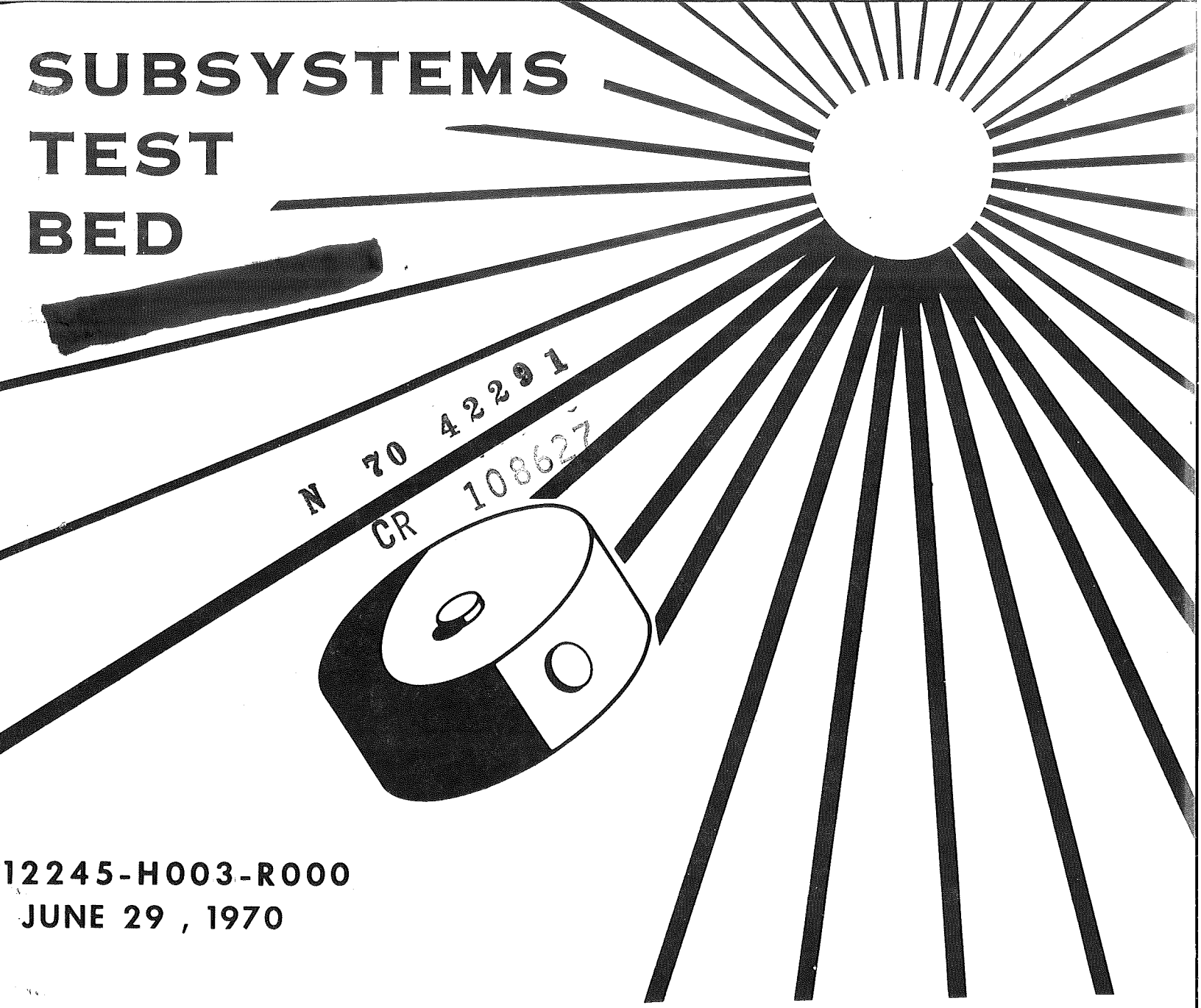
SUBSYSTEMS TEST BED

N 70 42291
CR 108627



12245-H003-R000
JUNE 29 , 1970

THERMAL MATHEMATICAL MODEL CORRELATION

CASE FILE COPY

TRW SYSTEMS GROUP
HEAT TRANSFER
HOUSTON OPERATIONS

SPACE HEAT
TRANSFER
NASA

12245-H003-R000

CR108627

SUBSYSTEMS TEST BED
THERMAL MATHEMATICAL MODEL CORRELATION

JUNE 29, 1970

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NASA Concurrence
R. E. Durkee
Technical Monitor

FOREWORD

Report No. 12245-H003-R000, "Subsystems Test Bed Thermal Mathematical Model Correlation," is presented as a deliverable item under contract NAS9-9392, Task Order No. 6 entitled "Post Test Evaluation."

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SUMMARY

The Subsystems Test Bed (STB) Thermal Mathematical Models (TMM's) have been correlated with the data obtained during the STB thermal vacuum (T/V) testing. The test was conducted in Chamber A of the Space Environment Simulation Laboratory (SESL) located at NASA/MSC. The test period consisted of 170 hours of real time testing performed between March 16 and March 23, 1970.

The STB TMM, a more detailed TMM of a quarter section of the STB, and a standoff TMM were used in the analysis. Comparison curves for representative thermocouples (T/C), as well as comparative cabin temperature distributions are presented for each test phase. Ninety percent of the calculated temperatures were within 10°F of their corresponding T/C readings. However, some model modification and further analysis are recommended to improve correlation in specific areas.

In addition, the results of a comparative analysis between a STB TMM with a multi-layer insulation (MLI) linear conductance and a STB TMM with a non-linear conductance calculated with an effective MLI emissivity is included.

DISCUSSION

The Thermal Mathematical Models used to correlate with the STB T/V test data are documented in Reference 1. The STB TMM has been updated and maintained during the past year to accommodate the modifications made to the STB prior to T/V testing. It was utilized in test planning and pretest temperature predictions. A model of a quarter section of the STB was constructed to correlate with the detailed pressure shell instrumentation located between the -Z and +Y axis of the STB. A third model, that of a typical standoff section, was constructed to correlate with standoff instrumentation.

All models utilized T/V test data to provide meteoroid shield temperatures as boundary conditions. This practice eliminated the errors propagated by intensity fluctuations common in the solar simulators and by variations in the chamber cold wall temperatures.

The STB TMM was used to correlate the majority of the STB T/C locations. The exceptions are the detailed pressure shell, window, and standoff instrumentation. Insufficient data hindered the development of an accurate window network prior to STB testing. As a result, difficulties with window T/C data correlation were encountered in the STB TMM. It was decided to use test data to provide boundary temperatures for the window nodes in the STB TMM to allow the correlation analyses of the STB TMM to continue while the problem with the window network was resolved with the detailed model.

The quarter section TMM of the STB was used to correlate with the detailed pressure shell and window test data. Parametric analyses were performed to determine the unknown thermophysical properties of the STB windows. The window network was corrected to include these properties, and the model correlated for all fourteen phases of the T/V test. The window network from the detailed quarter section TMM has not been included in the STB full scale model.

The standoff model was used to correlate test data from standoff instrumentation located on the STB top bulkhead. Pumpdown and top sun hot soak data were correlated and are considered representative of environment extremes experienced by the standoff instrumentation.

Both the full scale TMM and the quarter section TMM were correlated with the STB T/V data for every test phase. Phase durations and environments were taken from the User Test Conductor (UTC) log maintained during the test. The Thermal Vacuum Test Timeline is presented in Figure 1. Heater power levels and maximum and minimum THCP fan speeds referenced in the timeline are:

Heater Settings	Power (Watts) Large Heater	Small Heater
100%	300	150
50%	75	33
25%	3	1.5

Fan Setting	Air Flow (Ft^3/Min)
Max.	1500
Min.	500

Because of the vast amount of data involved, comparison curves are presented only for representative T/C locations. They include:

TP0109	Pressure Shell Top Bulkhead
TP0117	Pressure Shell Top Bulkhead
TP0132	Pressure Shell Sidewall
TP0138	Pressure Shell Sidewall
TP0142	Pressure Shell Sidewall
TP0148	Pressure Shell Sidewall
TP0170	Pressure Shell Bottom Bulkhead
TH0522	Sidewall Docking Hatch
TT1101	Truss Support Attachment
TT1104	Truss Support
TW0601	Window Frame Adapter
TW0602	Window Frame
TW0603	Window Pane
TP4193	Detailed Pressure Shell Sidewall
TP5138	Detailed Pressure Shell Sidewall
TP5139	Detailed Pressure Shell Sidewall
TS2062	Standoff Top Bulkhead
TS2063	Standoff Top Bulkhead

The locations of the correlated thermocouples are presented in Figures 2 through 6. Figures 2 and 3 illustrate the T/C locations correlated with the full size STB TMM. Figures 4 and 5 illustrate the locations correlated with the quarter section model, and Figure 6, illustrates the locations correlated with the standoff model.

All but TT1101, TT1104, TS2062, and TS2063 were correlated for all STB test phases. Initialization problems in the Truss Support network prevented TT1101 and TT1104 correlation in the last nine phases. TS2062 and TS2063 were correlated for pumpdown and Phase D (top sun hot soak).

An independent analysis was performed to determine the validity of an effective emissivity calculated for the STB MLI from T/V test data. The effective emissivity (.01) was determined to illustrate the overall insulating qualities of the STB MLI configuration in comparison to other vehicles (Apollo Lunar Module and Service Module). Data from a TMM with an MLI nonlinear conductance calculated with an effective emissivity is compared to data calculated with a model having an MLI linear conductance network. Phase A1 (side sun hot soak) was used for the comparison as it provided both maximum and minimum meteoroid shield temperature.

RESULTS

The results of the STB T/V test data correlation analysis are presented by phase. Included are actual and calculated temperature histories of representative T/C locations as well as actual/calculated STB cabin temperature distributions at the end of each test phase. The actual temperature history curves are marked with an X every hour while the calculated temperature curves are unmarked.

The full size STB TMM, which was used to correlate the majority of the T/C data, does have characteristics which resulted in poorer correlation in several specific areas of the STB. These difficulties appear in every phase of the T/V test and include:

1. Pressure shell nodes which surround windows have an additional heat leak which is not accounted for in the TMM. As a result, the calculated temperatures are high with cold soak environments and low with hot soak environments. Phase A1 illustrates this as the pressure shell node surrounding the window in the sun (T138) is calculated 11°F too low, while the pressure shell nodes surrounding the windows away from the sun are 5° to 9°F too warm.

2. The window network currently in the full size TMM will not yield good correlation with window and frame T/C data. The problem has been resolved with the detailed model, although the corrected network has not been included in the large model.

3. The model is unable to effectively account for large, localized heating rates not located near pressure shell node centers. This occurred during Phases C1, C2 and C4. The coarse network is unable to distribute the heat proportionally to the areas surrounding the heaters. Because of the difficulties encountered, reduced heater loads were calculated with the use of a detailed TMM of the STB pressure shell surrounding a typical heater. This model was executed with the actual heater heat loads, and the net heat flow from the heated area to the STB TMM node center was computed. The STB TMM was executed with both the total heater heat load and the reduced heat load for Phases C1 and C2. Representative temperature histories are presented for each condition. With the total heat load, the overall pressure shell temperature distribution is realistic while the nodes which received the heater heat loads reached temperatures much too high. When reduced heat loads were impressed on the heated nodes, their temperatures correlated well, however the other pressure shell temperatures were too low. This problem was not encountered in the detailed quarter section model. The node sizes around the heaters allowed for proportional distribution of the heater heat loads.

4. Effective film coefficients (h) for the forced convection phases were difficult to calculate, even with test data. At low nitrogen flow rates, such as those experienced by the STB interior during Phases F1 and F2, interaction between forced and free convection is predominant. This phenomenon was difficult to account for, and because time for a detailed convection analysis was not available, rough-cut film coefficients were utilized. The results indicate they were slightly large as the calculated temperatures on the heaters were low and the other temperatures were consistently high.

5. The truss support network correlated for the first few phases. After the side sun hot soak, the model consistently calculated higher truss node temperatures. The problem was in the initialization of the truss nodes surrounding the one used for correlation. In each case the calculated value rose sharply as it was influenced by surrounding nodes which had much higher initial values.

The detailed quarter section model, which was used to correlate window and detailed pressure shell thermocouple data, had problems only with the forced convection phases of the T/V test. Temperature deviations averaging less than $\pm$5°F for 12 of the 14 phases were encountered. The two forced convection phases (F1 and F2) calculated temperatures up to 15°F warmer than T/C data.

The standoff model correlated very well with test data obtained during pumpdown and the top sun hot soak (Phase D). The calculated temperatures were within 5°F of the actual temperatures during pumpdown and within 10°F during Phase D.

The following is a summary of the degree of correlation by phase:

Test Phase	Max./Average Temp. Deviation (°F)		Comments
	STB TMM	STB Quarter Section TMM	
Pumpdown	12°/5°	9°/4°	Correlation was excellent.
A1	13°/5°	15°/5°	Correlation was excellent.
A2	11°/5°	12°/4°	Correlation was excellent.
A3	9°/5°	8°/3°	Correlation was excellent.

Test Phase	Max./Average Temp. Deviation (°F)		Comments
	STB TMM	STB Quarter Section TMM	
C1	NA/10°	10°/5°	The STB TMM was executed with both the total heater heat loads and reduced heater heat loads. The total heat load results correlated well with T/C locations away from the heaters, while the reduced heat load results correlated well with T/C locations near the heaters. The cabin temperature distributions are given for the total heat load.
C2	NA/8°	7°/4°	Same as comments for C1.
C3	8°/4°	6°/3°	Correlation was excellent. The heater problem did not occur in this phase as the minimum heater Q did not significantly influence the model.
C4	20°/8°	10°/5°	Same as comment for C1. Conductors between Nodes 131 and 132 and between Nodes 148 and 147 were omitted by faulty unit record operations.
C5	11°/5°	6°/3°	Correlation was excellent.
D	10°/6°	6°/3°	Correlation was excellent.
E1	10°/4°	6°/3°	Correlation was excellent.
E2	32°/5°	20°/5°	An insufficient maximum heater Q was impressed on Nodes 132 and 148 in the STB TMM. This resulted in low calculated temperatures. In addition conductors between Nodes 131 and 132 and between 147 and 148 were missing.
F1	40°/5°	23°/15°	An insufficient heater Q was impressed on Node 148 in the STB TMM.
F2	14°/5°	12°/10°	Correlation was excellent.

The results of the analysis comparing a STB TMM with MLI conductance and a TMM with a MLI effective emissivity are presented with the correlation data for Phase A1. As seen in the pressure shell temperature distribution for the end of the phase, the "effective ε" model calculated higher temperatures for pressure shell nodes away from the side sun vector center line. This indicates that the heat transfer through the MLI computed by using an effective emissivity is less than that computed with the MLI linear conductance when the meteoroid shield temperatures are in the -150°F to -200°F range. Both models computed approximately the same pressure shell temperatures in areas which receive solar radiation and the meteoroid shield is much warmer (0° to 250°F).

CONCLUSIONS

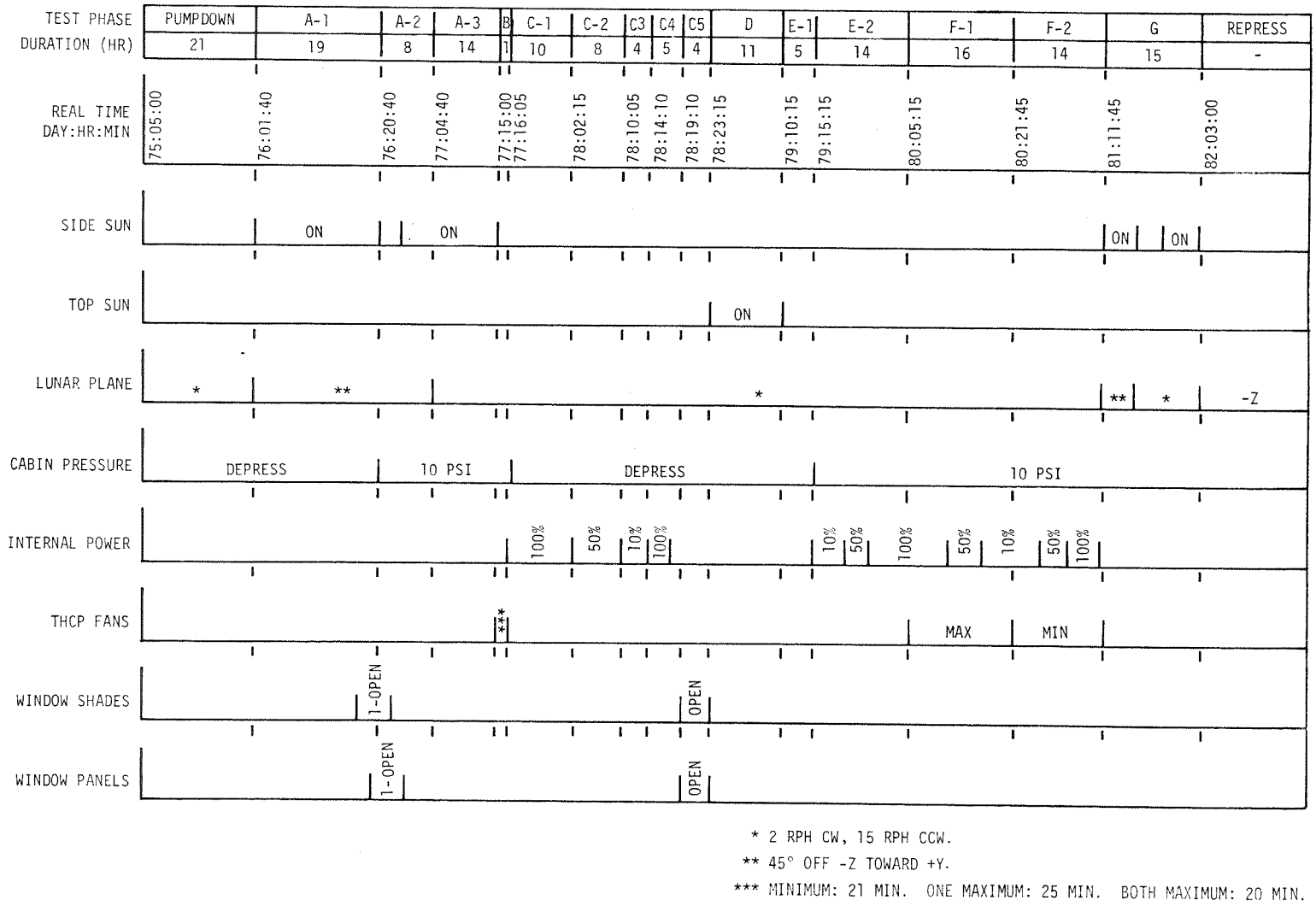
The STB Thermal Mathematical Models used in the analyses correlated well with the data obtained during the STB Thermal Vacuum Test. The problems encountered with the full size TMM can be remedied and a thermal network correction analysis performed. These projects would validate the use of the STB TMM to predict STB thermal response over a wide range of environments.

The TMM with the temperature dependent MLI conductivity correlated better over the temperature range experienced by the STB than did the model with the MLI effective emissivity.

REFERENCES

1. Mobley, T. B., Smith, J. P., and Seward, R. E., Subsystems Test Bed TMM Documentation, TRW Report No. 12245-H004-00, June 29, 1970.

2. Mobley, T. B., White, J. J., Instrumentation Requirements for the Subsystems Test Bed (STB) Thermal Vacuum Test Final Report - Revision A., Report No. 12245-H001-R001, January 15, 1970.

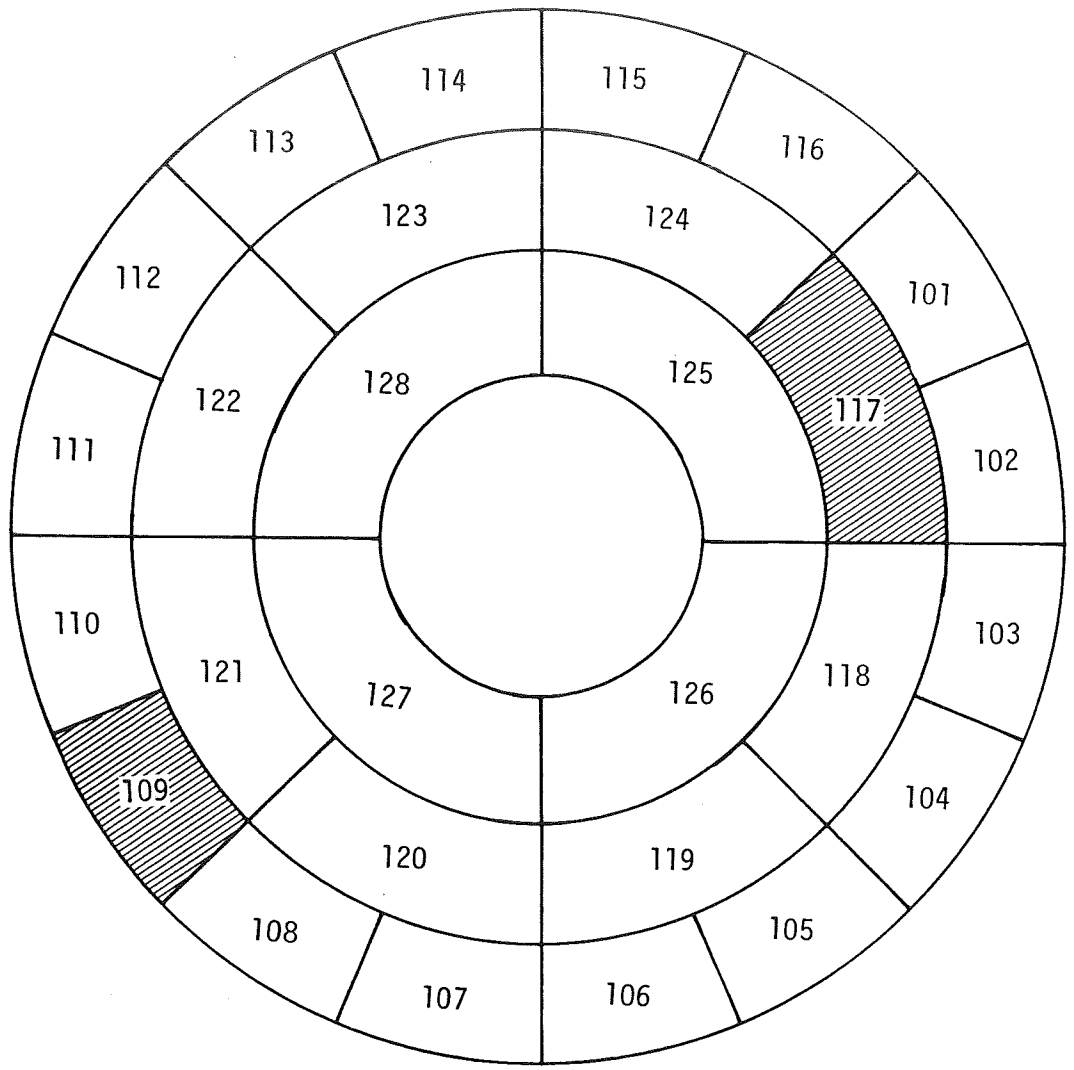


* 2 RPH CW, 15 RPH CCW.

** 45° OFF -Z TOWARD +Y.

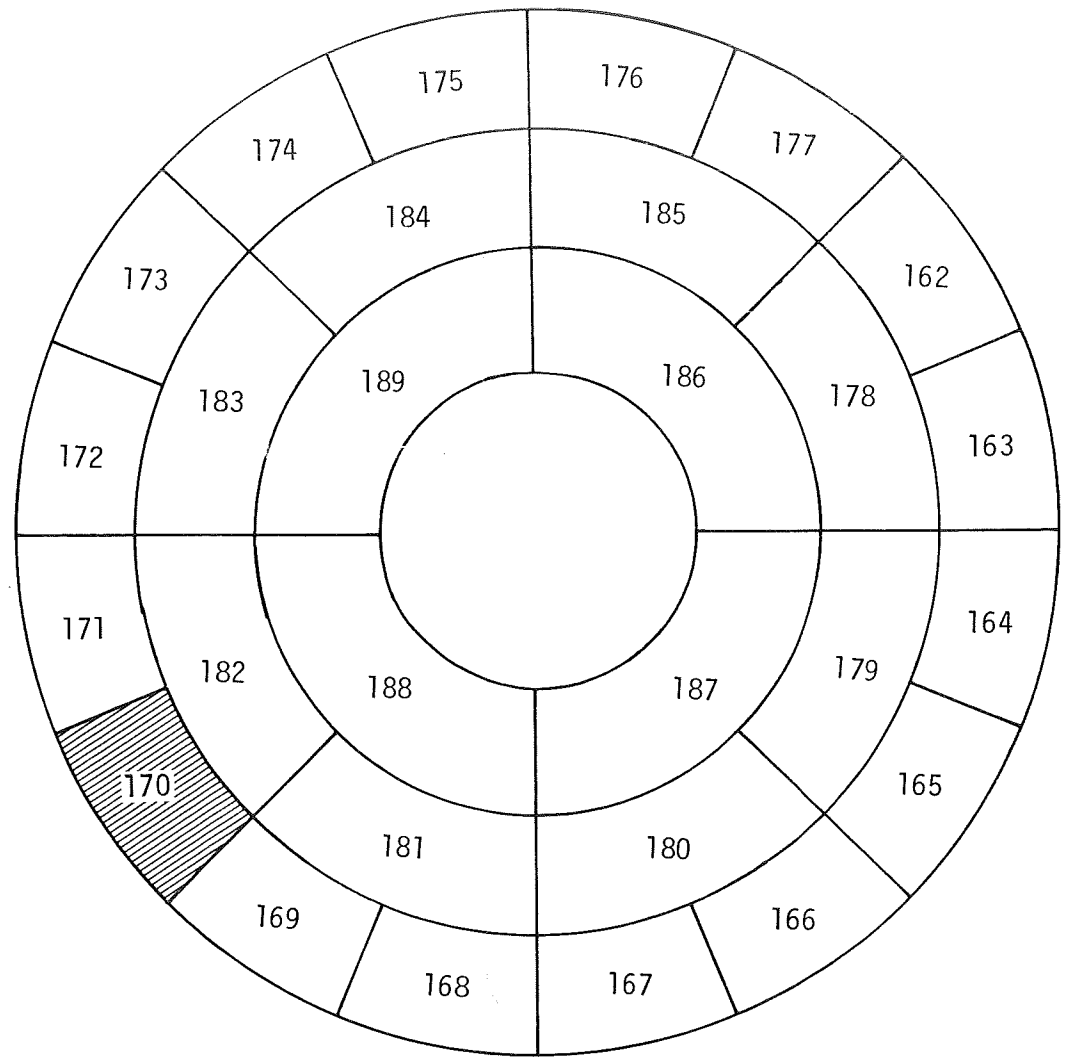
*** MINIMUM: 21 MIN. ONE MAXIMUM: 25 MIN. BOTH MAXIMUM: 20 MIN.

FIGURE 1 SUBSYSTEMS TEST BED THERMAL VACUUM TEST TIMELINE

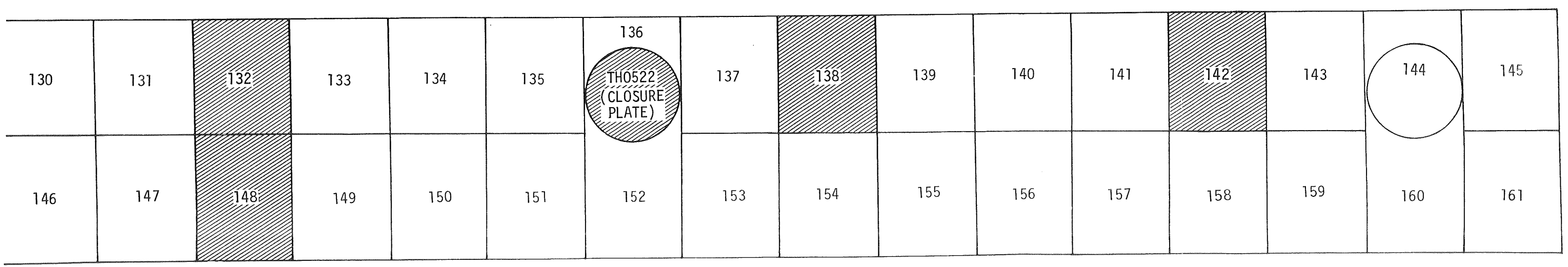


TOP
BULKHEAD

CORRELATED NODE LOCATIONS
(PRESSURE SHELL)

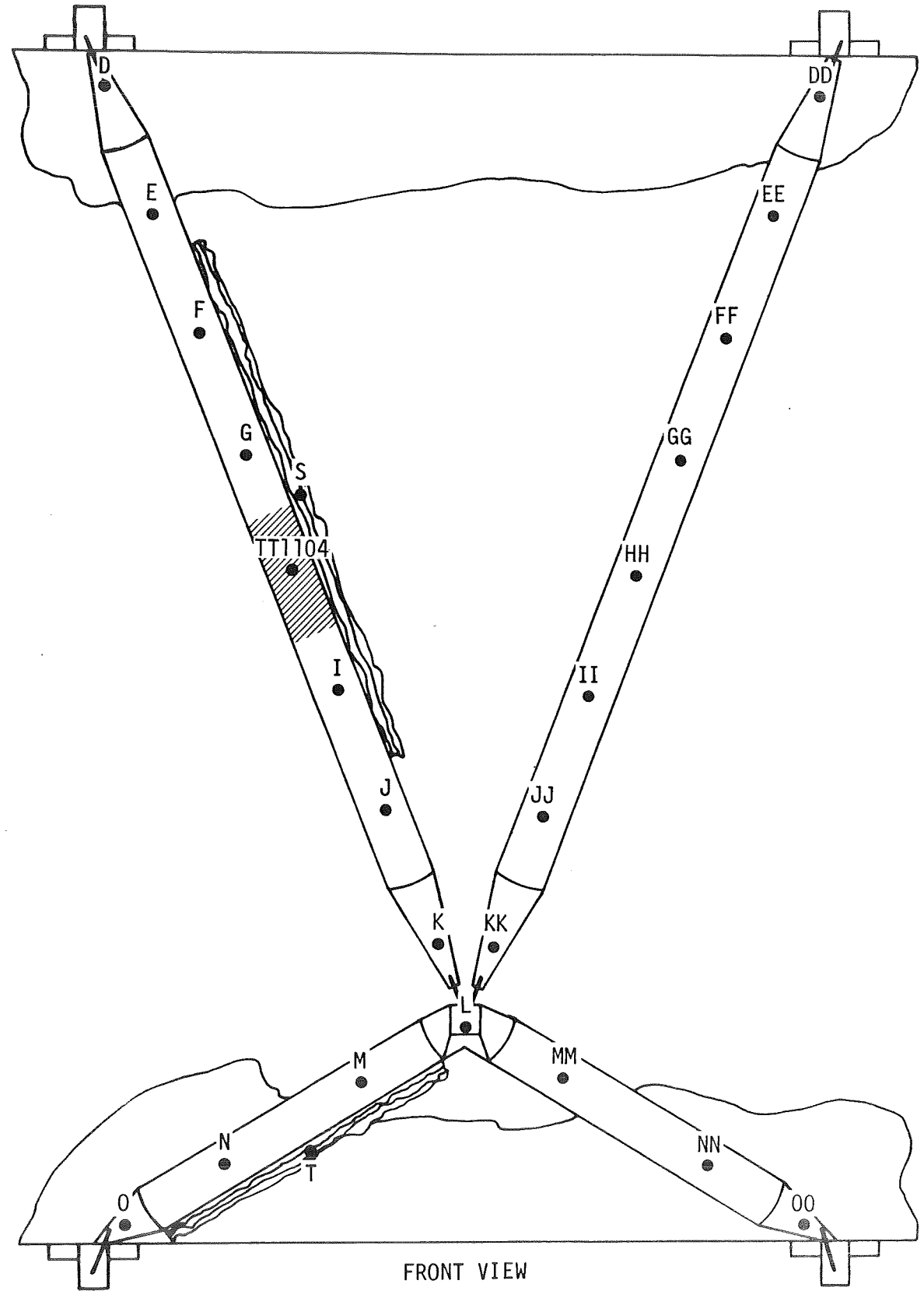


BOTTOM
BULKHEAD



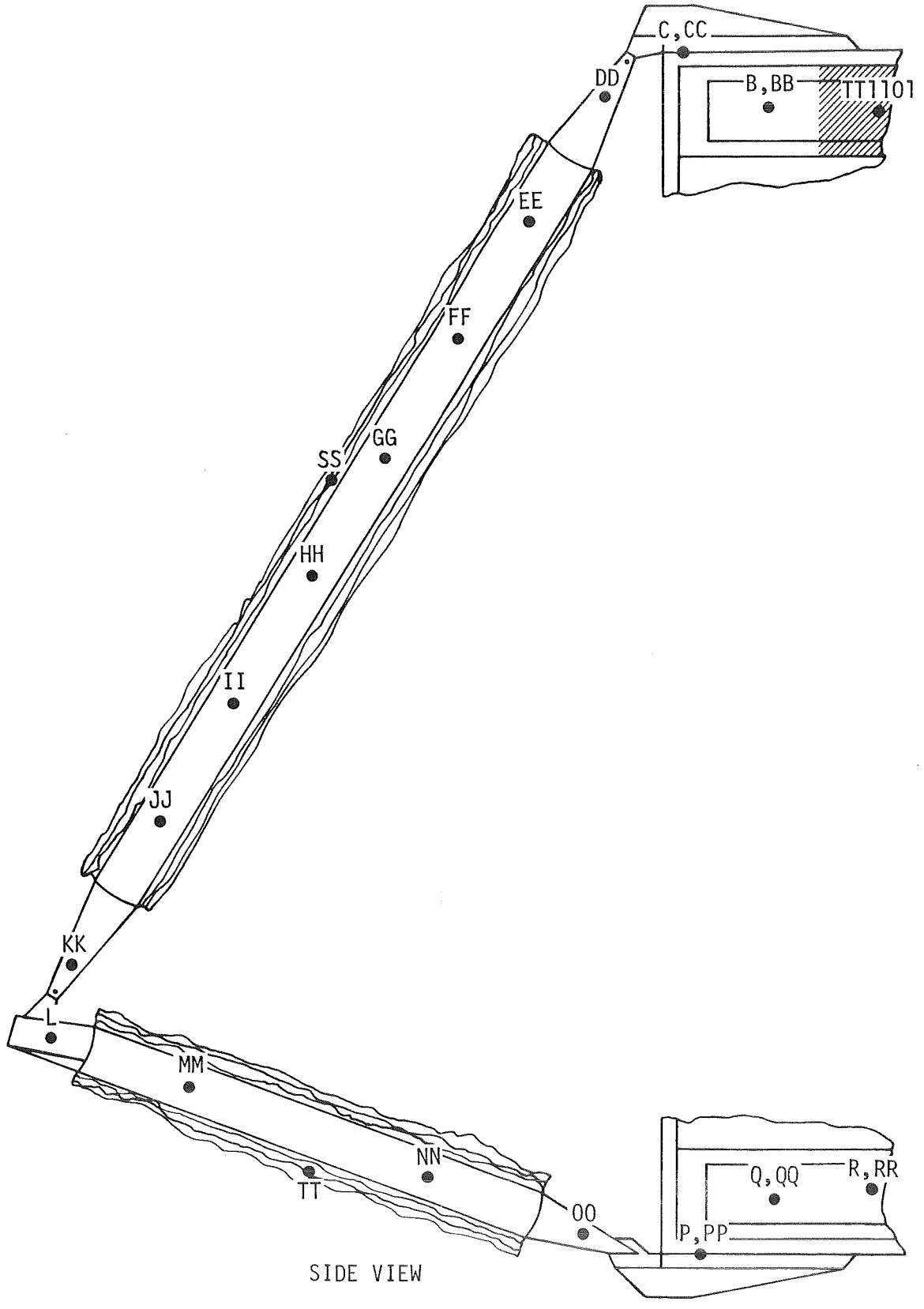
SIDEWALL

FIGURE 2 STB PRESSURE SHELL AND DOCKING HATCH CLOSURE PLATE CORRELATED NODE LOCATIONS



FRONT VIEW

CORRELATED NODE LOCATIONS
(TRUSS SUPPORT 3)



SIDE VIEW

FIGURE 3 STB TRUSS SUPPORT CORRELATED NODE LOCATIONS

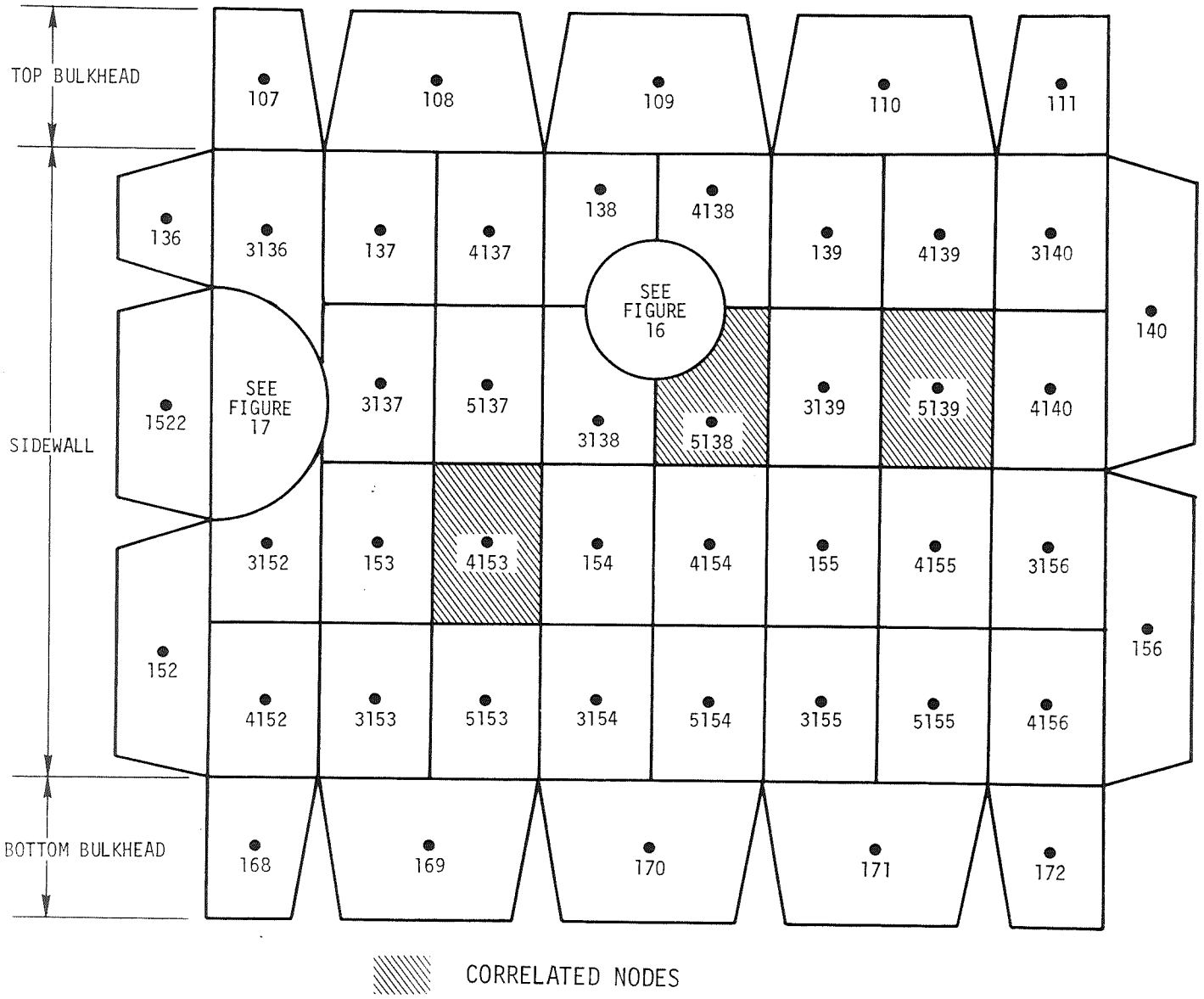
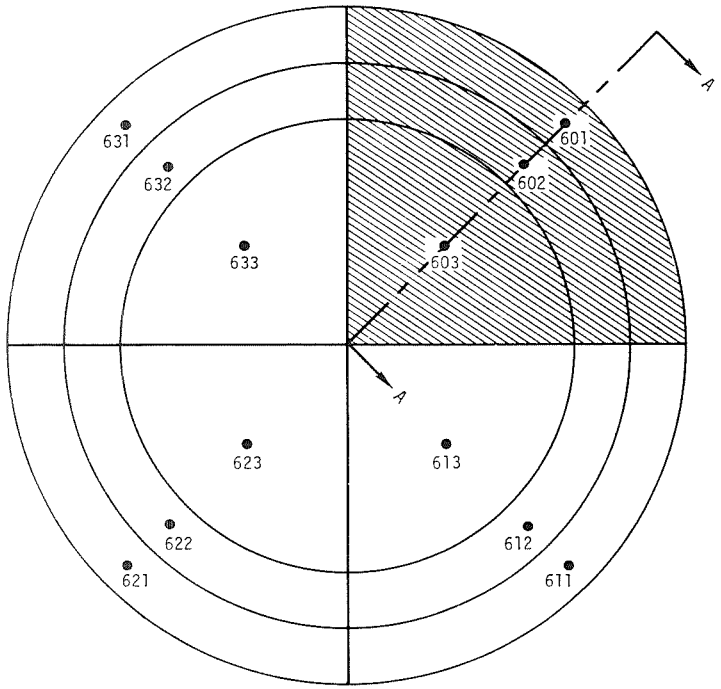
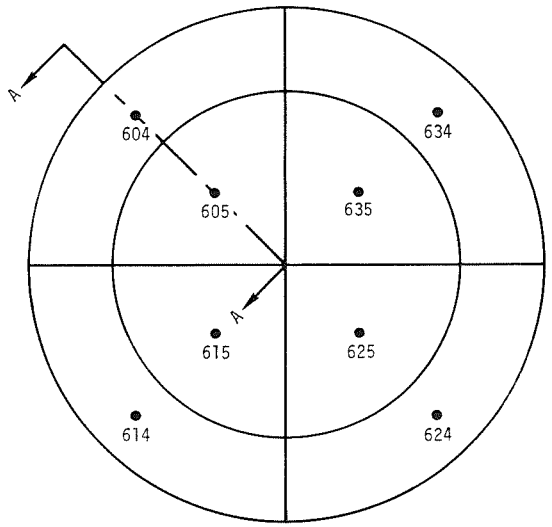


