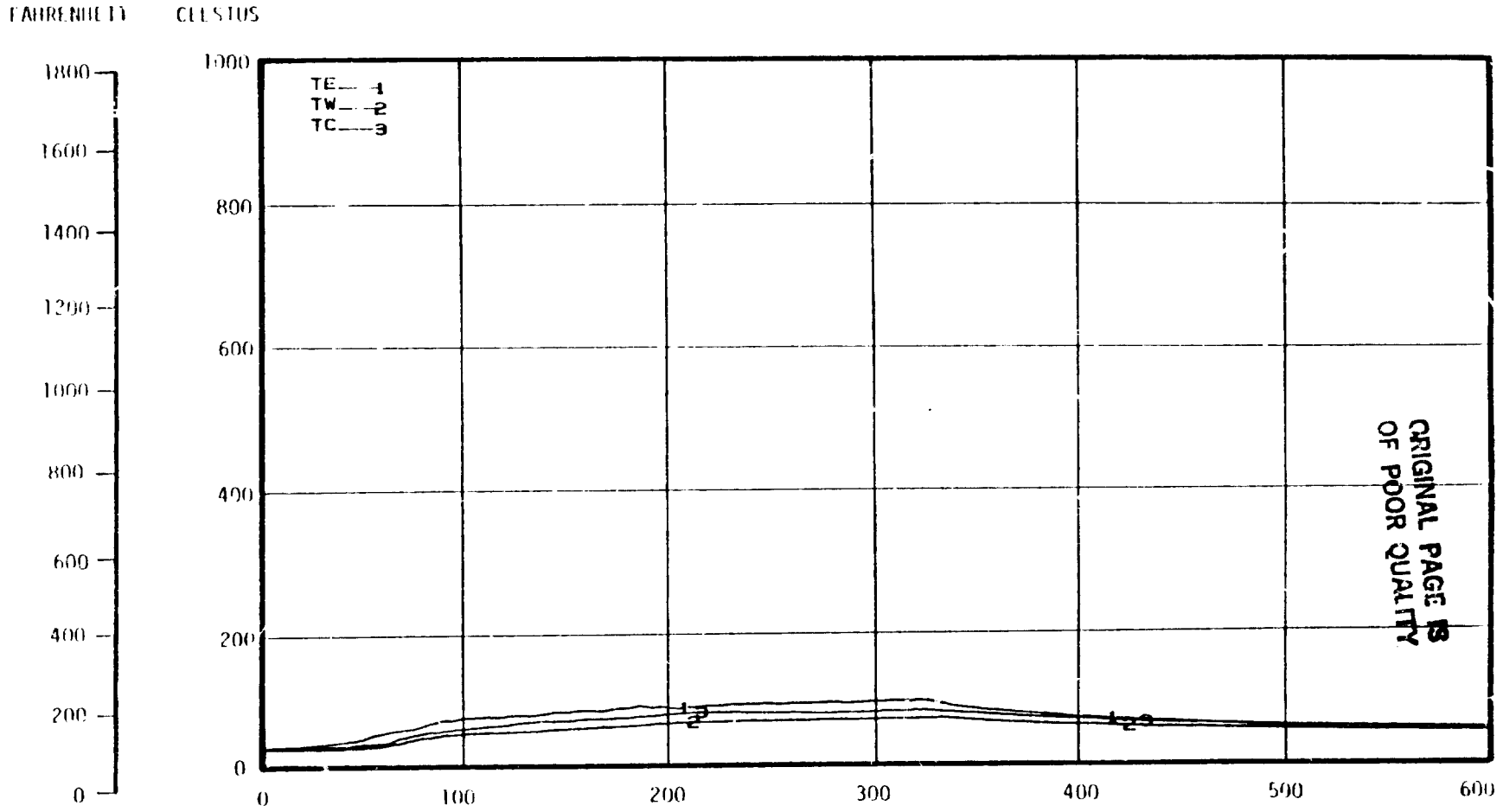


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14:31

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 9

CUSHION CONSTRUCTION NUMBER 10.0

CEILING TEMPERATURE

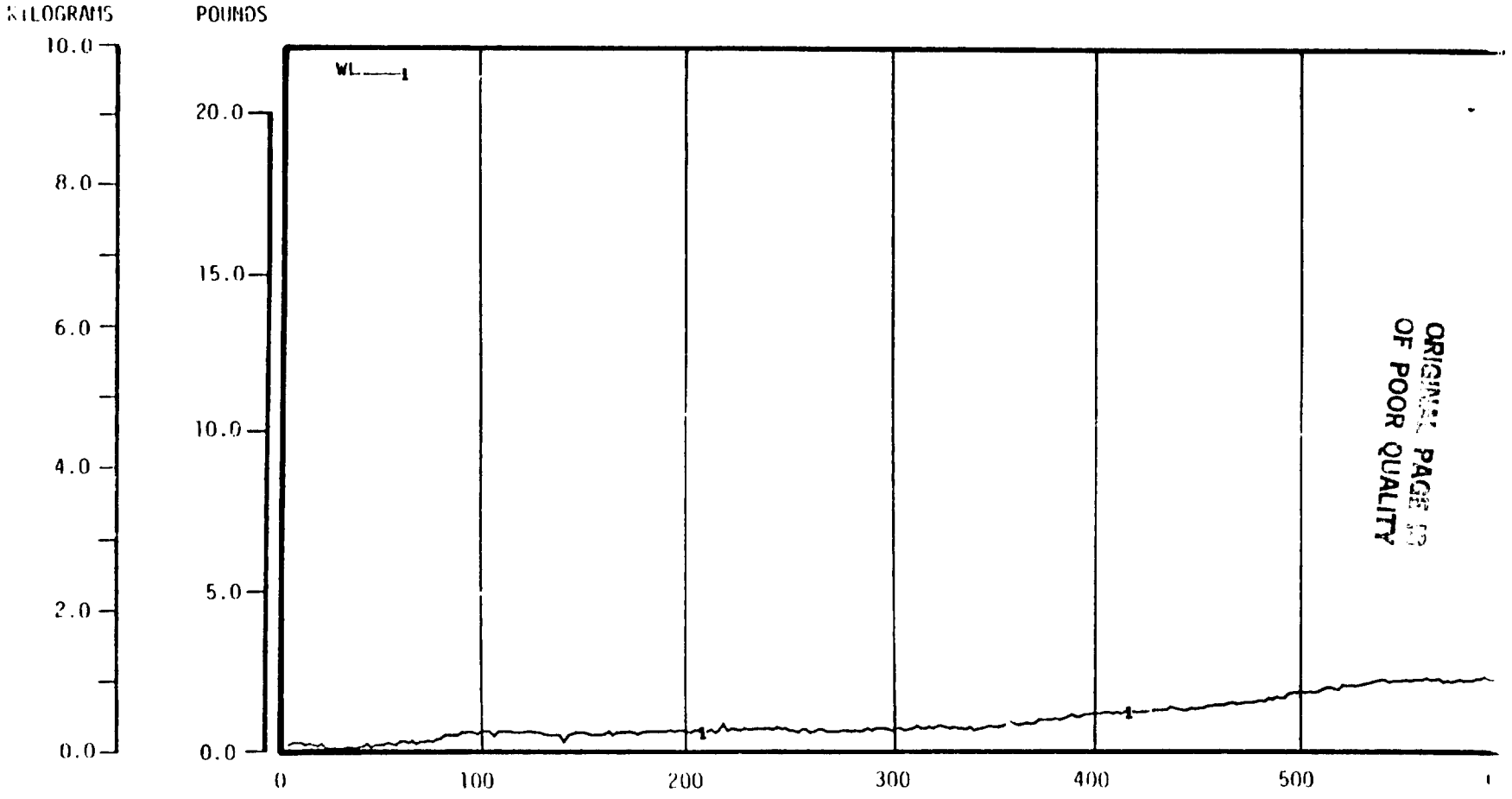


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14:31

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 2

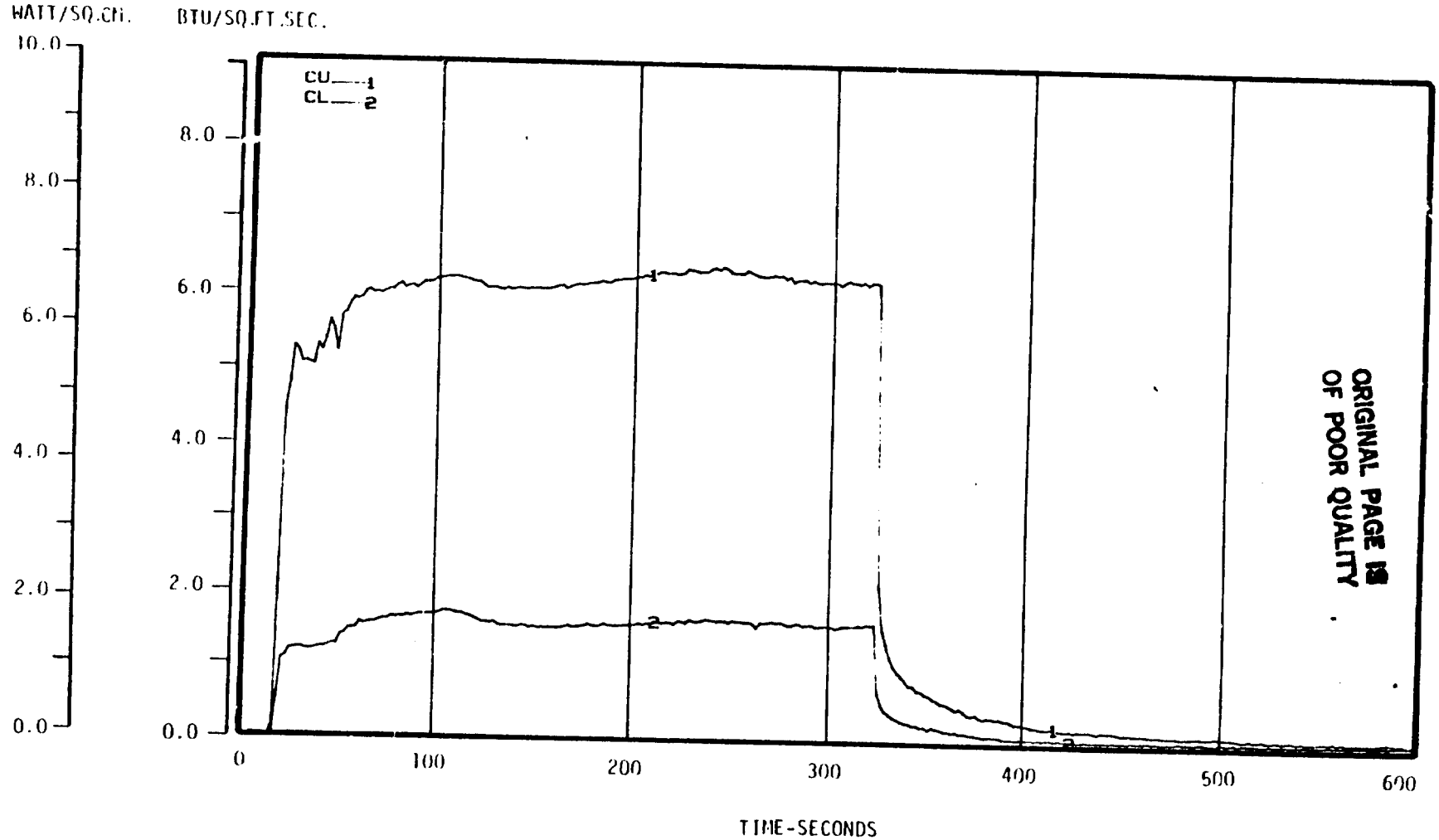
CUSHION CONSTRUCTION NUMBER 10.0

WEIGHT LOSS



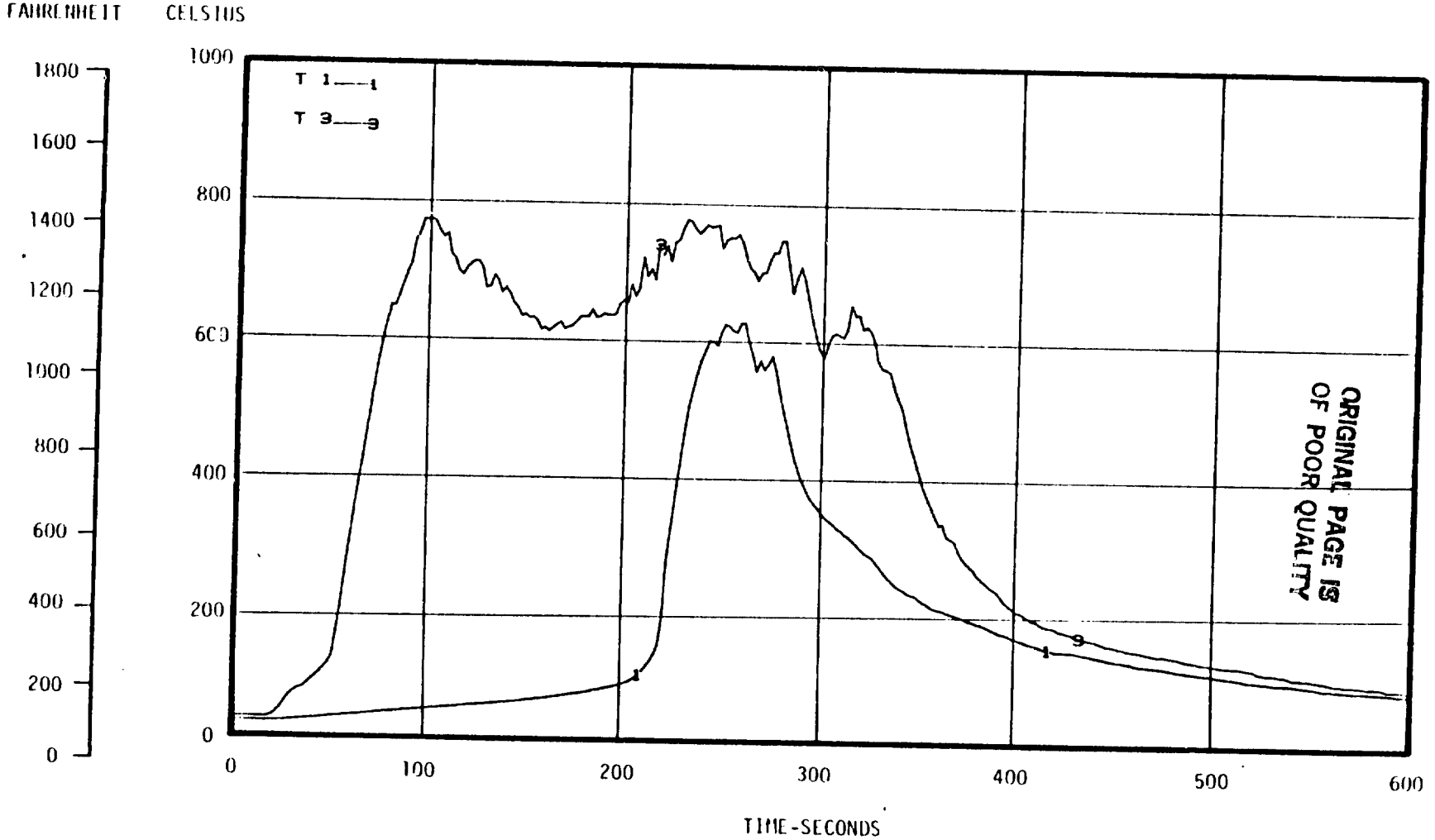
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/11/82 14:31
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 8
CUSHION CONSTRUCTION NUMBER 10.0

HEAT FLUX



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10./82 10.03
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6
CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES

