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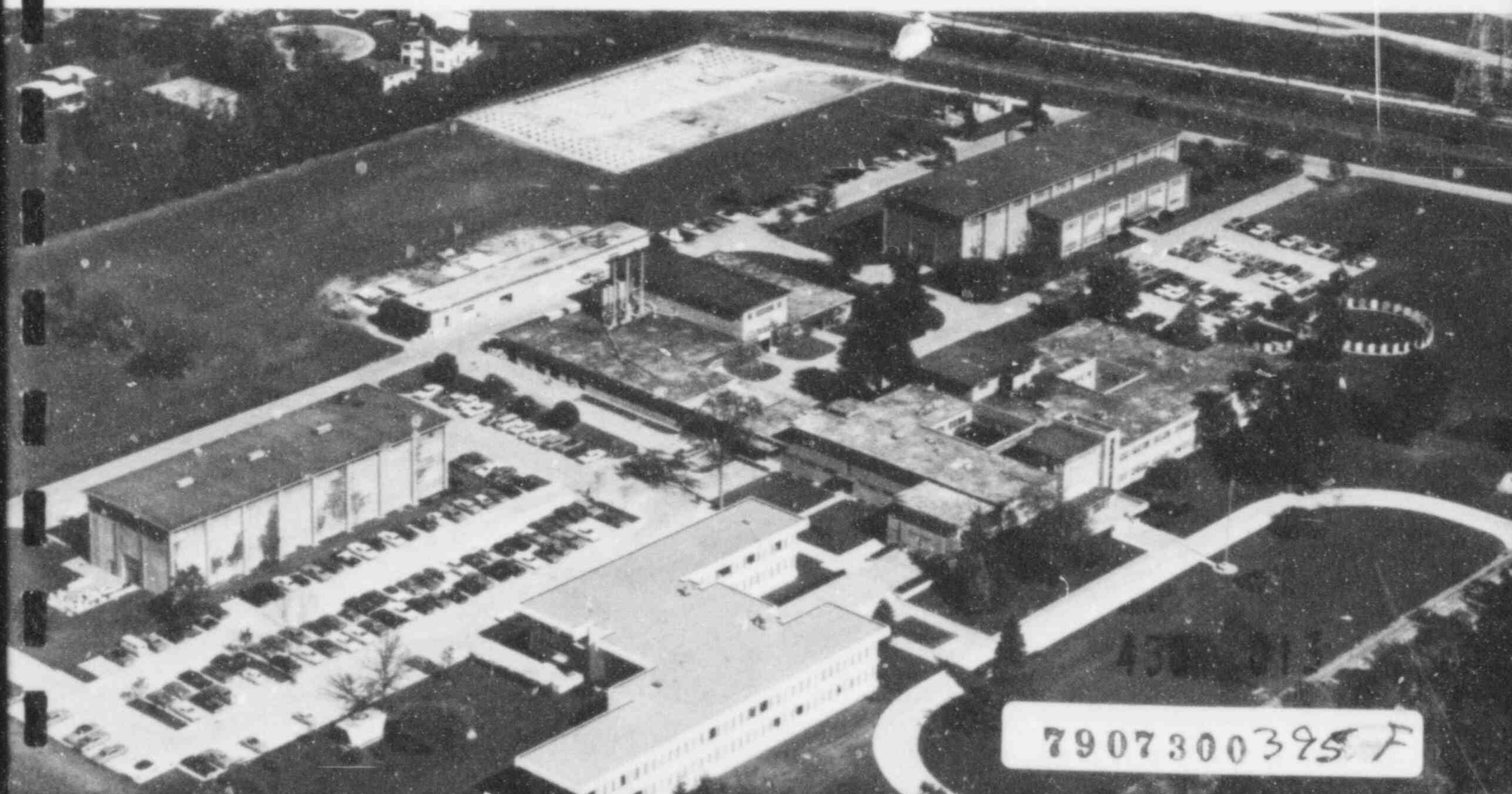

Report to
Cincinnati Gas and Electric Company
Dayton Power and Light Company
Columbus and Southern Ohio Electric Company
For the Wm. H. Zimmer Nuclear Power Station
Commonwealth Edison Company
For the LaSalle County Nuclear Power Station
Long Island Lighting Company
For the Shoreham Nuclear Power Station
Babcock and Wilcox Company, Refractory Division
Cosponsors of Test

FIRE PROTECTIVE CABLE TRAY FIRE TEST

by

Melvin S. Abrams

Submitted by
CONSTRUCTION TECHNOLOGY LABORATORIES
A Division of the Portland Cement Association
5420 Old Orchard Road
Skokie, Illinois 60077
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by

Melvin S. Abrams*

S Y N O P S I S

This report describes the fabrication of four cable-tray fire test specimens, discusses test procedures, and presents results of a fire test conducted on the specimens. Cable-tray specimens consisted of 16-ft long cable trays with 40% fill of EPR insulated, Hypalon jacketed IEEE 383 grade 7-conductor control cables in random lay. Cables were 14-ft long. Cable trays were protected with three 1-in. layers of Kaowool, a ceramic fiber blanket thermal insulation. Two cable-tray specimens were sealed at both ends, and two were sealed at one end only.

Continuity of 15 cables at the bottom, sides, top, and middle of each tray was monitored by observing lamps in a panel connected to 120 volts, ac, that were wired to conductors in each cable. The circuit was designed to indicate short circuit from the six outside conductors to the center conductor within each cable.

The fire test was conducted to evaluate the performance of thermal insulation material as a fire shield to

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protect electrical continuity of cables during the fire test. Cable-tray specimens were exposed to the Standard fire exposure of ASTM Designation: E119.(1)**

None of the 15 cables monitored in each cable-tray specimen exhibited short circuit or inability to carry current for at least 90 min of fire exposure. After 90 min of test, temperatures of cable insulation ranged from 94F to 426F. The first short circuit occurred after 94 min of exposure. The fire test was terminated at 1 hr 42 min when several more short circuits occurred. One tray was removed from the furnace about 30 min after test termination. Cables in this tray were visually inspected, and it was determined that they were not damaged by the exposure.

INTRODUCTION

As a result of recent fires at nuclear power plants there has been a great deal of interest in protecting cables in case of fire. In some areas of nuclear power plants, cables of redundant electrical systems, which are necessary for safe shutdown of the reactor, are located in close proximity. If a fire should occur in one of these areas, electrical systems could fail before the fire is extinguished, and a possibility exists that control of the reactor could be lost. Therefore, fire protection

**Superscript numbers in parenthesis designate References on Page 21.

for redundant cable systems, which are essential for the safe shutdown of the reactor, is needed when they are in close proximity. This fire test was devised to determine if three 1-in. layers of Kaowool, a ceramic fiber blanket of thermal insulation, provides 90 min of protection for cables in a complete fire engulfment.

The following report was prepared by M. S. Abrams, Director, Fire Research Department, Construction Technology Laboratories, a Division of the Portland Cement Association, and is based upon documentation of testing conducted on June 6, 1979, at that facility.

The fire protection design was a joint venture with C. E. Chaille, Senior Project Engineer, Development Laboratory, The Babcock and Wilcox Company; F. Horne, of R. E. Kramig Company, Insulating Contractor; R. E. Cotta, Electrical Project Engineer, Sargeant and Lundy; and R. J. Reiman, Senior Power Plant Engineer, Cincinnati Gas and Electric Company. The fire test conducted at the Construction Technology Laboratories on June 6, 1979, was witnessed by C. E. Chaille, R. E. Cotta together with L. Albers, Cincinnati Gas and Electric Company; H. Massin and B. Annis, B. M. Cohn, Gage-Babcock and Associates; and C. F. Baldassarra, Schirmer Engineering Corporation, Senior Engineer, Fire Protection Department. Schirmer Engineering Corporation were fire protection consultants on the Zimmer N. P. Project.

This report is a demonstration of the qualifications of insulating barrier to maintain circuit continuity during a specific fire exposure.

The fire test was conducted in the beam furnace of the Fire Research Laboratory of the Portland Cement Association.(2) A 10-ft section of each of the four 16-ft long fire test cable-tray specimens was exposed to the Standard fire described in ASTM Designation: E119. The section of the beam furnace used for the test contains three burners, each with a capacity of 3 million btu/hr.

Variations of furnace atmosphere temperature, as measured by control thermocouples, were within the limits outlined in ASTM Designation: E119.

Test fuel consumption was approximately 7,000,000 btu/hr. The insulation barrier qualified in this test was a ceramic fiber material of 8 lb/cu/ft density, manufactured by The Babcock and Wilcox Company, with the trademark "Kaowool". This material was examined because it has been previously accepted on Hatch Nuclear Power Station, Unit II, for thermal barrier use with cable trays and conduits, and because the material has been tested and qualified to ASTM Designation: E119, Fire Test Temperature Curve for that application at Hatch in July and August, 1978. This was documented in a UL Test Report No. R8758 dated September 6, 1978.

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The insulating barrier of Kaowool, application techniques, and thickness described in detail in the body of this report, proved to be qualified as a fire thermal barrier between the enclosed system and external area of exposure fire, for the system arrangement used during the testing program.

DESCRIPTION OF SPECIMENS

Four cable tray specimens were fabricated for the fire test. All materials for the specimens were provided by the sponsors. Insulated trays, tray covers, and cables cut to length were received at the Construction Technology Laboratories from the insulating contractor. Some of the thermocouples were installed when the material was received. Also received was a completed light monitoring panel.

Seventy cables were placed in a random manner in each of the trays by personnel of the Construction Technology Laboratories; this constitutes a 40% fill of the tray. Prior to putting cables in trays, thermocouples were attached to some of the cables. After a tray was filled, the insulated tray cover was placed on the tray and the entire assembly banded with ½-in. wide steel bands. All operations carried out by personnel of the Construction Technology Laboratories were in accordance with directions provided by sponsors of the test.

Following is a description of materials and procedures used in fabrication of the four test specimens.

Electrical Cable

EPR Insulated, 7-conductor Hypalon jacketed IEEE 383 Grade control cables were used in all trays. Six of the seven conductors are arranged in a symmetrical circular pattern. The seventh conductor is located in the center of the cable.

Cable Trays

All cable trays were 14-gage sheet steel, 24-in. wide, 4-in. deep with 22-gage expanded metal bottom, per Sargeant and Lundy's Specification H-2199, and were furnished by Husky Products, Inc. Minimum yield strength is 30 ksi. Cable trays in the fire test consisted of two 8-ft straight trays with splice plate per Sargeant and Lundy Drawing ES-121, dated 6/10/74. A 1-5/8-in. channel strut was welded at the bottom of each tray on 3-ft centers for 2 trays and at 3½-ft centers for the remaining two trays. The struts served as supports during test.

Fireproofing Material

Thermal insulation, 8 lb/cu ft density The Babcock & Wilcox Company, "Kaowool" ceramic fiber blanket, as described in Catalog Sheet 120-1, dated 10/1/74, was used as fire shields for cable trays. Thermal insulation blanket material used to cocoon cable trays was 1-in. thick by 4-ft wide.

Banding Material

Carbon steel strip banding material ½-in. wide by 0.020 in thick was used to secure insulated cable tray covers to cable trays.

Thermocouples

Thermocouples were fabricated from 24-gage chromel alumel special limit duplex wire. Wire was purchased from Claude S. Gordon, Richmond, Illinois, and is certified by the manufacturer to have the following limits of accuracy: 0 to 530F, ± 2F; 530 to 2300F, ± 3/8%.

Fabrication of Test Specimen

Cable trays and covers were insulated with Kaowool blanket material by R. E. Kramig Company, the insulating contractor. Insulated trays and cut cables were transported to the Construction Technology Laboratories. Trays and covers were well supported to avoid deformation during handling and shipping, and were protected with a heavy sheet plastic wrap. Trays and covers arrived in an undamaged condition.

Installation of thermocouples on cables and at some locations on trays, placement of cables in trays, sealing of trays, pleacement of covers on trays, and banding covers to trays were completed by personnel of the Construction Technology Laboratories. Procedures for insulating cable trays and covers, for installing thermocouples, and for filling and banding trays are given in the following paragraphs.

Insulation of Trays

Cable trays and covers were insulated with a 3-in. thickness of Kaowool blanket installed by R. E. Kramig Company, Cincinnati, Ohio. The ten-step procedure for "Cocoon Fireproofing, Electrical Cable Tray", given in Appendix A was carefully followed. Carbon steel banding material, rather than stainless steel bands, as required in Step 10, was used to secure tray covers to trays. Figures 1 to 14 show typical procedures followed in insulating cable trays and covers.

Cable Preparation and Installation

To monitor circuit continuity of cables during the fire test, 60 cables, 15 for each tray were prepared in the following manner: About 3 in. of the outer insulation jacket was cut away. Insulation was then stripped from the 7 conductors in each cable. For the center cable, only about 3/4-in. of insulation was removed. The six outer conductors were twisted tightly together to form a single lead. These 60 cables were meggered to insure that there was no shorting between the six outer conductors and the center conductor in each cable.

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Thermocouples were attached to four cables of each tray using brass wire ties. Thermocouples were attached at Locations 1 through 9 and 14. Locations of the 18 thermocouples used in each tray and cross-reference thermocouple numbers are given in Table 1. Thermocouple locations also are shown in Fig. 15. After thermocouples were attached, the 70 cables required for the 40% fill were placed in a random lay in three layers in each tray. Figure 16 shows the positions of the 15 cables to be monitored. Cables with thermocouples on the insulation jacket were placed in position in the tray, Fig. 17, so that the thermocouples would be properly located. A description of thermocouple locations are given in Table 2.

After all cables were installed in the trays, the 15 cables in each tray were again meggered to insure against short circuits. Figure 18 shows cables in one of the trays.

Sealing of Trays

Cable Trays 1 and 4 were sealed at both ends of the 10-ft span exposed to the fire. Cable Trays 2 and 3 were sealed at only one end of the 10-ft span. Trays were sealed by stuffing pieces of Kaowool around openings between cables and by filling the tray with Kaowool 1-in. thick blankets from the top of the cables to the top of the tray. The purpose of the seal was to prevent air from flowing through the tray during the fire test. Figure 19 shows one of the trays being sealed at one end and Fig. 20 shows a tray completely sealed at both ends.

Application of Steel Bands

After trays were sealed, insulated tray covers were placed on each tray with the metal side up. Three remaining thermocouples were installed at Locations 13, 15, and 16. Insulated tray covers were secured to insulated trays with steel bands ½-in. wide by .020 in. thick. Bands were applied with a conventional banding tool. Bands were positioned not more than 3 in. on either side of butt joints in the outer insulation layer, and approximately at 12-in. intervals elsewhere. Occasionally, the interval was somewhat greater or smaller depending upon location of joints and struts.

Metal straps were tightened as much as possible but care was taken not to spread butt joints in the insulation material or to damage the Kaowool wrap. Bands were fastened with metal banding clips applied with a conventional fastening tool. Figure 21 shows a completely banded tray being prepared for hoisting into the furnace.

INSTALLATION OF SPECIMENS IN FURNACE

About two weeks prior to test, two 6-in. thick concrete walls were cast to support the trays in the furnace.

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When the walls gained sufficient strength, they were positioned in the furnace 10 ft apart, and carefully packed with insulation around sides and bottom surfaces to prevent heat loss or air flow. The walls were dried for 4 days at temperatures of 400 to 500F while positioned in the beam furnace.

After trays were banded, they were installed one by one in the furnace. First the two bottom trays were placed on the lower support points of the walls as shown in Fig. 22. Trays were carefully hoisted with wide canvas slings that were placed around load-spreading 2x10-in. boards. Care was taken to keep the slings from crushing the Kaowool material. Also, lifting was performed in a manner to minimize deflection of the tray. The trays, however, were quite rigid and showed no tendency to deflect even when unsupported in the interior of the 10-ft span.

Figure 22 shows the two bottom trays positioned in the furnace. Eight-in. refractory cubes were placed under the unistrut supports to prevent deflection of the trays. Refractory bricks were then laid into place in the openings of the wall above the tops of the two trays to provide a seat for the top two trays. Metal seats to support the top two trays were fastened to the wall at the proper elevation. The top two trays were then installed in the furnace and refractory bricks mortared into place in the walls from the top of the trays to the top of the furnace.

Provisions were made to facilitate removal of refractory brick walls from one of the specimens at the end of test for easy removal of the tray from the furnace.

Metal tee struts wrapped with Kaowool blanket were fabricated as supports between the top and bottom trays at the unistrut support locations. The furnace with all four trays and end walls in place are shown in Fig. 23. The roof of the furnace was then put in place and furnace atmosphere control thermocouples positioned through the roof into the furnace. The light monitoring panel was then connected to the 60 cables of the four trays and all circuits tested. Figure 24 shows the sealed furnace with the light panel at one end with all 60 circuits lighted. Circuits for the light monitoring panel are shown in Fig. 25. Circuitry and circuit identification layouts of the light monitoring panel is also shown in Appendix A.

The relative position of the four cable trays in the furnace are shown in Fig. 26. Bottom trays were located about 22 in. from the top of the burners. Top trays were located 18 in. above bottom trays. There was about 18 in. from the top of the top trays to the furnace roof. As much space as possible was provided between trays to allow for circulation of heat during the fire test.

FIRE TEST

The fire test was conducted in the Portland Cement Association's beam furnace. The 16-ft long cable-tray specimens were supported on a 10-ft span with about 3 ft of each tray extending beyond the fire zone at each end. Specimens were also supported at the approximate quarter points in the fire zone, at the metal strut supports provided for this purpose. No service loads were applied to cable trays during the fire tests. Details of performance of specimens during the fire test are given in the following paragraphs.

Furnace Atmosphere Temperatures

Eight shielded thermocouples protected in accordance with the requirements of ASTM Designation: E119 were used to measure and control furnace atmosphere temperature. The fire was luminous, highly turbulent and well distributed throughout the test. About 7,000,000 btu/hr were used during the test.

Furnace atmosphere temperatures were programmed to follow the time-temperature relationships specified in ASTM Designation: E119. However, the average temperature measured by the furnace atmosphere control thermocouples showed some variation from this relationship. As shown in Fig 28 and 29, the average variation was small in the two zones used for the test. Average furnace atmosphere control temperatures are listed in Table 3. Average furnace atmosphere temperature was controlled with only a 1.5% variation from the Standard time-temperature curve throughout the 1 hr 42-min test period. This is well within the 7.5% tolerance allowed in ASTM Designation: E119.

TEST RESULTS

Details of performance of cable-tray fire test specimens during the fire test, observations of some of the specimens after fire test, and temperature information at different locations in the specimens follow.

Observations During Fire Test

Just prior to start of fire test, all 60 circuits were meggered. No short circuits were found. All circuits of the light monitoring panel were turned on and the absence of short circuits was verified. Circuit "C", which monitored continuity between cables and tray, was also free of short circuits.

The test proceeded without incident for 90 minutes. Some of the bands that secured cable tray covers to the cable trays loosened during the test. However, no appreciable difference in the condition of the joint between the insulation of the cover and the tray was noted. No deflection was noted on any of the cable trays during the entire test period.

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The light panel was carefully checked at 10 min intervals during the first ninety min of test. No short circuits were observed. At 91 min from start of test, bulbs in the circuit attached to Cable 15 in Tray 3, began to indicate a short circuit. At this time, the cable was meggered and still indicated circuit continuity. At 94 min, the bulbs indicated a short circuit and this was verified by meggering Cable 15. Ninety-six minutes after start of test, additional short circuits were indicated on the light panel for Cable 6 in Tray 4, and Cable 15 in Tray 3. An additional short circuit was observed beginning in Cable 14, of Tray 4 at 101 min. The test was terminated at 1 hr 42 min.

Immediately after the end of test, all 60 circuits were meggered. No short circuits were observed in Cable Trays 1 and 2. Short circuits indicated by the light panel in Tray 4 were verified.

Observations After Fire Test

Shortly following meggering of the cables after the fire test, preparations were made to remove Tray 1 from the furnace. Furnace atmosphere control thermocouples and the roof deck were first removed to expose the trays in the furnace. As shown in Fig. 30, the two top trays appeared undamaged after the fire test. The refractory brick walls were quickly removed from the ends of the fire zone above Tray 1, and all wires cut or removed from the cables and thermocouples. Chains were attached to the ends of the cable tray outside of the fire zone and the tray lifted out of the furnace, as shown in Fig. 31. Figure 32 shows the tray being moved away from the furnace. Note the absence of deflection, even though the specimen is supported only at the ends. Specimen was placed on the Laboratory floor, steel bands cut, and cover removed. Condition of the cables are shown in Fig 33, 30 min after the test was terminated. There was no visible damage to the cables due to fire exposure. The condition of Tray 4 after Tray 1 was removed is shown in Fig. 34. No damage was observed to any parts of this test specimen.

Tray 4 was removed from the furnace about 3½ hr after the end of test. The condition of the cables are shown in Fig. 35. Some of the cables that short circuited during test were carefully inspected. Although there were indications of softening of the cable jacket, one cable was meggered and found to be free of short circuits. Inspection of the temperature records indicated that some of the cables reached temperatures of nearly 600F after the fire was turned off, and temperatures still were about 400F when the tray was removed from the furnace.

Temperature Information

Complete temperature records for the [illegible] thermocouples of each of the four trays as recorded on strip-chart recorders in the control room of the Fire Research Laboratory, are given in Appendix B. Strip-chart recorders have an accuracy of ± 1/4 of 1% of full scale. This amounts to approximately ± 6F. However, all recorders were recently calibrated and error limits are considerably less than the ± 6F.

Table 4 lists temperature information for the 72 thermocouples at 90 min and at end of test. Although the furnace atmosphere temperature was closely controlled, to the Standard Fire of ASTM Designation: E119, and even though efforts were made to separate trays from each other as much as possible, higher temperatures were measured on bottom trays 3 and 4 than on top trays 1 and 2. Evidentally, bottom trays acted as a heat shield for top trays. As noted in Fig. 26, bottom trays were fairly close to burners of the furnace.

Ninety minutes after start of test, no short circuits were observed in any of the trays. The highest temperatures observed at that time were indicated by Thermocouples 57, 60, 63 at Locations 3, 6, and 9 of Tray 4. Temperatures were 387, 385, and 426F, respectively. At end of test,when several short circuits were observed in Cable Trays 3 and 4, temperatures ranged from 400 to 500F on some of the cables. Temperature data indicated that no short circuits occurred at a cable jacket temperature of 200C (392F). This temperature is usually considered as the maximum continuous service temperature for maintaining continuity of this type of cable jacketing.

The effect of sealing one or two ends of the cable tray was not clearly evident from temperature data. Generally, trays sealed at both ends had somewhat higher temperatures during the fire test. However, this was not consistent at all thermocouple locations.

SUMMARY

Four cable tray specimens consisting of a 40% fill of cables installed in a random lay pattern and with the trays insulated with three 1-in. layers of Kaowool thermal insulation, were subjected to a fire exposure for 1 hr 42 min. Provisions of ASTM Designation: E119 were followed in conducting the fire test. Pertinent test results are listed:

1. Wrapping cable trays with three 1-in. layers of Kaowool blanket thermal insulation protected the circuit continuity of cables in the trays for 94 min. No short circuits were indicated on the light panel or by meggering before that time.

2. No short circuits occurred at a cable jacket temperature of 200C (392F), which is considered as the maximum continuous service temperature for maintaining continuity of this type of cable jacketing.
3. Cable Tray 1 was removed from the furnace 30 min after the end of test. At this time, temperatures of the cables had increased about 50F over those at end of test. Cables were inspected visually, and it was determined that no damage occurred to cable jacketing material.
4. Tray 4 was removed from the furnace about 3½ hr after the test was terminated. Temperatures of the cables continued to rise from 100 to 200F for about 1½ hr after the test was terminated. When the tray was removed, some cable temperatures were still about the same as those at end of test. A visual inspection of cables indicated that there was some softening of jacket material. However, one such cable was meggered and found to have circuit continuity.
5. The effect on temperature of sealing one or two ends of the cable trays was not clearly

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defined. Generally, trays sealed at both ends had somewhat higher temperatures than trays sealed at only one end.

LABORATORY RESPONSIBILITY

The Construction Technology Laboratories, a Division of the Portland Cement Association, was not involved in the procurement of materials and in some phases of the fabrication of test specimens, and makes no judgment of the suitability of materials for particular end uses. The acceptance of test results for guidance of field installation is the prerogative of the authority having jurisdiction.

REFERENCES

1. ASTM Designation: E119-79, Standard Methods of Fire Tests of Building Construction and Materials, American Society for Testing and Materials, Philadelphia, Pa.

2. Carlson, C. C. and Tatman, Phil J., "The New Beam Furnace at PCA and Some Experience Gained From Its Use," PCA Research Department Bulletin 142.

TABLE 1 LOCATION AND THERMOCOUPLE NUMBERS

Location No.	Thermocouple Location			
	Tray 1	Tray 2	Tray 3	Tray 4
1	1	19	37	55
2	2	20	38	56
3	3	21	39	57
4	4	22	40	58
5	5	23	41	59
6	6	24	42	60
7	7	25	43	61
8	8	26	44	62
9	9	27	45	63
10	10	28	46	64
11	11	29	47	65
12	12	30	48	66
13	13	31	49	67
14	14	32	50	68
15	15	33	51	69
16	16	34	52	70
17	17	35	53	71
18	18	36	54	72

TABLE 2 DESCRIPTION OF THERMOCOUPLE LOCATIONS

1. Thermocouples 1, 2, 3, 4, 5, 6, 7, 8, and 9 are to be attached to the cables on the bottom of the tray.
2. Thermocouple 14 is to be attached to a cable on the top of the tray.
3. Thermocouple 10 and 11 are to be placed behind the first inch and second inch of Kaowool wrap on the tray.
4. Thermocouple 12 is to be attached to the metal tray itself.
5. Thermocouple 13 and 15 are to be attached to the outer wrap of Kaowool.
6. Thermocouple 16 is to be located inside the seal, between the lid and the tray.
7. Thermocouple 17 and 18 are to be attached to the unistrut supports.

ALL FOUR CABLE TRAYS WILL HAVE THE SAME THERMOCOUPLE LOCATIONS.

TABLE 3 AVERAGE FURNACE ATMOSPHERE CONTROL TEMPERATURES AND VARIATIONS

Test Time, Hr:Min	Furnace Temp., F	ASTM E119 Temp., F	Variation From ASTM Temp., F
Ambient	70	70	0
0:05	1052	1000	52
0:10	1212	1300	-88
0:15	1346	1399	-53
0:20	1404	1462	-58
0:25	1455	1510	-55
0:30	1519	1550	-31
0:35	1570	1584	-14
0:40	1605	1613	- 8
0:45	1623	1638	-15
0:50	1640	1661	-21
0:55	1656	1681	-25
1:00	1675	1700	-25
1:05	1704	1718	-14
1:10	1723	1735	-12
1:15	1730	1750	-20
1:20	1736	1765	-29
1:25	1752	1779	-27
1:30	1773	1792	-19
1:35	1795	1804	- 9
1:42	1808	1819	-11

TABLE 4 TEMPERATURE DATA

Tray No. 1			Tray No. 3		
Thermocouple No.	Temperature, F 90 Min	Temperature, F EOT[a]	Thermocouple No.	Temperature, F 90 Min	Temperature, F EOT[a]
1	181	211	37	98	100
2	120	137	38	193	230
3	175	208	39	256	310
4	160	190	40	360	432
5	199	259	41	237	270
6	260	310	42	277	330
7	187	215	43	337	400
8	205	224	44	100	101
9	180	210	45	285	336
10	993	1044	46	1514	1549
11	637	687	47	1150	1190
12	211	316	48	440	480
13	1328	1356	49	1730	1762
14	139	157	50	98	100
15	1035	1096	51	862	876
16	709	765	52	100	102
17	456	521	53	972	1080
18	460	524	54	578	630
Tray No. 2			**Tray No. 4**		
19	199	230	55	300	365
20	93	99	56	119	200
21	149	170	57	387	426
22	194	230	58	307	369
23	132	150	59	248	279
24	148	174	60	385	455
25	196	228	61	319	380
26	94	95	62	228	253
27	158	185	63	426	500
28	940	984	64	1518	1588
29	590	630	65	1130	1190
30	210	312	66	518	602
31	1125	1158	67	1770	1830
32	141	158	68	204	243
33	995	1039	69	769	810
34	875	920	70	929	983
35	450	520	71	739	838
36	332	430	72	947	1050

[a] End of Test

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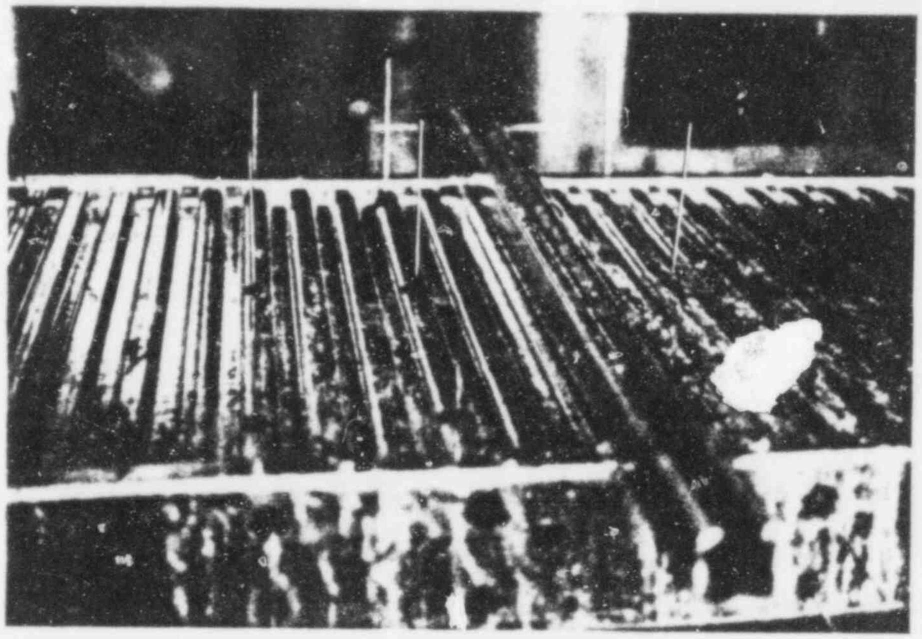

Fig. 1 Support Strut on Tray Bottom

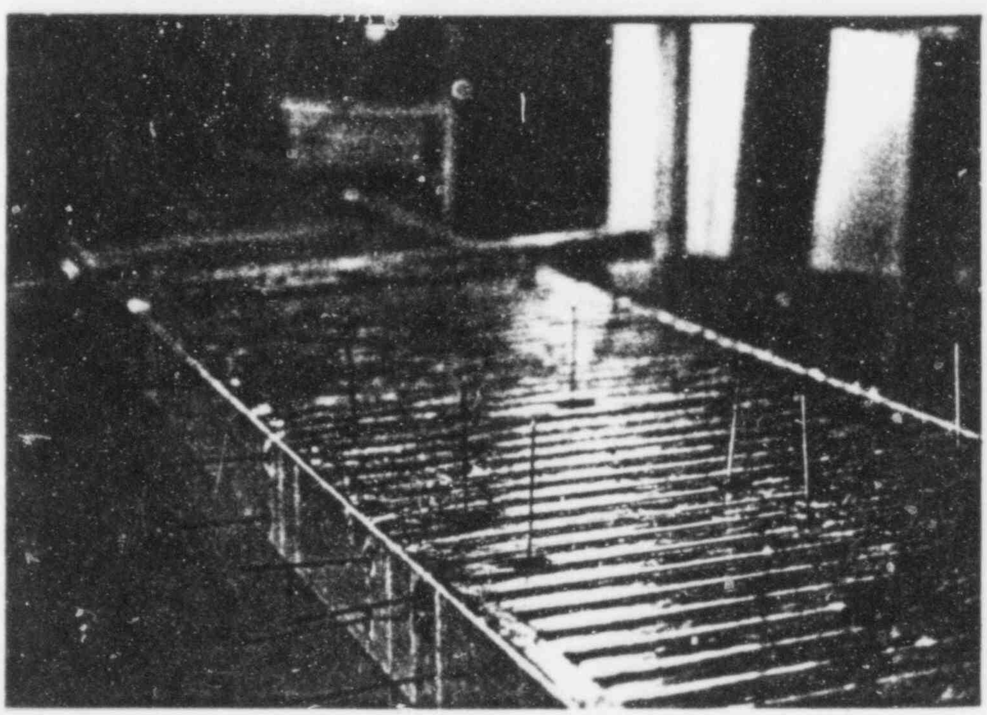

Fig. 2 Pin Arrangement on Tray

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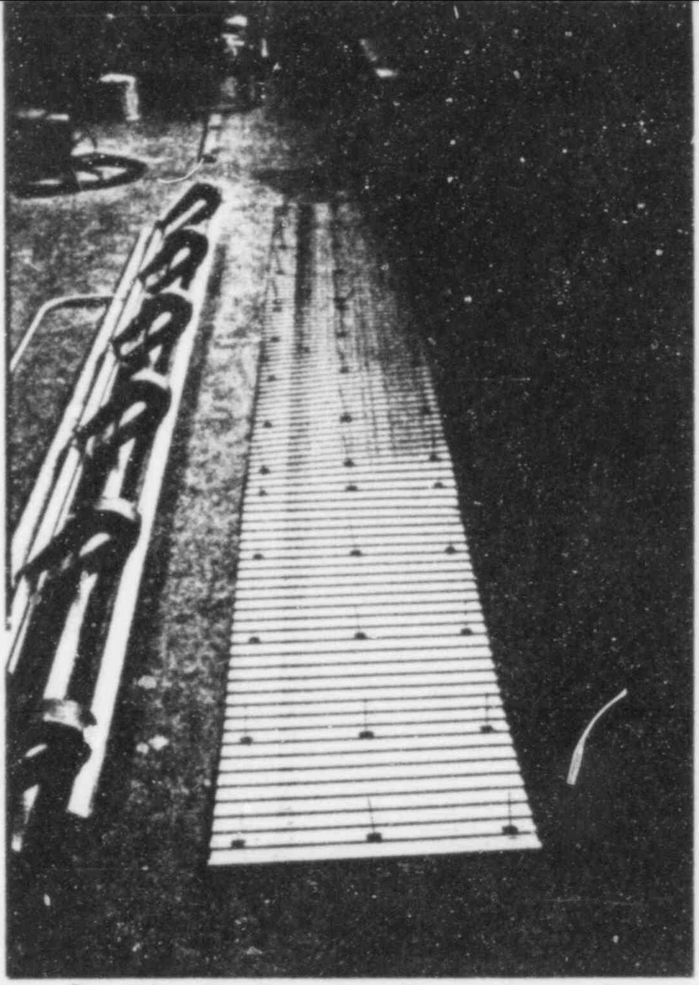

Fig. 3 Pin Arrangement on Tray Cover

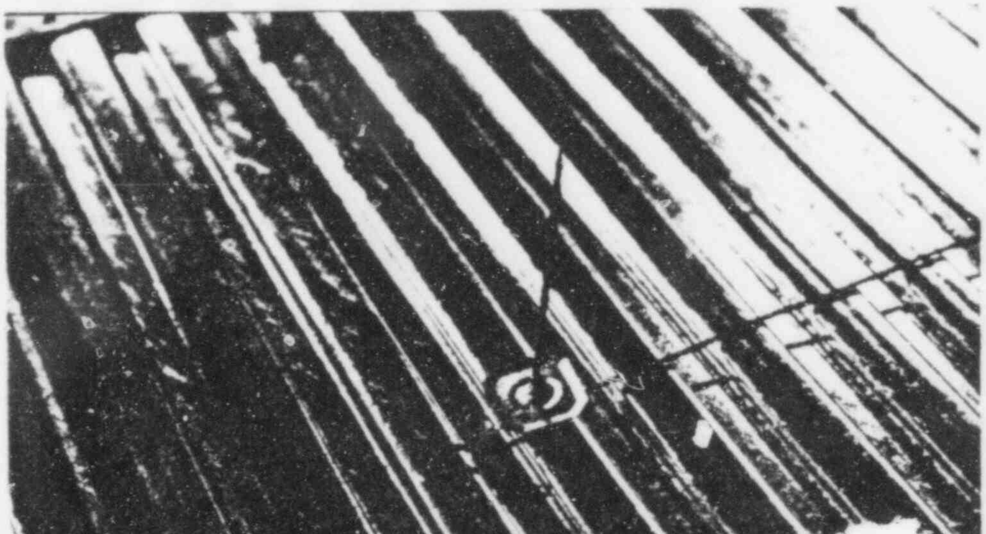

Fig. 4 Thermocouple Secured by Wrapping Around Pin

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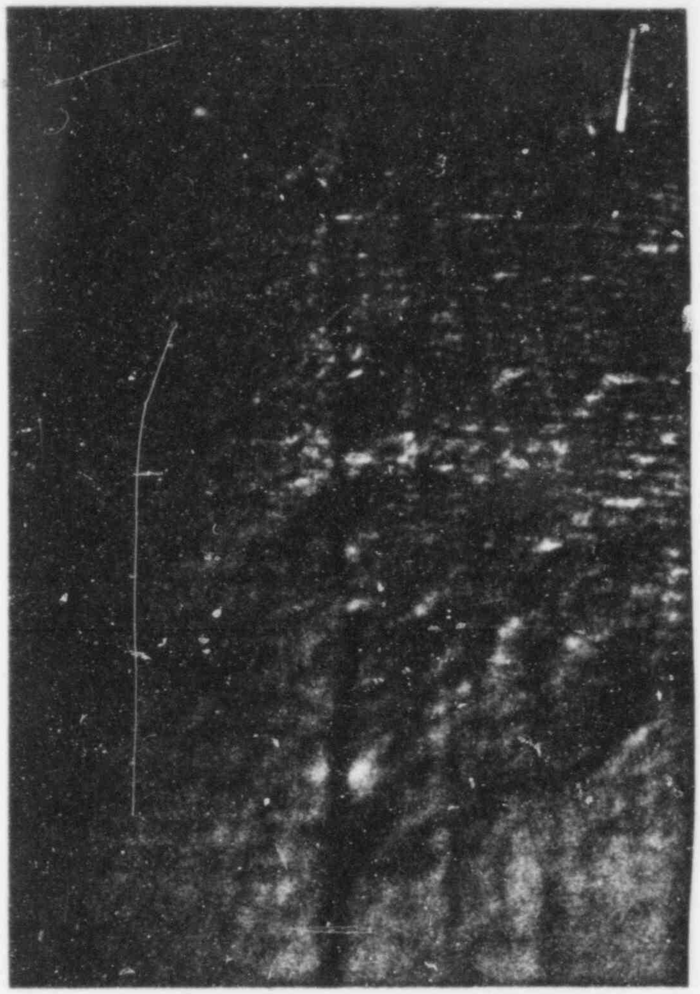

Fig. 5 Typical Kaowool Butt Joint

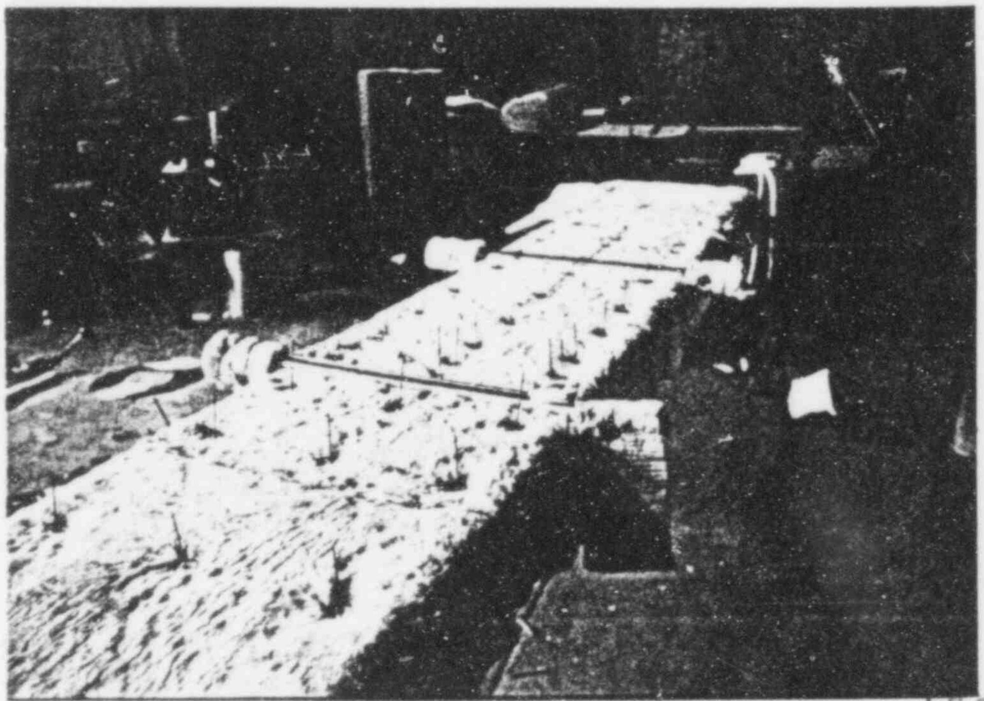

Fig. 6 Tray with First Layer of Kaowool

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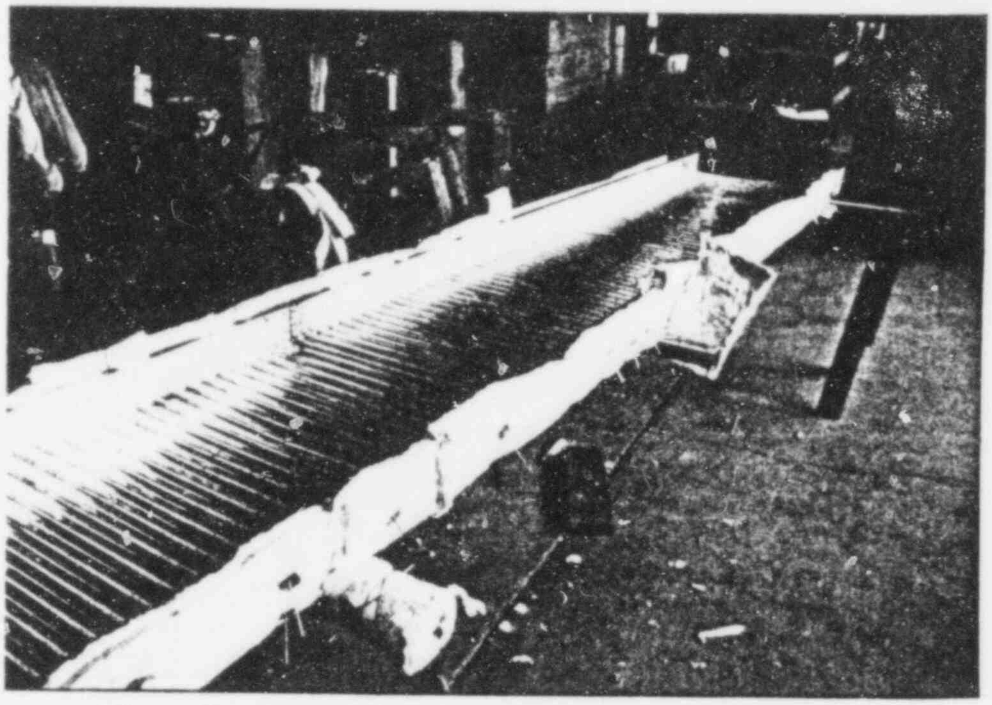

Fig. 7 Tray With First Layer of Kaowool
Note: Thermocouple on Uncovered Unistrut

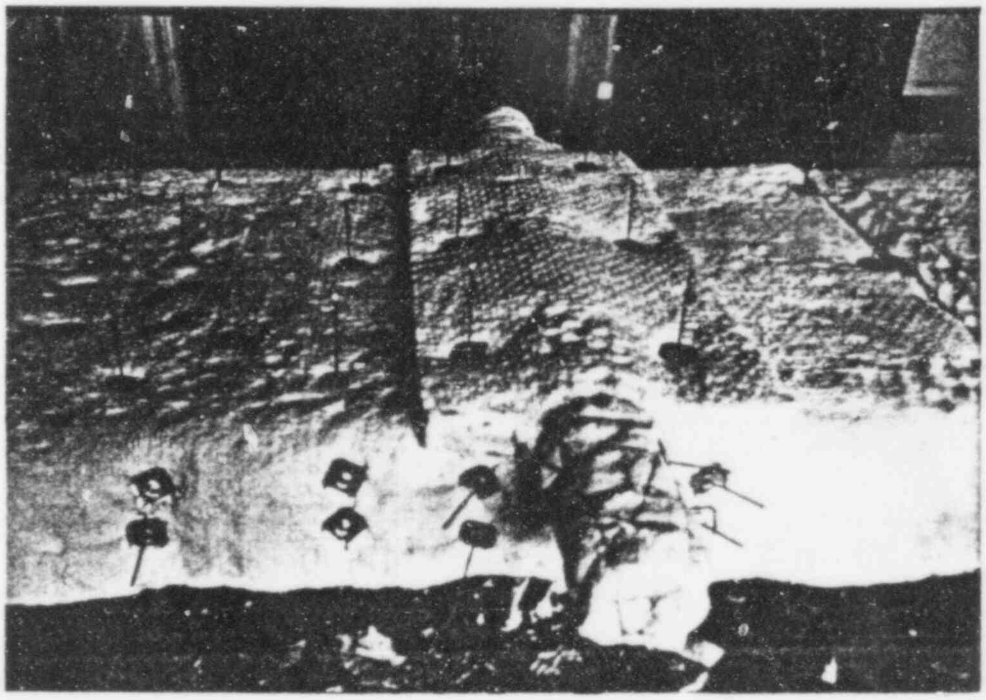

Fig. 8 Unistrut Joint Covered with Kaowool Strip

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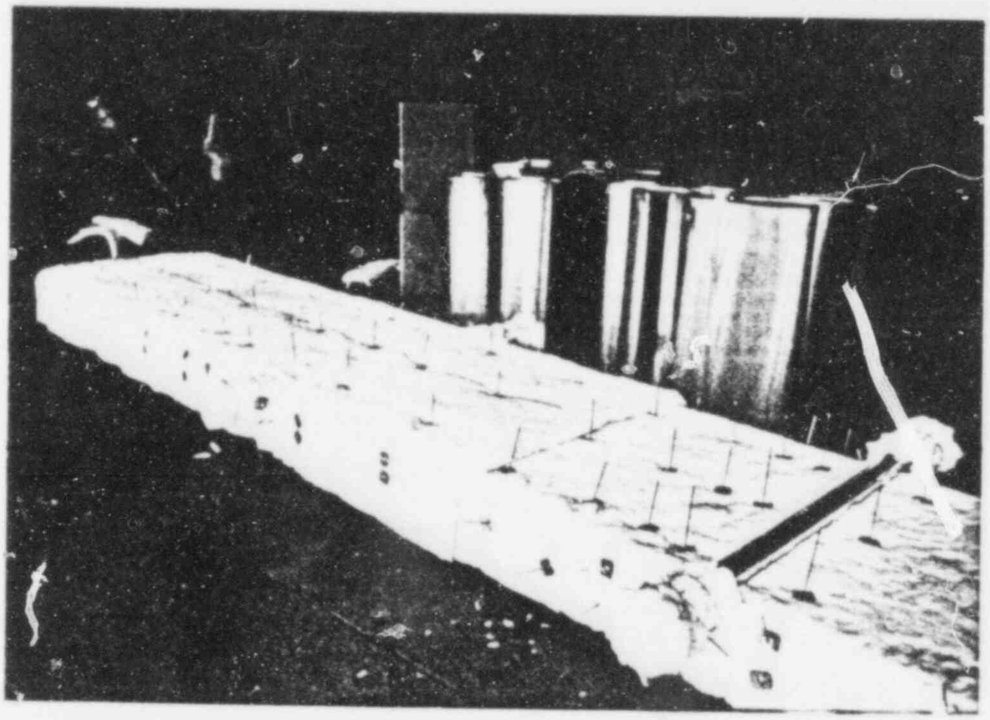