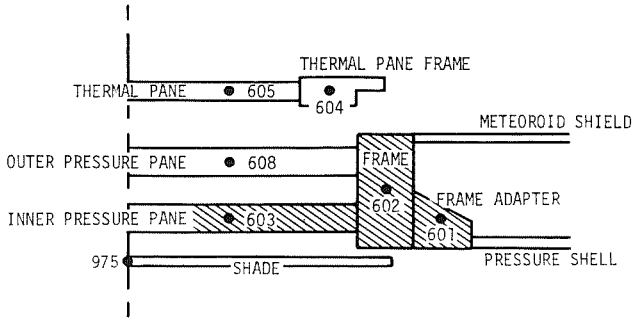
FIGURE 4 STB DETAILED PRESSURE SHELL CORRELATED NODE LOCATIONS



LOOKING AT WINDOW
FROM INSIDE STB



LOOKING AT WINDOW
FROM OUTSIDE STB



SECTION AA

CORRELATED NODES

FIGURE 5 STB WINDOW CORRELATED
NODE LOCATIONS

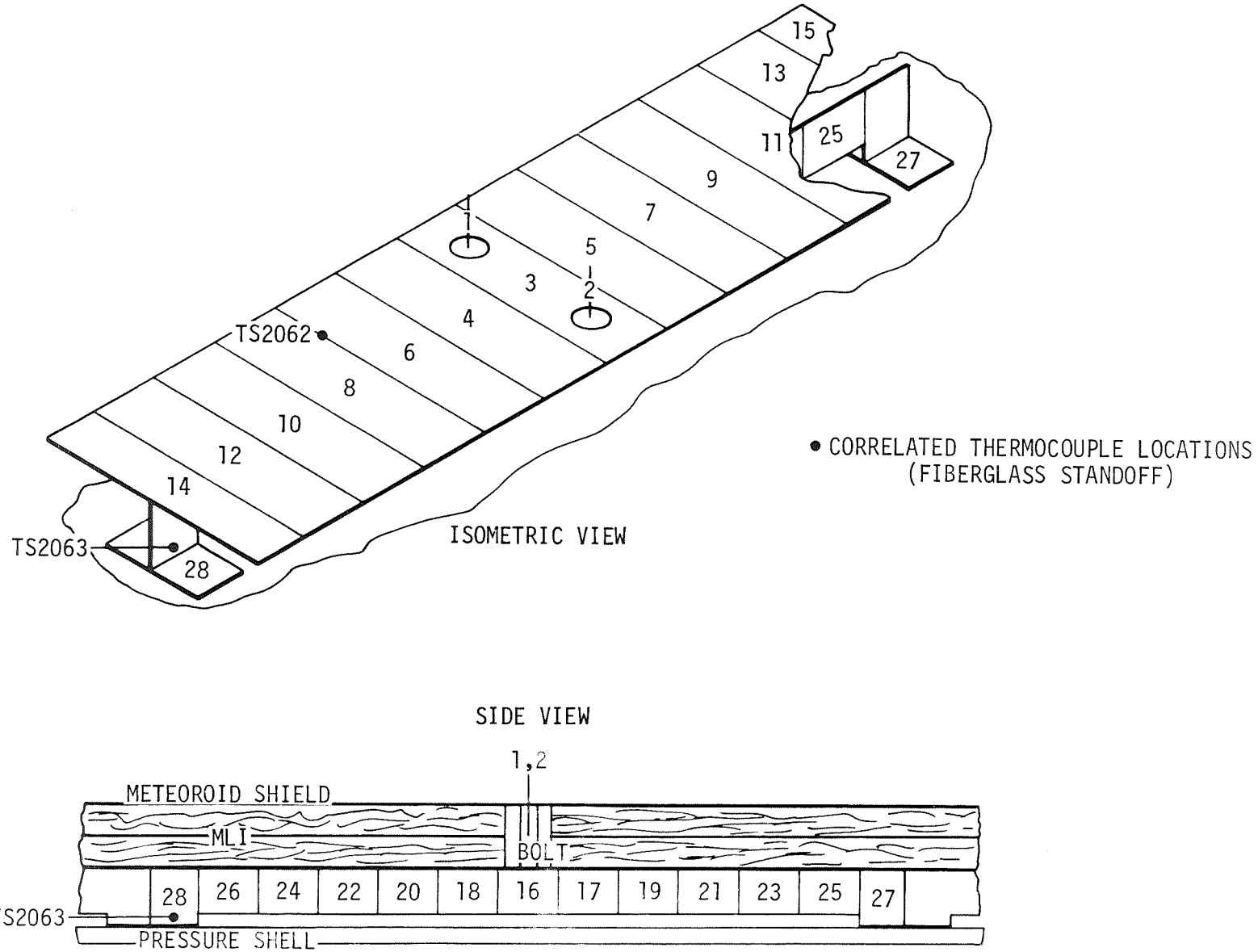
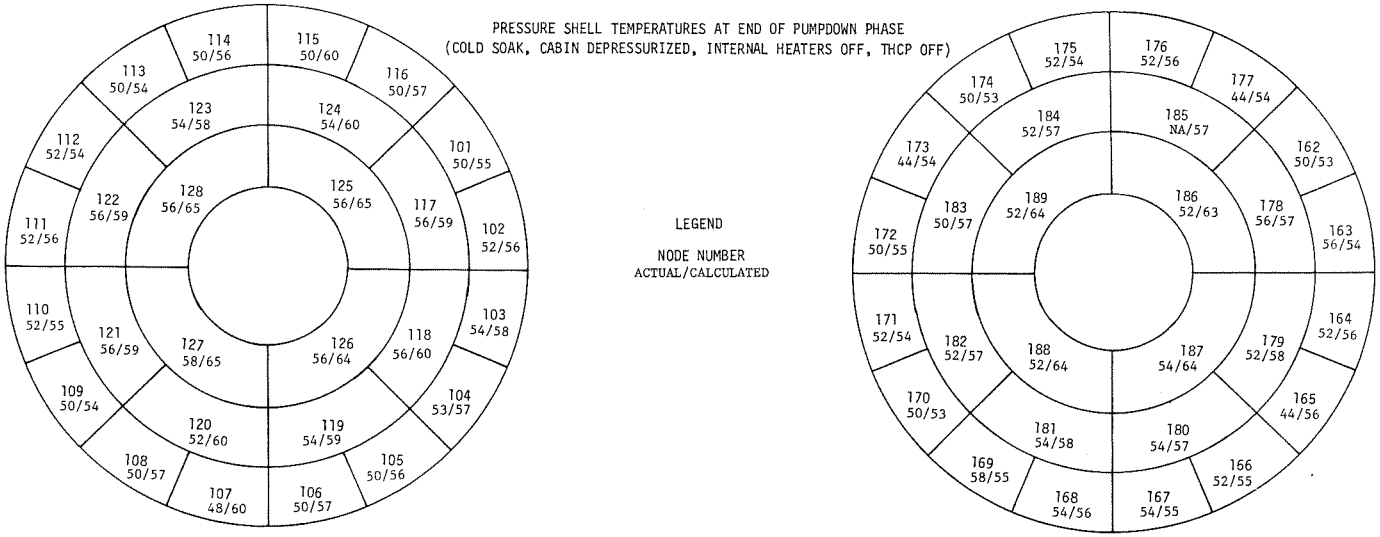


FIGURE 6 STB STANDOFF CORRELATED
NODE LOCATIONS

PRESSURE SHELL TEMPERATURES AT END OF PUMPDOWN PHASE
(COLD SOAK, CABIN DEPRESSURIZED, INTERNAL HEATERS OFF, THCP OFF)

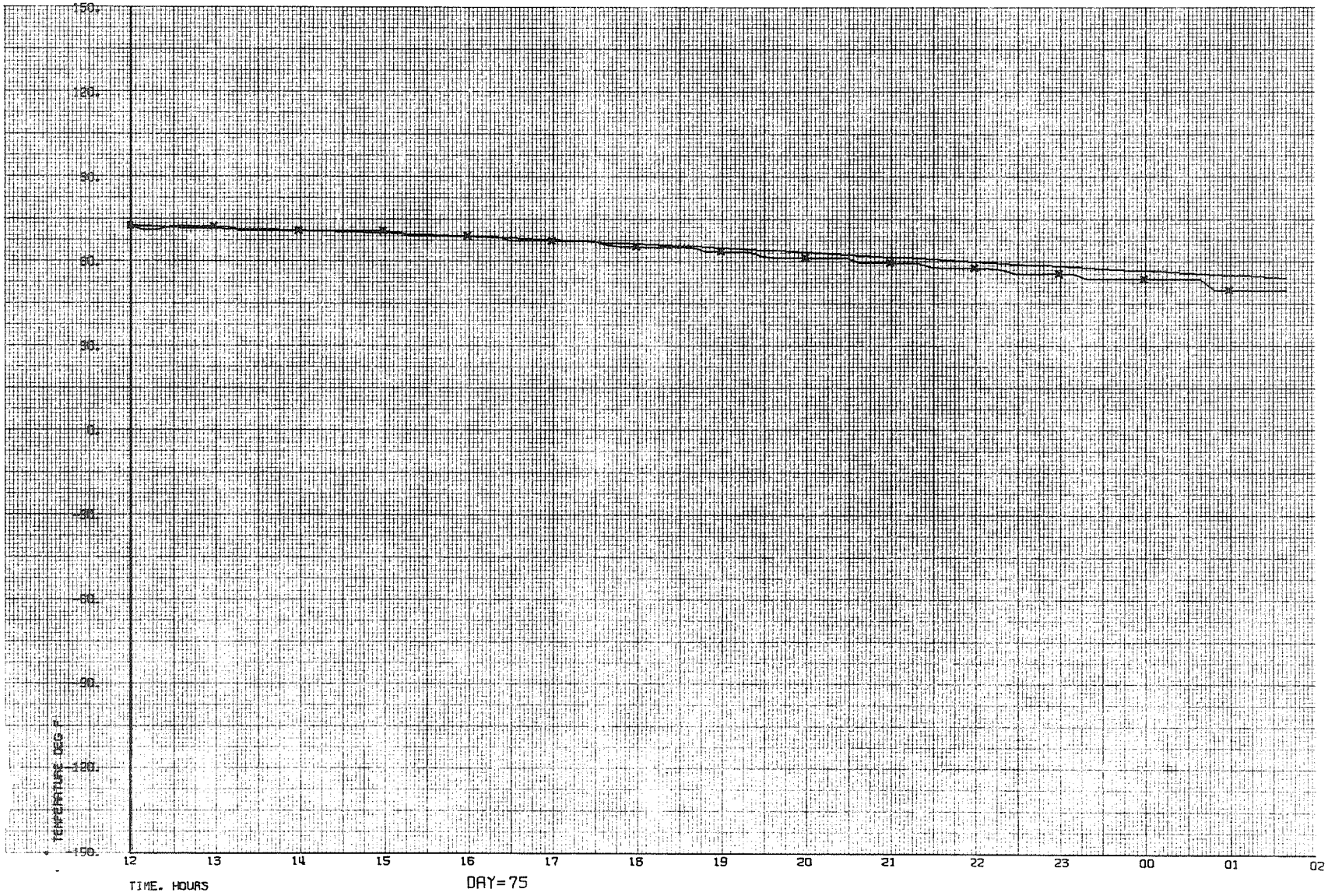


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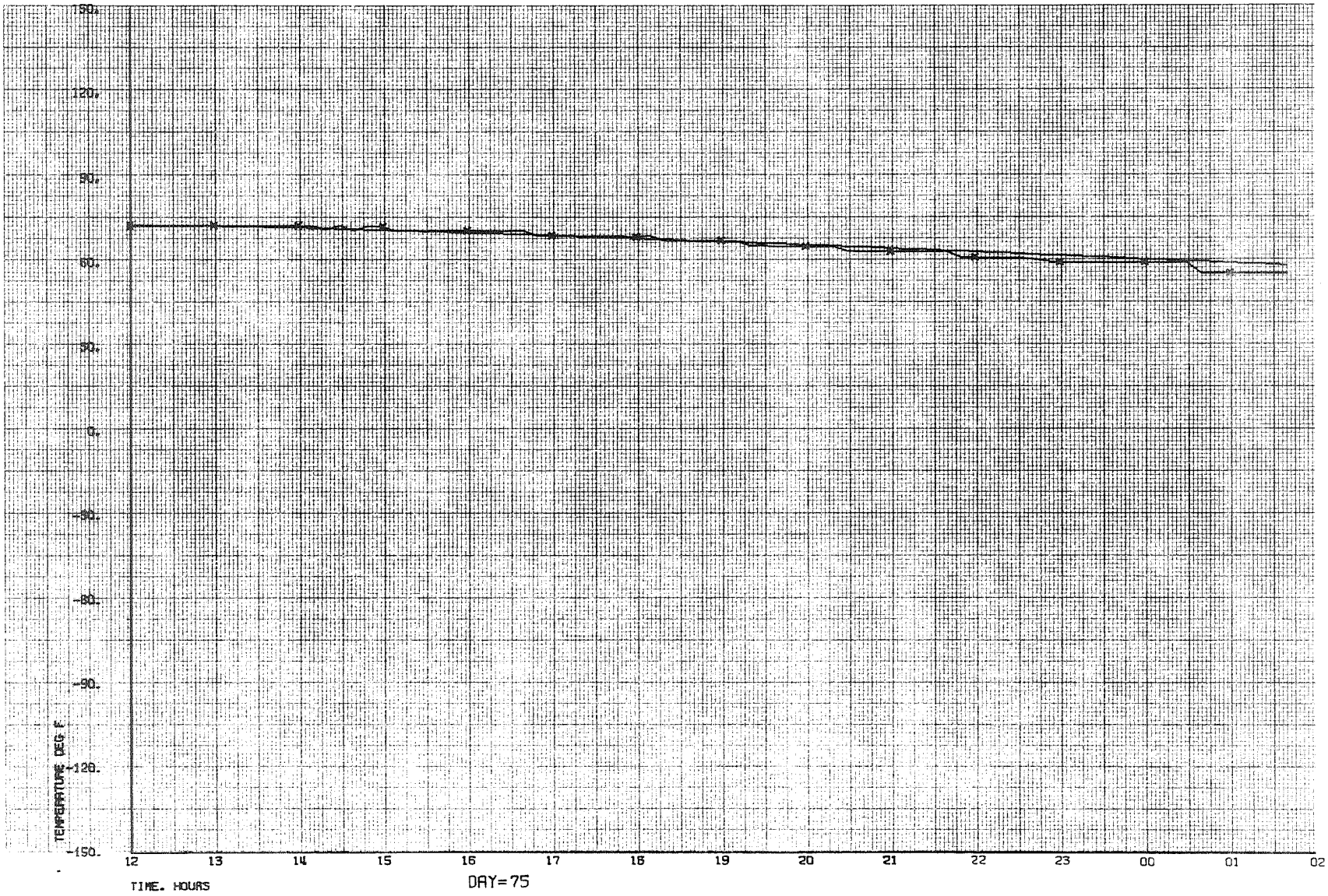
NODE NUMBER
ACTUAL/CALCULATED

130 44/53	131 NA/50	132 52/48	133 50/45	134 44/57	135 48/45	136 50/61	137 50/57	138 44/53	139 50/47	140 50/45	141 48/44	142 44/50	143 48/45	144 50/61	145 50/50
146 48/45	147 50/49	148 52/49	149 52/45	150 50/45	151 54/42	152 52/52	153 52/46	154 50/47	155 50/47	156 50/46	157 48/44	158 50/45	159 50/44	160 52/52	161 52/45

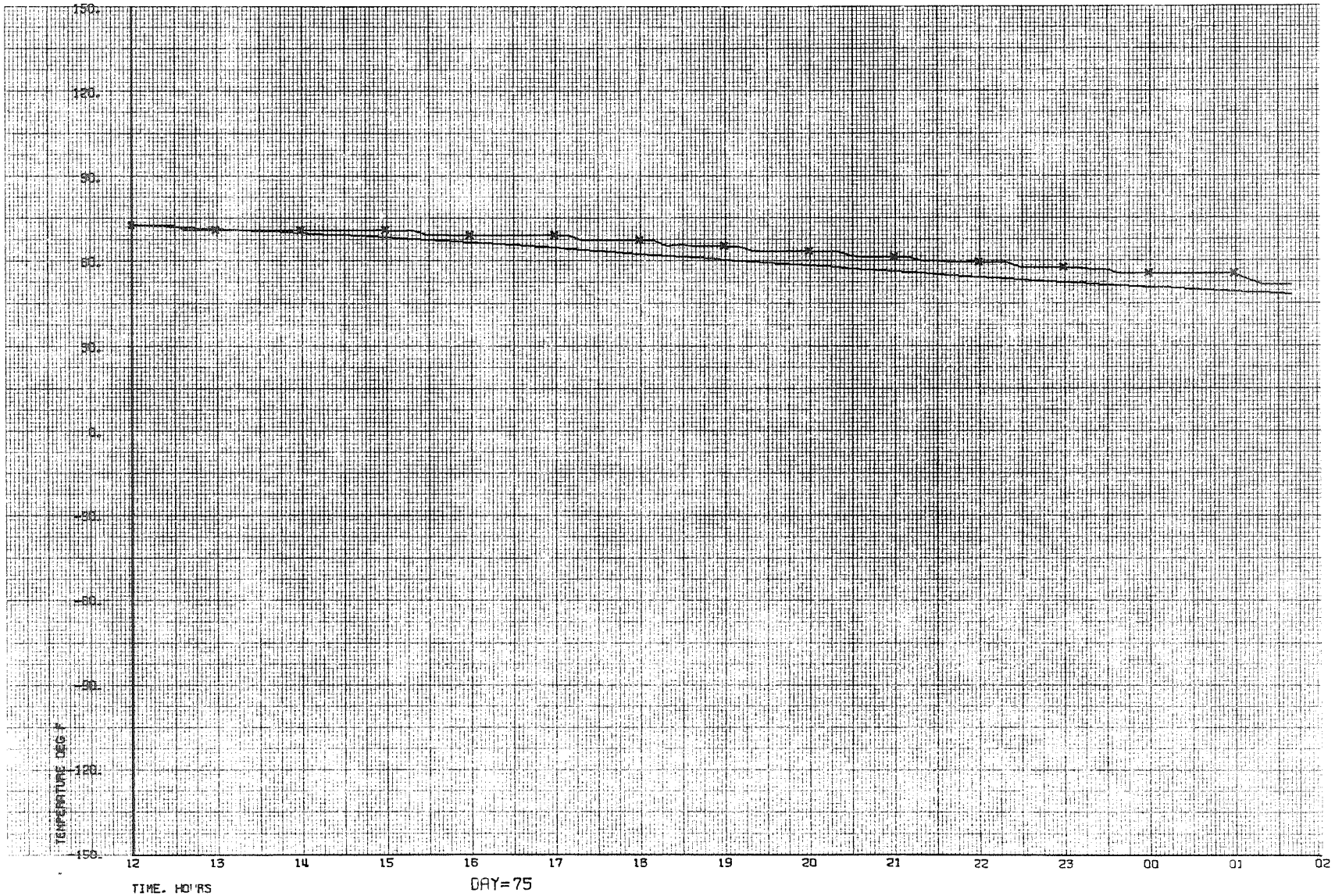
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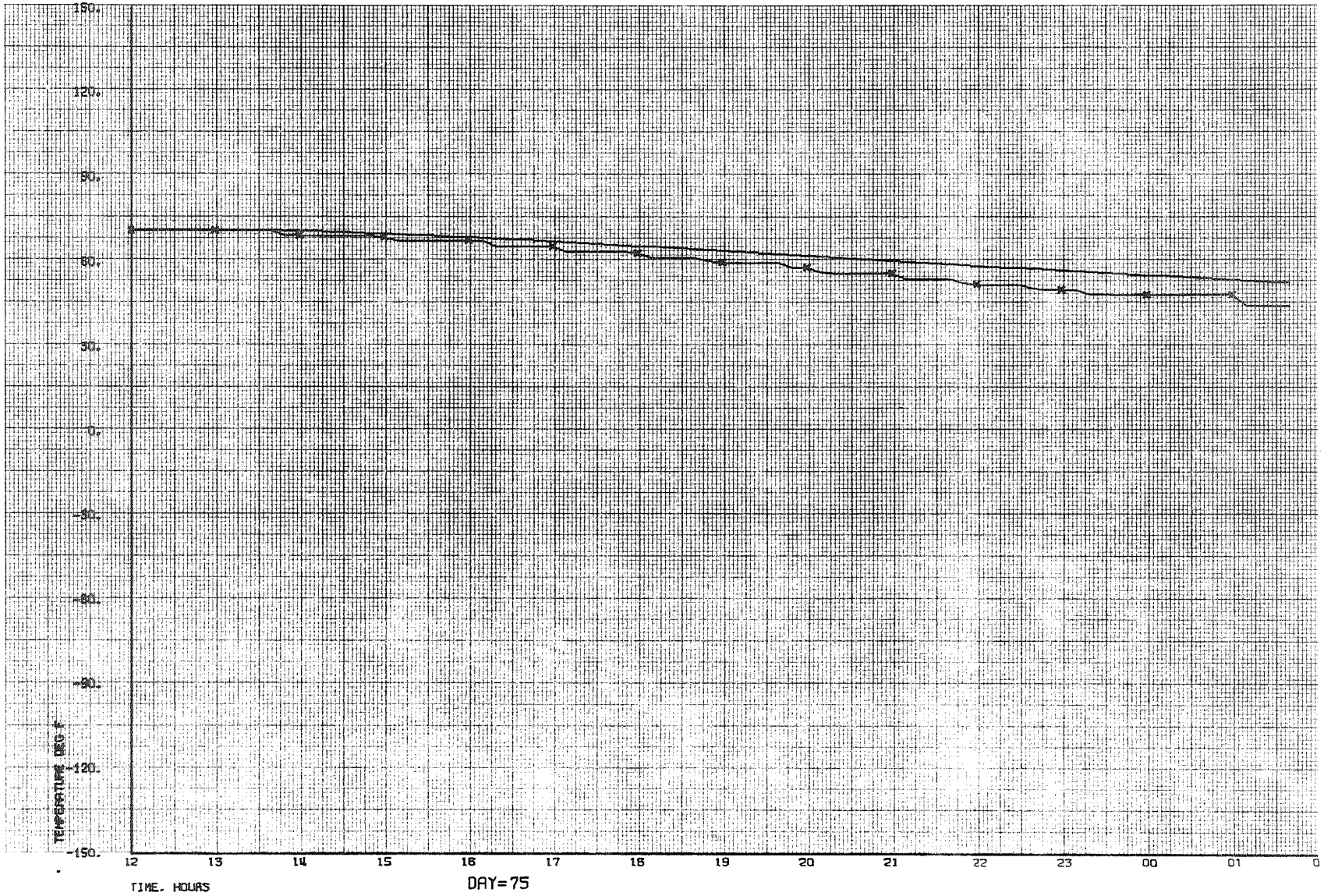
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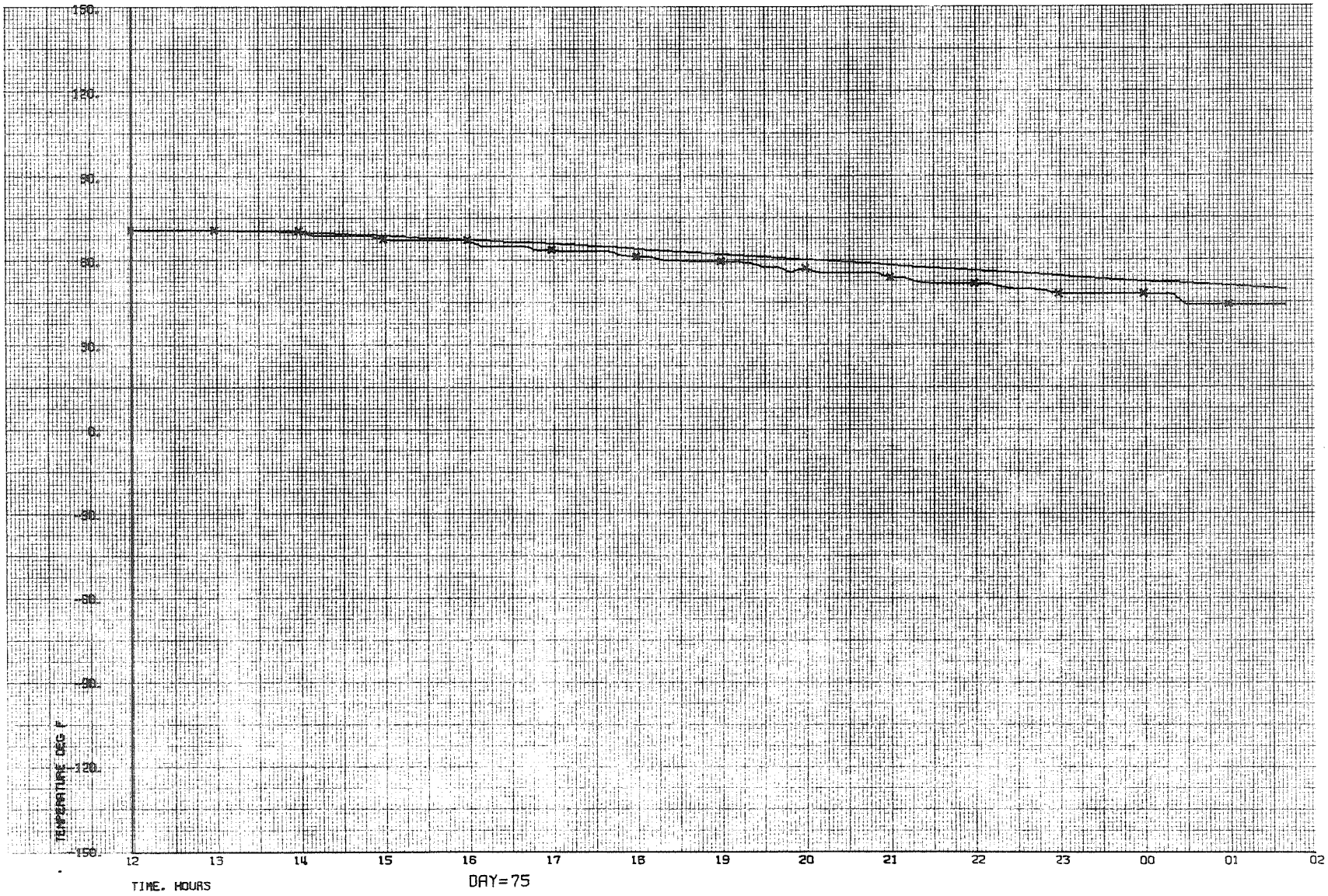
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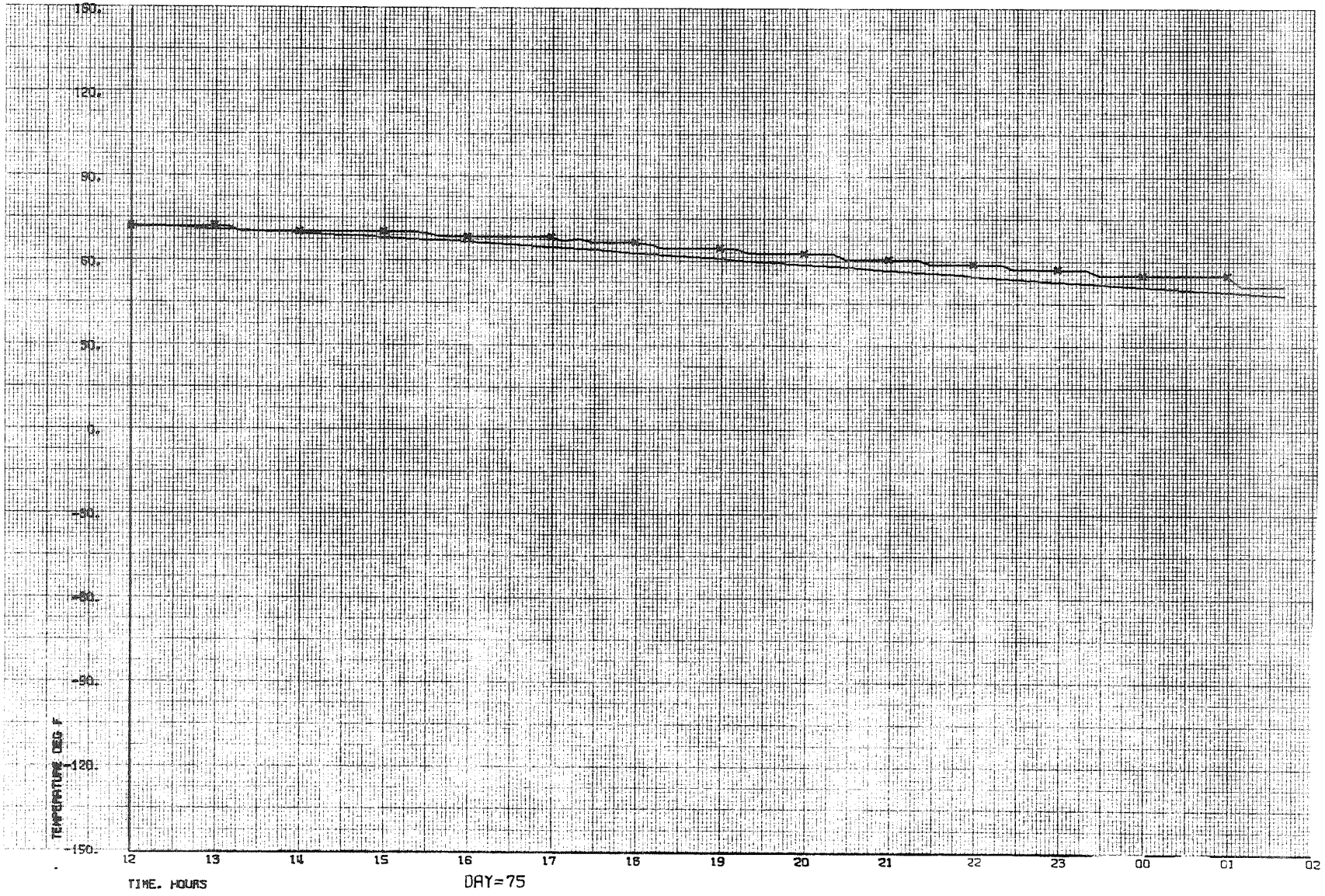
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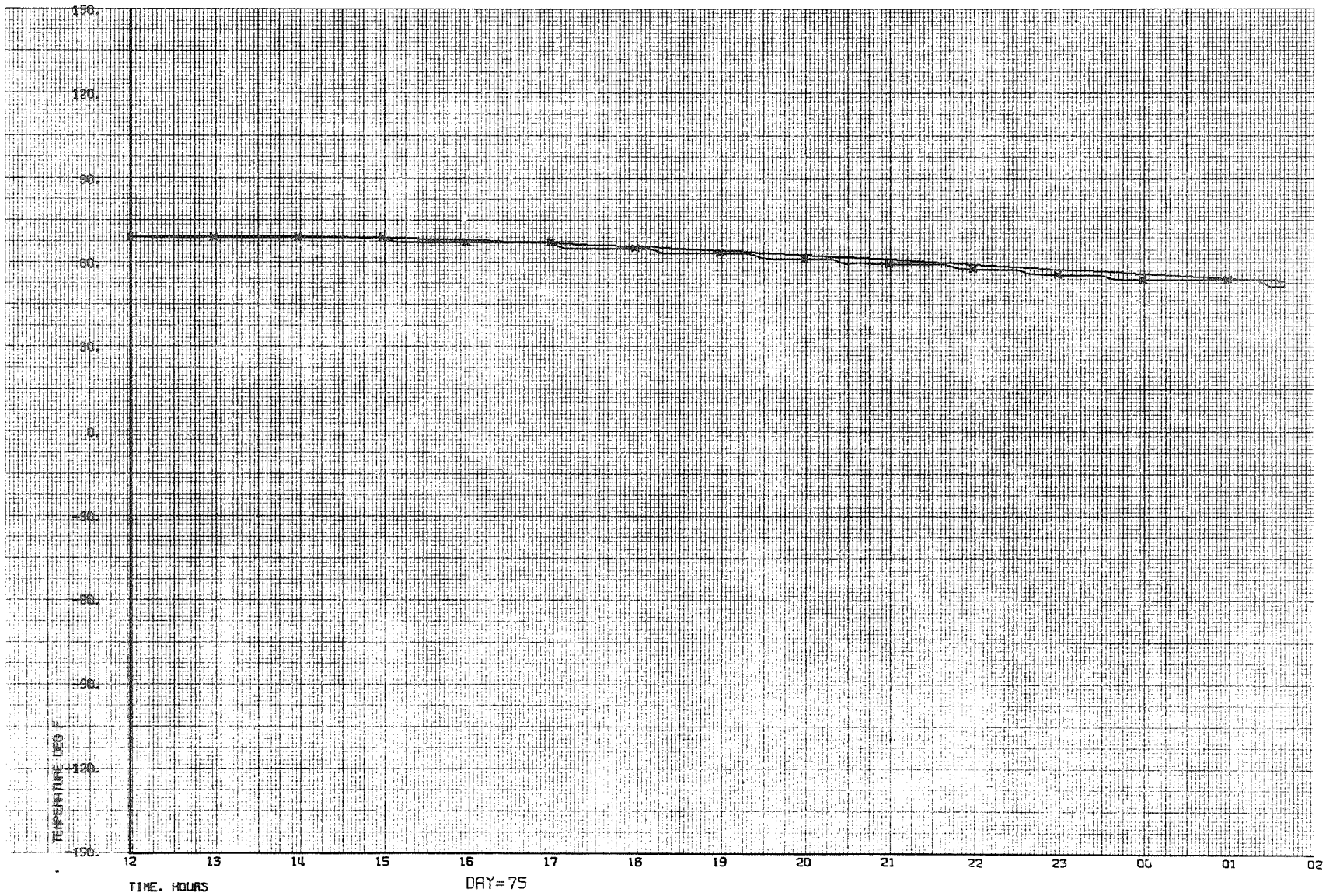
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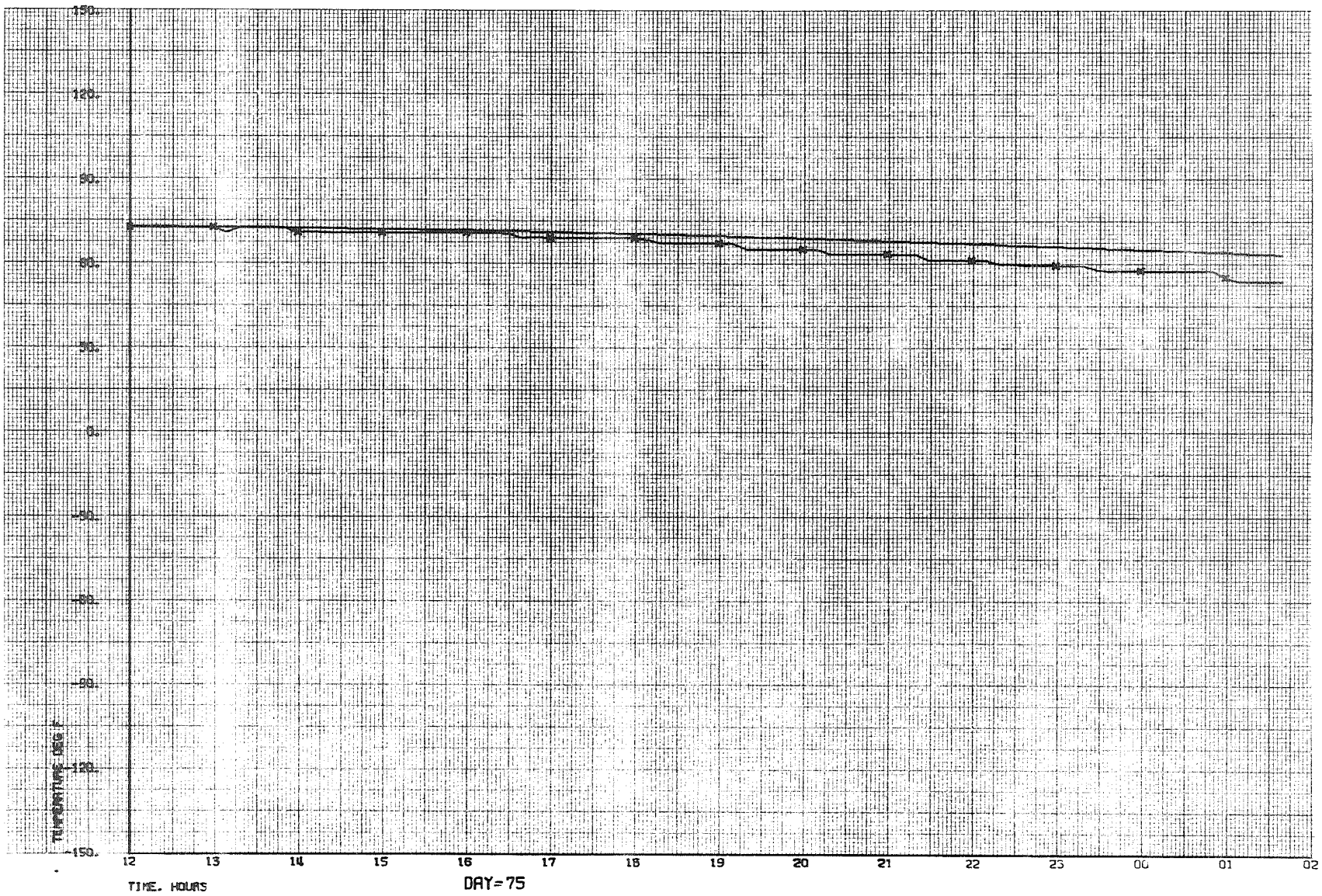
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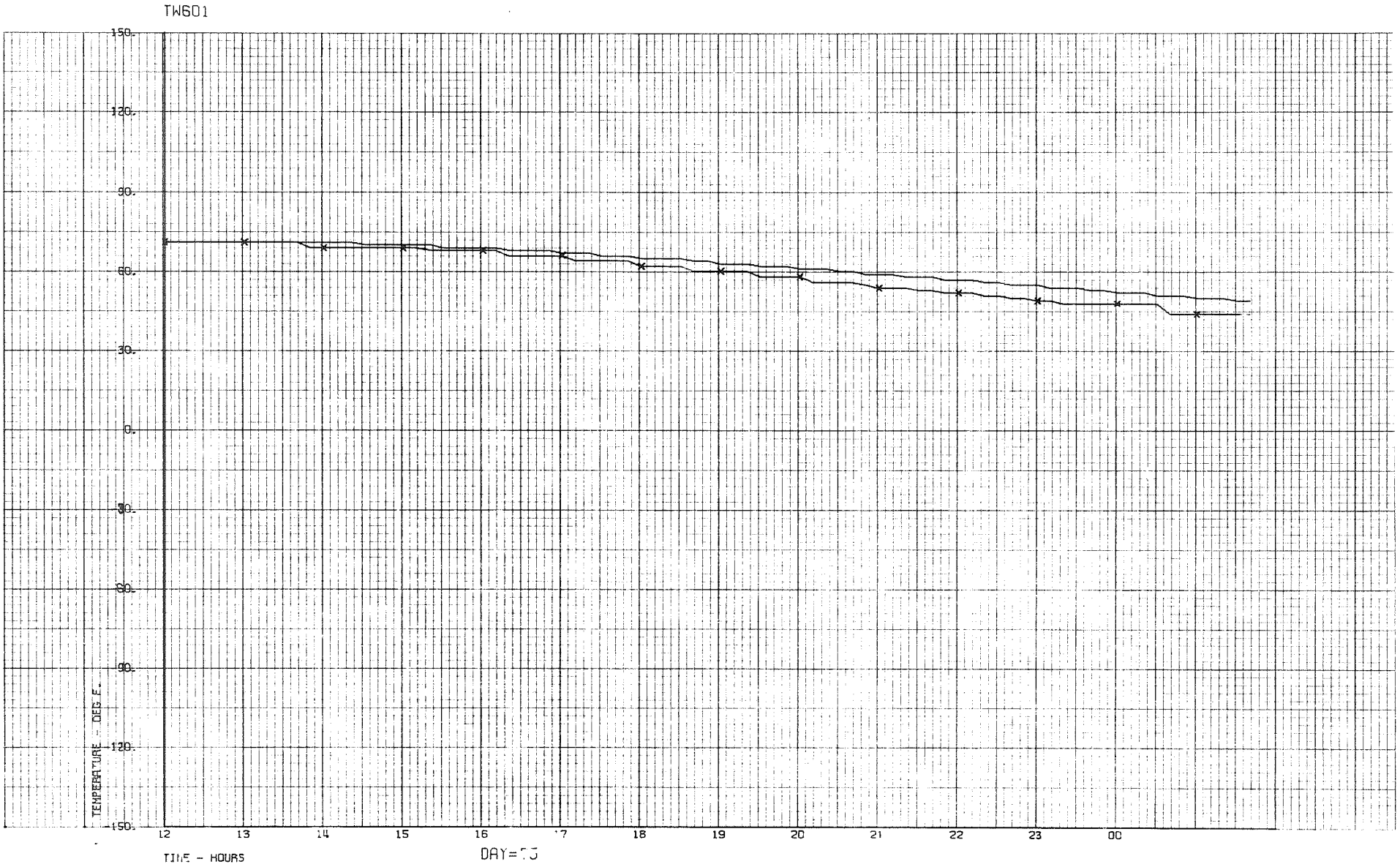

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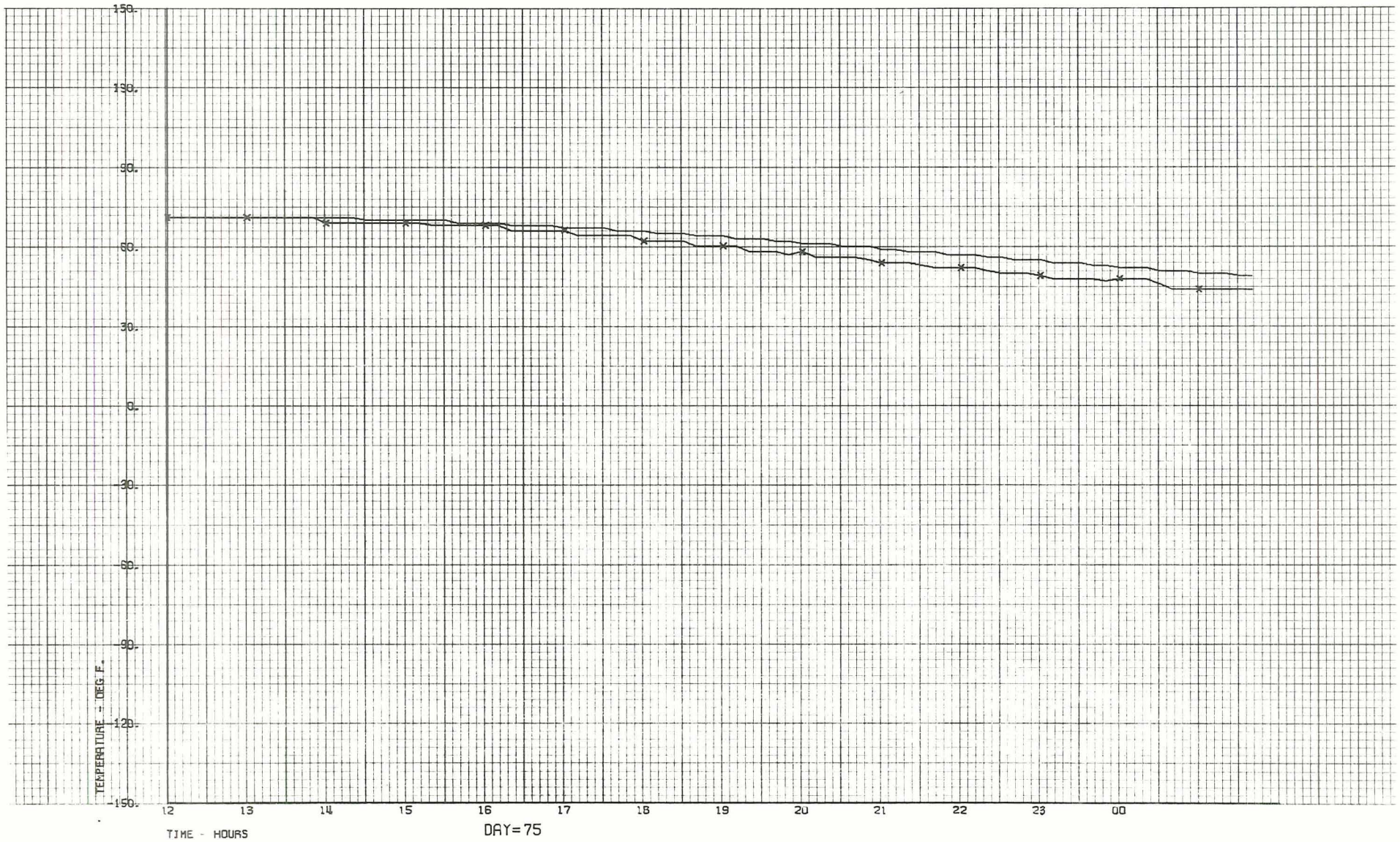

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TIME. HOURS
DAY=75

TH0522


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
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02
TIME. HOURS
DAY=75

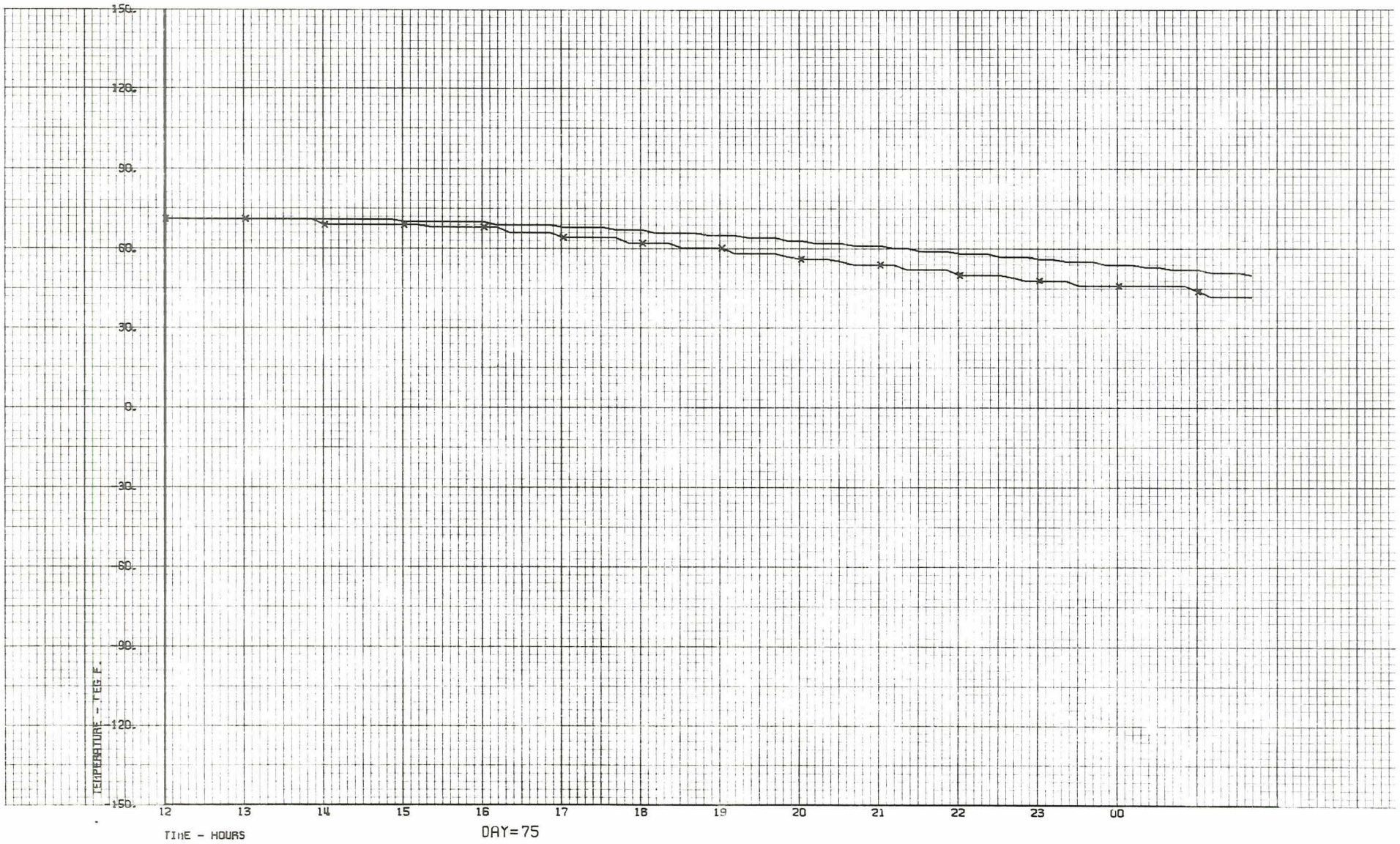

TW601
150.
120.
90.
60.
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-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
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TIME - HOURS
DAY=75