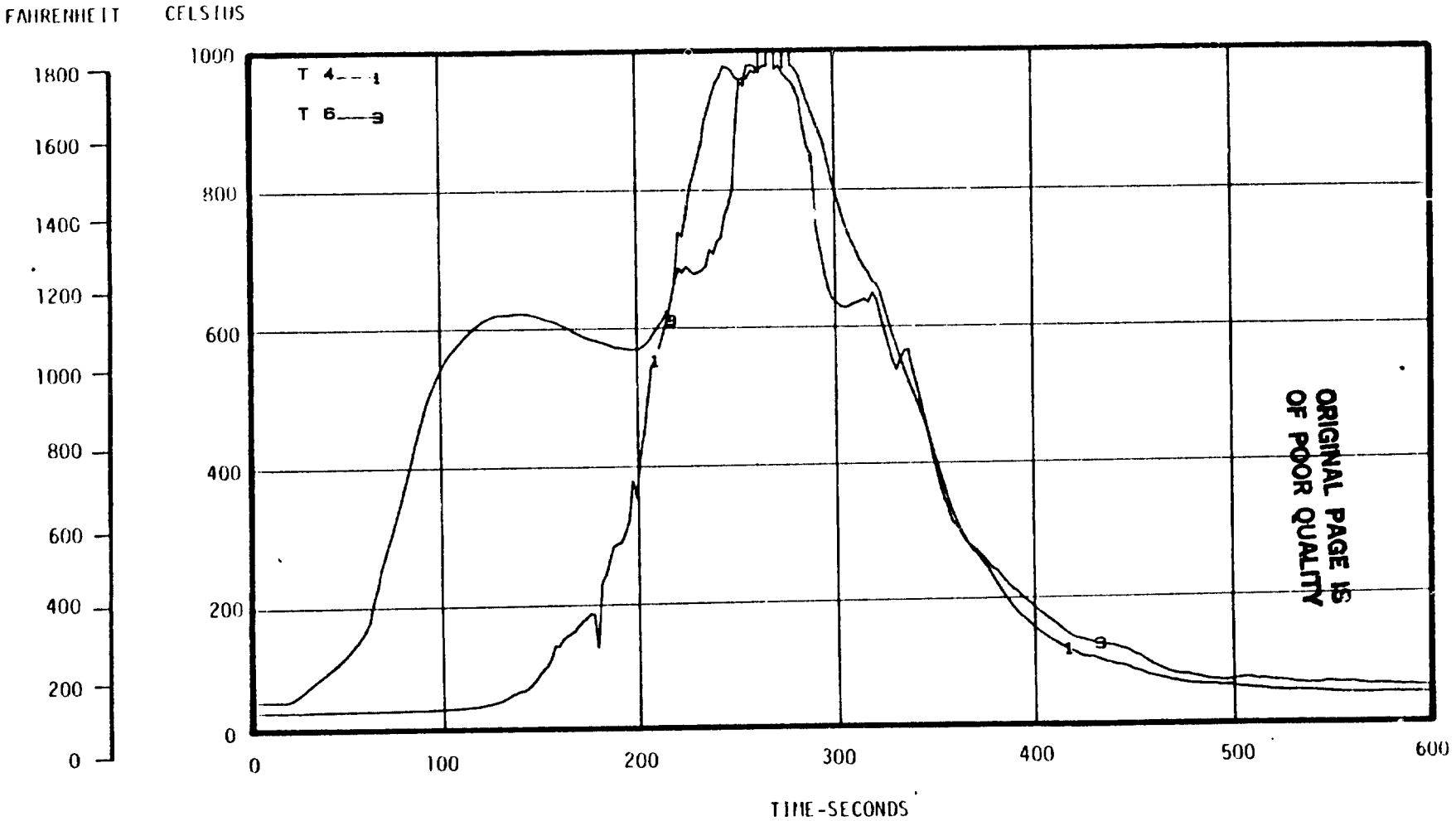


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 10.03

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6

CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES

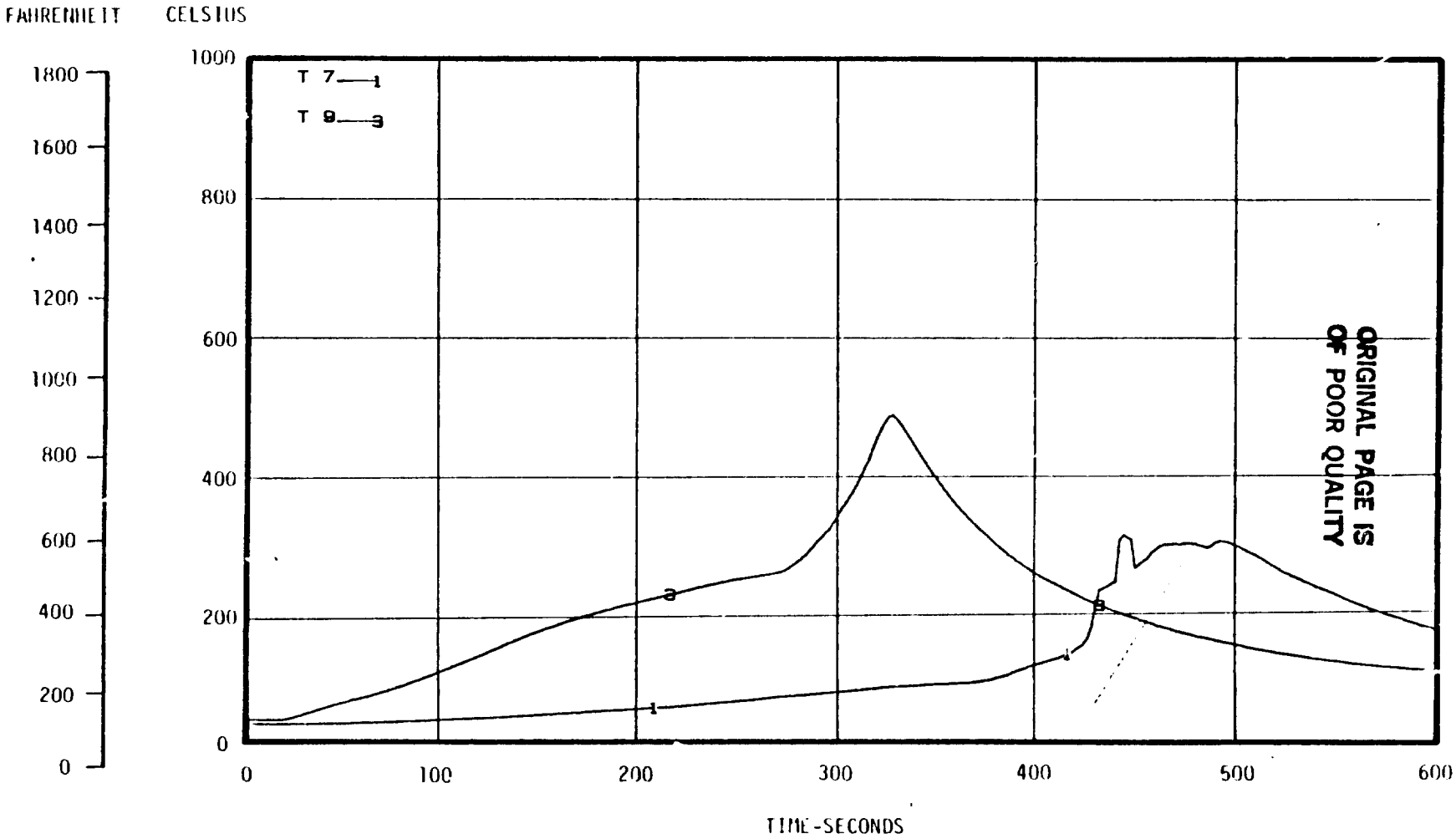


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 10.03

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6

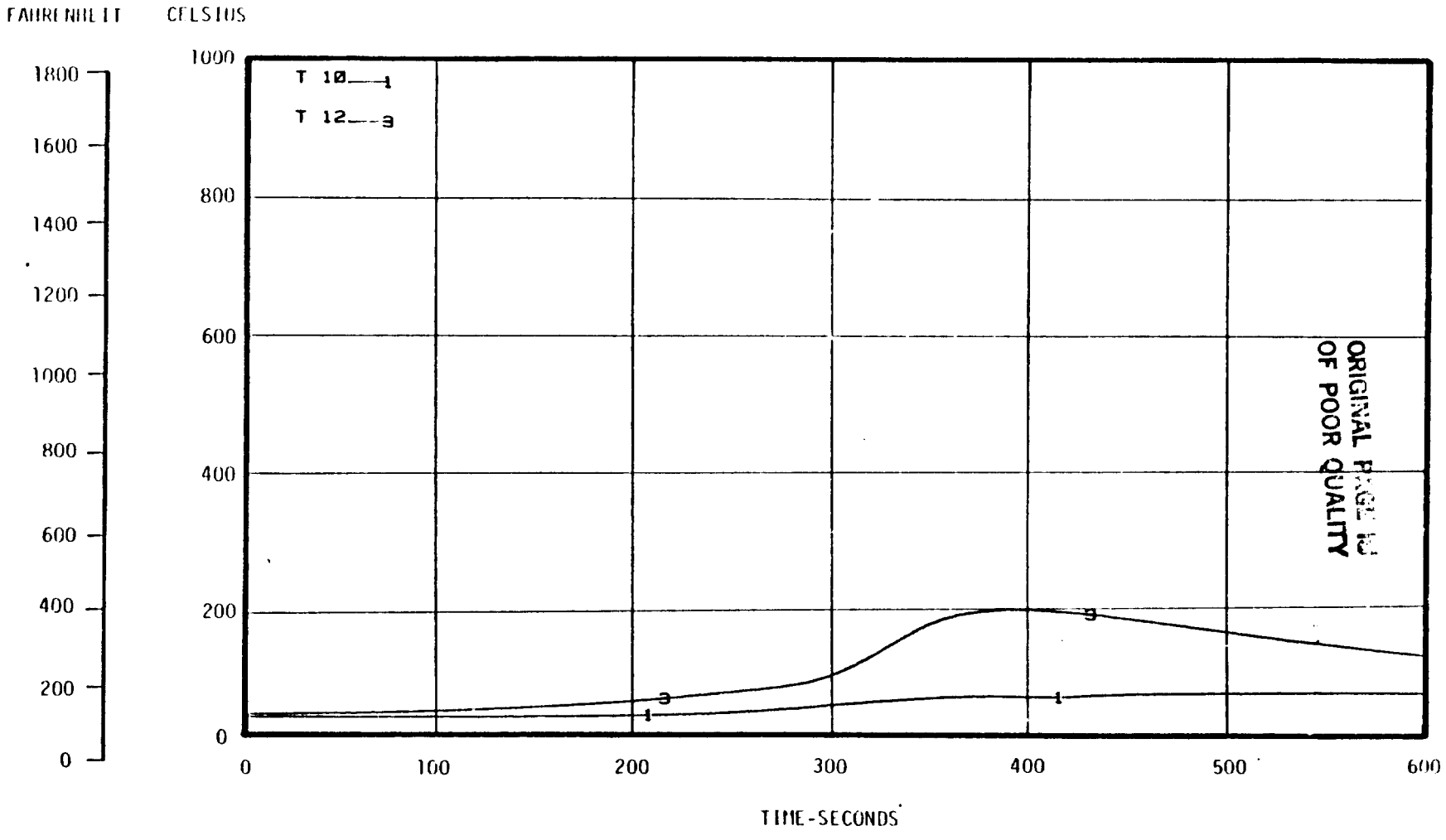
CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 10.03
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6
CUSHION CONSTRUCTION NUMBER 10.0

SEAT CUSHION TEMPERATURES

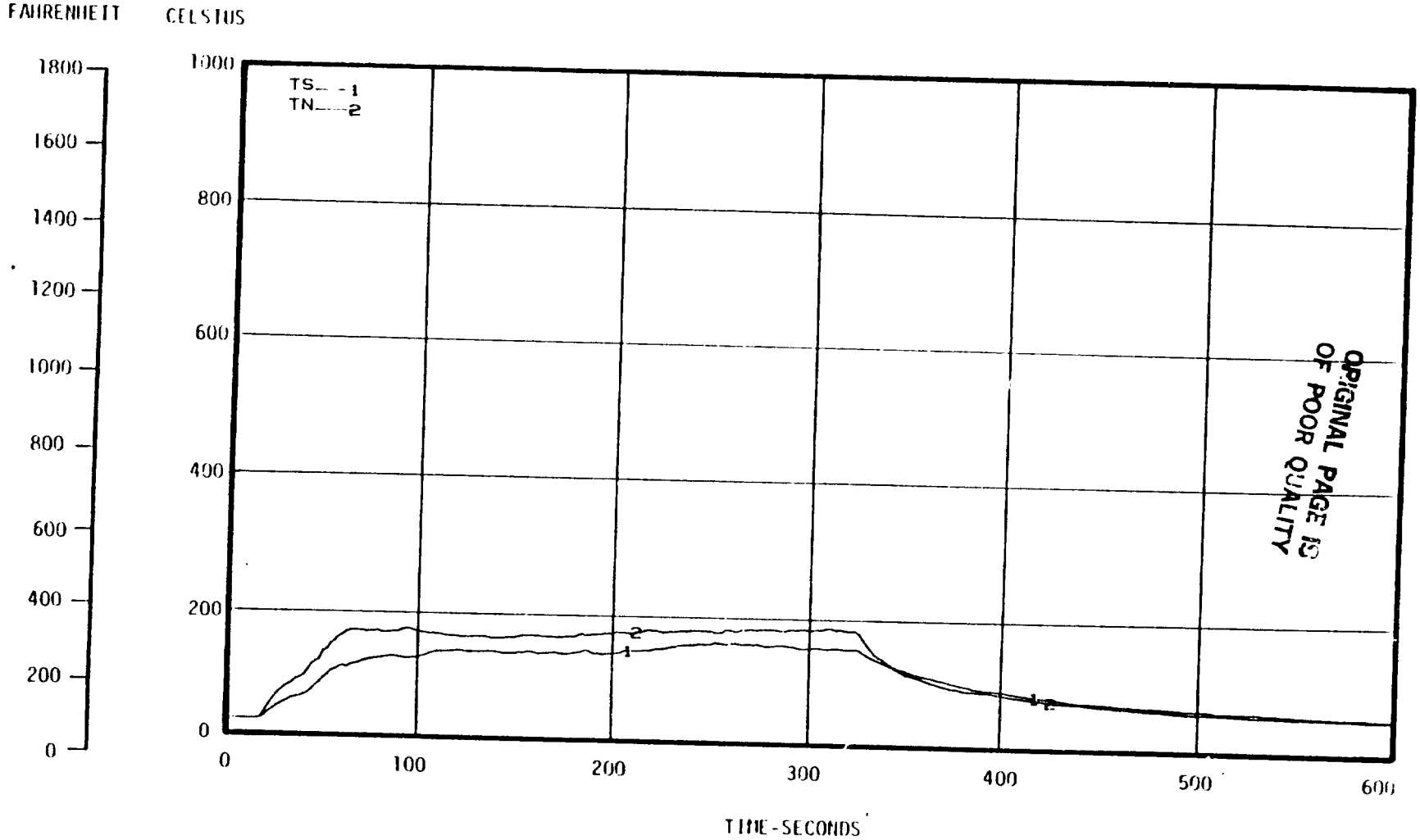


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 10.03

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6

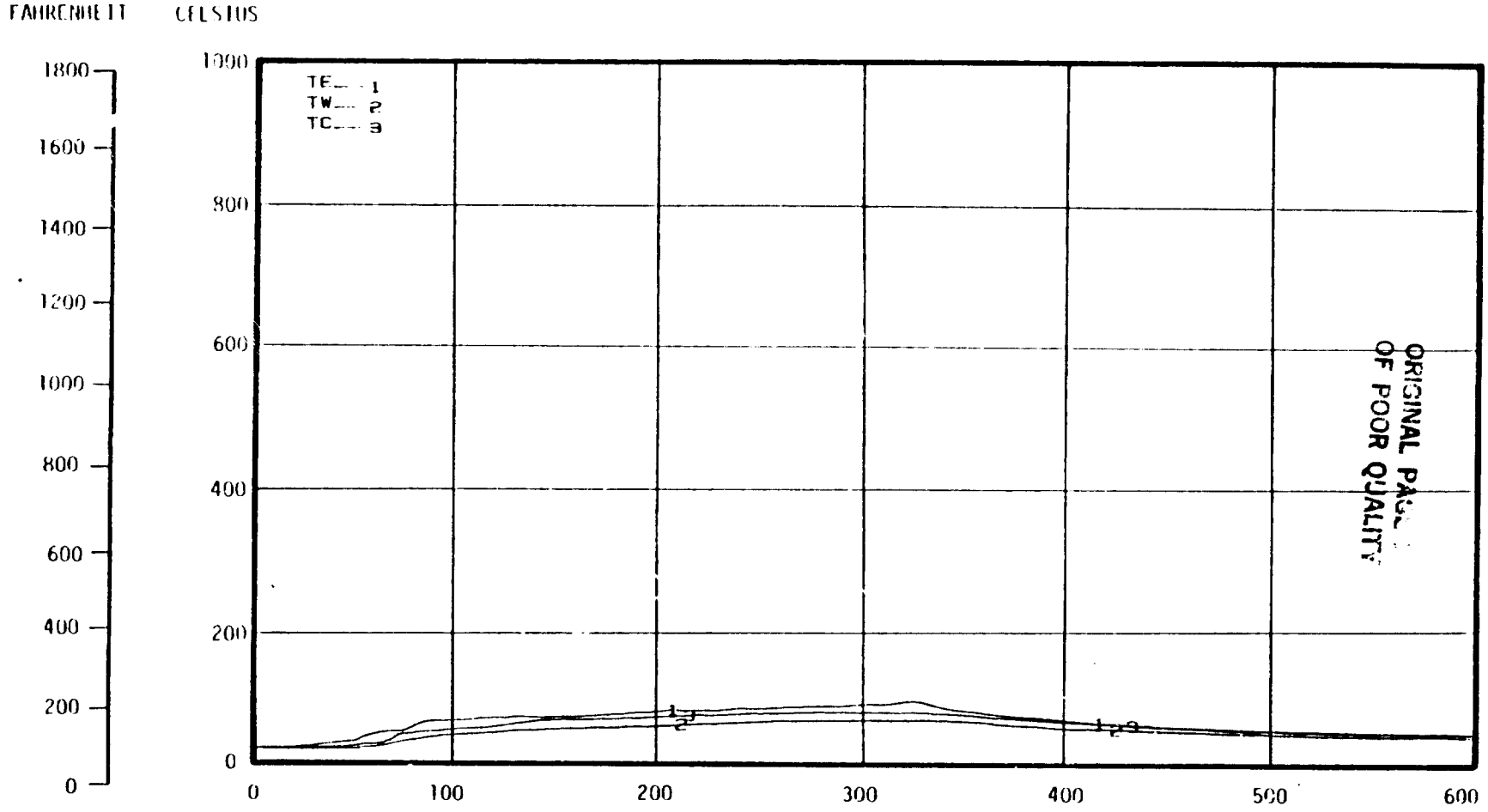
CUSHION CONSTRUCTION NUMBER 10.0

CEILING TEMPERATURE



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 10.03
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6
CUSHION CONSTRUCTION NUMBER 10.0