Fig. 9 Second Layer of Kaowool Being Applied

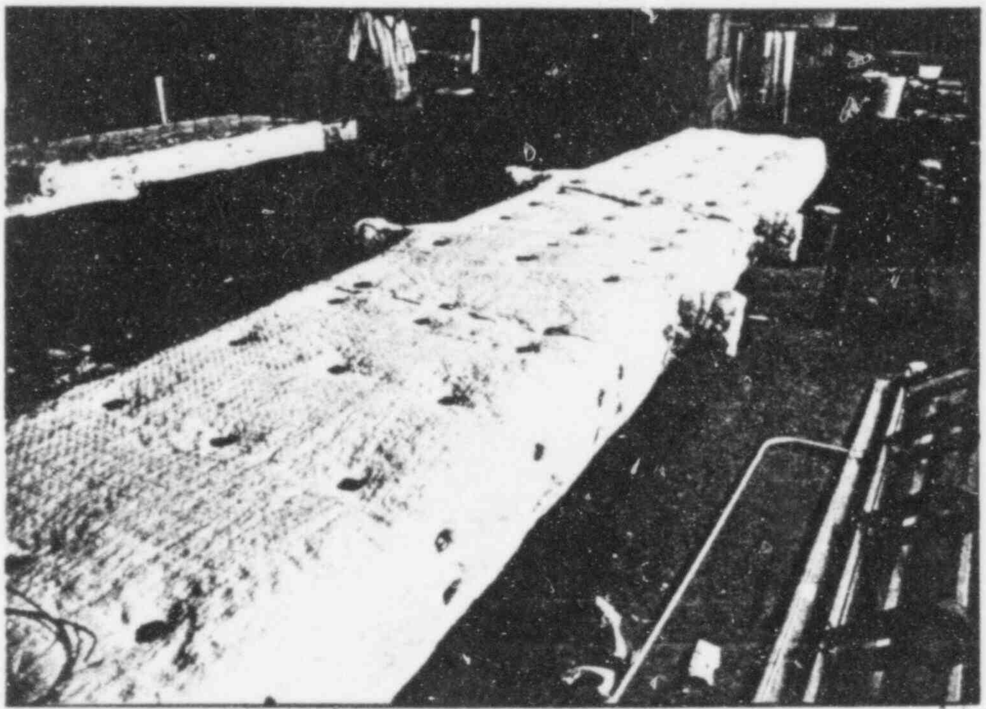


Fig. 10 Completed Tray

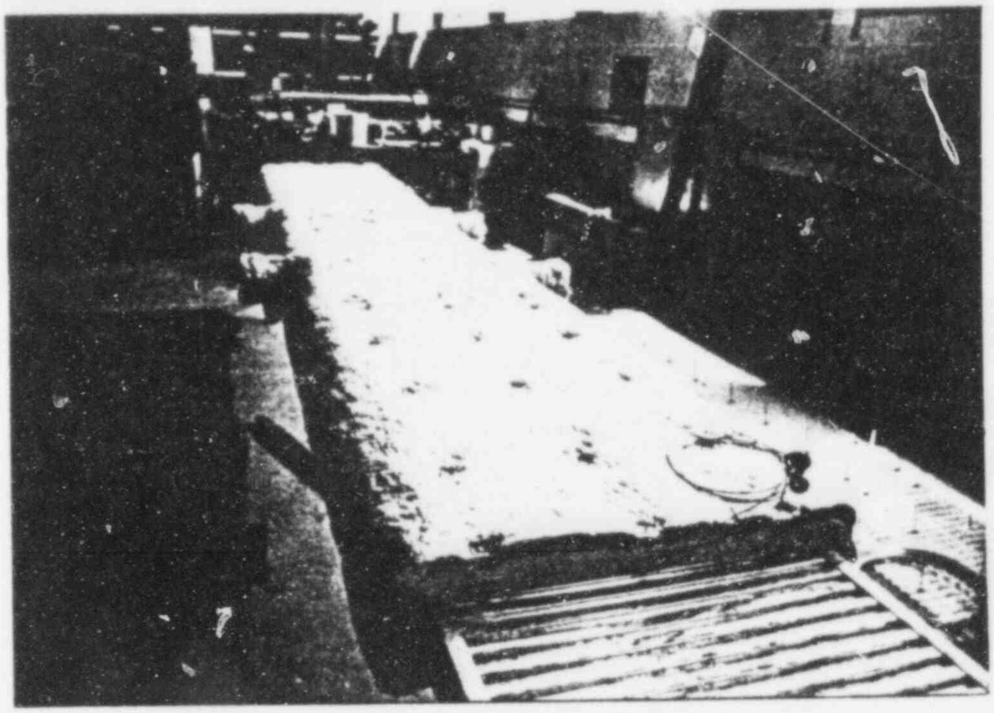


Fig. 11 Completed Tray

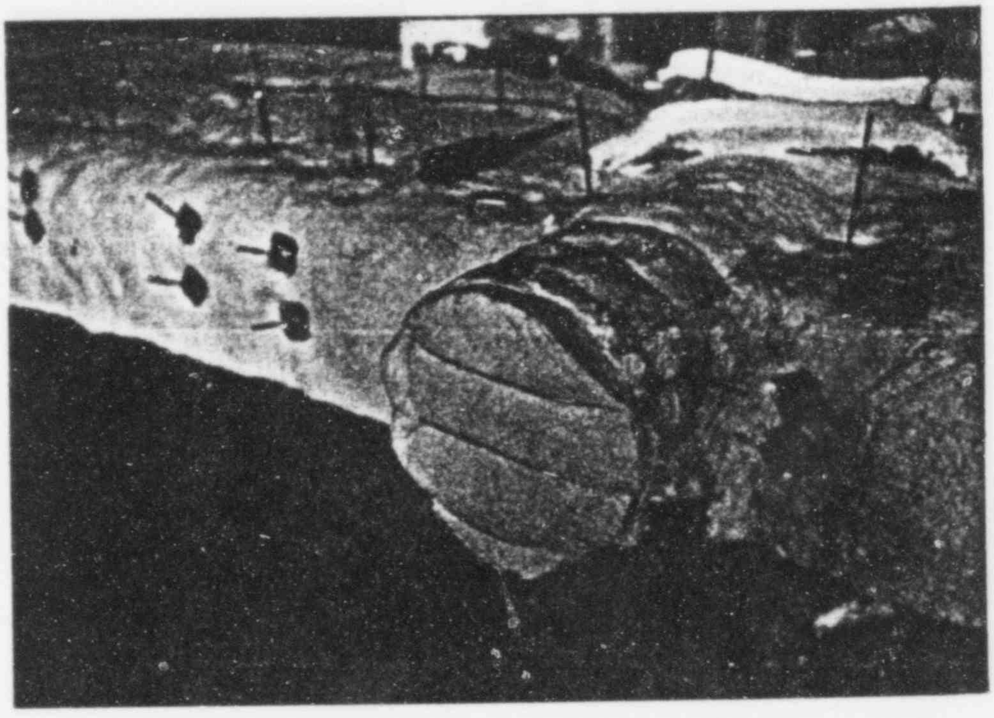


Fig. 12 Final Unistrut End Cover

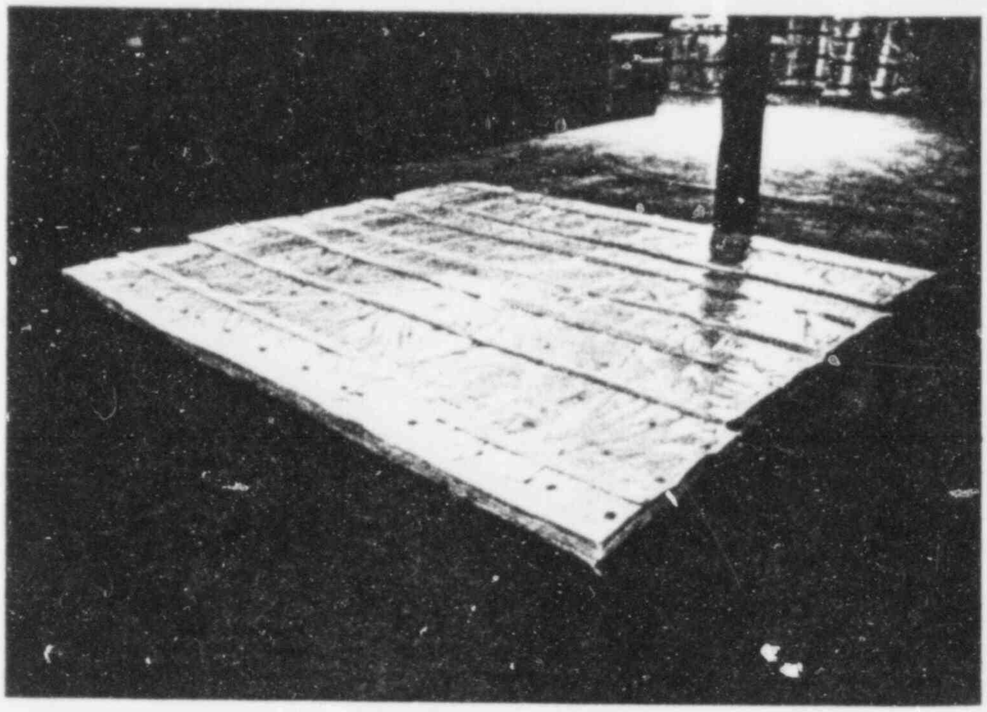


Fig. 13 Lids Ready for Shipment

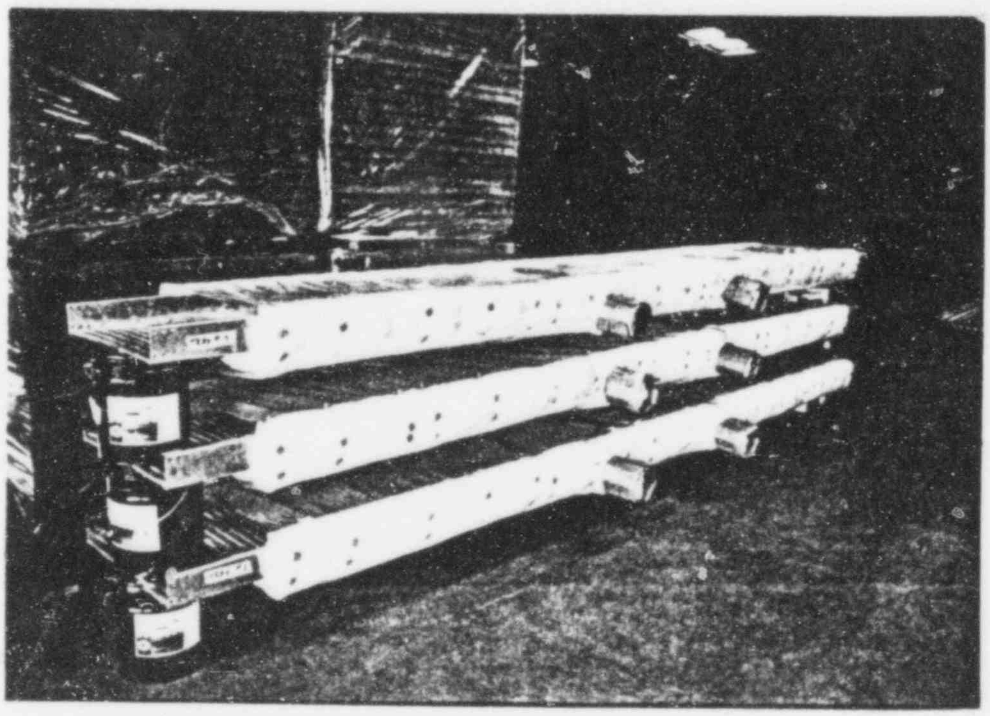


Fig. 14 Trays Ready for Shipment

 1158 046

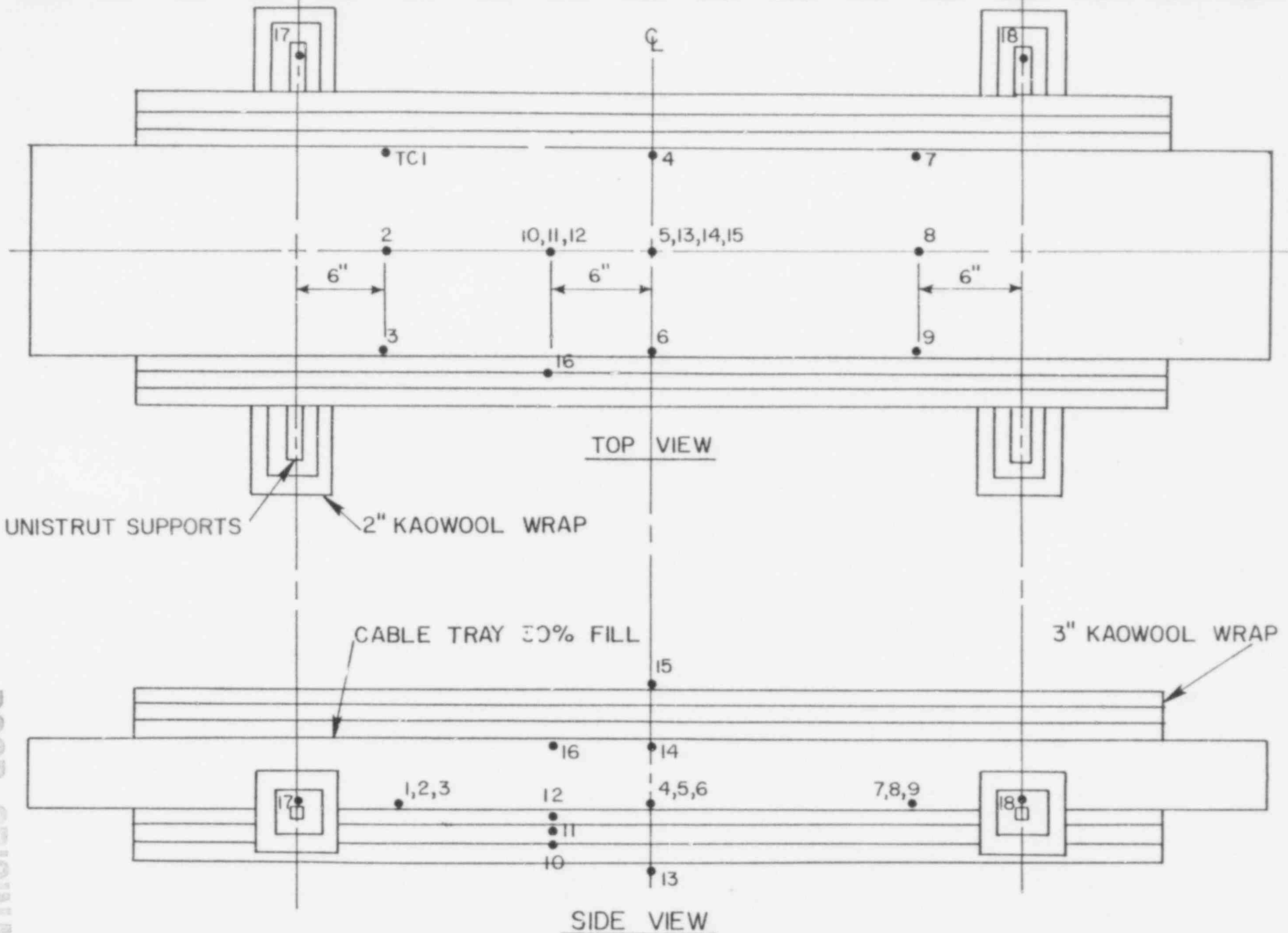
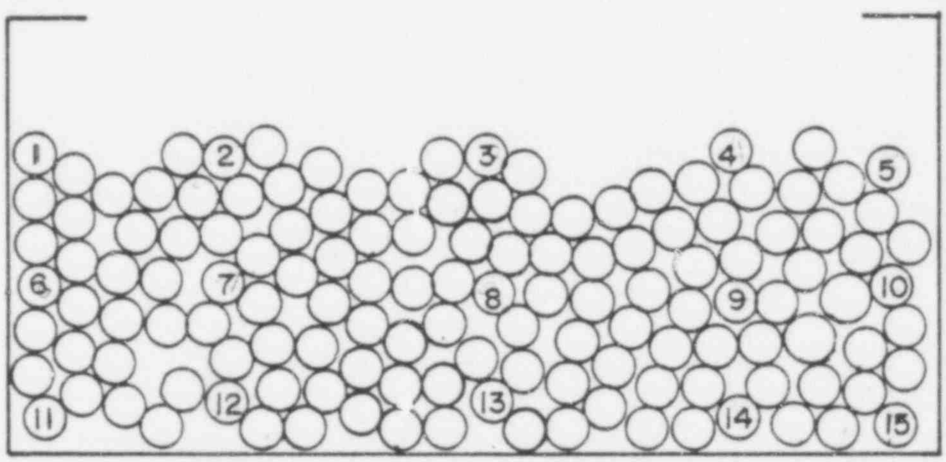


FIG. 15 THERMOCOUPLE LOCATIONS

ZIMMER N.P.S.
LASALLE N.P.S.
SHOREHAM N.P.S.

SAME ARRANGEMENT FOR EACH OF FOUR TRAYS



15 CABLES: MEGGER BEFORE & AFTER TEST

FIG. 16 SCHEMATIC DIAGRAM OF APPROXIMATE CABLE LOCATIONS IN CABLE TRAYS FOR MEGGERING AND LIGHT PANEL MONITORING

POOR ORIGINAL

458 048

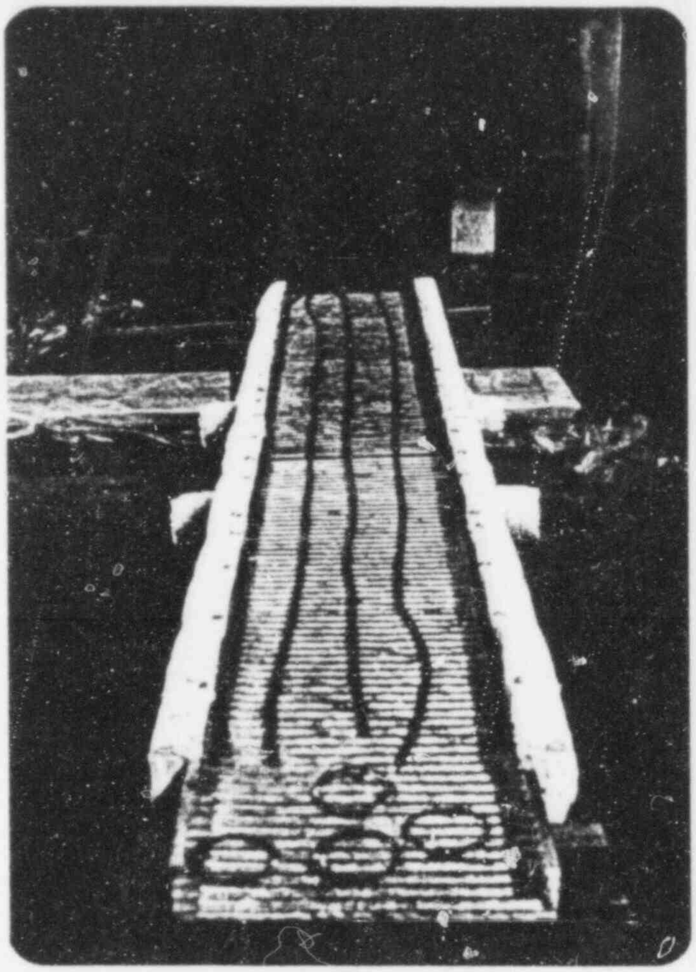


Fig. 17 Cables at Tray Bottom
with Thermocouples

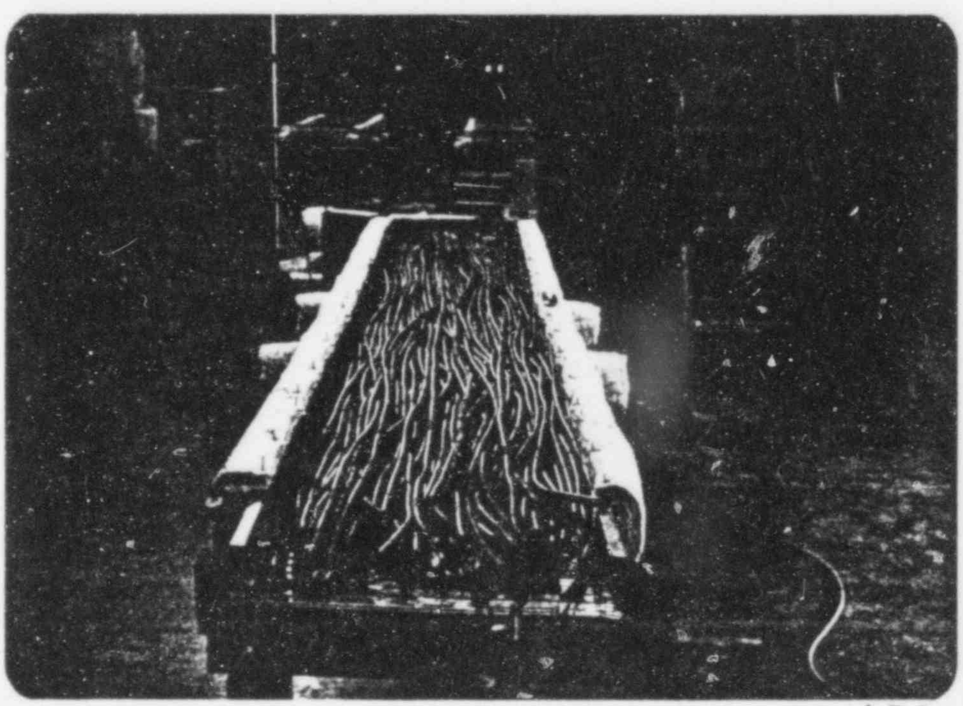


Fig. 18 Full Cable Tray

458 049

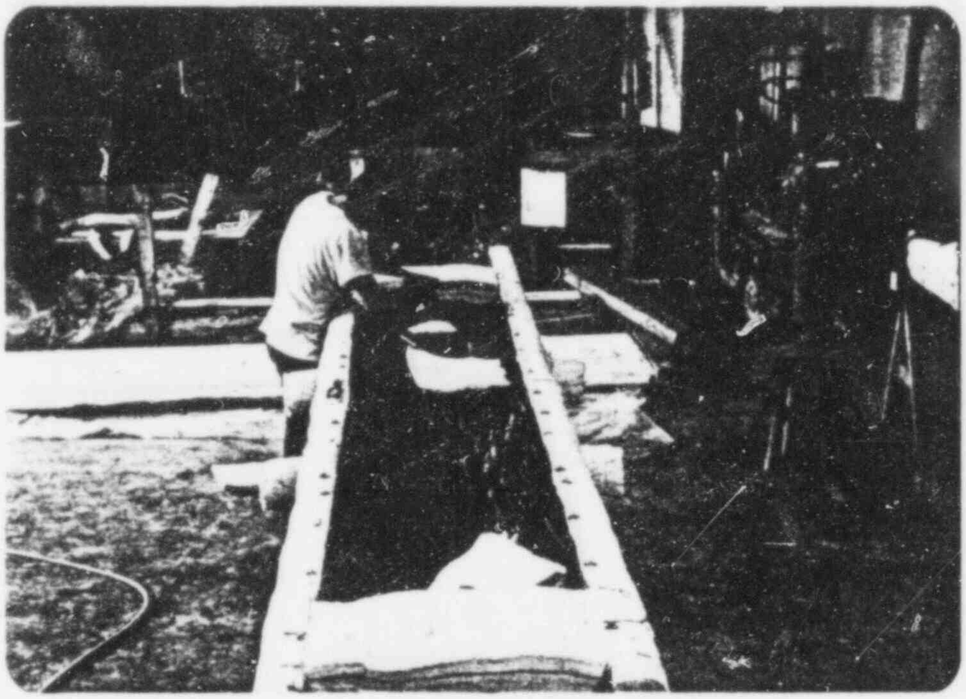


Fig. 19 Sealing of Tray

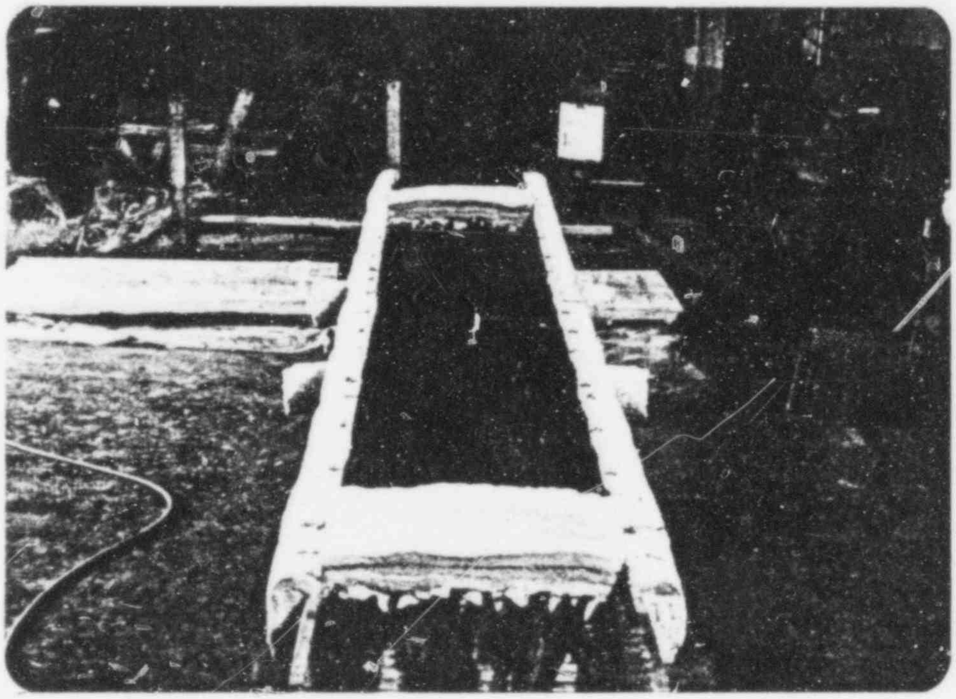


Fig. 20 Tray Sealed at Both Ends

458 050

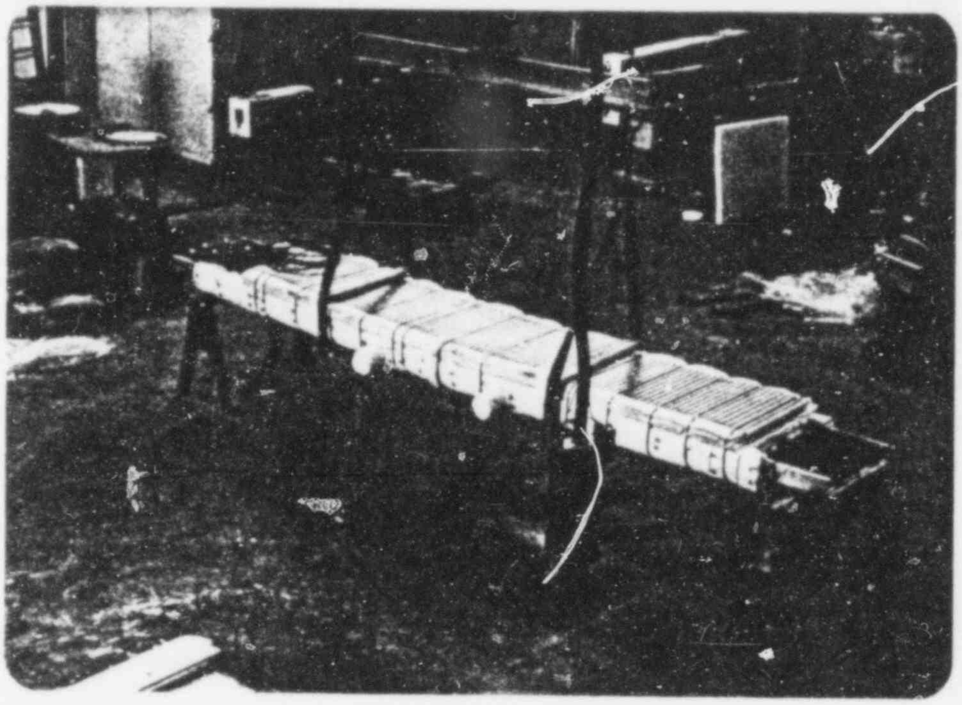


Fig. 21 Tray Ready for Hoisting Into Furnace

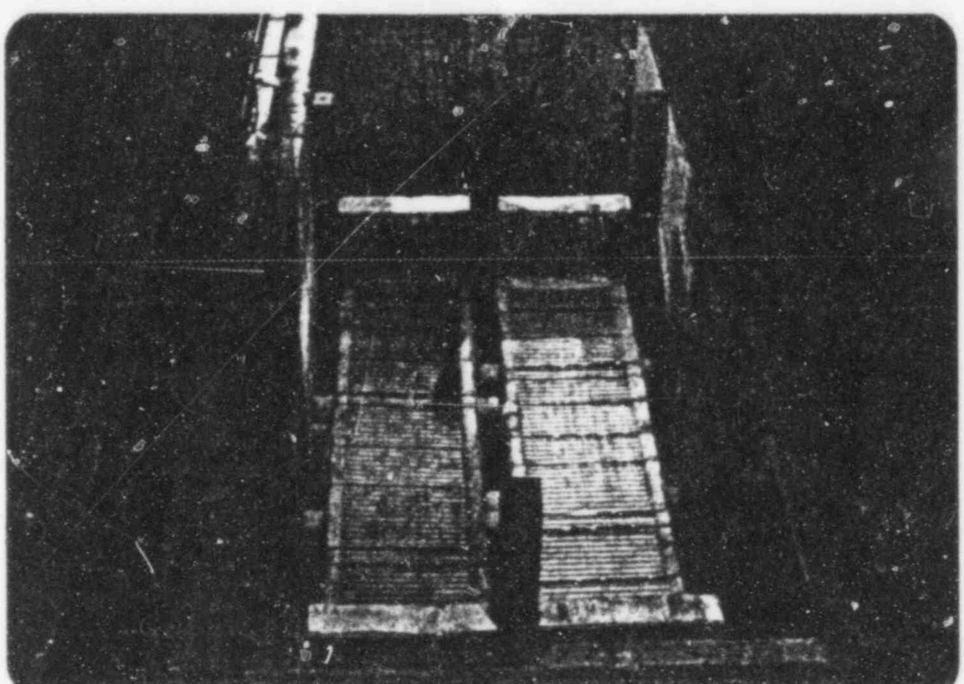


Fig. 22 Bottom Trays in Furnace

458 051

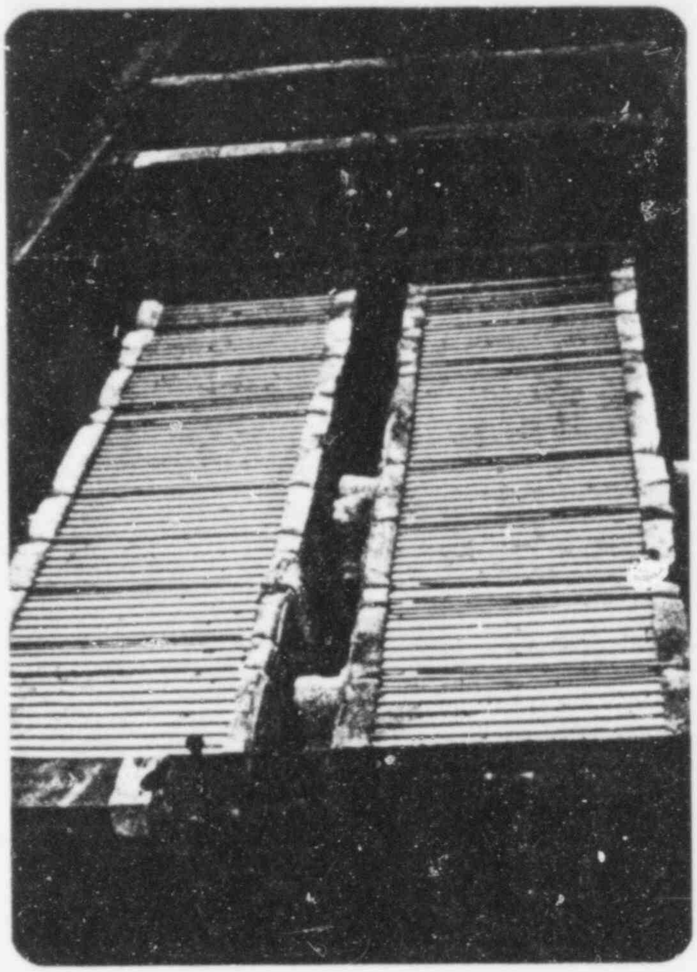


Fig. 23 Top Trays in Furnace

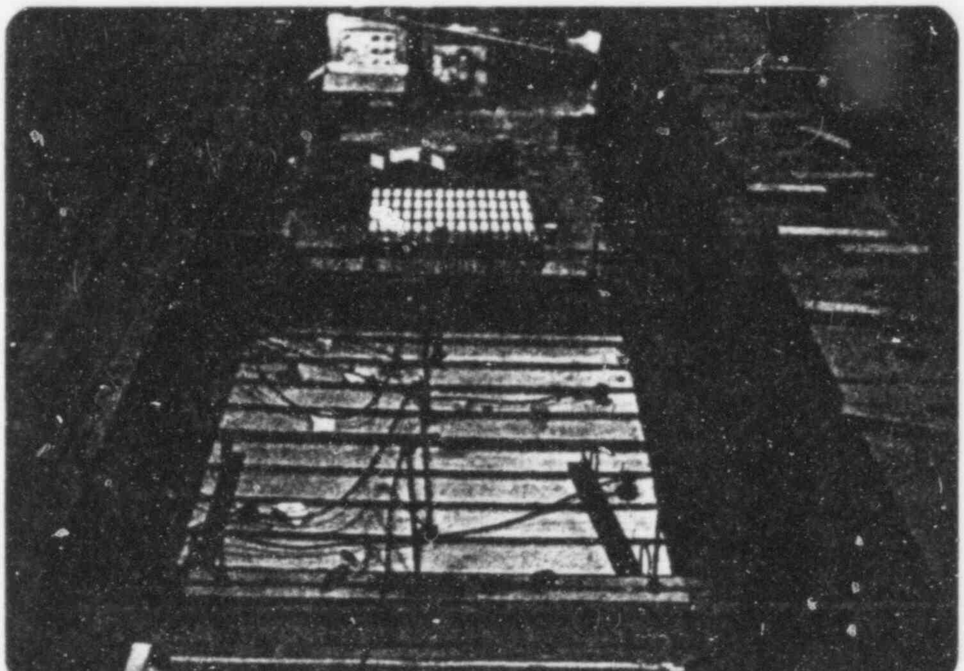
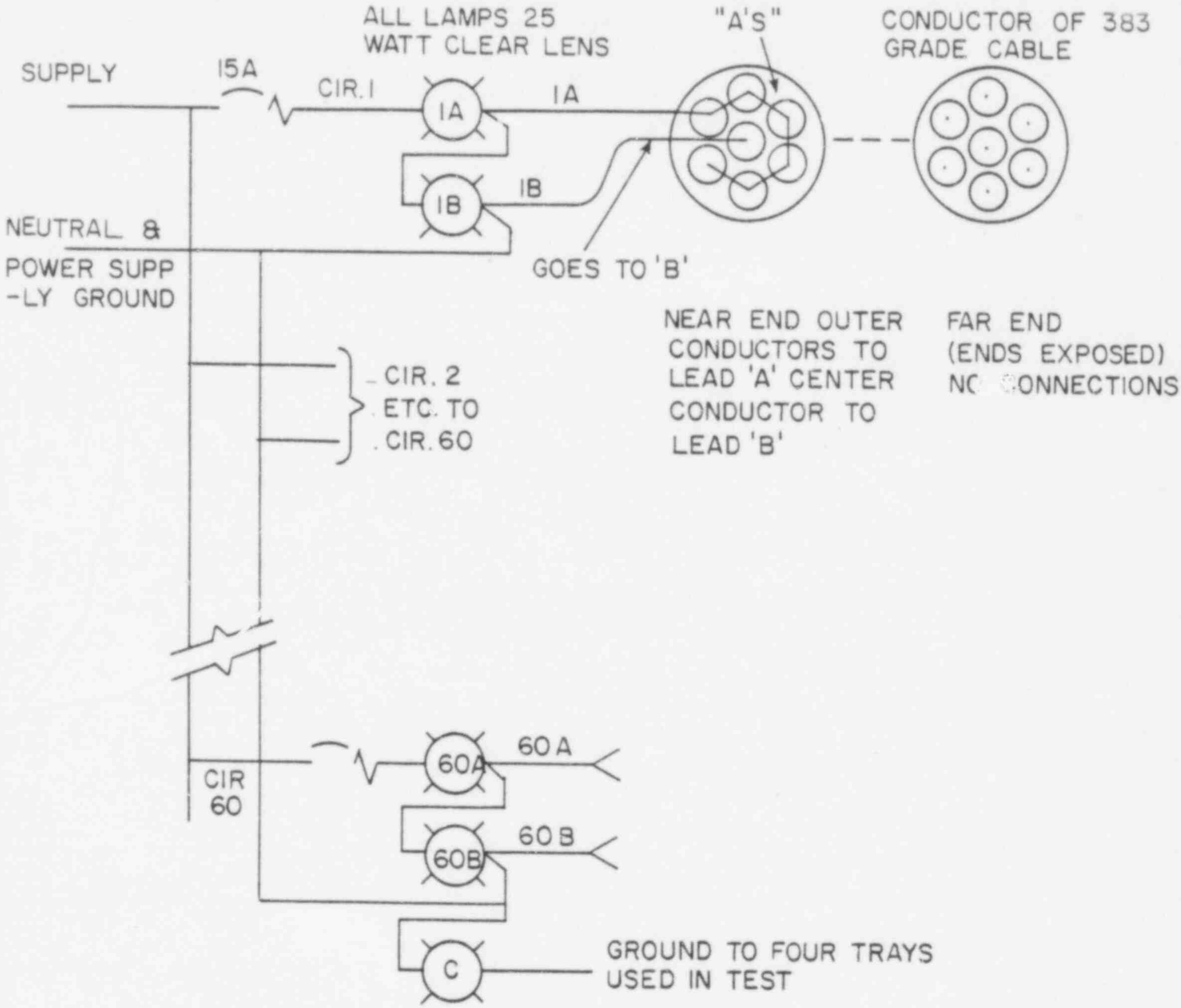


Fig. 24 Furnace Closed - Ready for Test

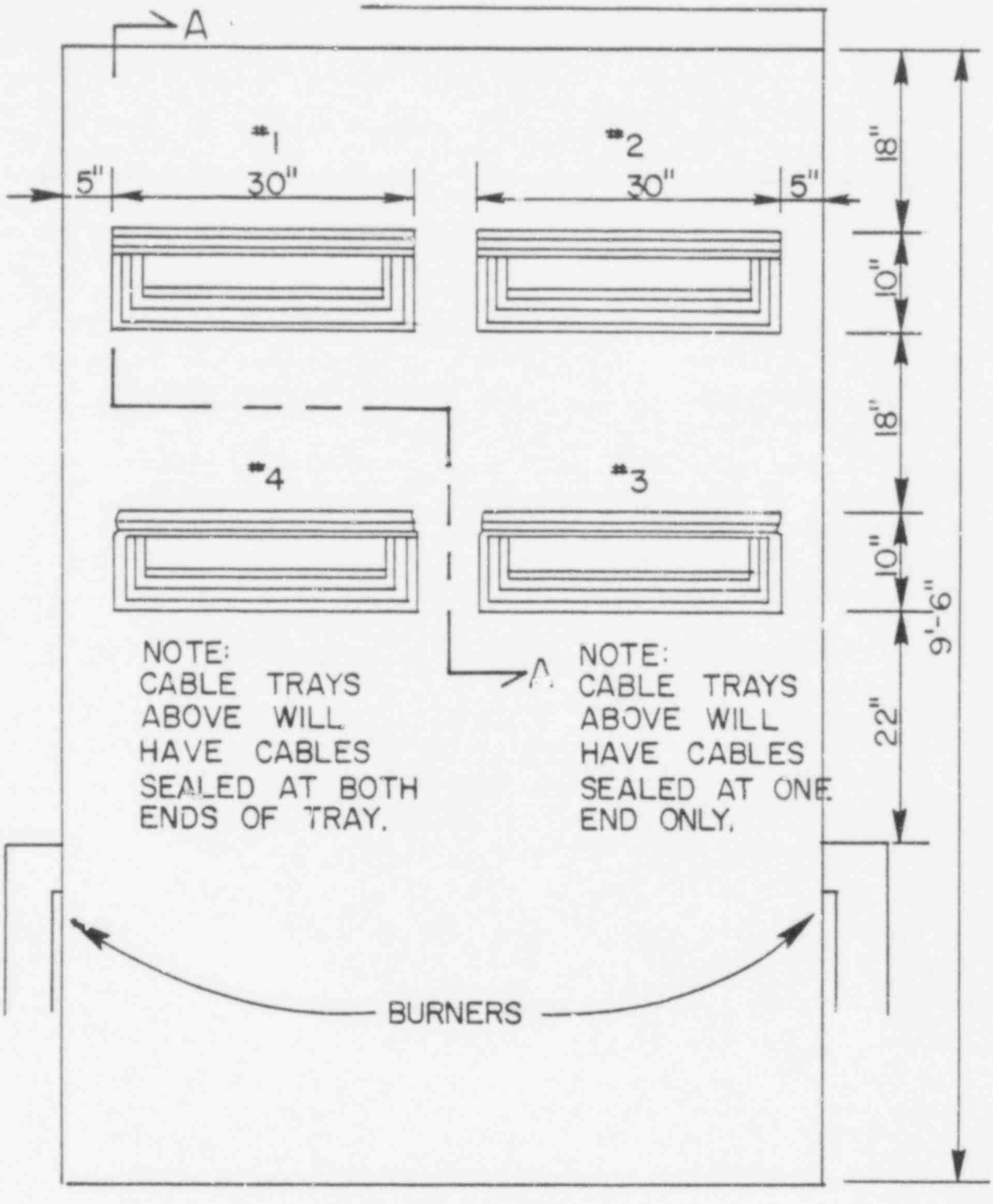


LEGEND

MODE	LAMP-A	LAMP-B	LAMP-C	CABLE CONDITION
NORMAL	1/2 LIT	1/2 LIT	DARK	NO SHORTS
SHORT 'A' TO 'B'	FULL LIT	DARK	DARK	ANY OF OUTER 'A' SHORTED TO 'B'
SHORT 'A' TO TRAY	PARTLY LIT	PARTLY LIT	PARTLY LIT	'A' SHORTED TO TRAY

FIG. 25 ELECTRICAL MONITORING CIRCUIT

458 053



END VIEW

PORTLAND CEMENT FIRE TEST
24" WIDE 4" DEEP TRAY WITH (3)
1" BLANKETS OF KAOWOOL

458 054

FIG. 26 CABLE TRAY POSITIONS IN FURNACE

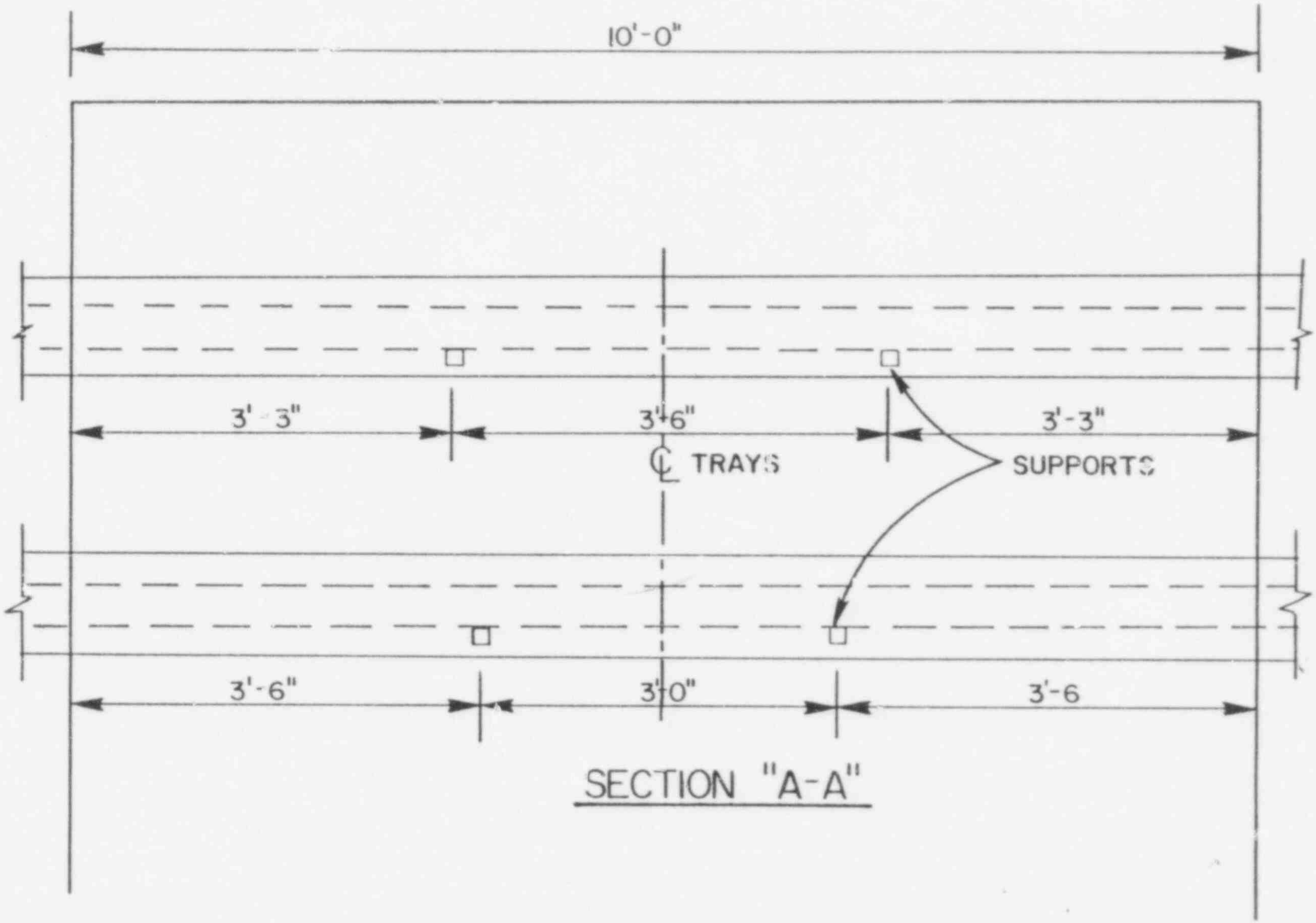
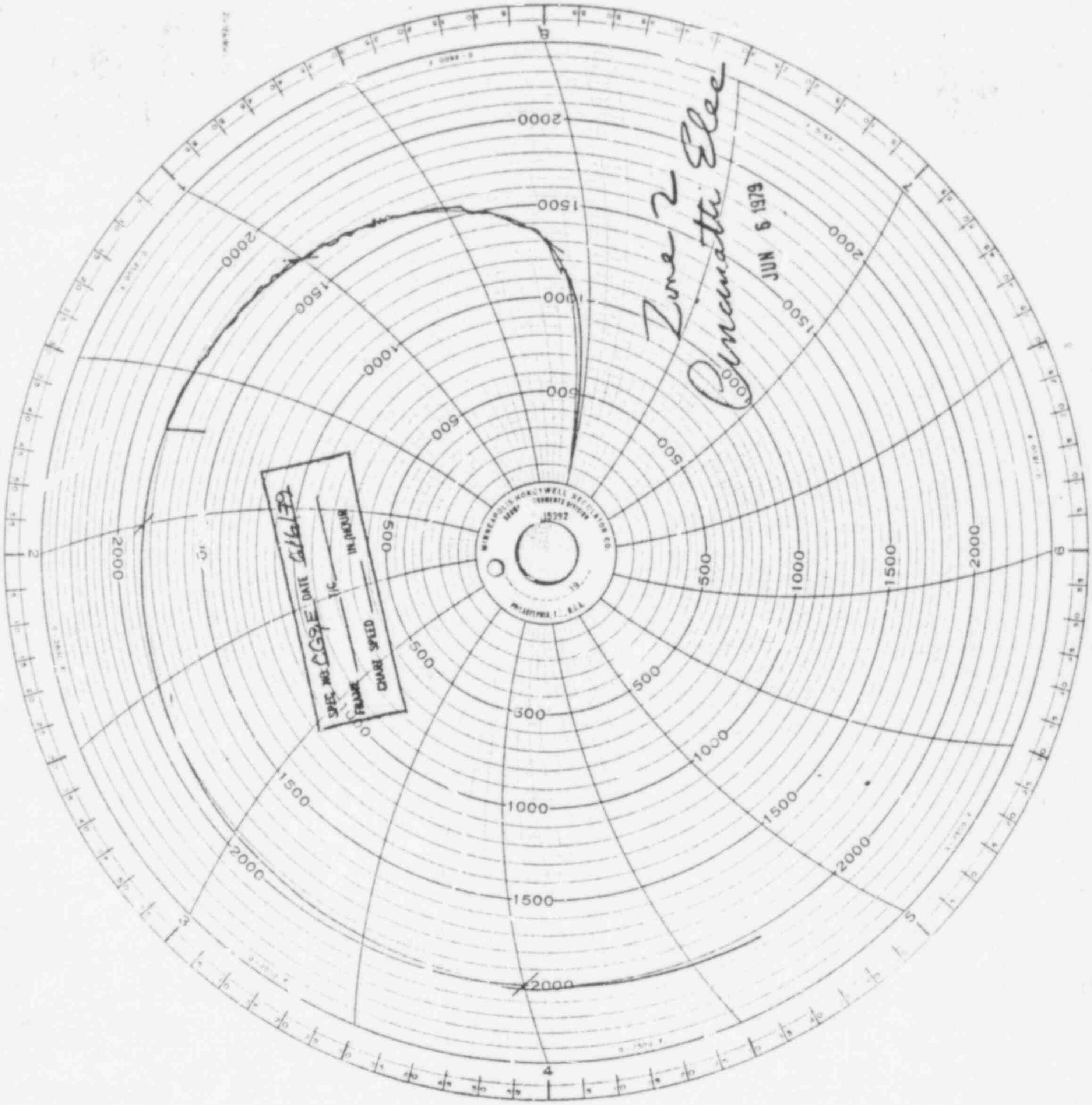
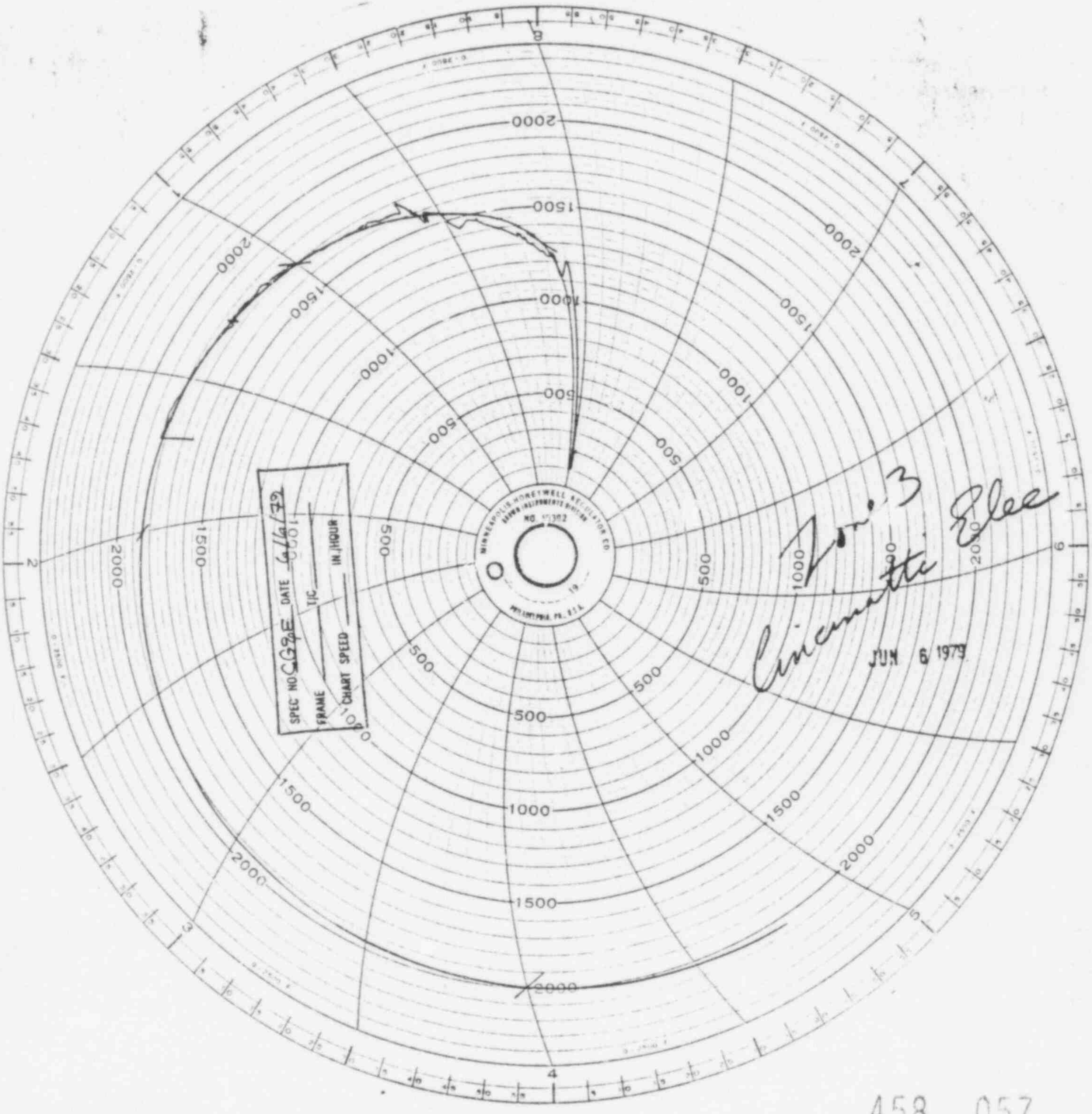