TW602


150.
120.
90.
60.
30.
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-30.
-60.
-90.
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TEMPERATURE - DEG.F.
12
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TIME - HOURS

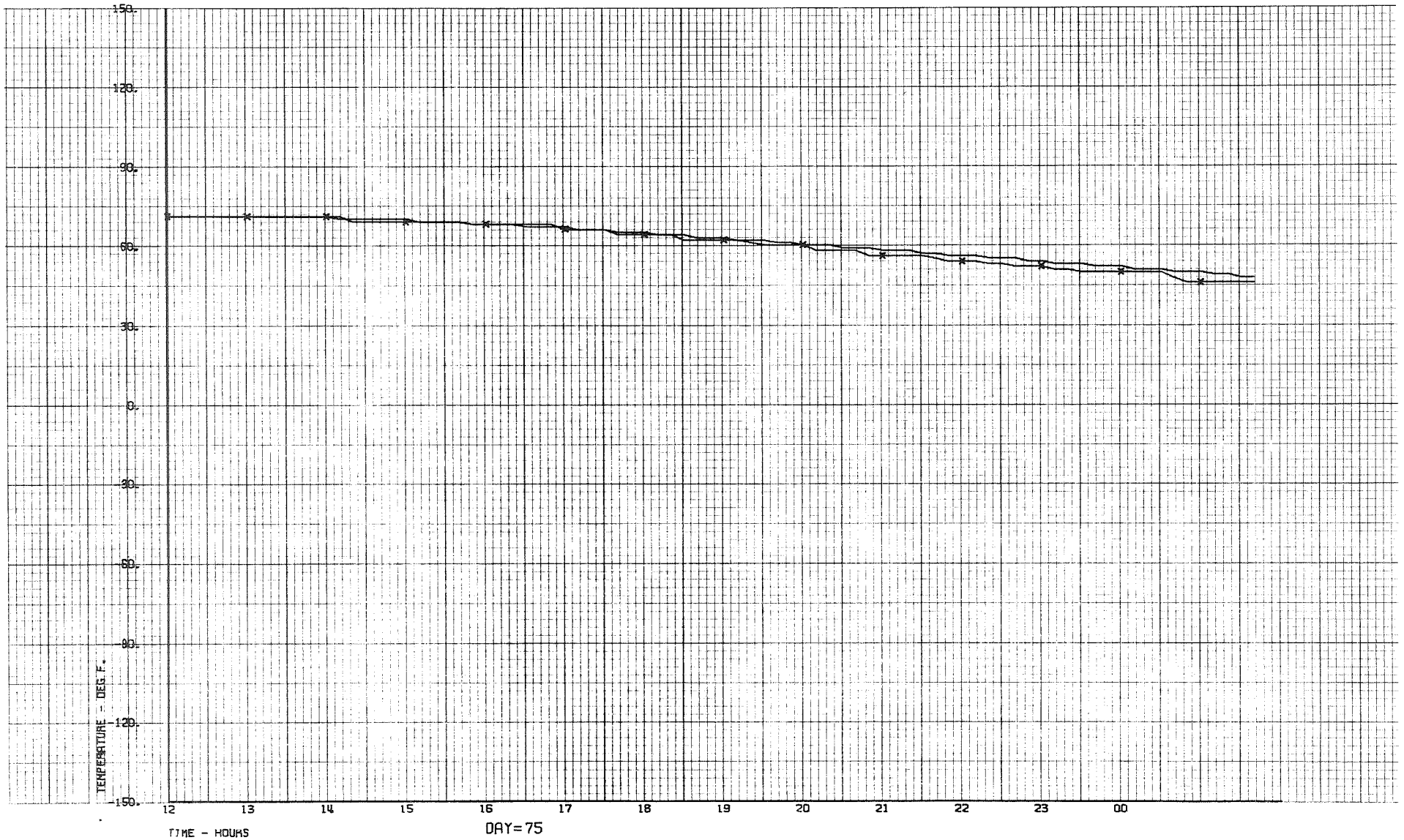
DAY=75

TW603

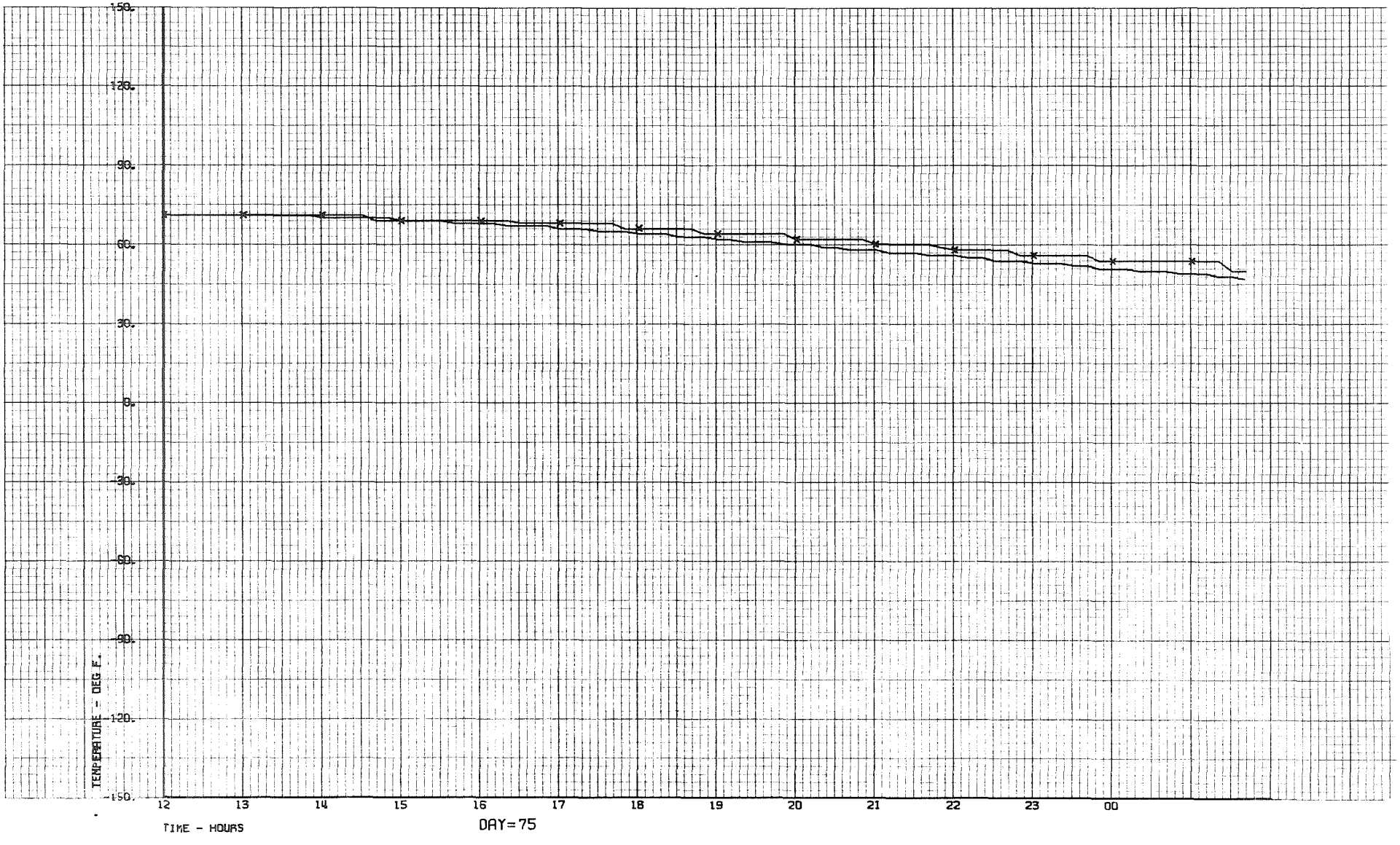

150.
120.
90.
60.
30.
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-30.
-60.
-90.
-120.
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TEMPERATURE - DEG. F.
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TIME - HOURS

DAY=75

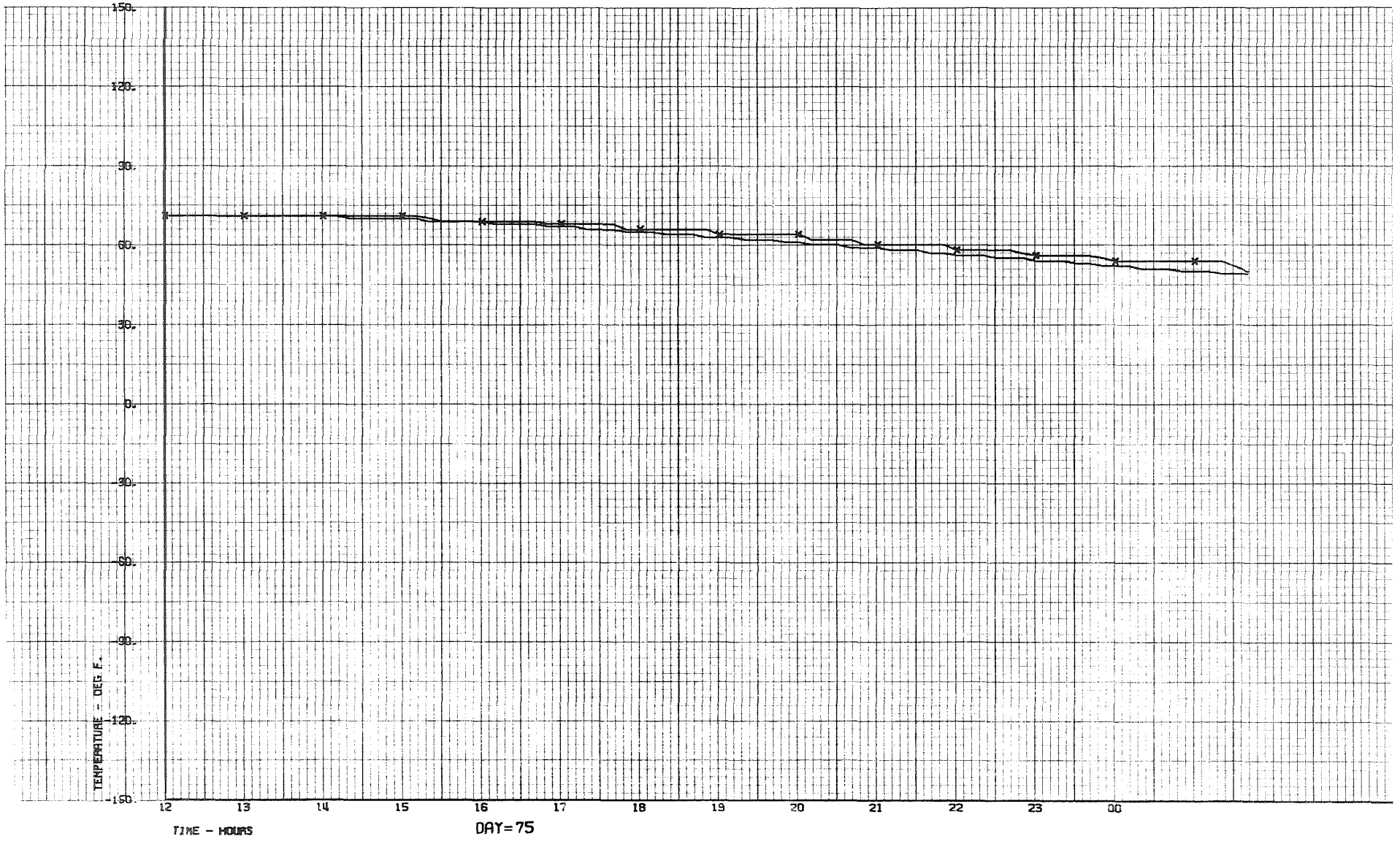
TP5138


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TEMPERATURE - DEG F.
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TIME - HOURS
DAY=75

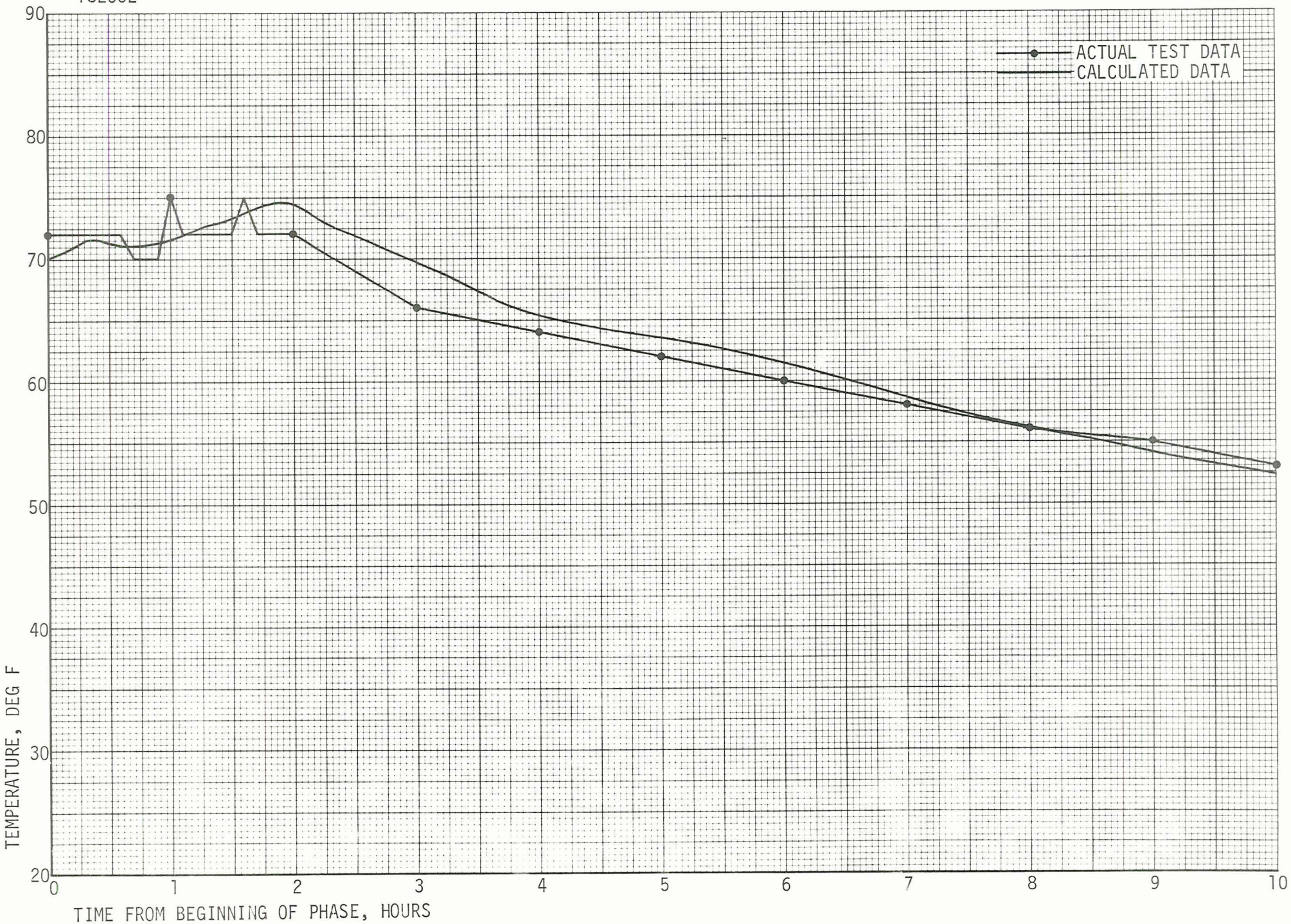
TP5139

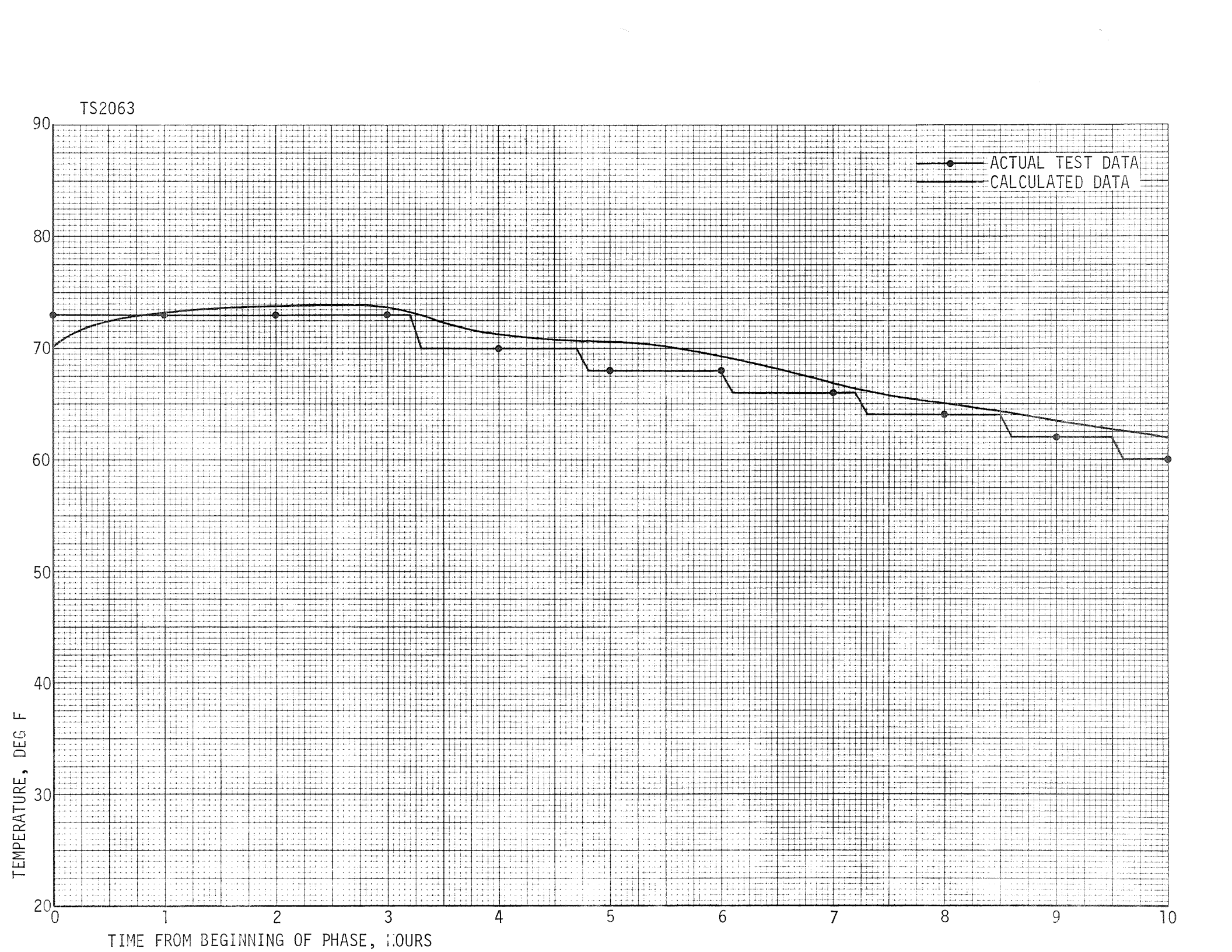

150.
120.
90.
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30.
0.
-30.
-60.
-90.
-120.
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TEMPERATURE - DEG F.
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TIME - HOURS
DAY=75

TP4158

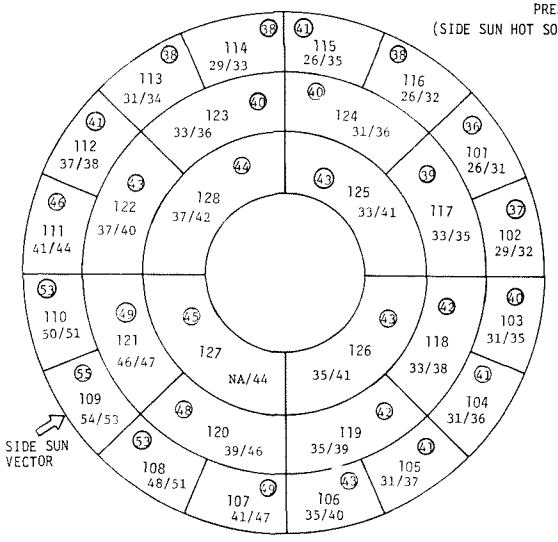

150.
120.
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-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG. F.
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TIME - HOURS
DAY=75

TS2062


ACTUAL TEST DATA
CALCULATED DATA
90
80
70
60
50
40
30
20
0
1
2
3
4
5
6
7
8
9
10
TEMPERATURE, DEG F
TIME FROM BEGINNING OF PHASE, HOURS


TS2063
ACTUAL TEST DATA
CALCULATED DATA
90
80
70
60
50
40
30
20
0
1
2
3
4
5
6
7
8
9
10
TEMPERATURE, DEG F
TIME FROM BEGINNING OF PHASE, HOURS

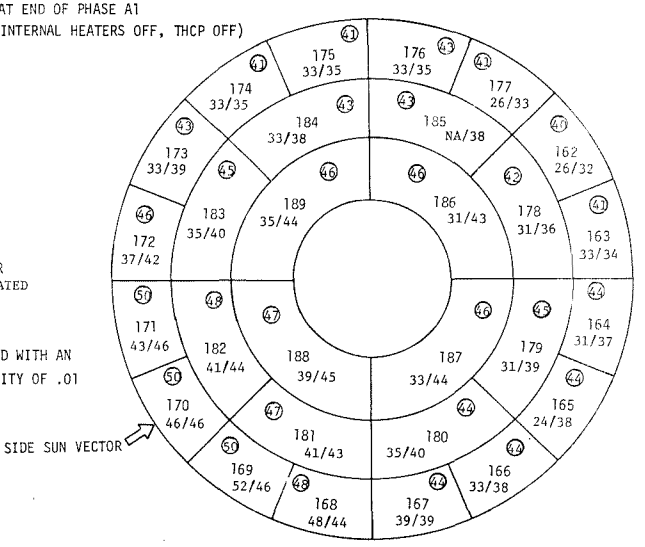
PRESSURE SHELL TEMPERATURES AT END OF PHASE A1
(SIDE SUN HOT SOAK, CABIN DEPRESSURIZED, INTERNAL HEATERS OFF, THCP OFF)



LEGEND

NODE NUMBER
ACTUAL/CALCULATED

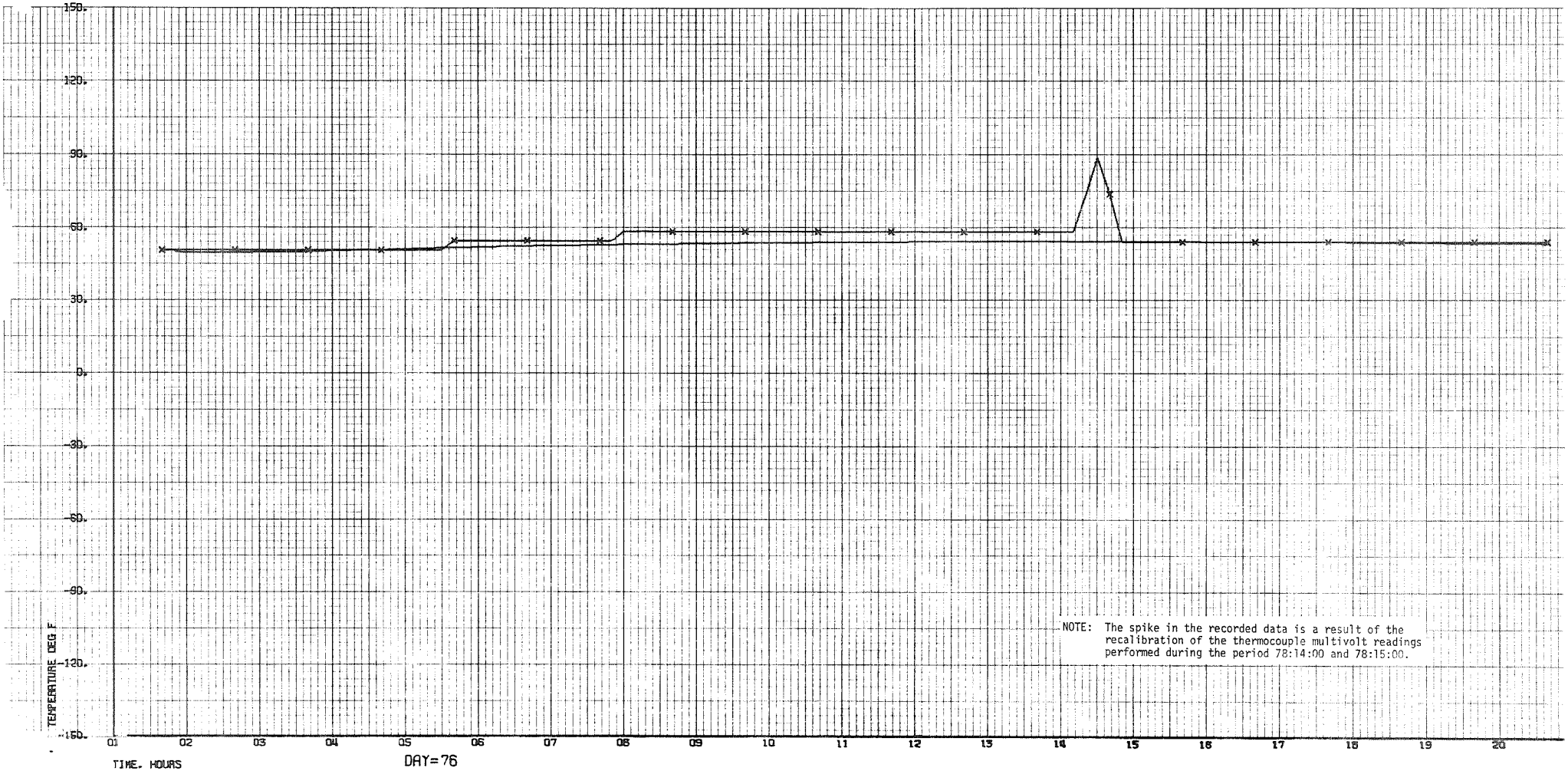
○ TEMPERATURE CALCULATED WITH AN MLI EFFECTIVE EMISSIVITY OF .01



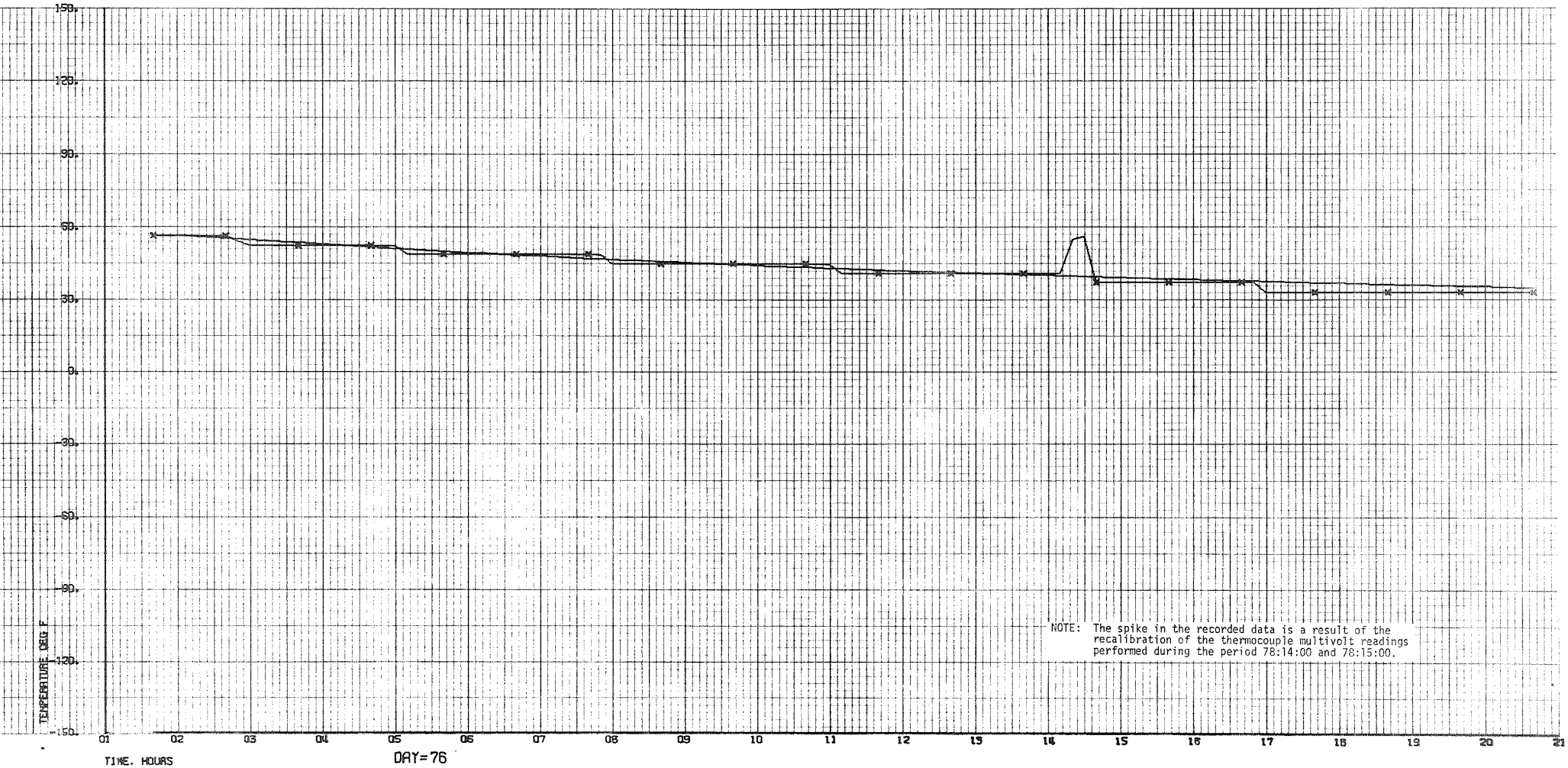
SIDE SUN VECTOR CENTER LINE

39 130 20/29	41 131 29/31	42 132 35/29	39 133 31/23	42 134 26/34	44 135 39/40	52 136 48/51	62 137 48/61	62 138 70/59	62 139 54/62	56 140 43/55	49 141 37/46	40 142 26/31	37 143 26/24	43 144 26/35	40 145 26/26
39 146 26/22	42 147 29/30	43 148 35/30	40 149 31/23	43 150 33/34	48 151 43/43	58 152 50/57	65 153 52/65	61 154 54/61	63 155 50/63	55 156 46/54	51 157 37/48	40 158 37/30	39 159 33/22	40 160 29/26	38 161 31/20

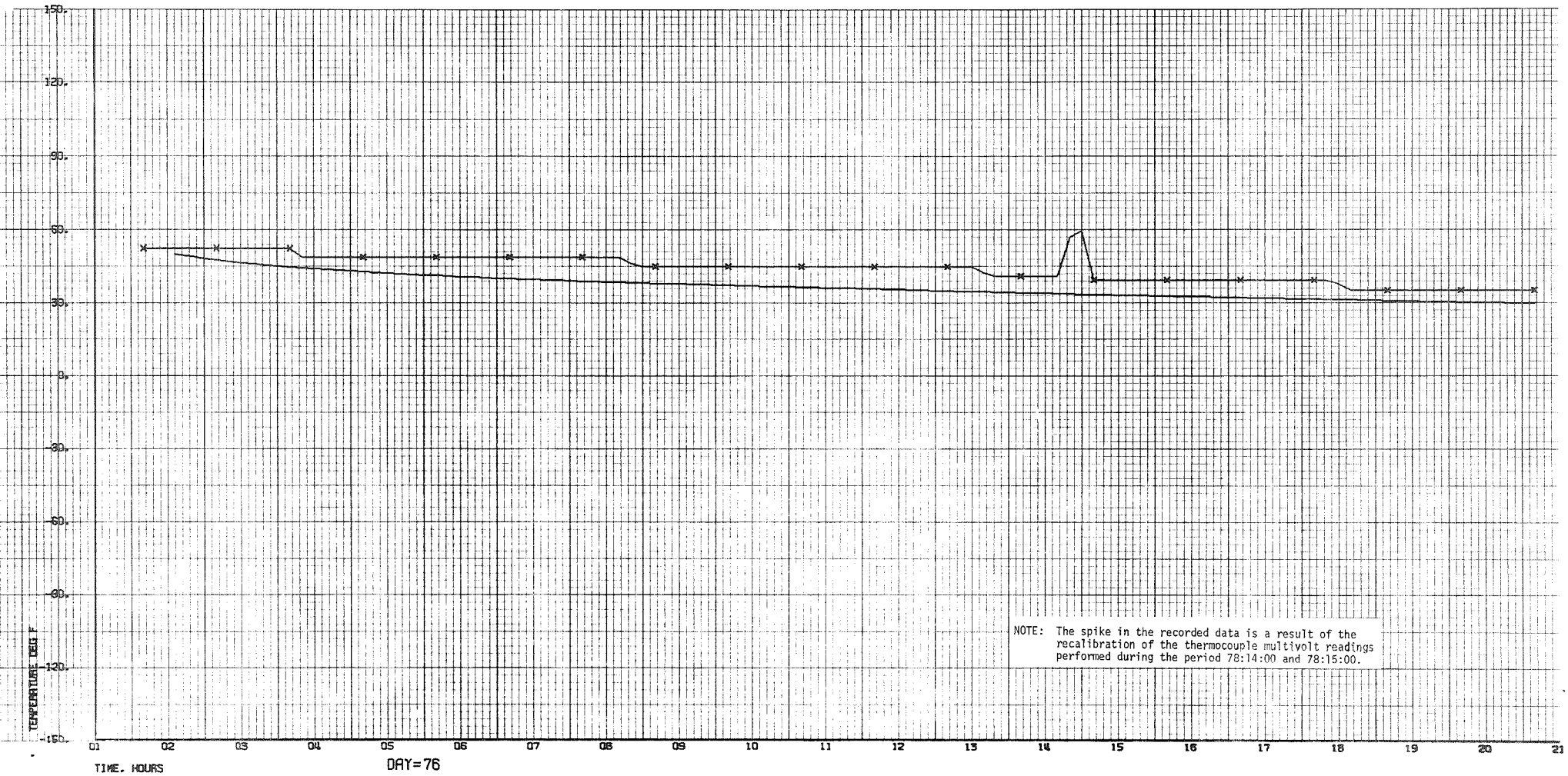
TP0109


150.
120.
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-90.
-120.
-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76
NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

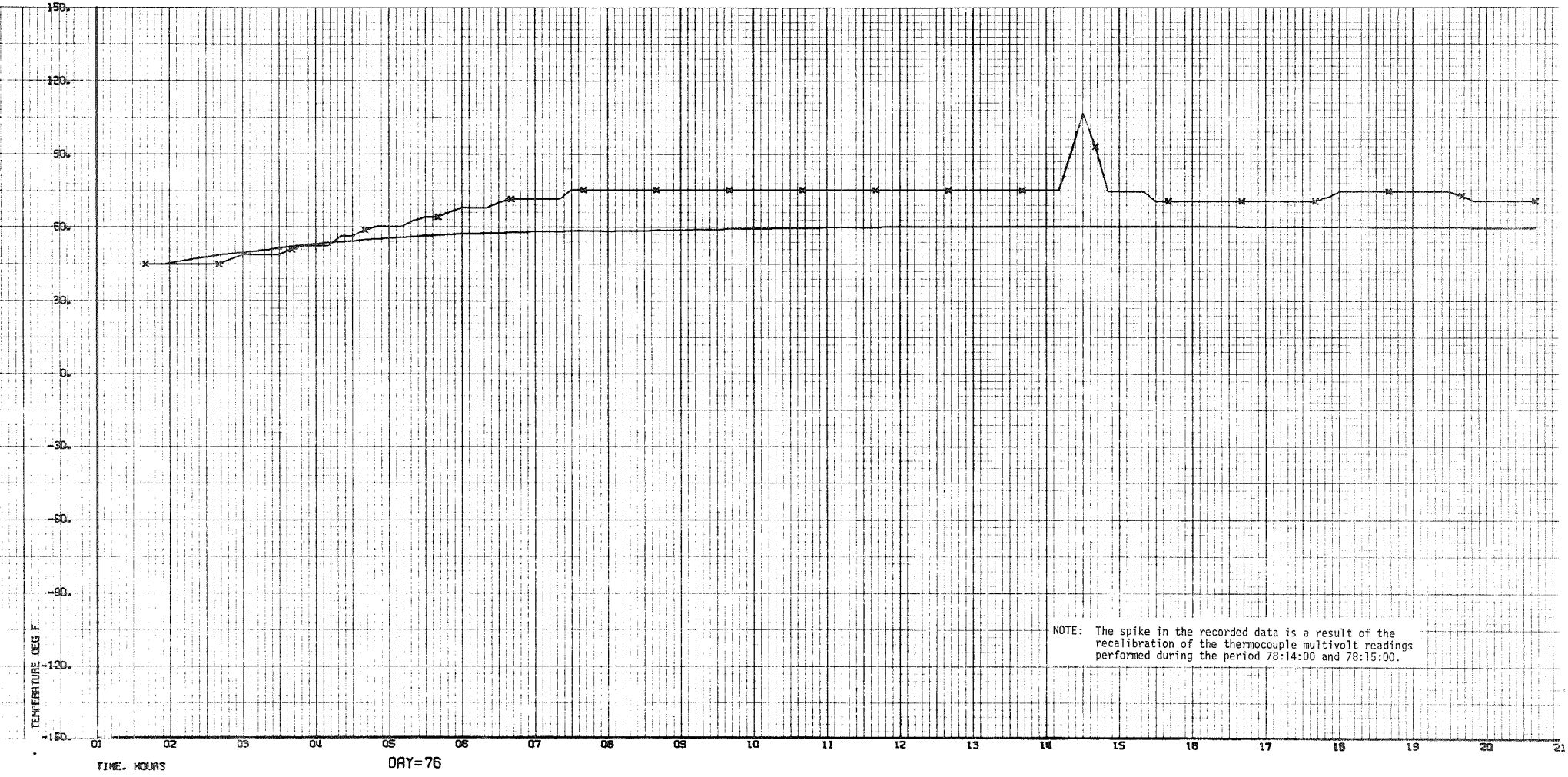
TP0117


150.
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-120.
-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76
NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

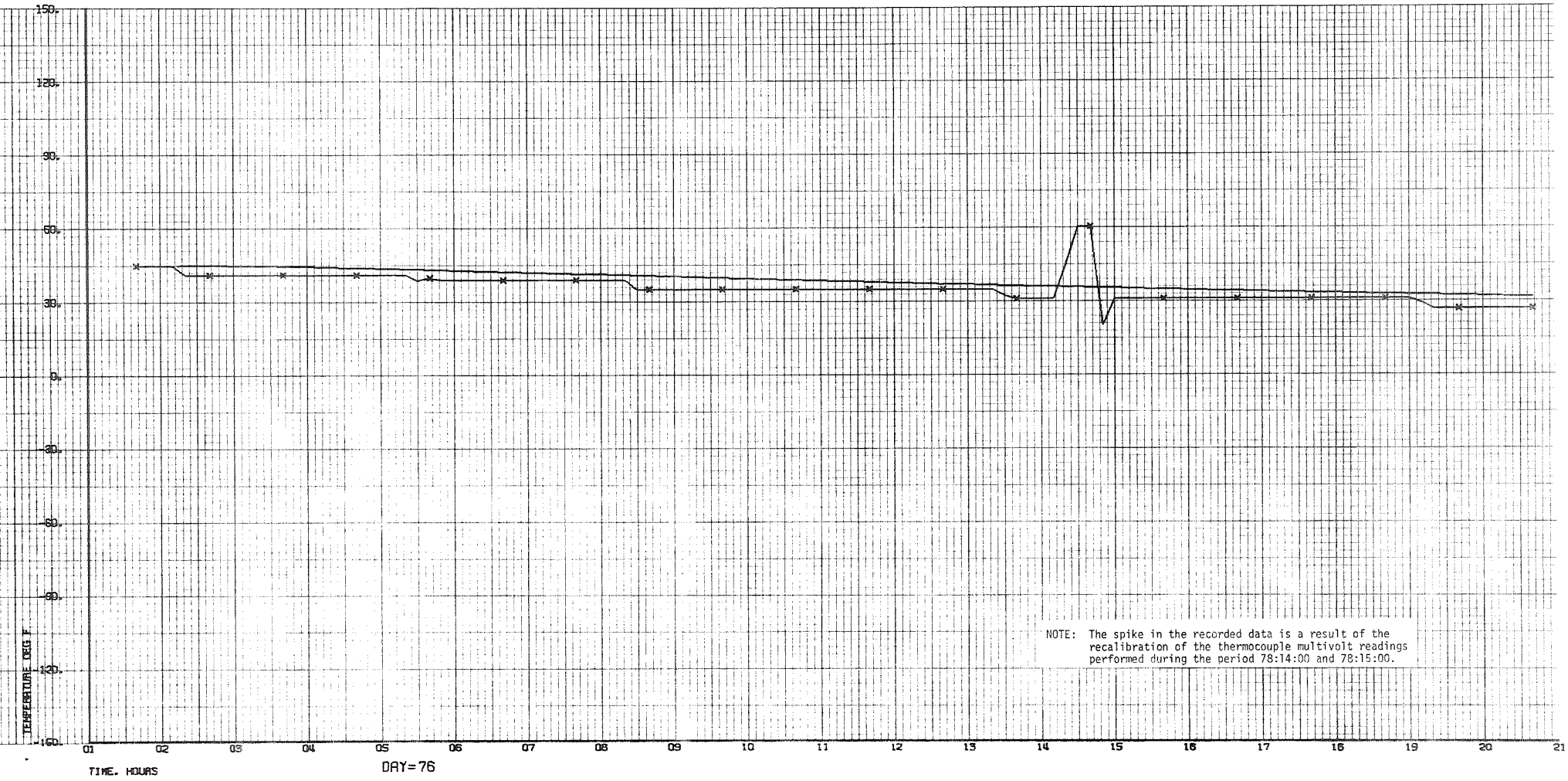
TP0132


150.
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90.
60.
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0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76
NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

TP0138

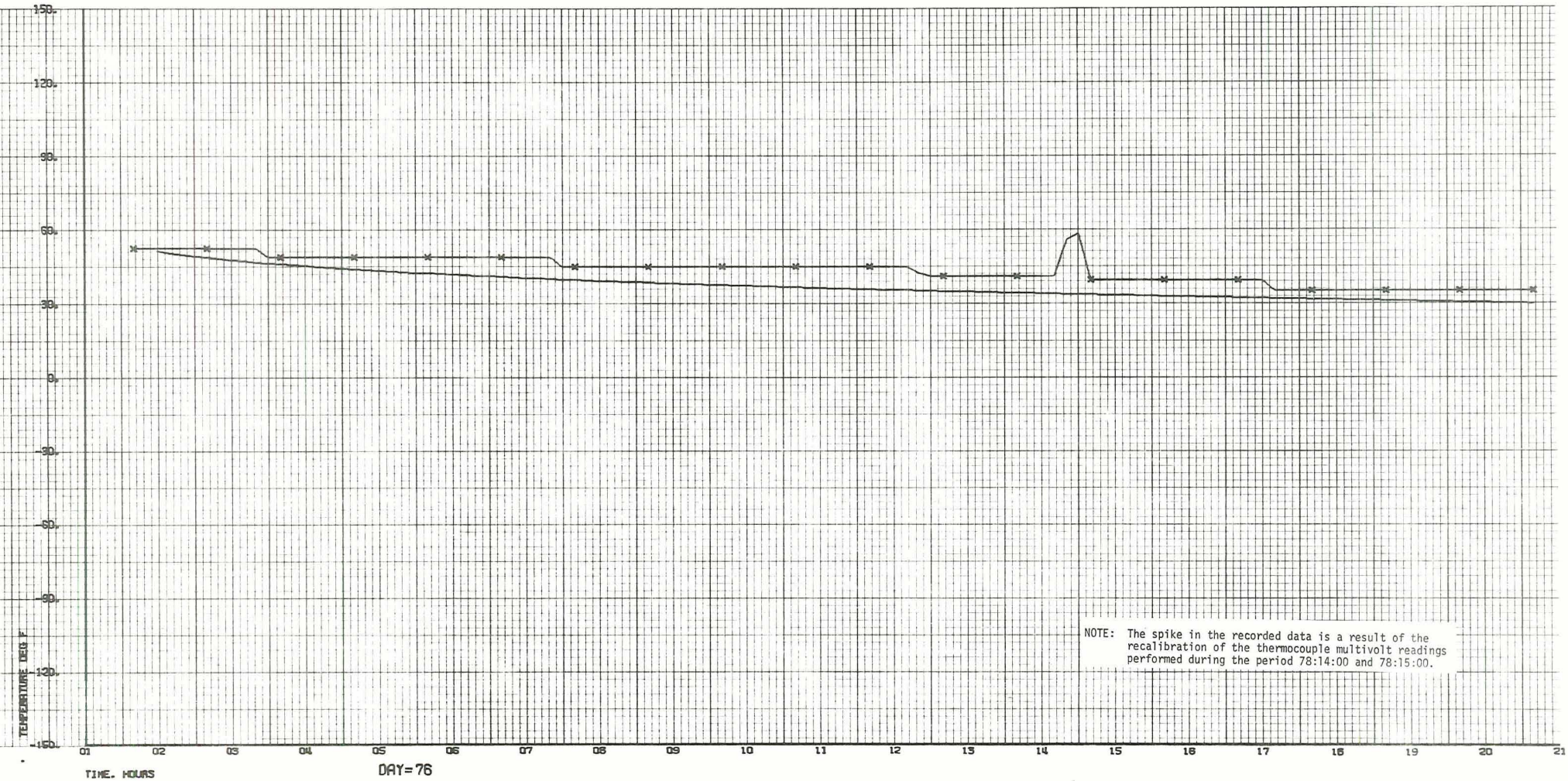

150.
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-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76
NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