CEILING TEMPERATURE

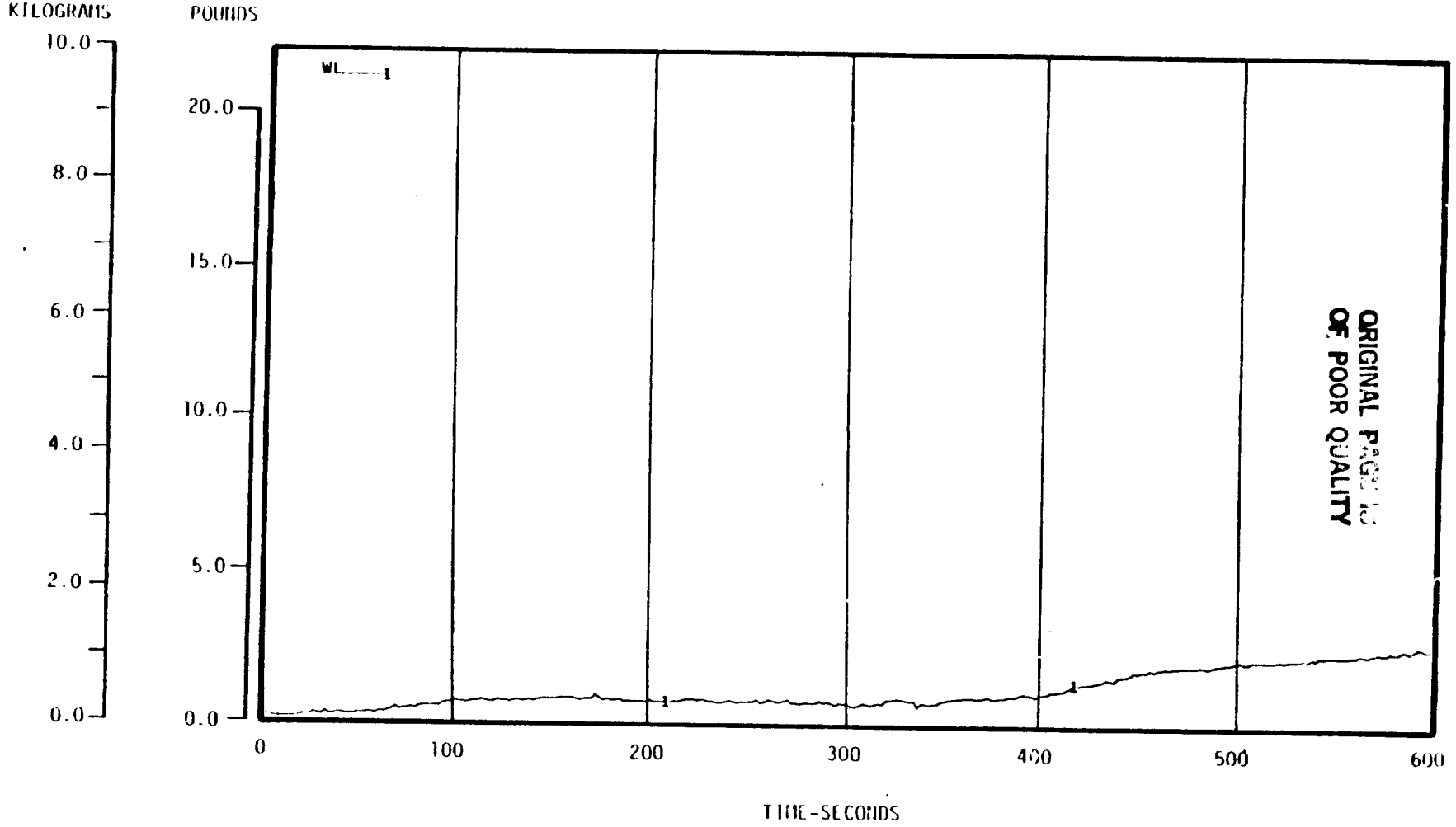


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 . 10.03

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6

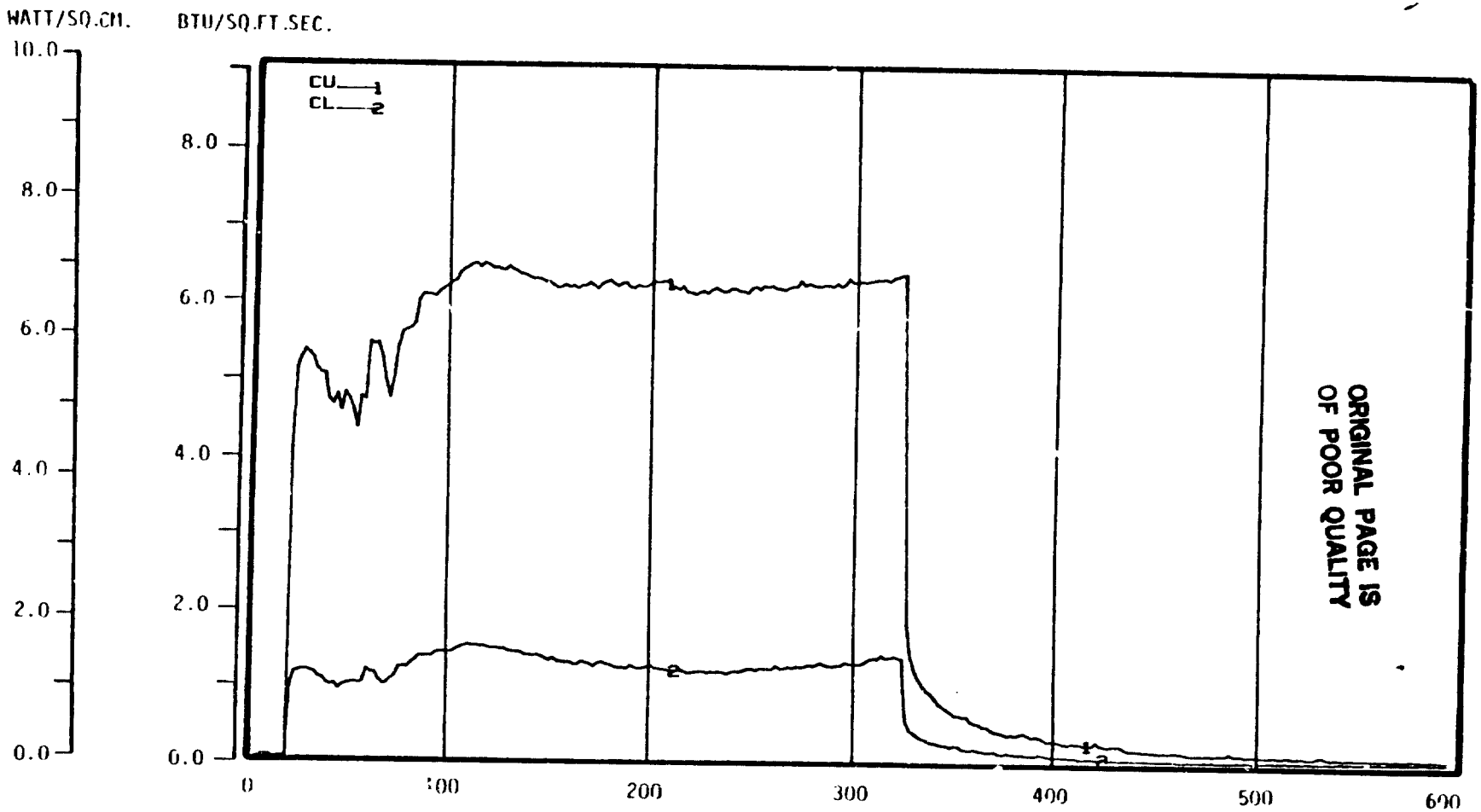
CUSHION CONSTRUCTION NUMBER 10.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 10.03
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 6
CUSHION CONSTRUCTION NUMBER 10.0