FIG. 27 CABLE TRAY SUPPORT POINTS



458 056

FIG. 28 FURNACE ATMOSPHERE CONTROL TEMPERATURE (ZONE-2)



458 057

FIG. 29 FURNACE ATMOSPHERE CONTROL TEMPERATURE (ZONE-3)

POOR ORIGINAL

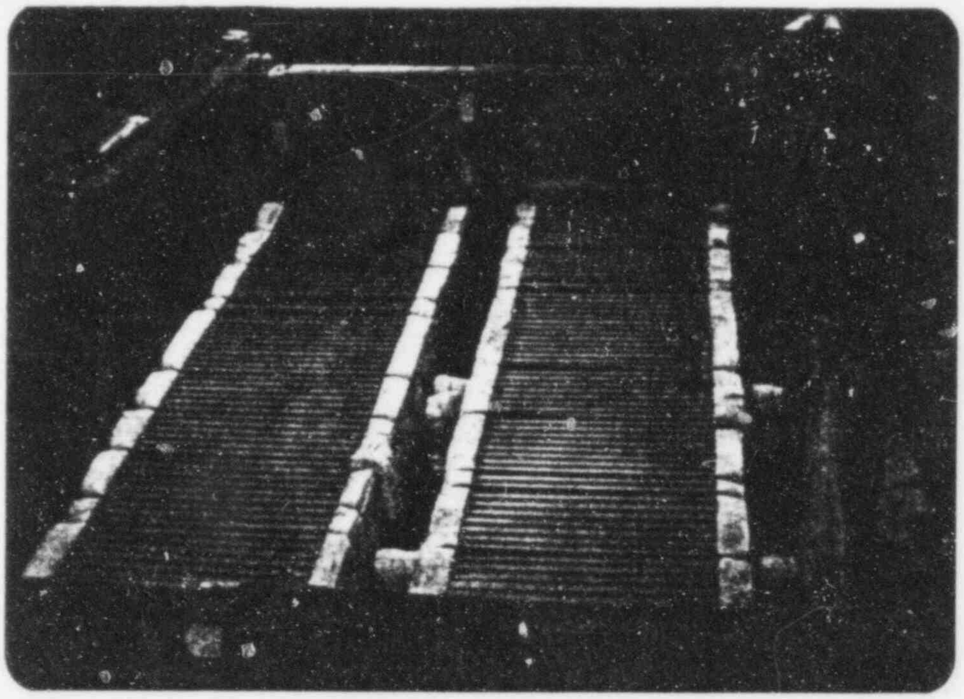


Fig. 30 Top Trays After Test

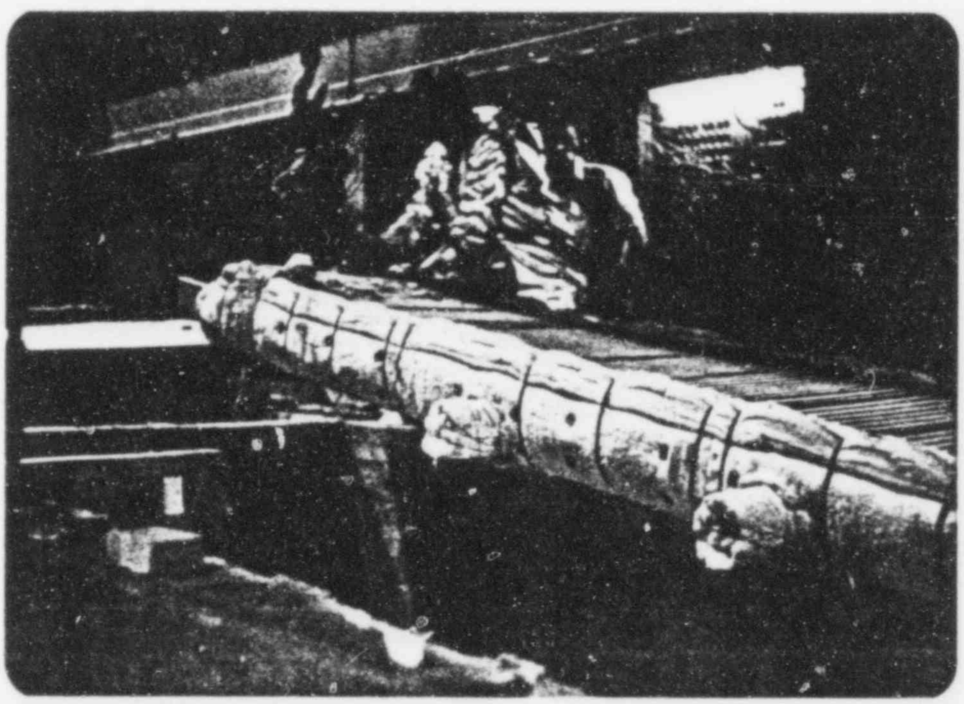


Fig. 31 Tray 1 Being Lifted From Furnace 458 058

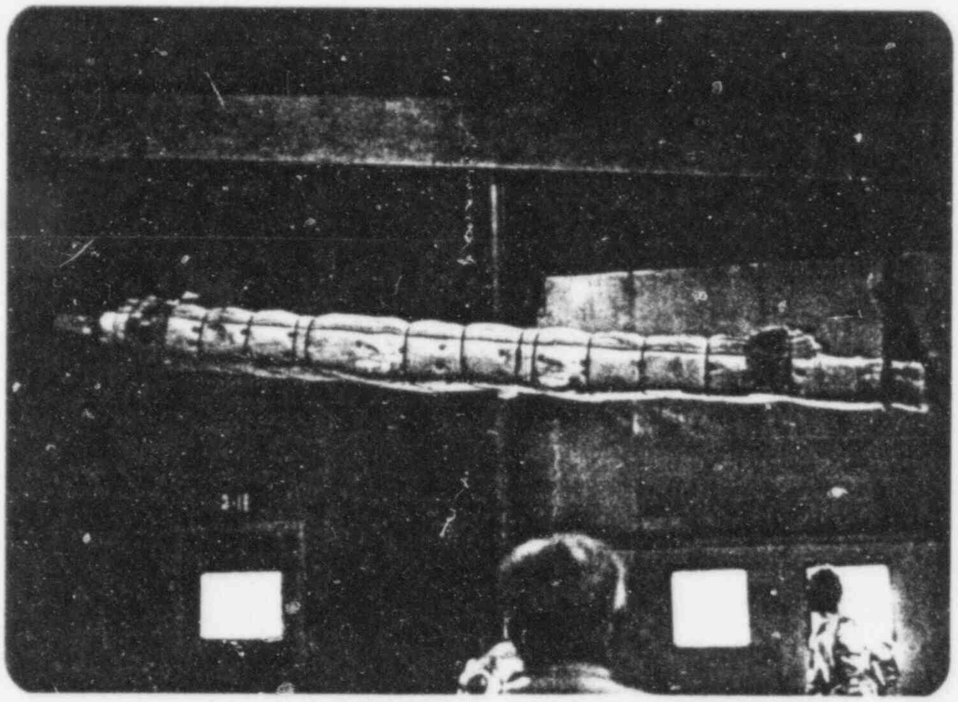


Fig. 32 Tray Being Moved Away From Furnace

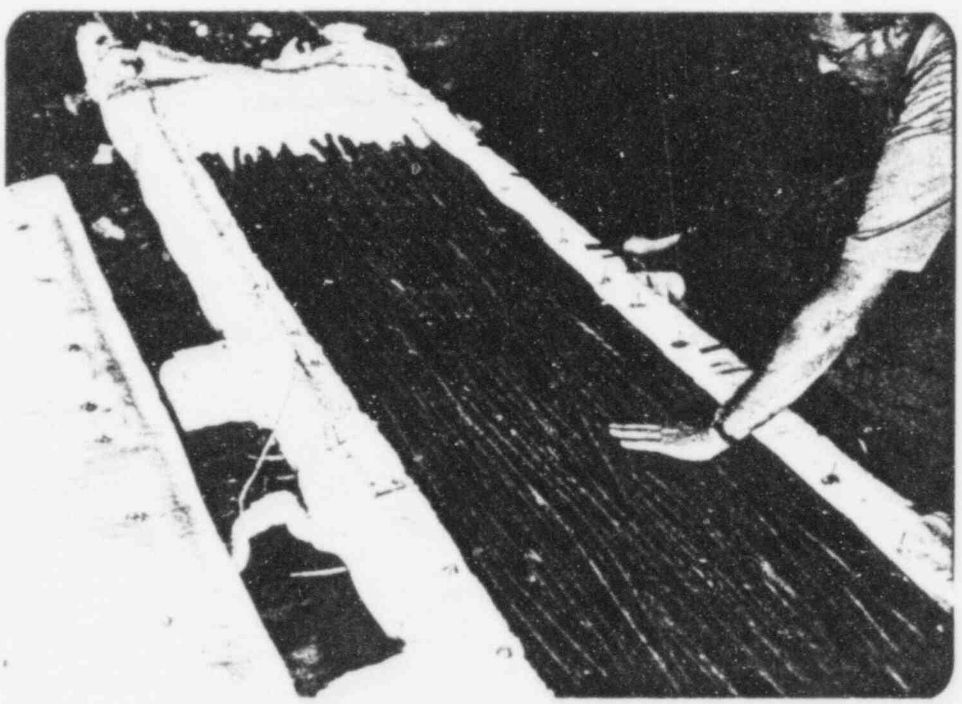


Fig. 33 Condition of Cables in Tray No. 1 After Test

458 059

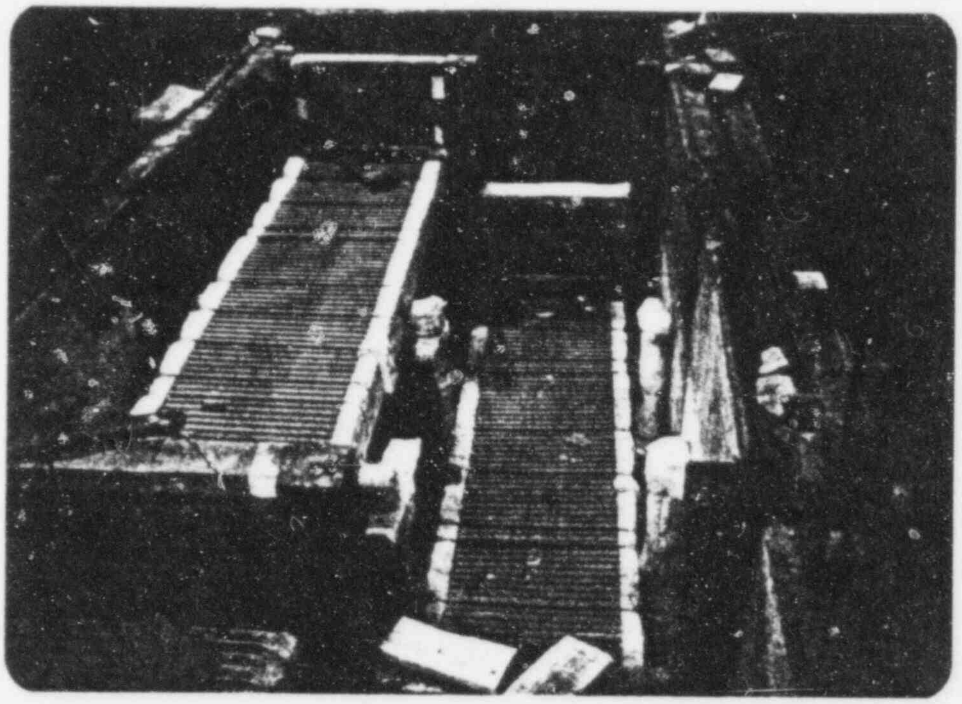


Fig. 34 Condition of Tray No. 4 in Furnace

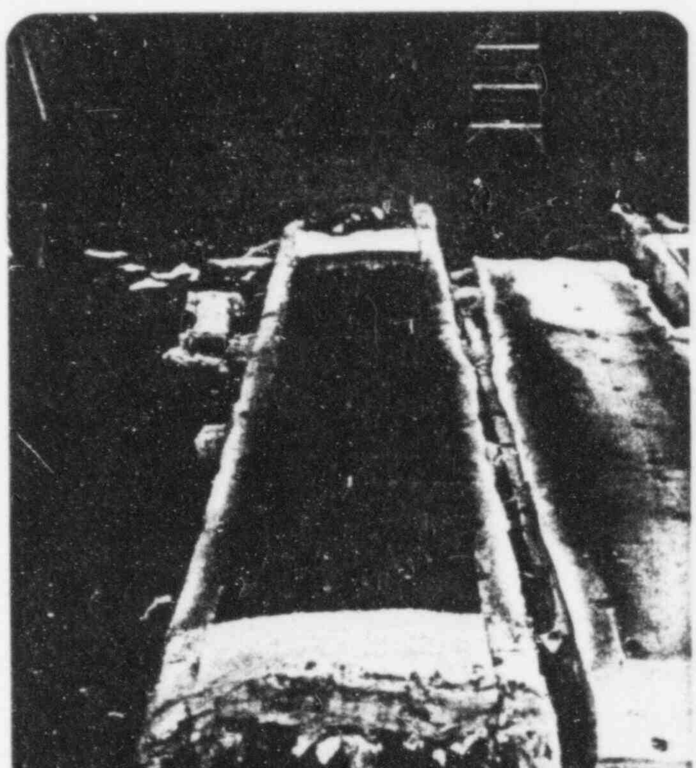


Fig. 35 Condition of Cables in Tray No. 4 After Test

A P P E N D I X   A

1. CABLE CERTIFICATION

2. KAOWOOL CATALOG

3. PROCEDURES FOR COCOON FIREPROOFING

4. MEGGER CERTIFICATION

5. LIGHT MONITORING PANEL

May 15, 1974 (Revised)

APPENDIX B

PHYSICAL CHARACTERISTICS
of
OKOLON (CHLOROSULFONATED POLYETHYLENE) JACKET

When samples are treated in accordance with IPCEA S-19-81, Fifth Edition, Part 6, the vulcanized thermoset Okolon jacket shall meet the following values:

	Guaranteed Value
Physical Requirements Before Aging	
Tensile Strength, min. psi	1,800
Tensile Stress at 200% Elongation, min. psi	500
Elongation at Rupture, min. %	300
Set, max. %	30
Physical Requirements After Aging	
After 168 hours in Air Oven Test at 121° C	
Tensile Strength, min. psi	1,500
Elongation, min.%	100
Oil Immersion, 18 hours at 121° C, ASTM #2 Oil	
Tensile Strength, min. % of Unaged Value	60
Elongation, min. % of Unaged Value	60
Mechanical Water Absorption	
7 days 70° C Water Mg/sq. in. - maximum	20
Oxygen Index, %	30
Electrical Requirements	
Specific Resistivity, min., megohms	200,000
Ozone Resistance	
After 24 hours exposure, .015% concentration	No Cracks
Cold Bend	
After 24 hours at -25° C	No Cracks
→ Flame Test, Completed Cable in Vertical Tray	
IEEE Standard 383-1974.	No Propagation

Radiation Resistance

The cable shall remain serviceable after being subjected to a total integrated radiation dosage of 2×10^8 rads plus an LOCA per IEEE Standard 383-1974.

POOR ORIGINAL

458 062

32766.178

MATERIAL AND EQUIPMENT RECEIVING AND INSPECTION REPORT
CECO ENGINEERING AND CONSTRUCTION

MRR # 6202 DATE 2/20/79

SHIPPER OKONITE COMPANY ORIGIN Richmond Ky DATE 2/12/79

CARRIER TRI-STATE PRO # 270624 RR CAR # —

CECO P.O. 181696 CONTR. REC'V FOLEY

NSSS P.O. — CECO REC'V STEINMETZ

SPEC OR OTHER DOC. J2966 PREP. BY (MRC) [signature]

STORAGE LOCATION CABLE YARD

RECEIPT INSPECTION: (SEE PAGE 2) SAFETY RELATED

EQUIP. OR IDENT. # cable type	DESCRIPTION	*	Quan.	INSP Accp	INSP Hold	HOLD TAG No.	HOLD TAG Rel. Date	Rejt. No.	NCR No.
09146	7/C-#14,600volt 3 reels Reel #'s -15158B — 5000' ← Shipped to Hughes Products -15158A1 — 5000' -15158A2 — 5024' 15024'	1	3	✓	–	–		–	–
09146	4/C-#4,600V 2 reels -15154C 5530 -15153A1 3550 9080'	1	2	✓					–

RECEIVED
MAR 6 1979
CECo LaSALLE SITE Q/A

* CODE CLASS: 1 - SAFETY RELATED NON-ASME SEC. III
2 - NON-SAFETY RELATED 3 - ASME SEC. III

POOR ORIGINAL

Document Review QA Acceptance
Cert. of Conf. By LJT
ASME Data Report By N/A
Complete Document Package By

Sta. Const. Acceptance John E Steinmetz 3/1/79
QA Acceptance:
a. Interim LJ Tapella 3/5/79
b. Final
QA Supr. Date

RECEIPT INSPECTION CHECKLIST

Item	ACPT.	REJ.	N/A
A. SHIPPING DAMAGE			
1. Corrosion/Exposure/Fire (Weathered, Road Salt, Contaminants)	✓		
2. Tie-Down Failure/Rough Handling (Damaged Containers, Shifted Load)	✓		
3. Physical Damage (Broken, Deformed, Cracked Parts)	✓		

Inspected By [illegible]

Item	ACPT.	REJ.	N/A
B. PHYSICAL CHARACTERISTICS			
1. MRR No. Affixed to Material/Equipment (See Page 1, Upper Left Corner, For MRR No.)	X		
2. Identification Markings (Affixed, Legible)	X		
3. Protective Covers/Seals (In Place, Intact)	X		
4. Preservatives/Desiccants/Inert Gas/Lubricants (Per Site Instructions)			X
5. Dimensional/Workmanship (Random Check, Per Mfr's. Drawings)			X
6. Electrical Insulation Check (Per Site Instructions)			X
7. Packaging Acceptable for Storage	X		
C. DOCUMENTATION			
1. Certificate of Conformance	X		
2. Certificate of Compliance			X
3. Certified Material Test Report	X		
4. Other (Specify)			✓
D. SPECIAL INSPECTION			
Specify			✓
			✓

Remarks:

RECEIVED MAR 0 1 1979 CECo La SALLE SITE Q.A.

POOR ORIGINAL

458 064

Inspected By [illegible] 3/1/79

THE OKONITE COMPANY
RFD #3
Richmond, Kentucky 40475

Date 2/8/79
Report No. 3224

Certified Test Report

Customer Commonwealth Edison Company   LaSalle County Station

Customer Order No. 181696   Item No. —   Cable Code No. 07146

Okonite Order No. 07-2686-1

Applicable Specification(s): S&L J-2966, Em-29115

Cable Description 7/c #14-7x T.C.-.030 Okonite-.015 Okolon-Print 7/c-Cable Fill & Belt-.060 Okolon

Quantity Ordered 47,000 Ft.   Quantity Accepted for Shipment 15,024 Ft.   Number of Reels 3

QA APPROVED
BY Paul W. Stain
DATE 2/9/79

Statement of Compliance:

The above material has been manufactured and has met or exceeded all applicable requirements. We certify that the statements herein are true and the data presented are an accurate presentation of the tests conducted.

POOR ORIGINAL

The Okonite Company

G. C. Hill
Engineer of Test

Sworn To and Subscribed Before Me
This 9 Day of Feb 1979
George W. Hume
Notary Public
MY COMMISSION EXPIRES JANUARY 3, 1982

458 065

MRR 6207

THE OKONITE COMPANY

Drawer L
U. S. Hwy 25, South
Richmond, Ky. 40475

Page 2 of 6

CERTIFICATE OF CONFORMANCE *

Customer COMMONWEALth EDISON COMPANY

Customer's Order No. 181696 Cable Code No. 07146

Okonite's Order No. 07-2686-1

Cable Description 7/c #14 - 7x T.C. - .030 OKONite - .015 OKOlON - Print %
CABlED - Fill & BElt - .060 OKOlON

Quantity Ordered 47,000 No. of Reels 3 Footage Shipped 15,024

Applicable Specifications S&L J-2966, EM-29115

THE OKONITE COMPANY hereby certifies to the Customer named above that the above described Materials were duly tested during manufacture and that the Materials meet or exceed the Applicable requirements.

THE OKONITE COMPANY

QA APPROVED
BY [signature]
DATE 2/9/79

By G. C. Hill Date 2/9/79
Engineer of Test

Shipment Identification

Cable QC Length No	Footage
151580A1	5000
151580A2	5024
15158B	5000

POOR ORIGINAL

458 066

* Issued in conjunction with and subject to Okonite's standard Warranty and Limitation of Liability.

THE OKONITE COMPANY
Drawer L
U. S. Hwy 25, South
Richmond, Ky. 40475

INSPECTION SHEET FOR WIRE AND CABLES

Electrical Test Dept.
Date 2/8/79

MFG. Order 07-2666-1 Customer's Order 181696 Item No. —

For COMMONWEALTH EDISON Co. Type Compound OKONITE (Insulation) OKOLON (Ins./Jkt.) OKOLON (Jacket)

Spec. No. SEL J-2966, EM-2945 Cable Description 7/C #14-7X T.C.-.030 OKONITE-.015 OKOLON-PRINT %-CABLED-FILL, BELT-.060 OKOLON

Electrical Requirements:

A-C Voltage/Time 4.0 KV/ 5 Mins

D-C Voltage/Time — KV/ — Mins

I R Constant (K Value) 20,000

CEV (Min.) N/A KV N/A

Test Conditions:

~~Preliminary~~ Final

Wet 9 ~~(Min)~~ Hours Immersed ~~Dry~~

½ 64 ° ½ 1.23

Test Temp ½ 69 F(C) Coef ½ 1.0120

Okonite Cable No (Customers)	Length (FT)	No. of Conds	IR MEGS-mft at 15.6 C	Cond Size	DC Cond Resistance OHM mft 25 C	Sequential Nos ~~Tape~~/Print	Customer Reel No.
REQUIREMENTS		→	5530 min		2.86 max		
1515BRA1	5000	7	min 11,685	#14	max 2.68	7004928 7000000	07146-94
1515BRA2	5024	7	min 9,269	#14	max 2.65	7004970 7000000	07146-95
1515B3	5000	7	min 11,774	#14	max 2.68	7005000 7000000	07146-93

Dimensional Data

	Sample	Insulation Min	Insulation Ave	Ins./Jkt. (Sdng) Min	Ins./Jkt. (Sdng) Ave	Jkt. Belt Min	Jkt. Belt Ave	Sig. Shld Min	Sig. Shld Ave
REQUIREMENTS		.027	.030	.0135	.015	.054	.060		
	1515BRA1	.029	.032	.016	.017	.055	.061		

QA APPROVED
BY [signature]
DATE 2/9/79

Inspected and passed

For ______ Company

By ______ Inspector

POOR ORIGINAL

The Okonite Company
By G. C. Hill
Engineer of Test

Q-117C

58 067

THE OKONITE COMPANY
Drawer L
U. S. Hwy 25, South
Richmond, Ky. 40475

Quality Assurance
Traceability Schematic

Customer Commonwealth Edison Co. Factory Order No. 07-2686-1

Construction 7/c #14-7x t.c.-.060 Okonite-.015 Okolon-Pvdt 7/c-CB10-.060 Okolon

Prepared By: [signature]

Shipping Reel Q.C. Length Number	Length (ft.)	Customer Reel Number (where applicable)	Q.C. No. Single Conductors In Finished Cable	Approved Compound (Batch/Lot Nos.) Cable Jacket	Sequential Q.C. No. of Single Conductors In Finished Cable*	Approved Compound Identification (Batch/Lot Nos.) Single Conductor: Ext. Strand Shield	Insulation	Insulation Jacket (Shield)
15159A1	5000	07146-94	1 Black 20978	19646			5055	16814
15158A2	5024	07146-95		19772			5583	17120
15158B	5000	07146-93	2 White 20920A	19781			5583	16810
				19742			5059	17170
			3 Red 20924B	19645			4796	16609
				19771			4795	
			4 Green 20921A				4759	17178
							5073	
			5 Orange 20925A				5584	16610
							5056	1717
			6 Blue 20967B				4758	17174
							4752 5072	
			7 Wht/Blk 20229A				4794	17475
							4754	

QA APPROVED
BY [signature]
DATE 2/9/79

POOR ORIGINAL

458 068

THE OKONITE COMPANY
Drawer L
U. S. Hwy 25, South
Richmond, Ky. 40475

Physical Test Report

Date: 1/22/79 Factory Order No.: 07-2689-1 / 07-2686-1 Customer: Commonwealth Edison

Description: 7/c #14 Cu .030 Okonite .015 Okolon, cabled, filled, .060 Okolon

Specification: S&L J-2966 EM29115 dtd 9/17/75 Prepared by: Paul W. Starnes

Following physical test data supports acceptance of cable shipped on the above factory order number.

Sample Identification (QC Length No.)	20971		15160		—	
Physical and Aging Properties	Insulation		OUTER JACKET		—	
Unaged	Actual	Minimum Acceptable	Actual	Minimum Acceptable	Actual	Minimum Acceptable
Tensile Strength (PSI)	1065	800	2327	1800	—	—
Elongation (%)	303	300	400	300	—	—
Tensile Stress @200% (PSI)	880	600	1216	500	—	—
Set Test (%)	N/R	N/R	11.2	max 30	—	—
After Air Oven Aging	168 Hrs. at 121 C.		168 Hrs. at 121 C.		___ Hrs. at ___ C.	
Tensile Strength	1111	—	2699	—	—	—
% of Unaged	104	75	116	75 to 125	—	—
Elongation	312	—	272	—	—	—
% of Unaged	103	75	68	50 to 150	—	—
After Air Pressure Heat Aging	42 Hrs. at 127 C. And 80 PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength	1065	—	—	—	—	—
% of Unaged	100	50	—	—	—	—
Elongation	320	—	—	—	—	—
% of Unaged	106	50	—	—	—	—
After Oxygen Bomb Aging	___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI		___ Hrs. at ___ C. And ___ PSI	
Tensile Strength	—	—	—	—	—	—
% of Unaged	—	—	—	—	—	—
Elongation	—	—	—	—	—	—
% of Unaged	—	—	—	—	—	—
After Oil Immersion Aging	___ Hrs. at ___ C.		18 Hrs. at 121 C.		___ Hrs. at ___ C.	
Tensile Strength		—	2511	—	—	—
% of Unaged		—	108	60	—	—
Elongation		—	370	—	—	—
% of Unaged		—	93	60	—	—
Miscellaneous Tests						
Ozone Resistance 25°c. 3 hrs .010 to .015% Concentration	Passes	Composite NO CRACKS				
Gravimetric Water Absorption 168 hrs @ 82°c	—	-	5.9	max 25 mg./in²		

BY Paul W. Starnes
DATE 2/7/79

POOR ORIGINAL

438 069

THE OKONITE COMPANY

Post Office Box 340
Ramsey, New Jersey 07446
201-825-0300/Cable Okonite

Page 6 of 6

May 5, 1975

CERTIFICATION * Rev. 2 June 12, 1975

for

Commonwealth Edison Co.-LaSalle County Station-Units #1 & 2
Purchase Order No. 181696
and 181697

INSULATION CHARACTERISTICS
GRAVIMETRIC WATER ABSORPTION
ACCELERATED WATER ABSORPTION - 75° C - Electrical Method
OZONE RESISTANCE

We certify that the Okonite EP insulating compound being furnished on your order meets the following requirements:

GRAVIMETRIC WATER ABSORPTION When tested in accordance with IPCEA methods, the insulation, after being immersed in water for 7 days at 70° C, does not exceed the maximum moisture absorption value of 5.0 Mg/sq. in.

ACCELERATED WATER ABSORPTION - 75° C - Electrical Method
After immersion in 75° C water, the Okonite EP insulation does not exceed the following values when tested in accordance with IPCEA methods:

Dielectric Constant (SIC)

After 24 hrs. immersion (Max.)	3.5
Increase between 1 and 14 days (% Max.)	3.0
Increase between 7 and 14 days (% Max.)	1.5
Stability Factor after 14 days (% Max.)	0.5

OZONE RESISTANCE The Okonite EP insulating compound meets the requirement of "No Cracks" after exposure at 25° C to an ozone concentration of .025 to .030% after 24 hours exposure when tested in accordance with IPCEA methods.

We certify that actual tests have been performed in our laboratory as indicated above and the formulation released to our manufacturing plant for the Okonite EP insulating compound is of the identical recipe.

Because of the bonded Okolon (hypalon) jacket, these tests cannot be performed on production samples nor are they required to be performed per IPCEA specifications.

*JACKET COVERING CHARACTERISTIC
COLD BEND The Okolon (chlorosulforated polyethylene) jackdting compound meets the requirements of "NO CRACKS" after 24 hours exposure @-25° C, when tested in accordance with IPCEA methods.

Sworn and subscribed to before me this 13th day of June, 1975.

[signature]

Notary Public

QA APPROVED
BY Paul W Stevenson
DATE 2/9/79

POOR ORIGINAL

[signature]
Dr. J. S. Lasky
Vice President, Research

A9

458 070

TYPICAL

Blanket

B&W Kaowool ceramic fiber is the basic fiber from which the Kaowool family has grown. The raw material is kaolin, a naturally occurring, high purity, alumina-silica fireclay. Kaowool has a melting point of 3200F, a normal use limit of 2300F, but can be used at even higher temperatures in certain applications. B&W Kaowool has fiber lengths up to 10 in., average lengths of 4 in. These long fibers, thoroughly interlaced in the production process, provide Kaowool blanket, bulk, and strip products with unsurpassed strength without the addition of a binder system. Other forms are processed from basic Kaowool ceramic fiber.

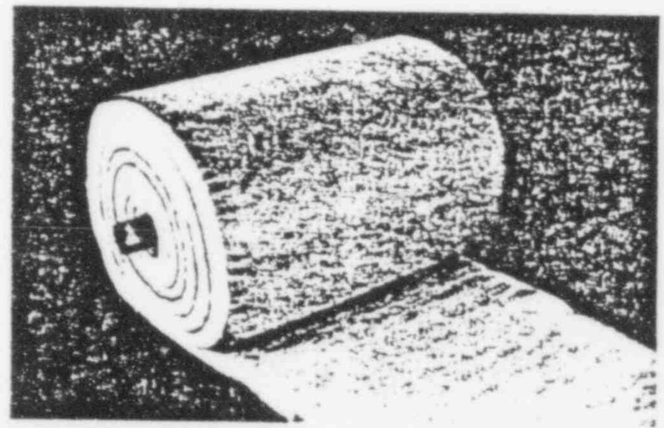
B&W Kaowool blanket contains no organic binder or other organic constituents. Blanket will not contaminate furnace atmospheres or emit offensive odors. Available in nominal densities of: 3, 4, 6 and 8 lb / cu ft. Width: 2 ft and 4 ft. Length: 25 ft.

High purity blanket is also available for reducing conditions or in applications where low percentages of iron oxide and titania are required in the fiber.

Thickness

B&W Kaowool blankets are manufactured in the following thicknesses for the indicated density:

	3 lb cu ft	4 lb cu ft	6 lb cu ft	8 lb cu ft
¼ in.	—	—	yes	yes
½ in.	yes	yes	yes	yes
1 in.	yes	yes	yes	yes
1½ in.	yes	yes	yes	yes
2 in.	yes	yes	—	—



Physical properties

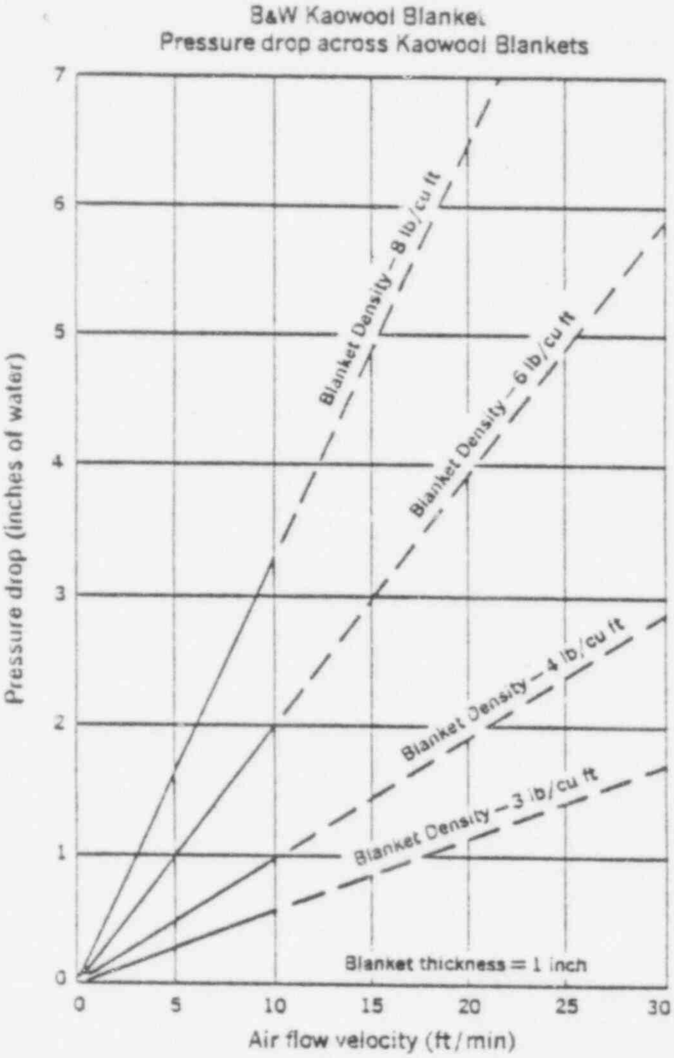
Color	white
Fiber diameter, microns (avg)	2.8
Fiber length, inches	4 (avg) to 10
Specific gravity (ASTM C 135)	2.56
Specific heat, Btu/lb/F @ 1800F mean	0.255
Fiber tensile strength, psi	1.65×10^5
Fiber tensile modulus, psi	12 [illegible] x 10^6
Use limits, F	
Continuous	2300
Single application	3000
Melting point, F	3200
Hardness	
MOH	6
Knoop (100g load)	700

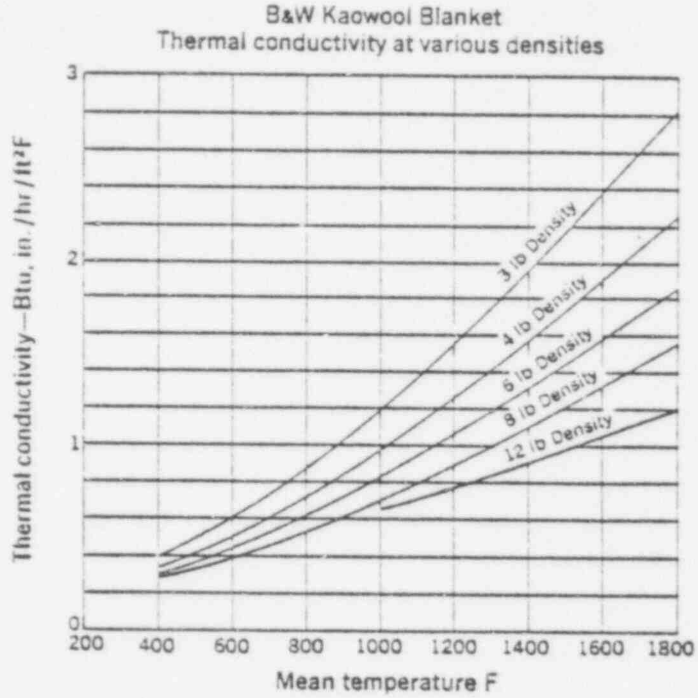
Kaowool ceramic fiber is a highly efficient insulator. Kaowool's low shot content gives more usable fiber for your insulating dollar. Kaowool's longer fibers give it the high tensile strength and resiliency to withstand vibration and physical abuse. Kaowool is self-supporting—will not separate, sag or settle. Kaowool has low thermal conductivity, low heat storage, and is extremely resistant to thermal shock.

POOR ORIGINAL

458 071

Data are average results of tests conducted under standard procedures and are subject to variation. Results should not be used for specification purposes.





Chemical properties

B&W Kaowool ceramic fibers possess excellent resistance to chemical attack. Exceptions are hydrofluoric acid, phosphoric acid and strong alkalies. Kaowool is unaffected by oil or water. Thermal and physical properties are restored after drying.

Chemical analysis, %

		Kaowool	Kaowool High Purity Blanket
Alumina	Al_2O_3	45.1	47.0
Silica	SiO_2	51.9	52.9
Ferric oxide	Fe_2O_3	1.3	0.05 (0.15 max)
Titanium oxide	TiO_2	1.7	0.07 (0.15 max) trace inorganics
Magnesium oxide	MgO	trace	
Calcium oxide	CaO	0.1	
Alkalies, as	Na_2O	0.2	
Boron oxide	B_2O_3	0.08	

Maximum quantities of water leachable elements on surface of fiber.

	PPM
Boron	100
Chlorine	5
Fluorine	50
Sulphur	10

Typical applications

Furnace linings
Boiler combustion chambers and heat exchangers, oil-fired
Catalytic mufflers and automotive afterburners
Gas turbines
Fans—high temperature
Laboratory ovens
Steam valves of headers and steam separators
Thin wall kilns—backup
Water and steam tubes—backup
Petroleum catalytic crackers
Protection on water-cooled risers and cross-over rails—reheating furnaces
Oven linings
Superheater seals
Wrapping pipe and tubing after welding for stress relieving
Furnace repair
Acoustical service for missiles, rockets, and jet aircraft
Cryogenic vessel fire protection
Furnace door linings and seals
Expansion joint packing
High temperature filters
Wrapping investment casting molds
Annealing cover seals
Soaking pit cover seals

POOR ORIGINAL

458 072

Data are average results of tests conducted under standard procedures and are subject to variation. Results should not be used for specification purposes.

COCOONED FIREPROOFING, ELECTRICAL CABLE TRAY

Tray to be fireproofed with 3 layers 1" thick 8 lb. density Kaowool.

Step 1. Visually inspect outer surface of tray for dirt, grease, etc. and remove if present.

Step 2. Lay out spacing of insul pins along tray to assure that pins will be within 3" of each side of Kaowoll joints in the outer layer. Pins between outer layer joints should be approximately 11" on center.

Step 3. Grind away galvanizing at pin locations.

Step 4. Using capacitor - discharge welder, attach 4" 12 ga. carbon steel insul pins in configuration shown at spacings along tray determined in Step 2.

Step 5. Measure sides and bottom, cut piece of Kaowool to fit, and impale over pins with edges approximately 16" from outer layer joint locations. Secure Kaowool with K.125 galvanized insul clips.

Step 6. Apply several first layers. Then repeat for second layer, being certain to locate edges of Kaowool between first layer joints and outer layer joint locations. Keep all joints tight. Secure with insul clips. Trim top edges of both layers even with flange of tray.

Step 7. Cut outer layer Kaowool long enough to wrap over top flange of tray, position with edges at outer layer joint locations, impale on pins and secure with insul clips. Cut off excess pin to approximately 1/4", and flatten this portion slightly to help prevent insul clip from coming off. Leave pin on flange of tray approximately 3/4" long.

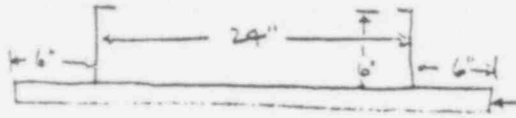
Step 8. Measure 18 inch wide cover to determine spacing of pins as in Step 2, grind away galvanizing and weld 4" 12 ga. carbon steel pins to cover in configuration shown.

Step 9. Measure maximum dimension (w) of outer layer of Kaowool on tray. Cut Kaowool to this width and apply 3 layers to cover with joints staggered, each layer secured with K.125 galvanized insul clips, all joints tight, and pins within 4" on each side of outer layer joints. Cut off pins 1/4" and flatten.

Step 10. Insulated cover should be centerd on tray with Kaowool toward inside and banded with 1/2" .020 stainless steel bands, 12 inches on center.

KE FRAMIG & CO
5/4/79

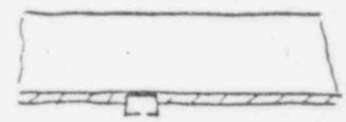
WHZ #1
FIREPROOFING CABLE TRAY



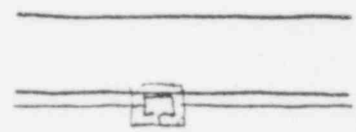
END VIEW — SIDE VIEW

① INSTALL PINS ON TRAY (5" NEAR UNISTRUT)

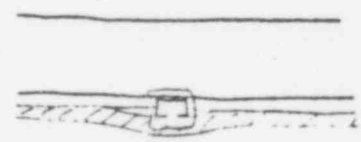
② INSTALL 1ST LAYER KAOWOOL ON TRAY - BUTT AGAINST UNISTRUT ON BOTTOM - CUT OUT FOR UNISTRUT ON SIDES



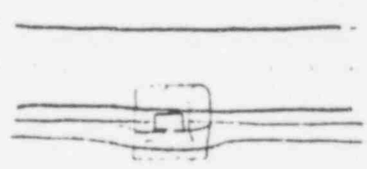
③ WRAP KAOWOOL ON PROTRUDING UNISTRUT - IMPALE ON PINS & SECURE W SS WIRE. STOP FLUSH WITH END

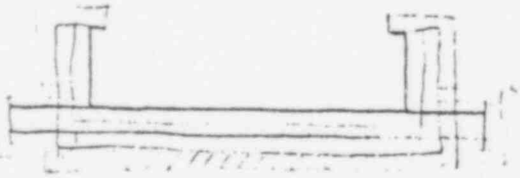


④ WRAP 2ND LAYER KAOWOOL ON TRAY RUN OVER UNISTRUT ON BOTTOM & NOTCH OUT FOR UNISTRUT ON SIDES

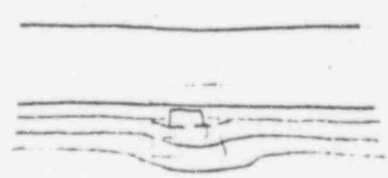


⑤ WRAP KAOWOOL ON PROTRUDING UNISTRUT - IMPALE ON PINS + SECURE W SS WIRE. EXTEND 1" BEYOND END OF UNISTRUT.





⑥ WRAP 3RD LAYER KAOWOOL ON TRAY EXTEND OVER LIPS ON TOP & NOTCH OUT FOR UNISTRUT PROTRUSION (KEEPING JOINTS STAGGERED)



⑦ INSTALL 12" WIDE SECTION OF KAOWOOL OVER UNISTRUT ON BOTTOM

498 074

⑧ INSERT PLUG OF KAOWOOL AGAINST END OF UNISTRUT, COVER WITH ADDITIONAL PIECE & SECURE WITH SS WIRE

POOR ORIGINAL

A-900—Gen.