TP0142

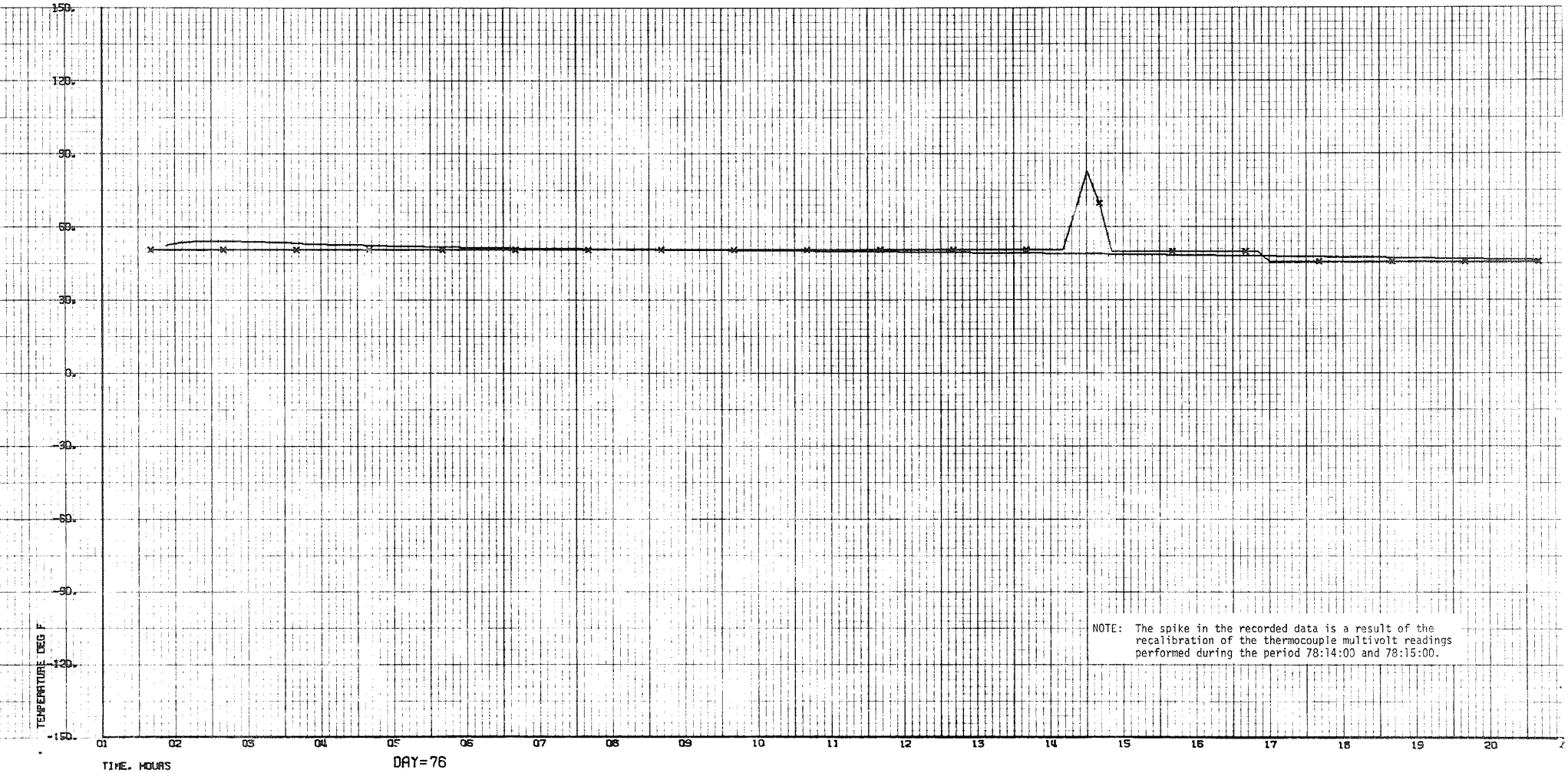


NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

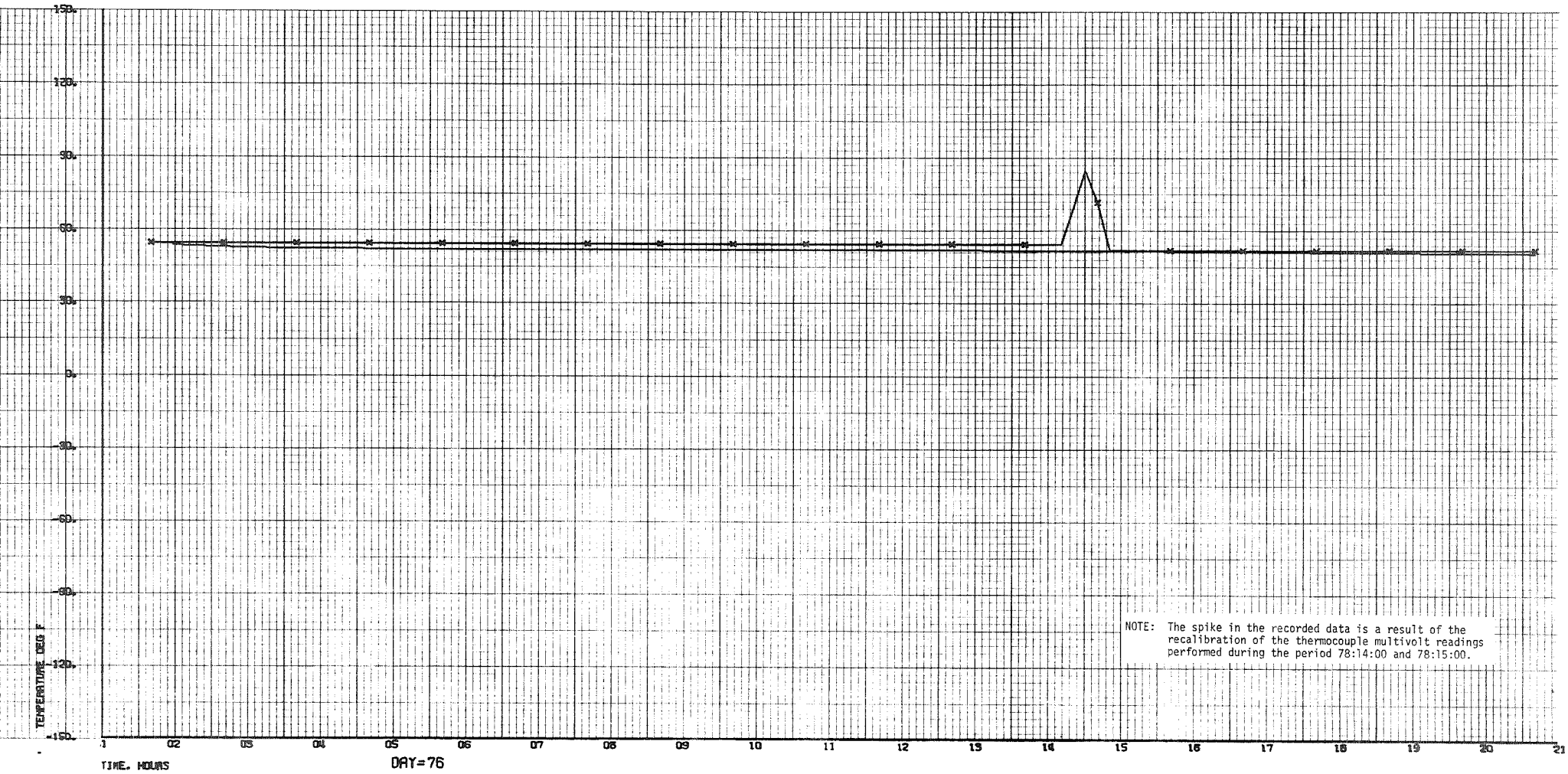
TP0148


150.
120.
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-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76
NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

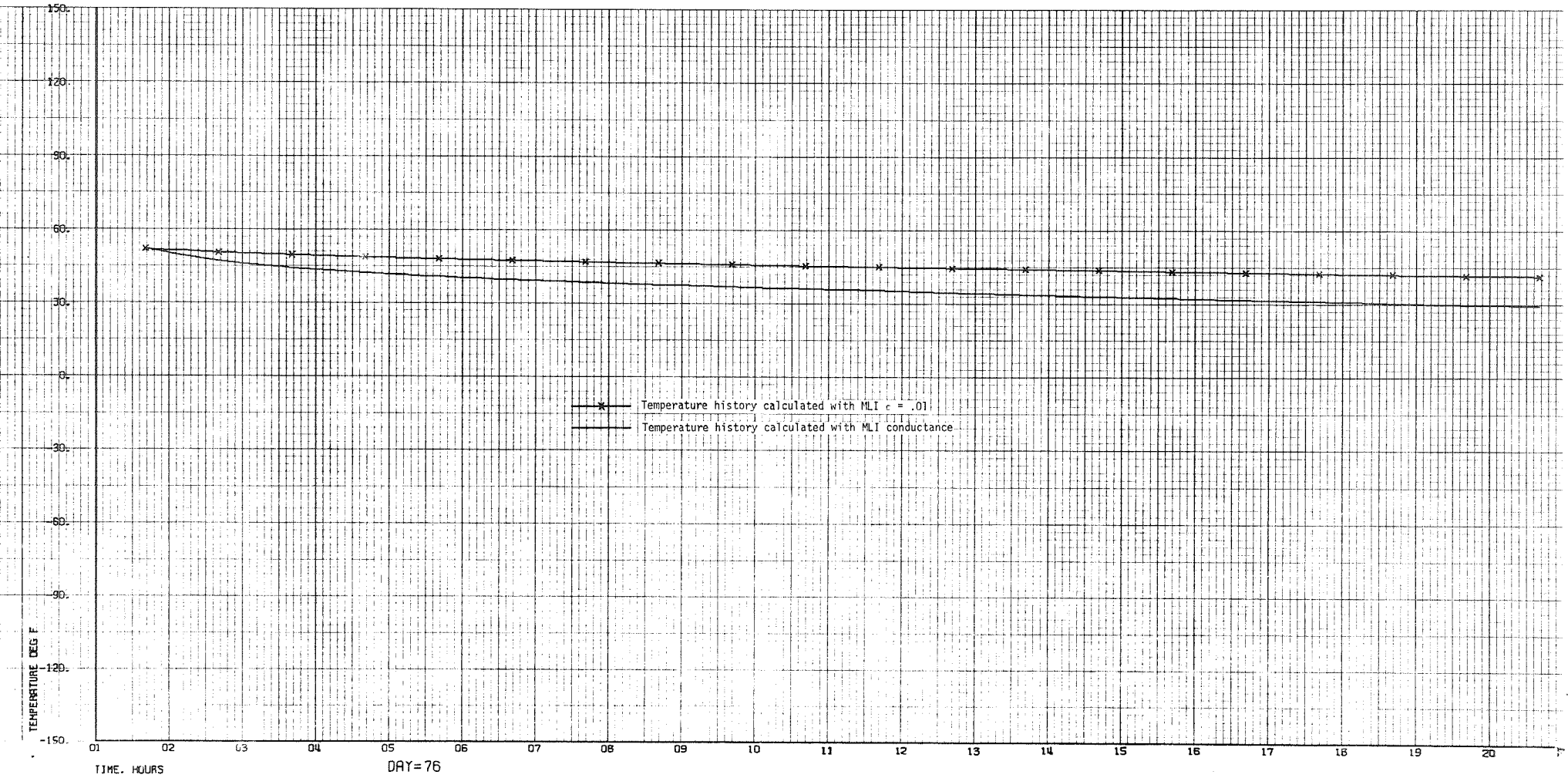
TPQ170


150.
120.
90.
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-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76
NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

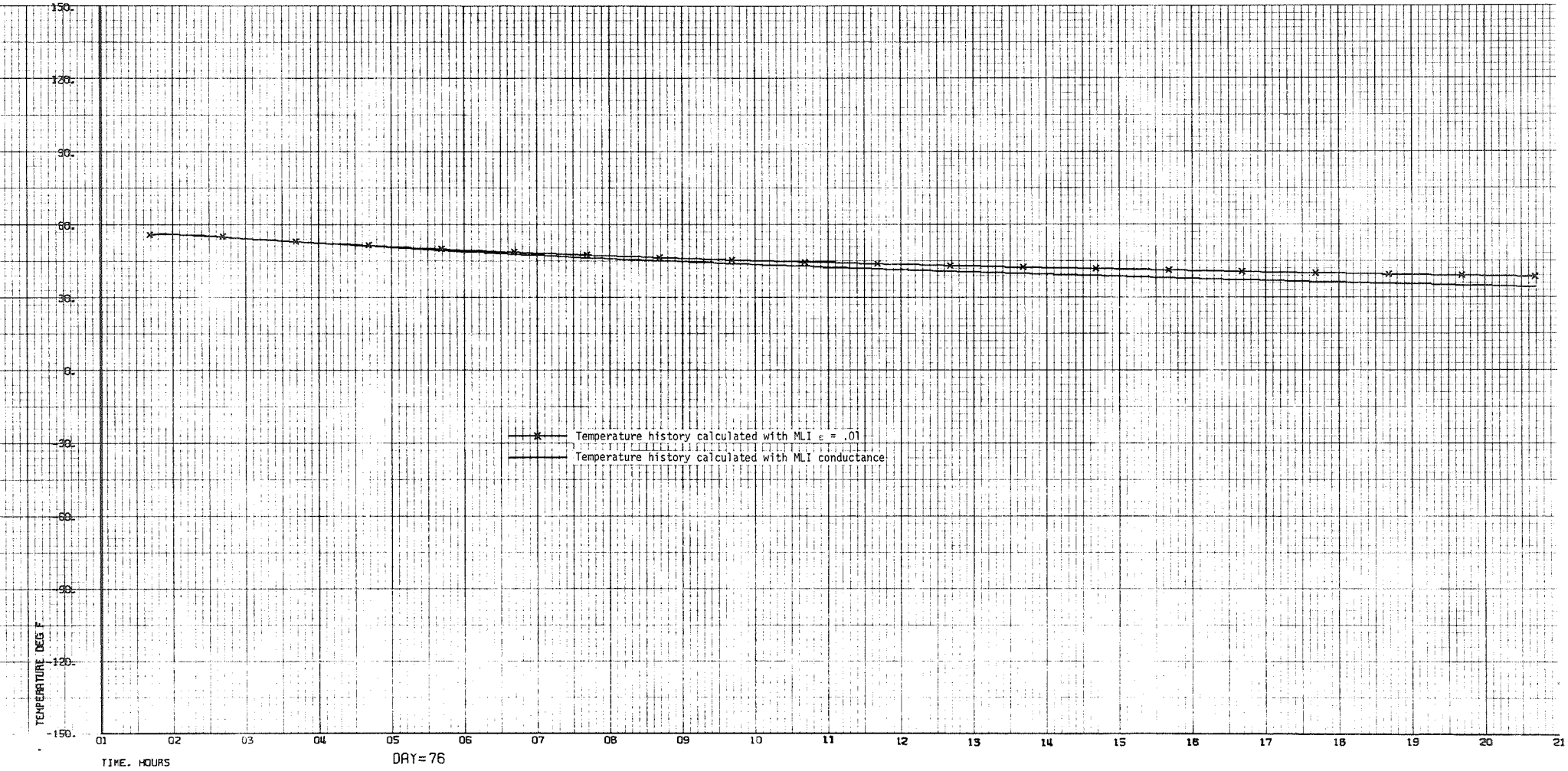
TH0522


150.
120.
90.
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-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76
NOTE: The spike in the recorded data is a result of the recalibration of the thermocouple multivolt readings performed during the period 78:14:00 and 78:15:00.

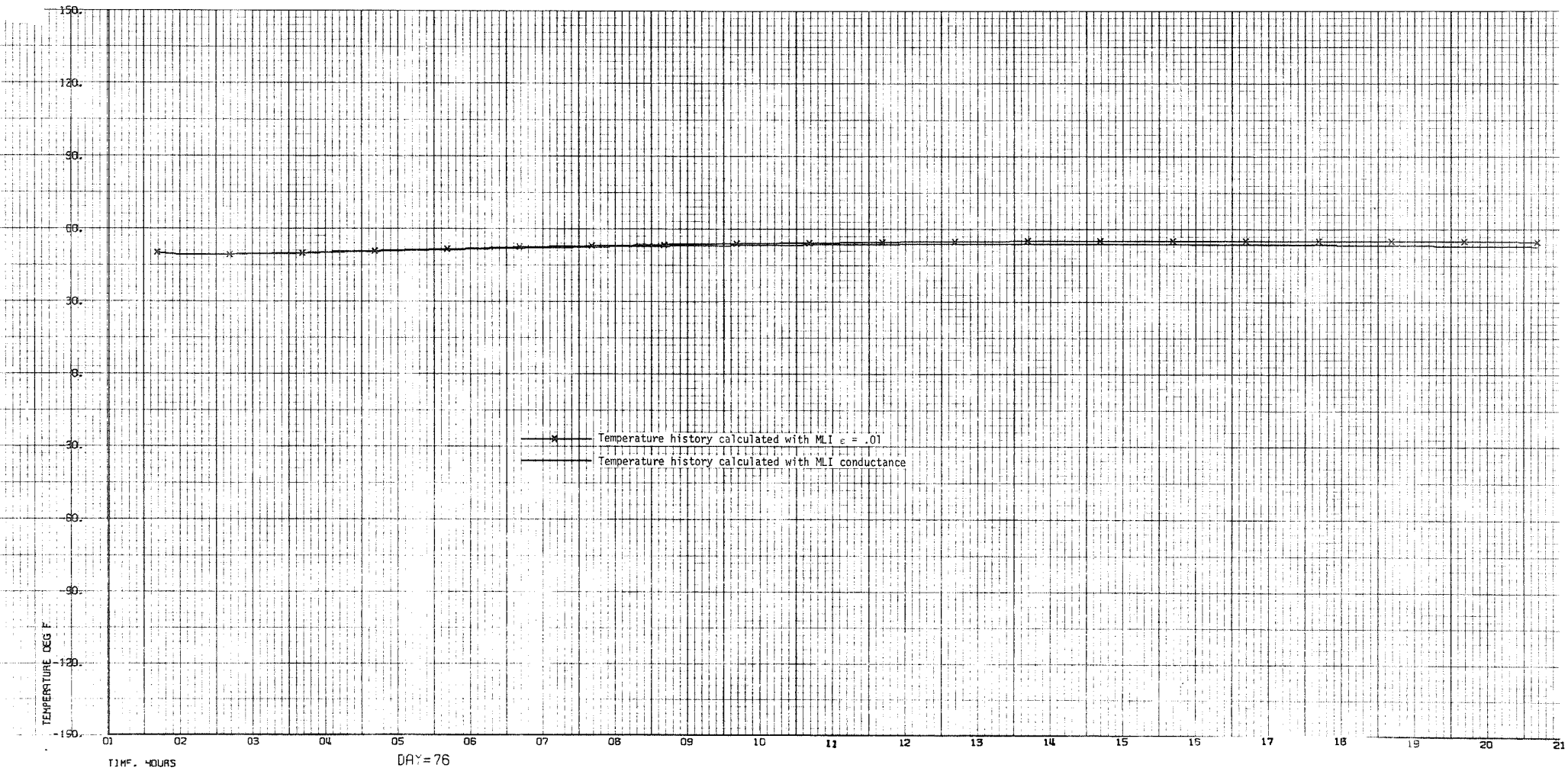
TP0132


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120.
90.
60.
30.
0.
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-90.
-120.
-150.
TEMPERATURE DEG F
01
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19
20
TIME. HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

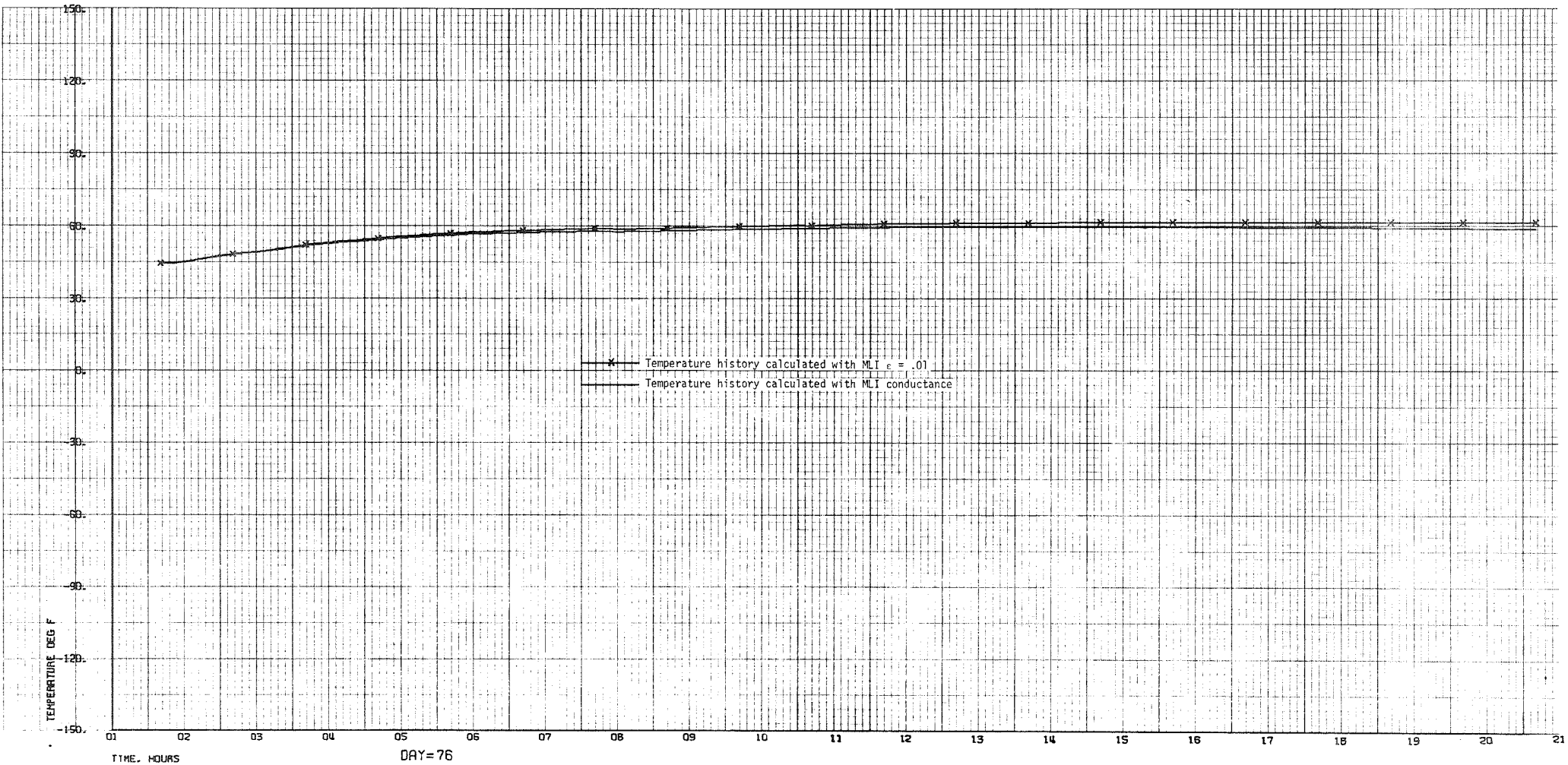
TPQ117


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TEMPERATURE DEG F
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21
TIME. HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

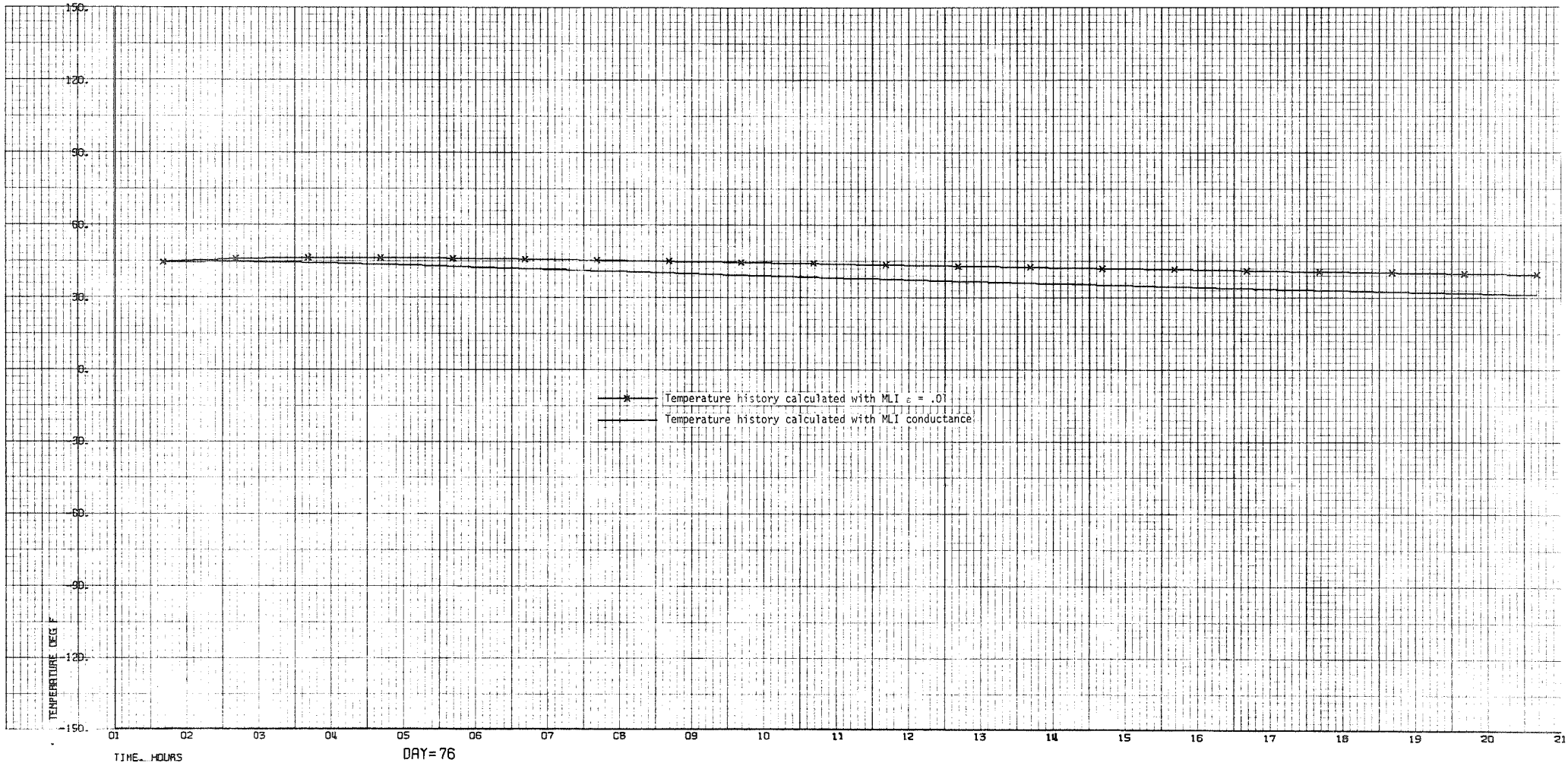
TP0109


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-150.
TEMPERATURE DEG F
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TIME, HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

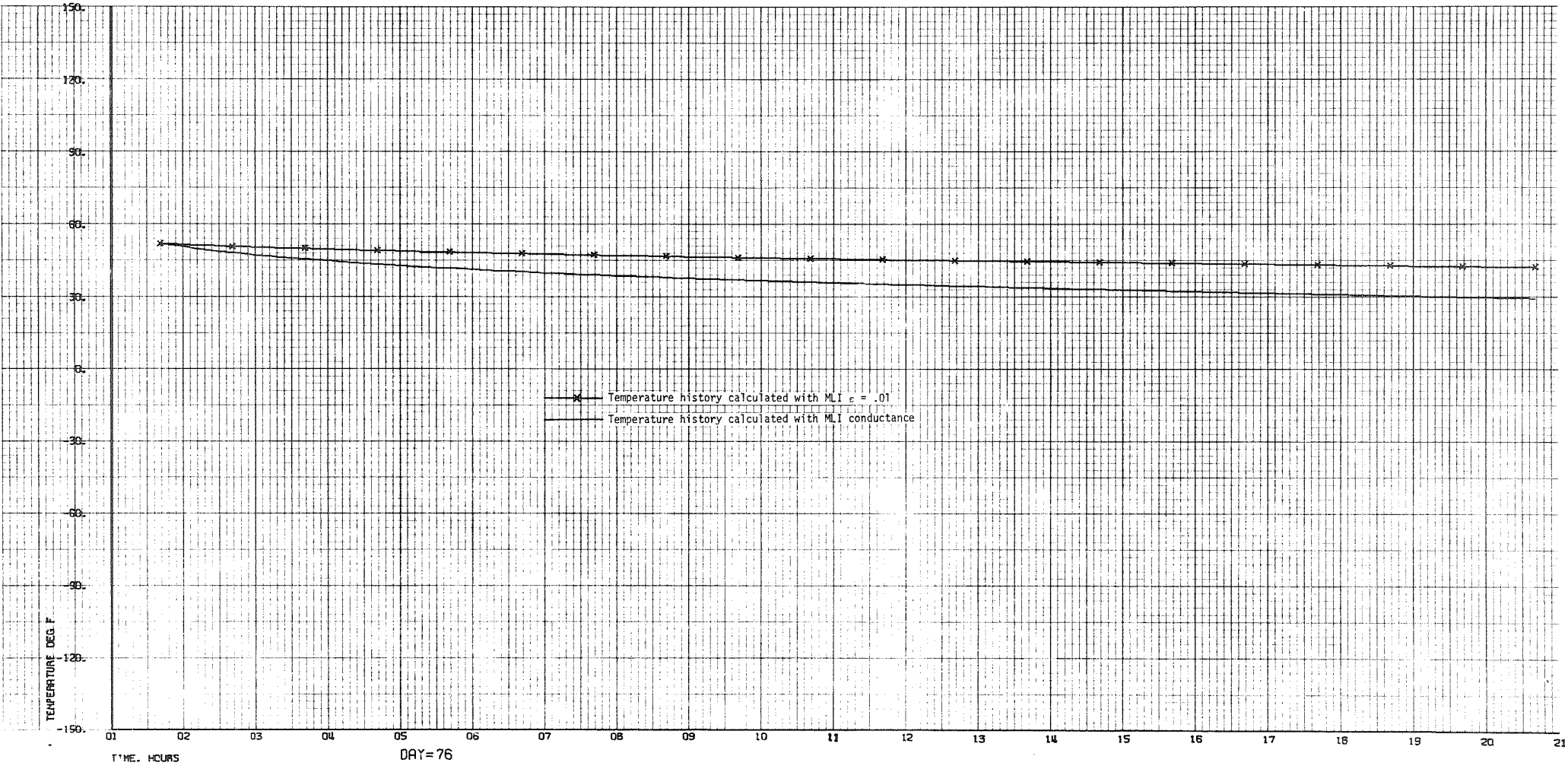
TP0138


150.
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-120.
-150.
TEMPERATURE DEG F
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TIME, HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

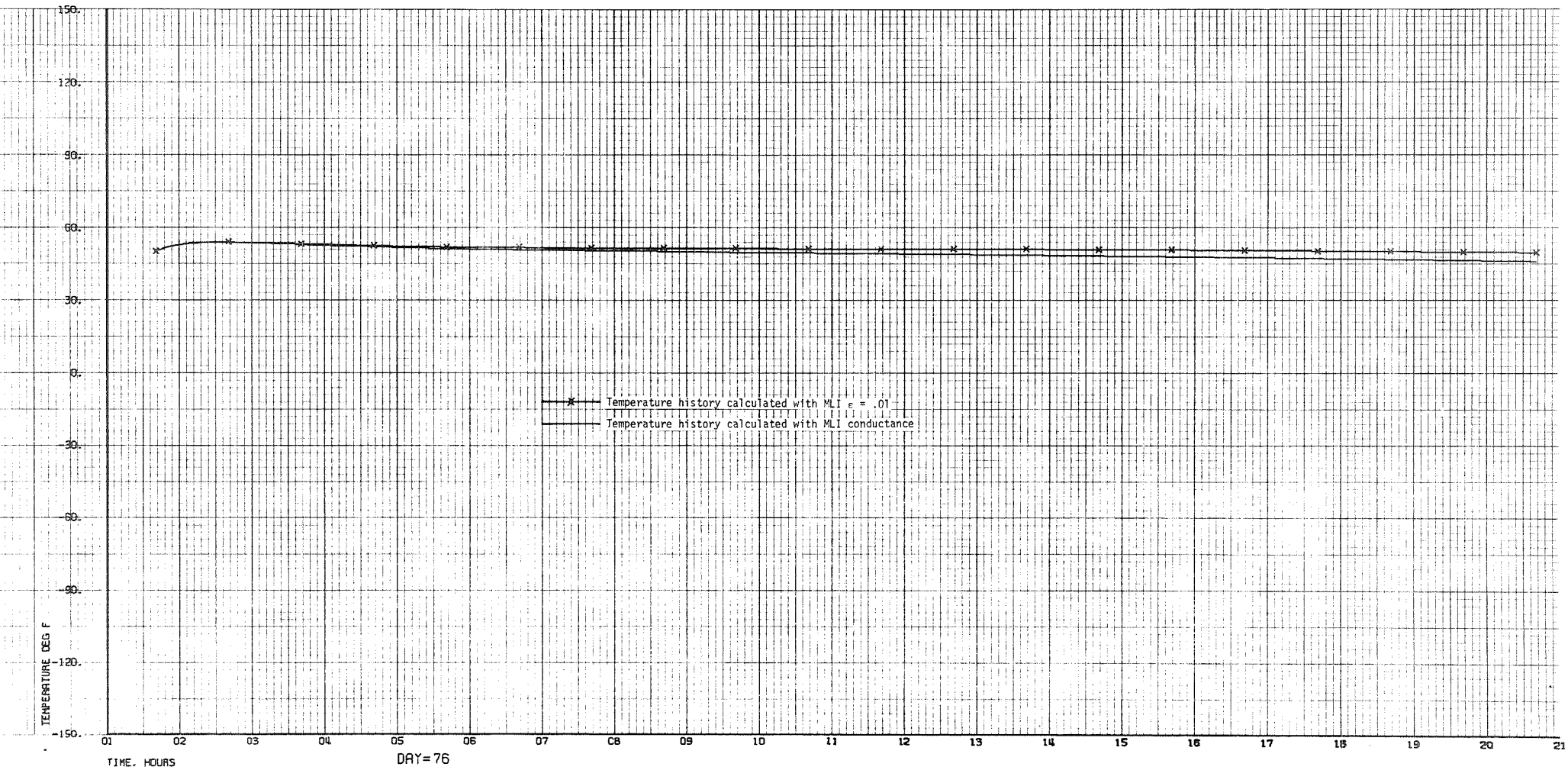
TP0142


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TEMPERATURE DEG F
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TIME, HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

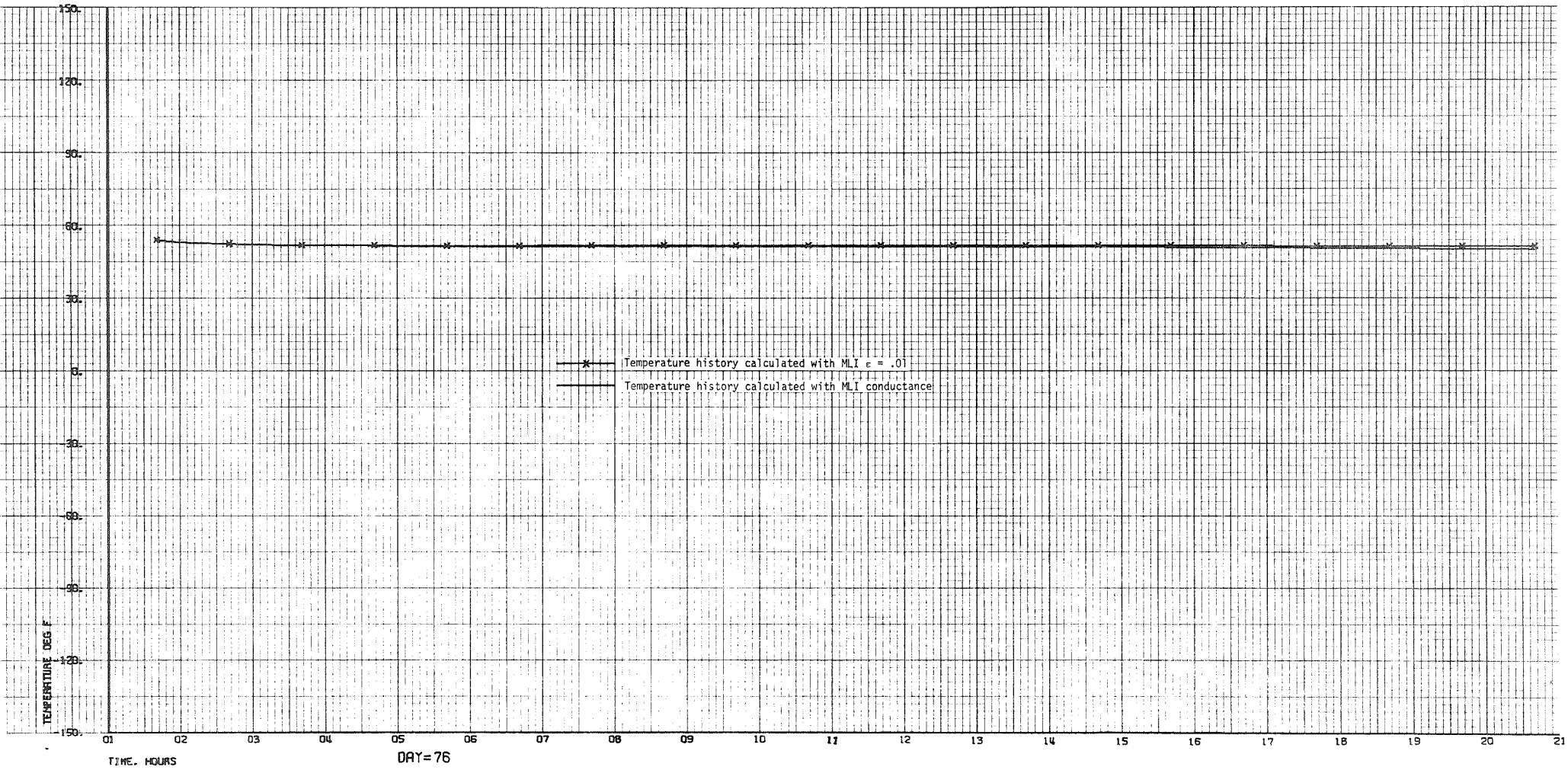
TP0148


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120.
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-120.
-150.
TEMPERATURE DEG.F
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TIME. HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

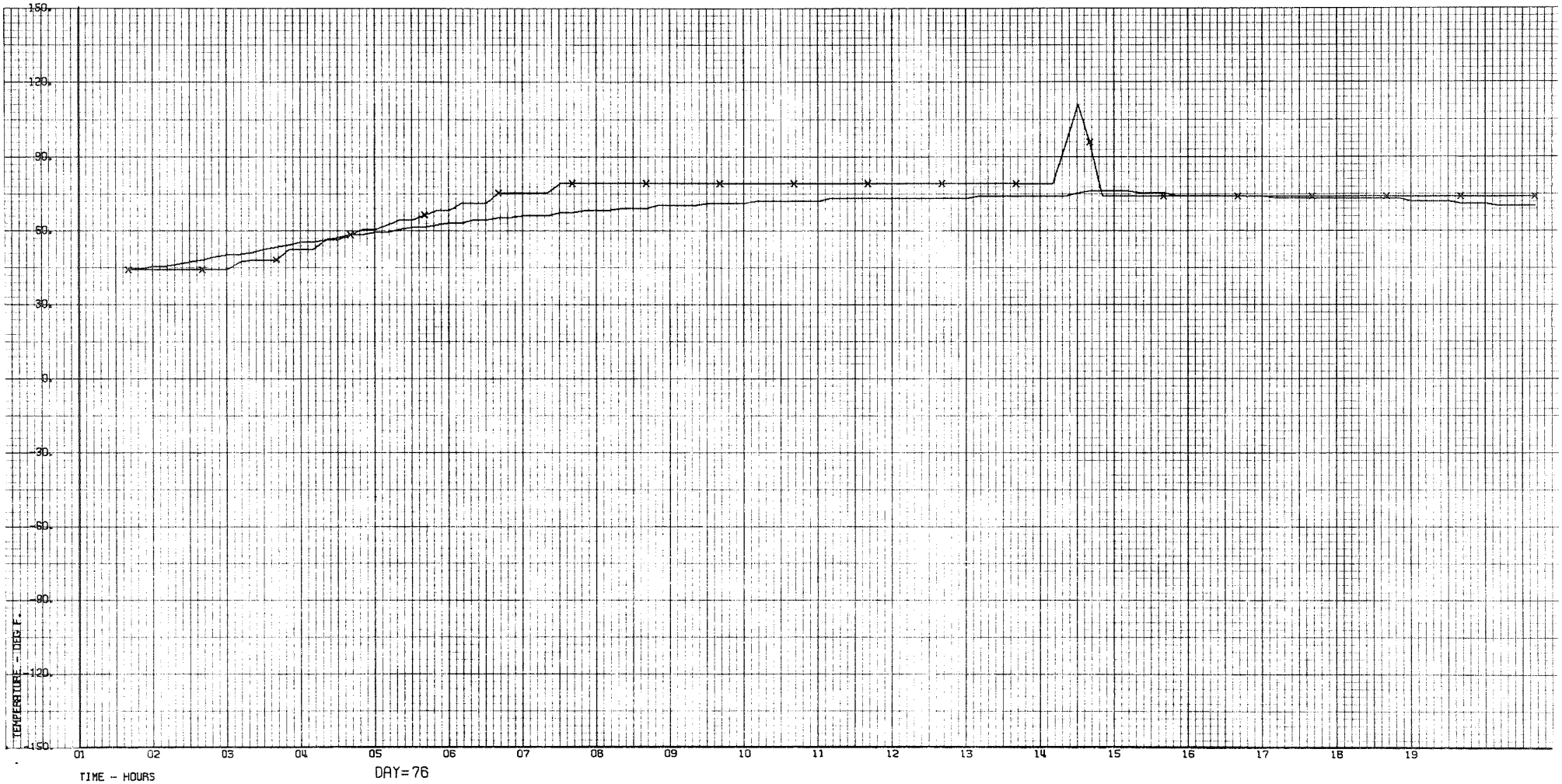
TP0170


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TEMPERATURE DEG F
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TIME, HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