HEAT FLUX

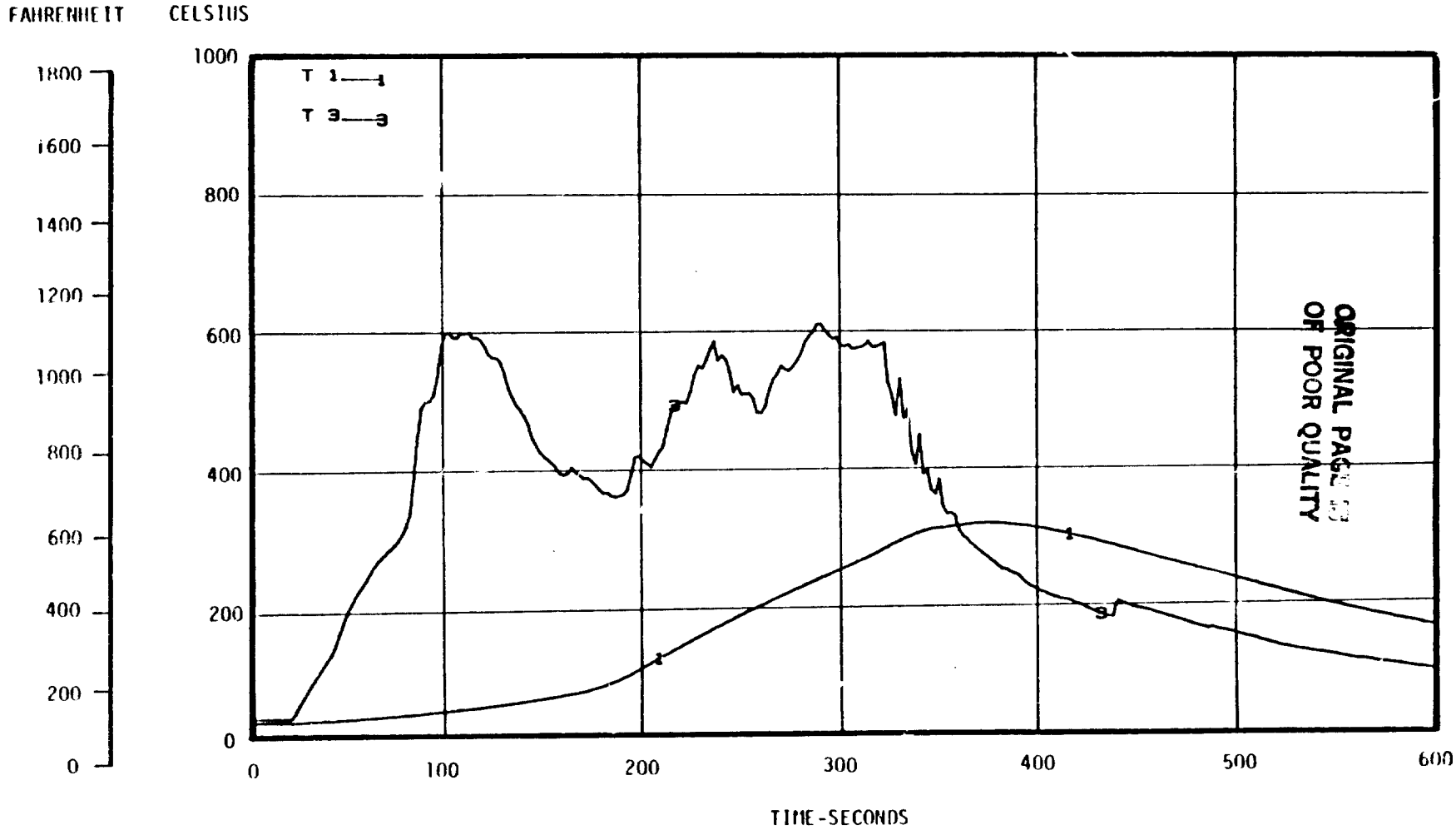


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 09.04

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20

CUSHION CONSTRUCTION NUMBER 11.0

SEAT CUSHION TEMPERATURES

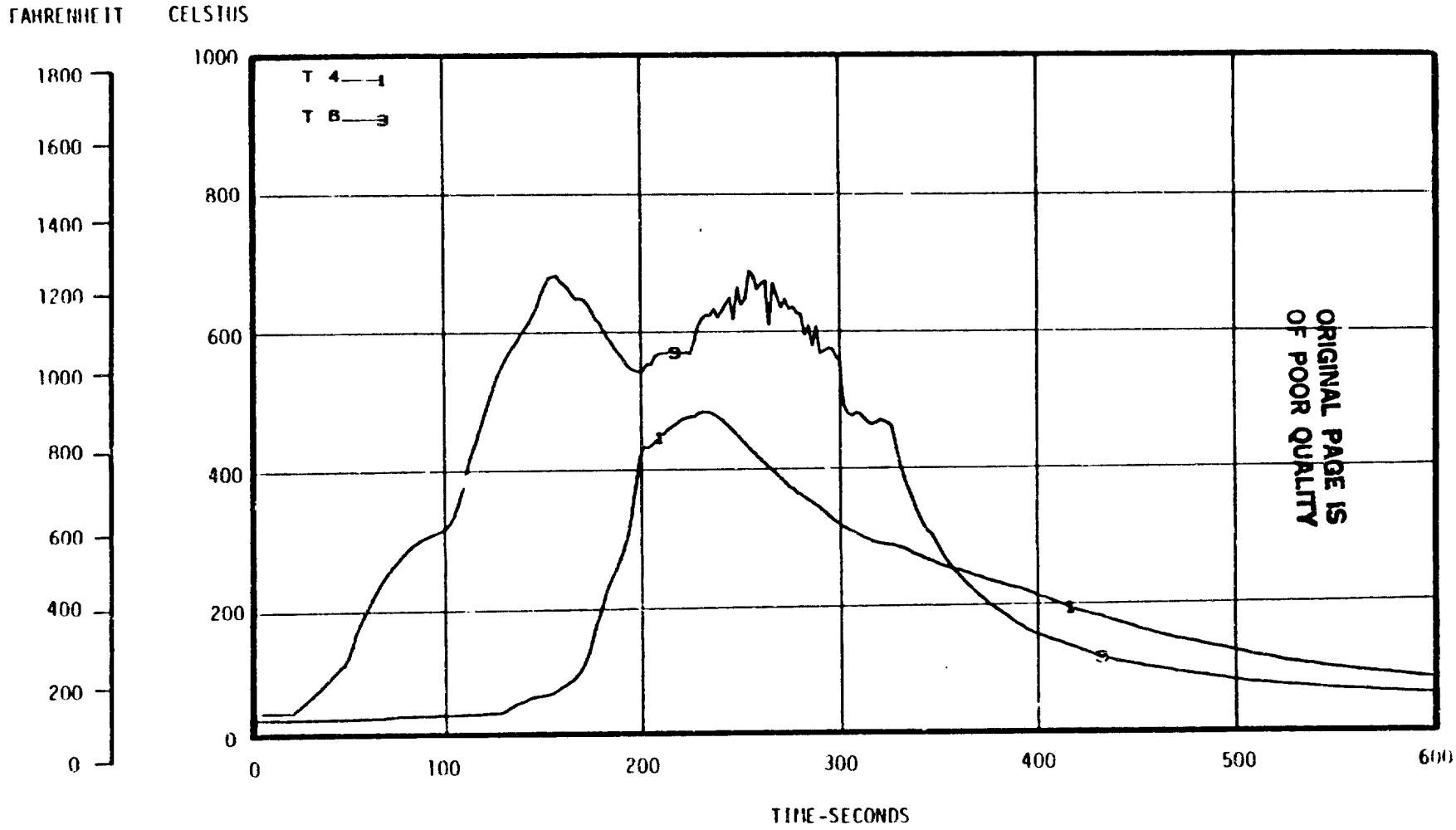


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 00.04

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20

CUSHION CONSTRUCTION NUMBER 11.0

SEAT CUSHION TEMPERATURES

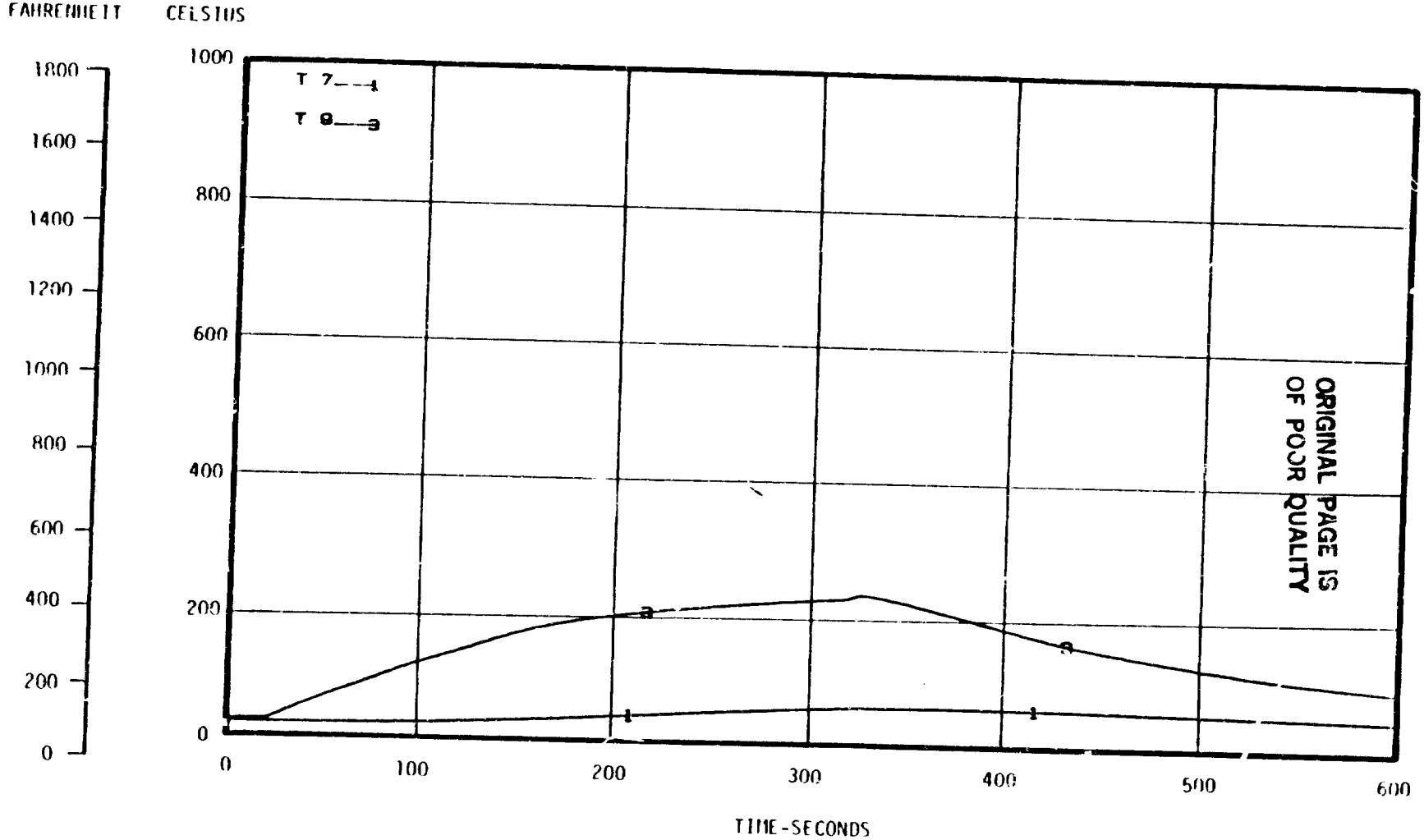


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 09.04

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20

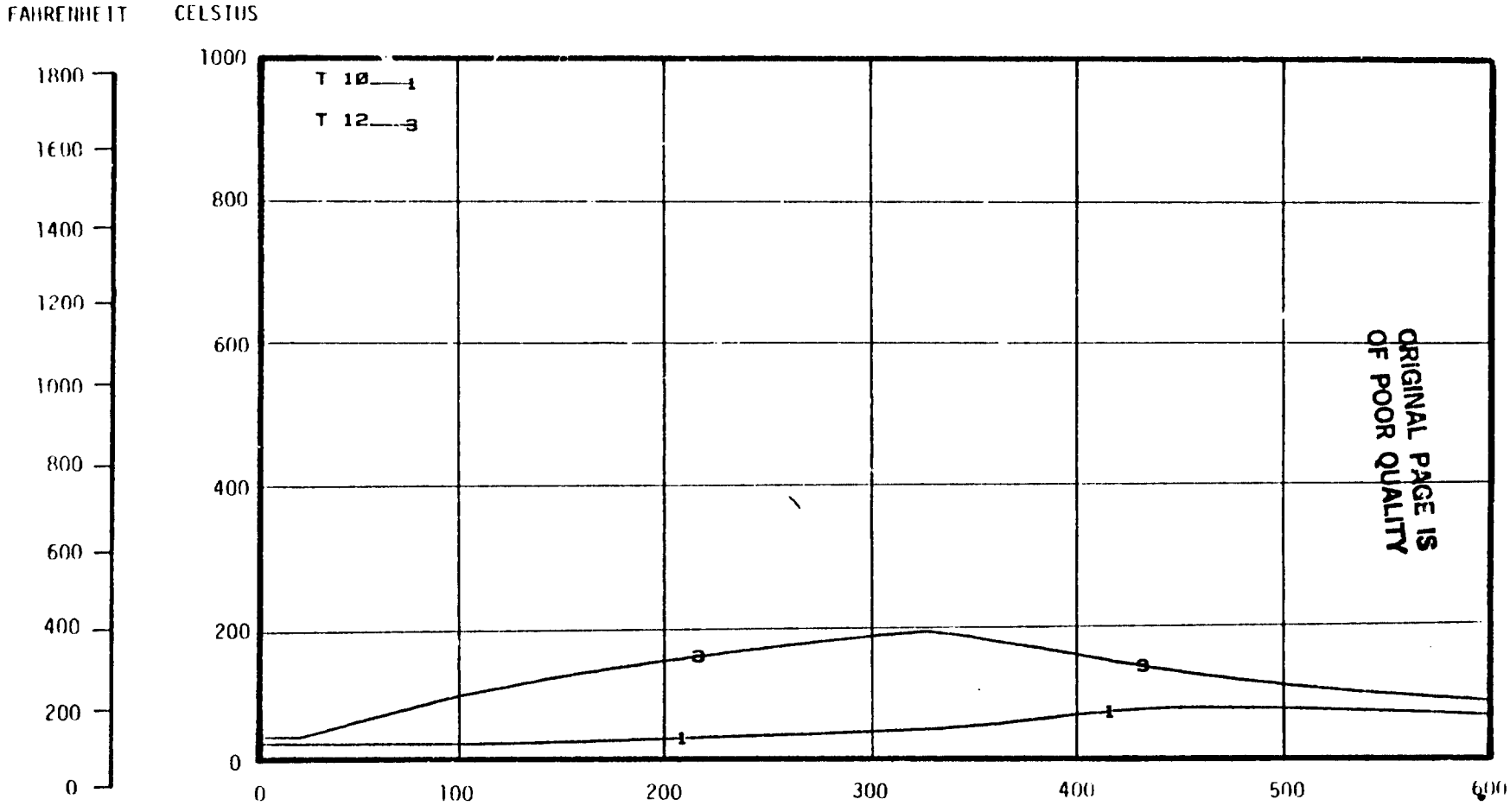
CUSHION CONSTRUCTION NUMBER 11.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 PG. 04
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20
CUSHION CONSTRUCTION NUMBER 11.0