INTER-DEPARTMENT CORRESPONDENCE

TO: N. L. Kaestle

DATE: 10/11/78

FROM: R. J. Eyer

SUBJECT: INSTRUMENT ACCURACY

DESCRIPTION: 500 Volt Megger

MANUFACTURER: J.G.Biddle

MODEL: Hand crank

SERIAL NO.: 690326

ELECTRIC OPERATING TEST DEPT.
IDENTIFICATION NO.: T.D. 61.4

RATED ACCURACY: 1% of scale length

This is to certify that:

The accuracy of this instrument has been verified under the conditions stated above with standards traceable to the National Bureau of Standards. Evidence of traceability is on file at our Laboratory.

TESTED BY: R. J. Eyer / C. Frazier.

458 075

Biddle Megger
Serial #690326 TD #61.4

Ohm Scale	Value Resistor	Read
	100 ohms	N/A
	499.9 ohms	N/A
	997.3 ohms	N/A
	5050 ohms	5K
Megohm Scale Standard	62.81 megohms	70 megohms
	40.85 megohms	45 megohms
	30.65 megohms	35 megohms
	20.54 megohms	23 megohms
	10.11 megohms	12 megohms

R-K ELECTRIC CO., INC.

11315 WILLIAMSON RD.
CINCINNATI, OHIO 45241
PHONE 793-4060

Dwg. ____________

Sheet No. 1 of 1
S.O. No. 4734

Customer CINCINNATI GAS & ELECTRIC COMPANY Order No. 3270 Mat'l Del. Date ____

Item	Quan.	Description			P.O. No.	Supplier	
1.	1	PLYWOOD 4' X 6' X ½" SHEET					
2.	121	PAULDING PORCELAIN PONY CLEAT RECEPTACLE #50714					
3.	120	MUELLER TEST CLIPS #48B					
4.	60	MUELLER INSULATOR #49 RED					
5.	60	MUELLER INSULATOR #49 BLACK					
6.	132	25 WATT 120V CLEAR LAMP 25A-25CL					
7.	1	ROYAL ITT #0-1852 CABLE 50' LONG 14 GAUGE (14/350)					
8.	2	SQ. D 30 CIRCUIT PANELBOARD QO30HW					
9.	2	SQ. D COVERS QOC30WS					
10.	60	SQ. D CIRCUIT BREAKERS QO115					
11.	A/R	WIRE #14 SIS					
12.	A/R	ANGLE 1" X 1" X 1/8"					
13.	60 SETS	SP CORD 18-2 BLACK 10' LENGTHS					

POOR ORIGINAL

RECEIVED
GENERAL ENGR. DEPT.
[illegible] 01 [illegible]
RETURN TO
FILE No.

458 078

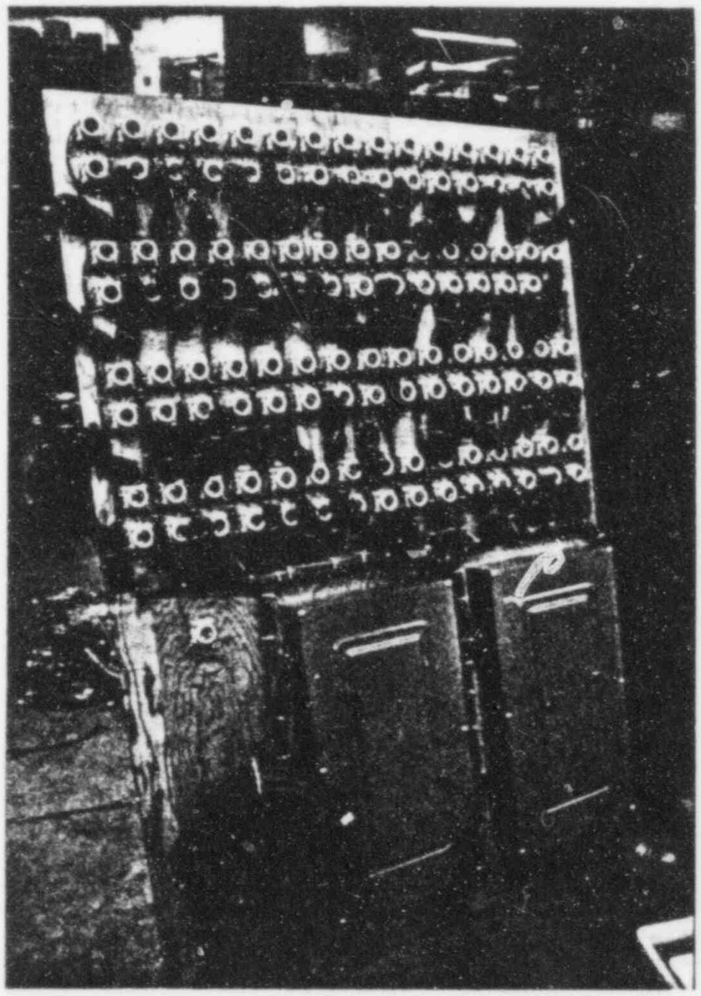
R-K Electric Co., Inc. CINCINNATI, OHIO 45241

SCALE	S. O.	A-
DRWG. BY	DATE	

POOR ORIGINAL

LAYOUT DRAWING

R-K Electric Co., Inc. CINCINNATI, OHIO 45241	SCALE	S. O.	A-3
	DRWG. BY	DATE	

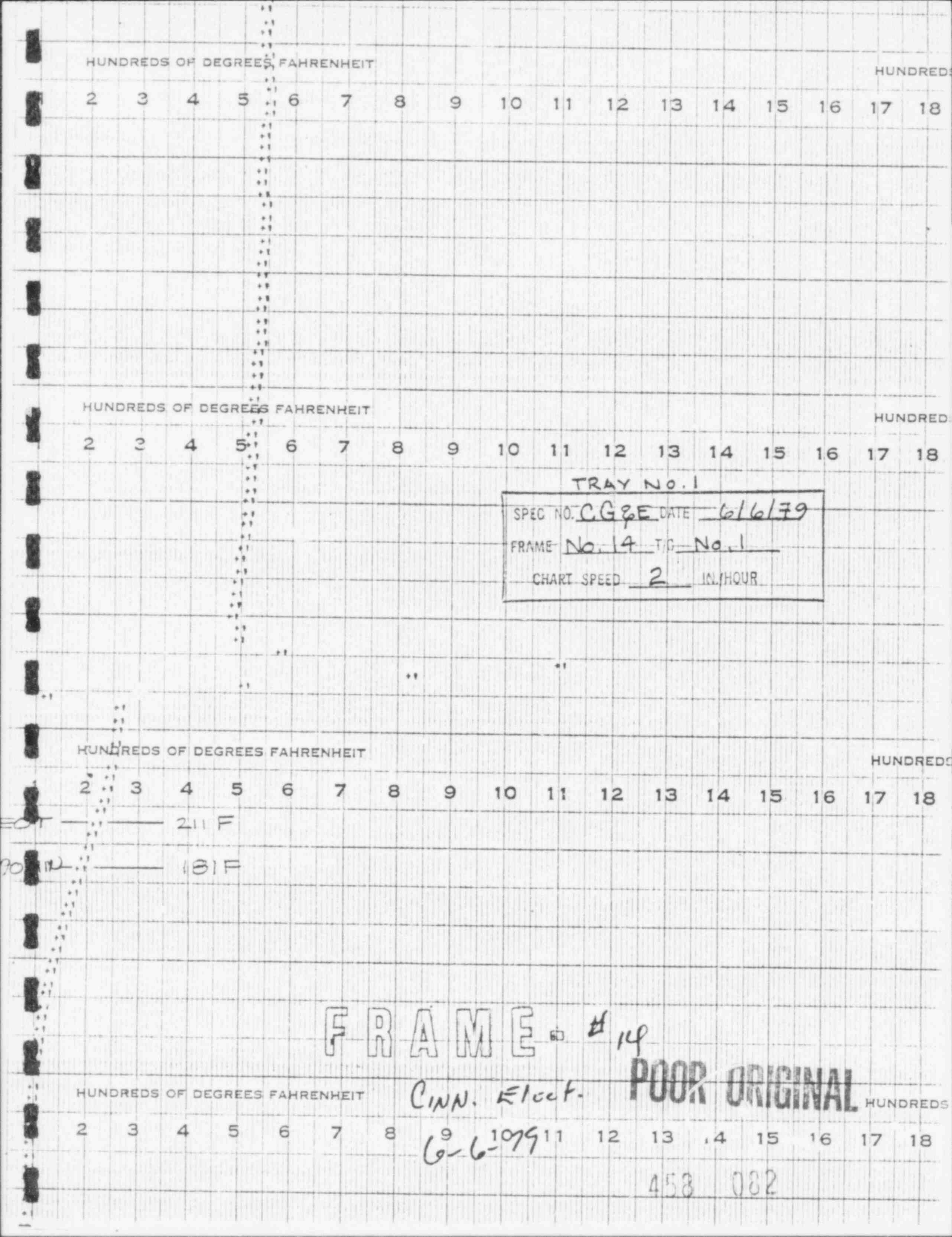


Light Panel Without Bulbs

APPENDIX B

TEMPERATURE RECORDS

458 081


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 1
SPEC NO. CG&E DATE 6/6/79
FRAME No. 14 T/C No. 1
CHART SPEED 2 IN./HOUR
211 F
181 F
FRAME #14
Cinn. Elect.
6-6-1979
POOR ORIGINAL
458 082

HUNDREDS OF DEGREES FAHRENHEIT

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 HUNDRED

HUNDREDS OF DEGREES FAHRENHEIT

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 HUNDREDS

TRAY NO. 1

SPEC NO. CG&E DATE 6/6/79

FRAME No. 14 T/C No. 2

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 HUNDREDS

EOT —— 137F

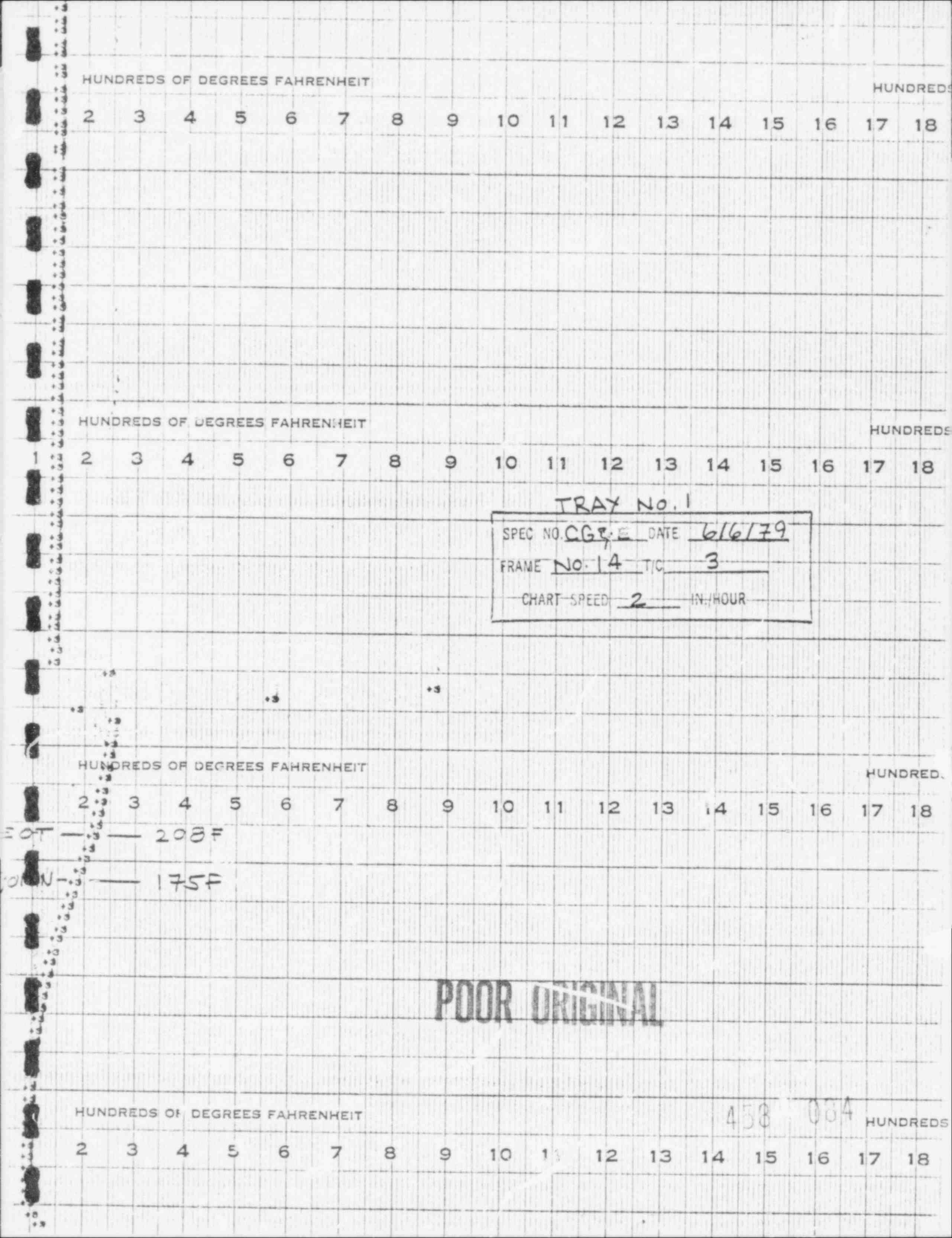
90 MIN —— 120F

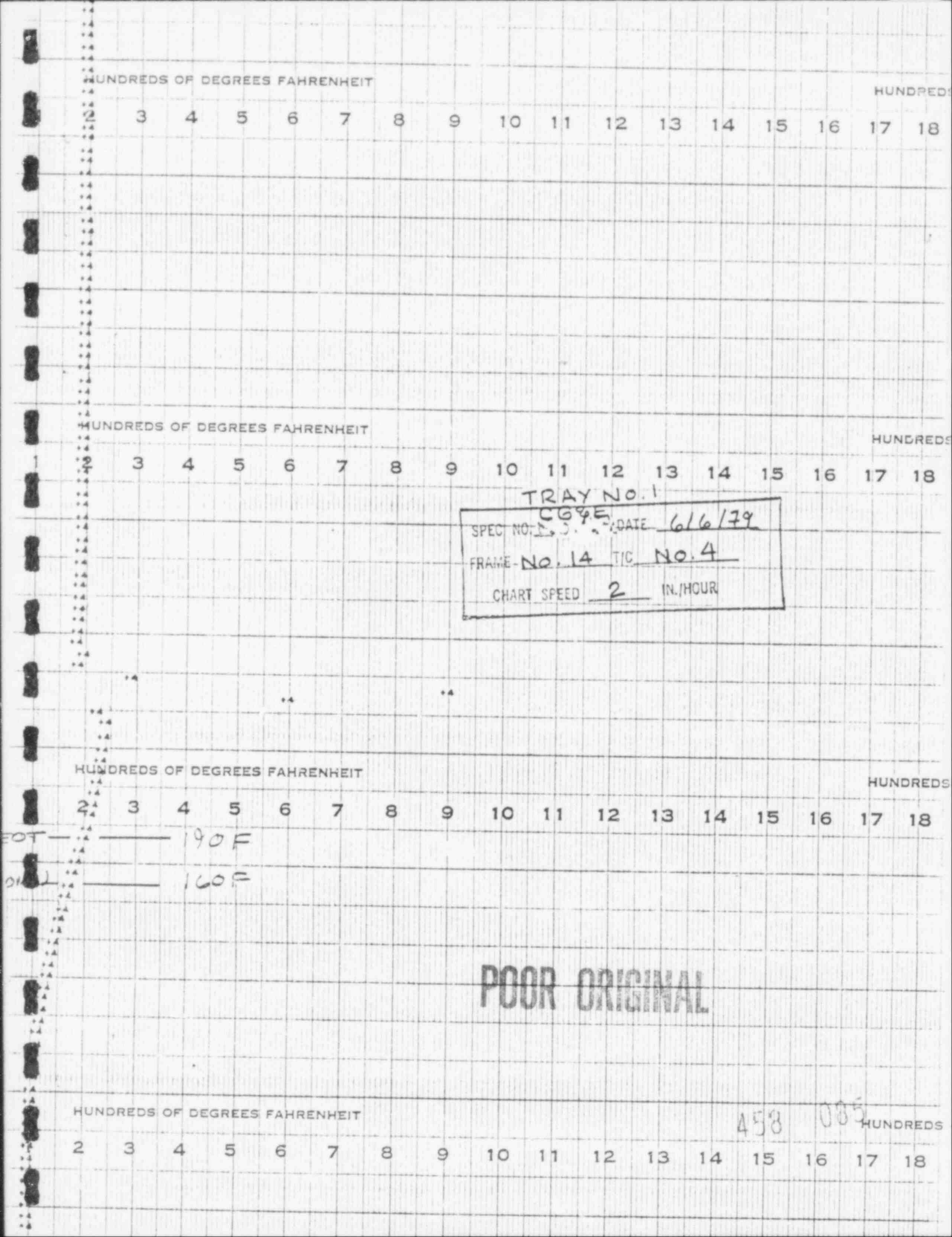
POOR ORIGINAL

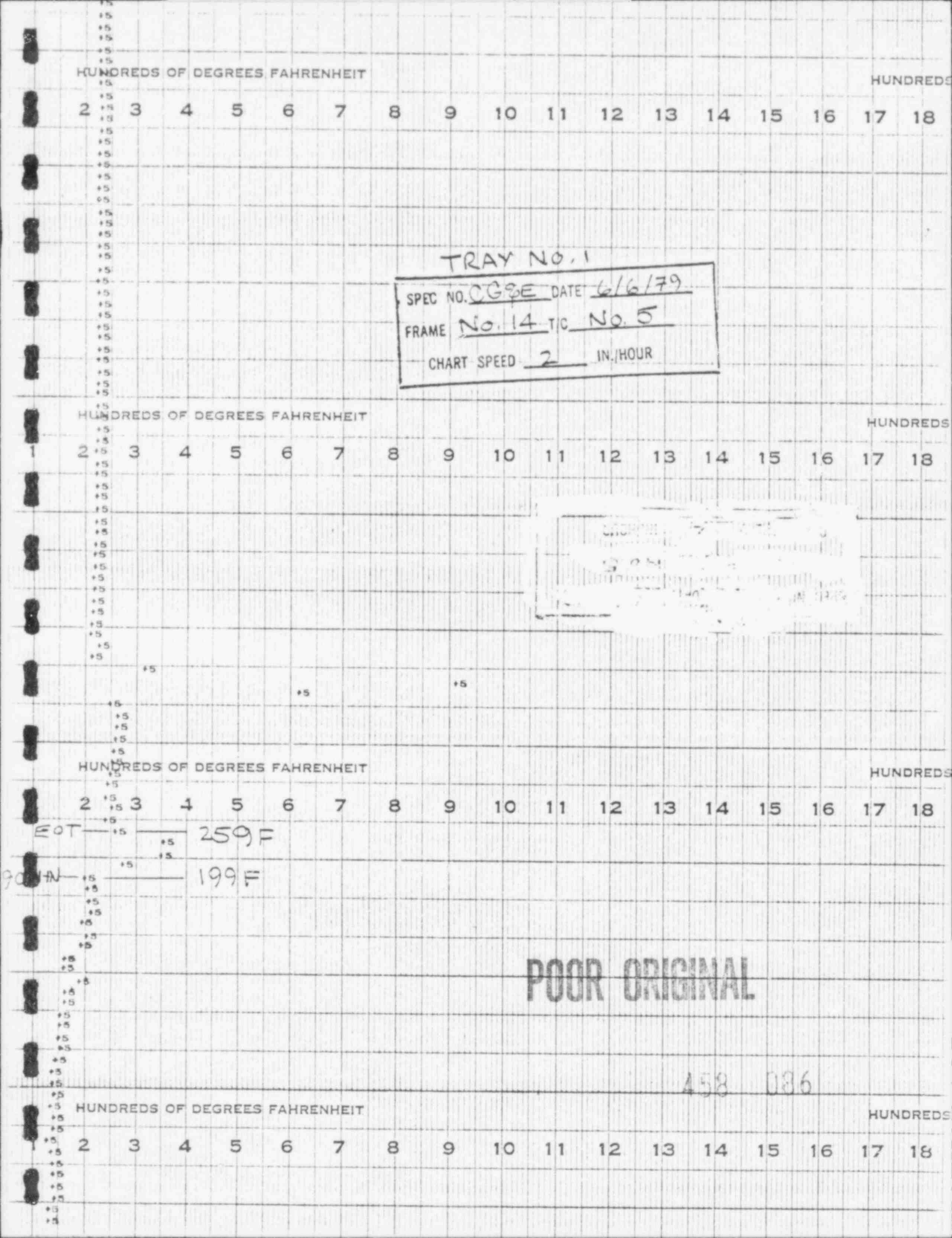
HUNDREDS OF DEGREES FAHRENHEIT

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 HUNDREDS

458 083

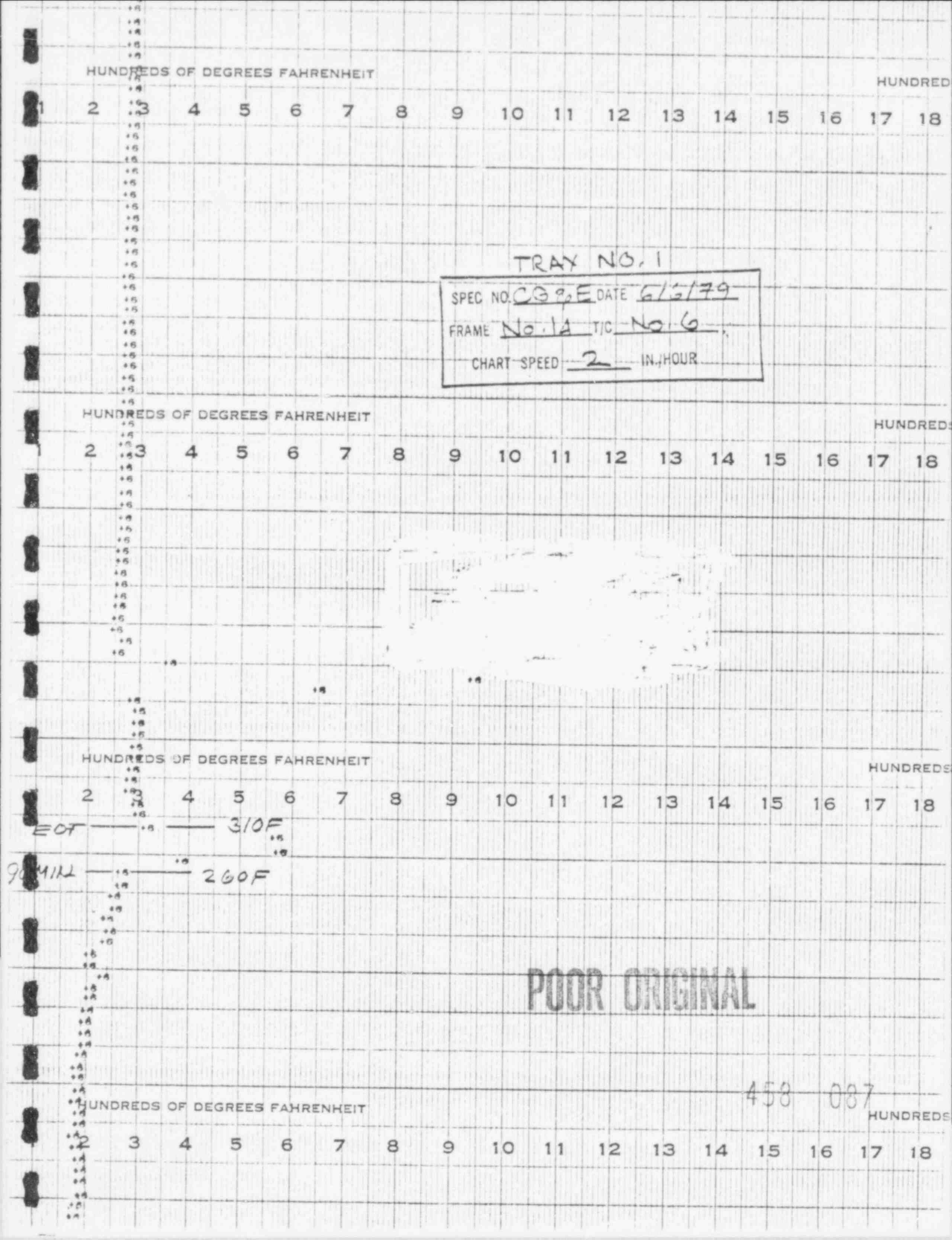

HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 1
SPEC NO. CG&E DATE 6/6/79
FRAME No. 14 T/C 3
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDRED
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
208F
175F
POOR ORIGINAL
HUNDREDS OF DEGREES FAHRENHEIT
458 084
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO.1
C6&E
SPEC NO.
DATE 6/6/79
FRAME-NO. 14 T/C NO. 4
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
190F
160F
POOR ORIGINAL
HUNDREDS OF DEGREES FAHRENHEIT
458 085
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18



POOR ORIGINAL

458 086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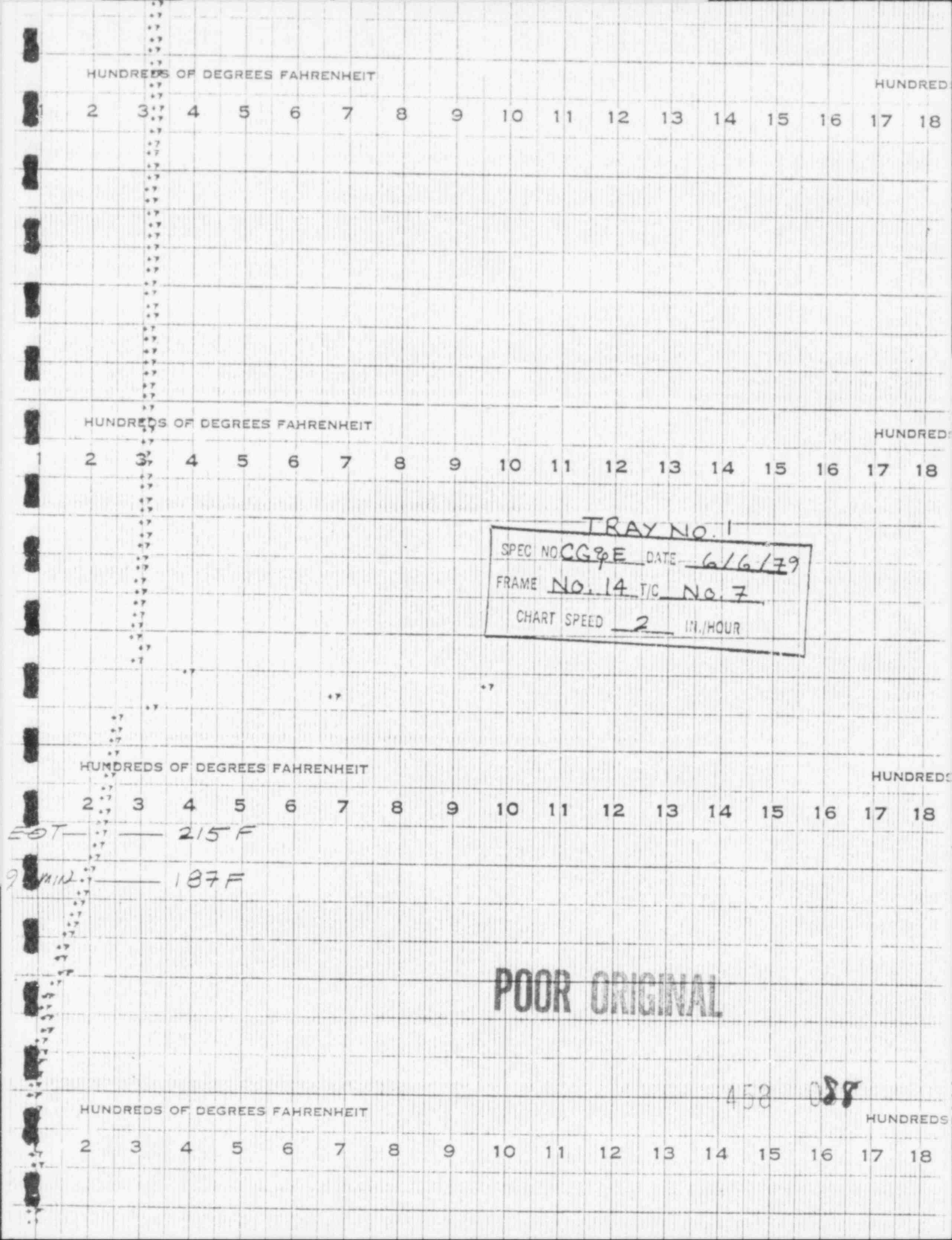
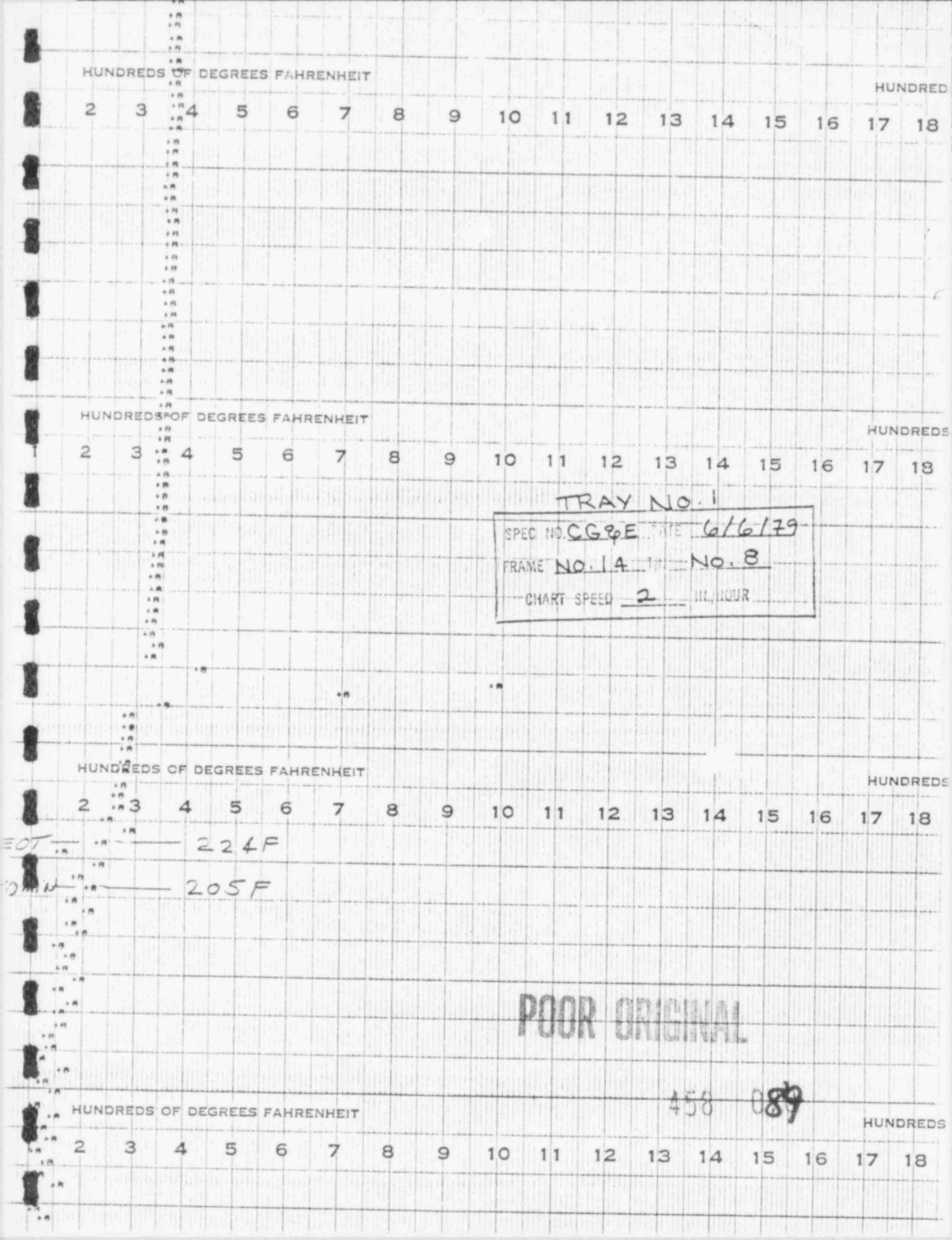
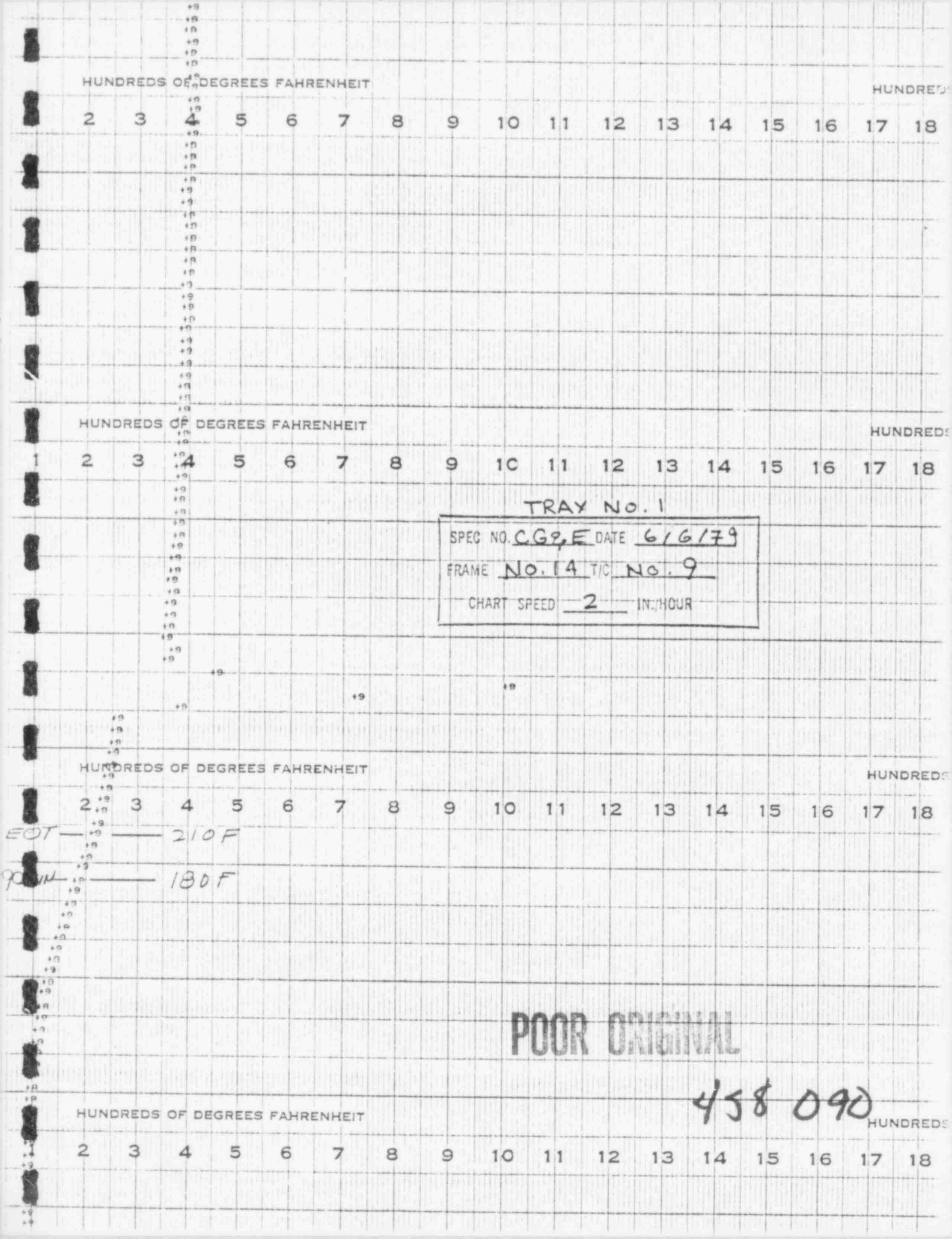
TRAY NO. 1
SPEC NO. CG&E DATE 6/5/79
FRAME No. 1A T/C No. 6
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT — 310F
90 MIN — 260F
POOR ORIGINAL
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
458 087


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 1
SPEC NO CG&E DATE 6/6/79
FRAME NO. 14 T/C NO. 7
CHART SPEED 2 IN./HOUR
EOT — 215 F
187 F
POOR ORIGINAL
458 088


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDRED
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
TRAY NO. 1
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 14 NO. 8
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
224F
205F
POOR ORIGINAL
458 089
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS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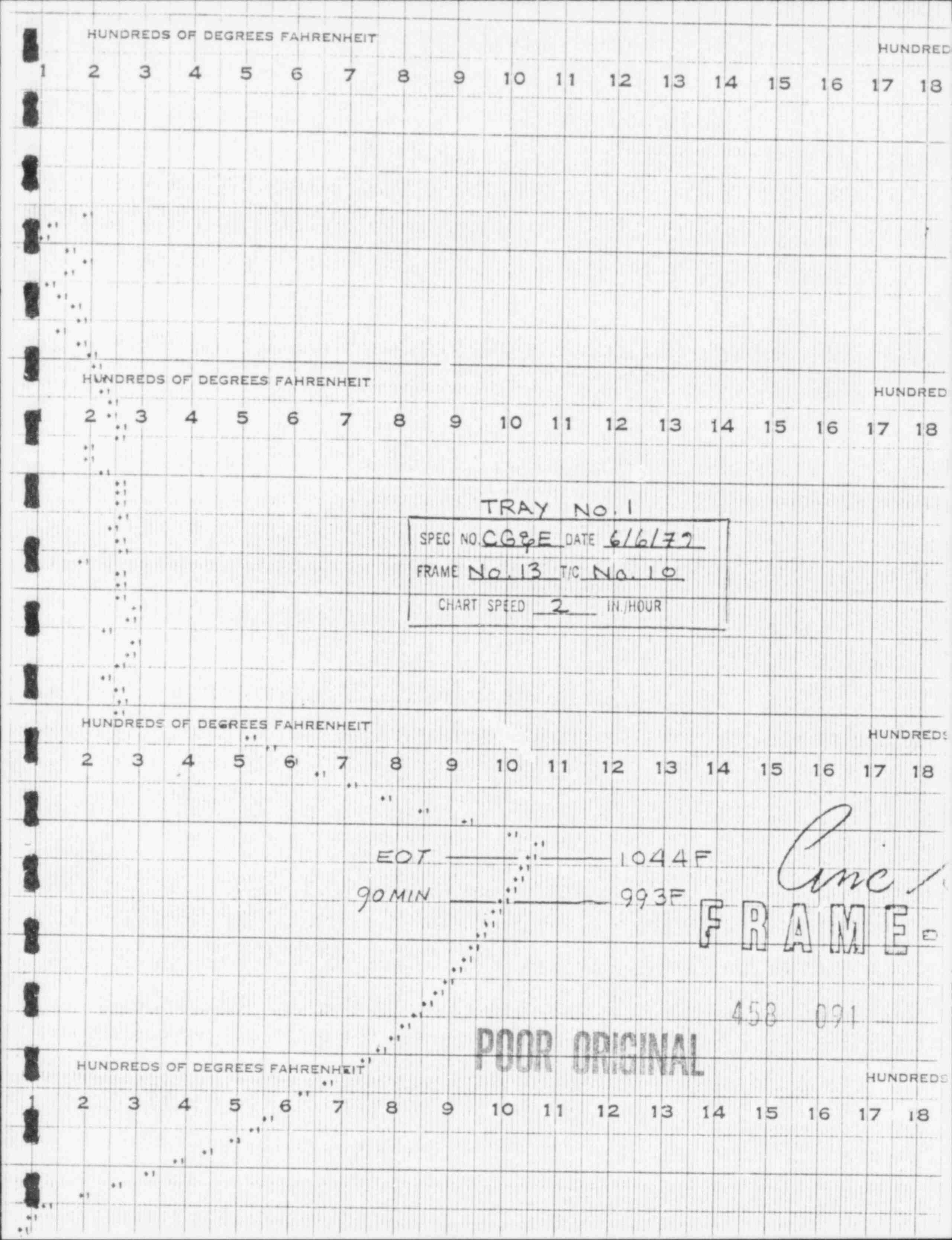
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 1
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 14 T/C NO. 9
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT — 210F
180F
POOR ORIGINAL
458 090
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18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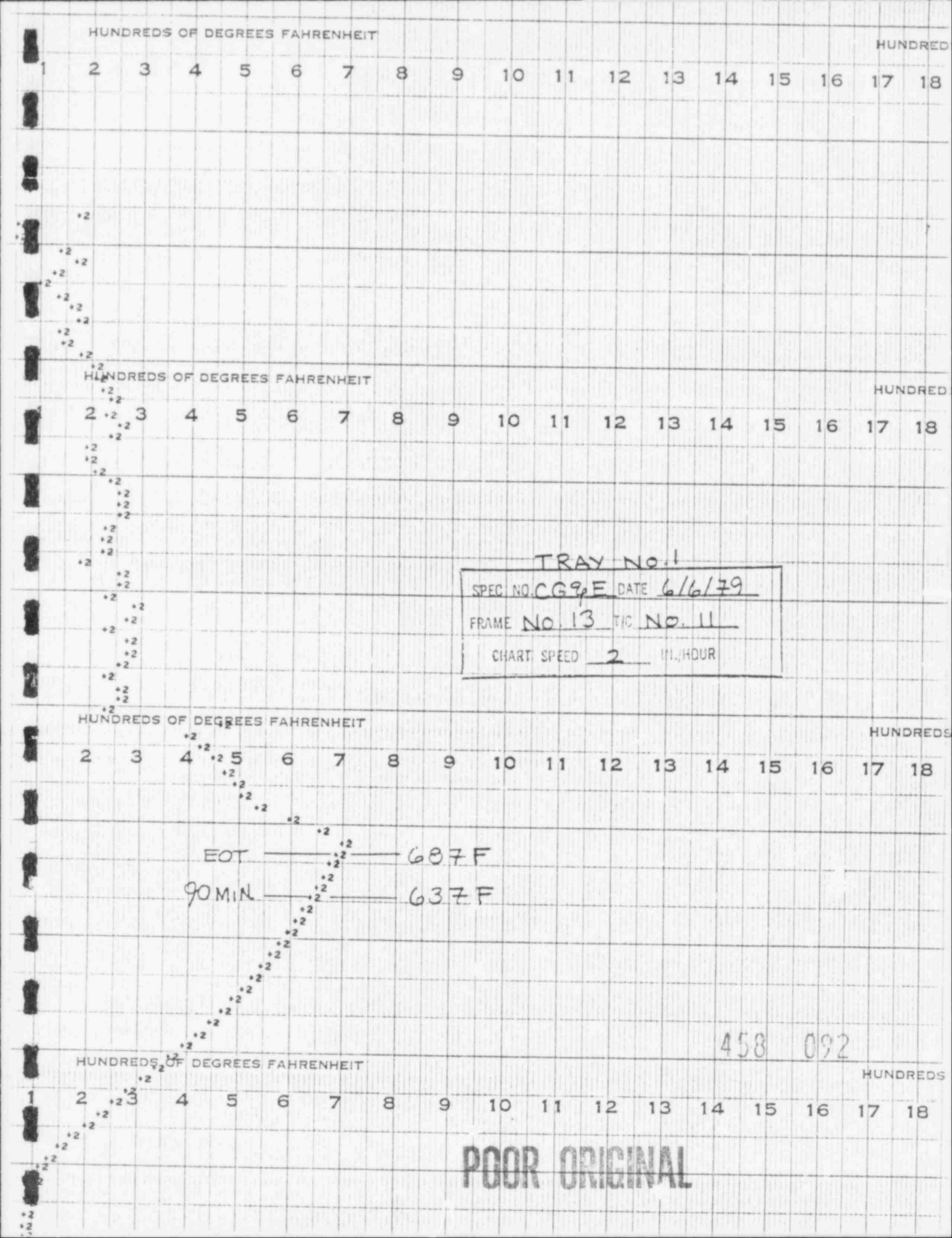
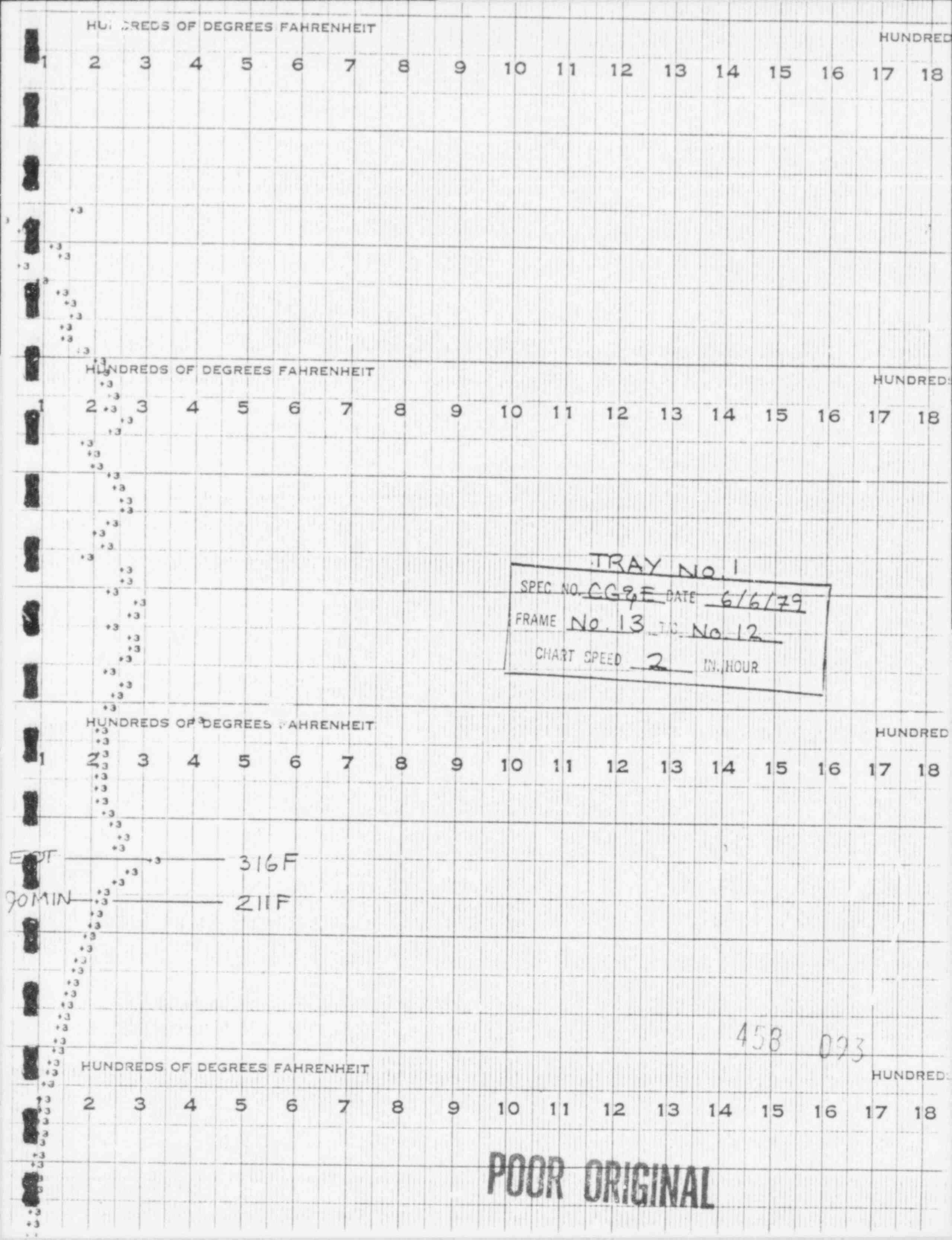
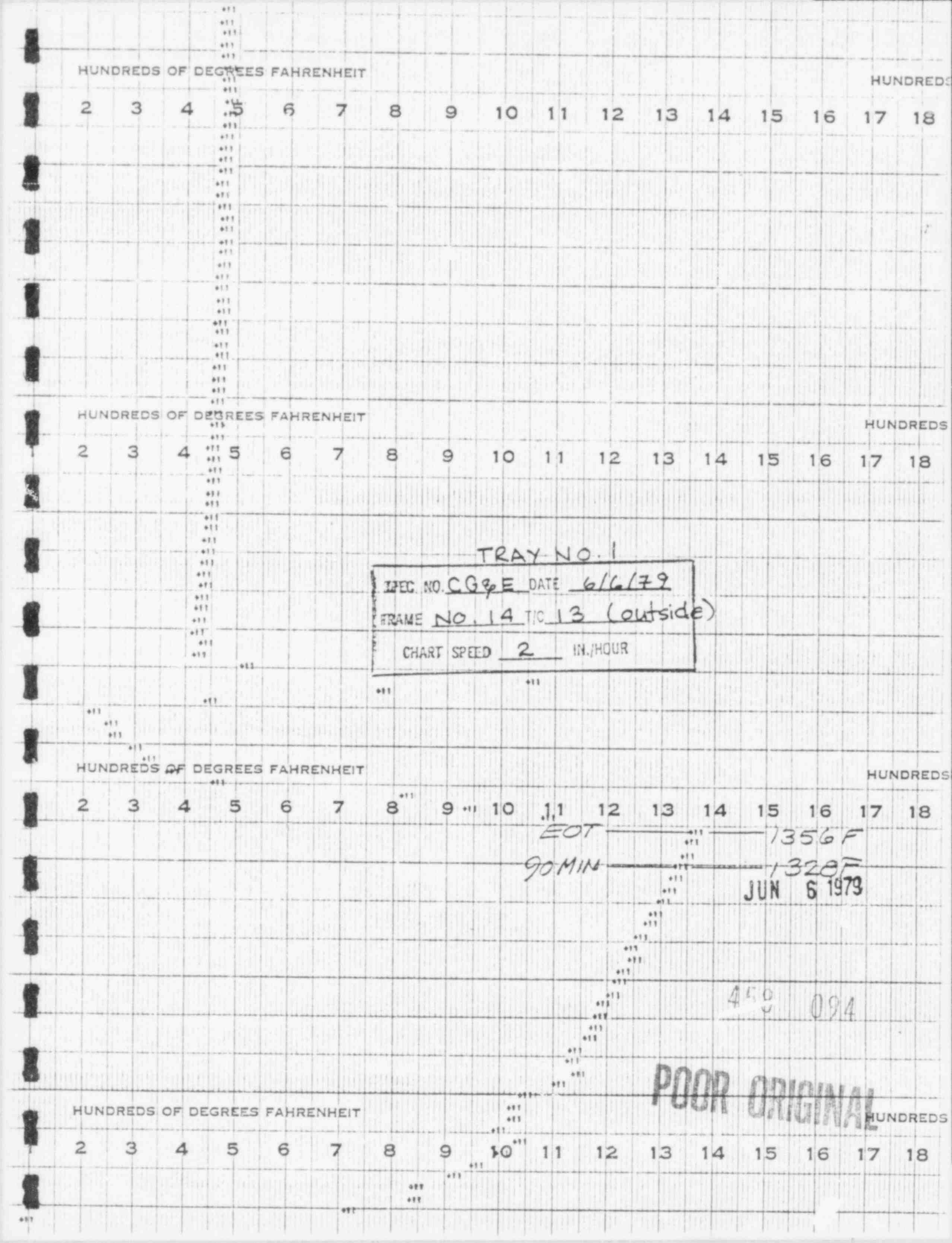
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 1
SPEC NO. CG&E DATE 6/16/77
FRAME No. 13 T/C No. 10
CHART SPEED 2 IN./HOUR
EOT 1044F
90 MIN 993F
FRAME
458 091
POOR ORIGINAL