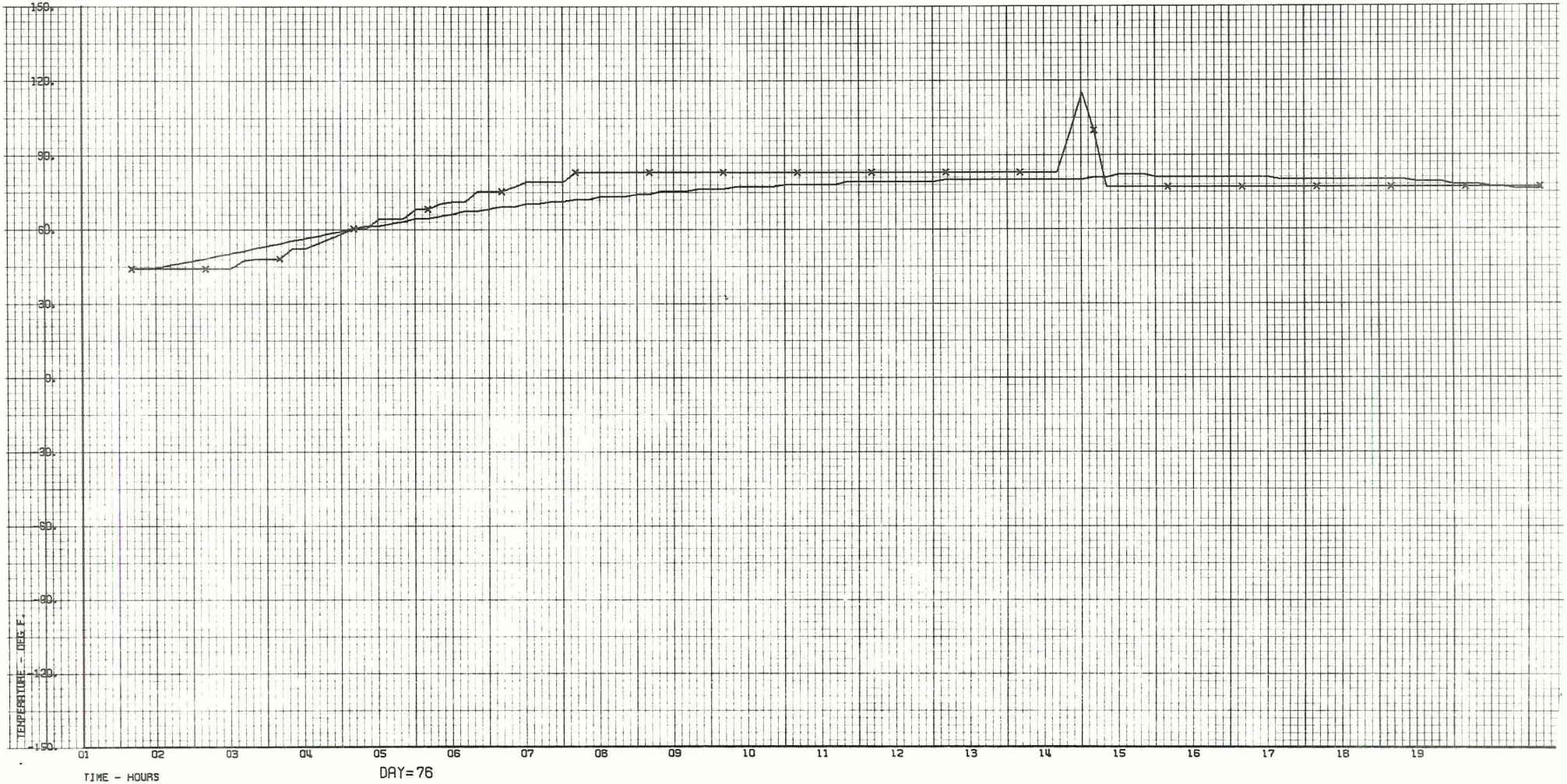
TH0522


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TEMPERATURE DEG F
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TIME. HOURS
DAY=76
Temperature history calculated with MLI ε = .01
Temperature history calculated with MLI conductance

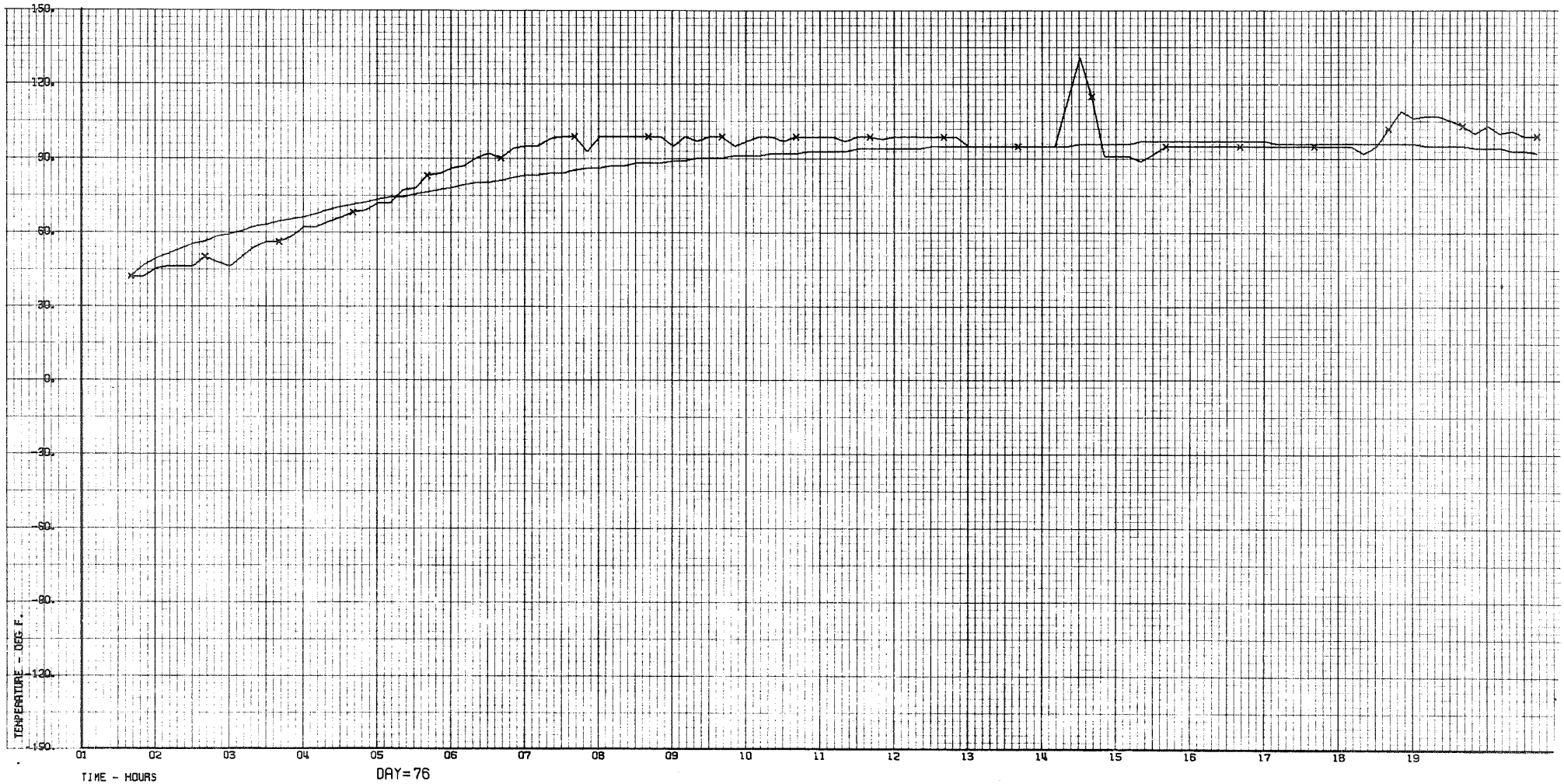
TW601


150.
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-90.
-120.
-150.
TEMPERATURE - DEG F.
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TIME - HOURS
DAY=76

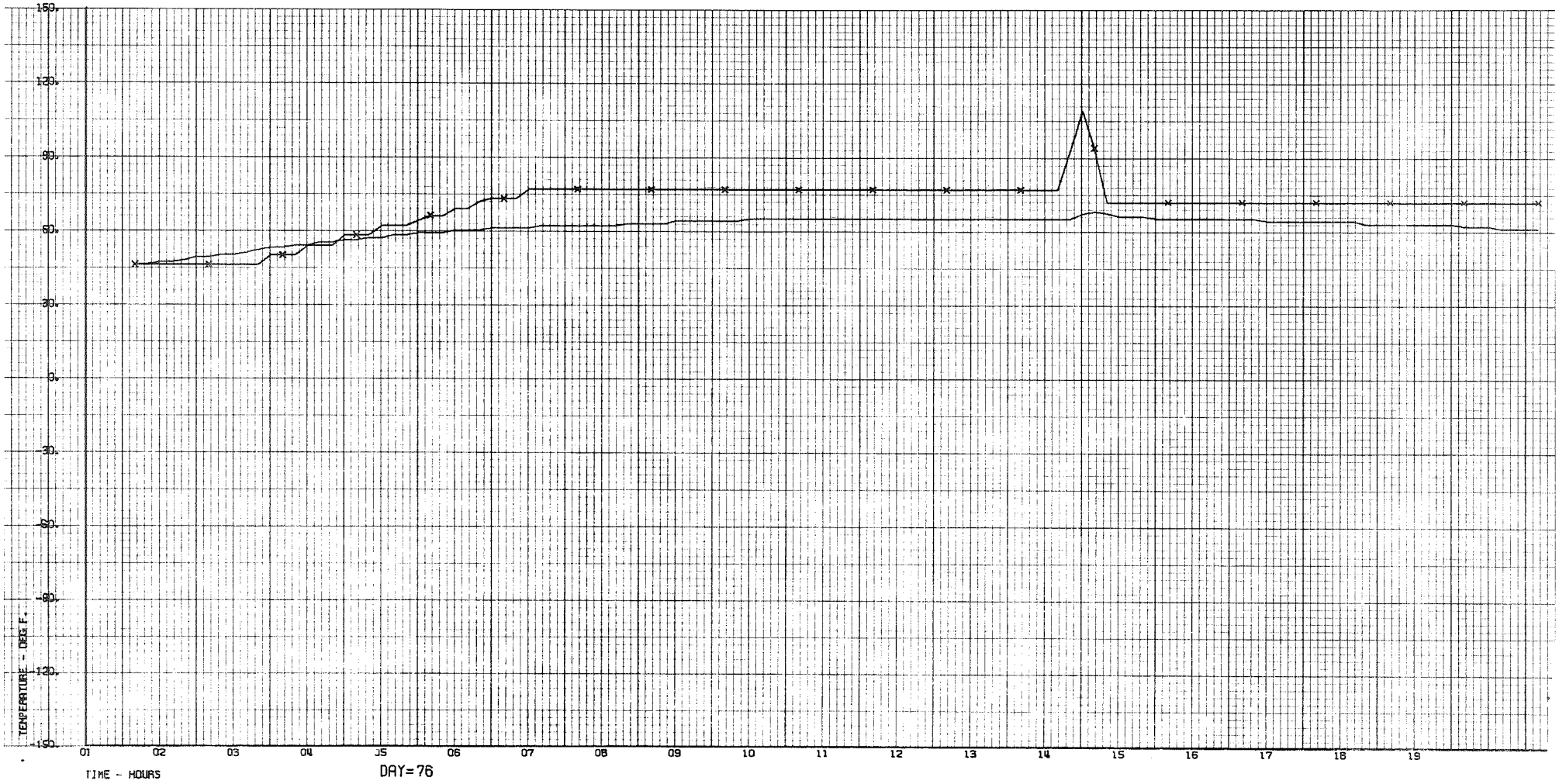
TW602


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150.
TEMPERATURE - DEG. F.
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TIME - HOURS
DAY=76

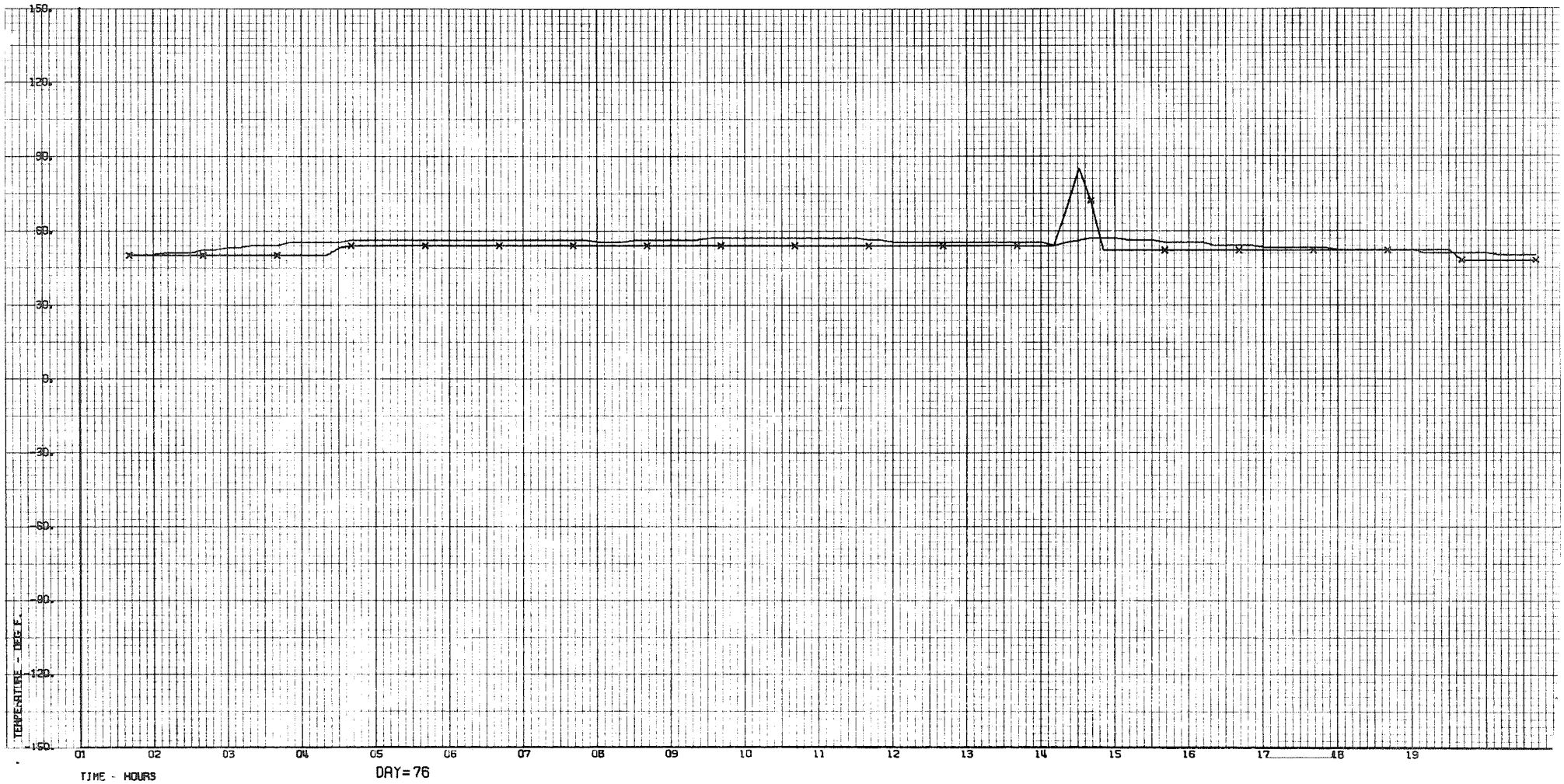
TW603


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30.
0.
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-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
01
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TIME - HOURS
DAY=76

TP5138


150.
120.
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60.
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-60.
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-150.
TEMPERATURE - DEG F.
01
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15
16
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18
19
TIME - HOURS
DAY=76

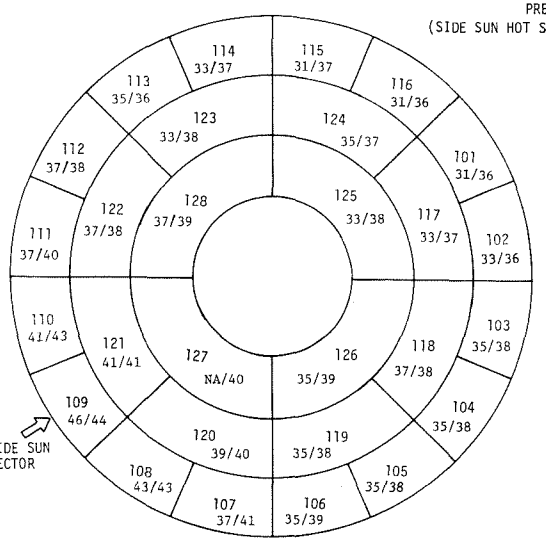
TP5139


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-60.
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TEMPERATURE - DEG F.
01
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19
TIME - HOURS
DAY=76

TP4158

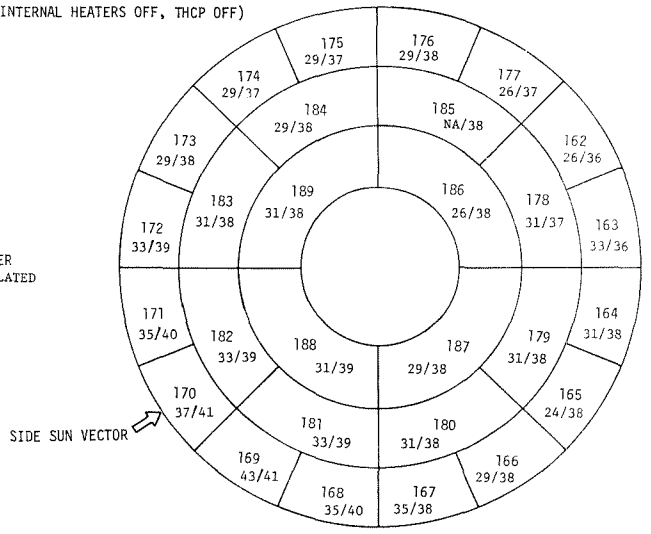

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60
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-90
-120
-150
TEMPERATURE - DEG F.
01
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TIME - HOURS
DAY=76

PRESSURE SHELL TEMPERATURES AT END OF PHASE A2
(SIDE SUN HOT SOAK, CABIN PRESSURIZED, INTERNAL HEATERS OFF, THCP OFF)



LEGEND

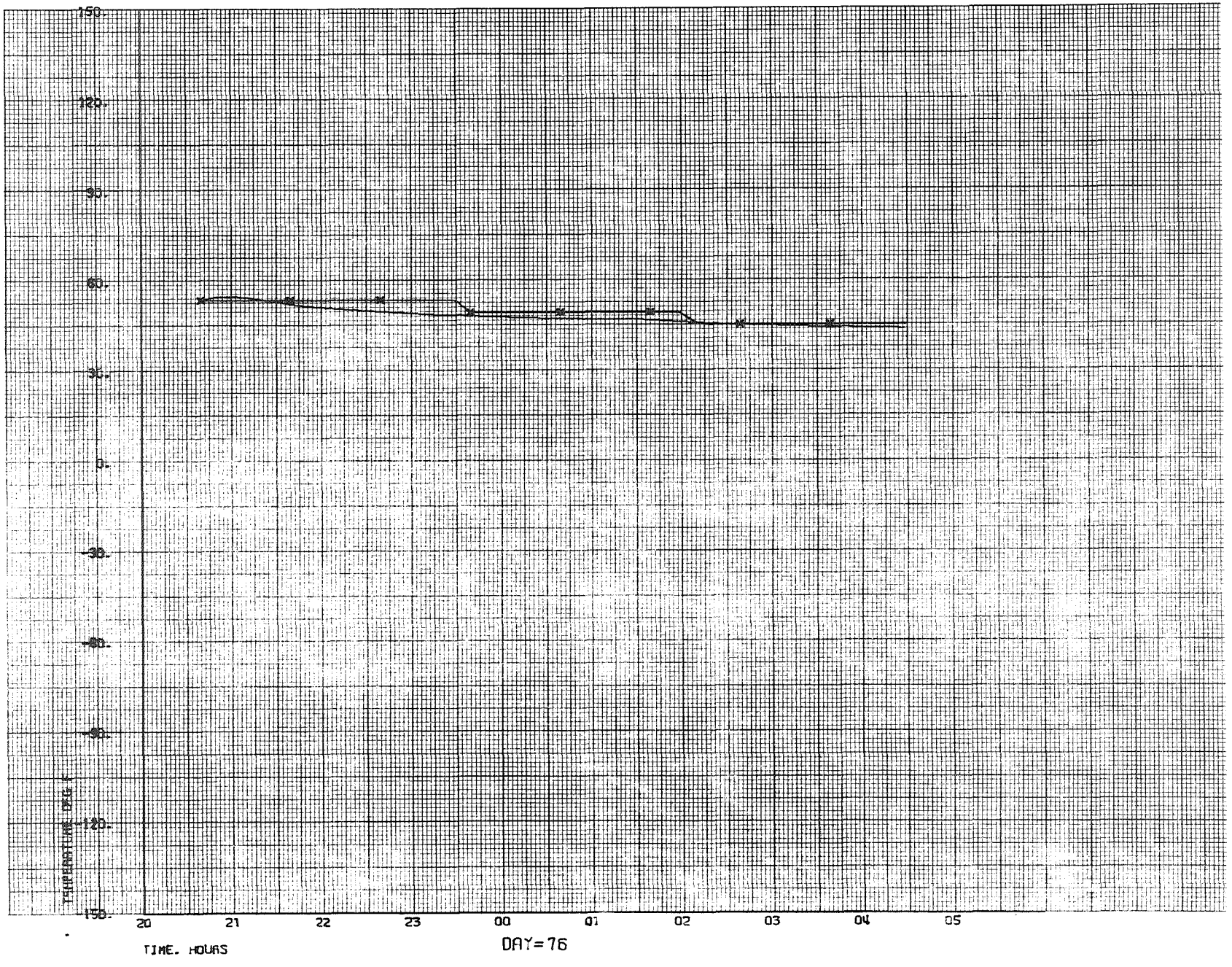
NODE NUMBER
ACTUAL/CALCULATED



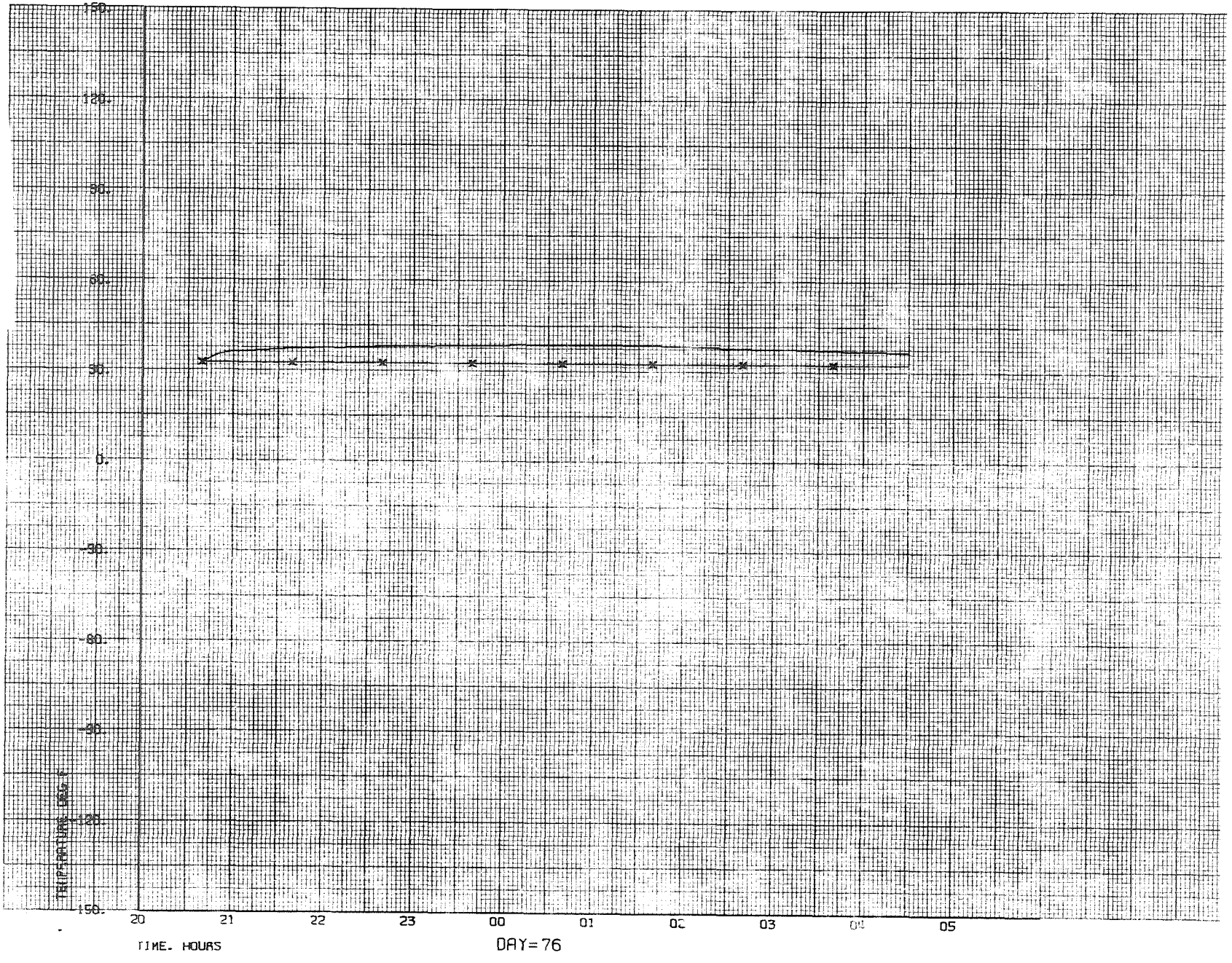
SIDE SUN VECTOR CENTER LINE

130 29/36	131 33/35	132 35/34	133 31/34	134 31/37	135 39/39	136 43/42	137 43/46	138 54/45	139 41/45	140 39/43	141 37/40	142 31/36	143 31/33	144 31/37	145 31/34
146 31/34	147 29/35	148 31/35	149 31/34	150 33/36	151 39/40	152 37/44	153 39/45	154 37/44	155 37/45	156 37/44	157 33/40	158 33/36	159 33/34	160 33/35	161 35/34

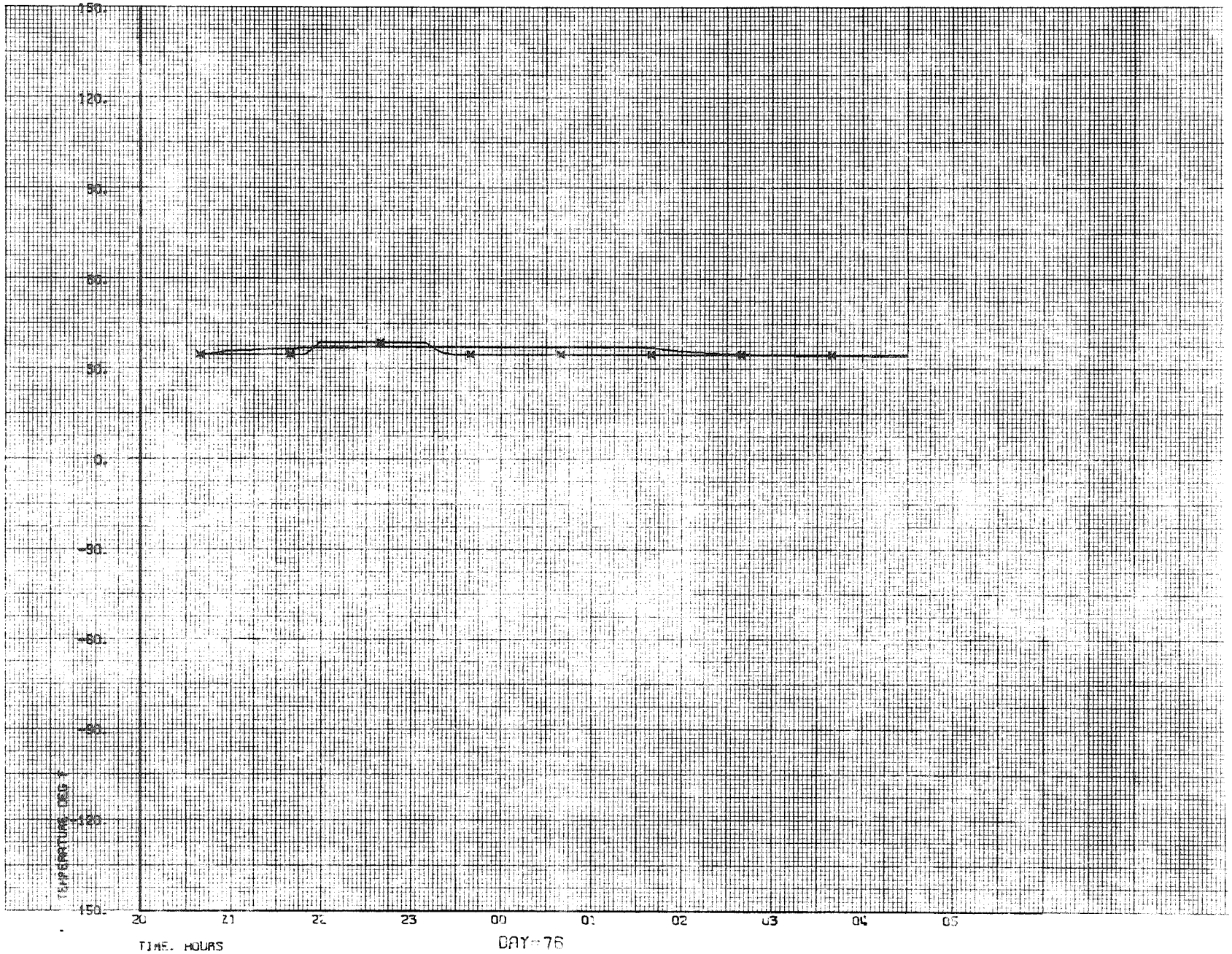
TP0109


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60.
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0.
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-60.
-90.
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TEMPERATURE DEG F
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TIME. HOURS
DAY=76

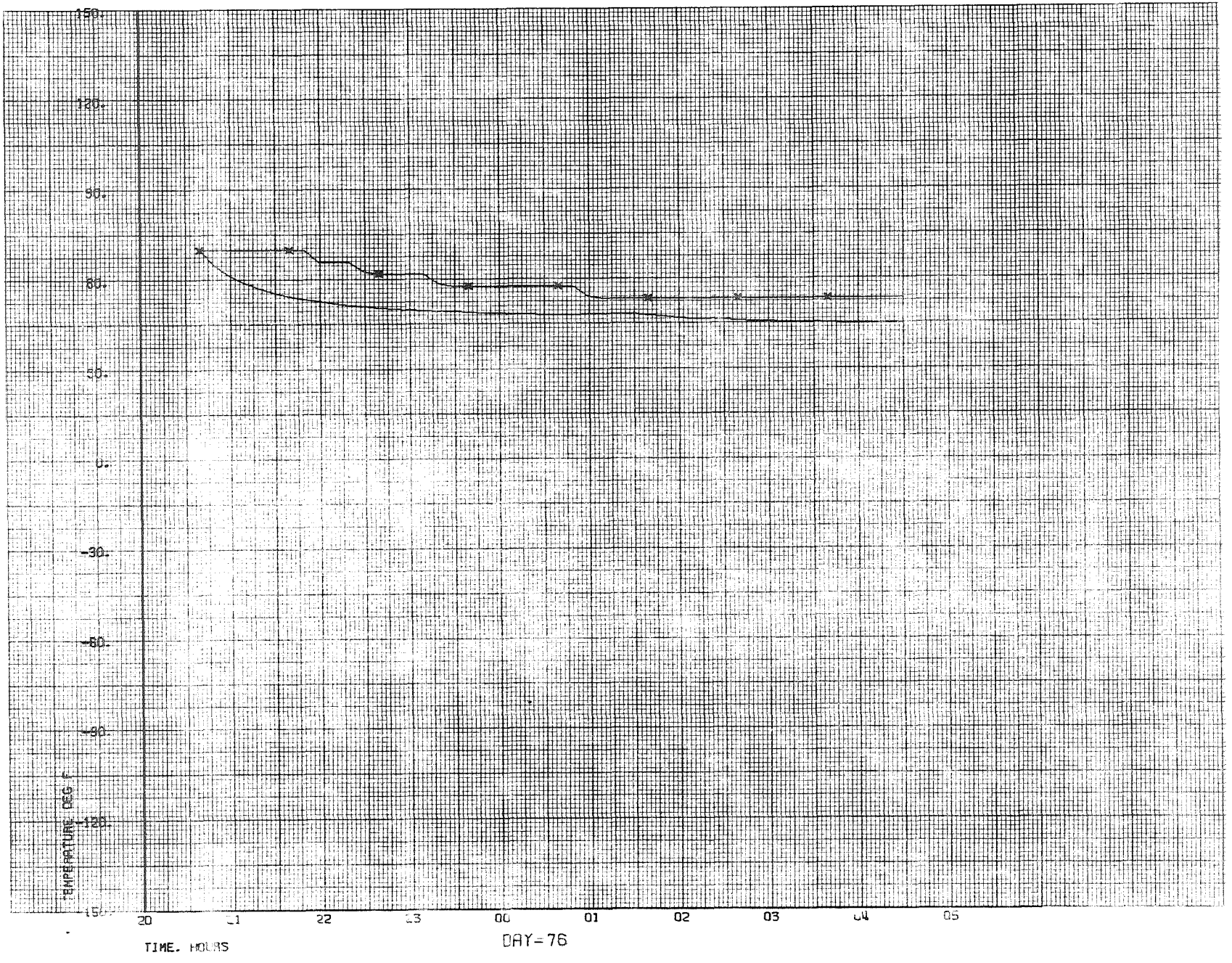
TP0117


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-60.
-90.
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TEMPERATURE DEG F
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TIME. HOURS
DAY=76

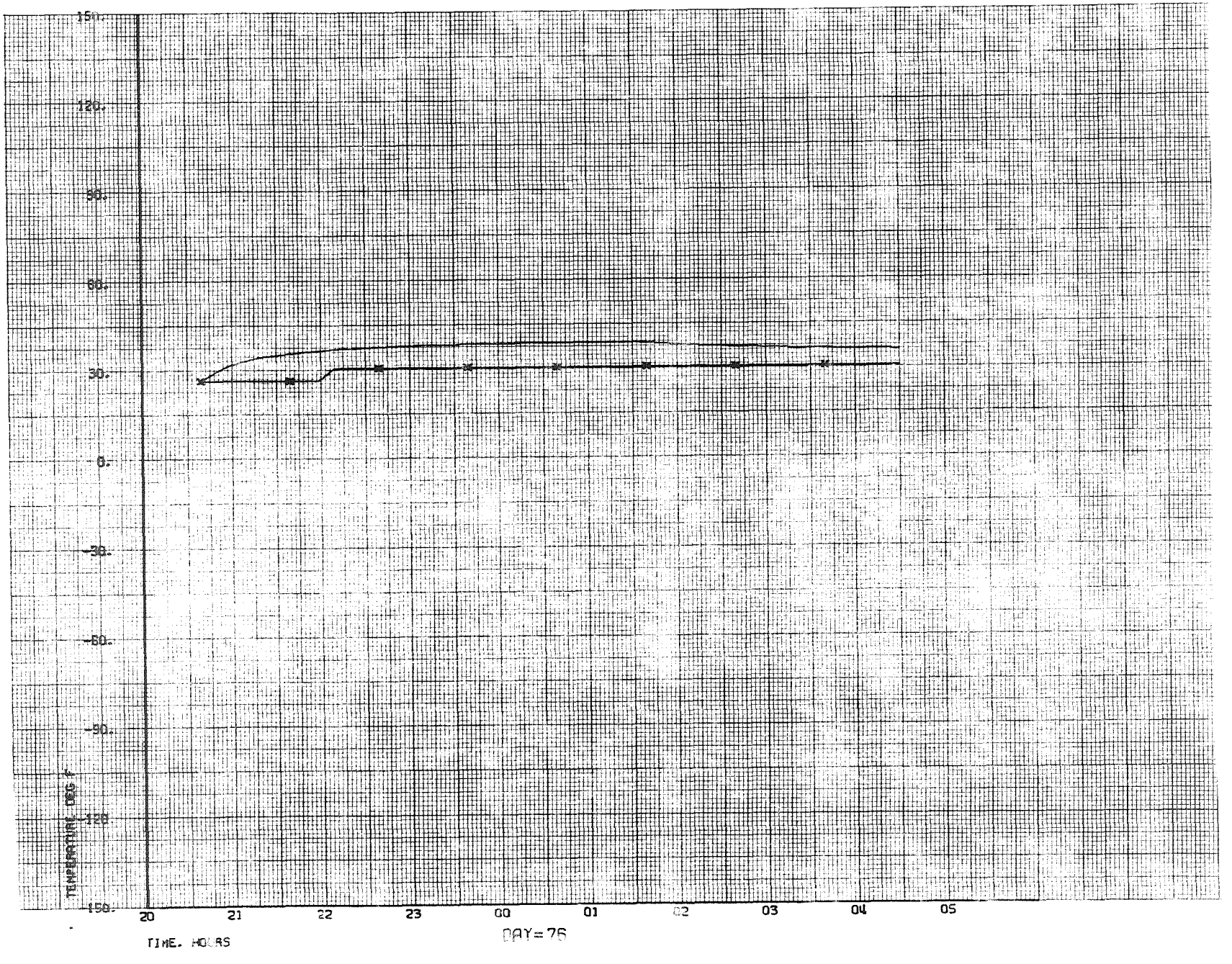
TP0132


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-90.
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TEMPERATURE DEG F
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TIME. HOURS
DAY-76

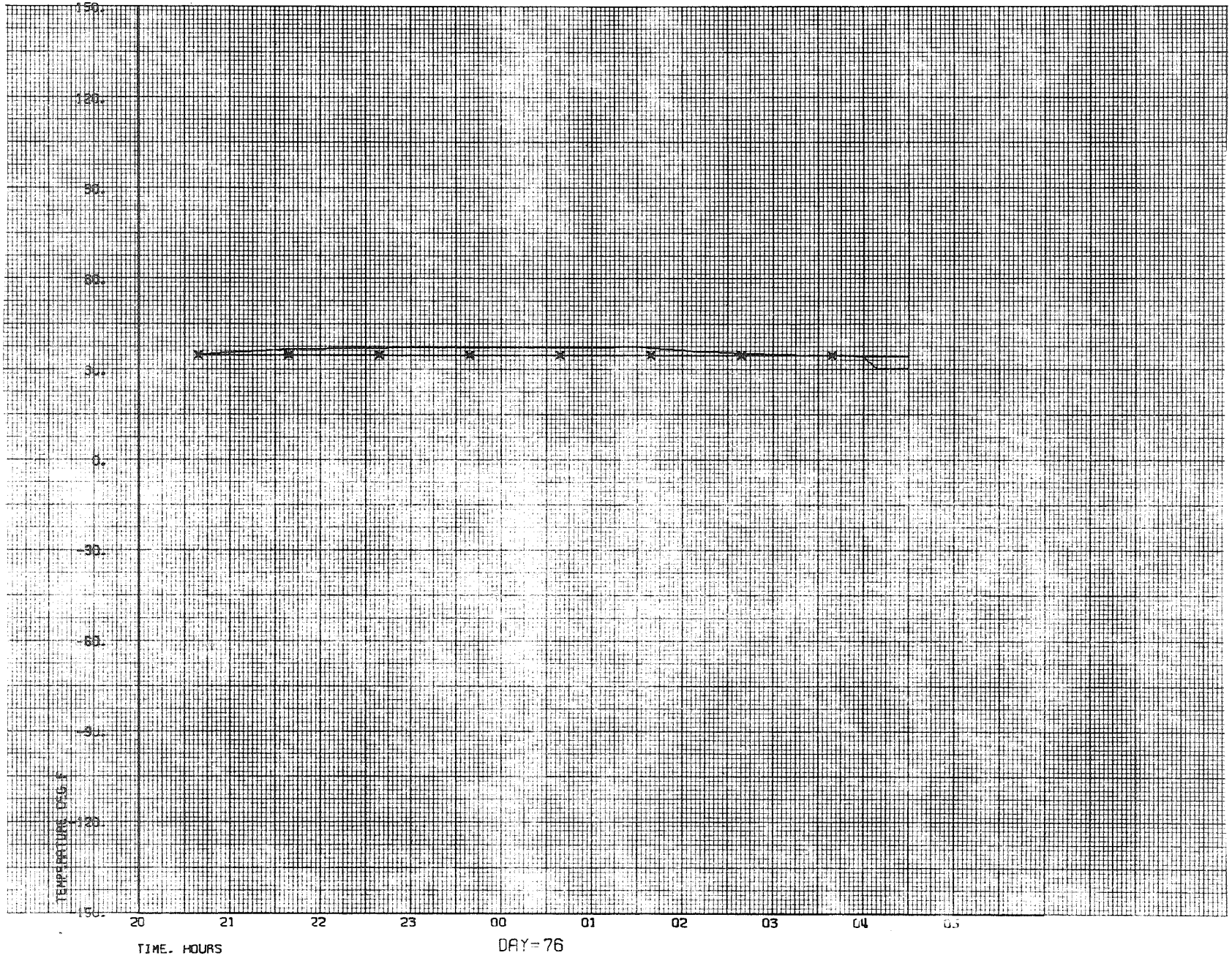
TP0138


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-30.
-60.
-90.
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TEMPERATURE DEG F
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TIME, HOURS
DAY=76

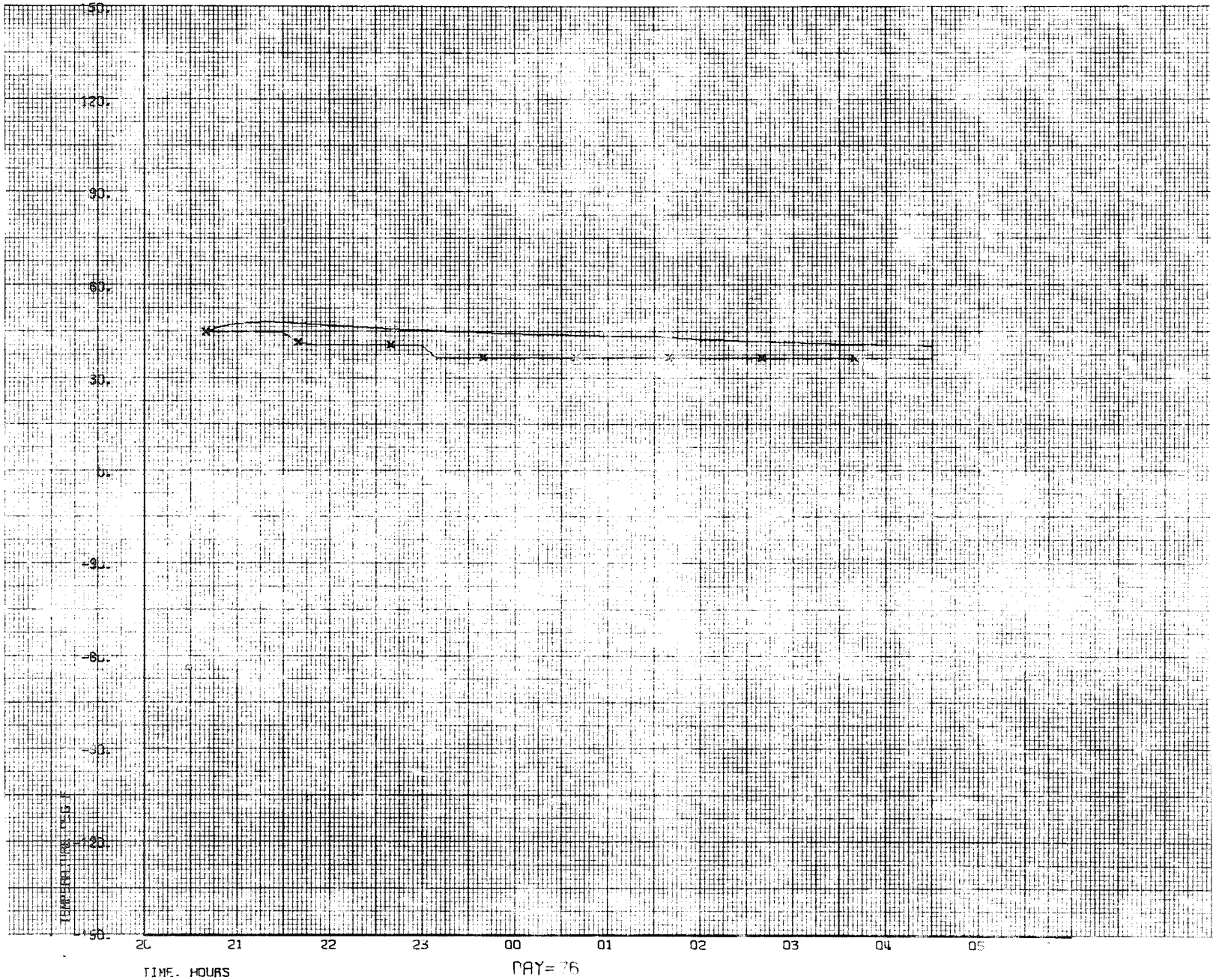
TP0142


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30.
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-30.
-60.
-90.
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TEMPERATURE DEG F
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TIME. HOURS
DAY=76