SEAT CUSHION TEMPERATURES

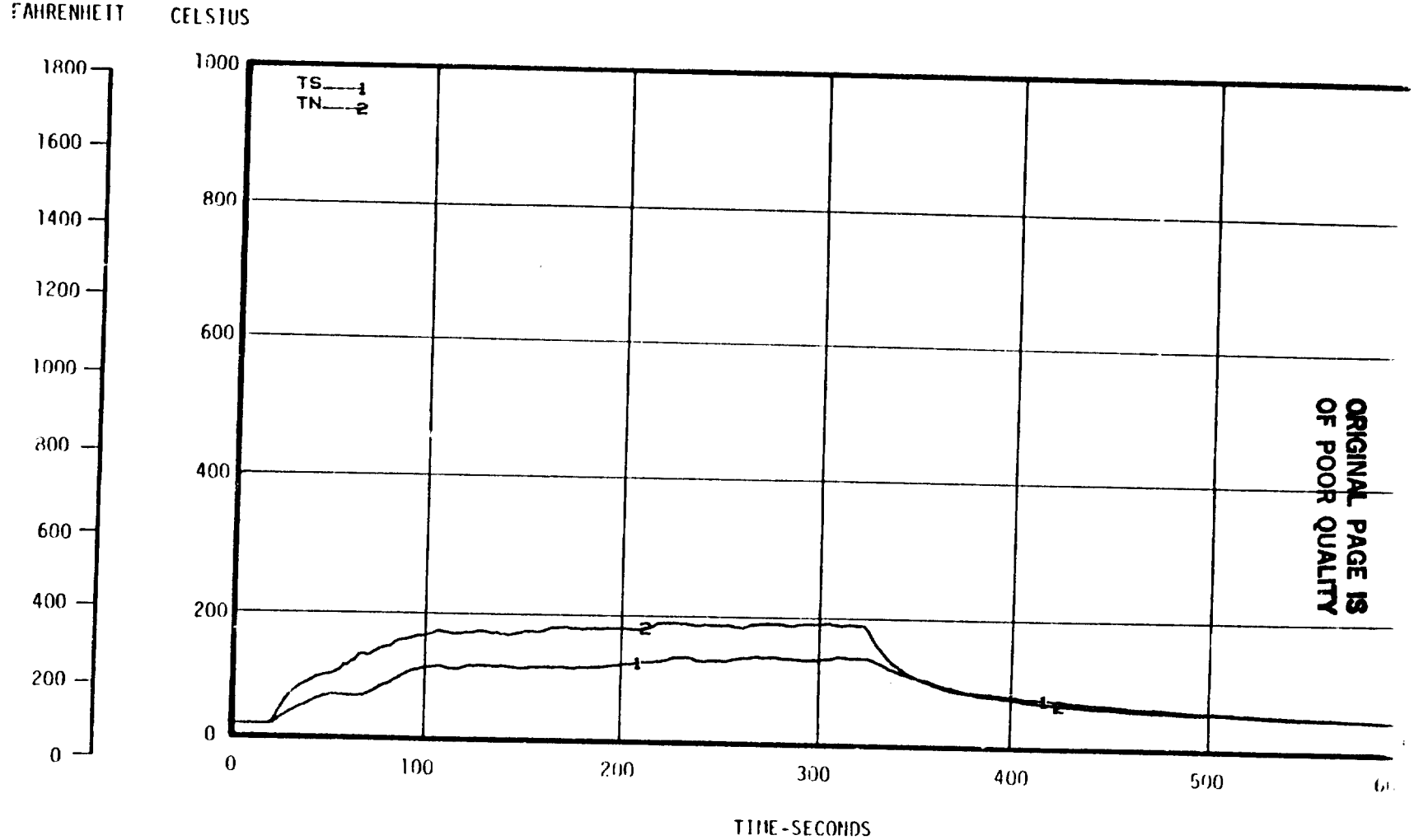


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 00.04

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20

CUSHION CONSTRUCTION NUMBER 11.0

CEILING TEMPERATURE

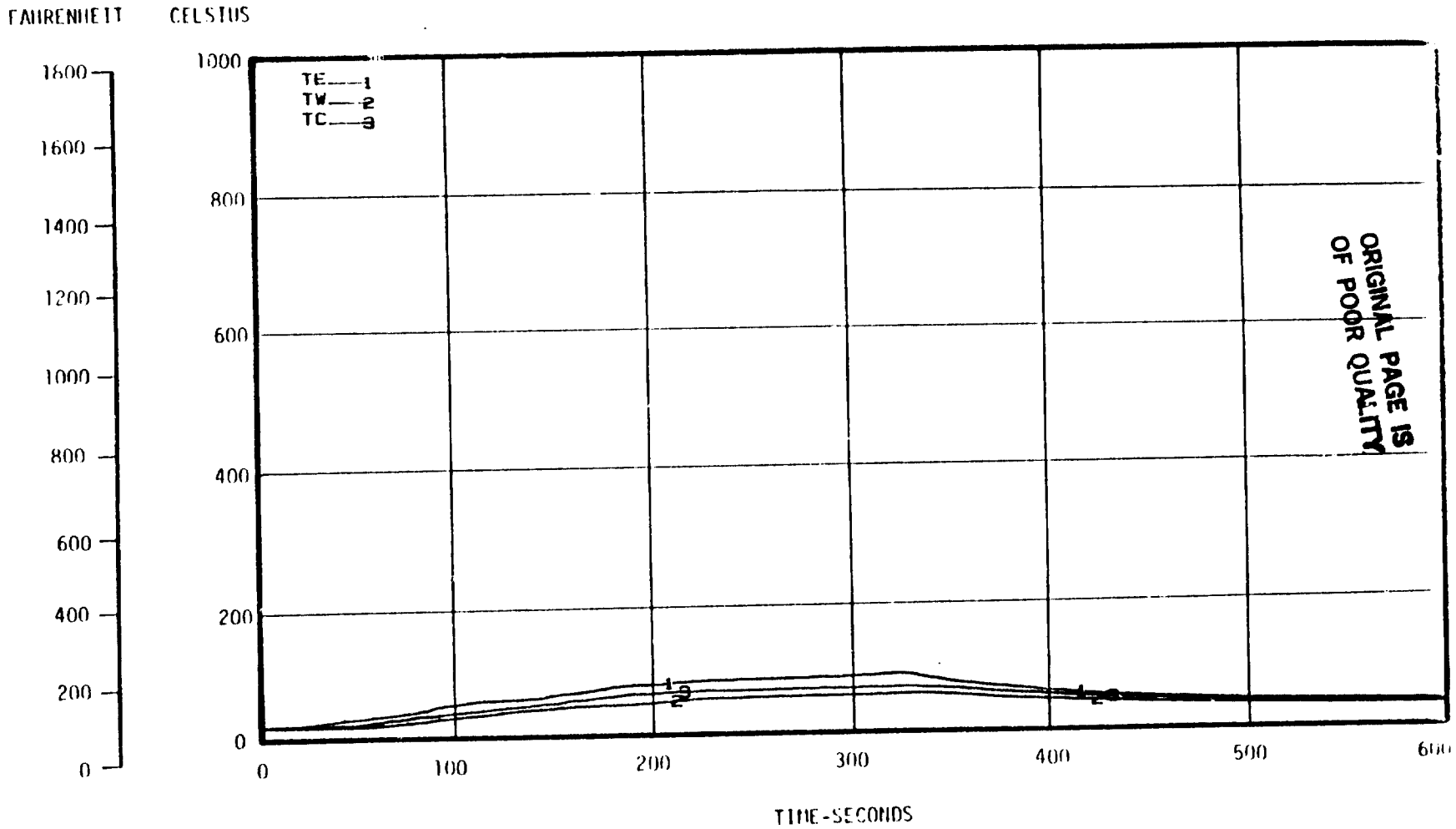


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 09.04

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20

CUSHION CONSTRUCTION NUMBER 11.0

CEILING TEMPERATURE

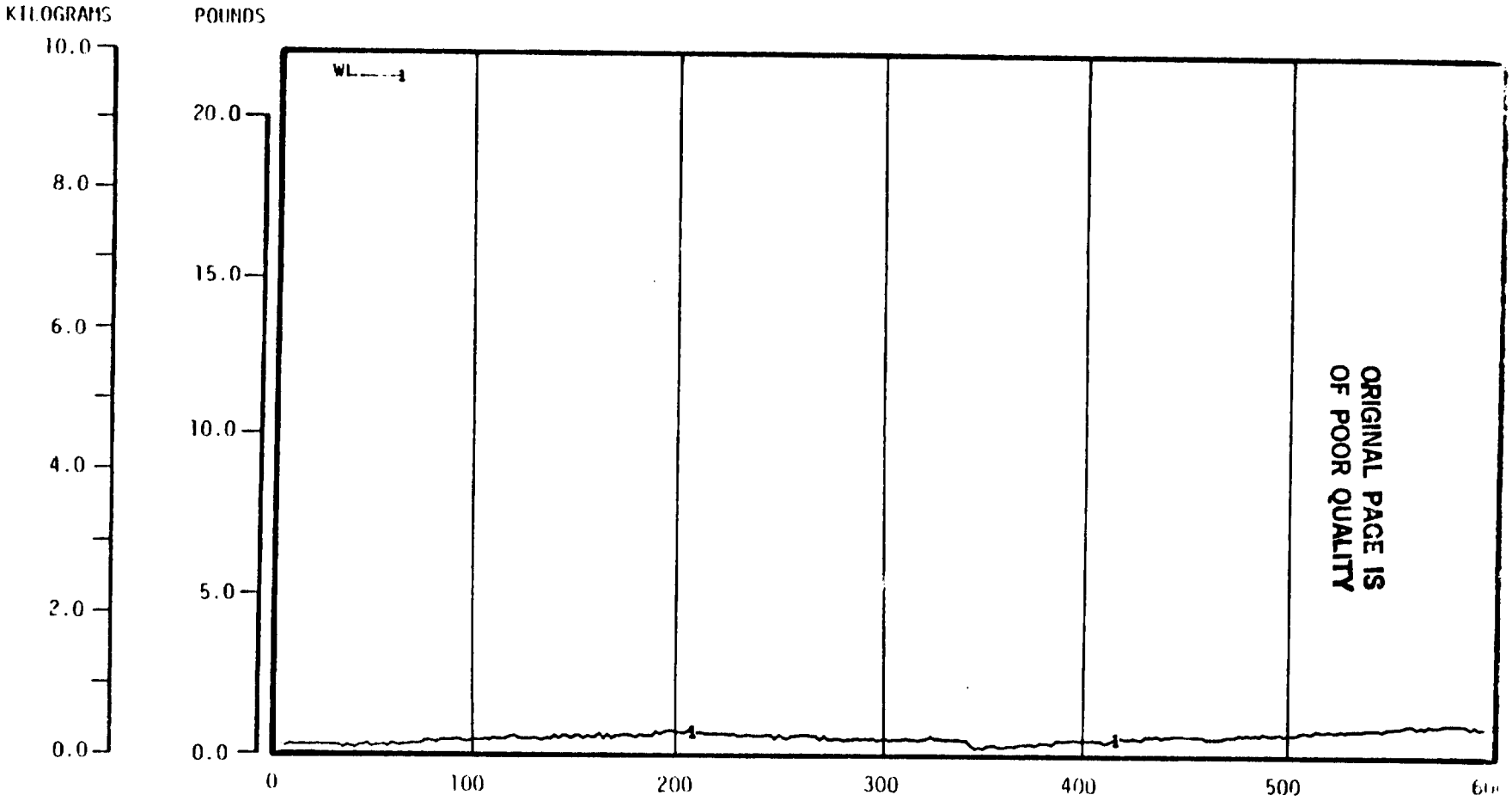


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 09:04

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20

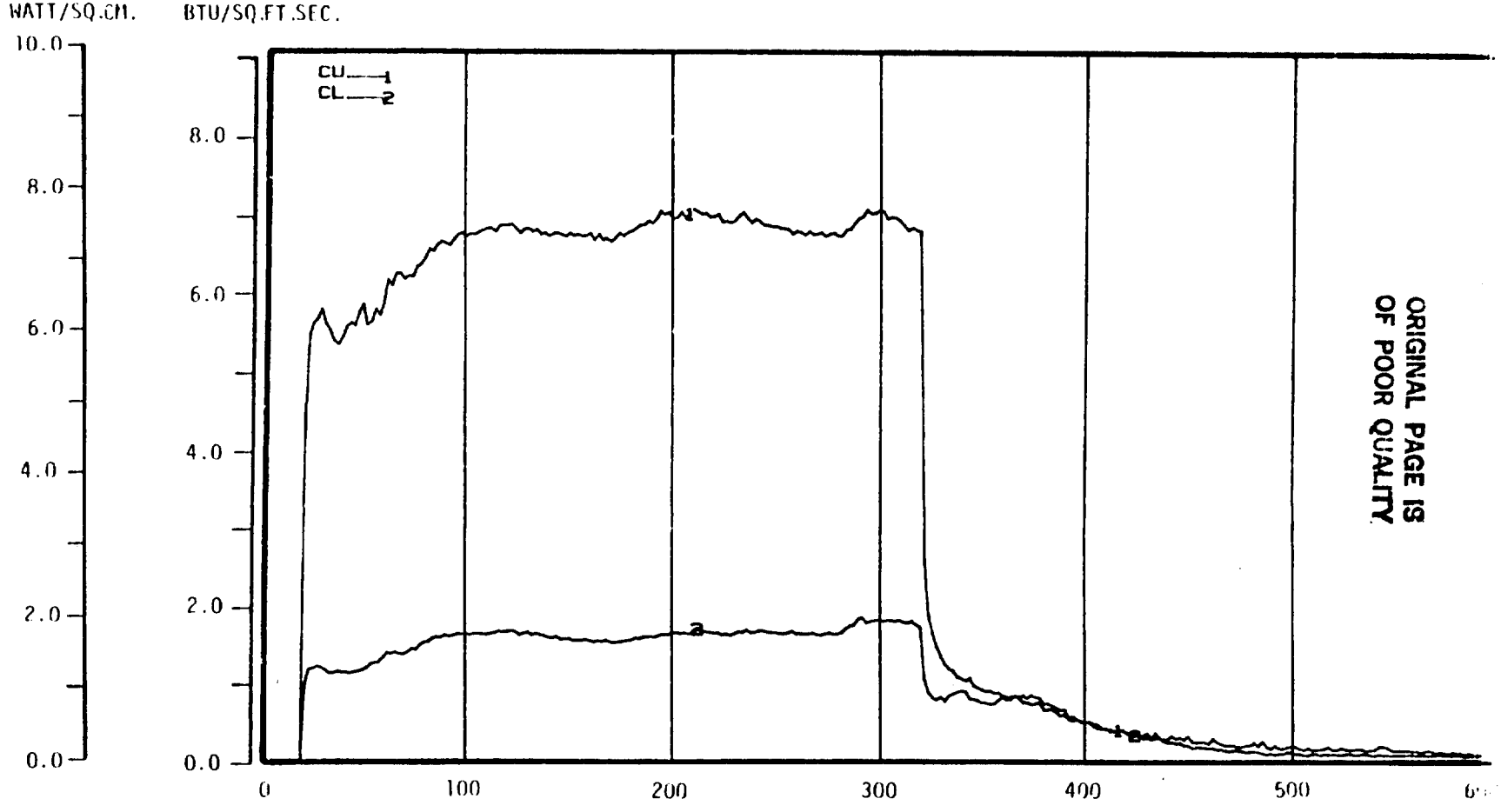
CUSHION CONSTRUCTION NUMBER 11.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 09.04
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 20
CUSHION CONSTRUCTION NUMBER 11.0