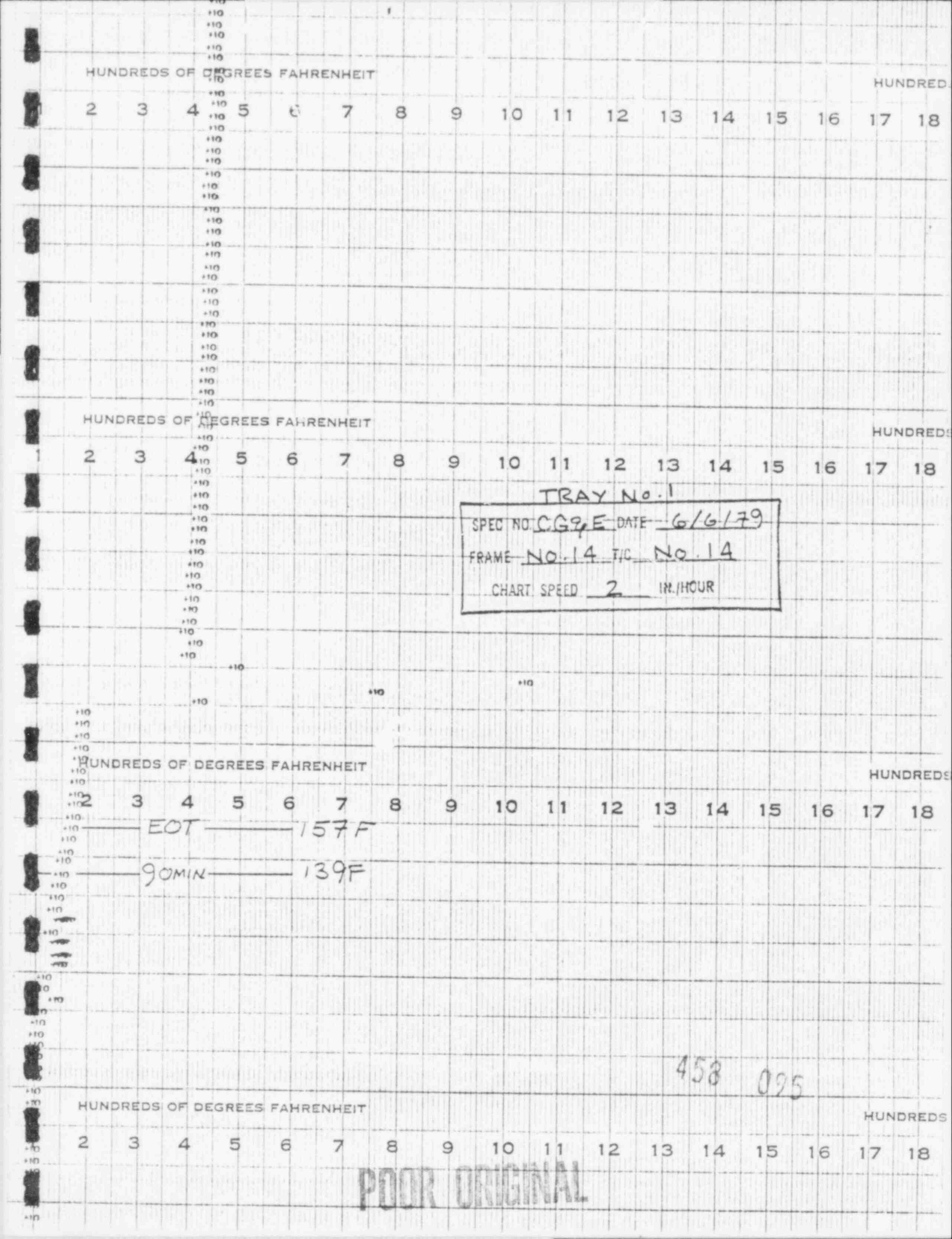

HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 1
SPEC NO. CG9E DATE 6/6/79
FRAME No. 13 T/C No. 11
CHART SPEED 2 IN./HOUR
EOT 687 F
90 MIN 637 F
458 092
POOR ORIGINAL

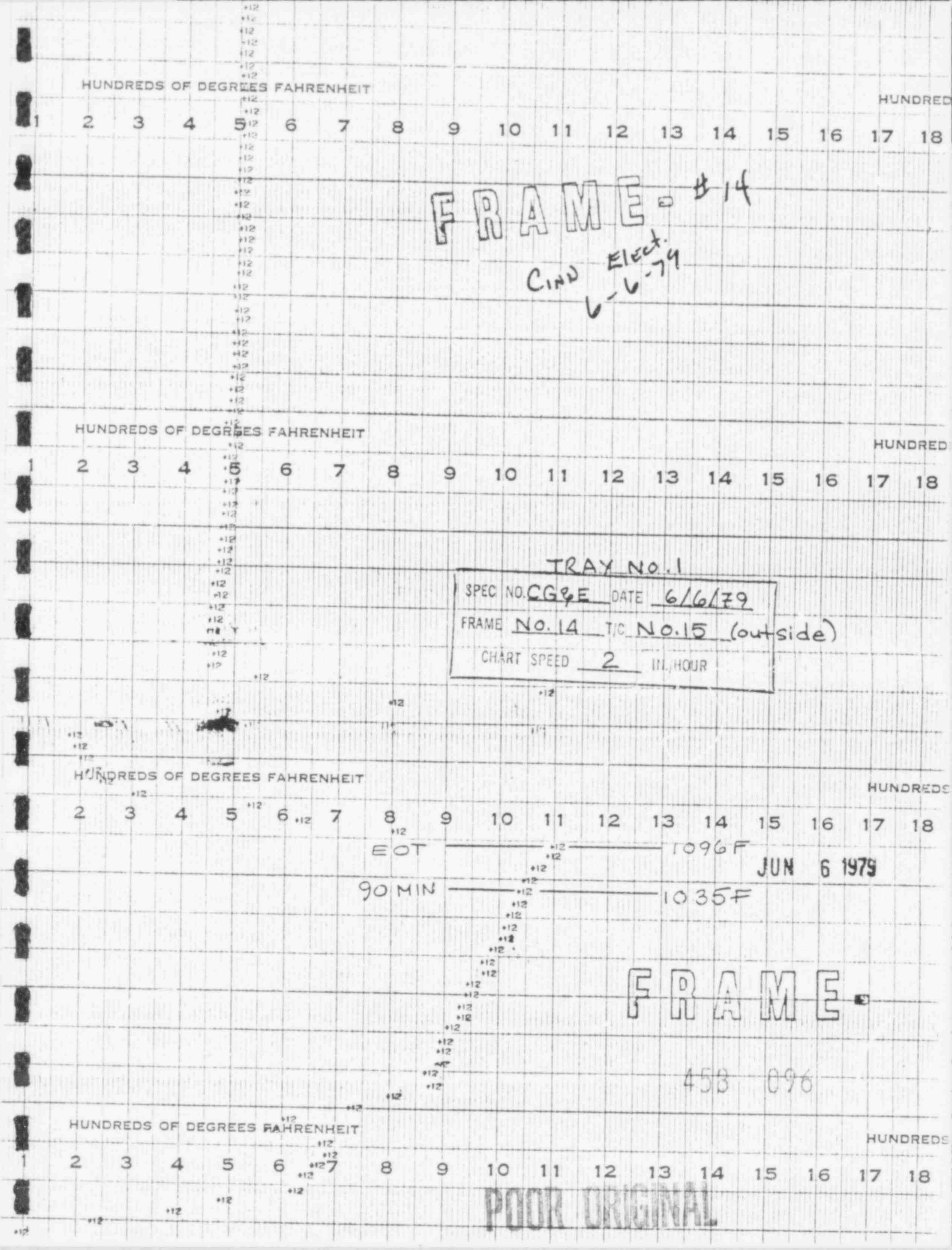


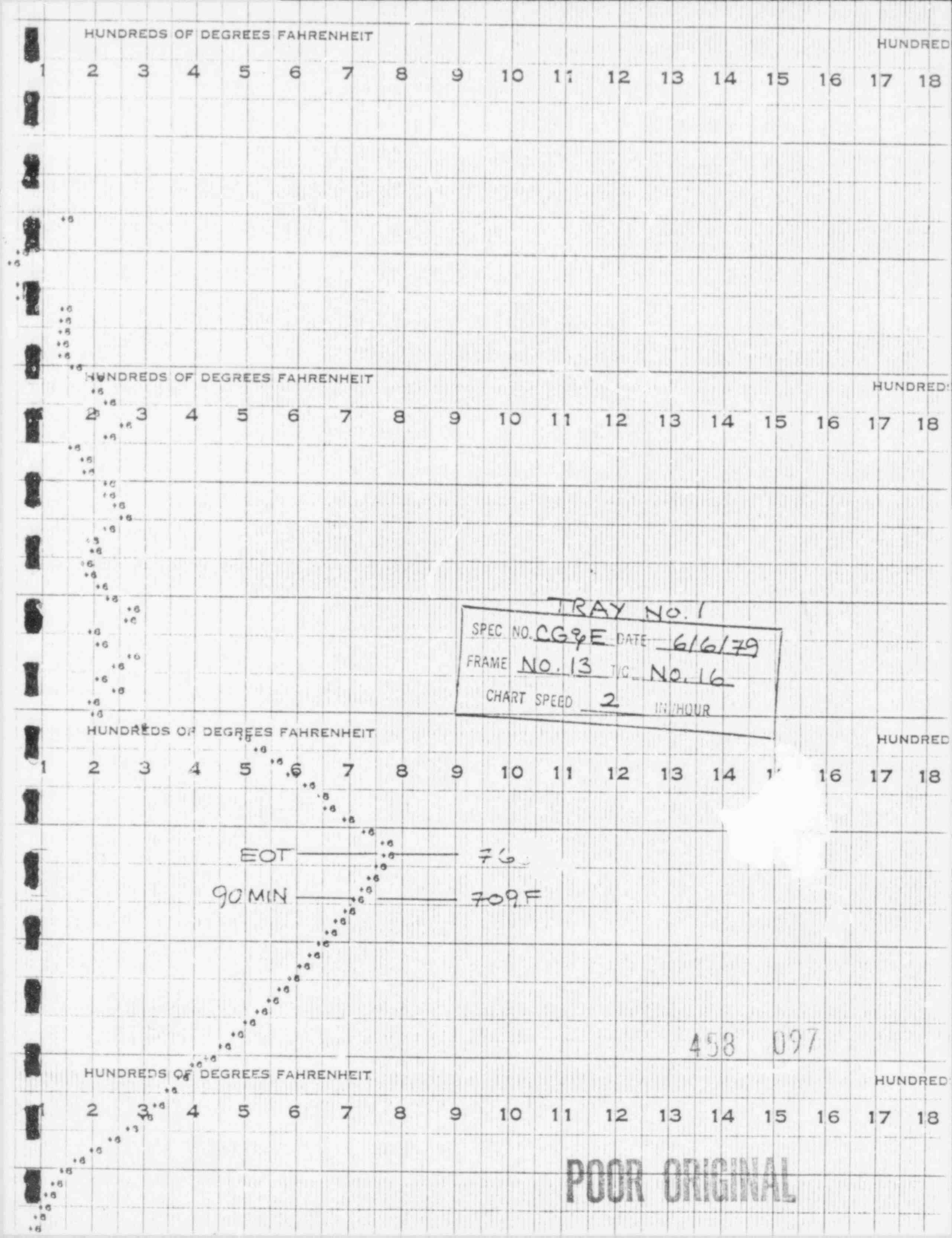
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 1
SPEC NO. CG&E DATE 6/6/79
FRAME No. 13 T.C. No. 12
CHART SPEED 2 IN./HOUR
EPOT 316F
90MIN 211F
458 093
POOR ORIGINAL



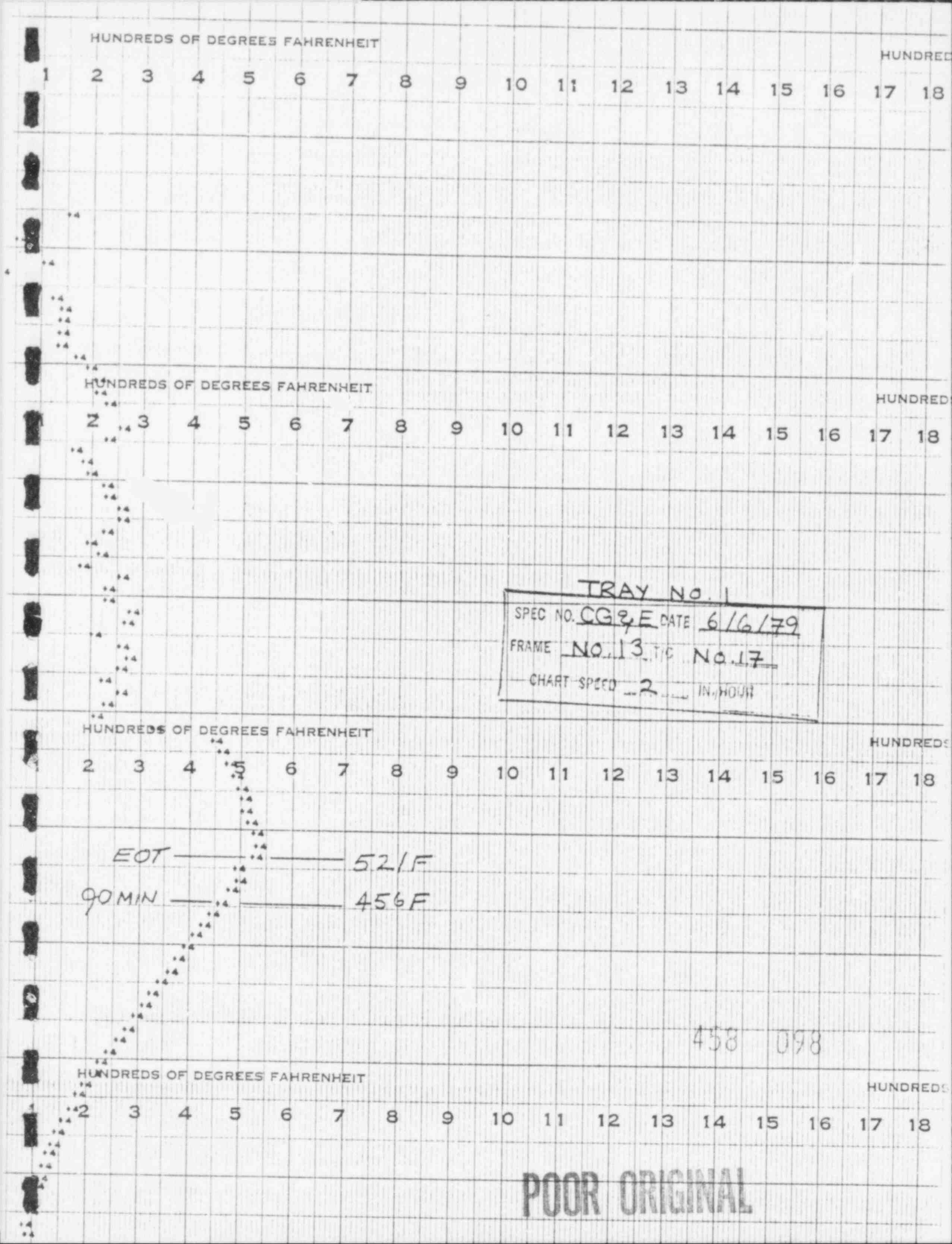
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 1
SPEC. NO. CG&E DATE 6/6/79
FRAME NO. 14 T/C 13 (outside)
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT 1356F
90 MIN 1328F
JUN 6 1979
POOR ORIGINAL
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 1
SPEC NO. CG9,E DATE 6/6/79
FRAME NO. 14 T/C NO. 14
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT 157F
90MIN 139F
458 095
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
POOR ORIGINAL

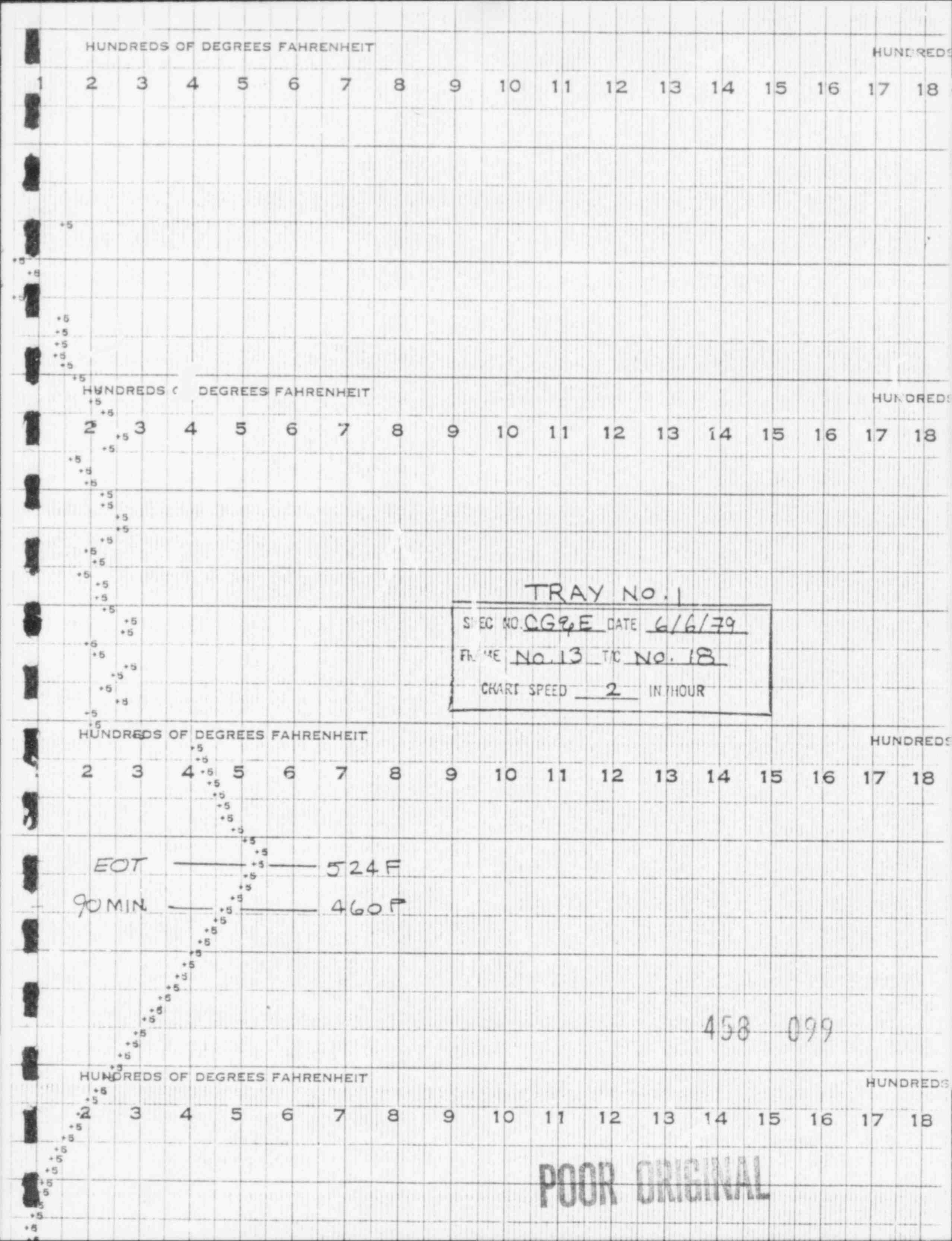

FRAME - #14
Cinn Elect.
6-6-79
HUNDREDS OF DEGREES FAHRENHEIT
TRAY NO. 1
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 14 T/C NO. 15 (outside)
CHART SPEED 2 IN./HOUR
EOT 1096F
90 MIN 1035F
JUN 6 1979
FRAME
458 096
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 1
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 13 T/C NO. 16
CHART SPEED 2 IN/HOUR
EOT 76
90 MIN 709F

458 097



POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 1
SPEC NO. CG&E DATE 6/6/79
FRAME No. 13 T/C NO. 18
CHART SPEED 2 IN/HOUR
EOT 524F
90 MIN 460F
458 099
POOR ORIGINAL

HUNDREDS OF DEGREES FAHRENHEIT

HUNDRED

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY No. 2

SPEC NO. CG&E DATE 6/6/79

FRAME No. 16 T/C No. 19

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

ECT —— 230F

IN —— 199F

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

FRAME #16

458 100

Cinn. Elect.

6-6-79

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY No. 2

SPEC NO. CG&E DATE 6/6/79

FRAME No. 16 T/C No. 20

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

EOT —— 99F

90MIN —— 93F

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458 101

POOR ORIGINAL

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY NO. 2

SPEC NO. CG&E DATE 6/6/79

FRAME NO. 16 T/C NO. 21

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

170 F

149 F

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458 102

POOR ORIGINAL

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAX NO. 2

SPEC NO. CG&E DATE 6/6/79

FRAME No. 16 T/C No. 22

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

EOT ——— 230F

DMN ——— 194F

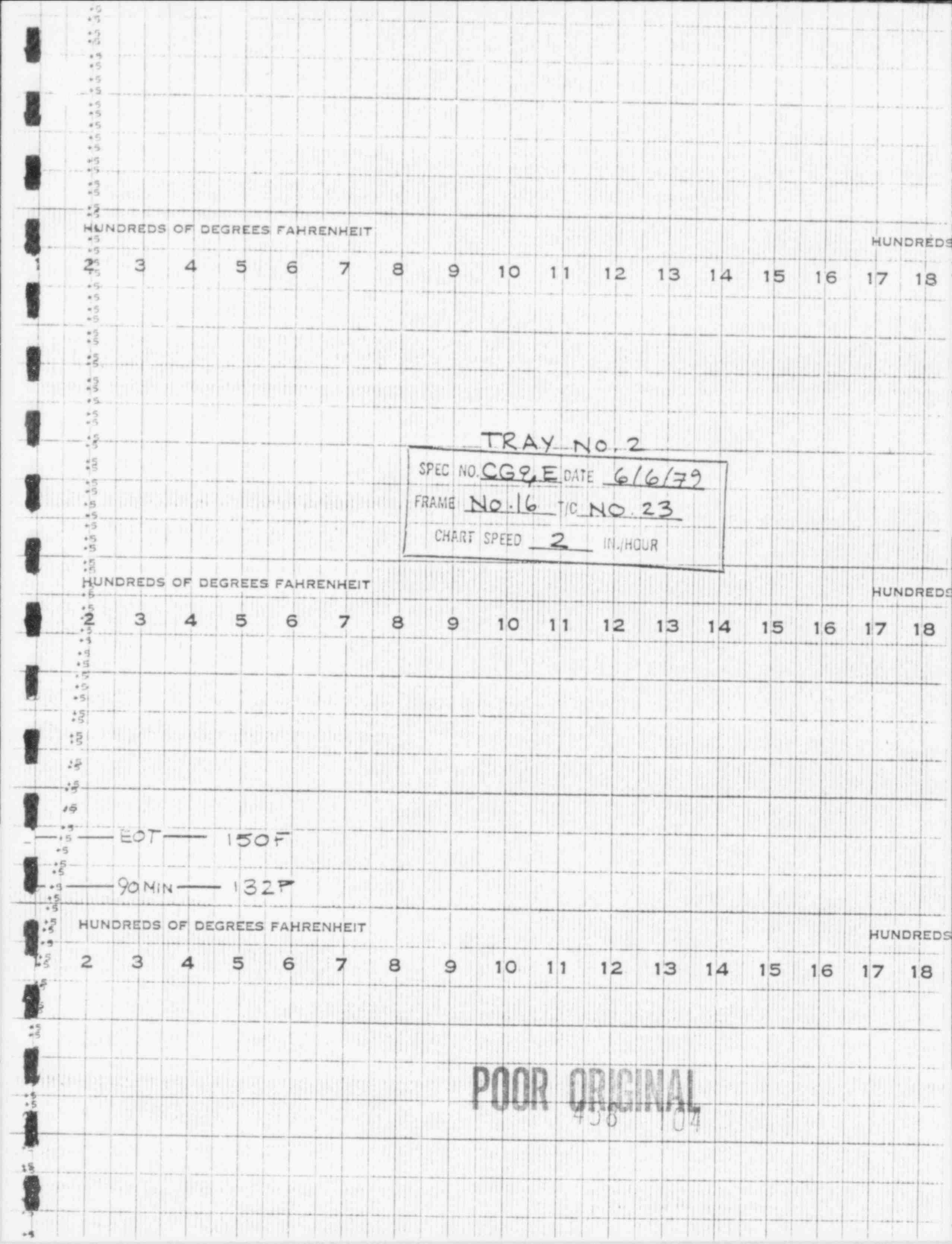
HUNDREDS OF DEGREES FAHRENHEIT

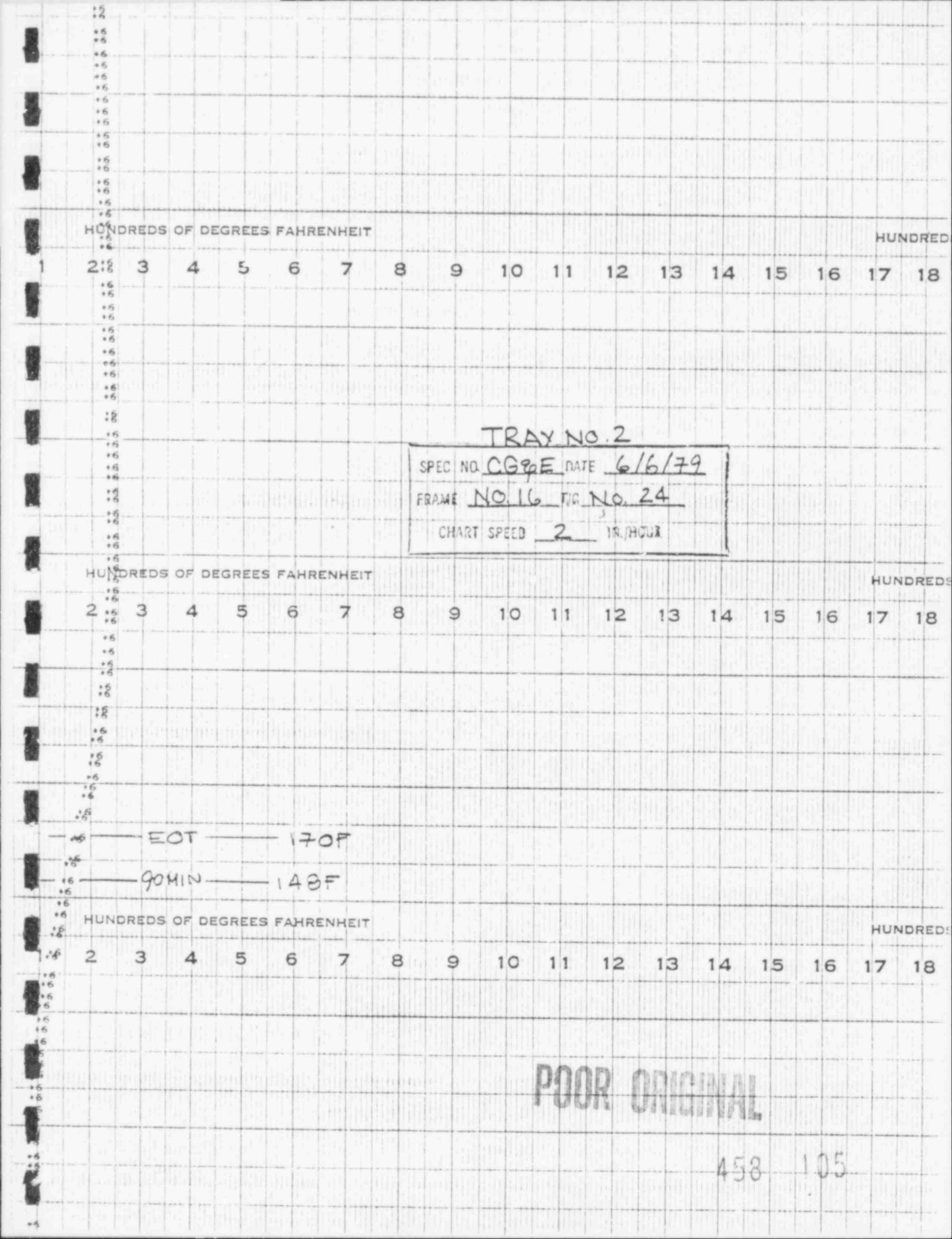
HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458 103

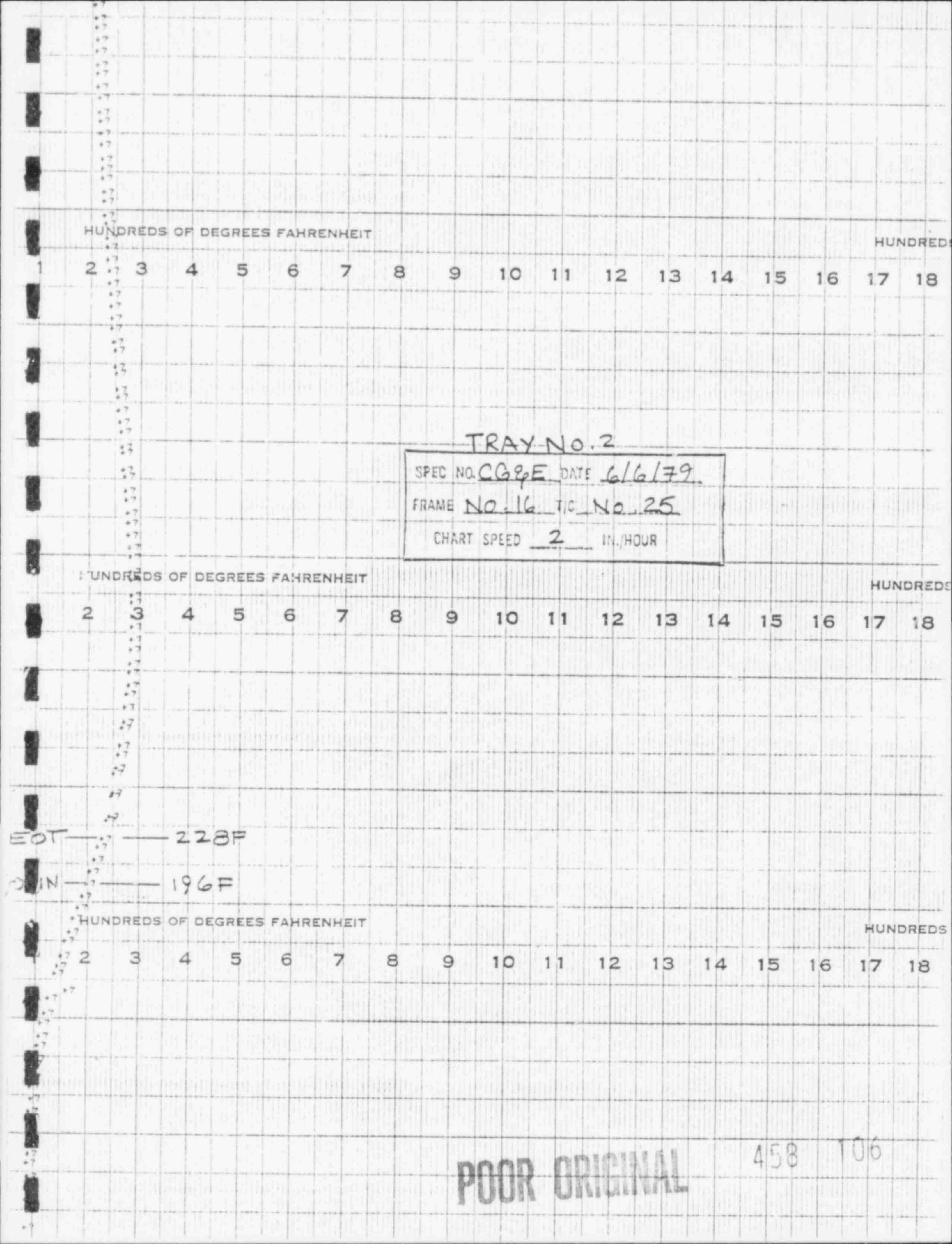
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 2
SPEC NO. CG&E DATE 6/6/79
FRAME No. 16 T/C NO. 23
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT 150F
90 MIN 132F
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18



POOR ORIGINAL

458 105



POOR ORIGINAL

458 106

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TR — NO. 2

SPEC NO. CG&E DATE 6/6/79

FRAME NO. 16 T/C No. 26

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

— EOT ——— 95F

— 90 MIN ——— 94F

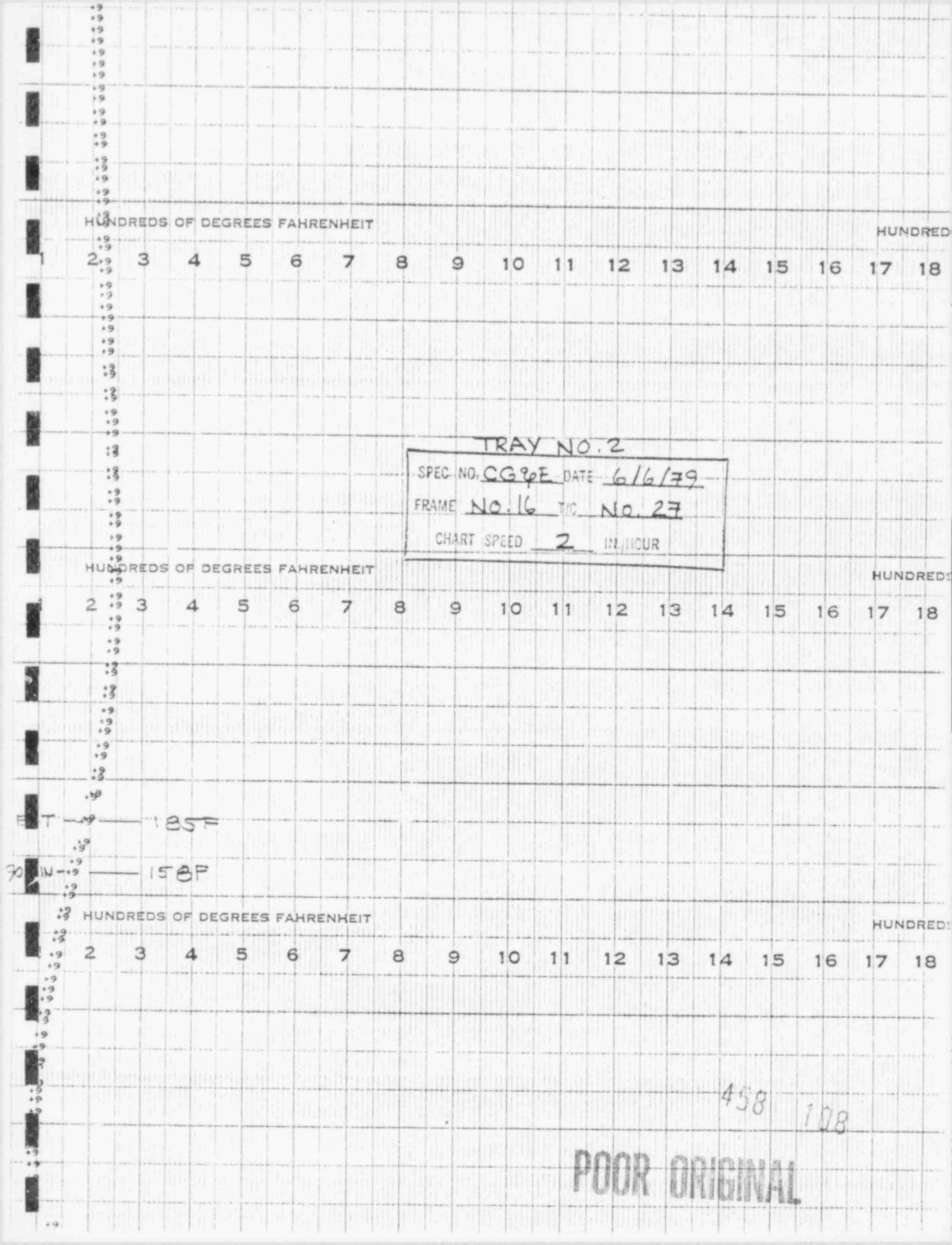
HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

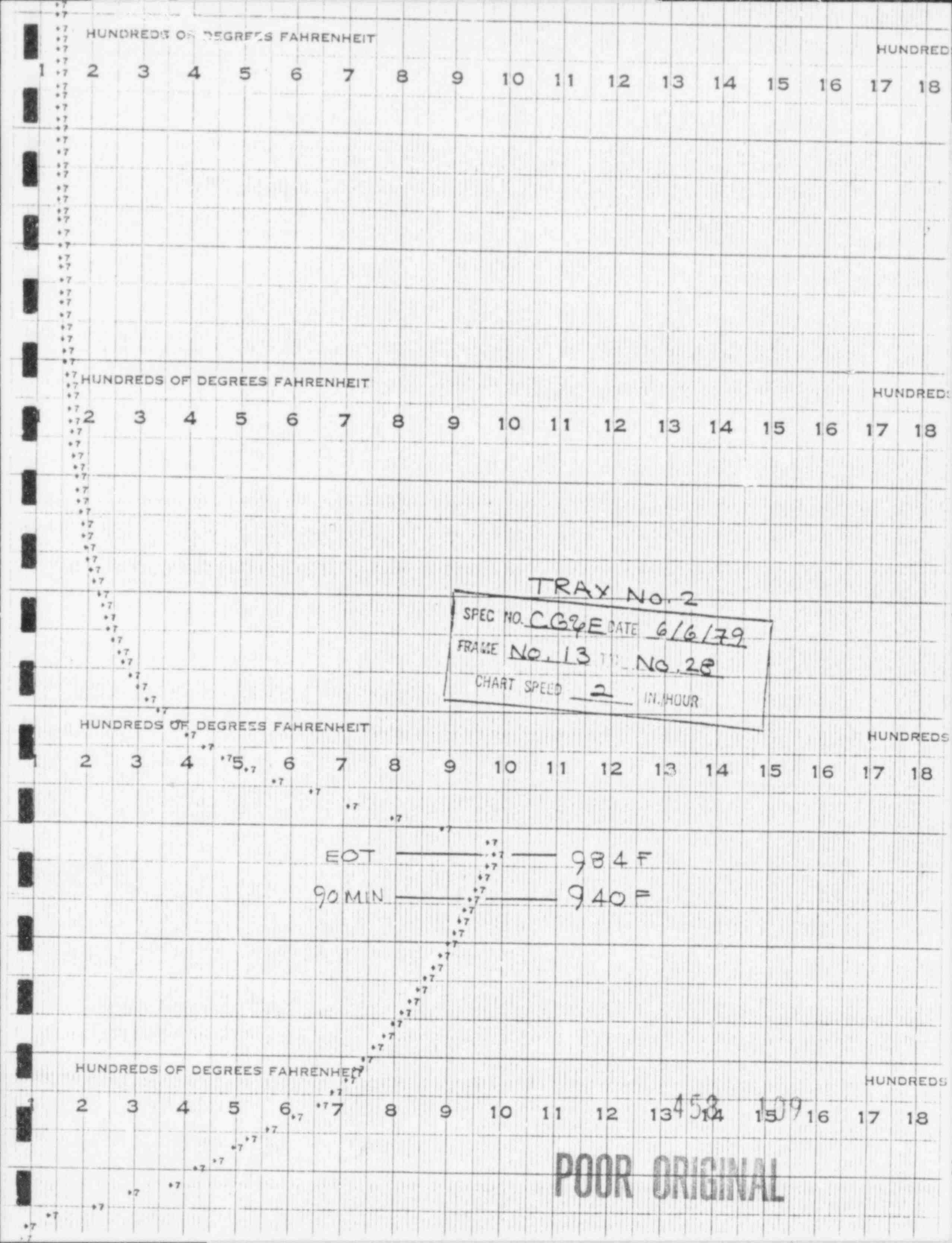
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458 107