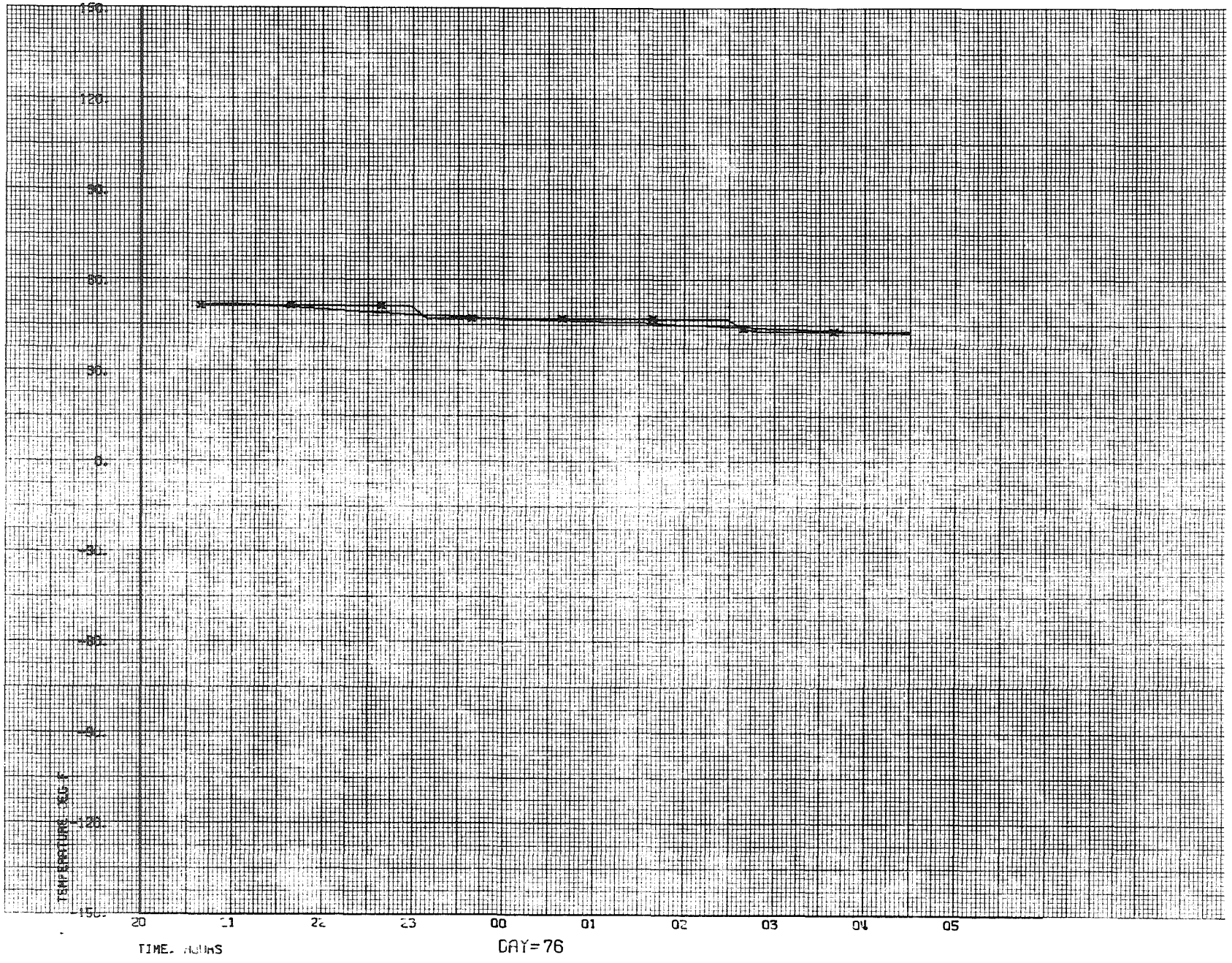
TP0148


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-90.
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TEMPERATURE DEG.F
TIME. HOURS
DAY=76

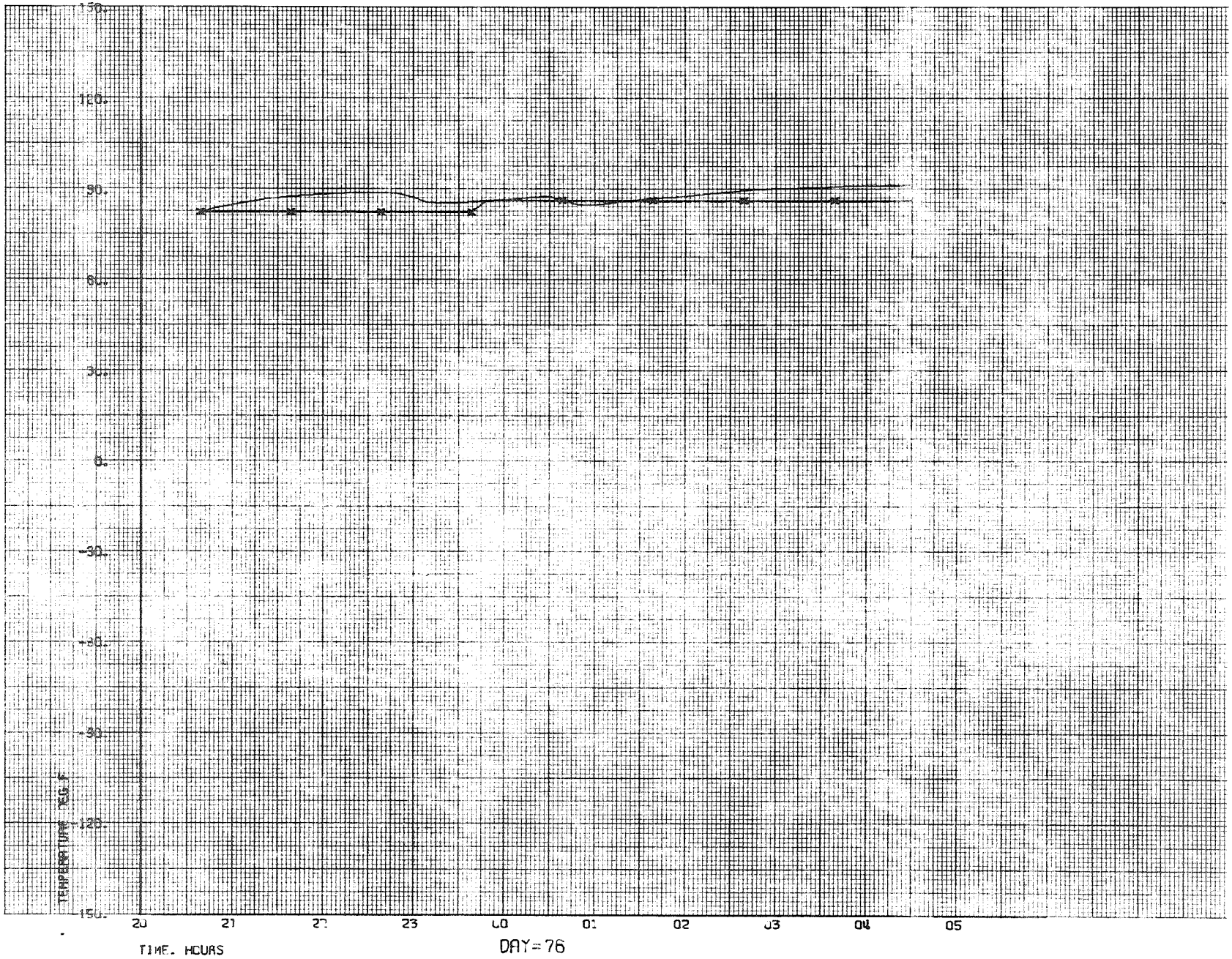
TP0170


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TEMPERATURE, DEG F
20
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TIME, HOURS
DAY= 76

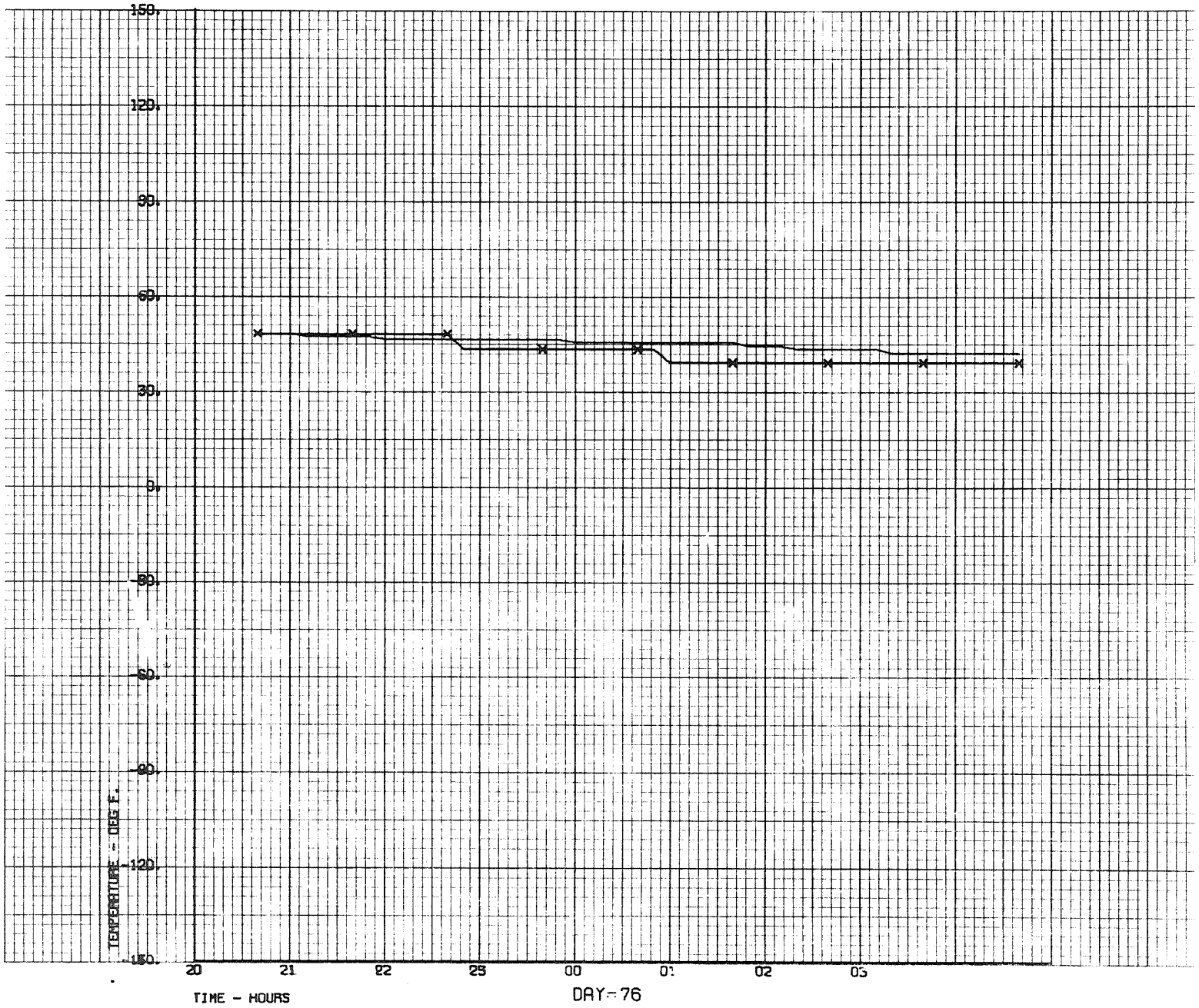
TH0522


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TEMPERATURE, DEG F
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05
TIME, HOURS
DAY=76

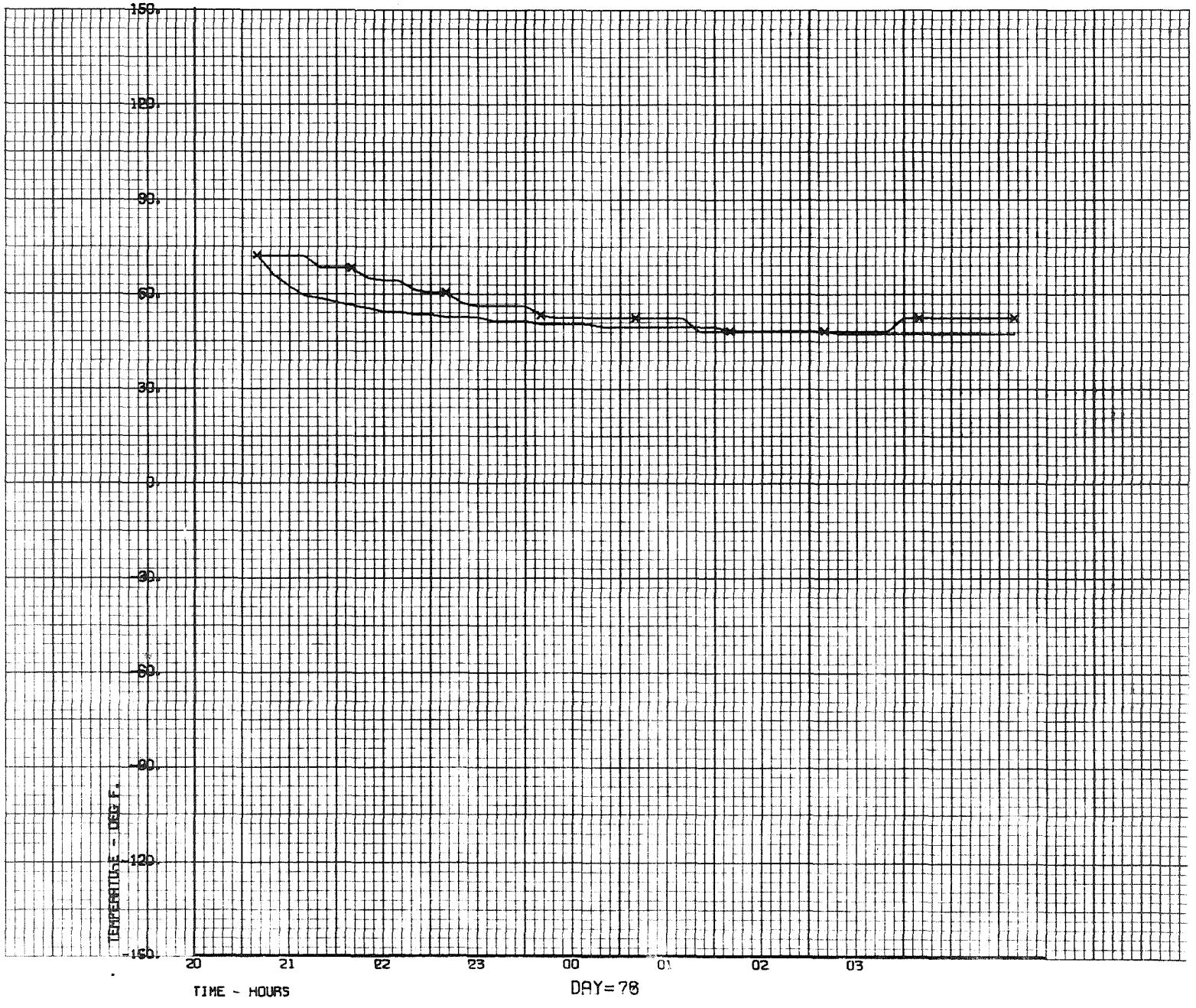
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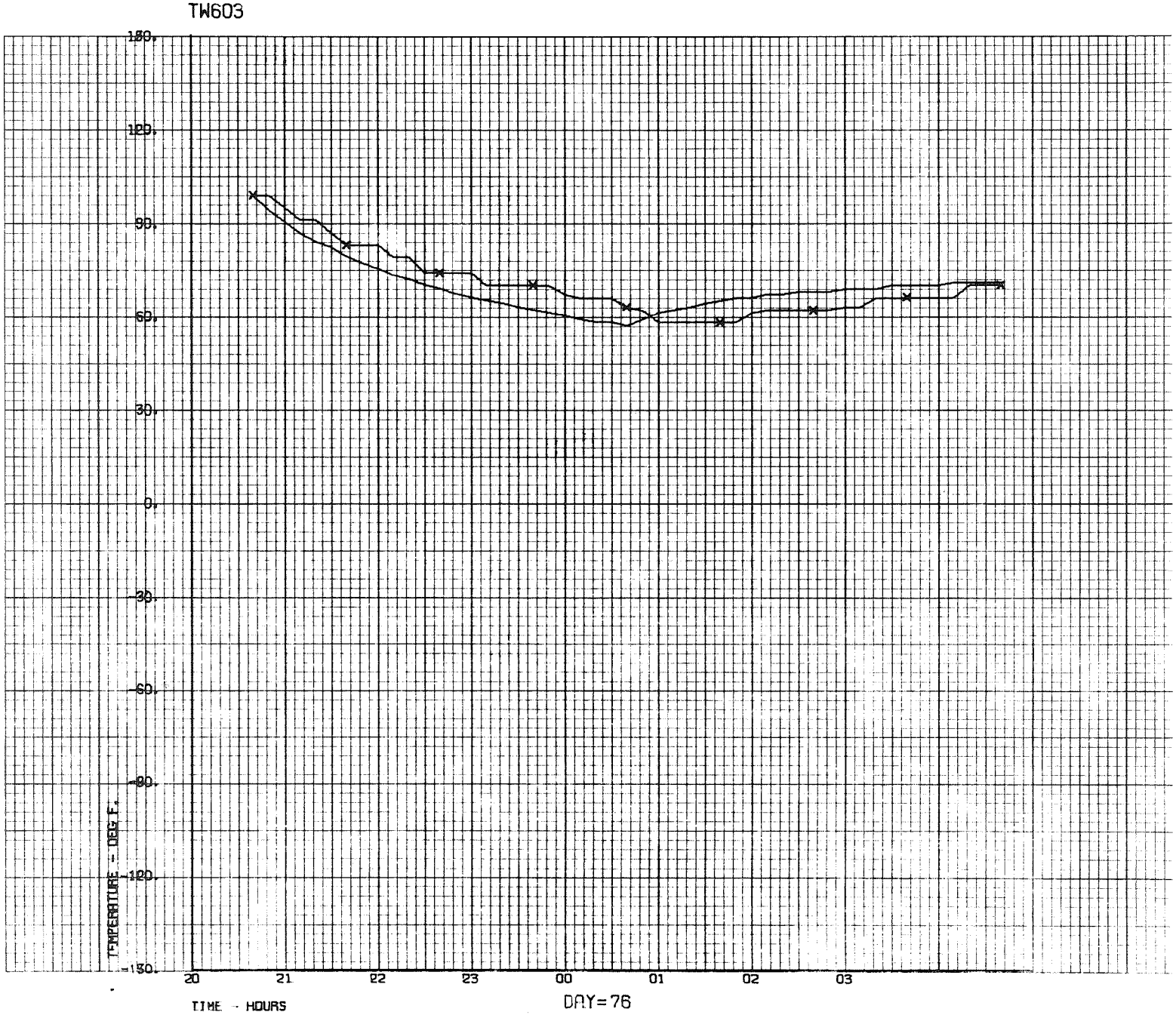

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-150.
TEMPERATURE DEG F
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TIME. HOURS
DAY=76

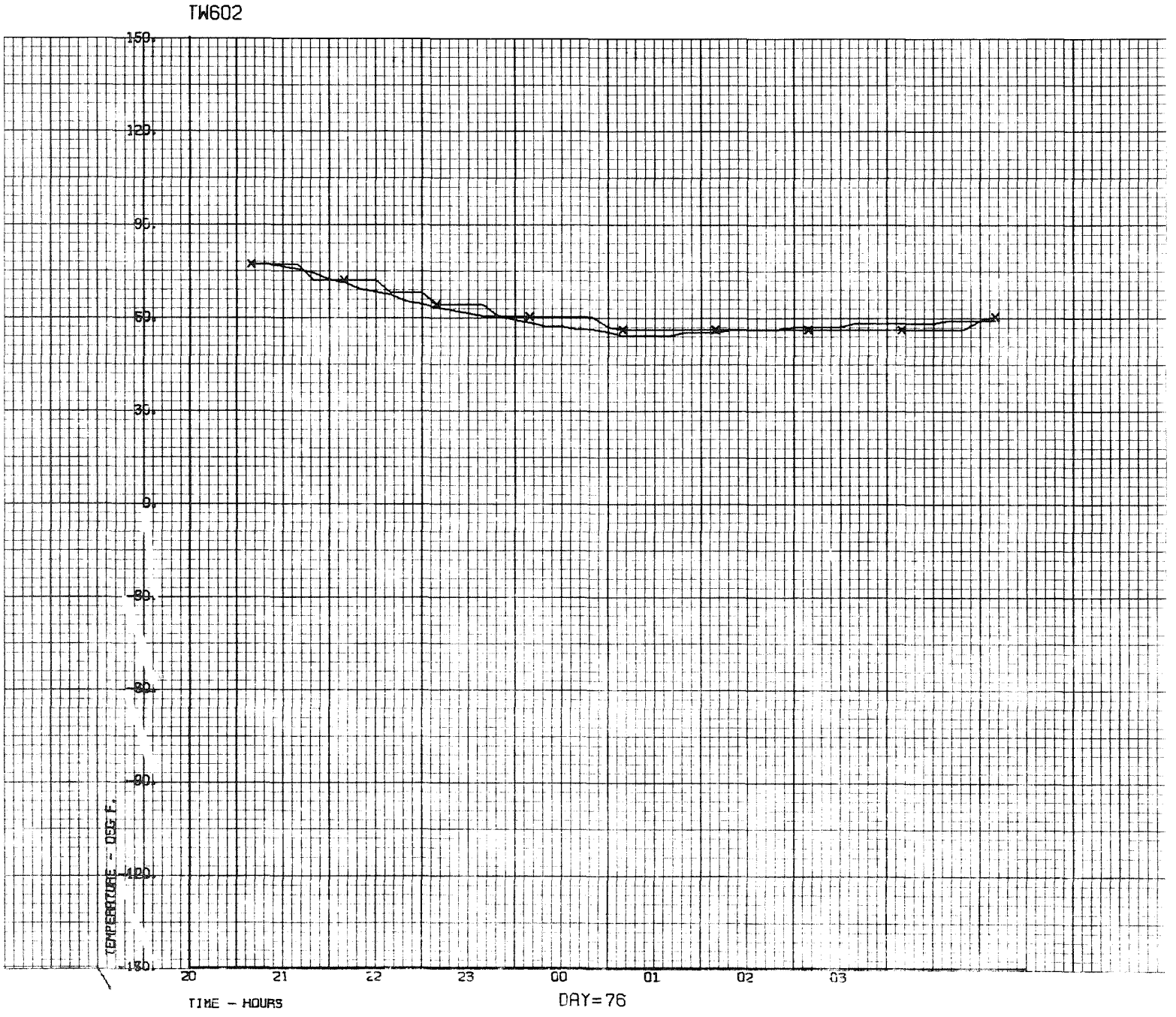
TP5139


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TEMPERATURE - DEG F.
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TIME - HOURS
DAY=76

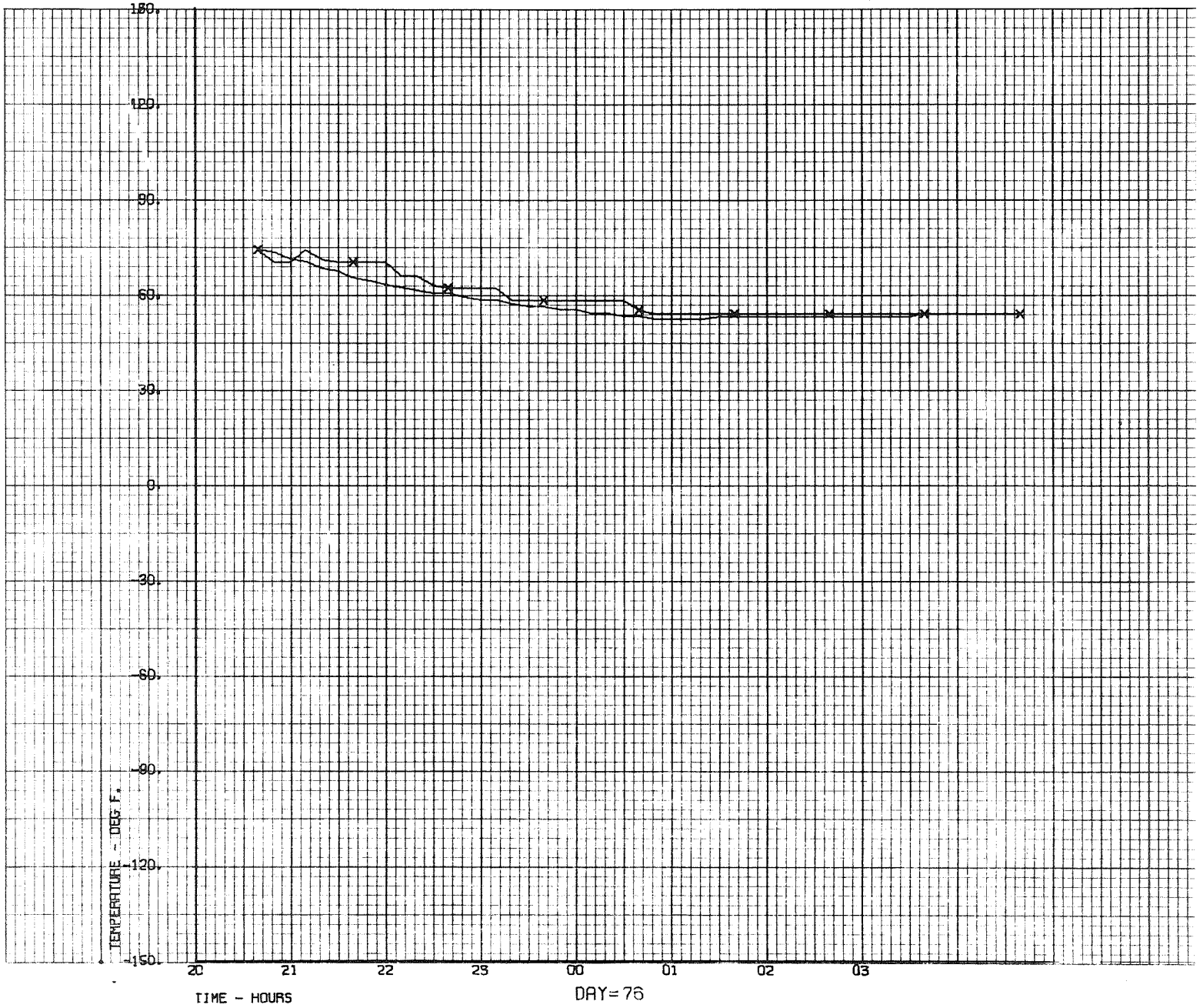
IP5138


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TEMPERATURE - DEG F.
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TIME - HOURS
DAY=78

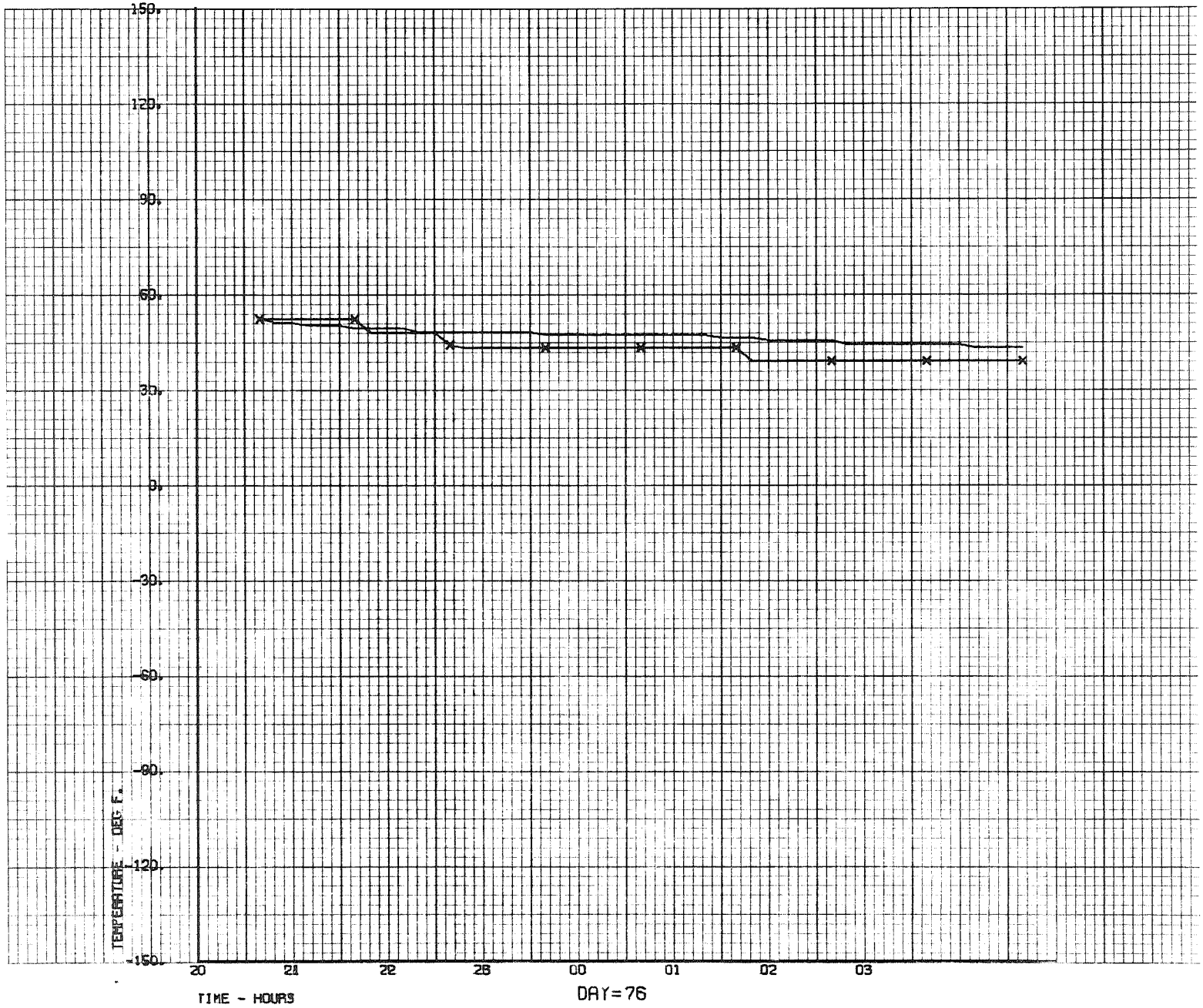

TW603
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60.
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-90.
-120.
-150.
TEMPERATURE - DEG F.
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TIME - HOURS
DAY=76


TW602
150.
120.
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-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
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TIME - HOURS
DAY=76

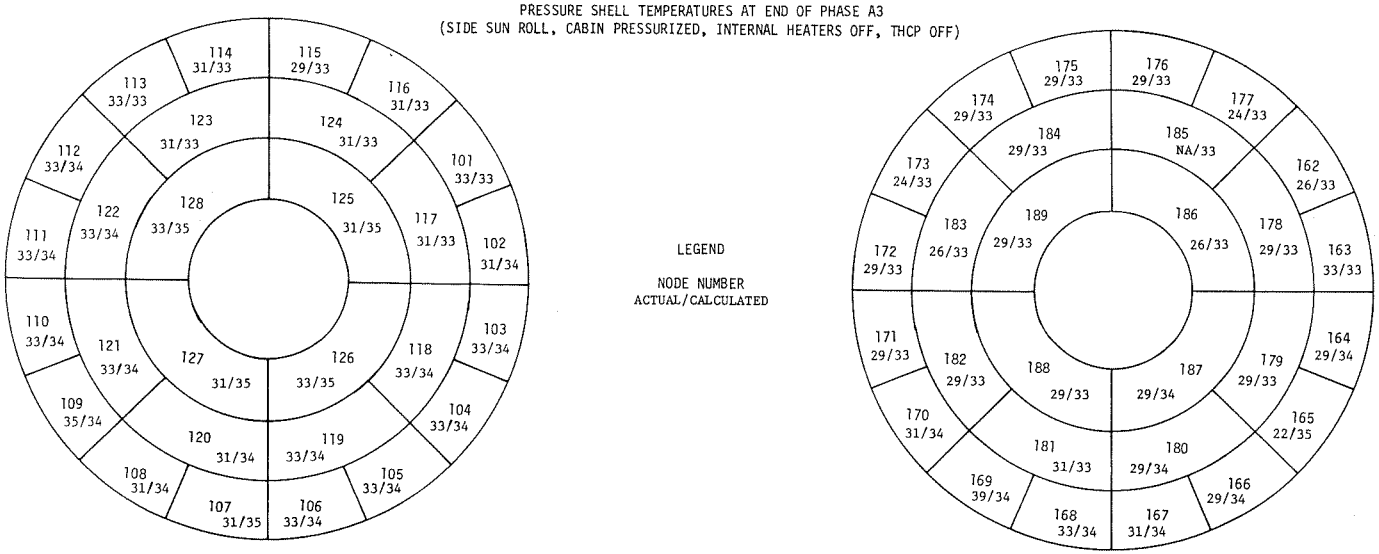
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-150.
TEMPERATURE - DEG F.
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TIME - HOURS
DAY=76

TP4158


150.
120.
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TEMPERATURE - DEG F.
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01
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03
TIME - HOURS
DAY=76

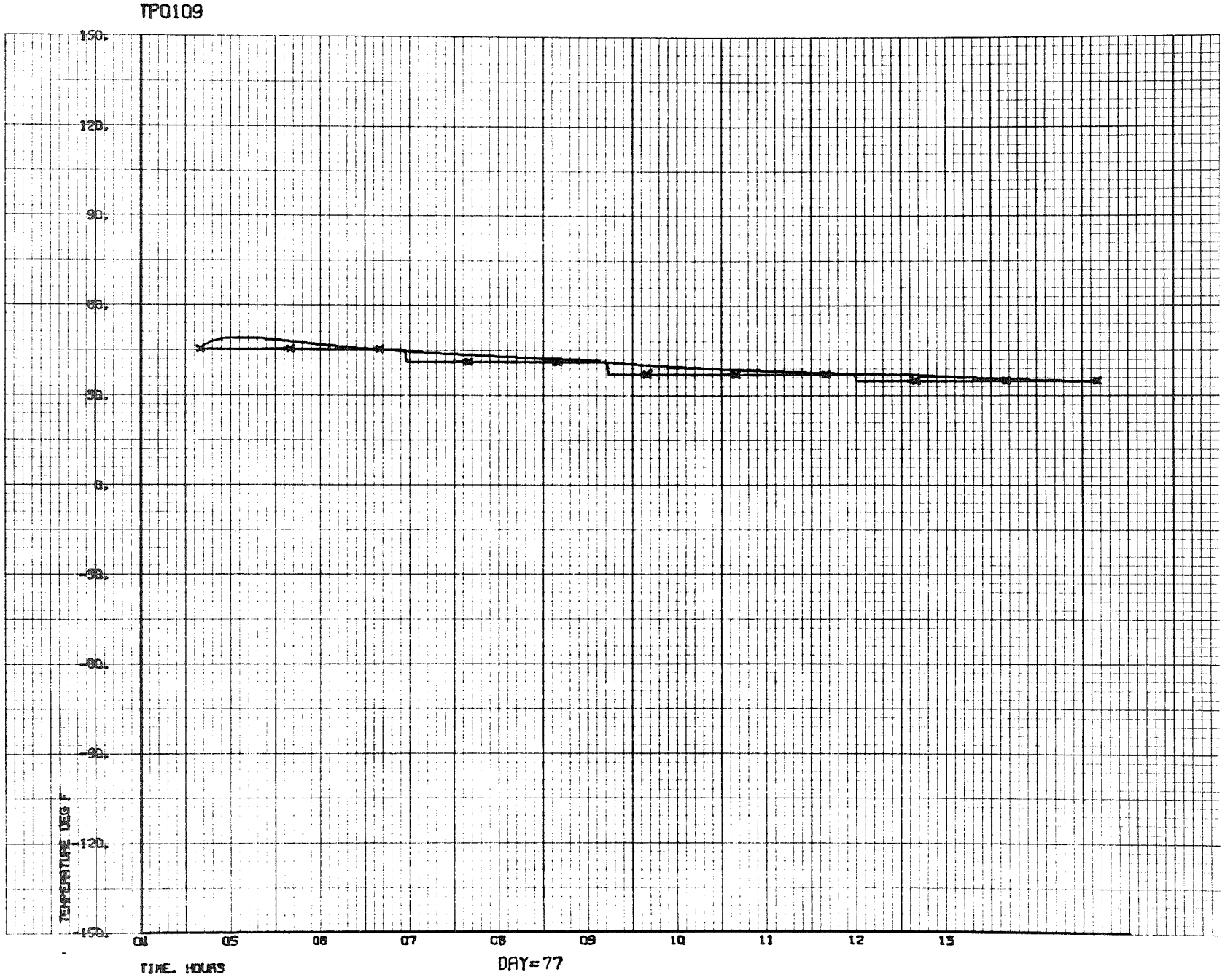
PRESSURE SHELL TEMPERATURES AT END OF PHASE A3
(SIDE SUN ROLL, CABIN PRESSURIZED, INTERNAL HEATERS OFF, THCP OFF)



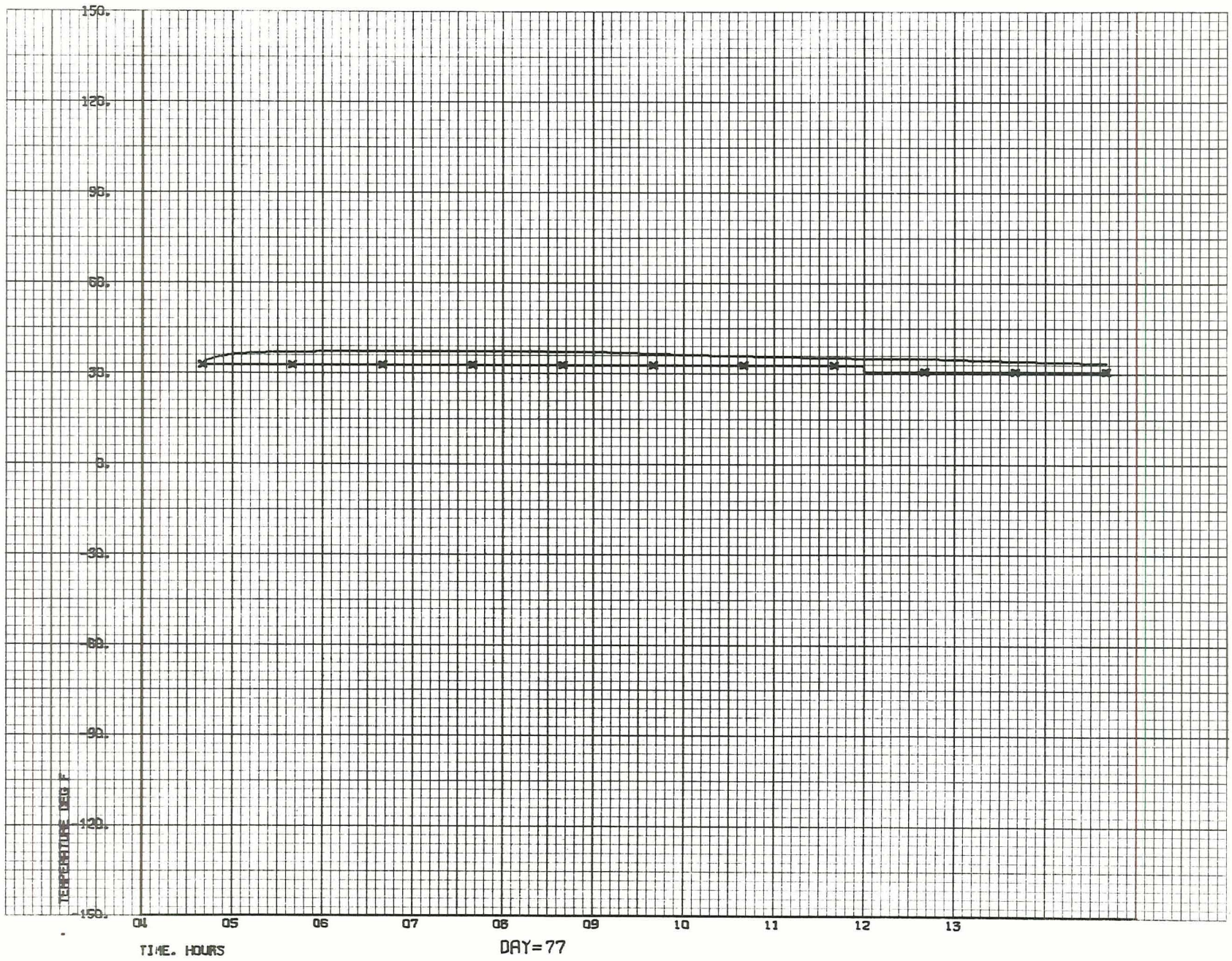
LEGEND

NODE NUMBER
ACTUAL/CALCULATED

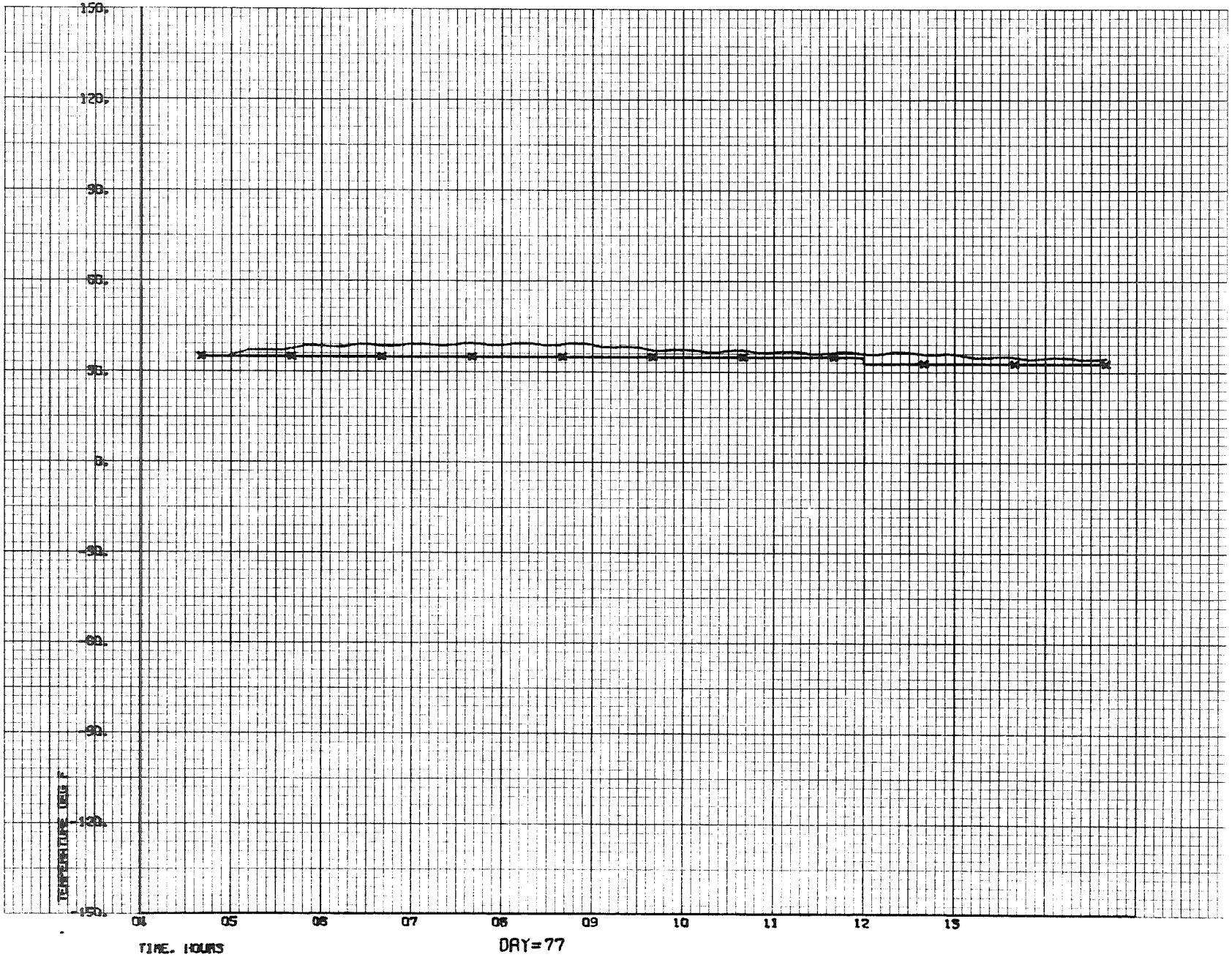
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146 31/34	147 33/34	148 33/34	149 29/34	150 33/34	151 37/34	152 33/34	153 35/34	154 33/34	155 33/34	156 46/34	157 33/34	158 33/34	159 33/33	160 33/34	161 35/34


TP0109
150.
120.
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-30.
-60.
-90.
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TEMPERATURE DEG F
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12
13
TIME. HOURS
DAY=77