HEAT FLUX

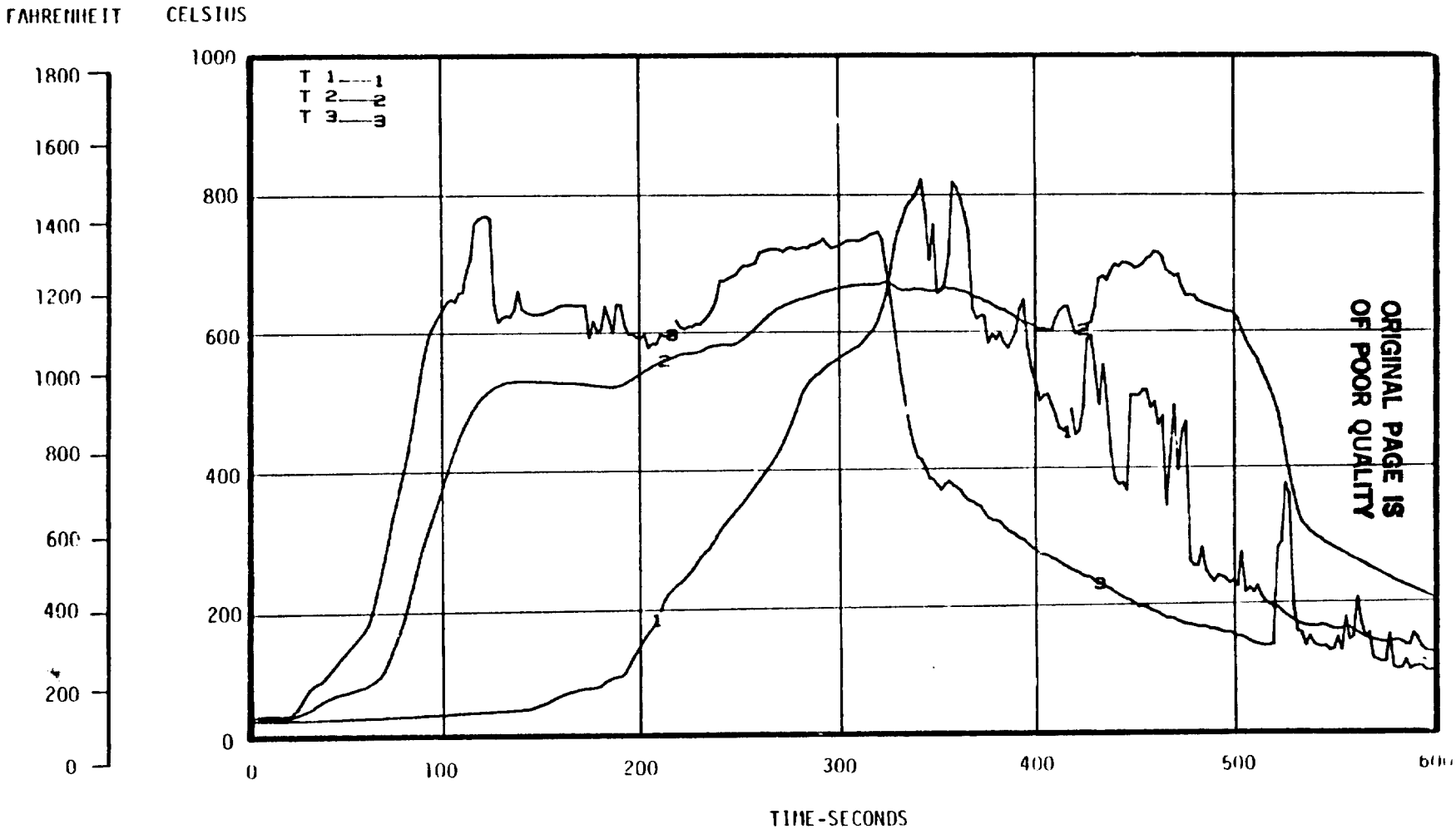


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 11.00

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21

CUSHION CONSTRUCTION NUMBER 12.0

SEAT CUSHION TEMPERATURES

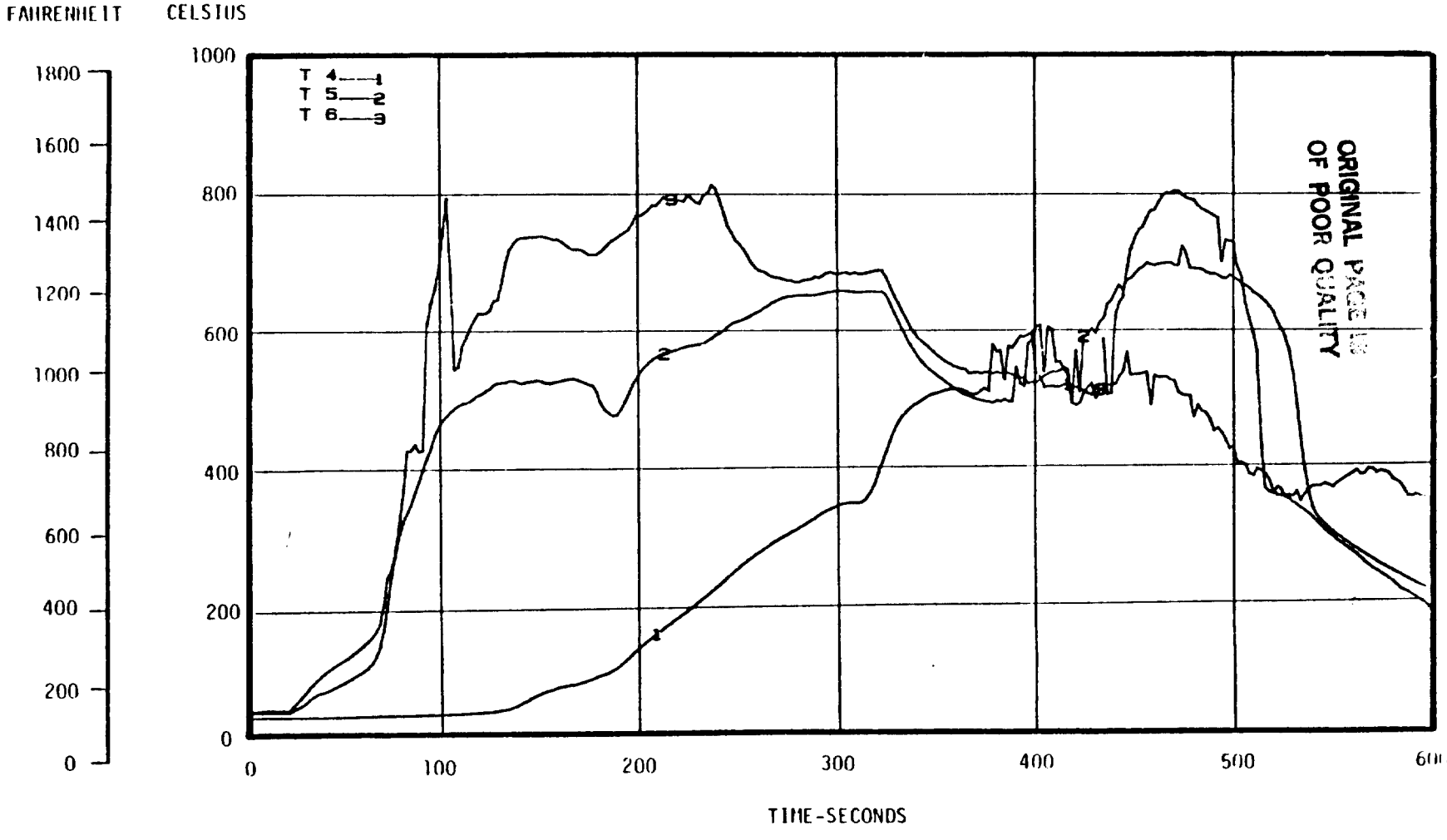


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 11.00

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21

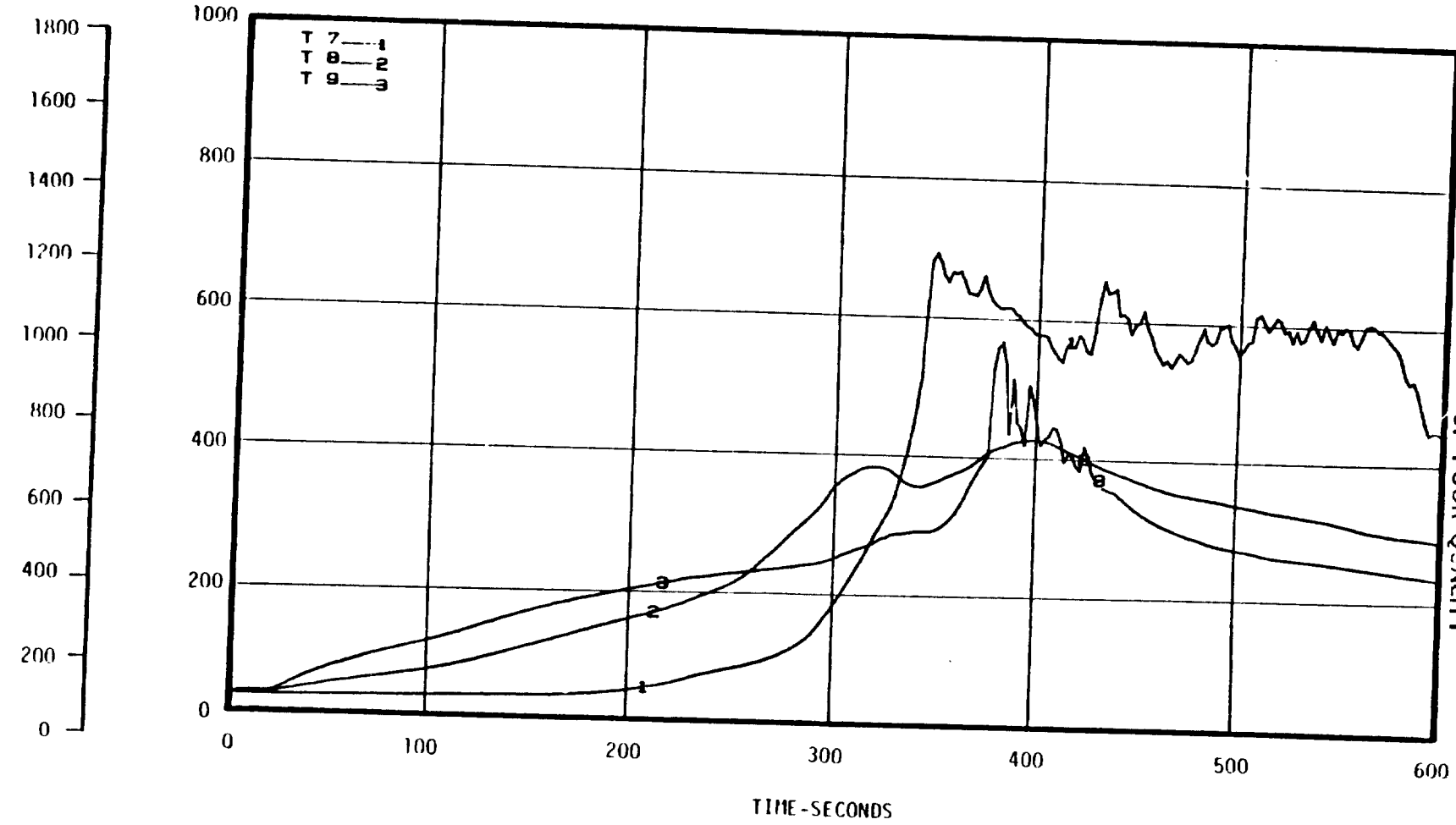
CUSHION CONSTRUCTION NUMBER 12.0

SEAT CUSHION TEMPERATURES



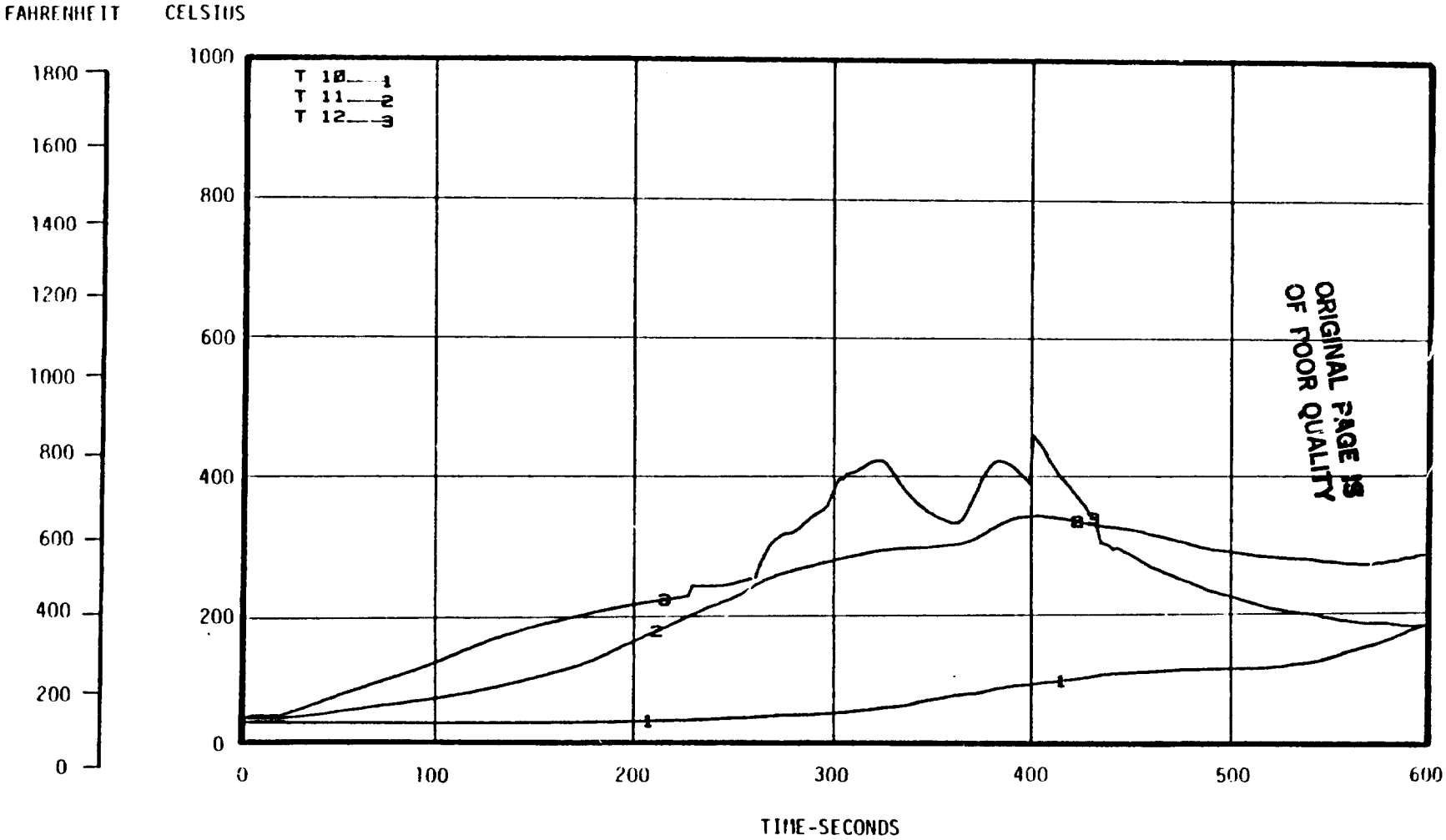
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 11:00
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21
CUSHION CONSTRUCTION NUMBER 12.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 11.00
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21
CUSHION CONSTRUCTION NUMBER 12.0