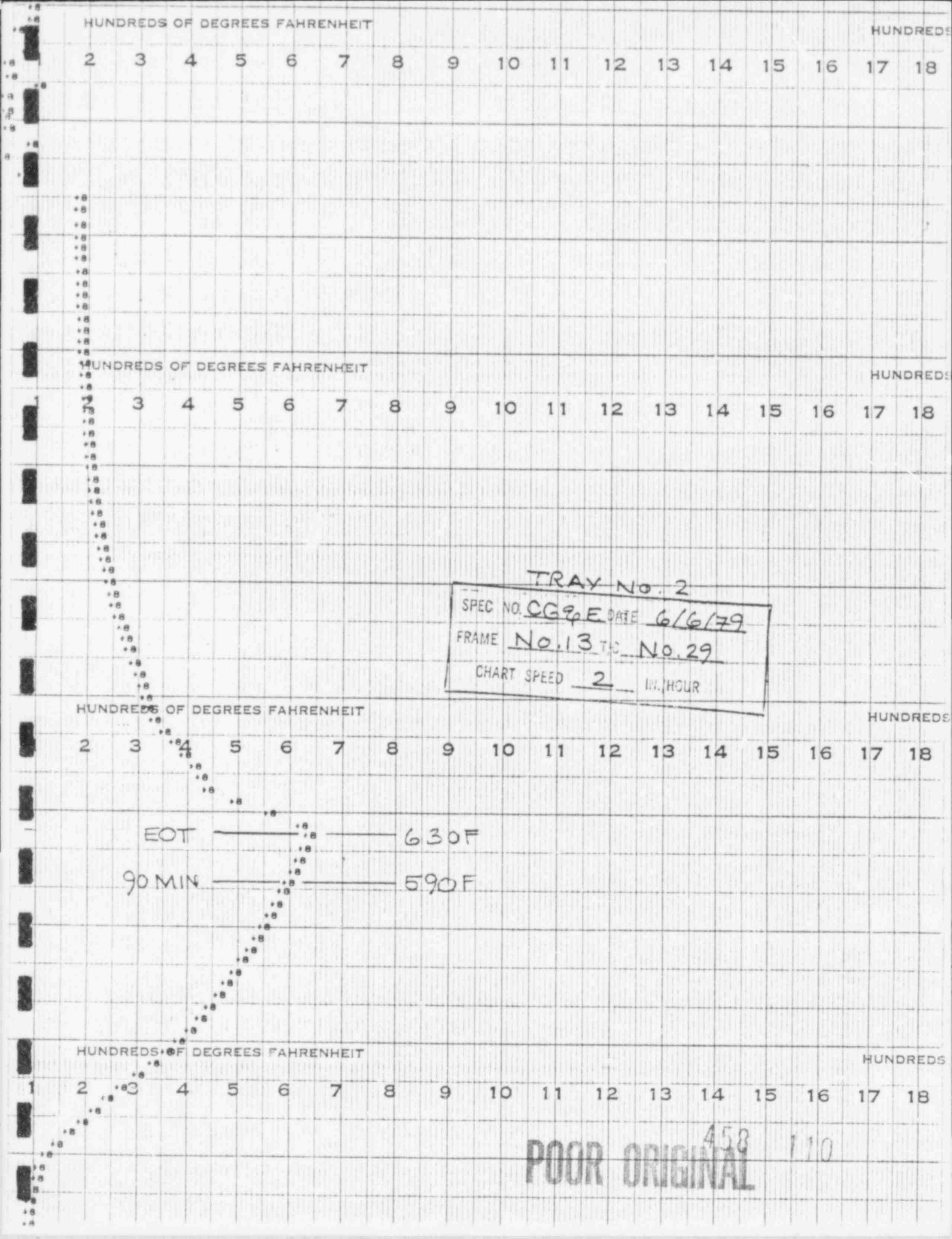
POOR ORIGINAL

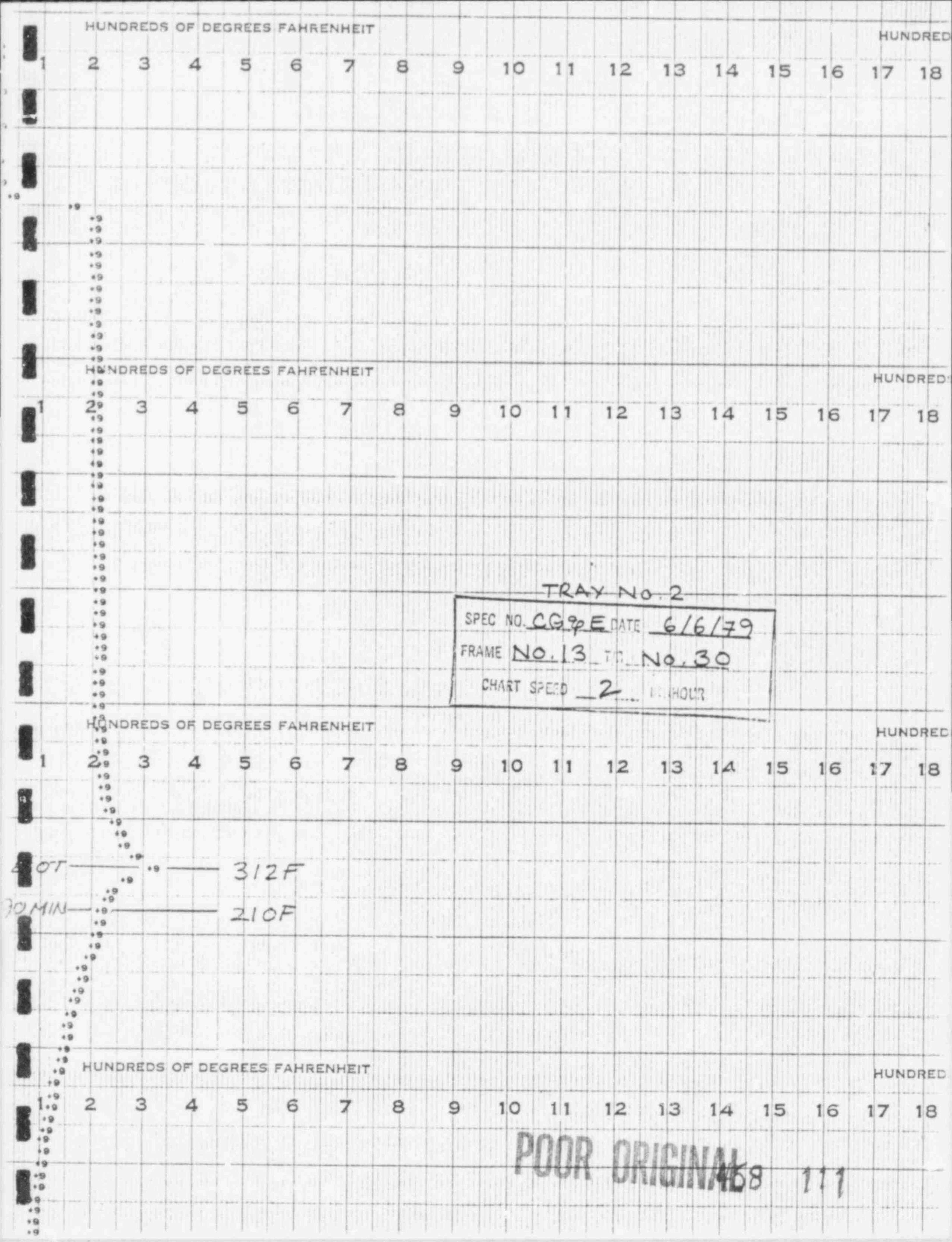


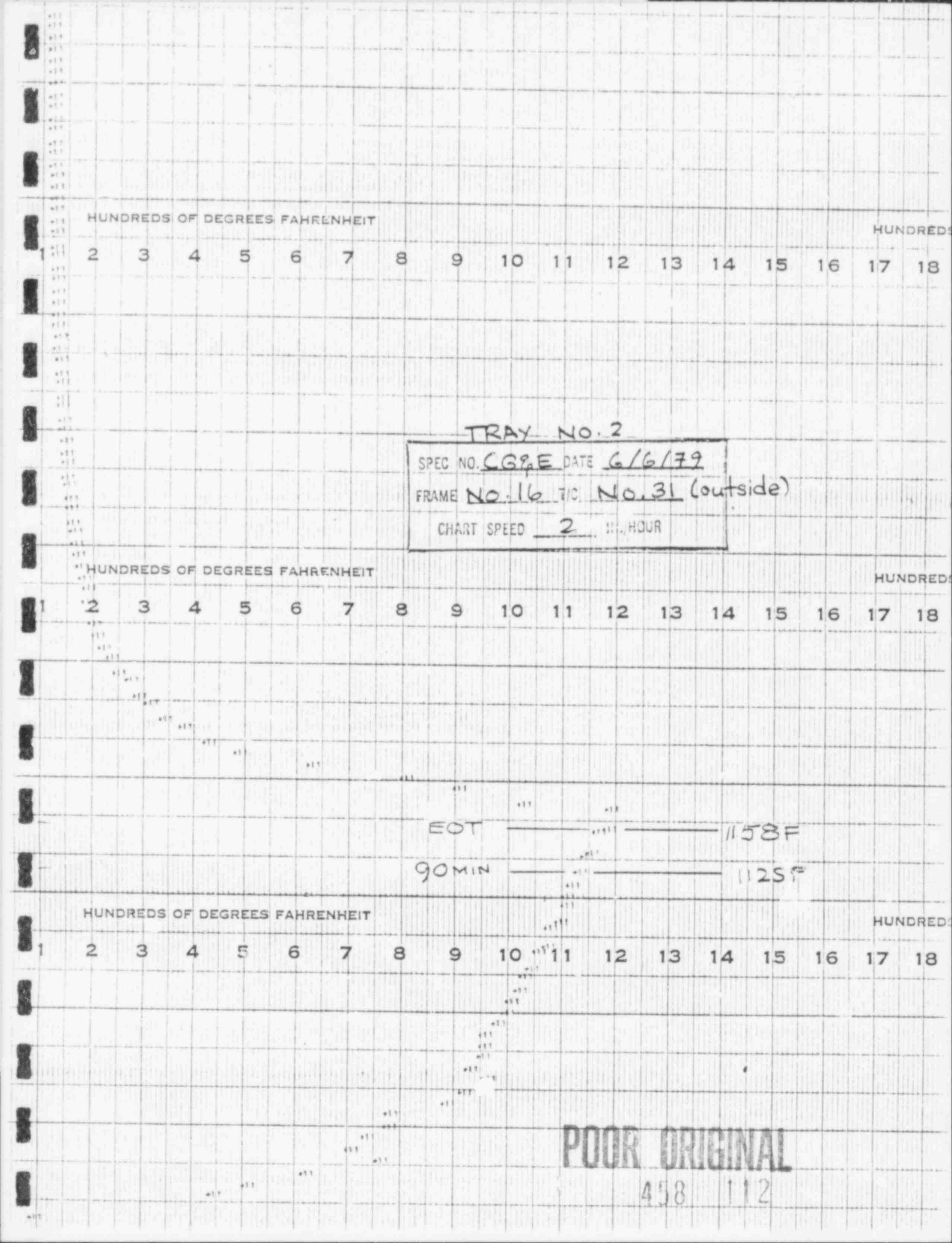
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 2
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 16 T/C NO. 27
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
T — 185F
IN — 158F
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
458 108
POOR ORIGINAL



HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 2
SPEC NO. CG4E DATE 6/6/79
FRAME No. 13 TTL No. 28
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT 984 F
90 MIN 940 F
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
453 109
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 2
SPEC NO. CG9E DATE 6/6/79
FRAME No. 13 TC No. 29
CHART SPEED 2 IN./HOUR
EOT 630F
90 MIN 590F
458 110


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 2
SPEC NO. CG&E DATE 6/6/79
FRAME No. 13 TO No. 30
CHART SPEED 2 HOUR
OT 312F
MIN 210F
POOR ORIGINAL
468 111


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 2
SPEC NO. CG&E DATE 6/6/79
FRAME No. 16 T/C No. 31 (outside)
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT 1158F
90MIN 1125F
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458 112

HUNDREDS OF DEGREES FAHRENHEIT HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY NO. 2

SPEC NO. CG9φE DATE 6/6/79

FRAME NO. 16 T/C NO. 32

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

— EOT —— 158F

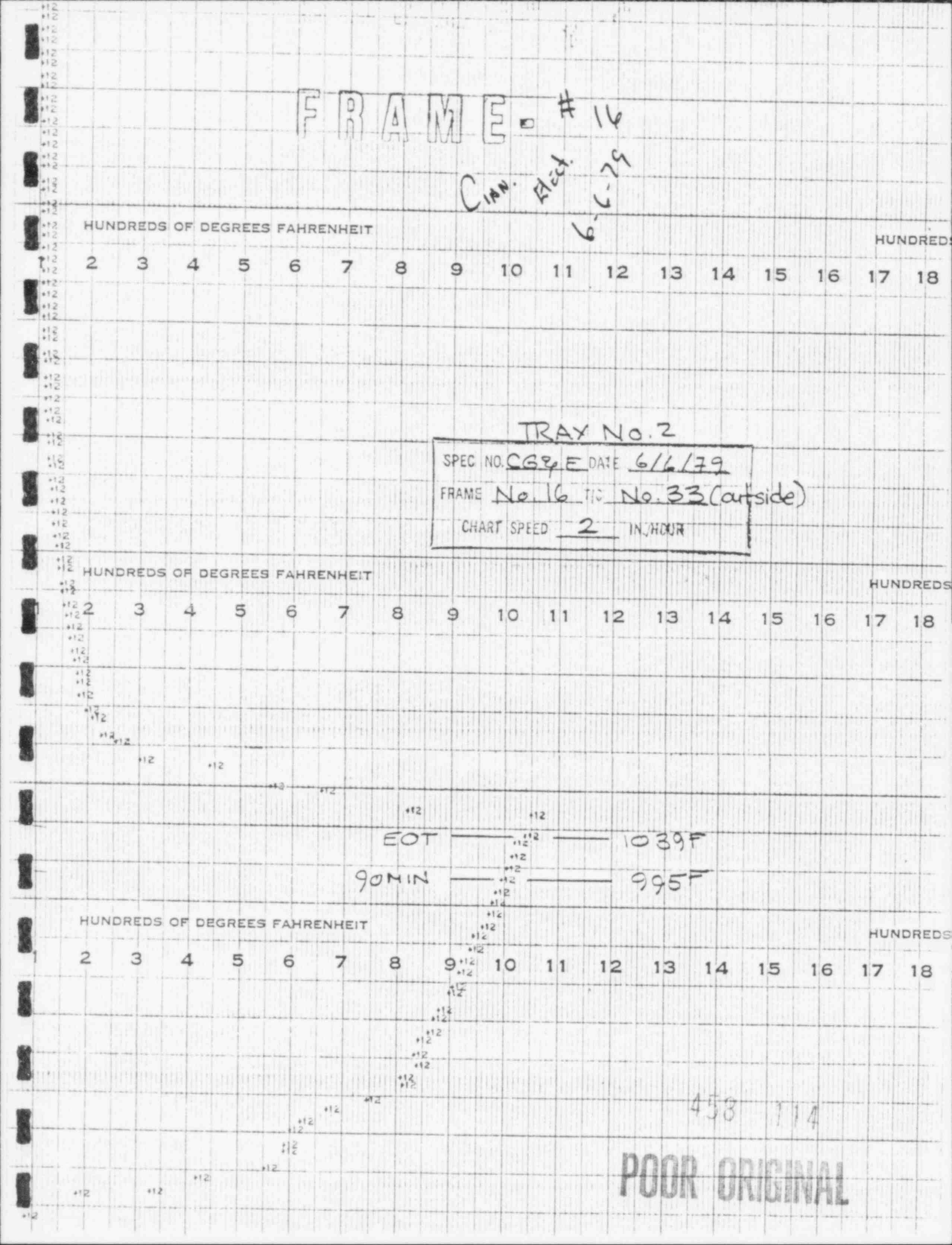
— 90 MIN —— 141 F

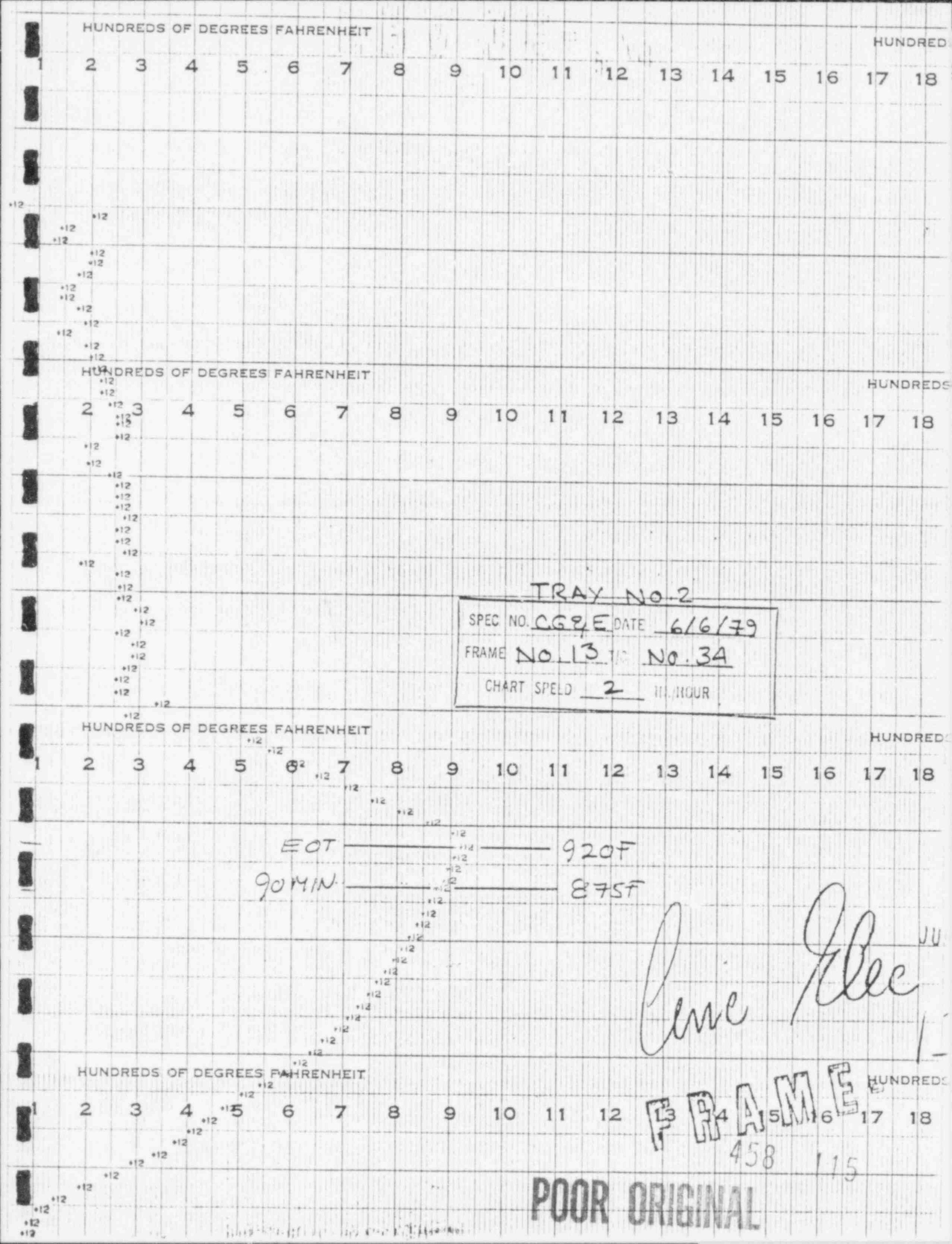
HUNDREDS OF DEGREES FAHRENHEIT HUNDREDS

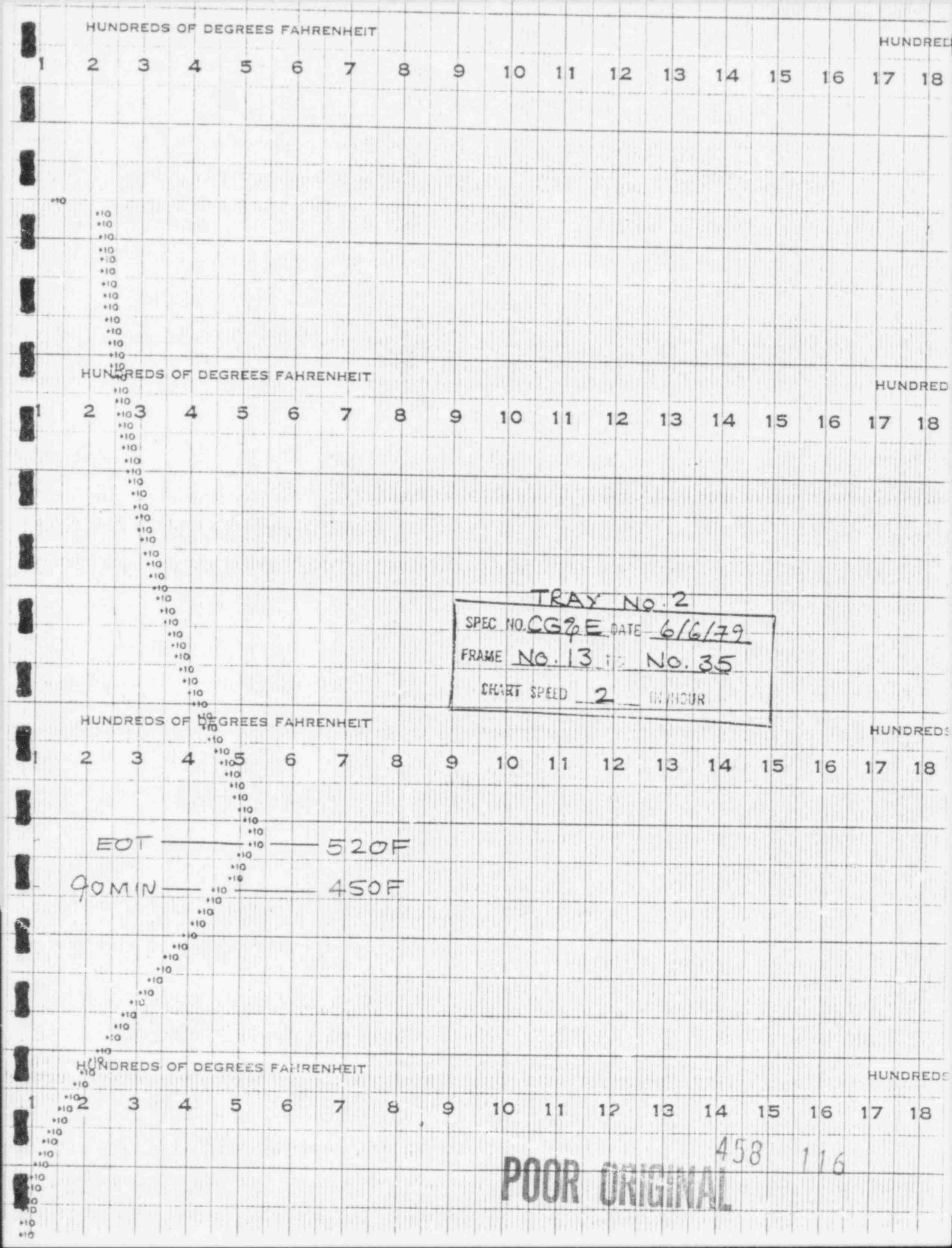
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

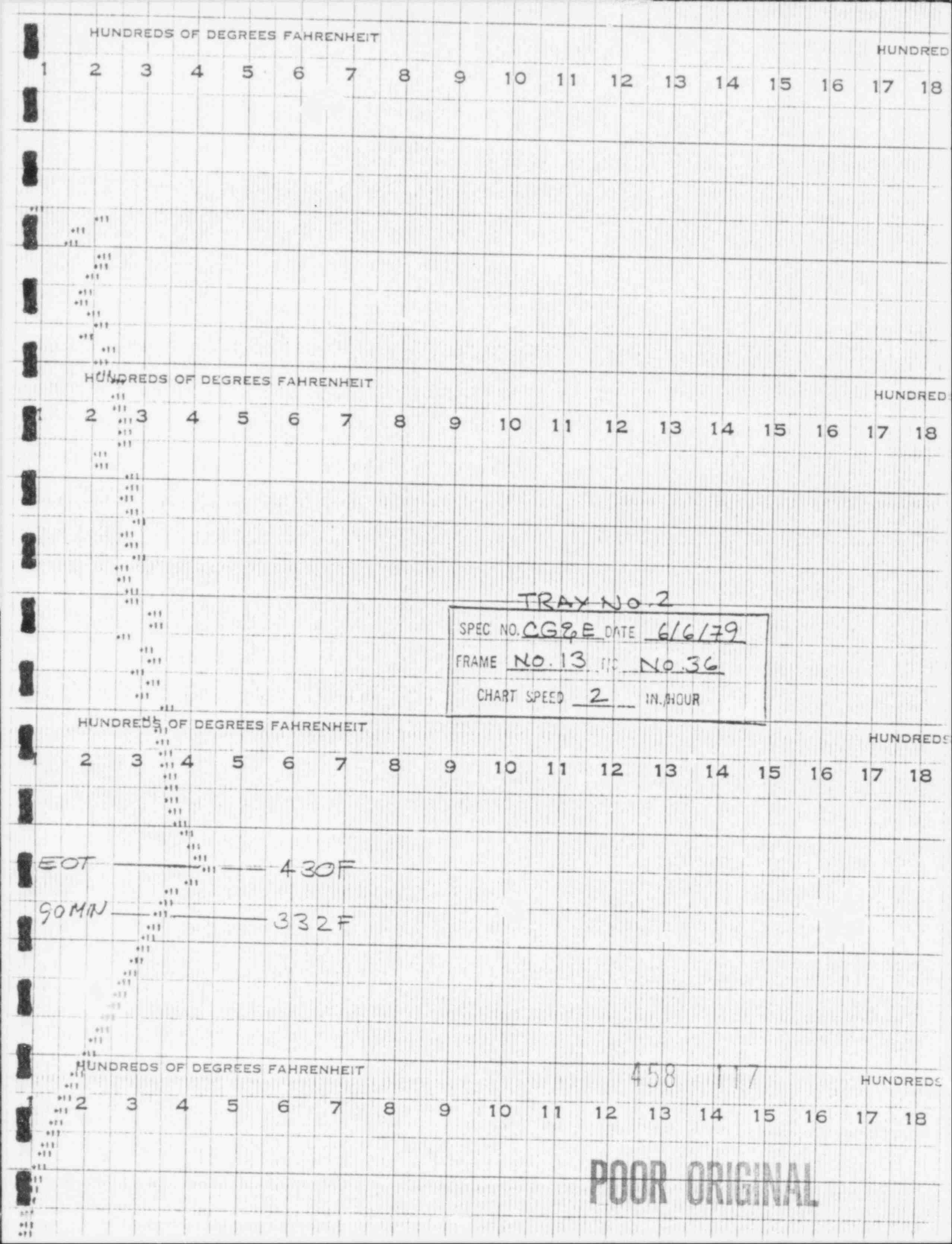
POOR ORIGINAL

438 113


FRAME - # 16
Cian. Elect.
6-6-79
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 2
SPEC NO. CG&E DATE 6/6/79
FRAME No. 16 T/C No. 33 (outside)
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT — 1039F
90MIN — 995F
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
458 114
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO 2
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 13 NO. 34
CHART SPEED 2
EOT 920F
90MIN 875F
FRAME
458 115
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 2
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 13 TO No. 35
CHART SPEED 2 IN/HOUR
EOT 520F
90MIN 450F
POOR ORIGINAL
458 116


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 2
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 13 T/C NO. 36
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT — 430F
90 MIN — 332F
HUNDREDS OF DEGREES FAHRENHEIT
458 117
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
POOR ORIGINAL

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY NO. 3

SPEC NO. CG&E DATE 6/6/79

FRAME NO. 9 T/C NO. 37

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

— EOT — 100F

— 90 MIN — 98F

Cinc. Elec FR

JUN 6 1979

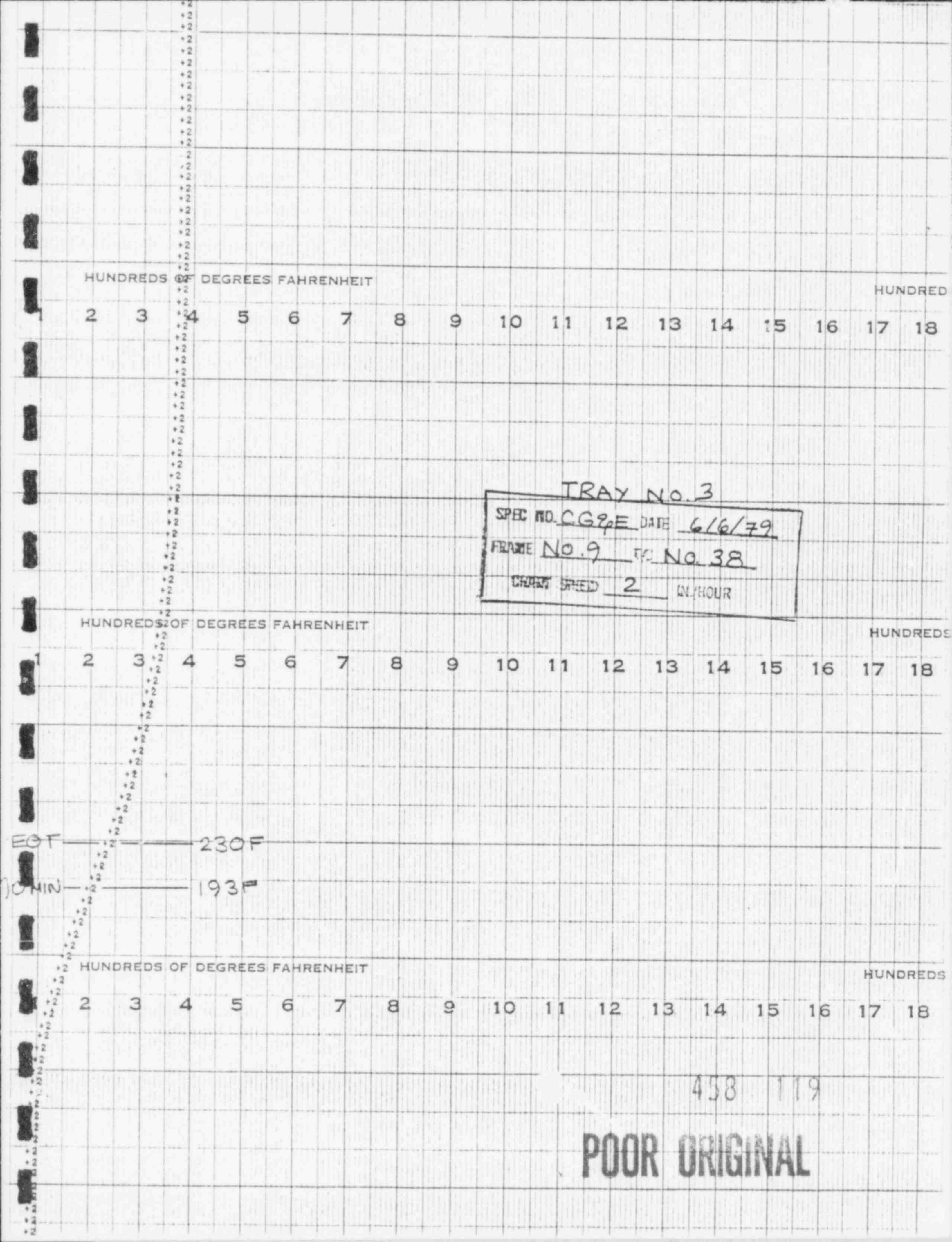
HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

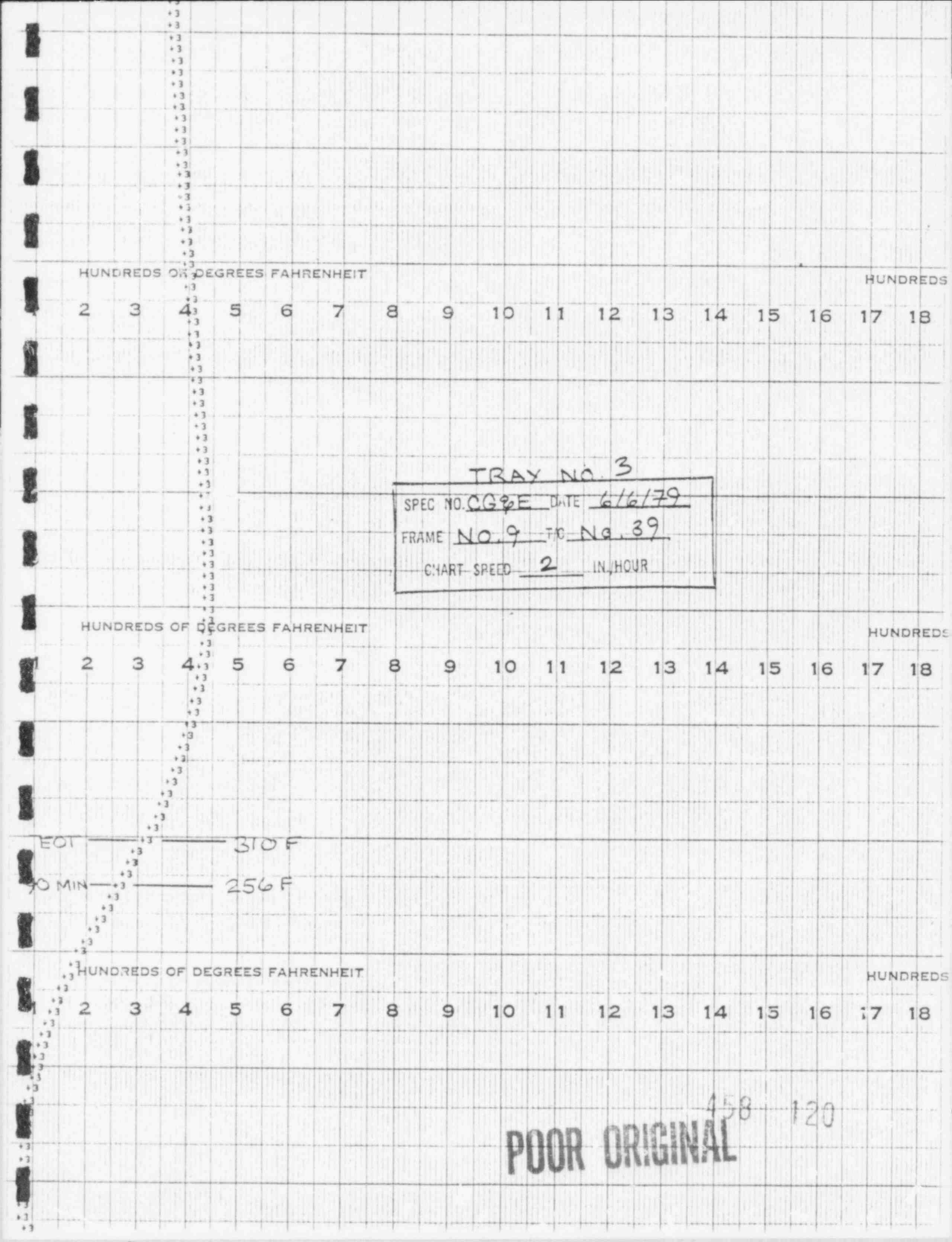
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

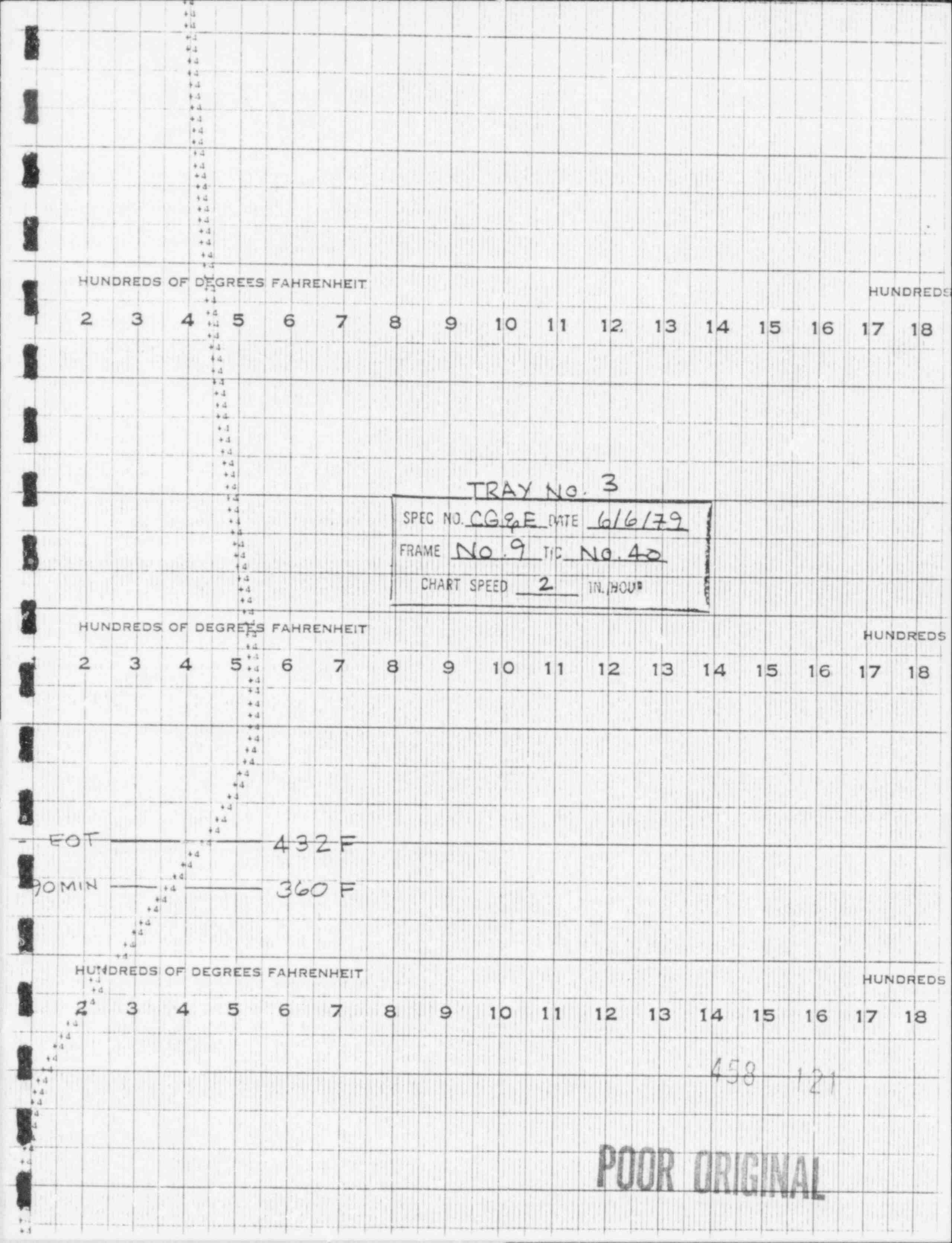
458 118

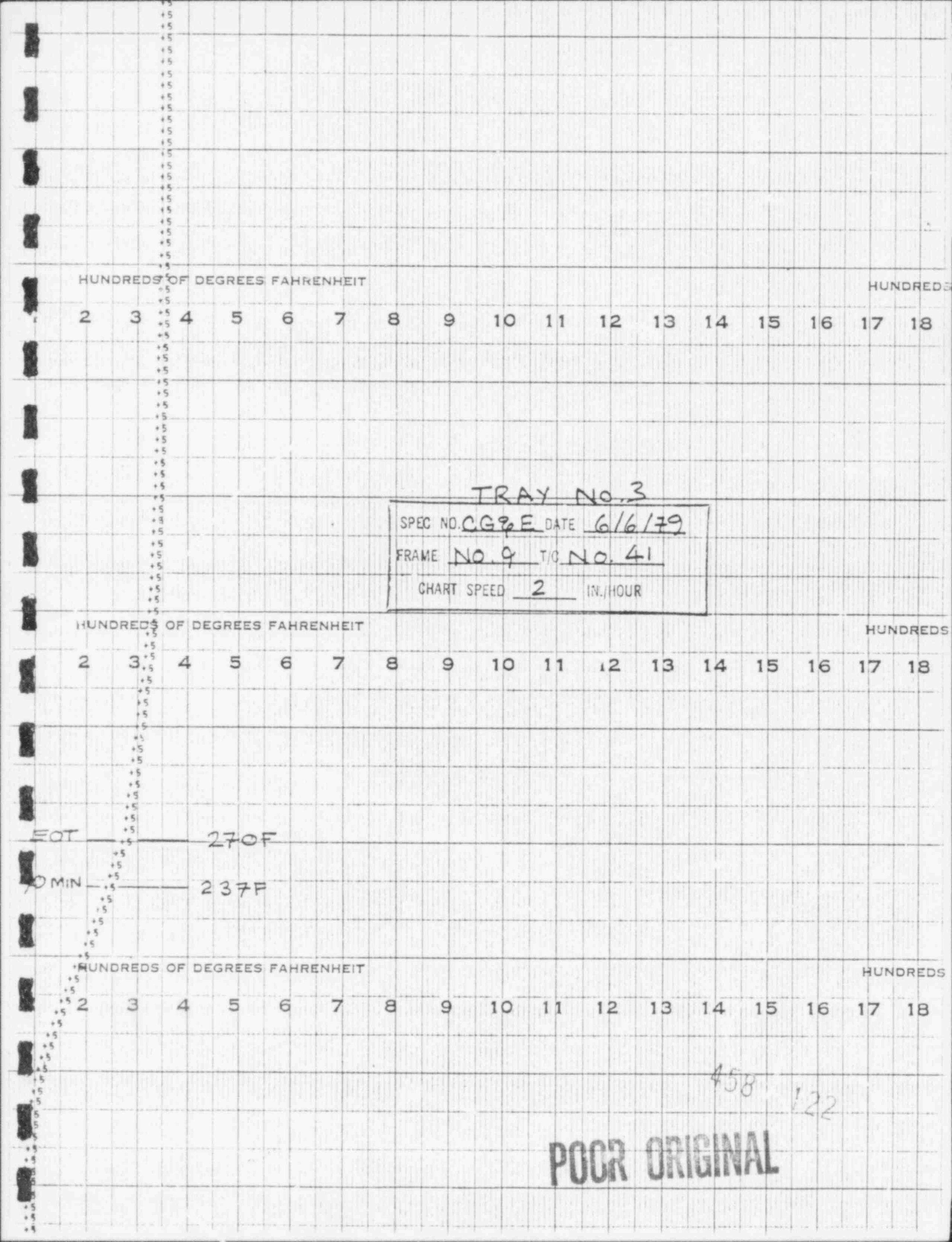
POOR ORIGINAL

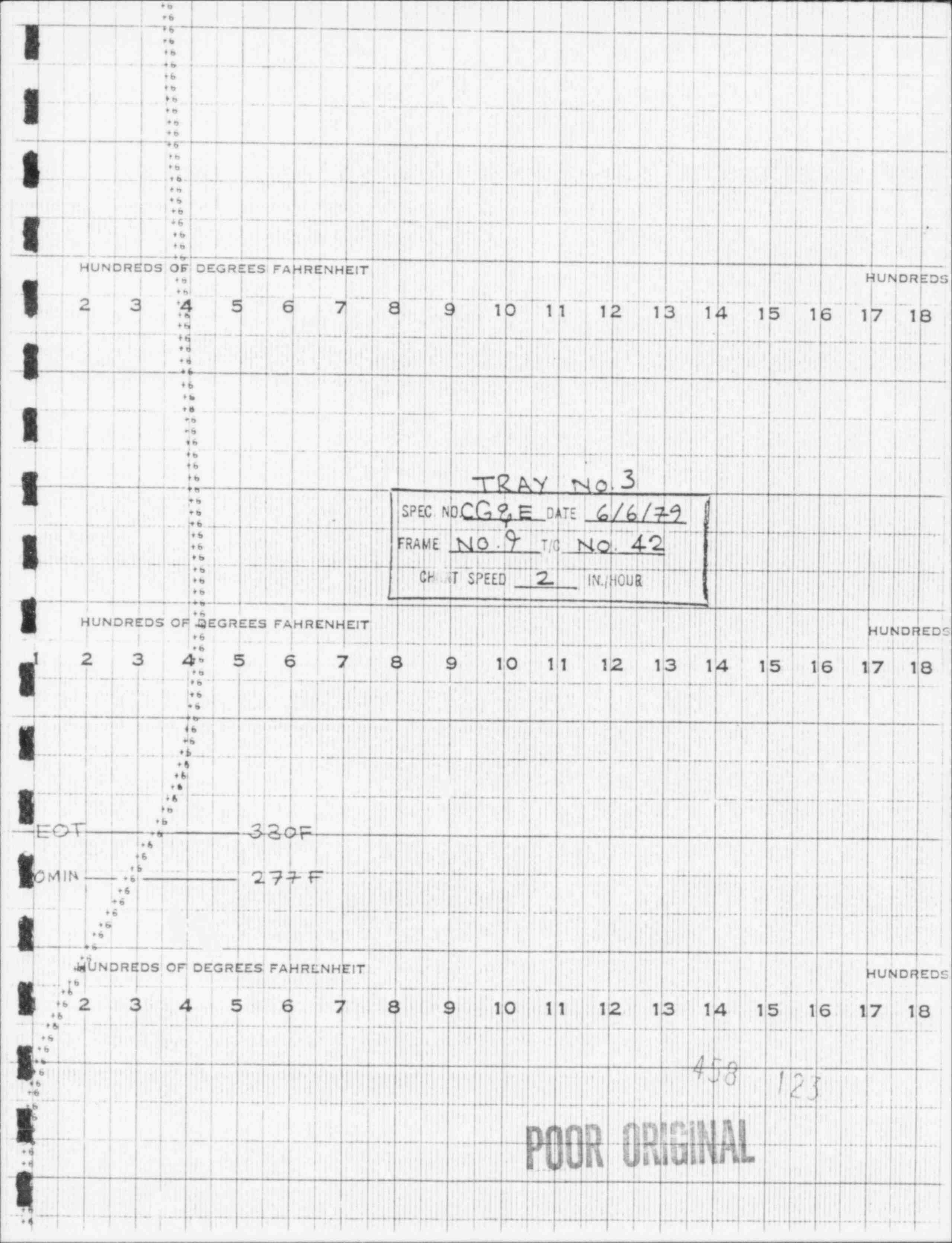


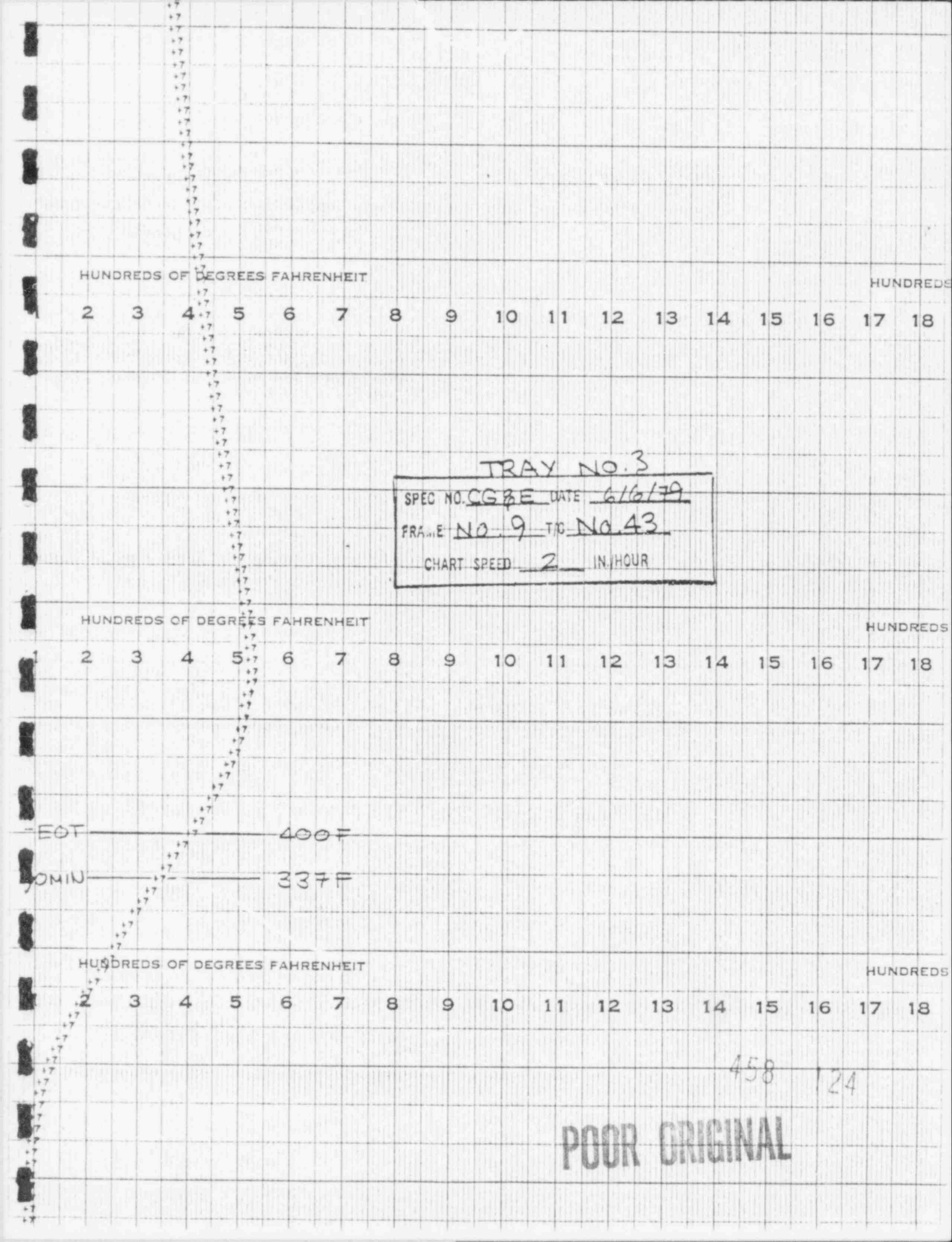
HUNDREDS OF DEGREES FAHRENHEIT
HUNDRED
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 3
SPEC NO. CG&E DATE 6/6/79
FRAME No. 9 TC No. 38
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT 230F
10 MIN 193F
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
458 119
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
TRAY NO. 3
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 9 T/C No. 39
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
EOT 310 F
70 MIN 256 F
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
458 120
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
TRAY NO. 3
SPEC NO. CG&E DATE 6/6/79
FRAME No. 9 T/C No. 40
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
EOT 432 F
90 MIN 360 F
HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
458 121
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS
TRAY NO. 3
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 9 T/C NO. 41
CHART SPEED 2 IN./HOUR
EOT 270F
MIN 237F
458
122
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 3
SPEC. NO. CG&E DATE 6/6/79
FRAME NO. 9 T/C NO. 42
CHART SPEED 2 IN./HOUR
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
EOT 330F
0MIN 277F
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
458 123



POOR ORIGINAL

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY NO. 3

SPEC NO. CG9E DATE 6/6/79

FRAME No. 9 T/C No. 44

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

EOT — 101 F

90 MIN — , 0 F

HUNDREDS OF DEGREES FAHRENHEIT

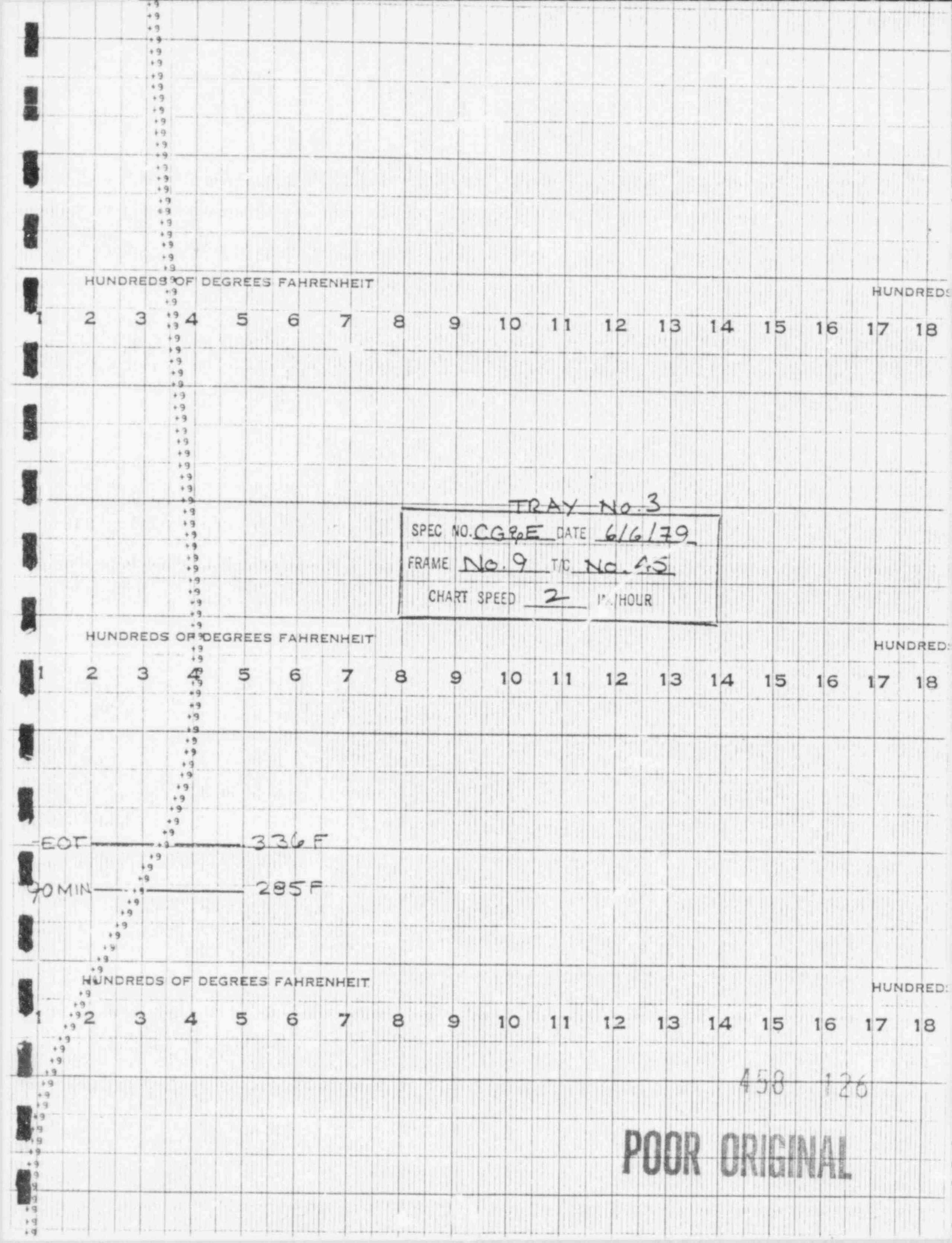
HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458