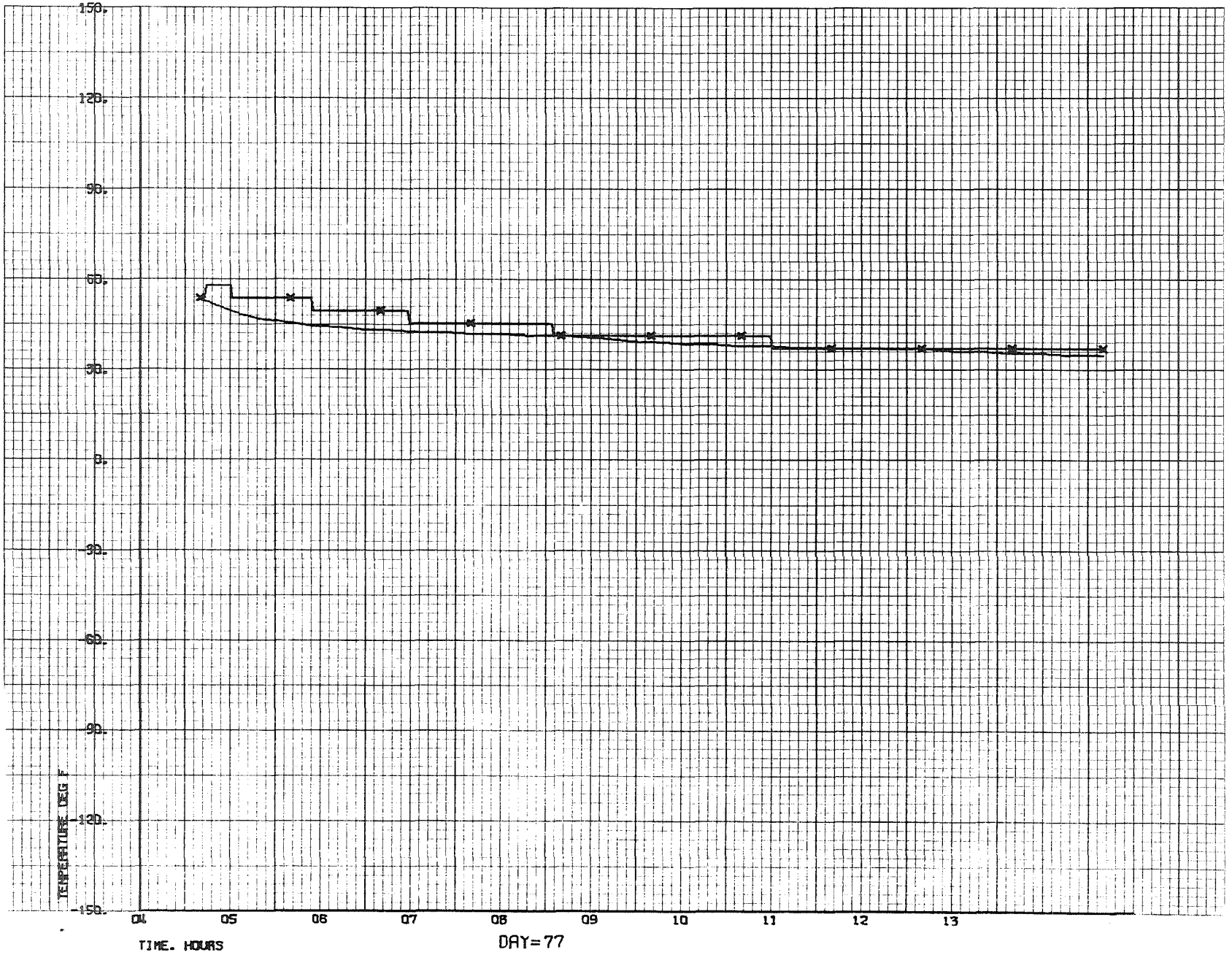
TP0117


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TEMPERATURE DEG F
04
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13
TIME. HOURS
DAY=77

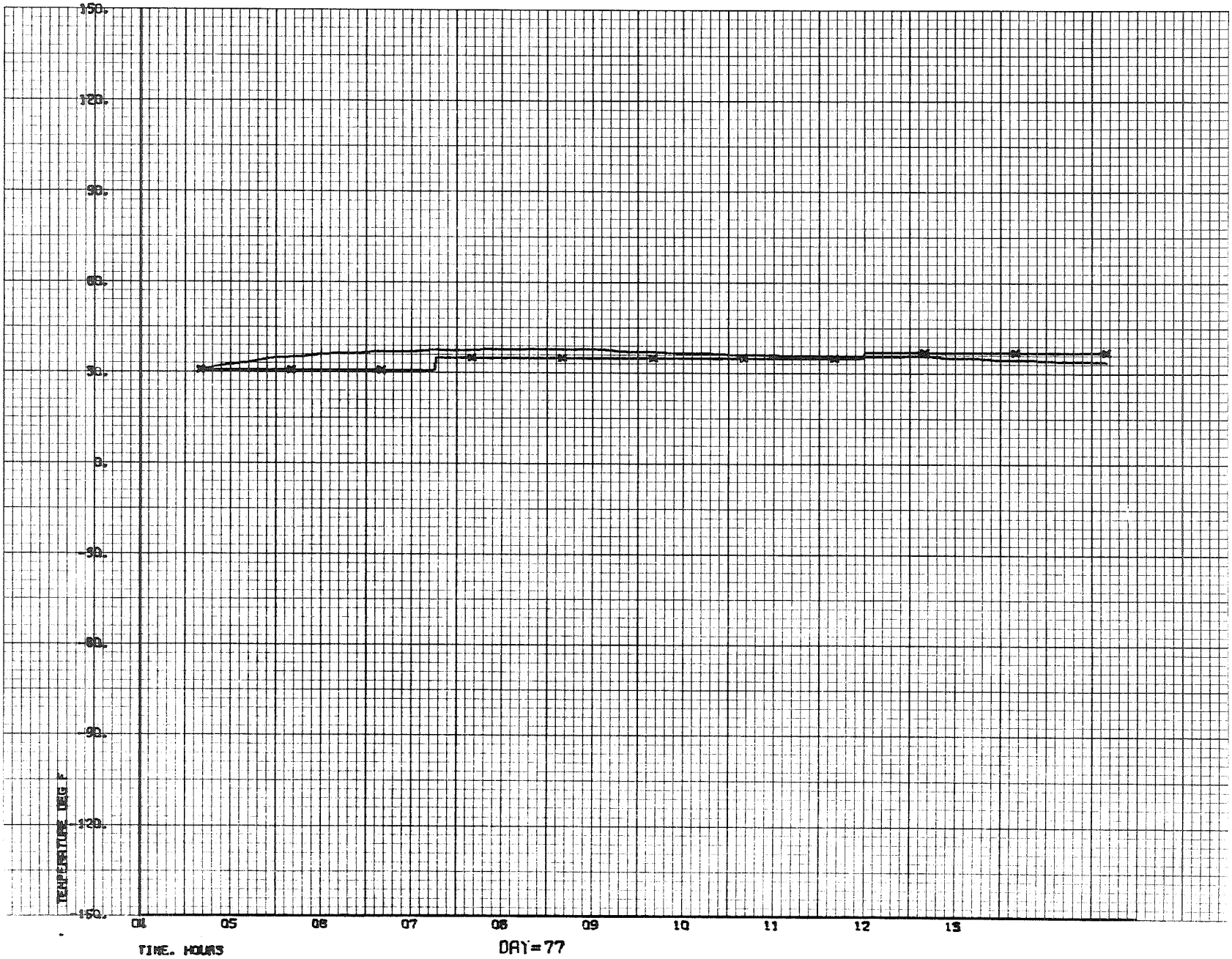
TP0132


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TEMPERATURE DEG F
04
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13
TIME. HOURS
DAY=77

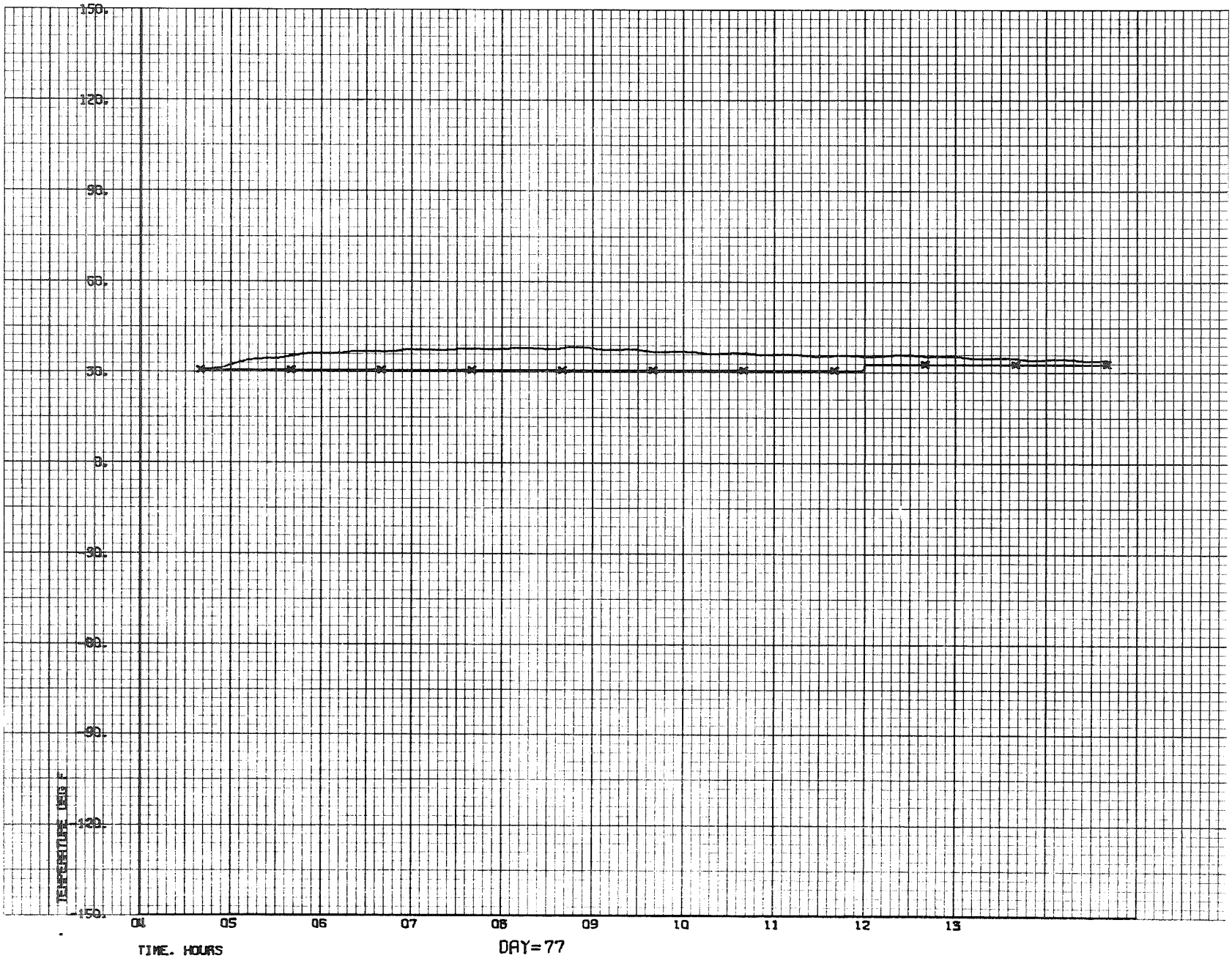
TP0138


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TEMPERATURE DEG F
04
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TIME. HOURS
DAY=77

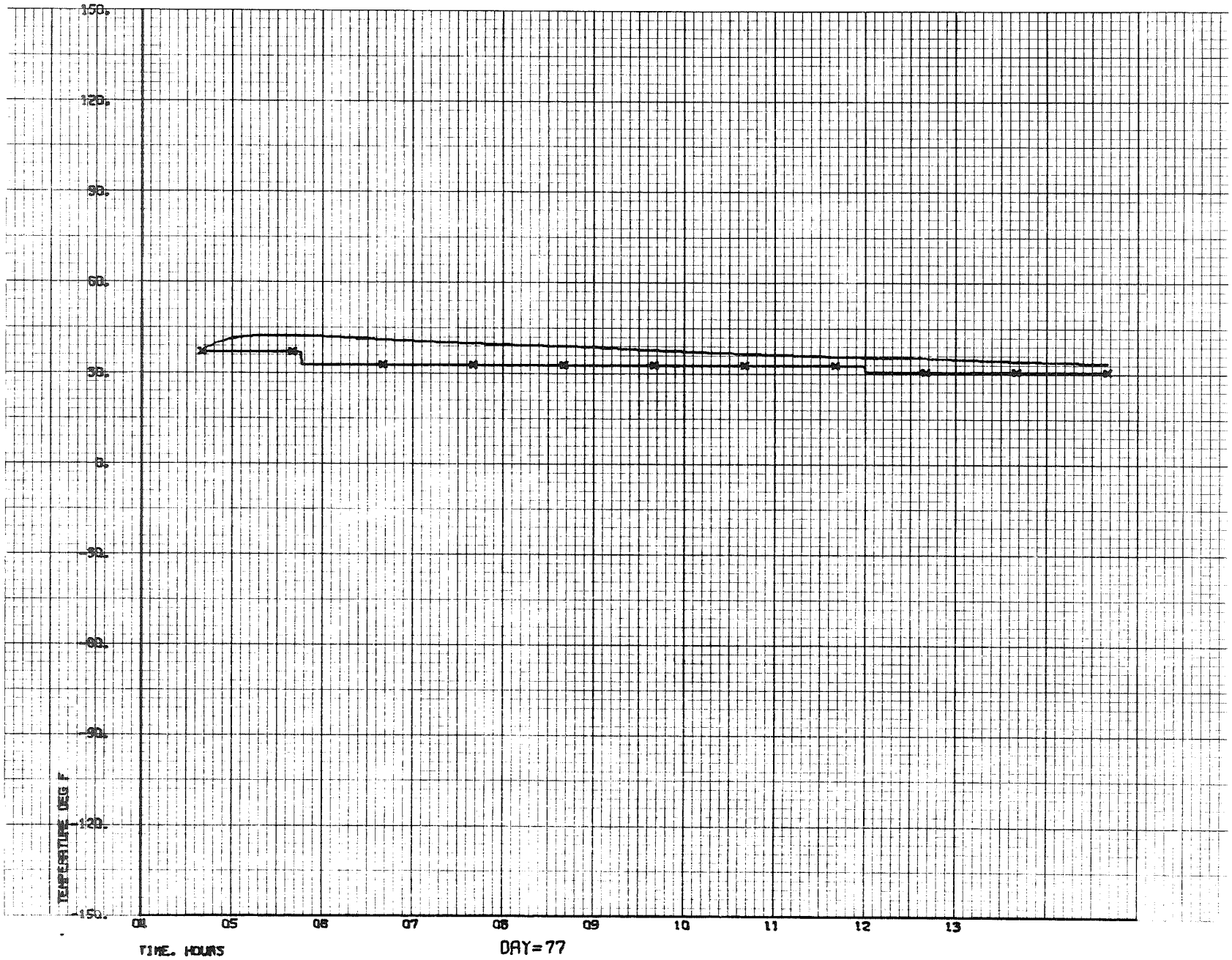
TP0142


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TEMPERATURE DEG F
01
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13
TIME. HOURS
DAY=77

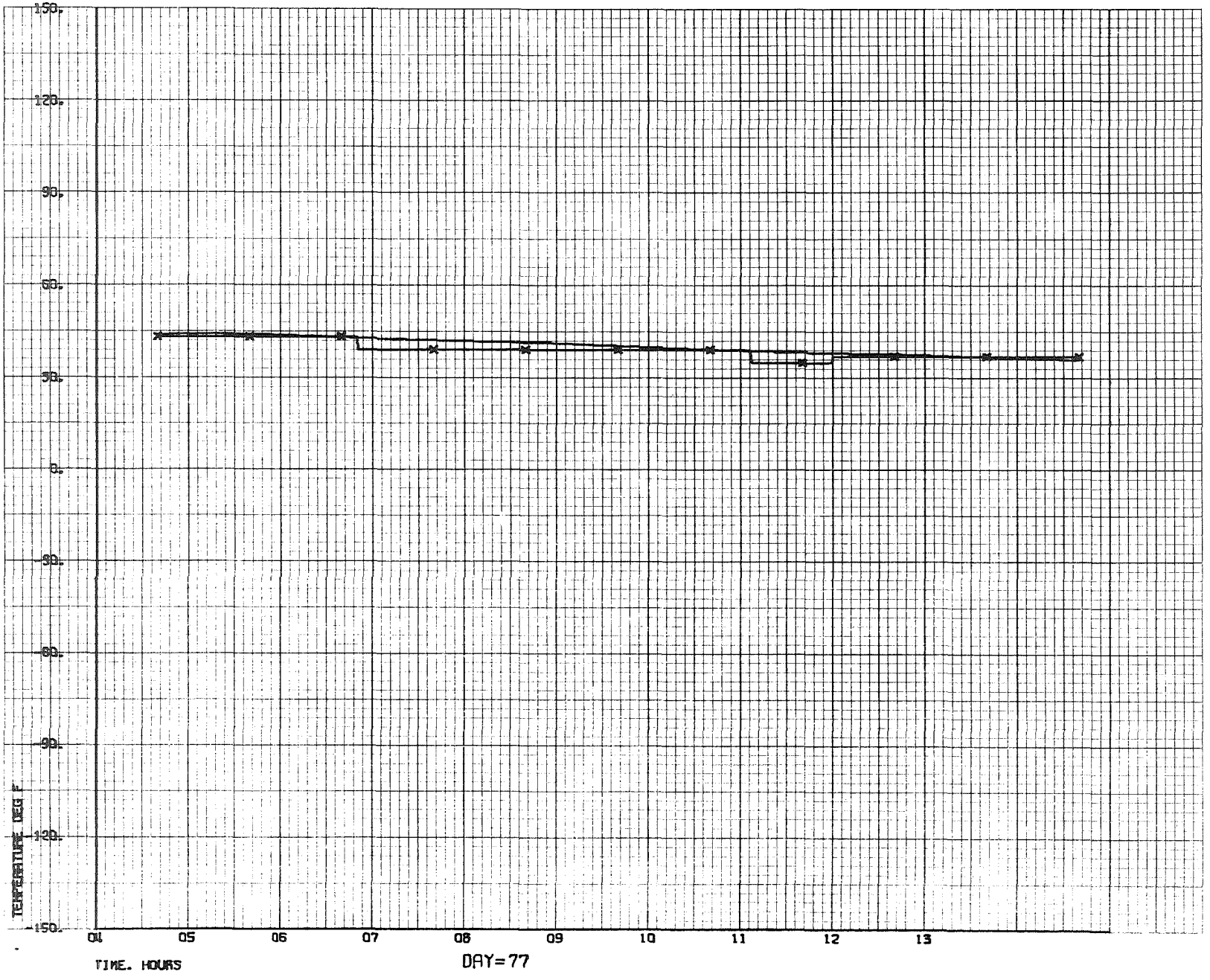
TP0148


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TEMPERATURE DEG F
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TIME. HOURS
DAY=77

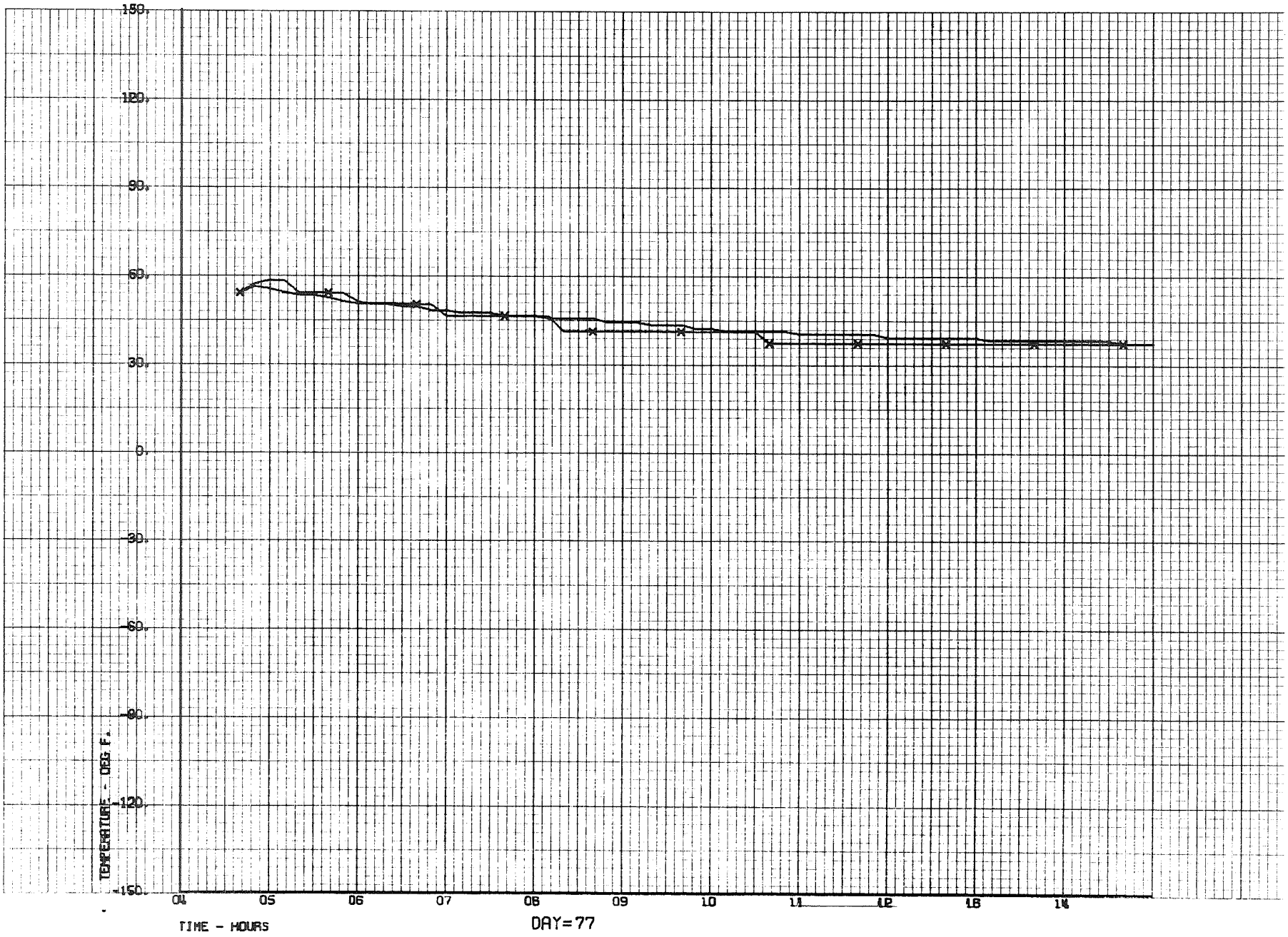
TP0170


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TEMPERATURE DEG F
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TIME. HOURS
DAY=77

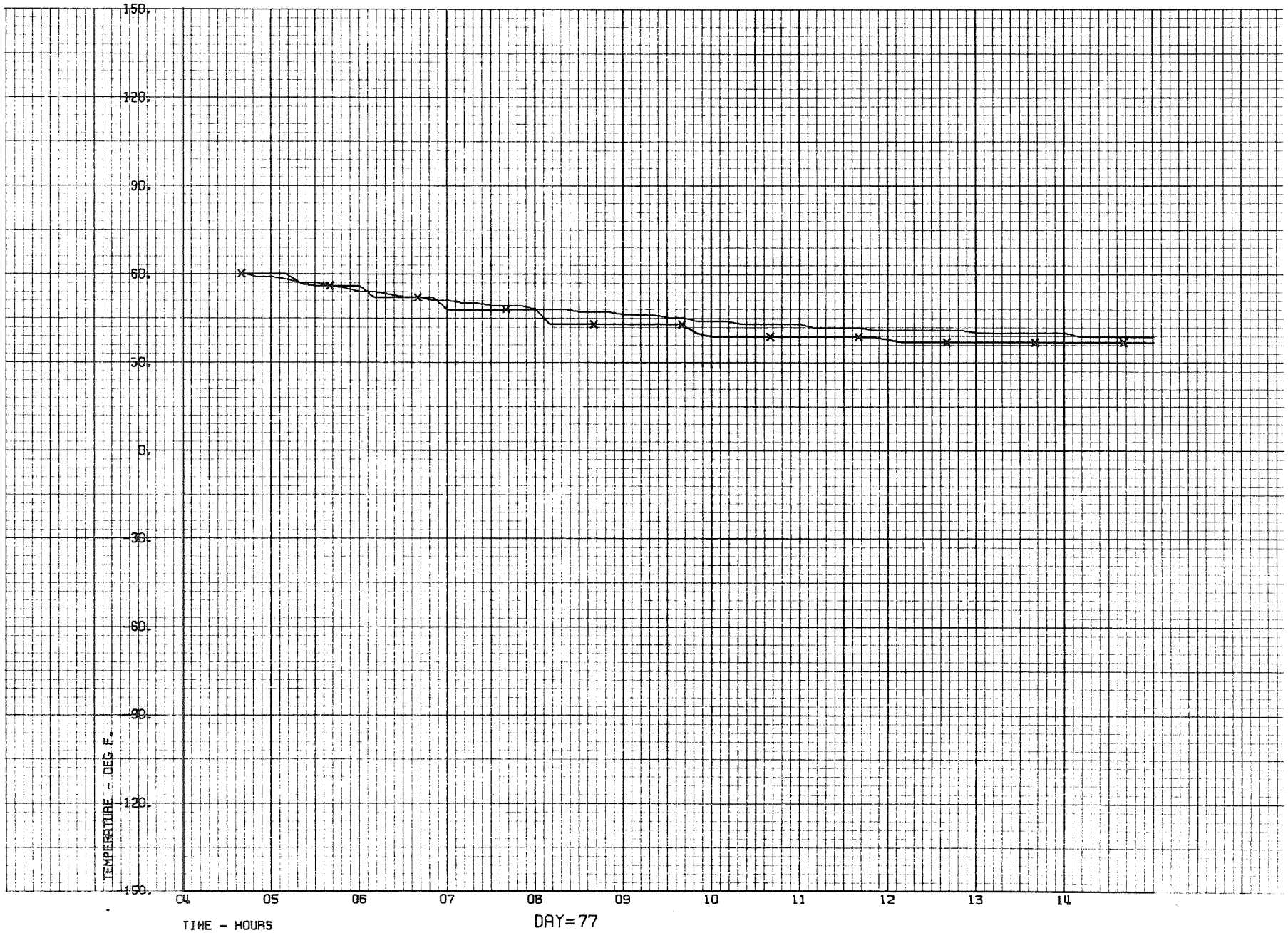
TH0522


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TEMPERATURE DEG F
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TIME. HOURS
DAY=77

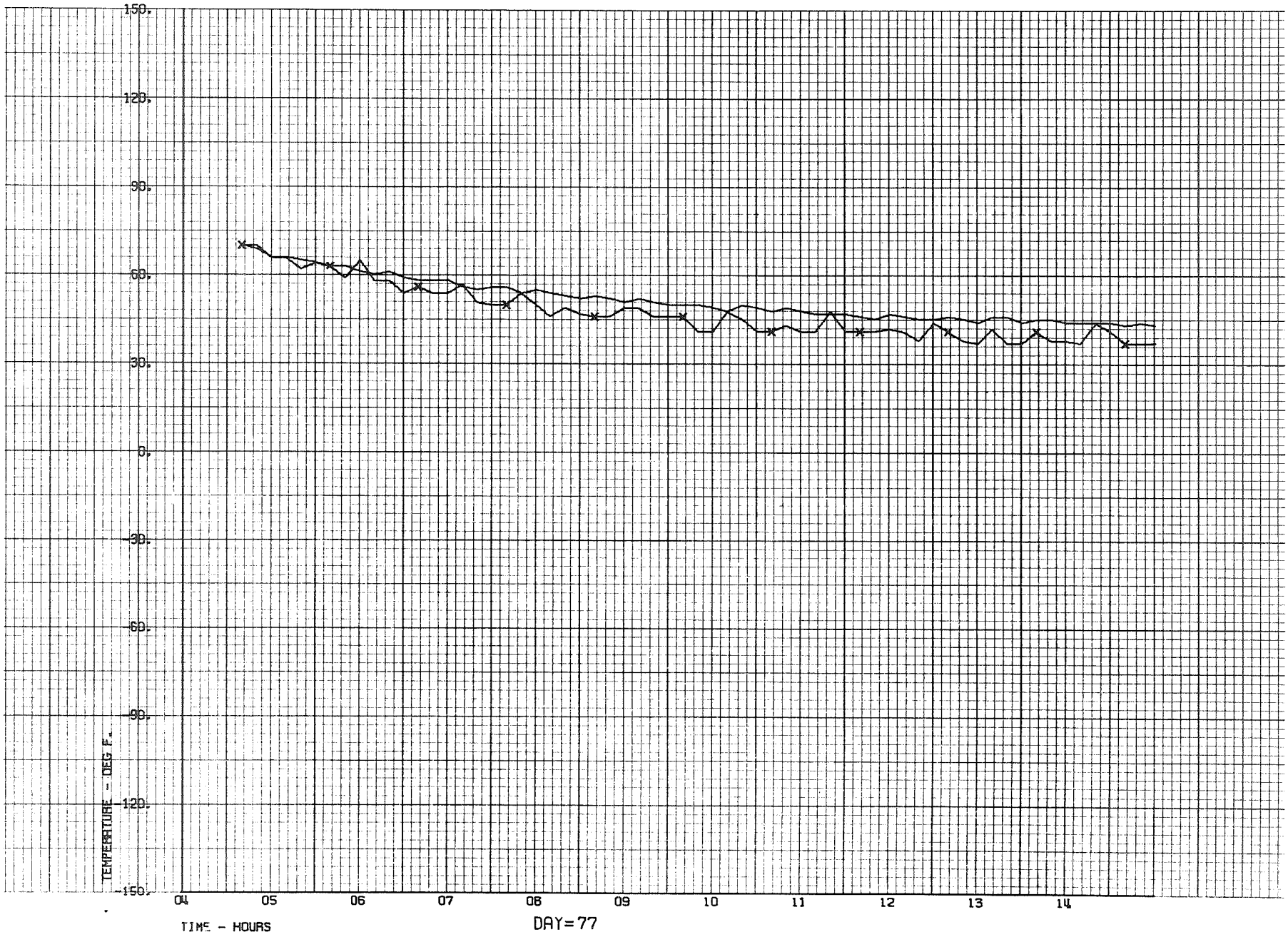
TW601


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TEMPERATURE - DEG F.
04
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13
14
TIME - HOURS
DAY=77

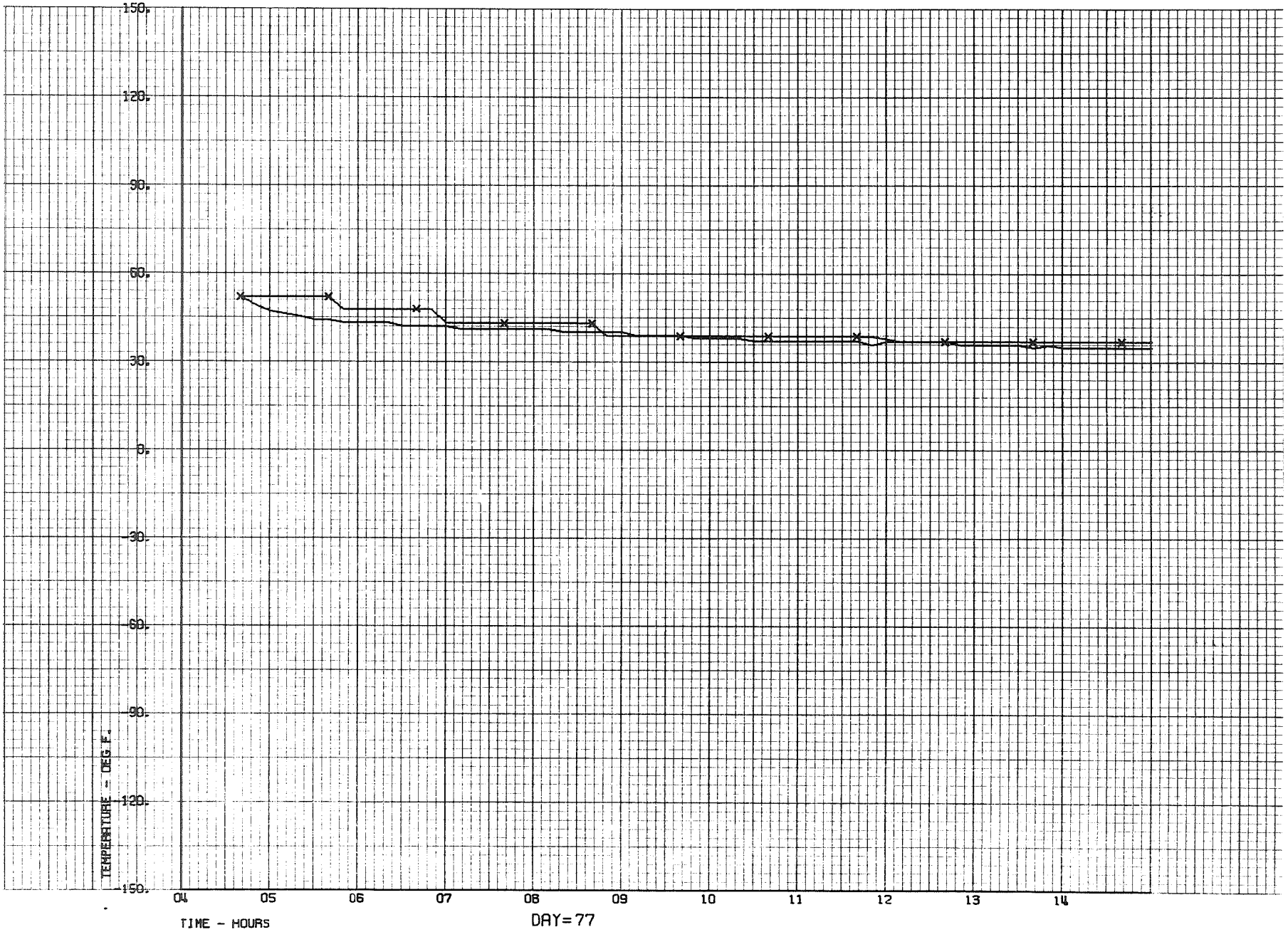
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TIME - HOURS
DAY=77

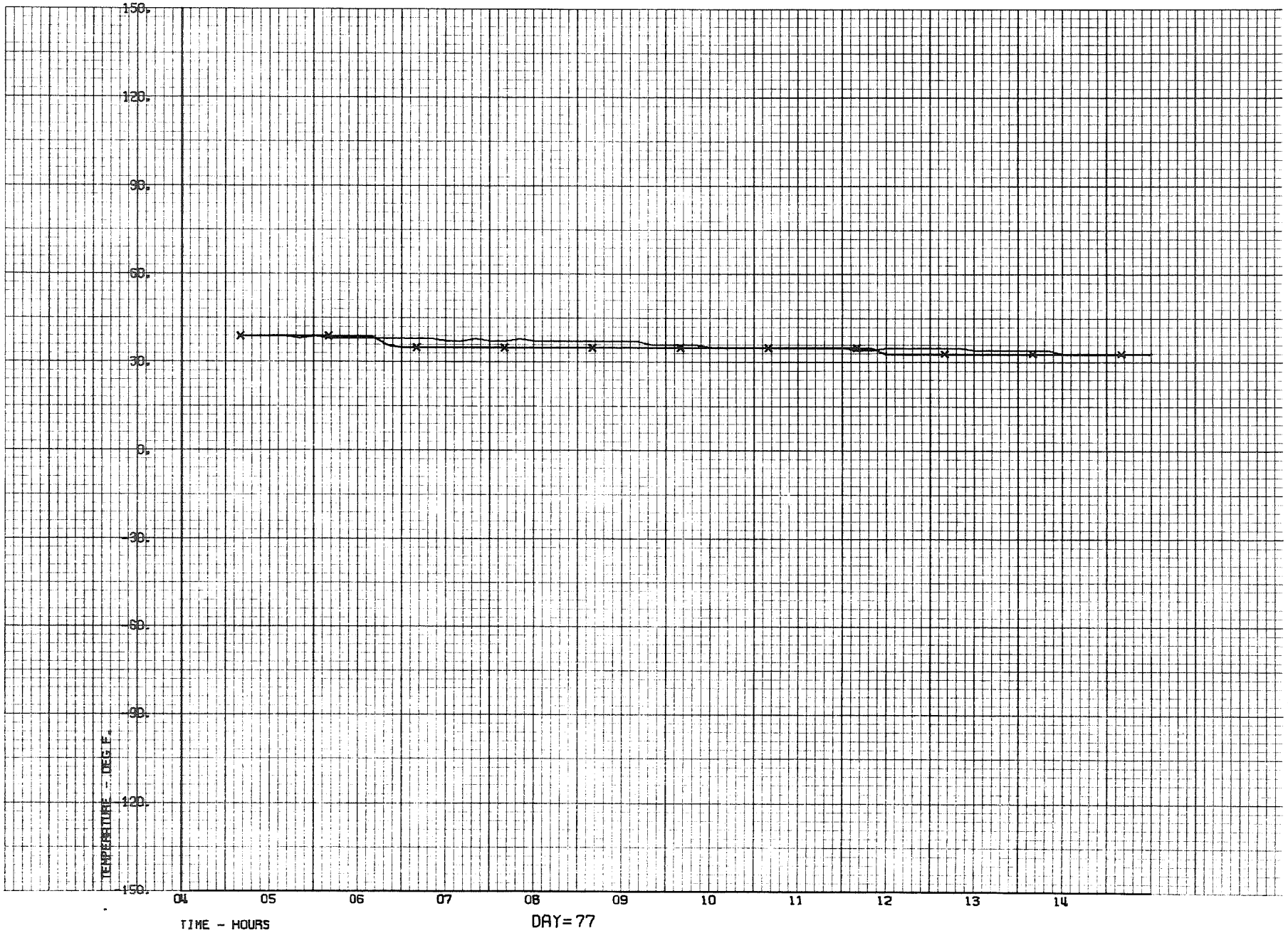
TW603


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TEMPERATURE - DEG F.
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TIME - HOURS
DAY=77

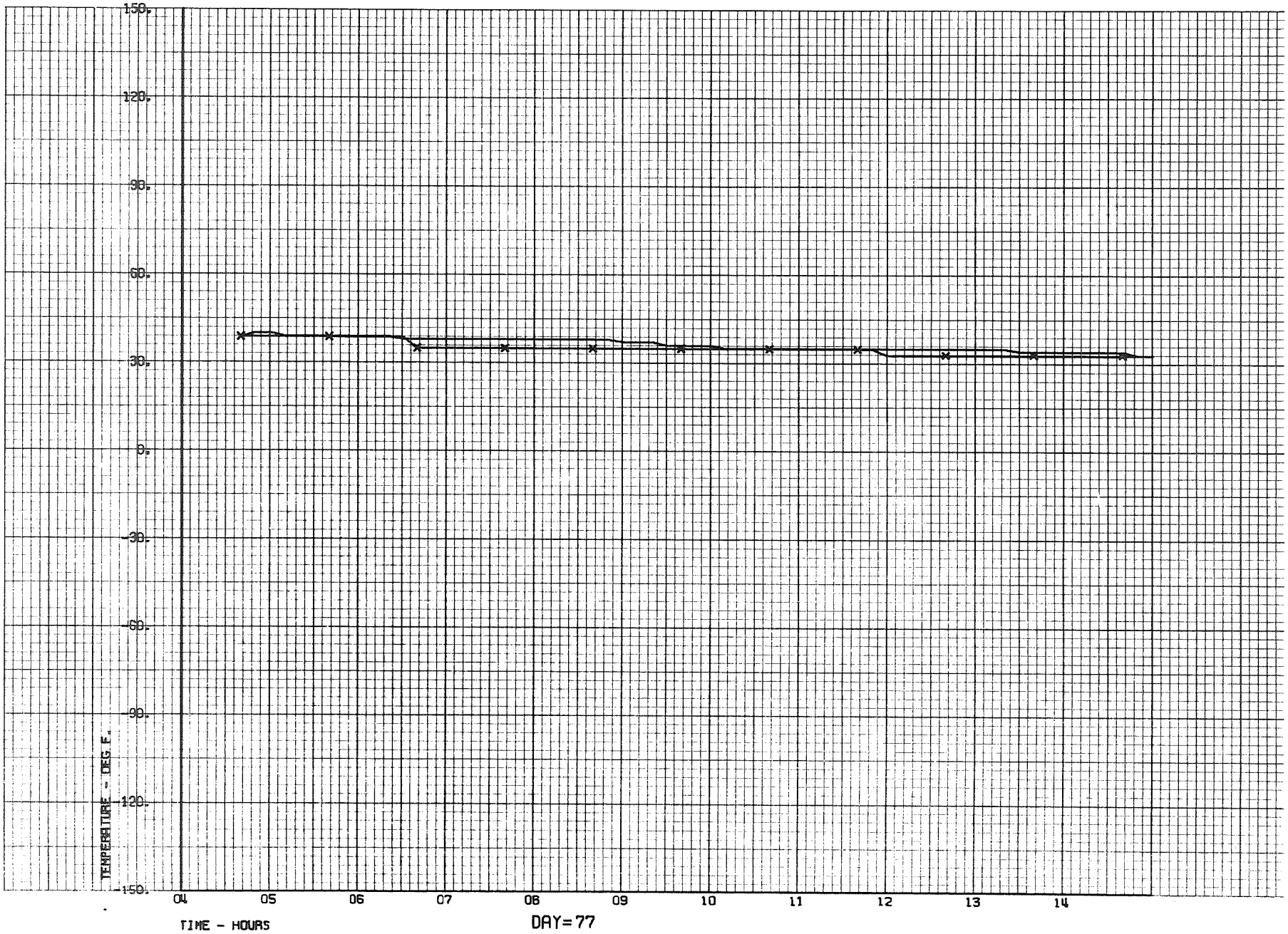
TP5138


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
04
05
06
07
08
09
10
11
12
13
14
TIME - HOURS
DAY=77

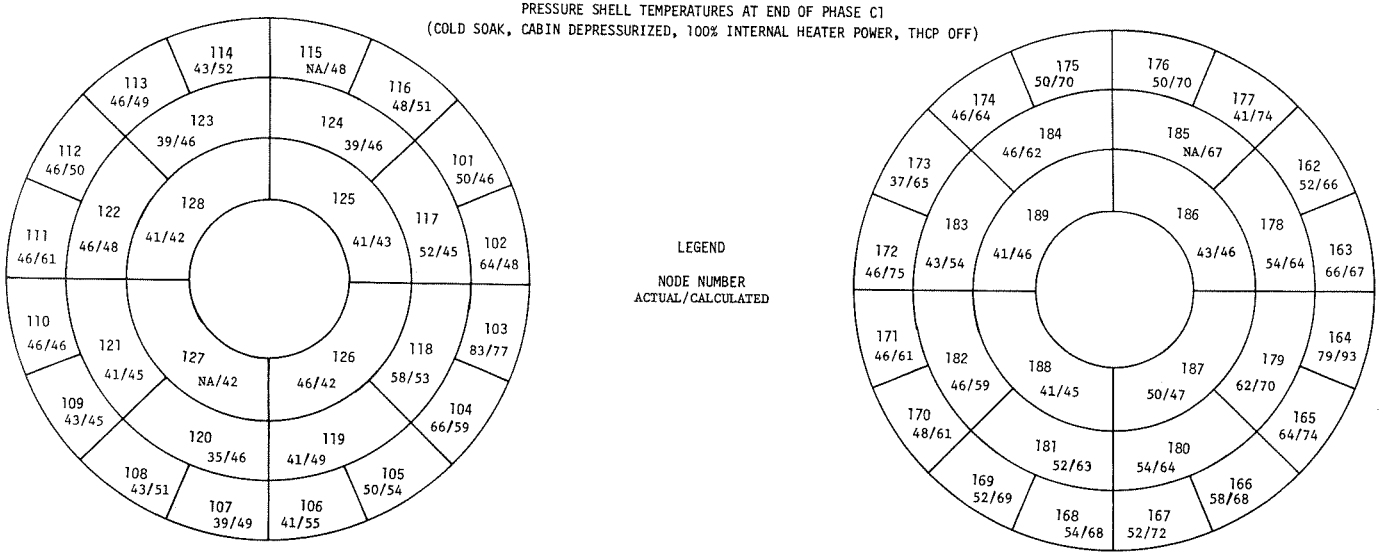
TP5139


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
04
05
06
07
08
09
10
11
12
13
14
TIME - HOURS
DAY=77

TP4158


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
04
05
06
07
08
09
10
11
12
13
14
TIME - HOURS
DAY=77

PRESSURE SHELL TEMPERATURES AT END OF PHASE C1
(COLD SOAK, CABIN DEPRESSURIZED, 100% INTERNAL HEATER POWER, THCP OFF)