SEAT CUSHION TEMPERATURES

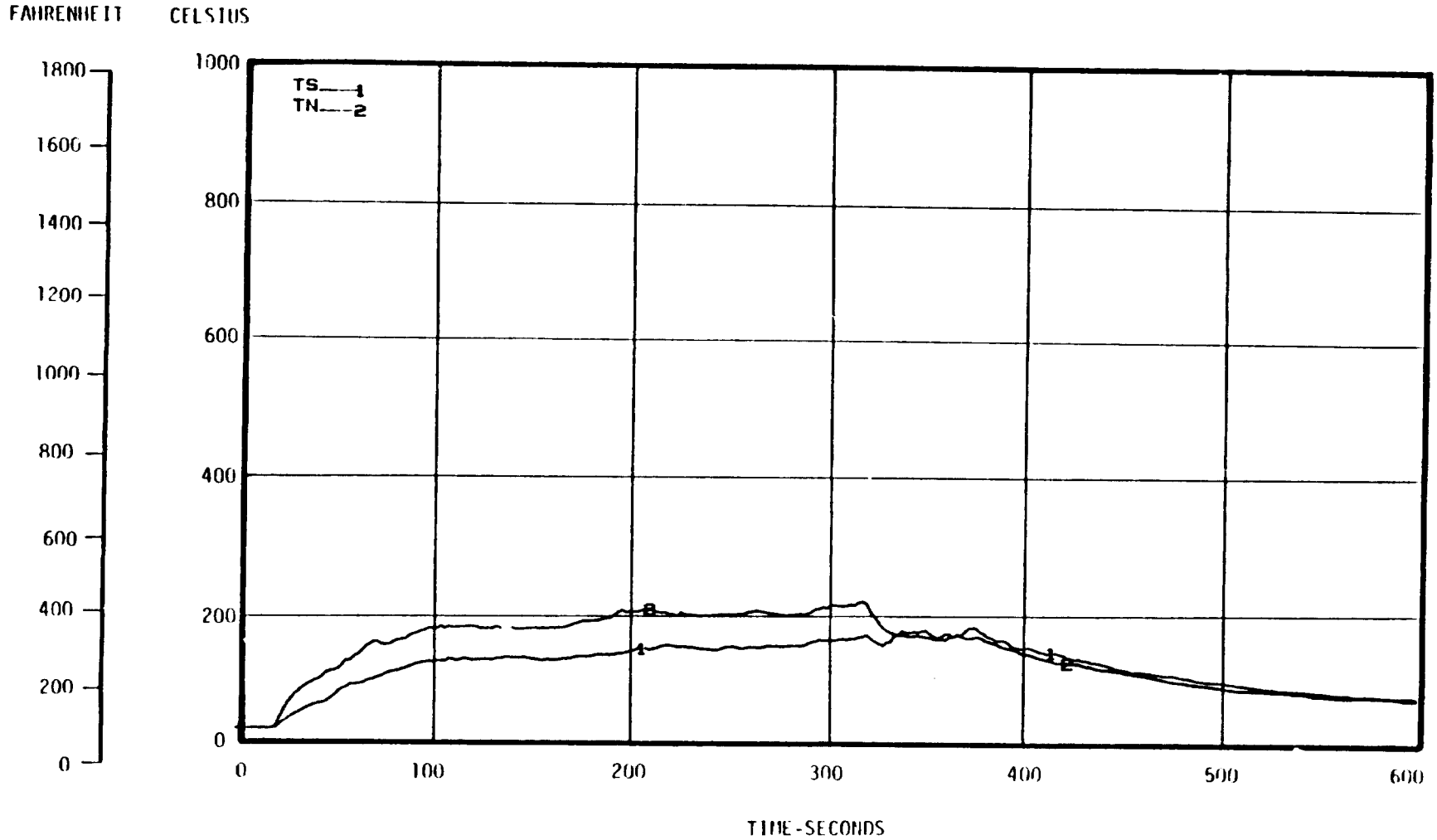


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 11.00

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21

CUSHION CONSTRUCTION NUMBER 12.0

CEILING TEMPERATURE

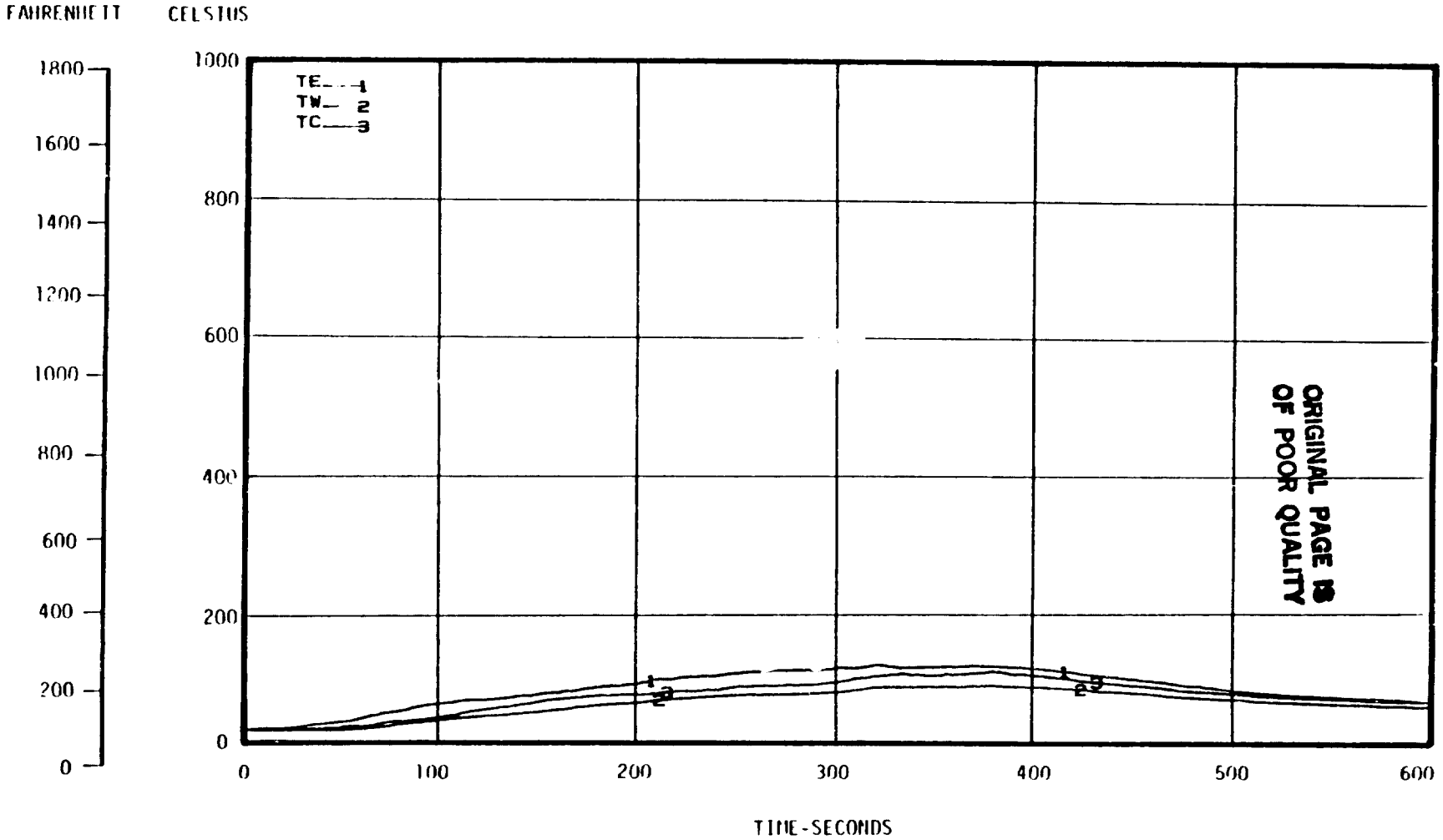


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 11.00

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21

CUSHION CONSTRUCTION NUMBER 12.0

CEILING TEMPERATURE

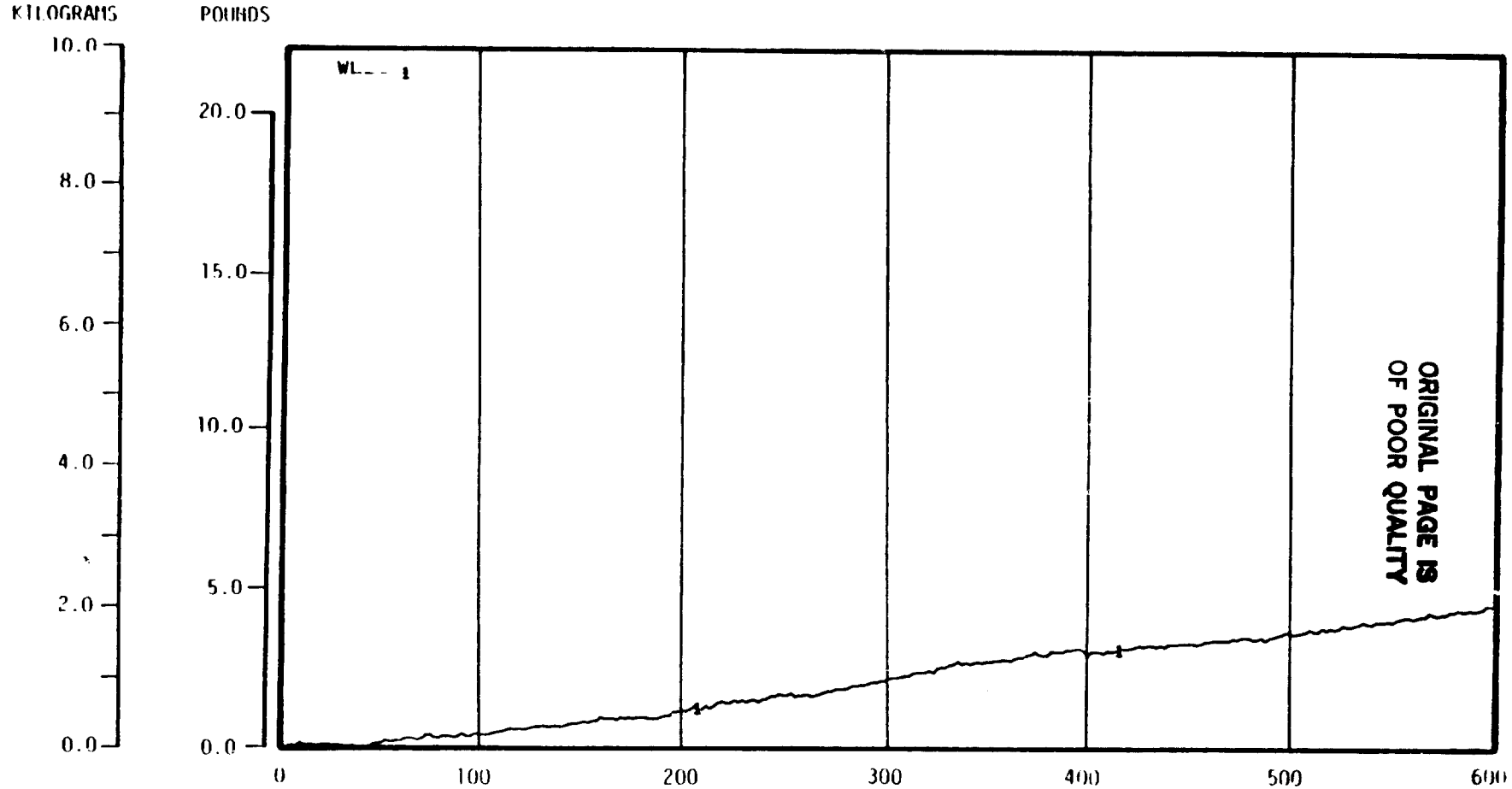


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 11.00

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21

CUSHION CONSTRUCTION NUMBER 12.0

WEIGHT LOSS

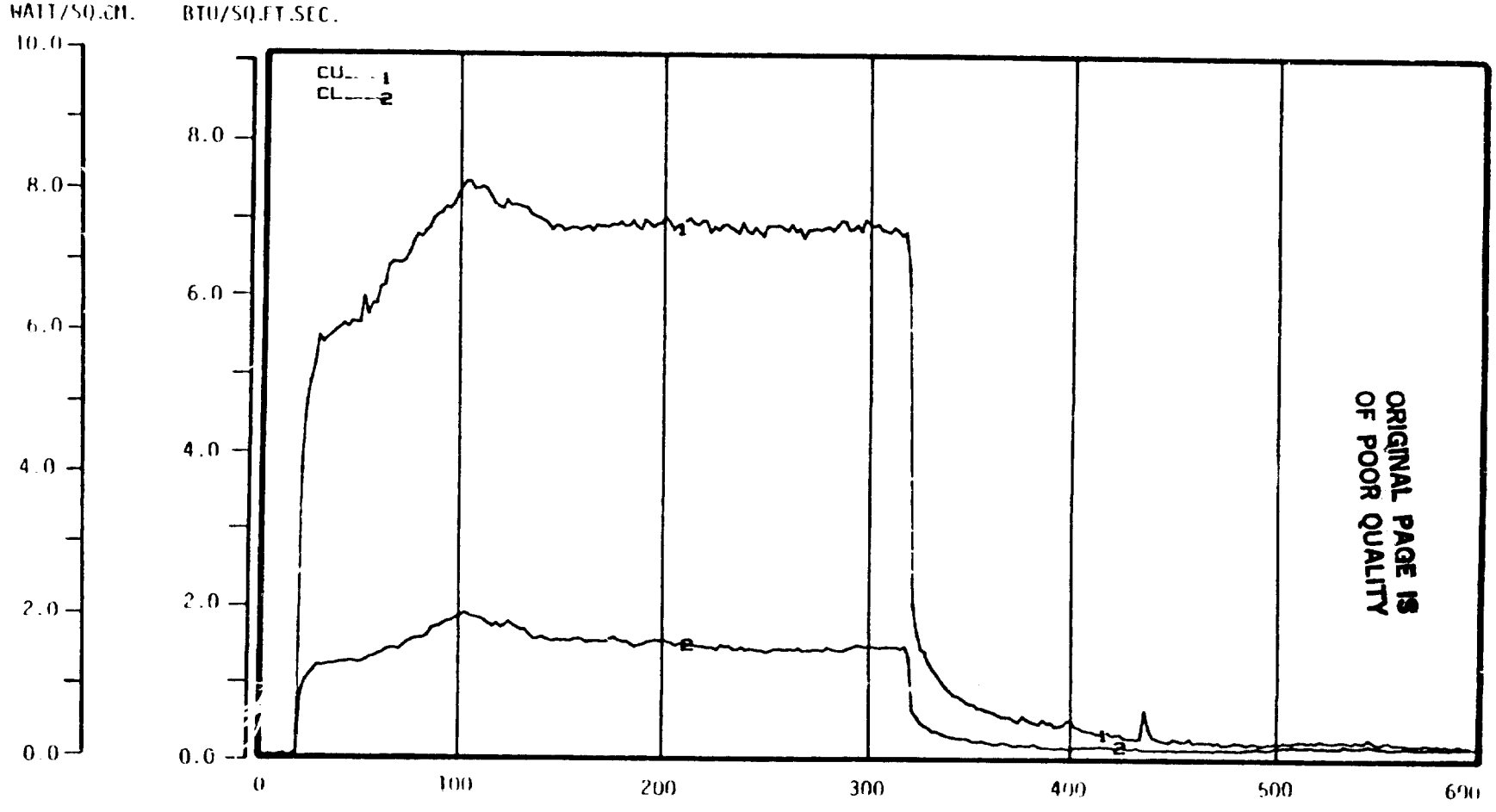


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 11.00

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 21

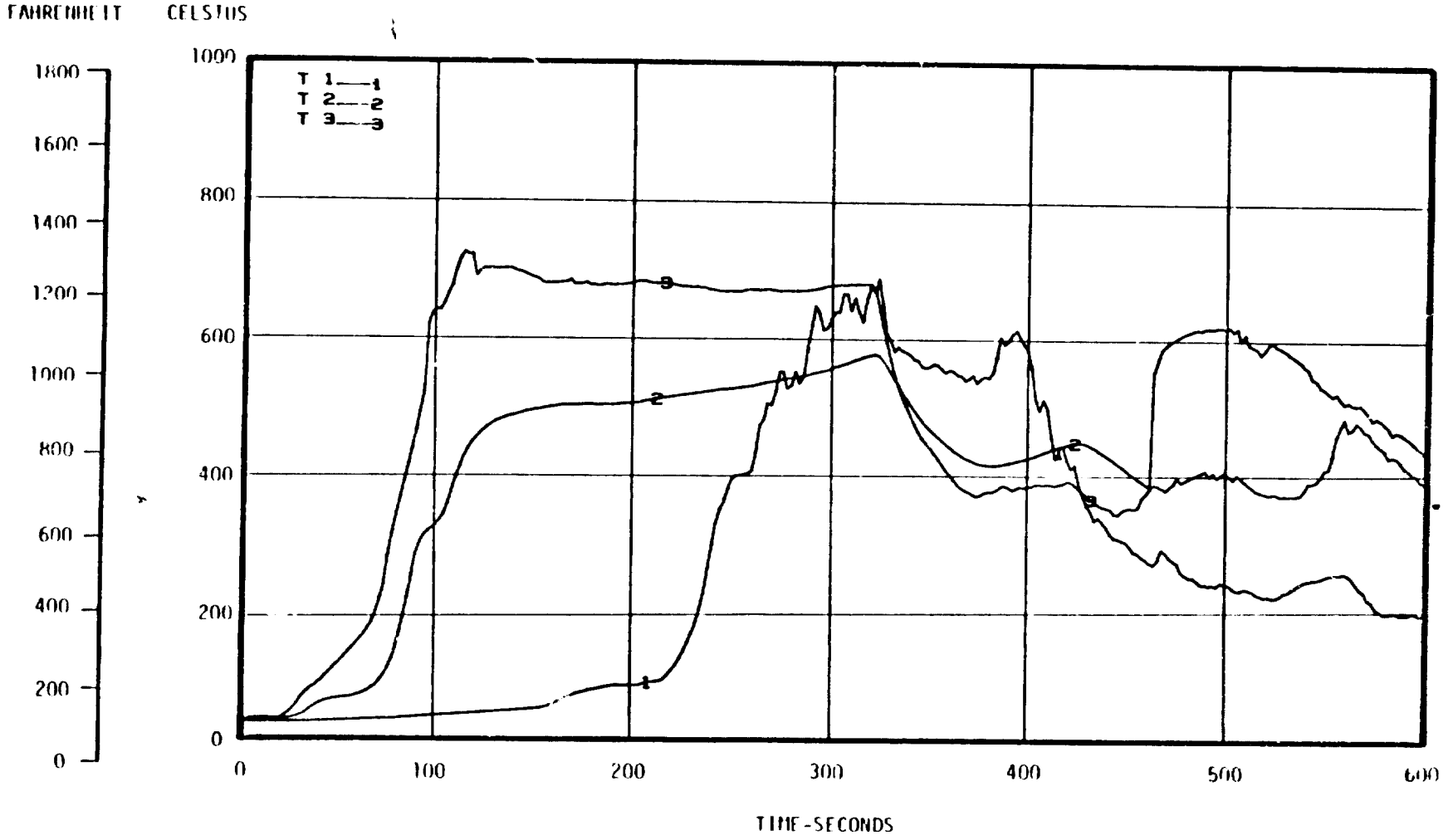
CUSHION CONSTRUCTION NUMBER 12.0

HEAT FLUX



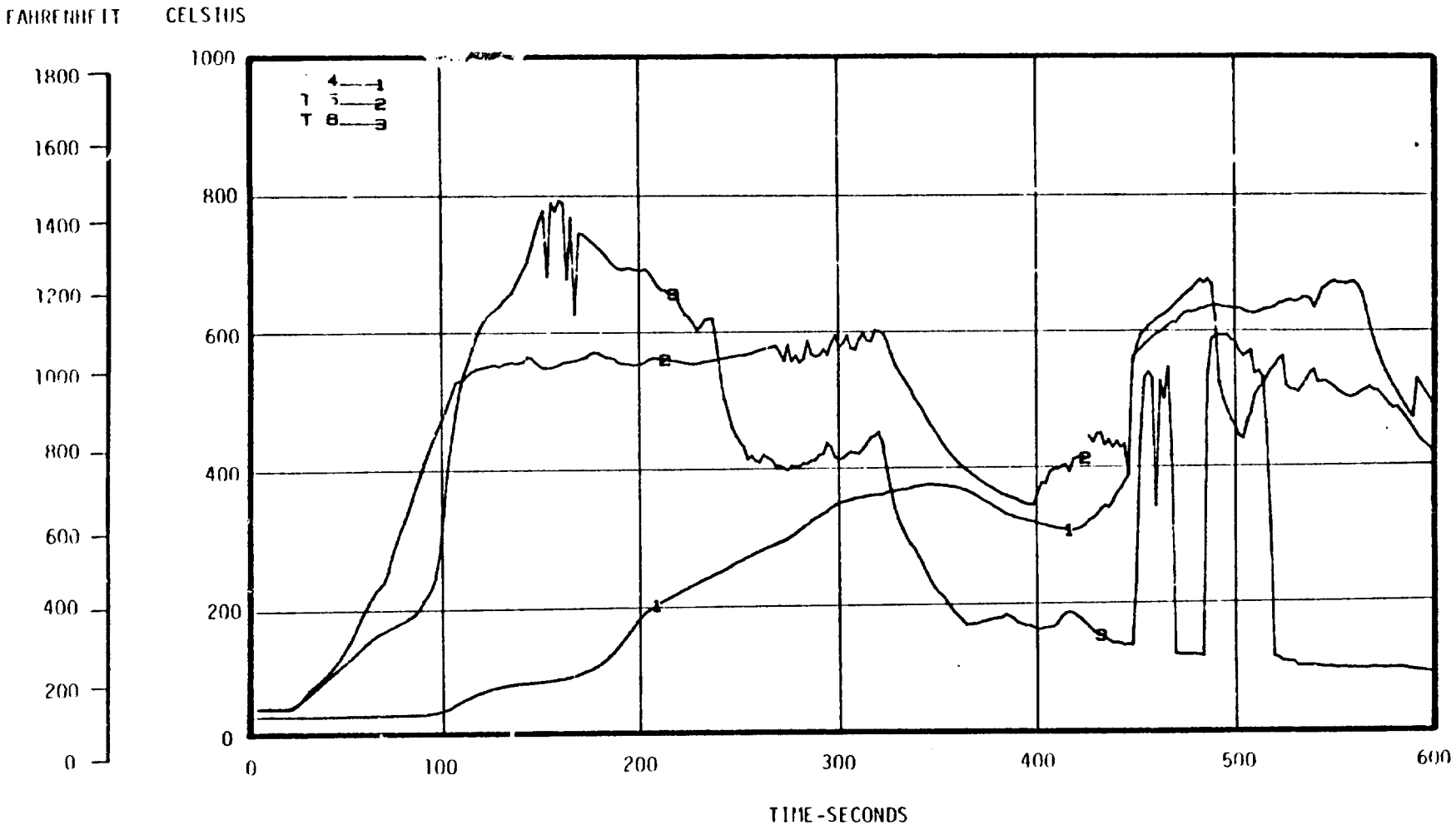
DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 13.42
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 22
CUSHION CONSTRUCTION NUMBER 13.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 13.42
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 22
CUSHION CONSTRUCTION NUMBER 13.0