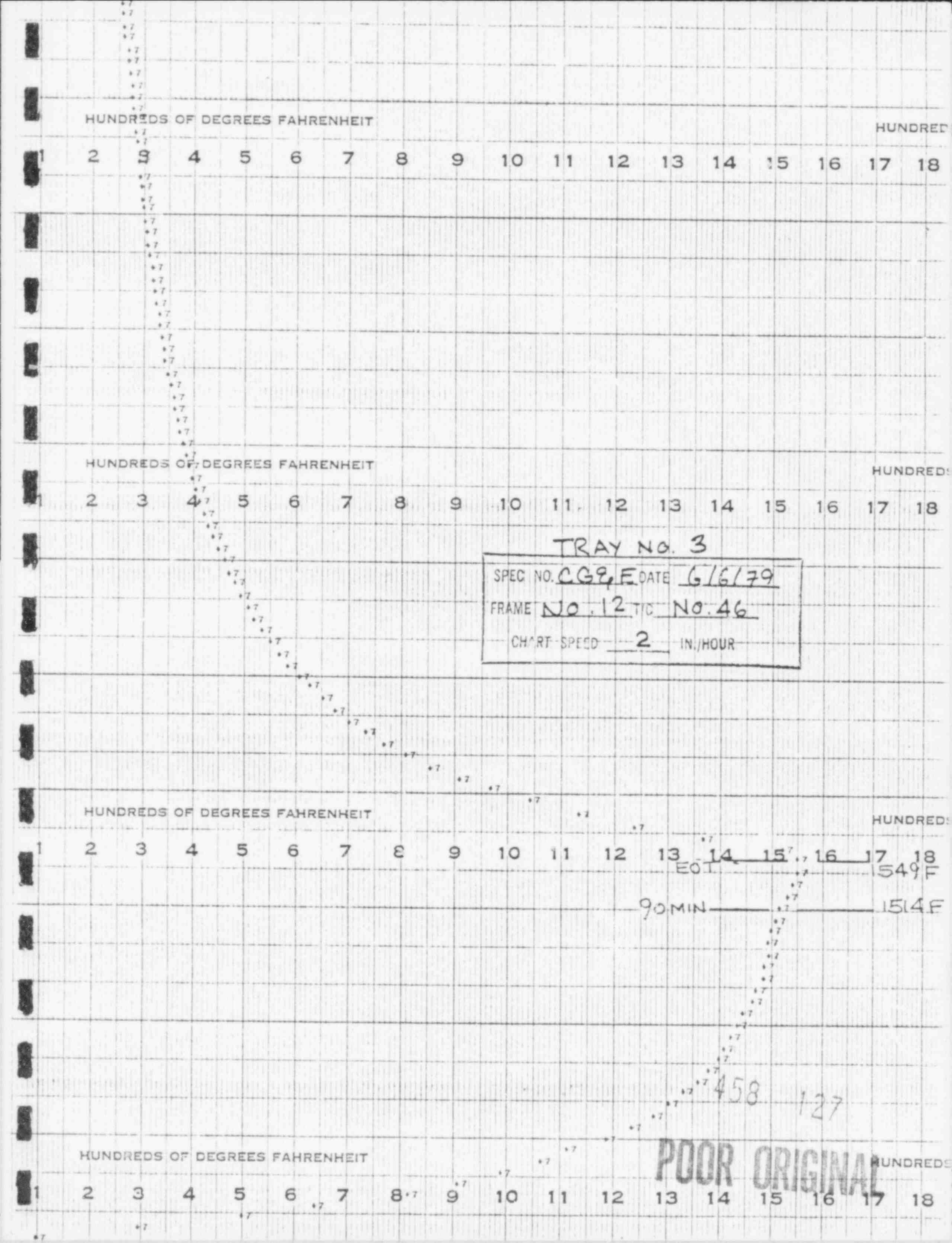
125

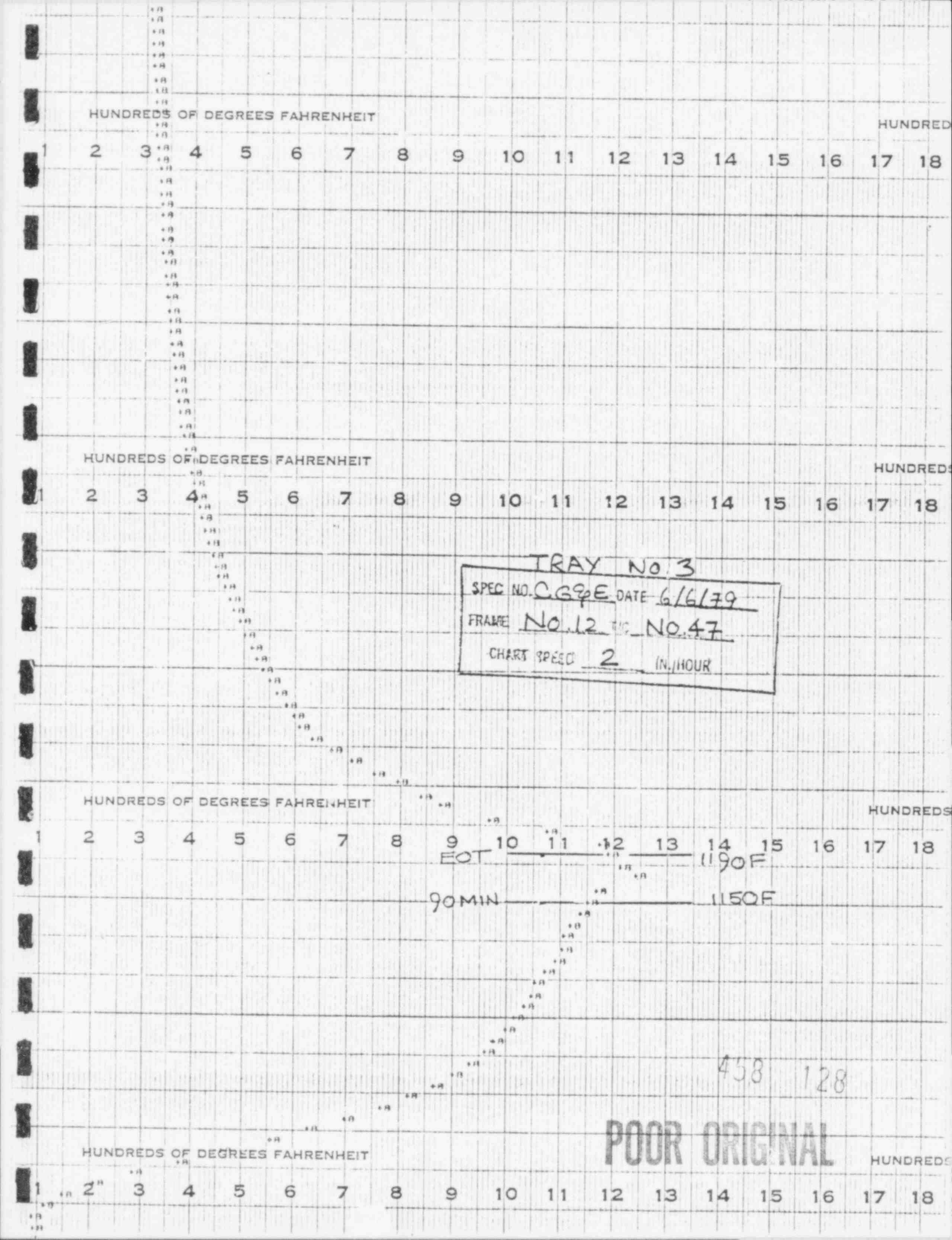
POOR ORIGINAL

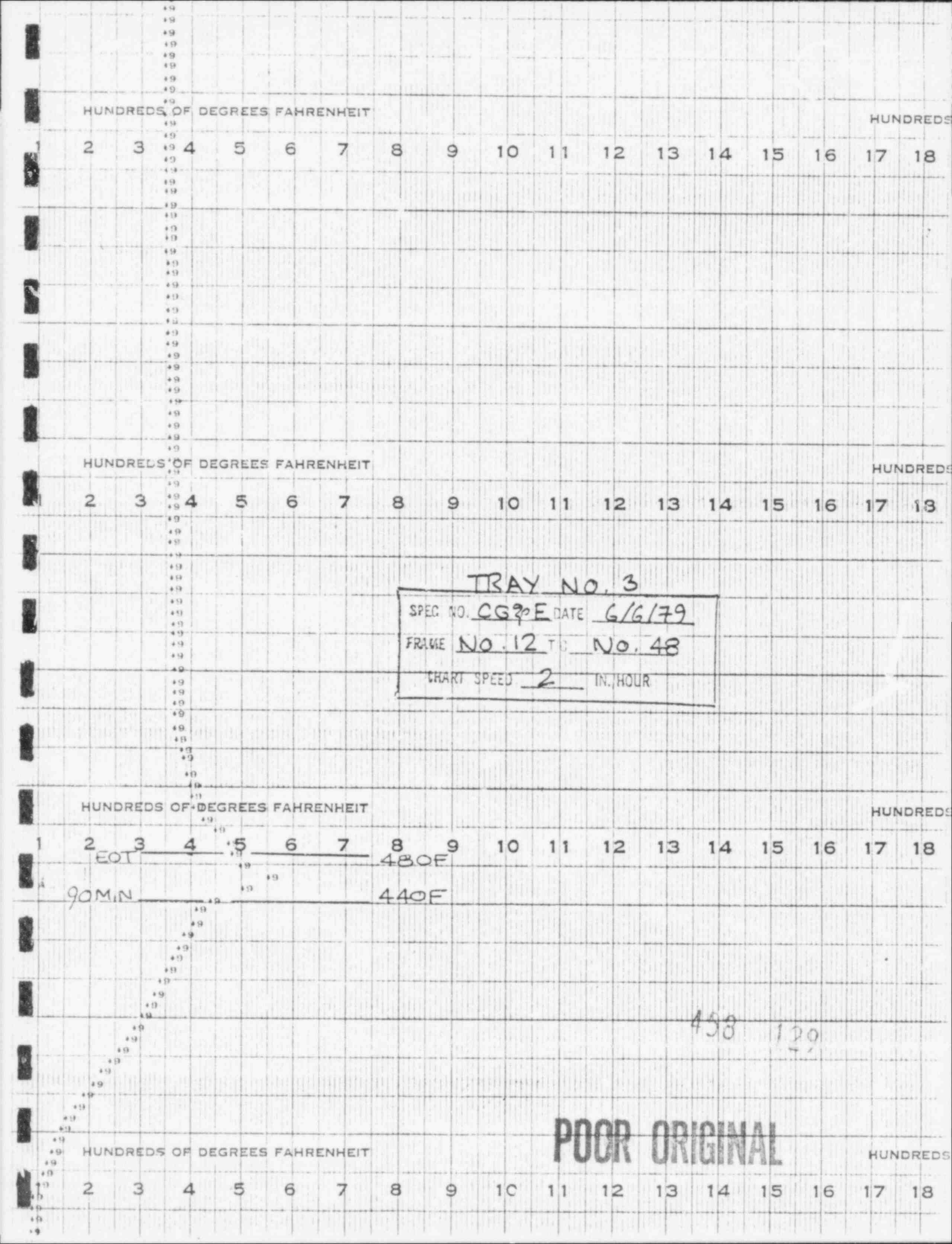


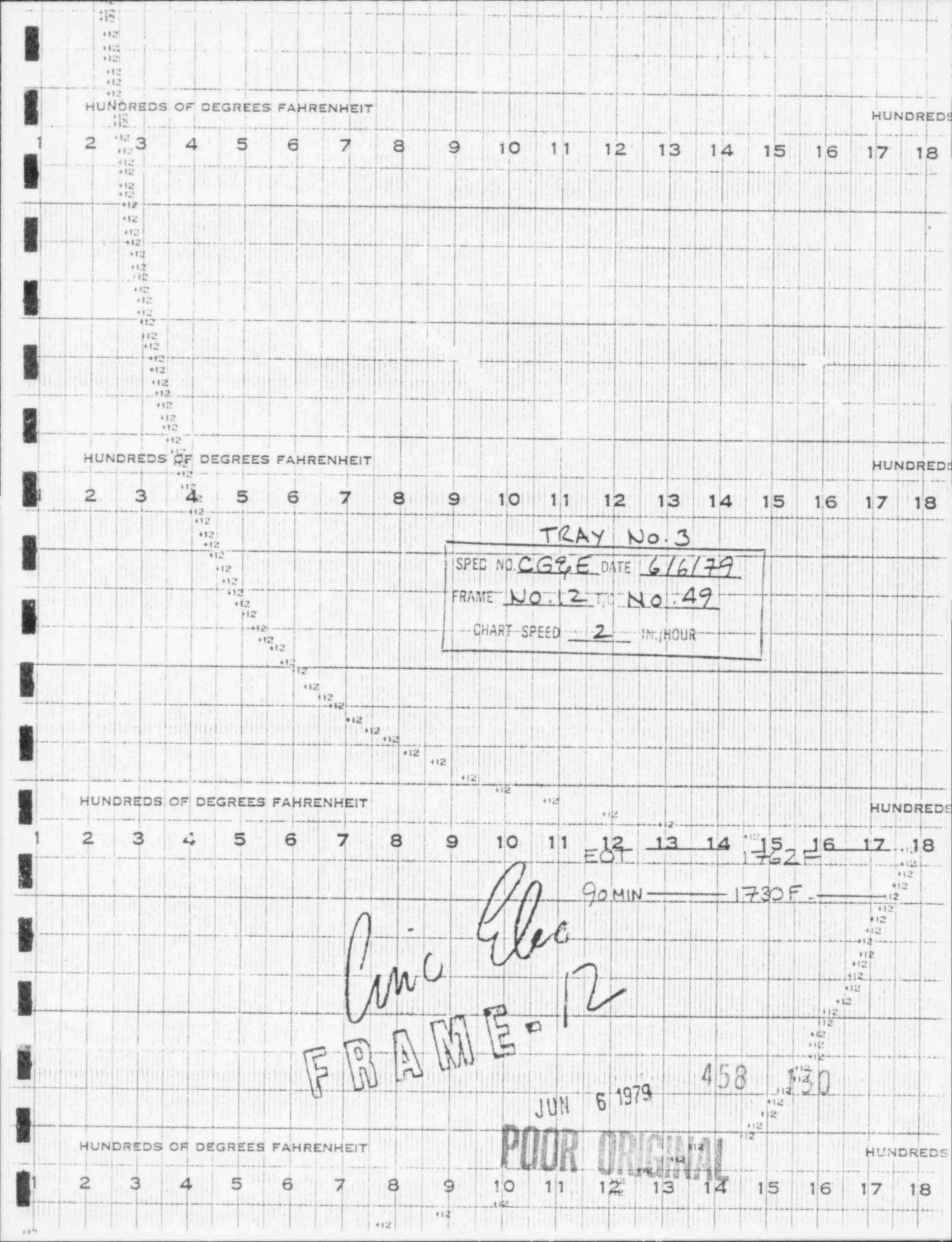
458 126

POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 3
SPEC NO. CG9,F DATE 6/6/79
FRAME NO. 12 T/C NO. 46
CHART SPEED 2 IN./HOUR
EOT 1549 F
90 MIN 1514 F
458
127
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO 3
SPEC NO. CG&E DATE 6/6/79
FRAME NO.12 T/C NO.47
CHART SPEED 2 IN./HOUR
EOT 1190F
90MIN 1150F
458 128
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 3
SPEC NO. CG90E DATE 6/6/79
FRAME NO. 12 TC NO. 48
CHART SPEED 2 IN./HOUR
EOT 480F
90MIN 440F
498 129
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 3
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 12 T.C. NO. 49
CHART SPEED 2 IN./HOUR
EOT 1762F
90 MIN 1730F
Cinc Elec
FRAME-12
JUN 6 1979
458 130
POOR ORIGINAL

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY NO. 3

SPEC NO. CG&E DATE 6/6/79

FRAME No. 9 T/C No. 50

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

—EOT— 100F

—90MIN—98F

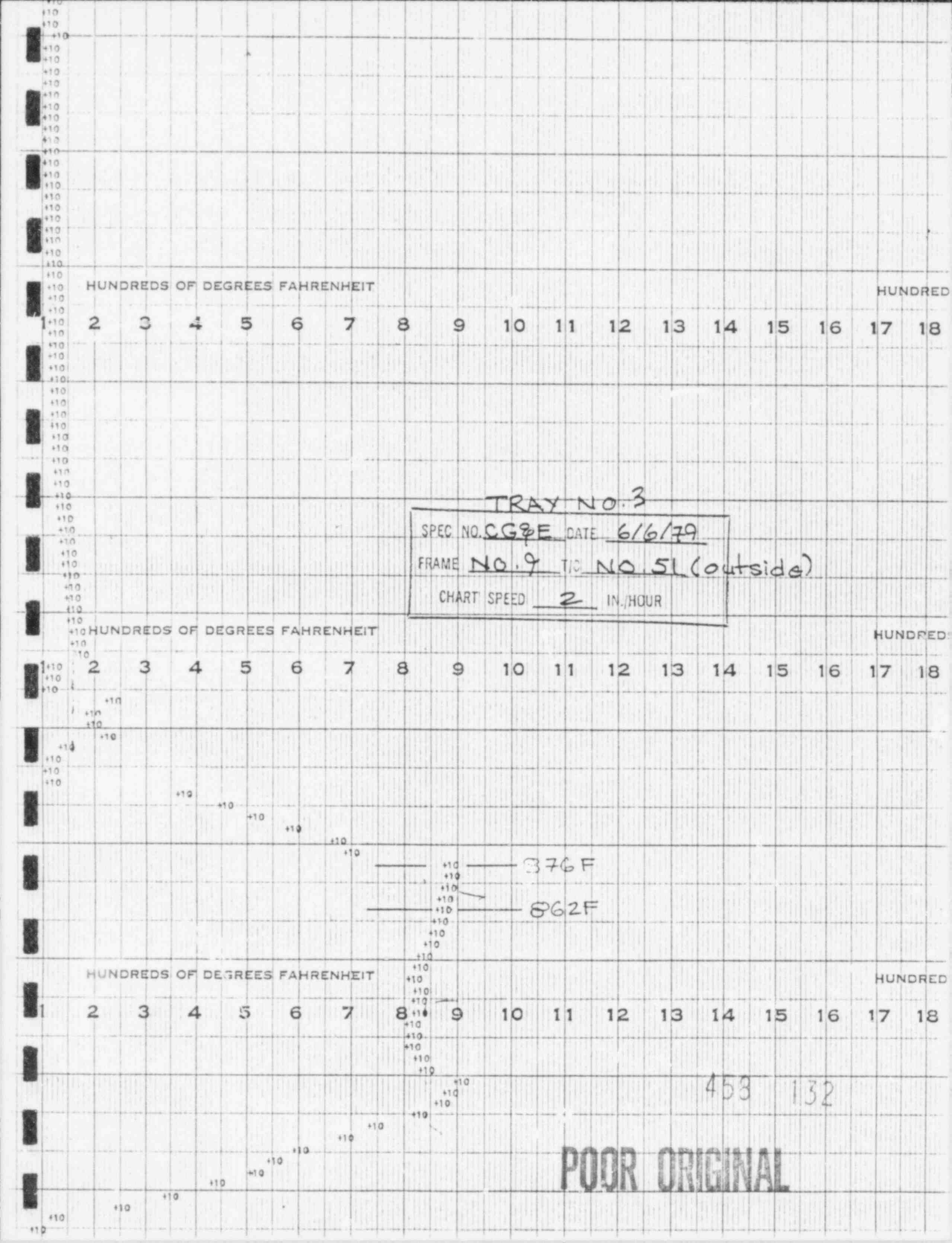
HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458 131

POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 3
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 9 T/C NO. 51 (outside)
CHART SPEED 2 IN./HOUR
876F
862F
458 132
POOR ORIGINAL

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY No. 3

SPEC NO. CG9φE DATE 6/6/79

FRAME No. 9 T/C No. 52 (outside)

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

— EOT — 102F

— 90MIN — 100F

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

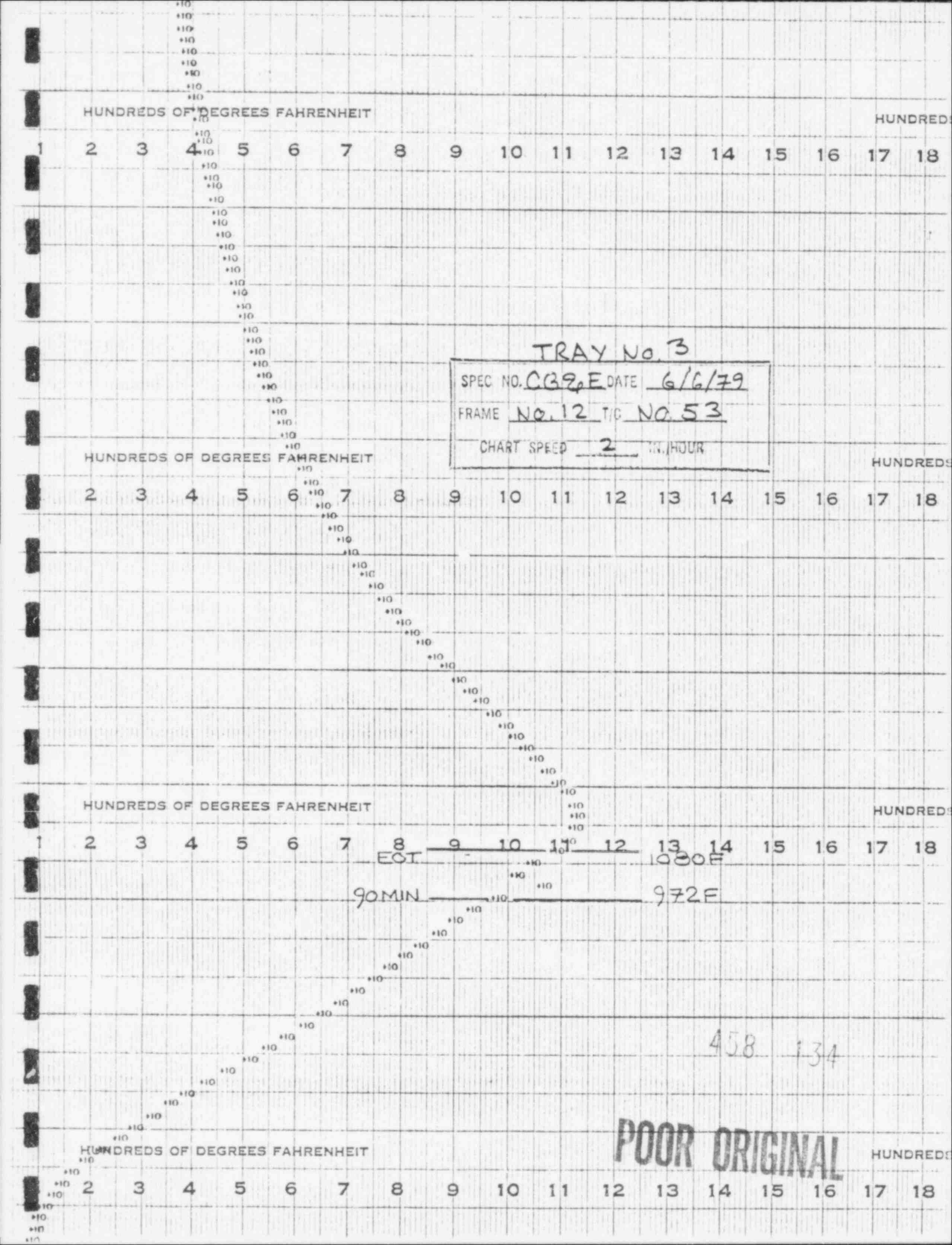
Cinc-Elec

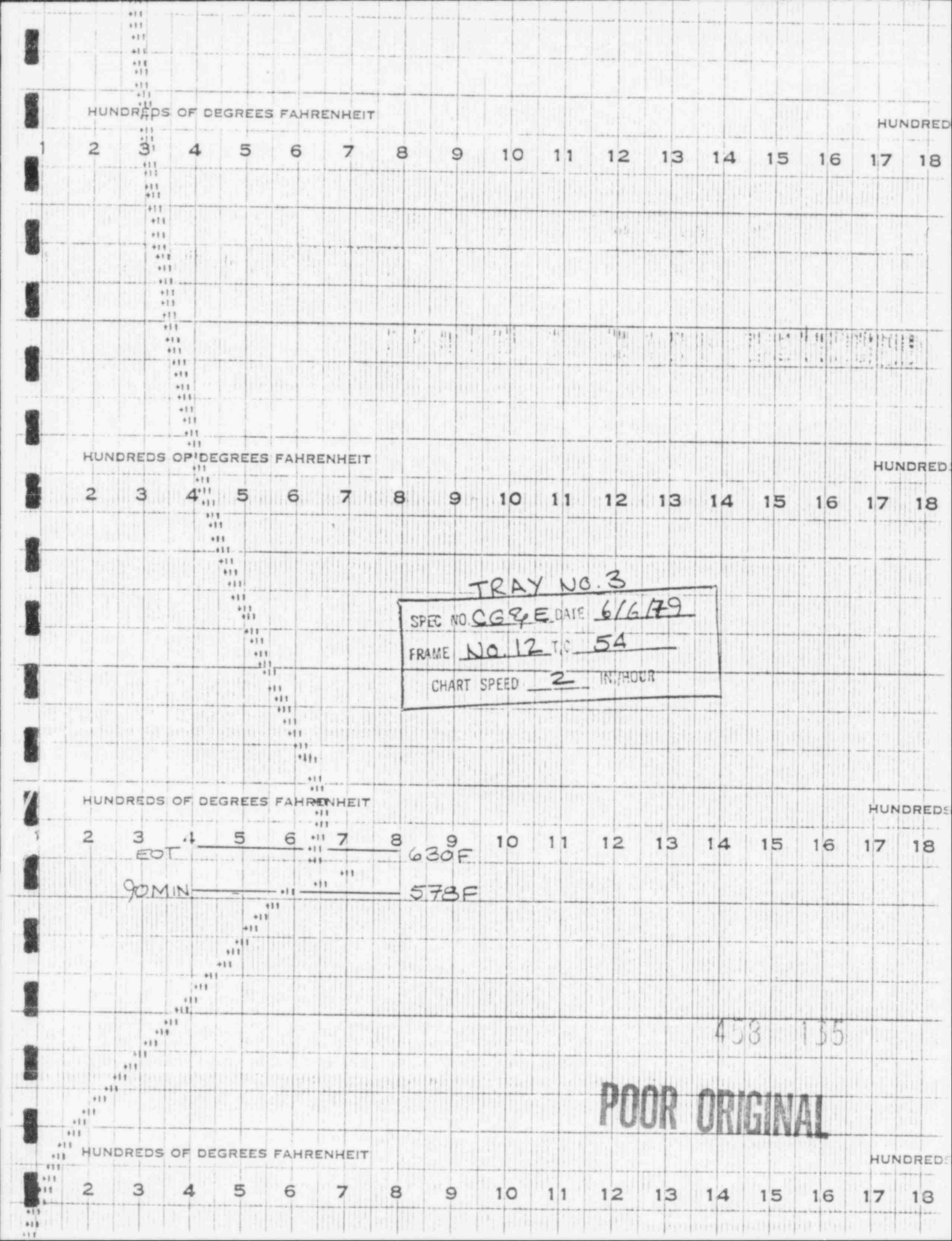
4?8 133

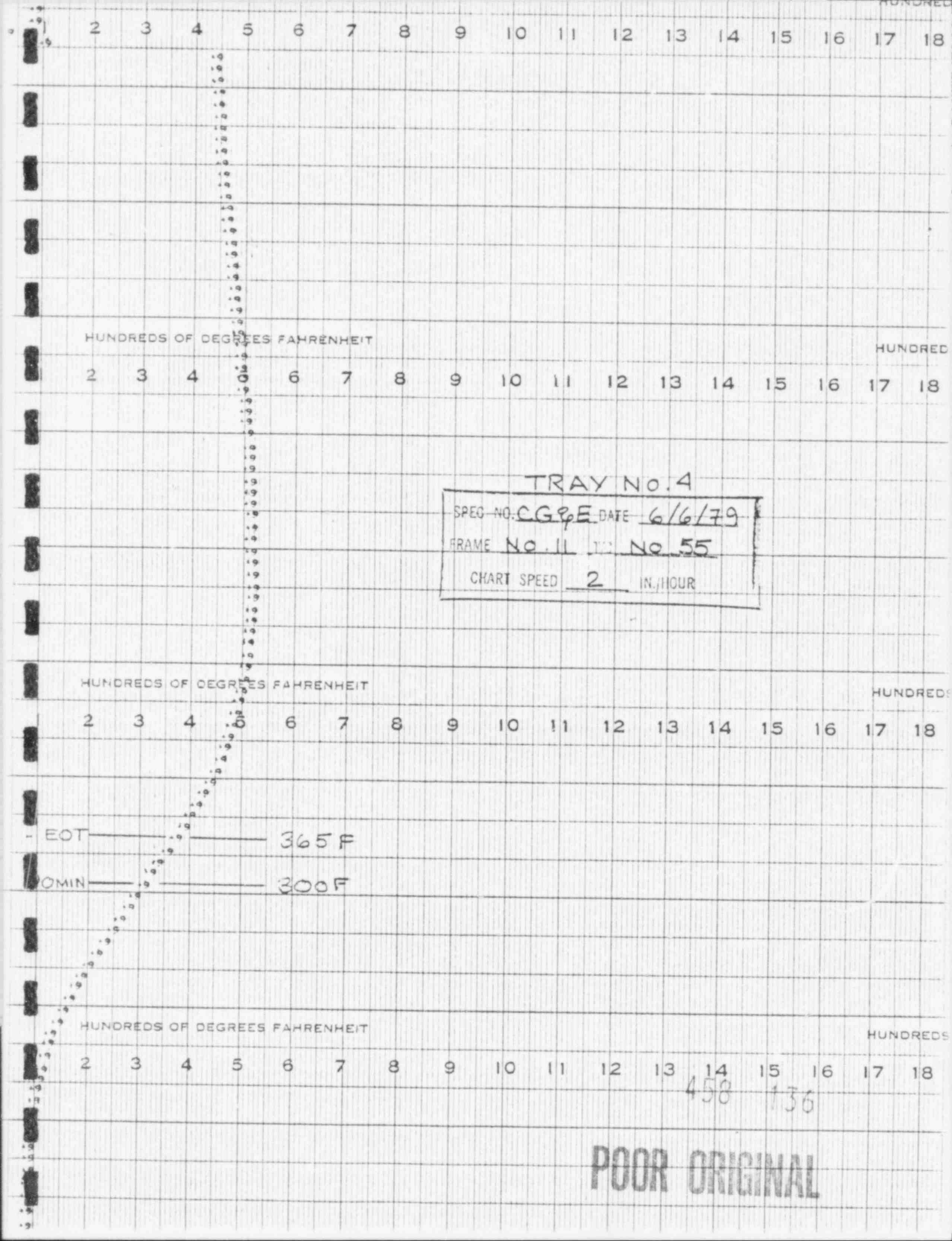
POOR ORIGINAL

JUN 6 1979

FRAME 9


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 3
SPEC NO. CG9-E DATE 6/6/79
FRAME No. 12 T/C No. 53
CHART SPEED 2 IN./HOUR
EOT 1080F
90 MIN 972F
458 134
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 3
SPEC NO. CG&E DATE 6/6/79
FRAME No. 12 T/C 54
CHART SPEED 2 IN/HOUR
EOT 630F
90MIN 578F
458 155
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 4
SPEC NO. CG&E DATE 6/6/79
FRAME No. 11 TO No. 55
CHART SPEED 2 IN./HOUR
EOT 365F
0 MIN 300F
458 136
POOR ORIGINAL

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

HUNDREDS OF DEGREES FAHRENHEIT

HUNDRED

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

TRAY NO. 4

SPEC NO. CG&E DATE 6/6/79

FRAME NO. 11 TO NO. 56

CHART SPEED 2 IN./HOUR

HUNDREDS OF DEGREES FAHRENHEIT

HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

— EOT — 200F

— 90MIN — 119F

JUN

Cinci. Elec

FRAME-11

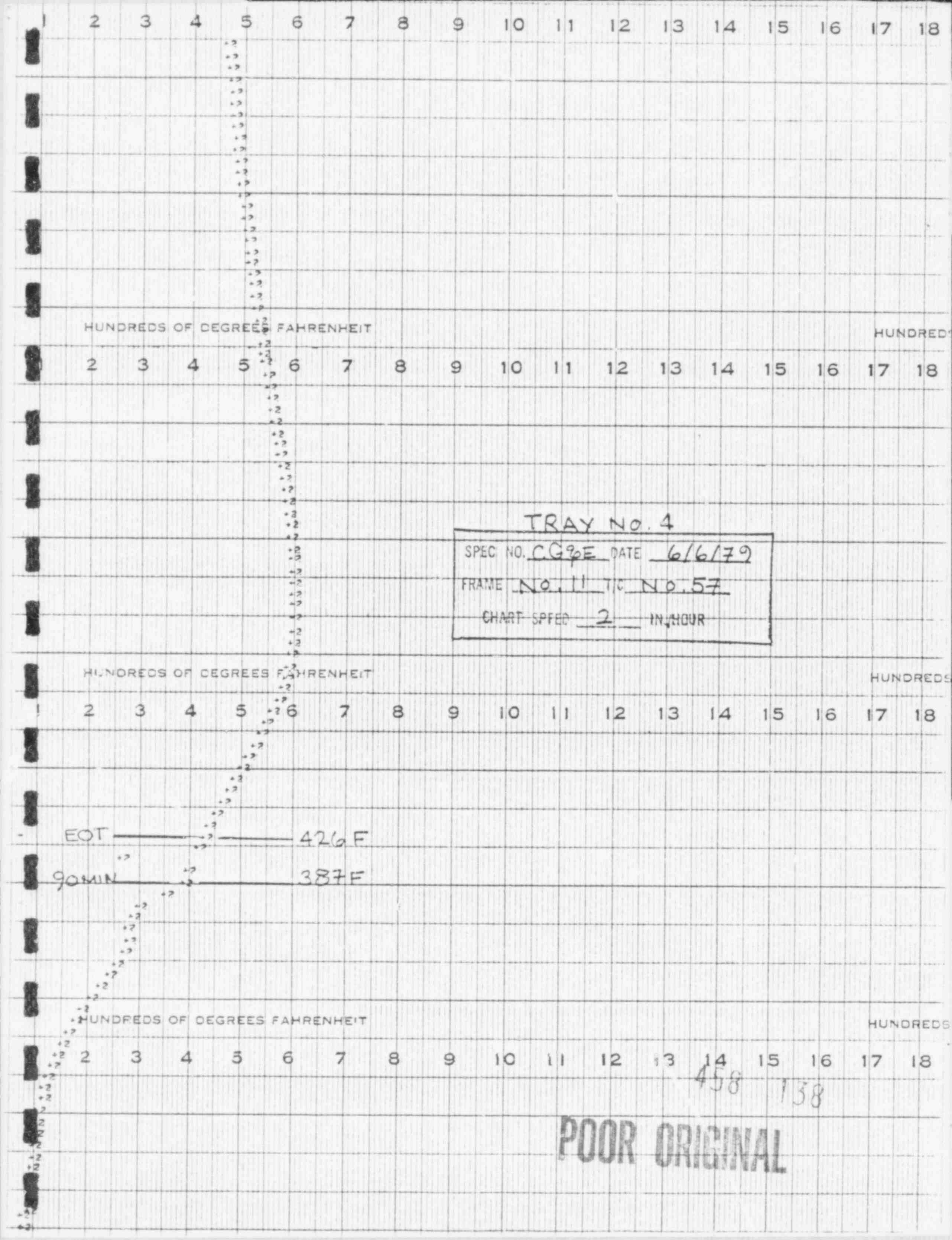
HUNDREDS OF DEGREES FAHRENHEIT

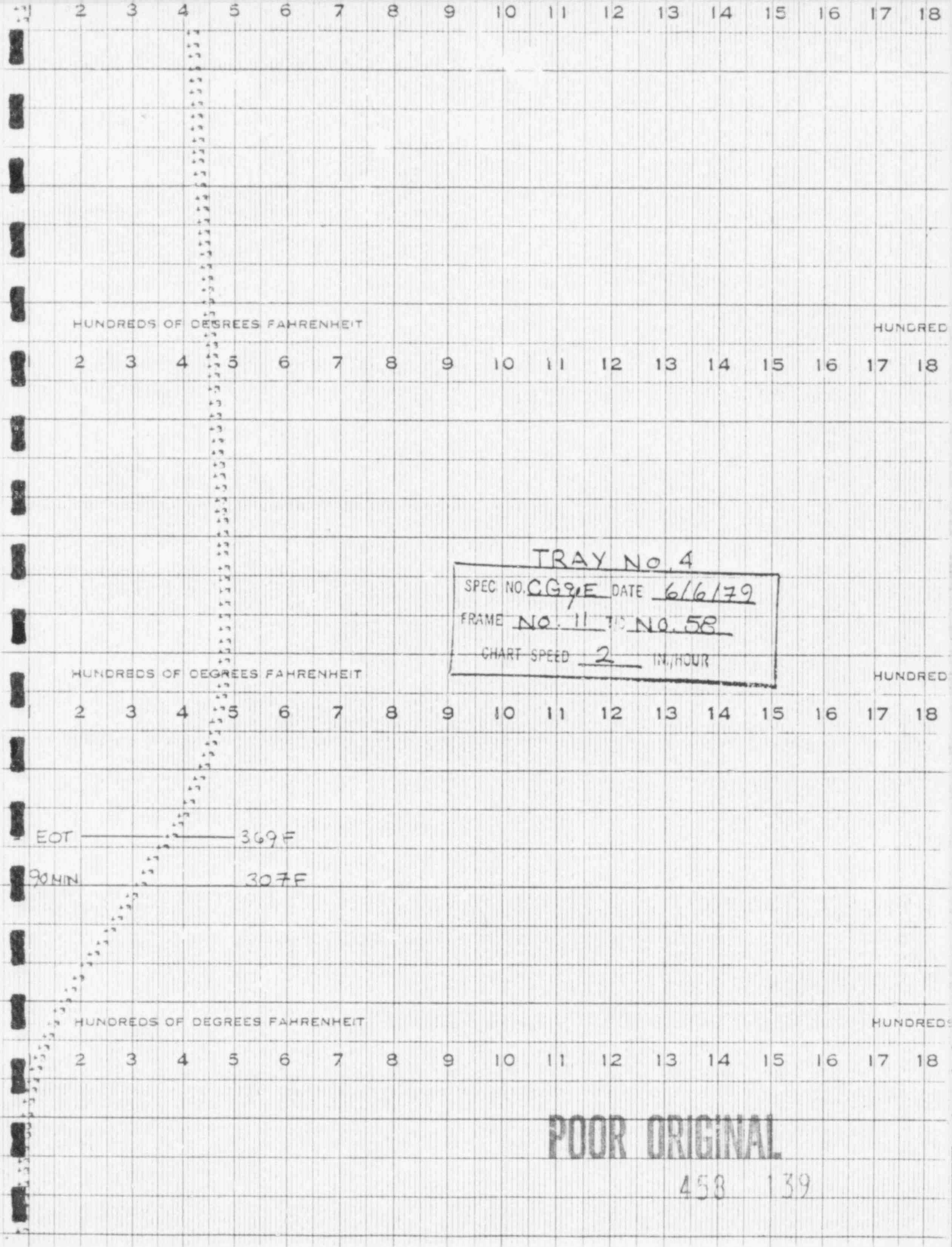
HUNDREDS

2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18

458 137

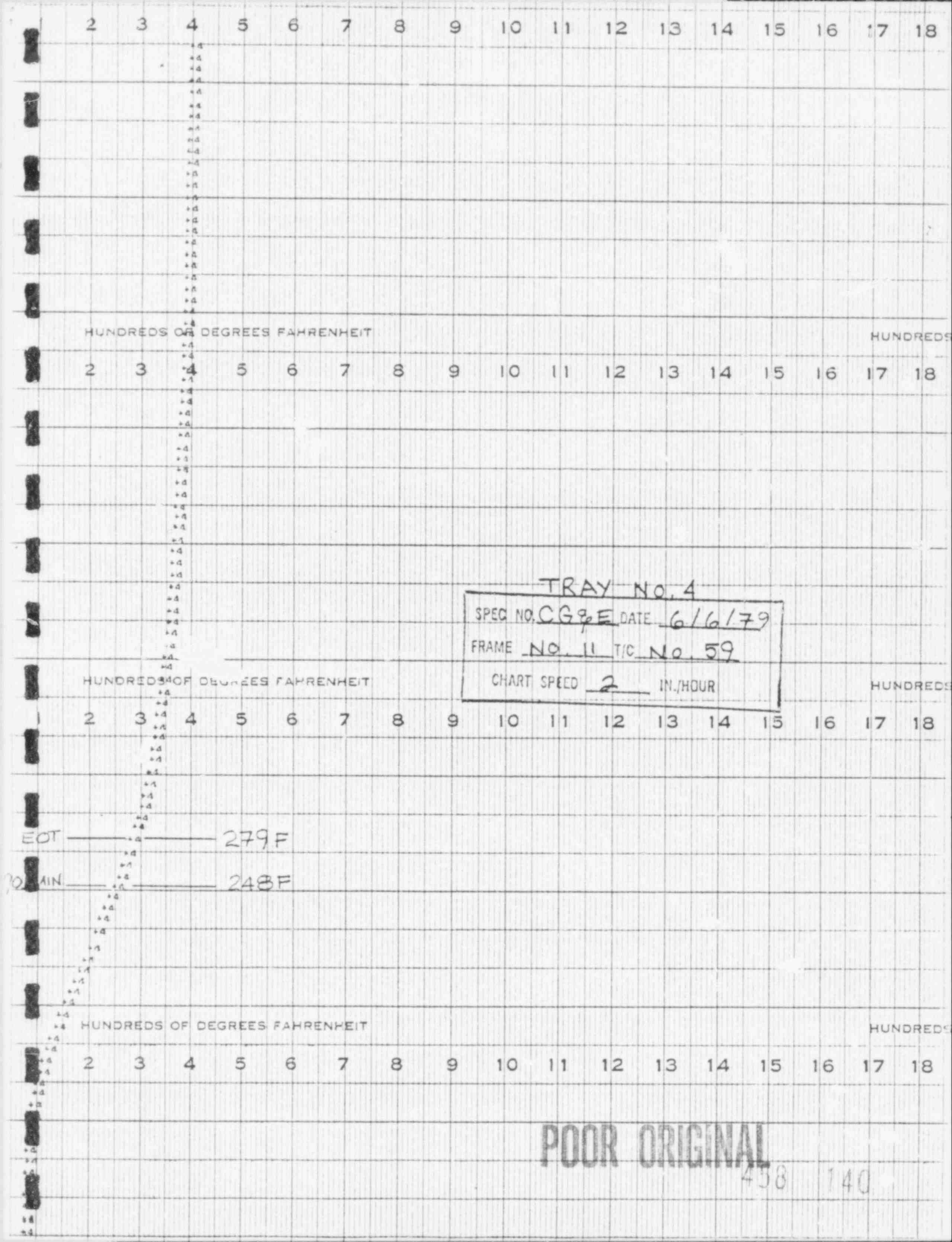
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
TRAY NO. 4
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 11 T/C NO. 57
CHART SPEED 2 IN/HOUR
EOT 426 F
90MIN 387F
458 138
POOR ORIGINAL