SEAT CUSHION TEMPERATURES

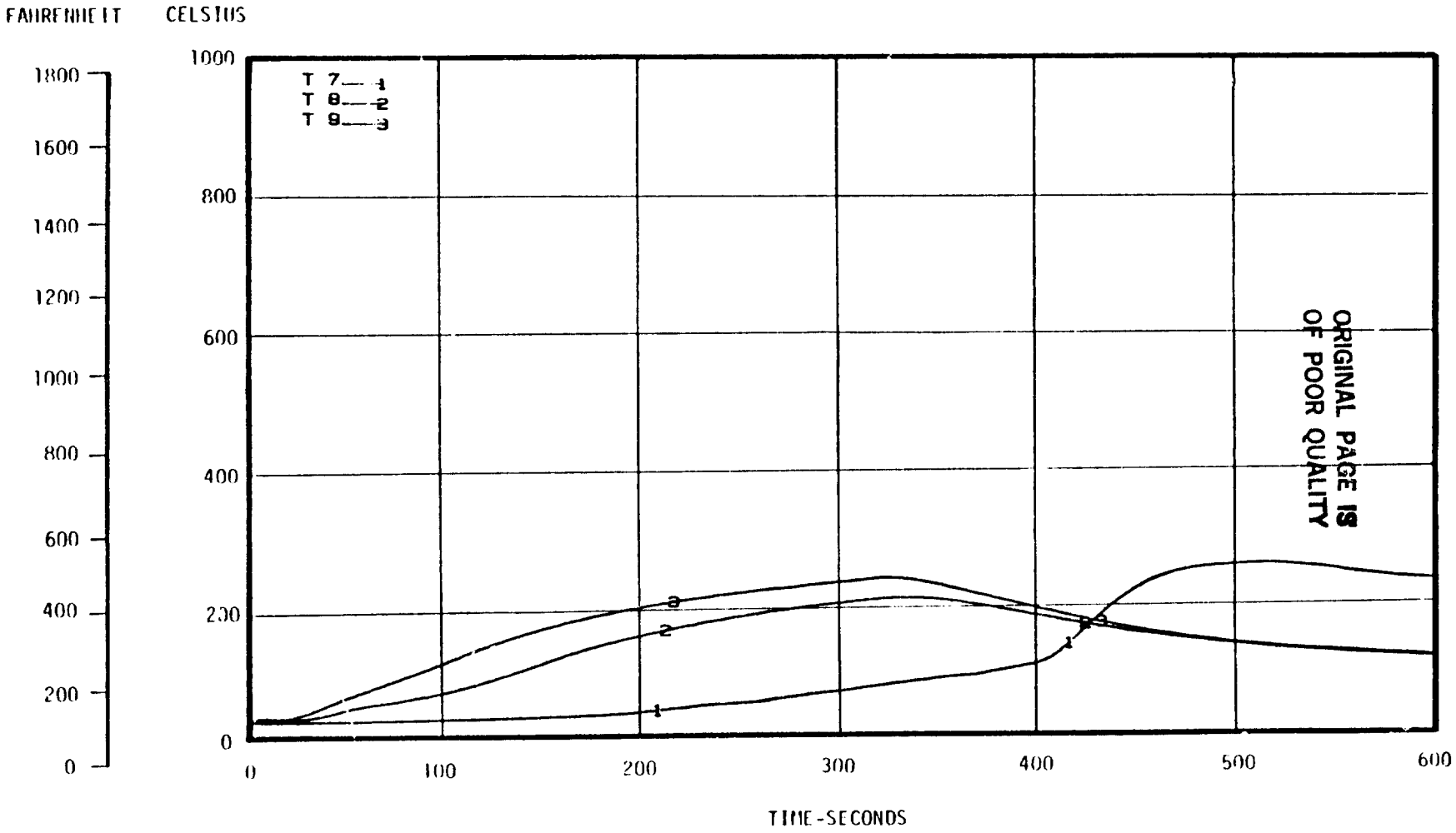


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 13.42

NASA-MIES FULL SCALE CUSHION BURN TEST NUMBER 22

CUSHION CONSTRUCTION NUMBER 13.0

SEAT CUSHION TEMPERATURES

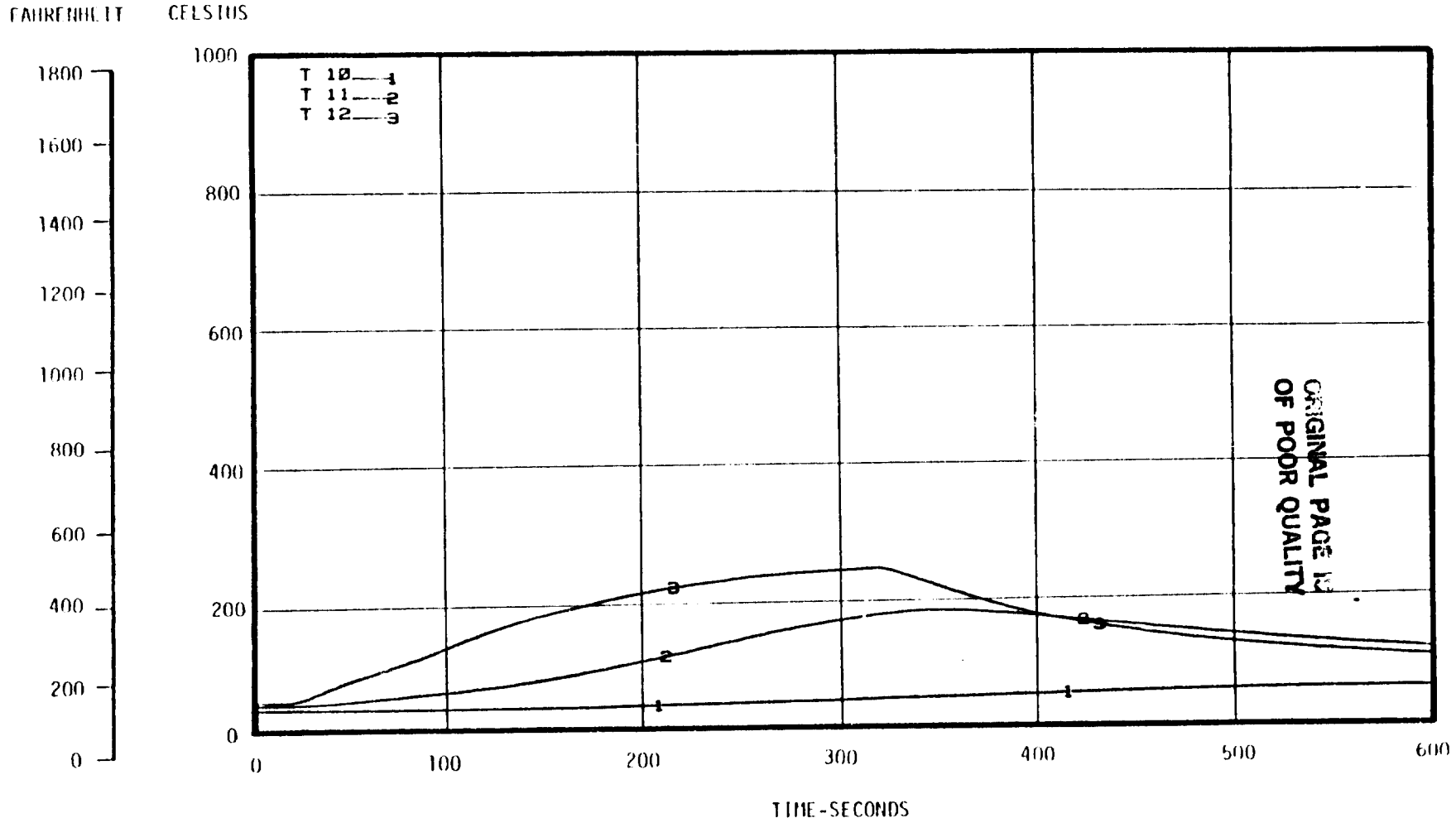


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.42

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 22

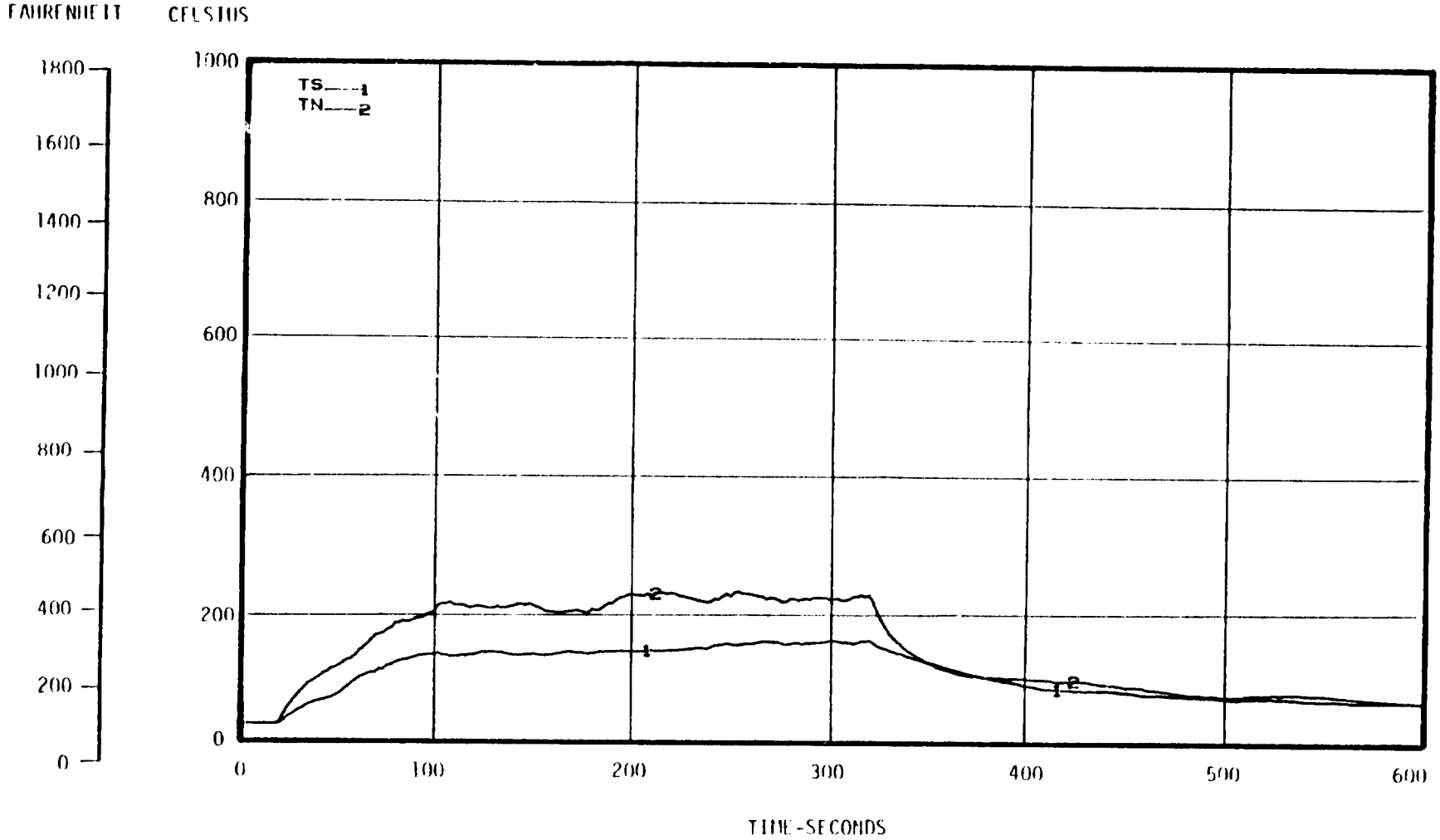
CUSHION CONSTRUCTION NUMBER 13.0

SEAT CUSHION TEMPERATURES



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 13.42
NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 22
CUSHION CONSTRUCTION NUMBER 13.0

CEILING TEMPERATURE

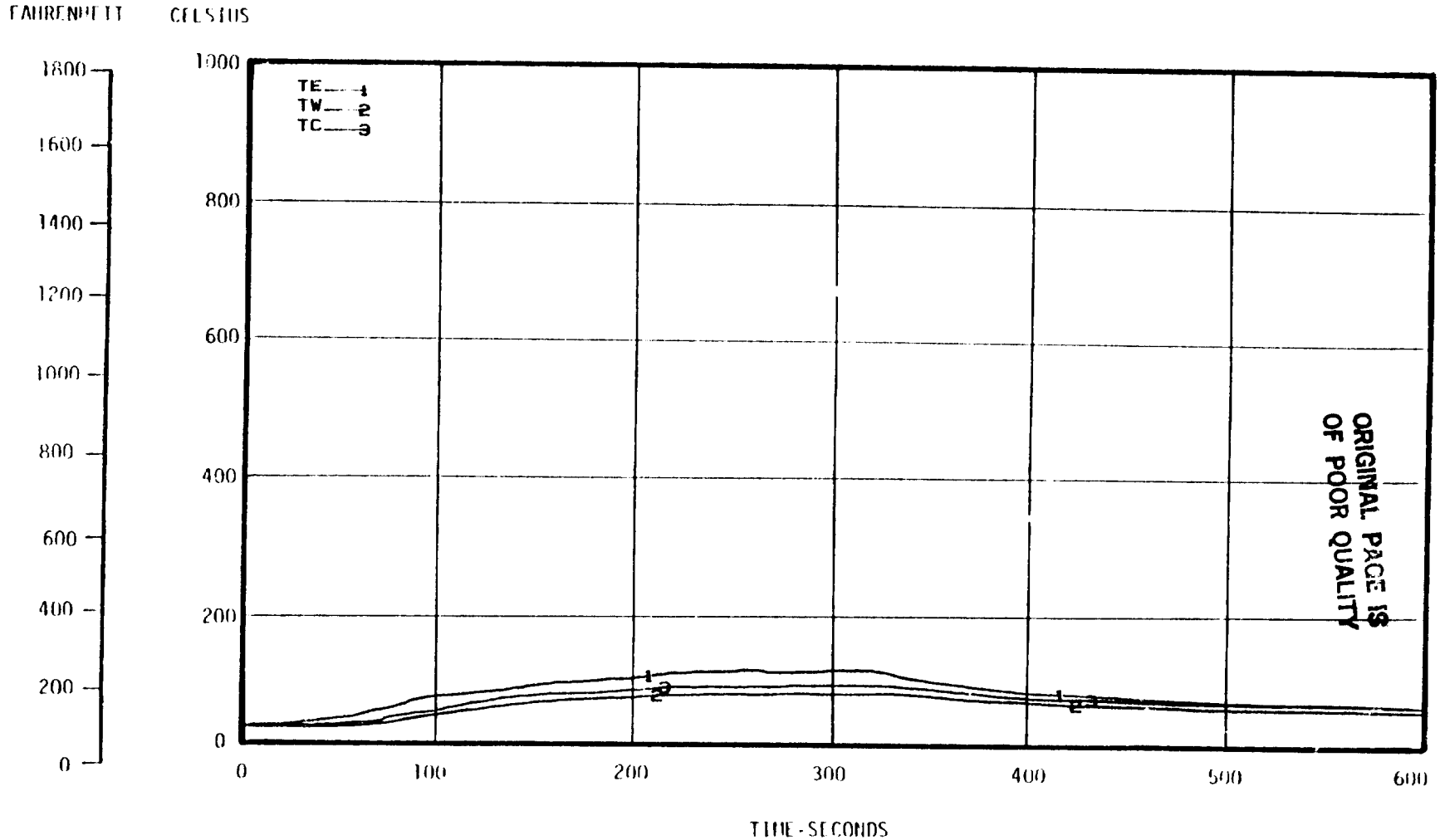


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 13.42

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 22

CUSHION CONSTRUCTION NUMBER 13.0

CEILING TEMPERATURE

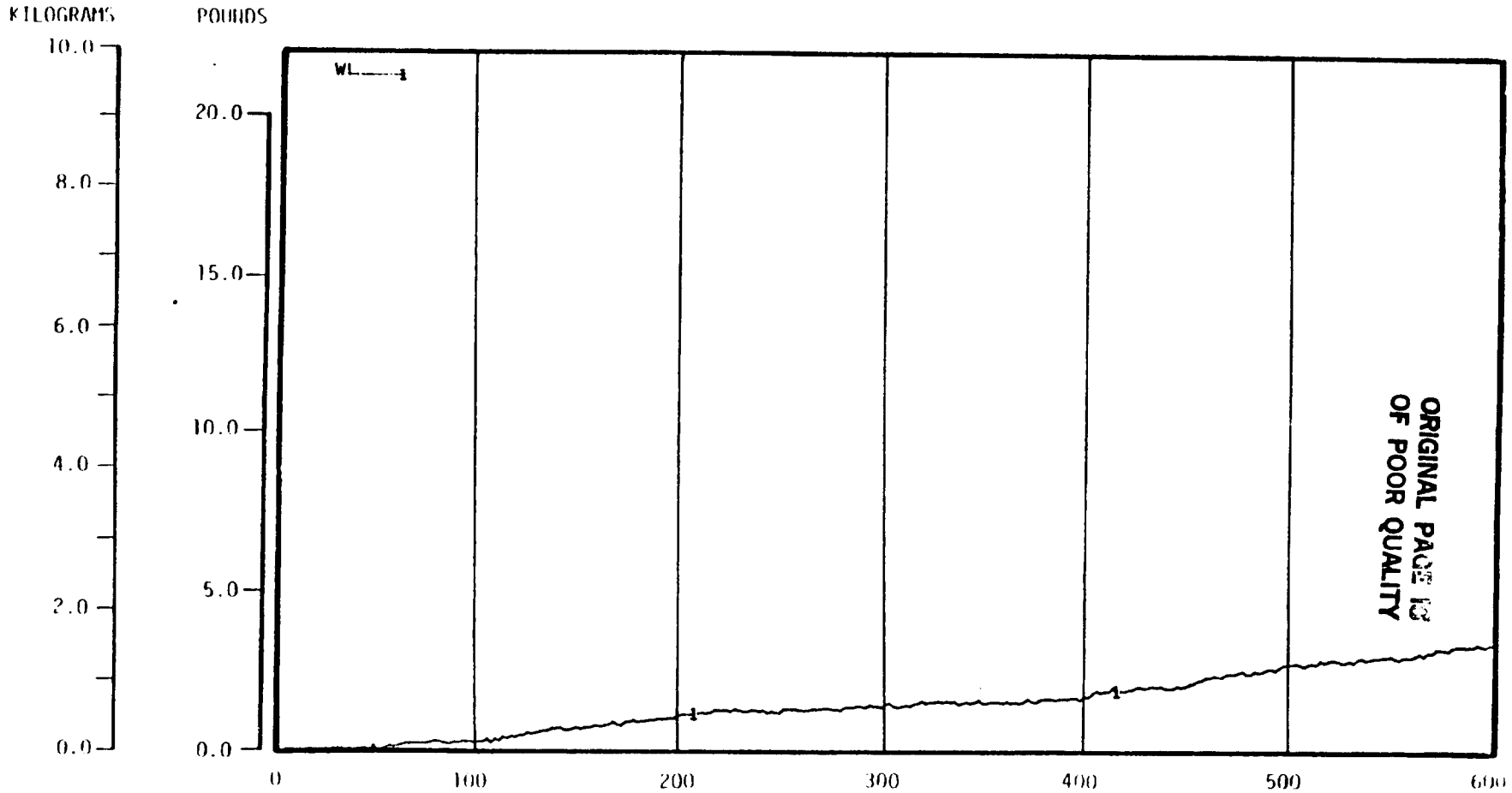


DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/10/82 13.42

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 22

CUSHION CONSTRUCTION NUMBER 13.0

WEIGHT LOSS



DOUGLAS AIRCRAFT CABIN FIRE SIMULATOR 03/18/82 13.42

NASA-AMES FULL SCALE CUSHION BURN TEST NUMBER 22

CUSHION CONSTRUCTION NUMBER 13.0