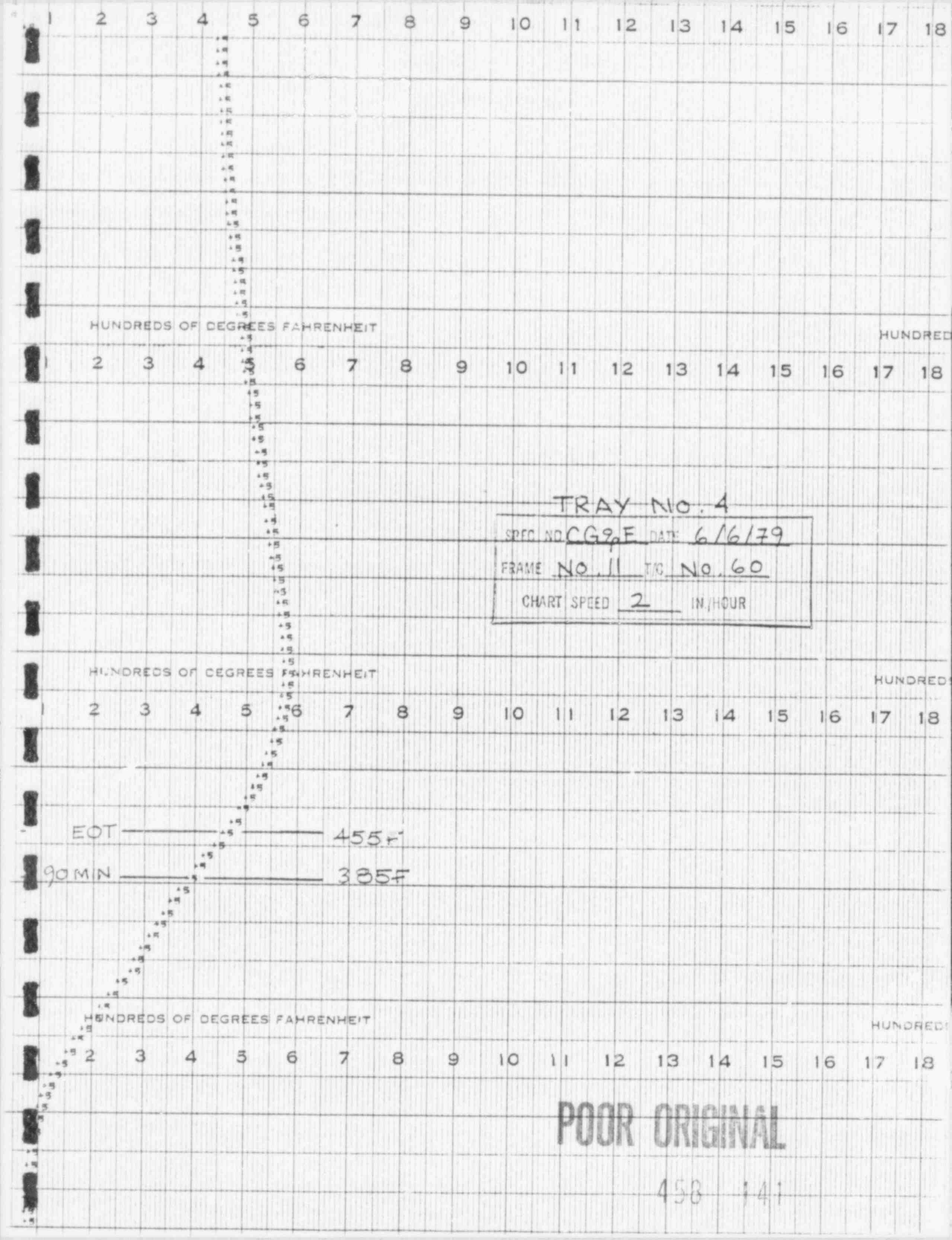


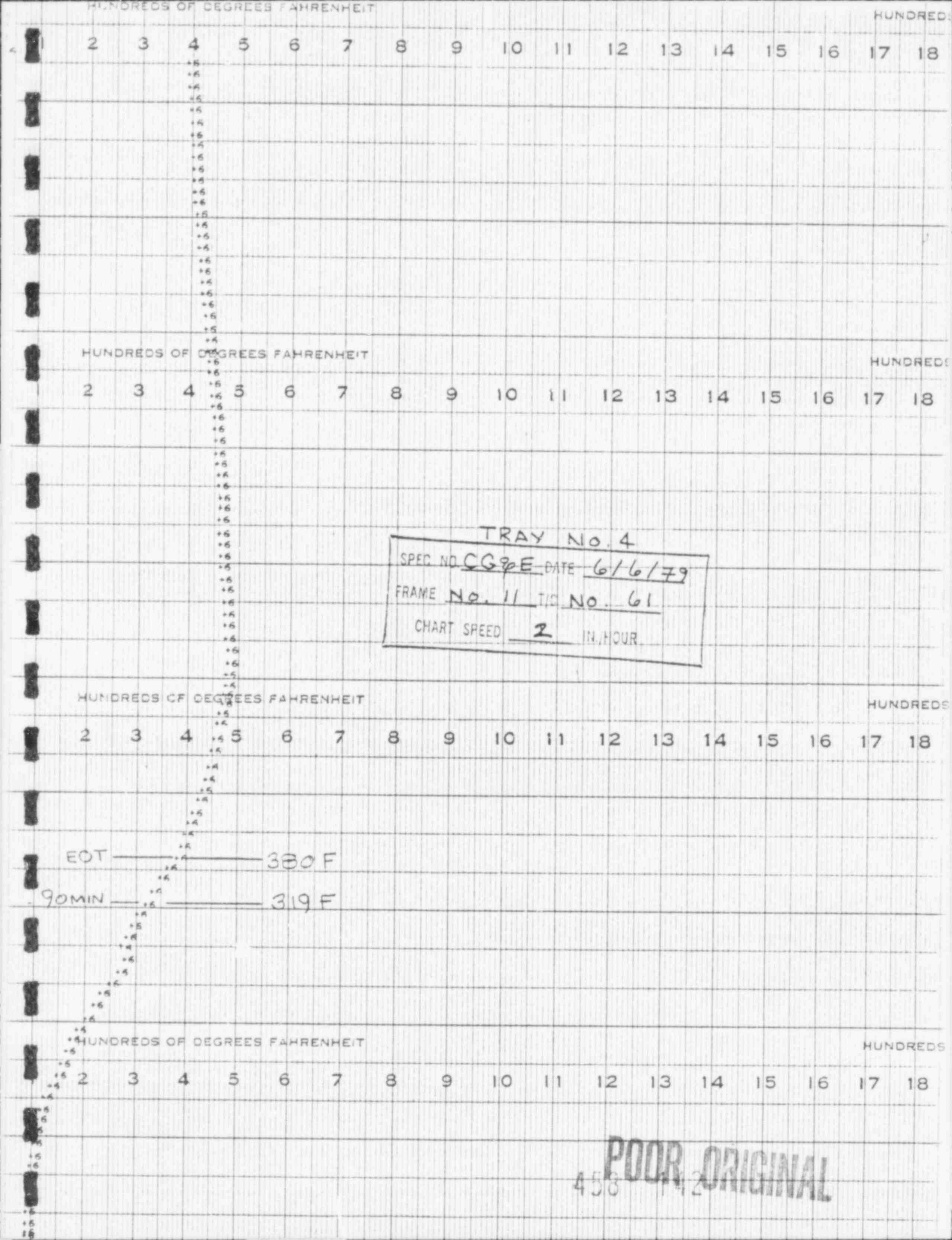
POOR ORIGINAL

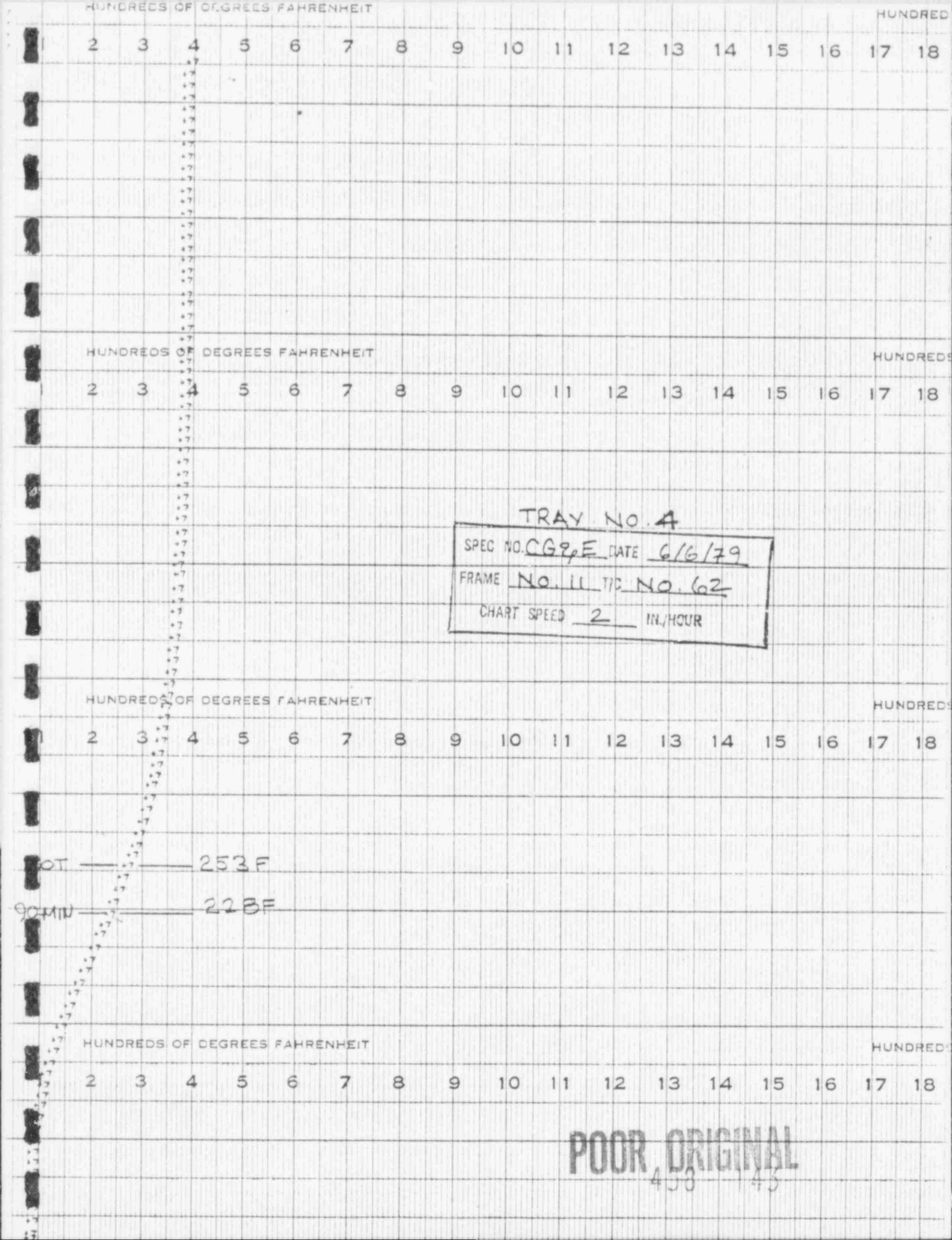
458 139

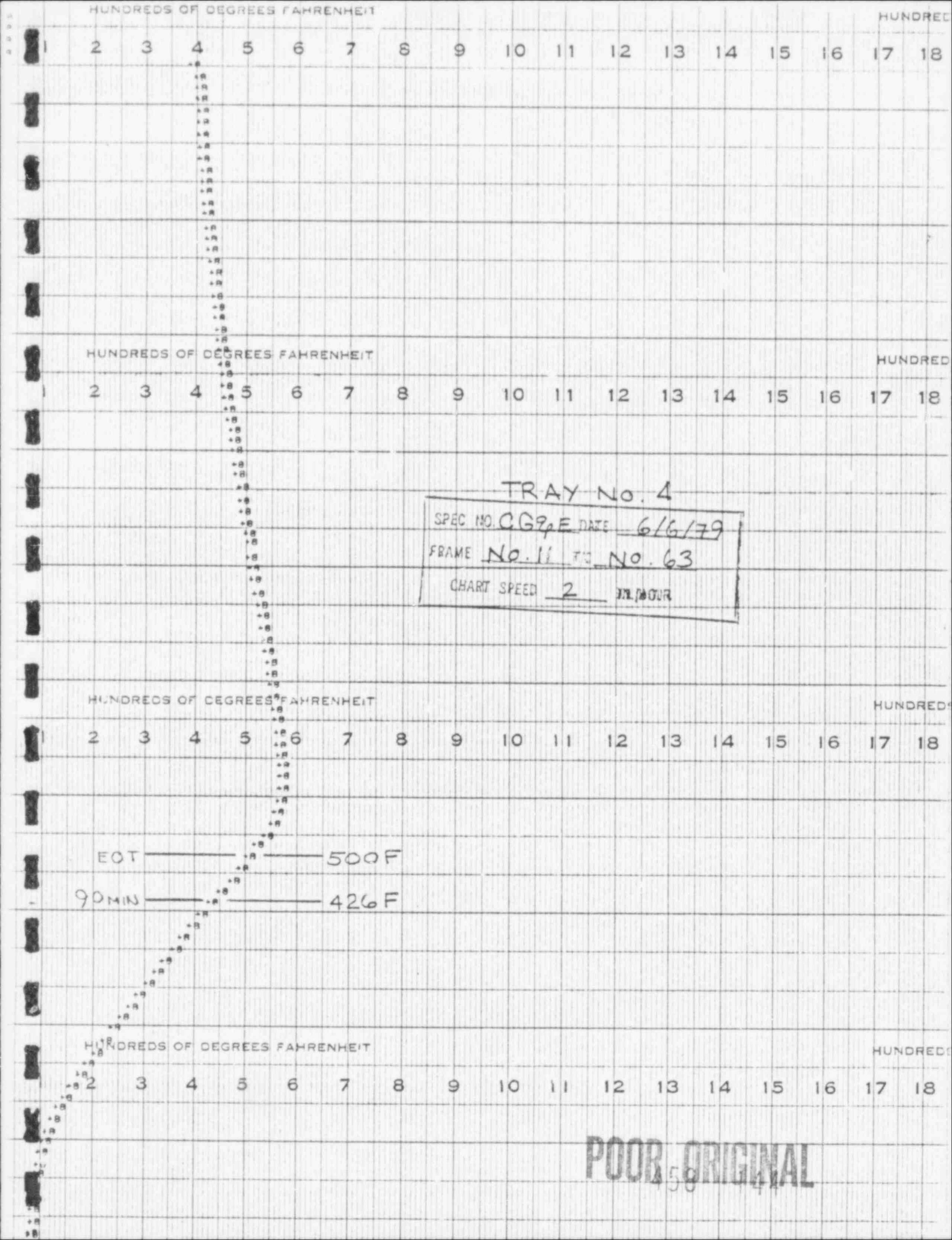


2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
TRAY NO. 4
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 11 T/C NO. 59
CHART SPEED 2 IN./HOUR
EOT 279F
MIN 248F
POOR ORIGINAL
458 140

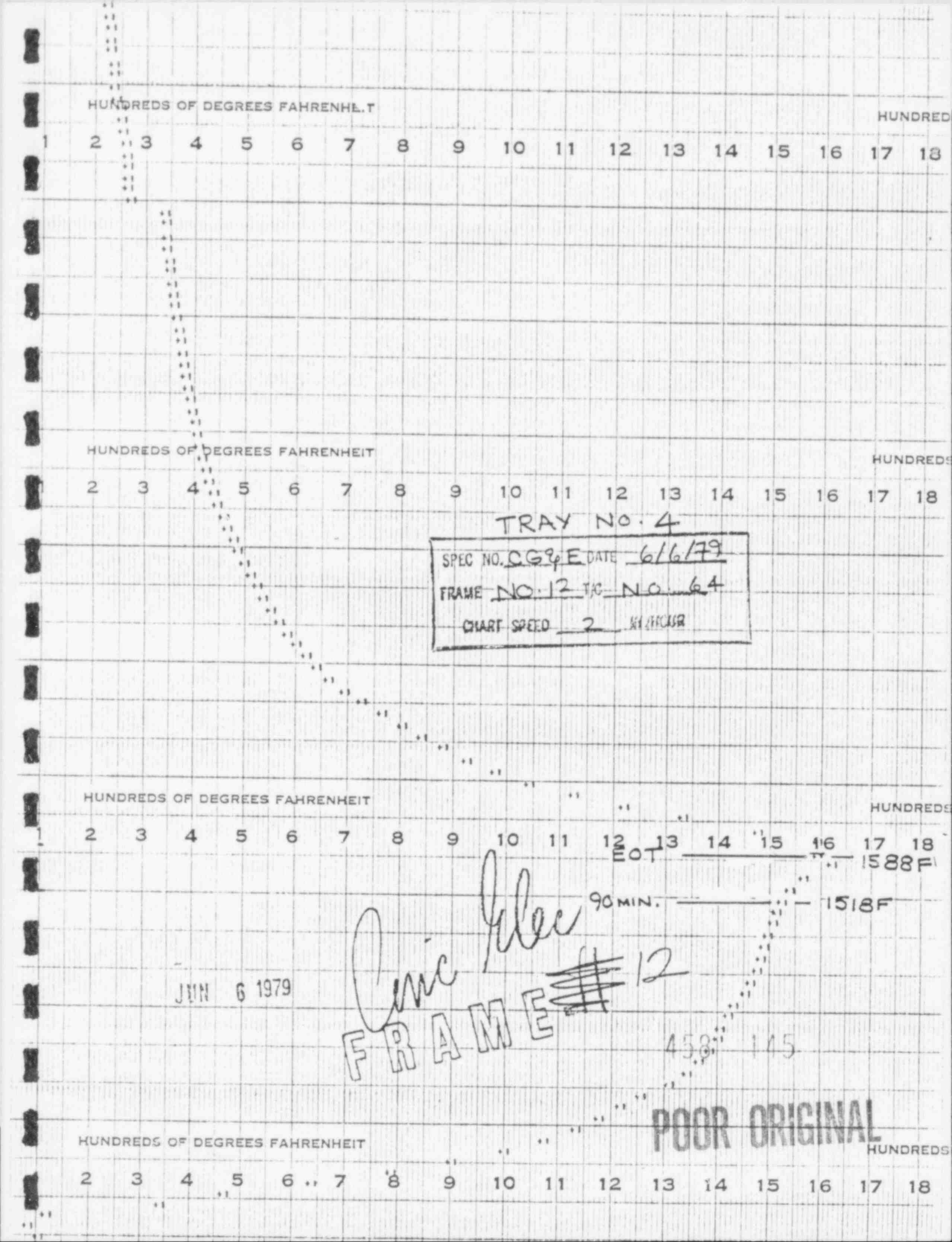

HUNDREDS OF DEGREES FAHRENHEIT
TRAY NO. 4
SPEC NO CG9,E DATE 6/16/79
FRAME NO. 11 T/C NO. 60
CHART SPEED 2 IN./HOUR
EOT 455F
90 MIN 385F
POOR ORIGINAL

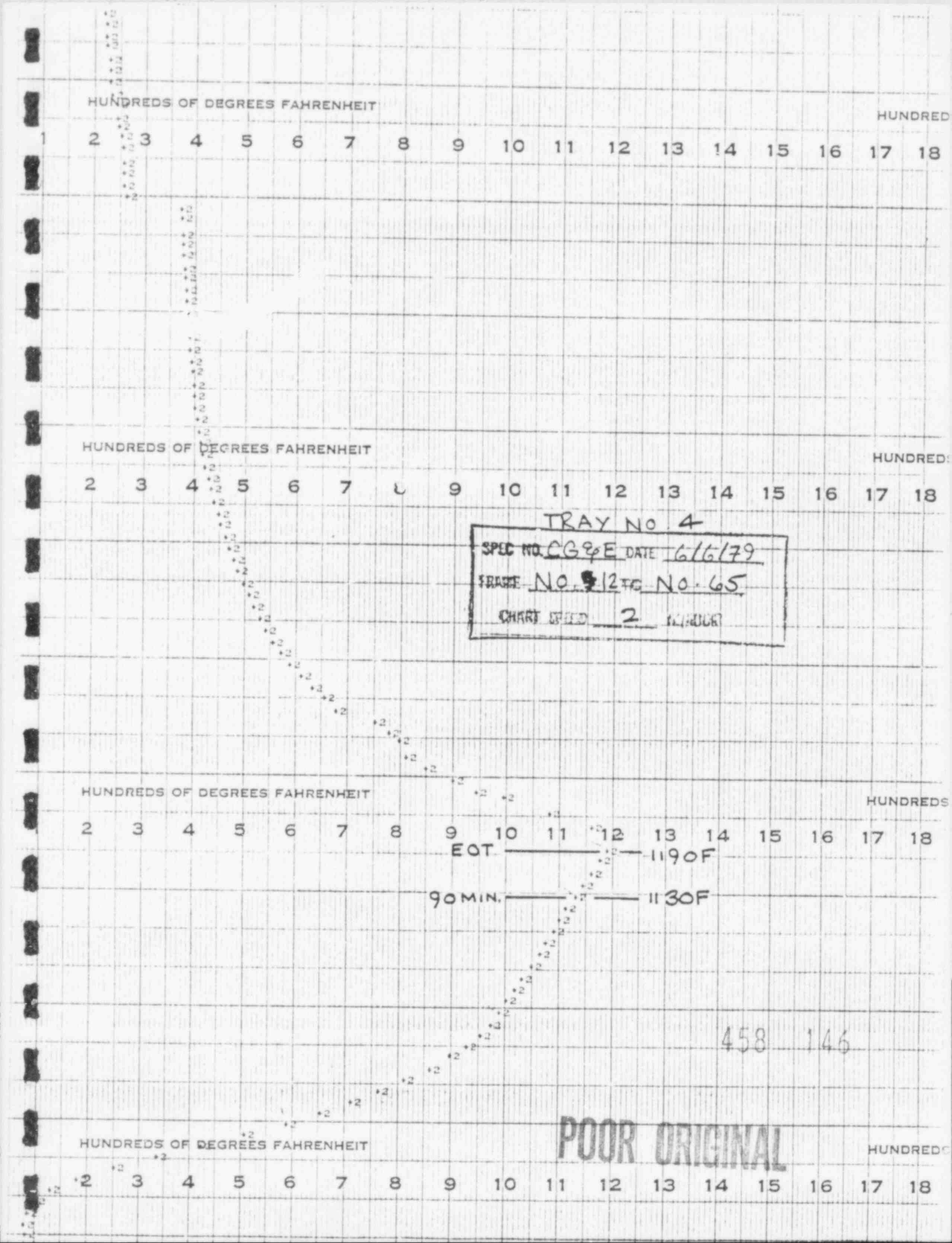

HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 4
SPEC NO CG&E DATE 6/6/79
FRAME No. 11 T/C No. 61
CHART SPEED 2 IN./HOUR
EOT 380 F
90MIN 319 F


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 4
SPEC NO. CG&E DATE 6/6/79
FRAME No. 11 T/C No. 62
CHART SPEED 2 IN./HOUR
OT 253F
90 MIN 228F
POOR ORIGINAL
498 145

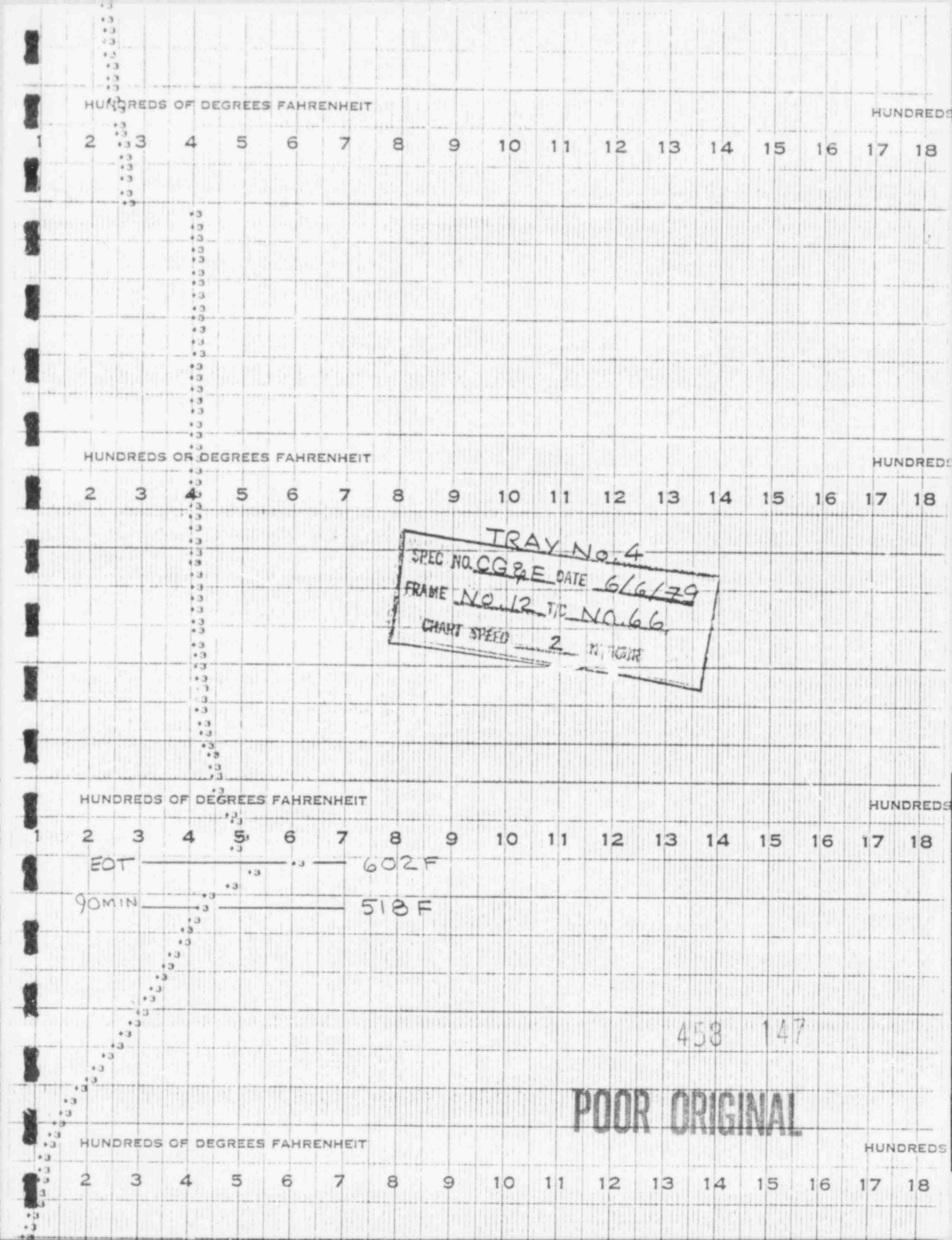


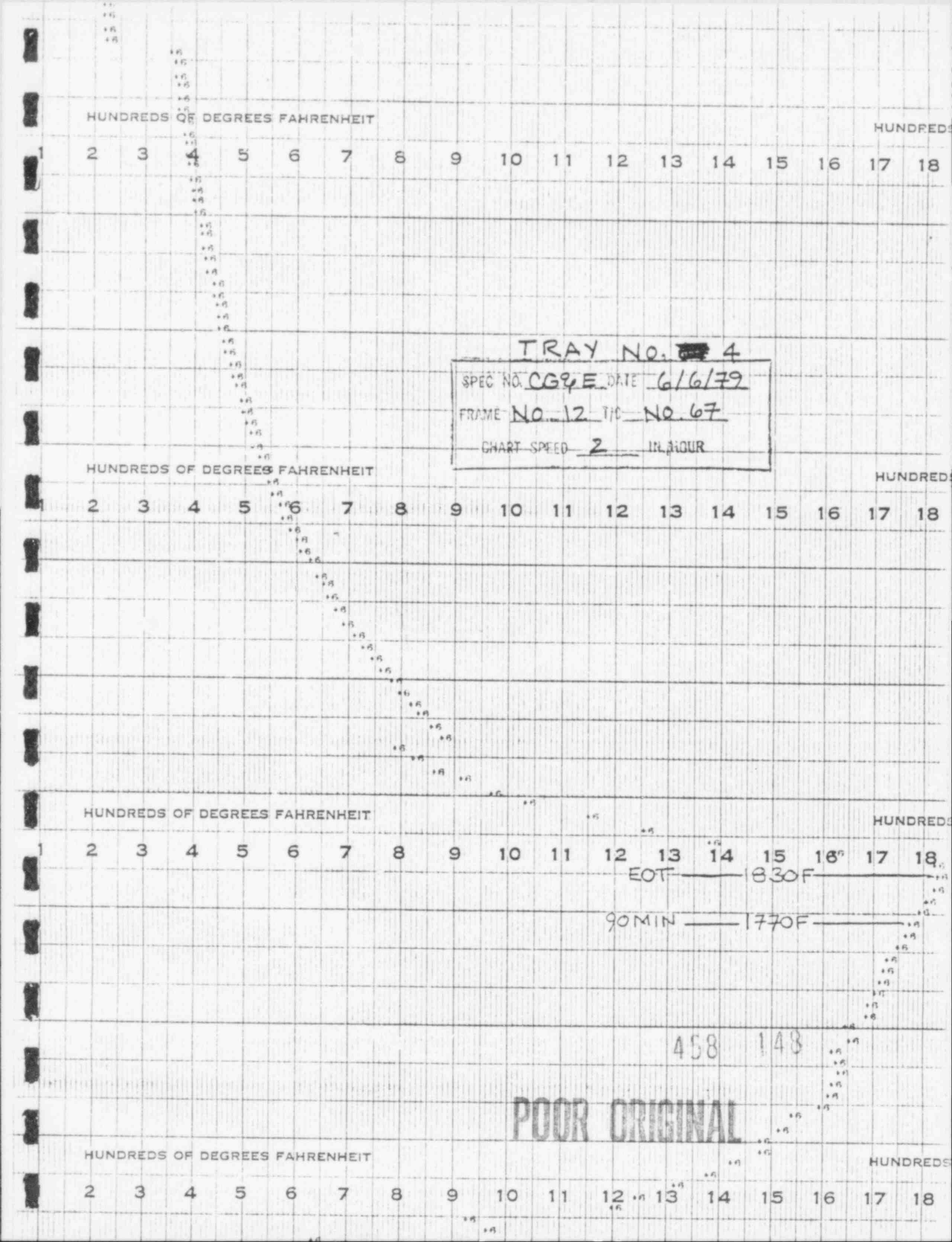
HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 4
SPEC NO CG9,E DATE 6/6/79
FRAME No. 11 TO No. 63
CHART SPEED 2 IN/HOUR
ECT 500F
90MIN 426F
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 4
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 12 T/C NO. 64
CHART SPEED 2
EOT 1588F
90 MIN. 1518F
FRAME #12
JUN 6 1979
POOR ORIGINAL

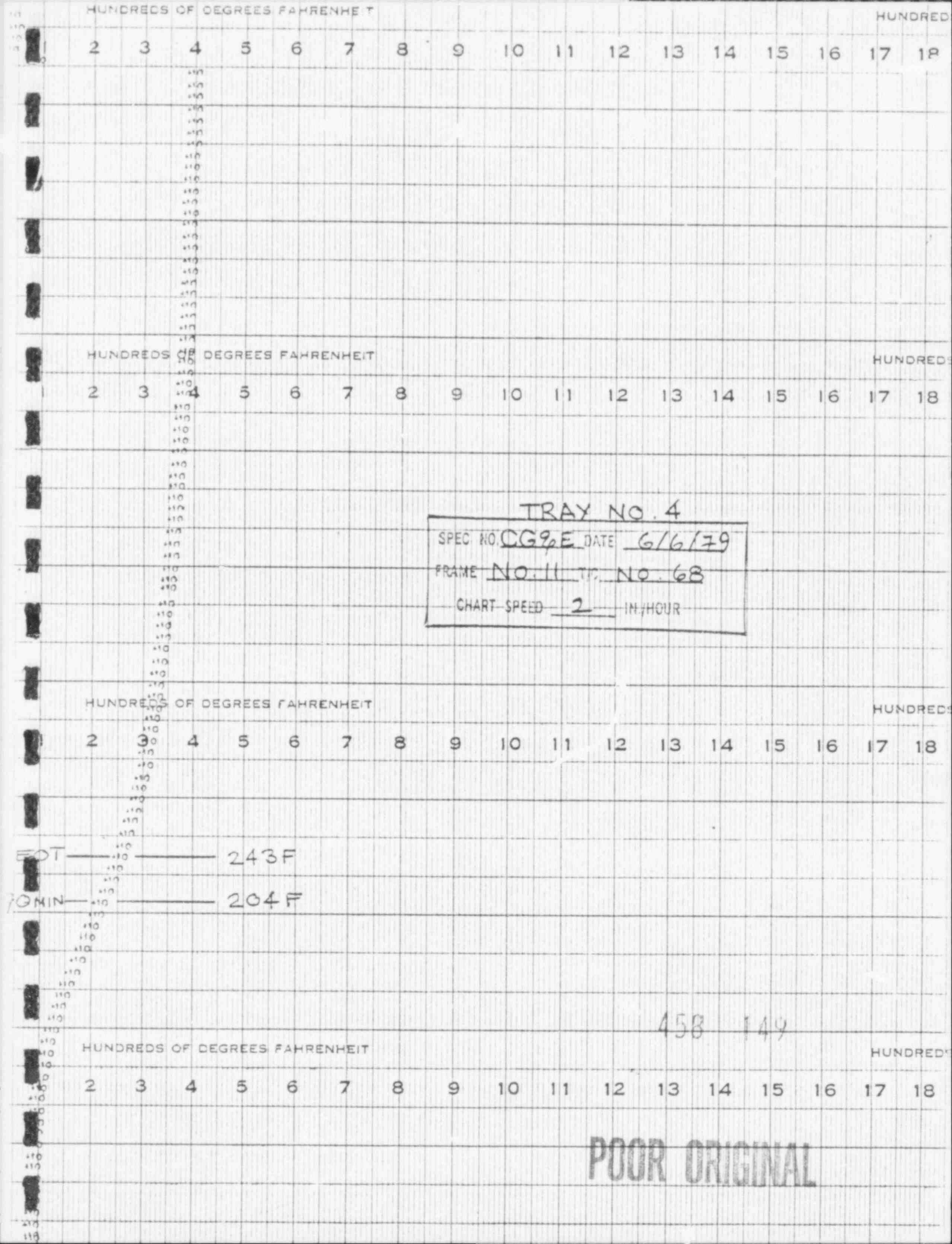


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO 4
SPEC NO. CG&E DATE 6/6/79
TC NO. 65
CHART 2
EOT — 1190F
90 MIN. — 1130F
458 146
POOR ORIGINAL

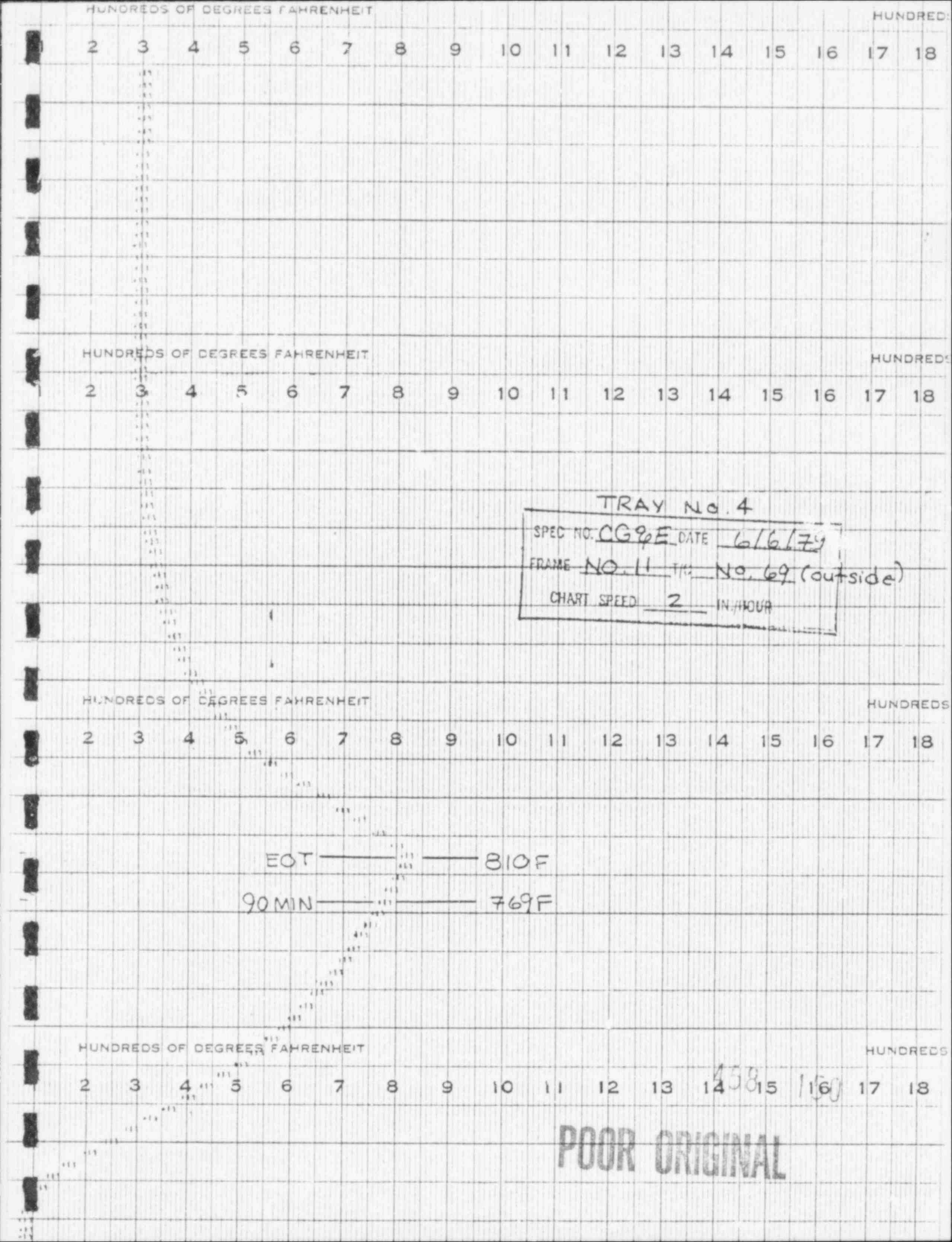

HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 4
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 12 T/C NO. 66
CHART SPEED 2
EOT 602F
90MIN 518F
458 147
POOR ORIGINAL

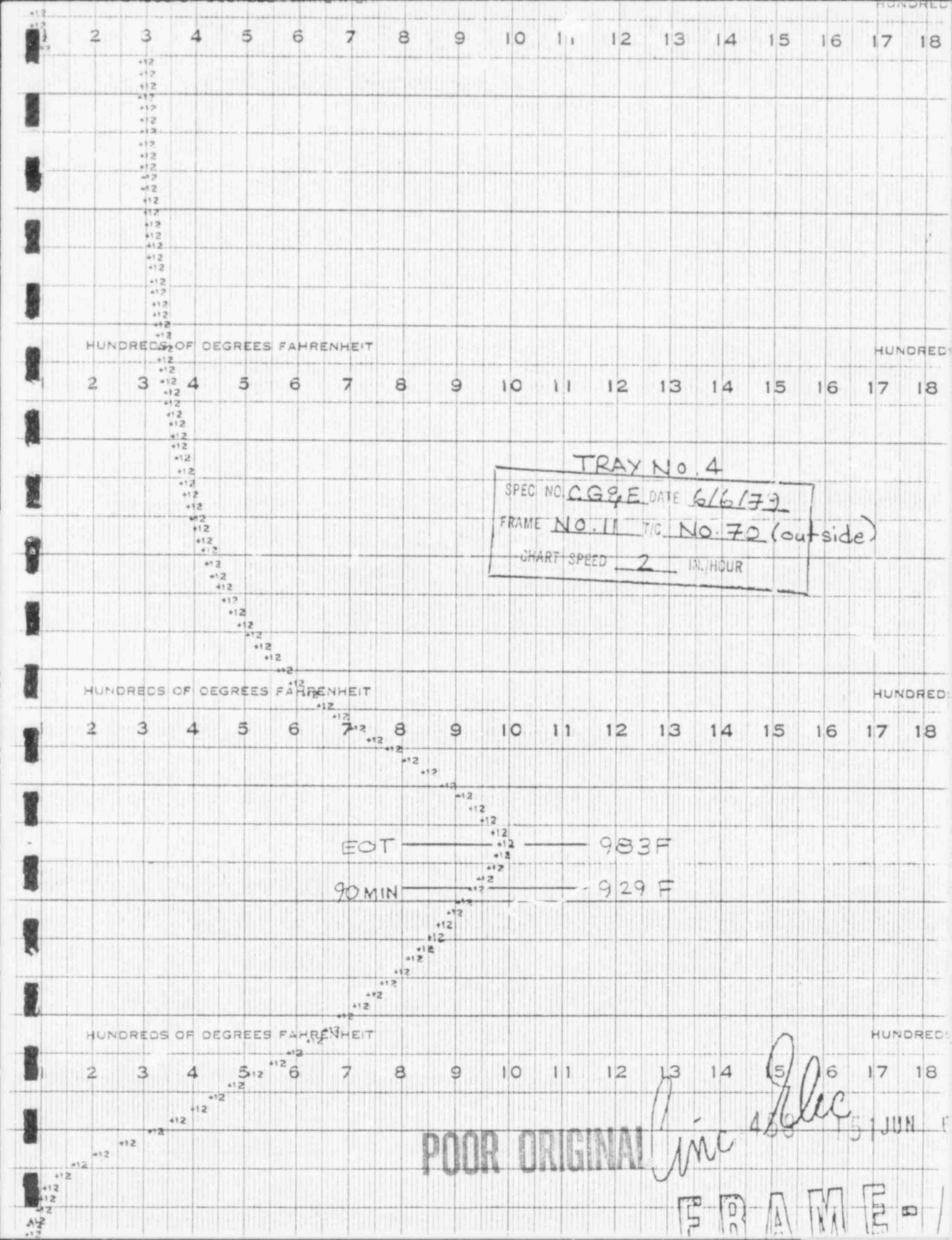


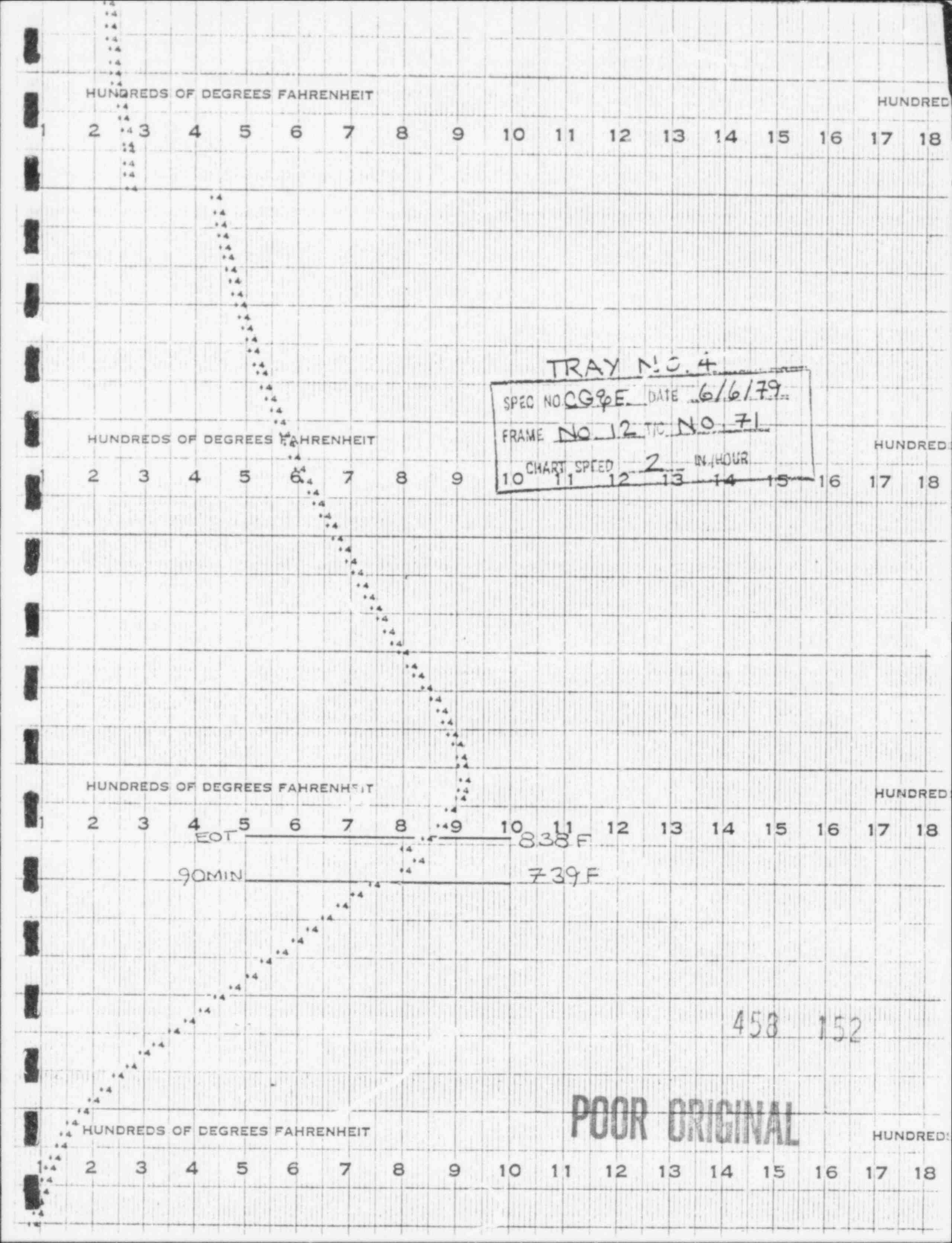
HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. [redacted] 4
SPEC NO. CG&E DATE 6/6/79
FRAME NO. 12 T/C NO. 67
CHART SPEED 2 IN./HOUR
EOT — 1830F
90MIN — 1770F
458 148
POOR ORIGINAL

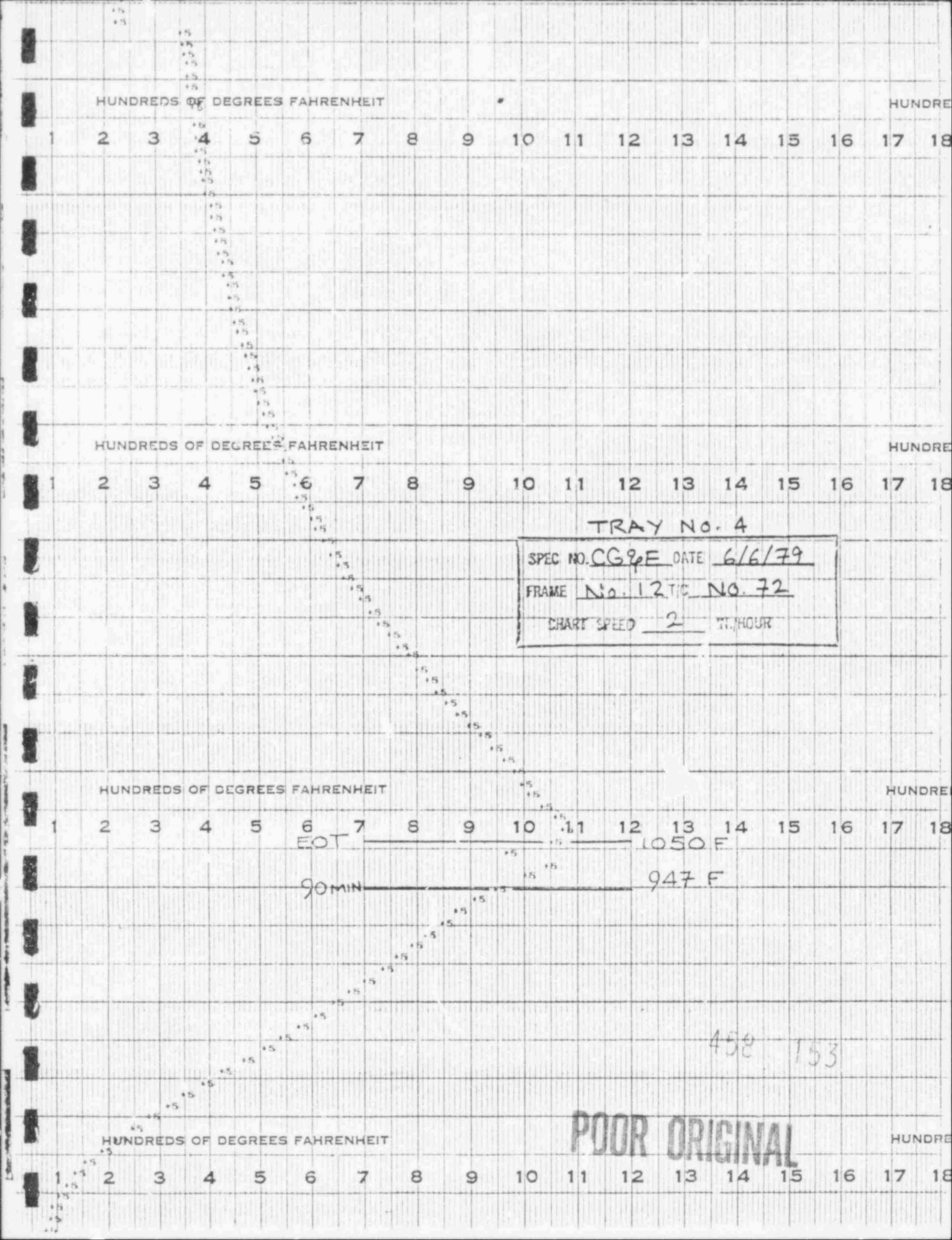


HUNDREDS OF DEGREES FAHRENHEIT
HUNDREDS
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 4
SPEC NO. CG%E DATE 6/6/79
FRAME No. 11 TC No. 68
CHART SPEED 2 IN/HOUR
EOT 243F
70 MIN 204F
458 149
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 4
SPEC NO. CG9E DATE 6/6/79
FRAME NO. 11 T/C No. 69 (outside)
CHART SPEED 2 IN/HOUR
EOT 810F
90 MIN 769F
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY No. 4
SPEC NO CG&E DATE 6/6/79
FRAME NO. 11 T/C No. 70 (outside)
CHART SPEED 2 IN./HOUR
EOT 983F
90 MIN 929 F
POOR ORIGINAL
Cinc Elec
51 JUN
FRAME


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 4
SPEC NO CG&E DATE 6/6/79
FRAME NO. 12 T/C NO. 71
CHART SPEED 2 IN./HOUR
EOT 838 F
90MIN 739 F
458 152
POOR ORIGINAL


HUNDREDS OF DEGREES FAHRENHEIT
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
TRAY NO. 4
SPEC NO. CG&E DATE 6/6/79
FRAME No. 12 T/C NO. 72
CHART SPEED 2 IN./HOUR
EOT 1050 F
90 MIN 947 F
458 153
POOR ORIGINAL