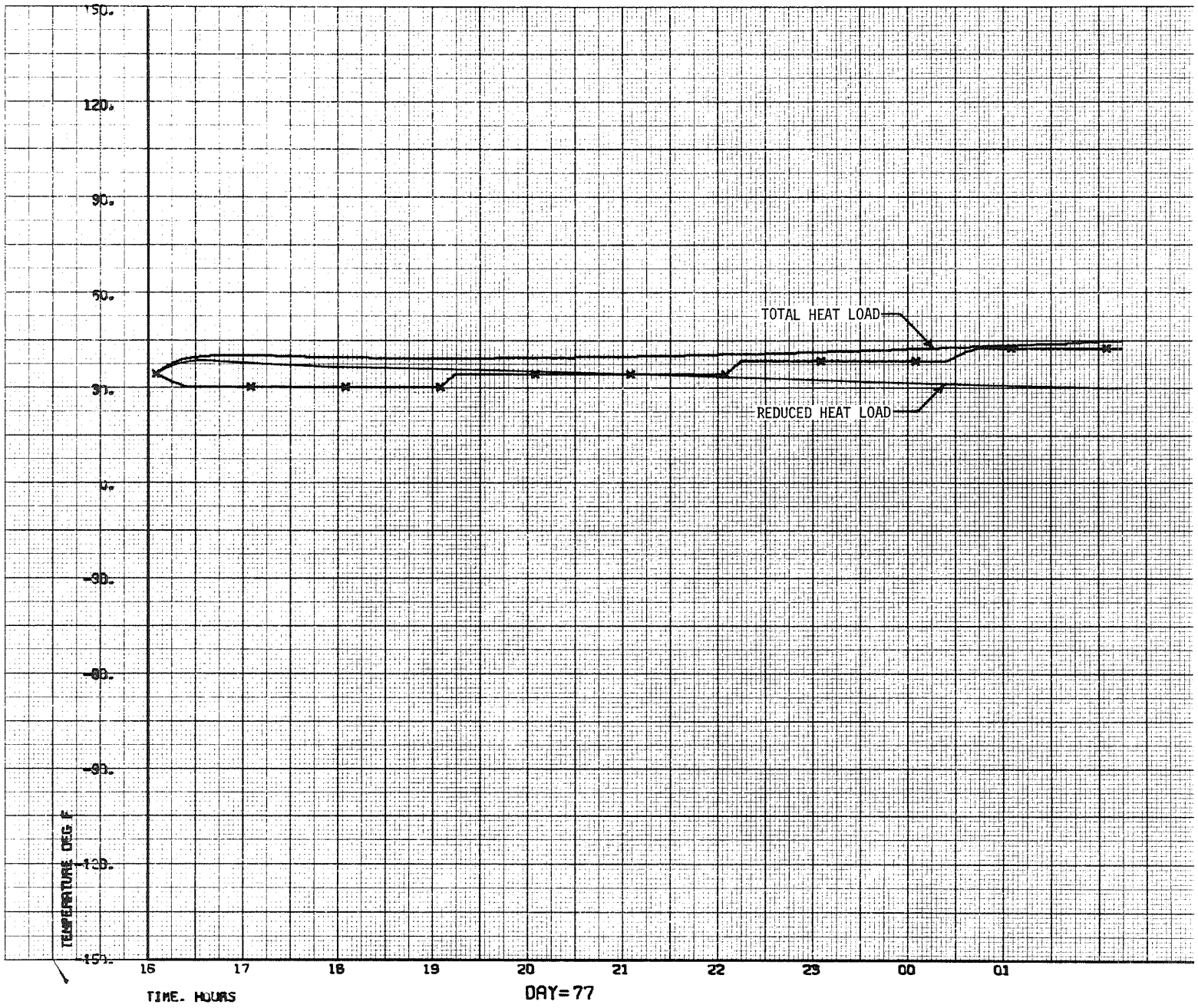


LEGEND

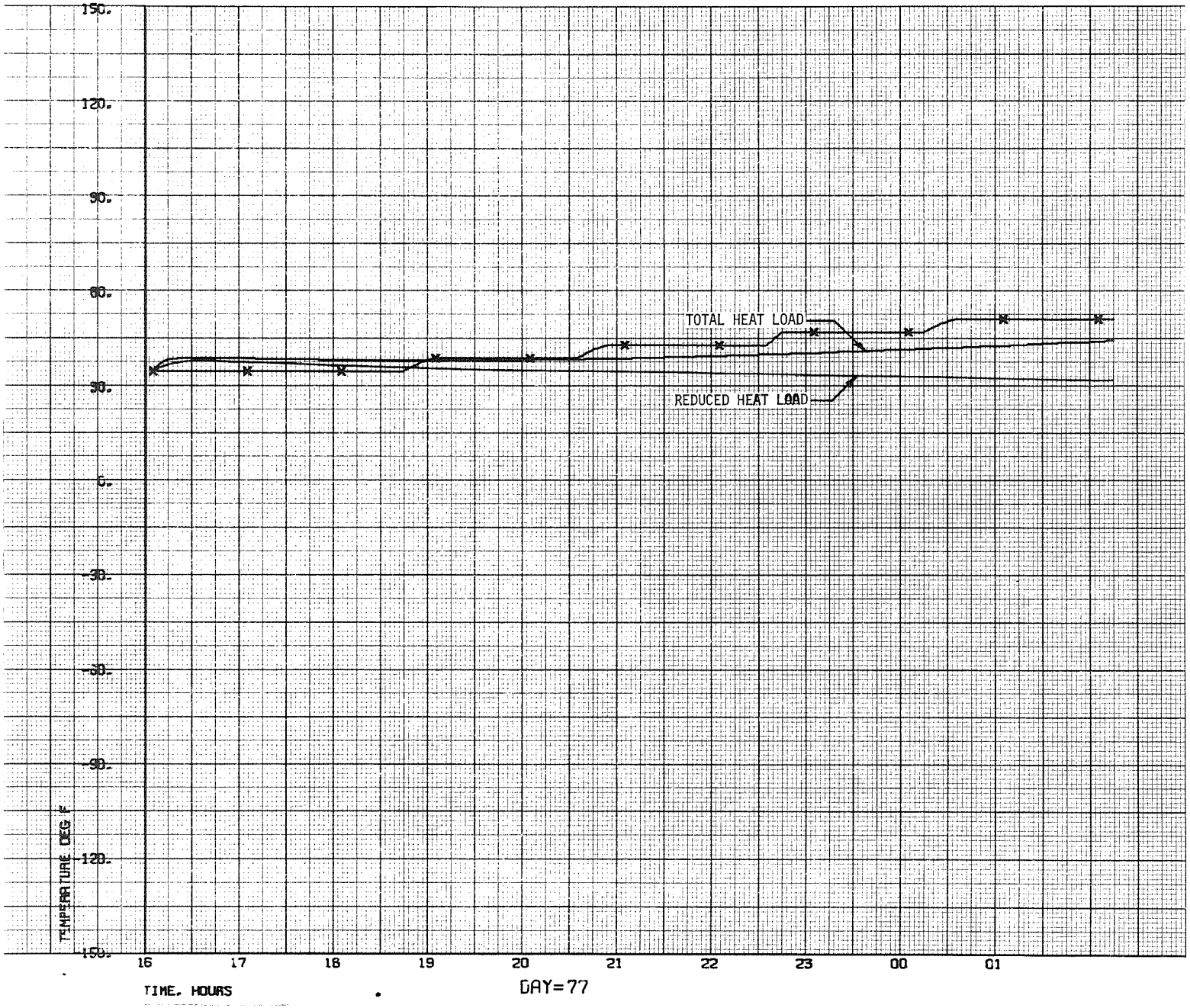
NODE NUMBER
ACTUAL/CALCULATED

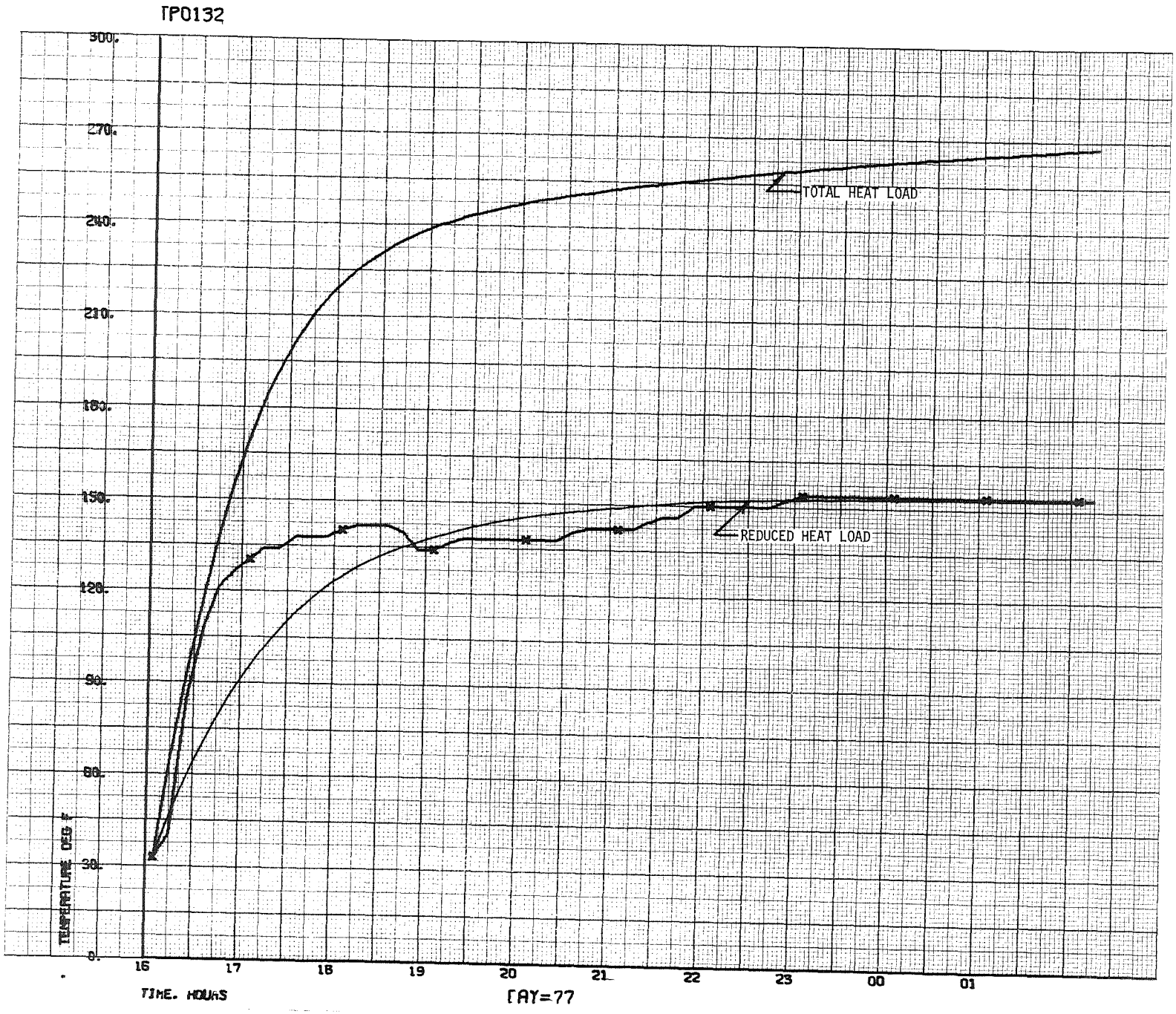
130 52/47	131 83/NA	132 139/269	133 77/101	134 50/72	135 72/136	136 50/56	137 54/NA	138 50/52	139 52/51	140 74/149	141 62/72	142 46/66	143 70/133	144 48/56	145 74/137
146 68/46	147 83/NA	148 150/269	149 87/104	150 70/74	151 74/159	152 58/58	153 81/155	154 87/49	155 66/48	156 70/144	157 62/69	158 66/69	159 70/153	160 58/59	161 72/161

TP0109

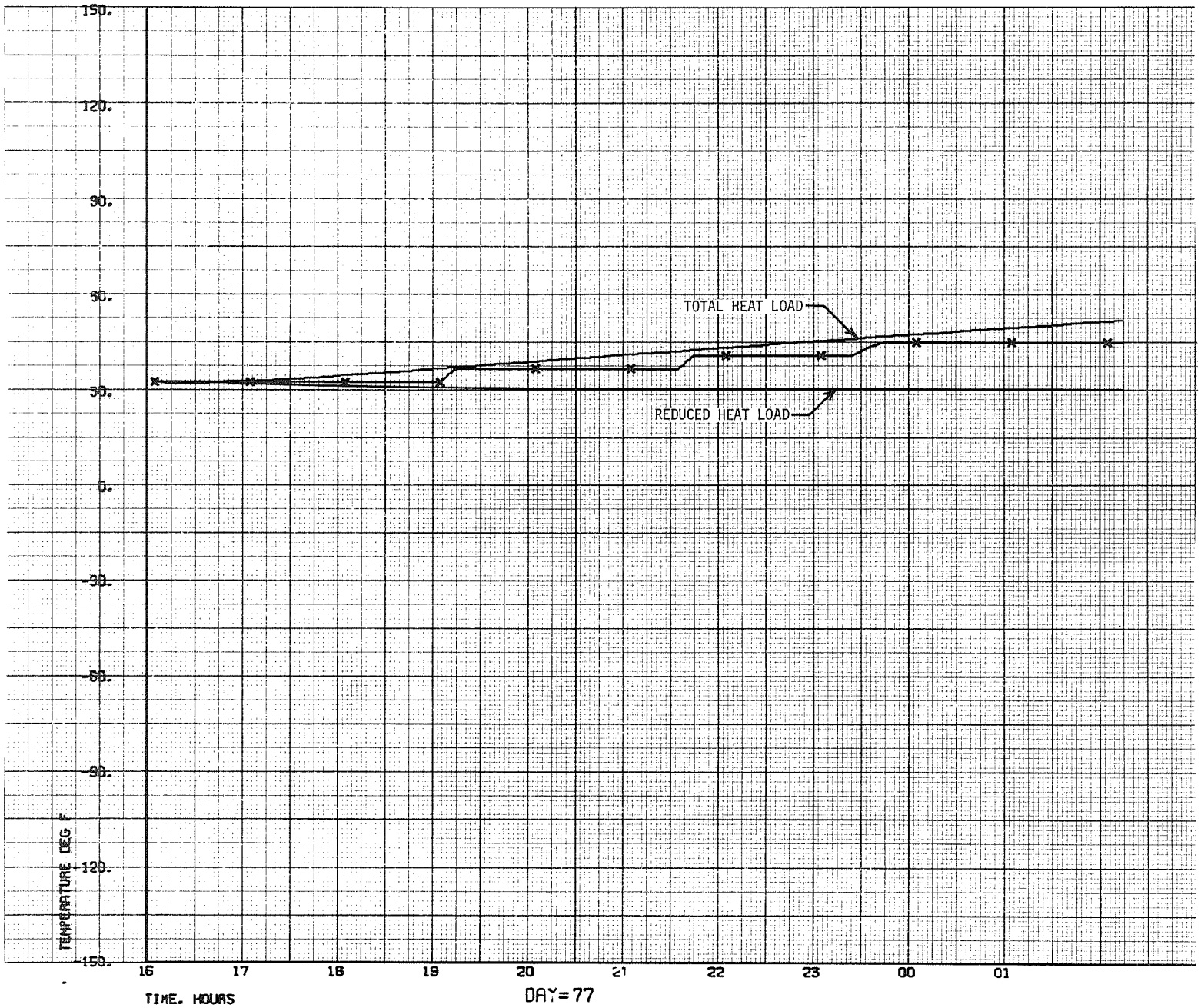

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
16
17
18
19
20
21
22
23
00
01
TIME. HOURS
DAY=77

TP0117

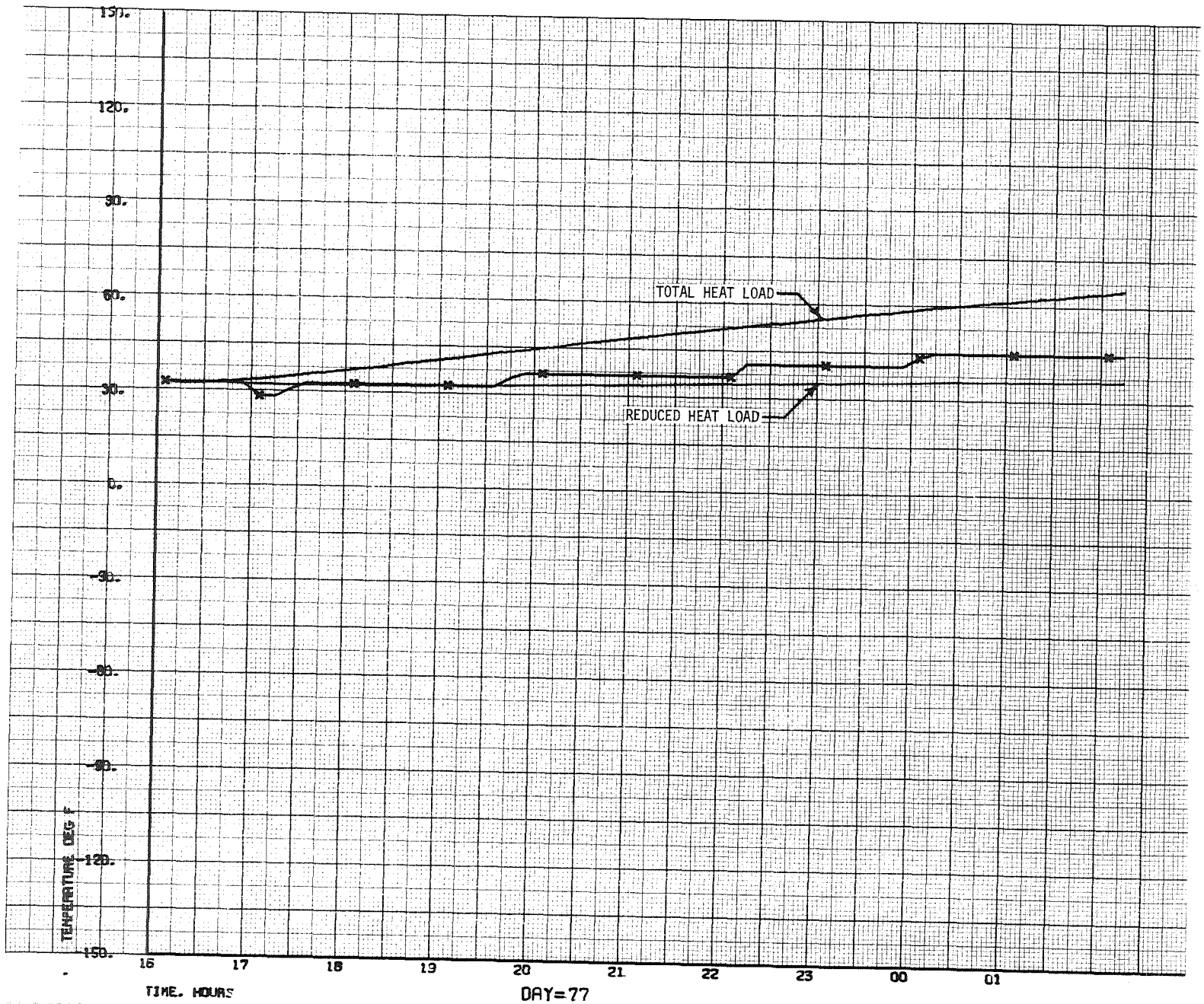

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
16
17
18
19
20
21
22
23
00
01
TIME, HOURS
DAY=77


TP0132
300.
270.
240.
210.
180.
150.
120.
90.
60.
30.
0.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
16
17
18
19
20
21
22
23
00
01
TIME. HOURS
DAY=77

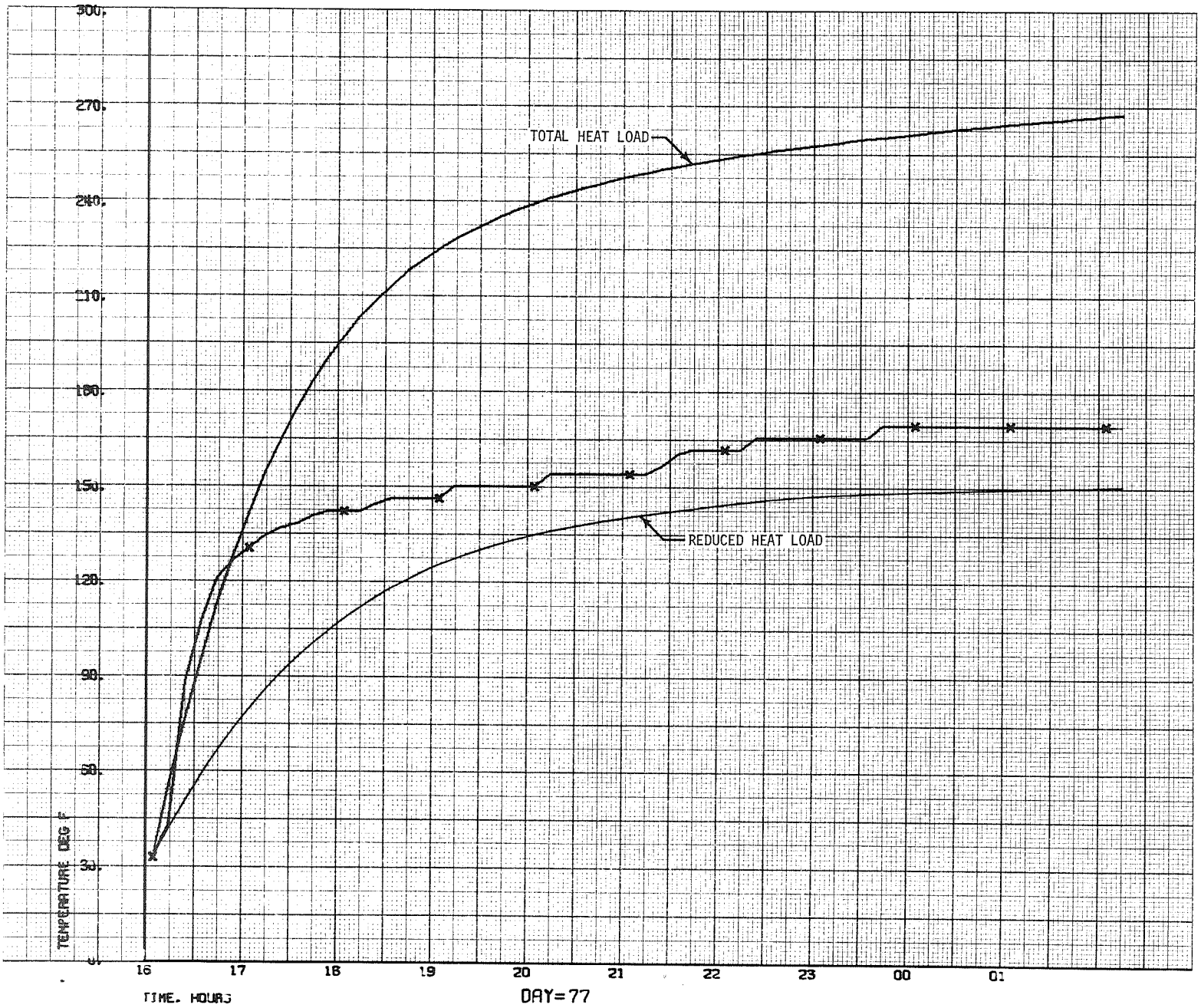
TPC138


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90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
16
17
18
19
20
21
22
23
00
01
TIME. HOURS
DAY=77

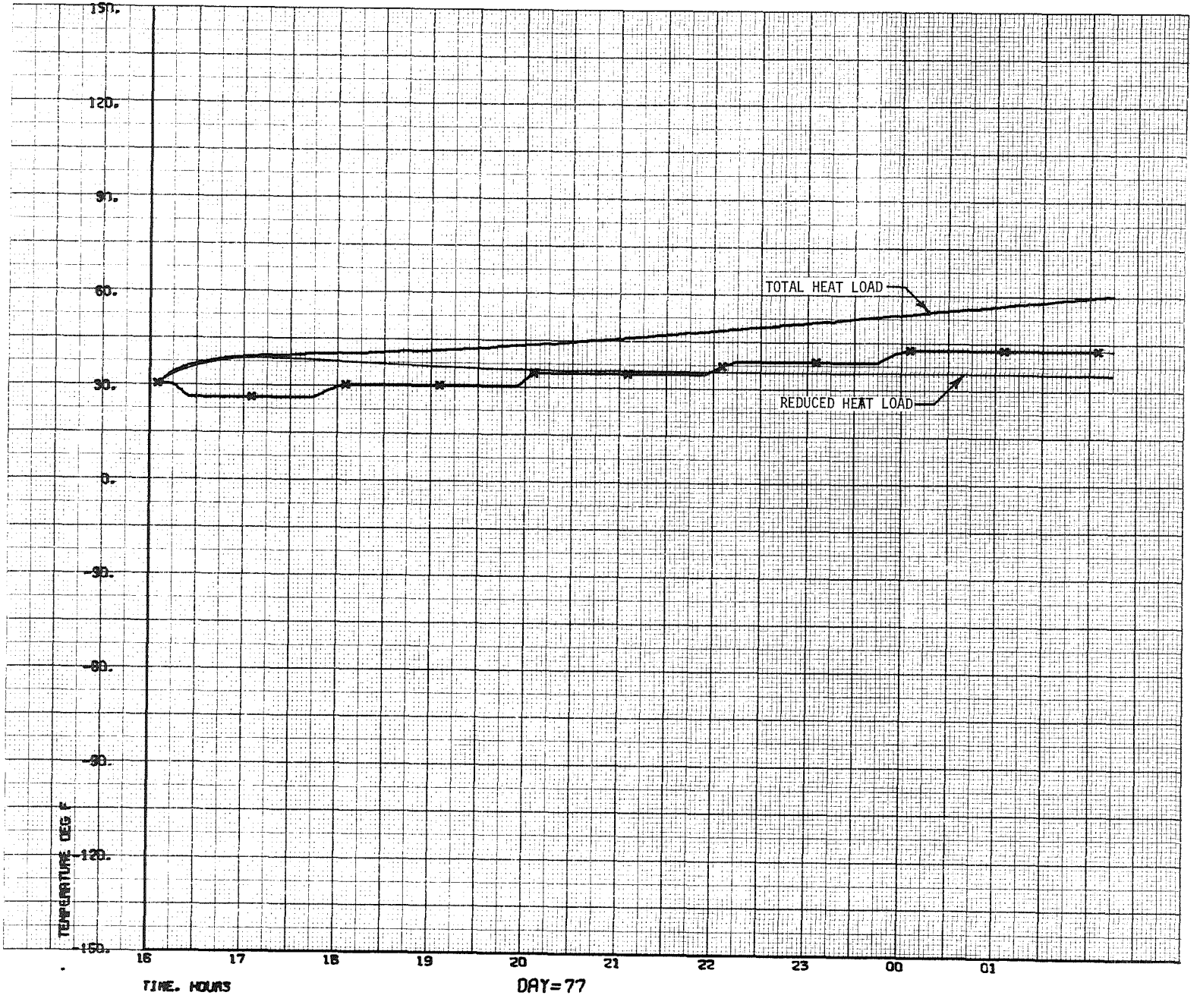
TP0142

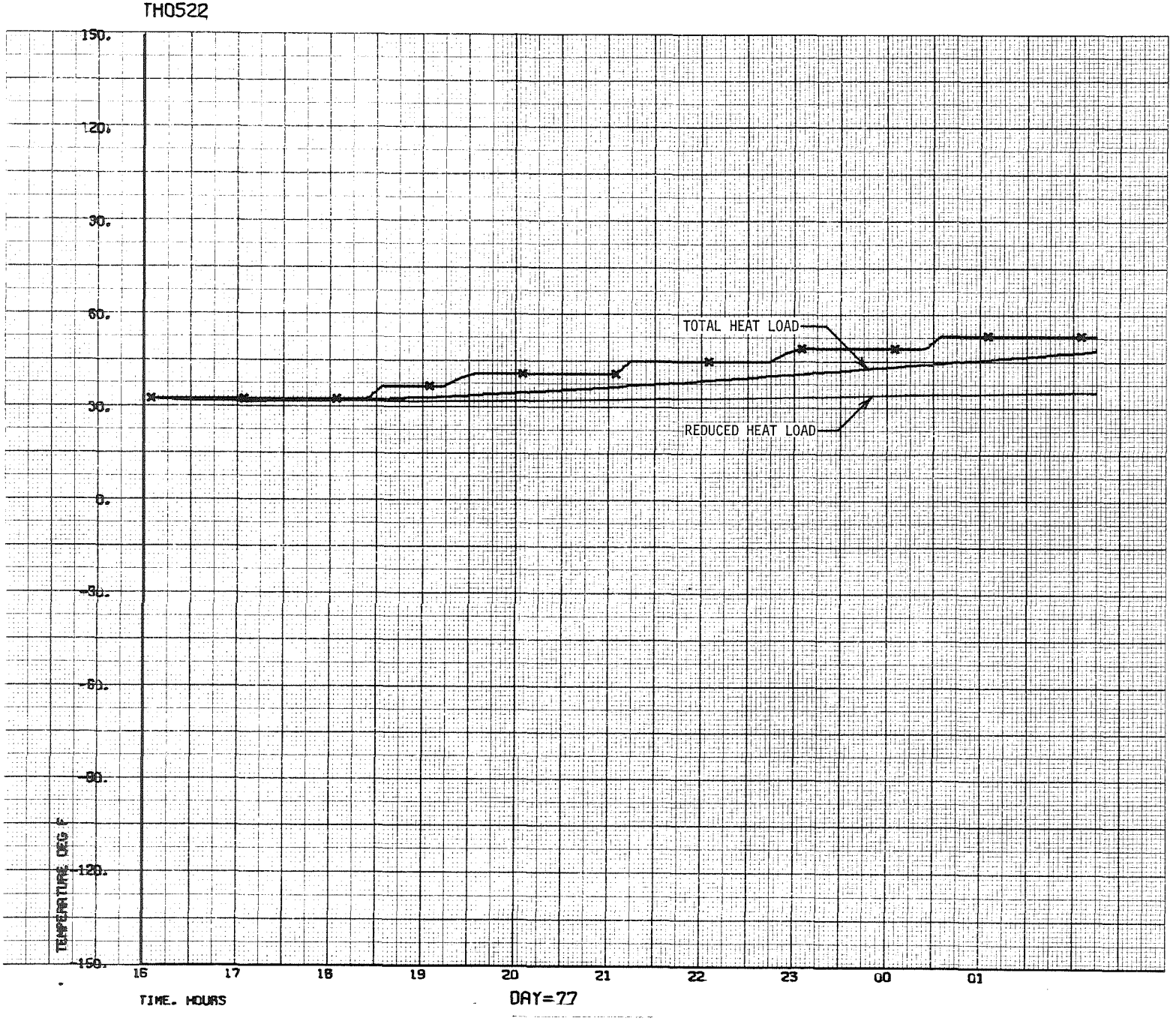

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
16
17
18
19
20
21
22
23
00
01
TIME. HOURS
DAY=77

TP0148

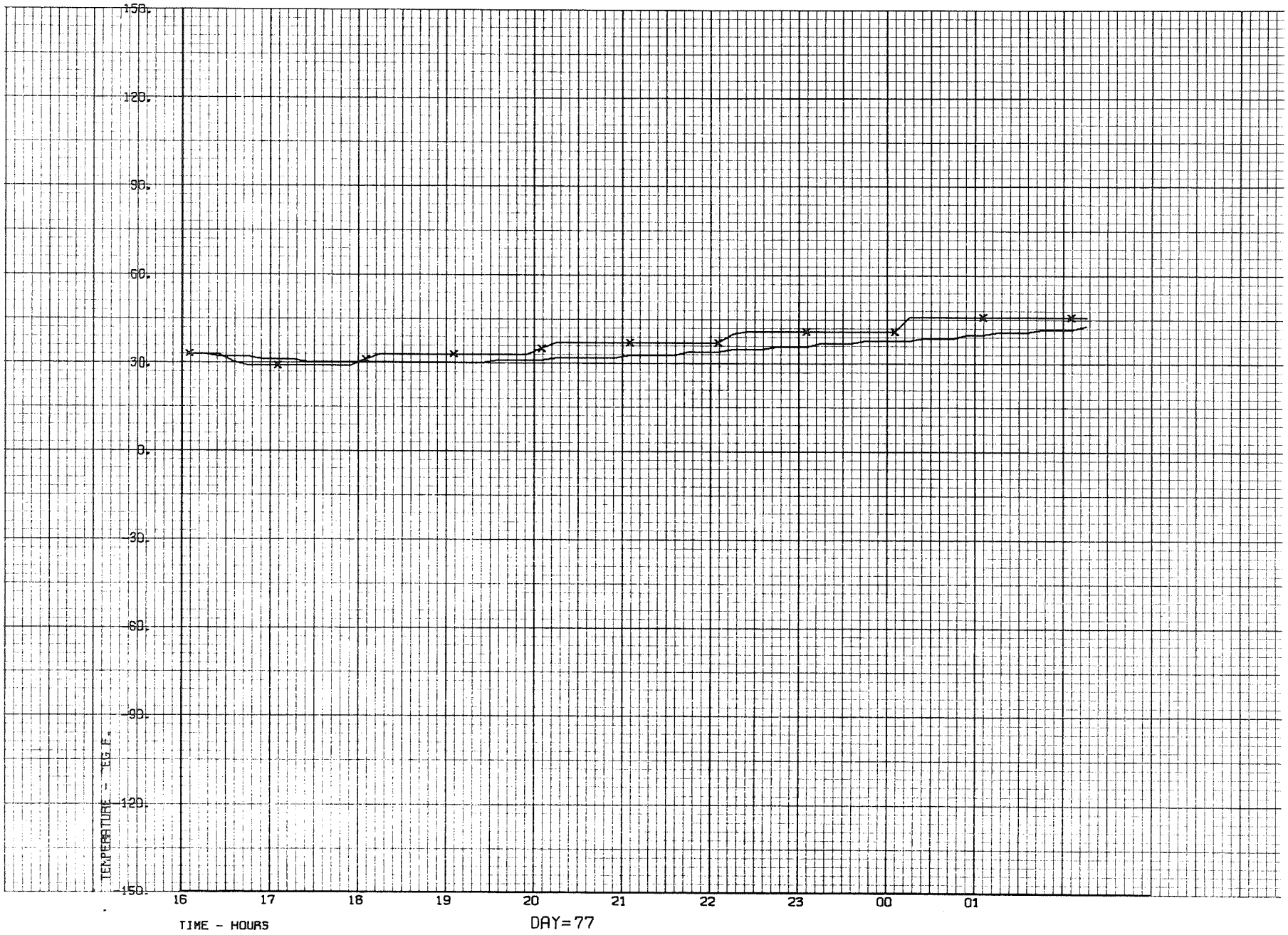

300.
270.
240.
210.
180.
150.
120.
90.
60.
30.
0.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
16
17
18
19
20
21
22
23
00
01
TIME. HOURS
DAY=77

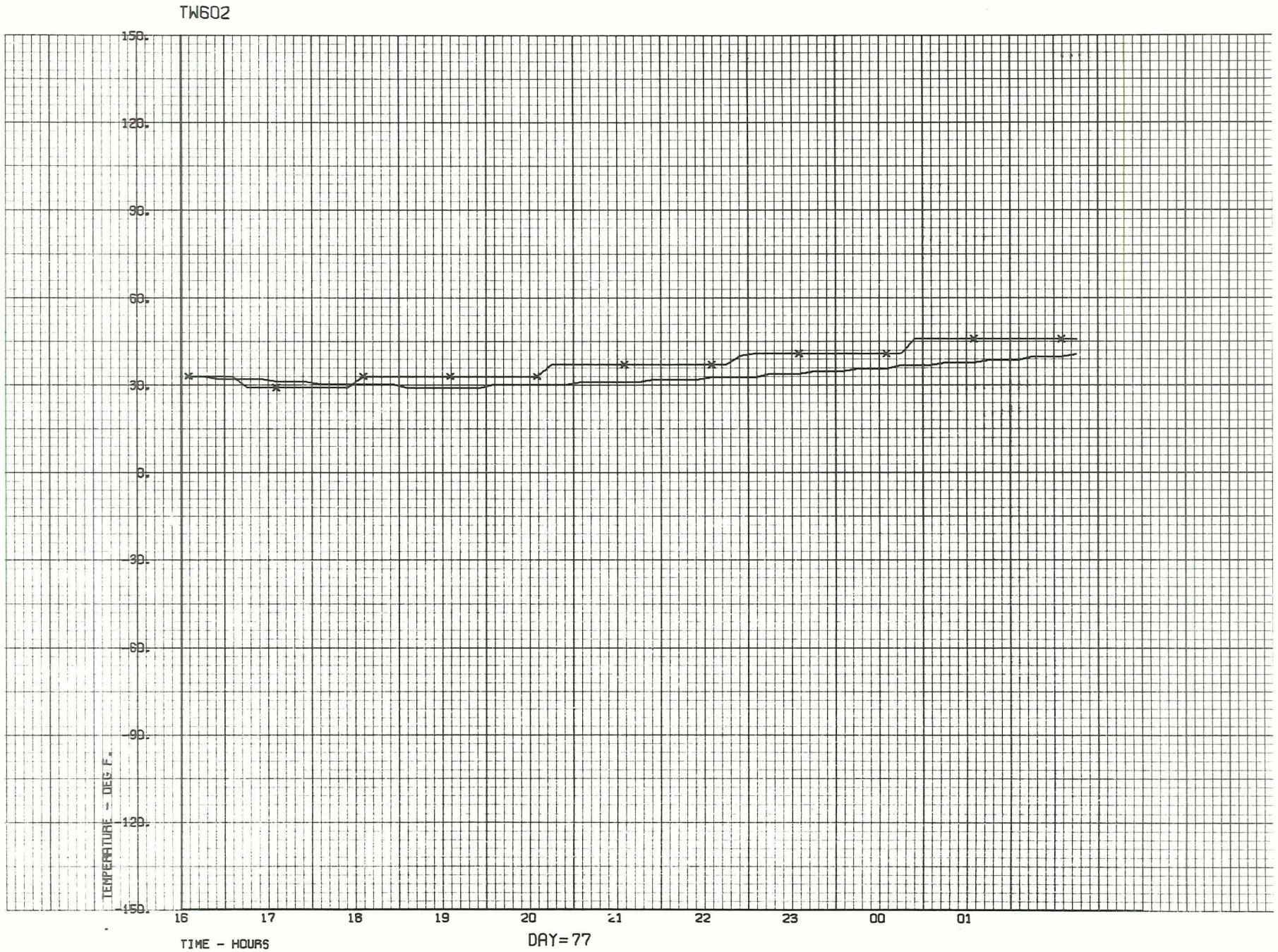
TP0170


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90.
60.
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0.
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-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
16
17
18
19
20
21
22
23
00
01
TIME. HOURS
DAY=77

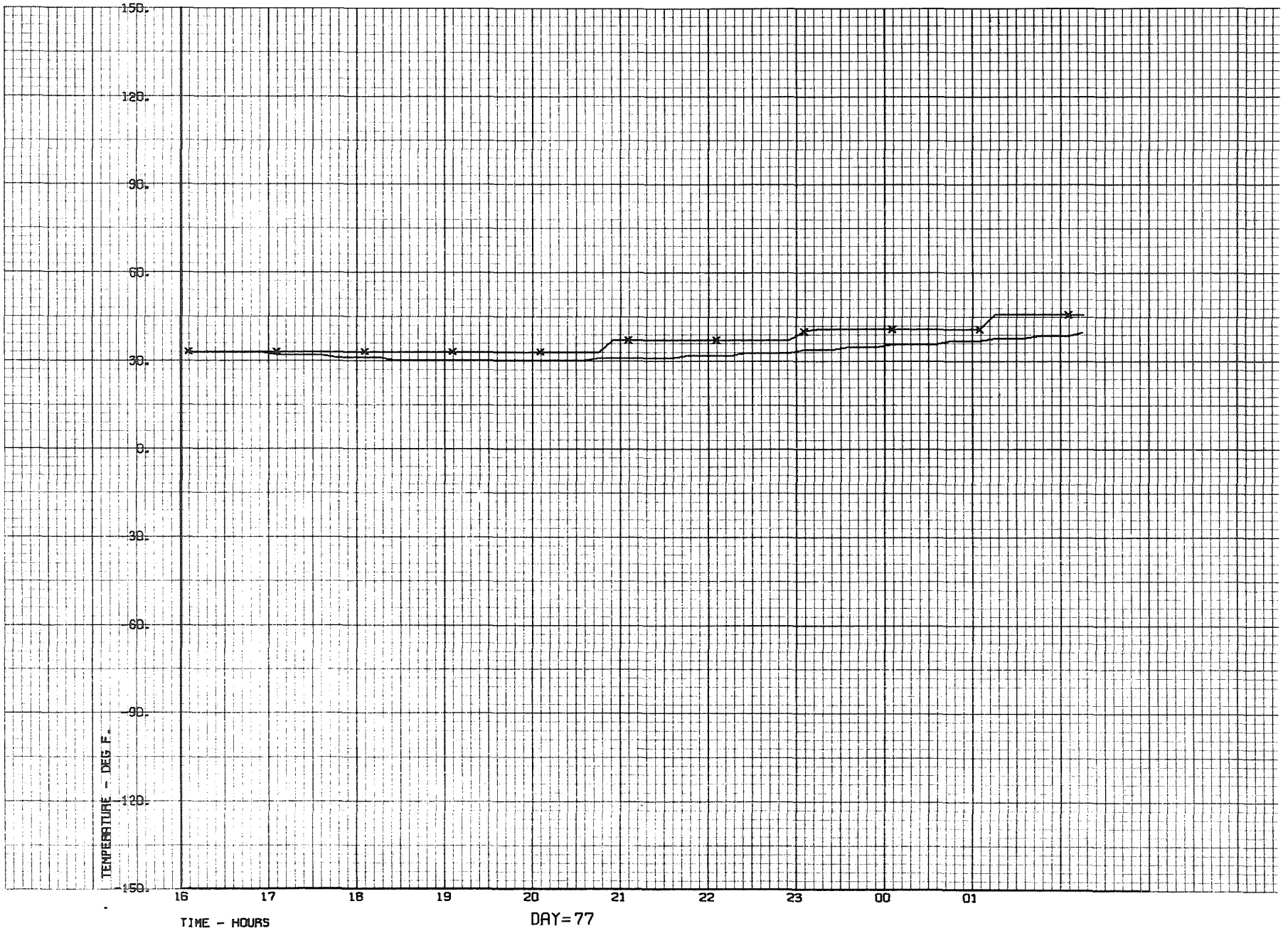

TH0522
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TOTAL HEAT LOAD
REDUCED HEAT LOAD
TEMPERATURE DEG F
16
17
18
19
20
21
22
23
00
01
TIME. HOURS
DAY=77

TW601

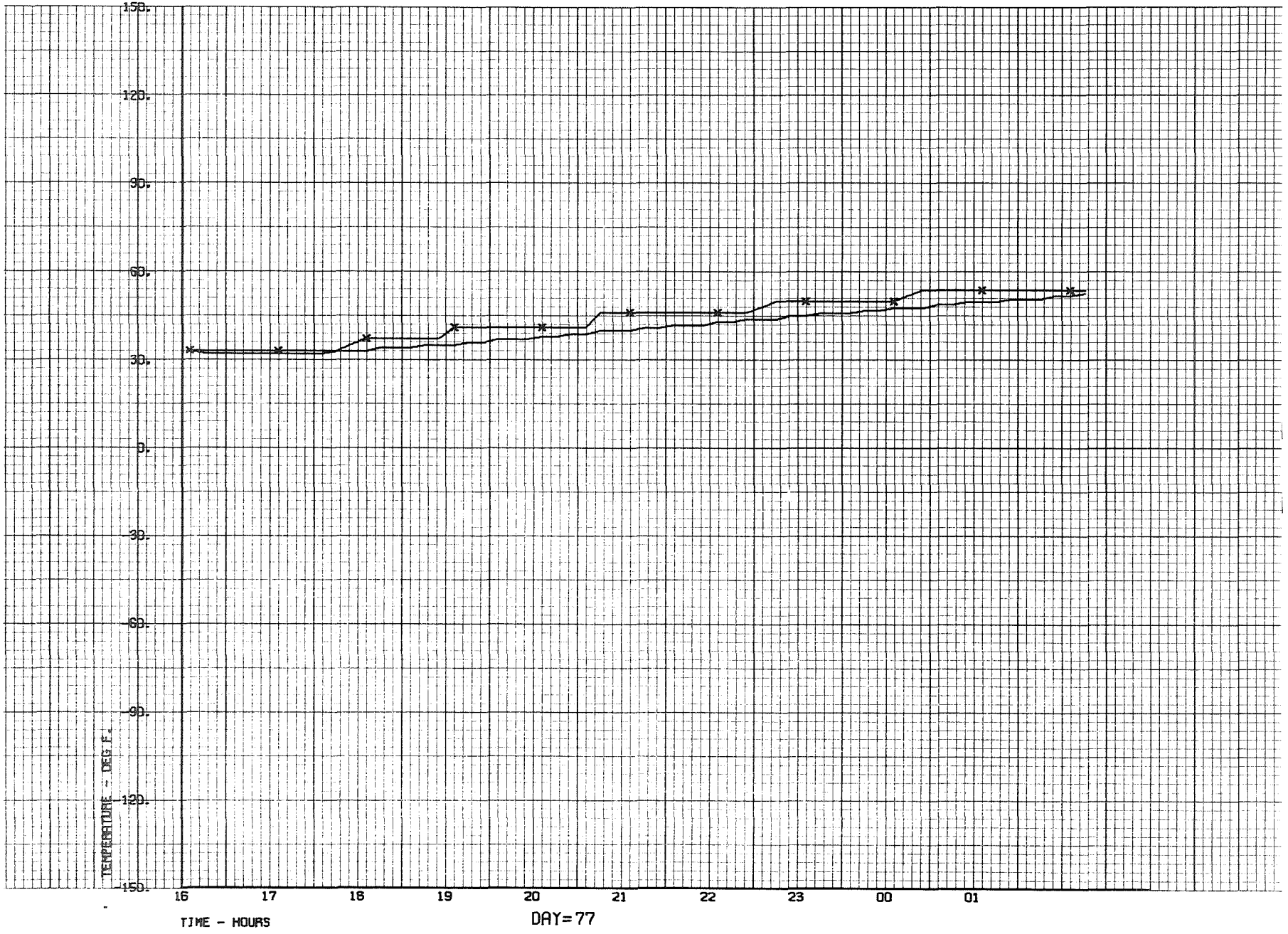

150.
120.
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60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
16
17
18
19
20
21
22
23
00
01
TIME - HOURS
DAY=77


TW602
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG.F.
16
17
18
19
20
21
22
23
00
01
TIME - HOURS
DAY=77

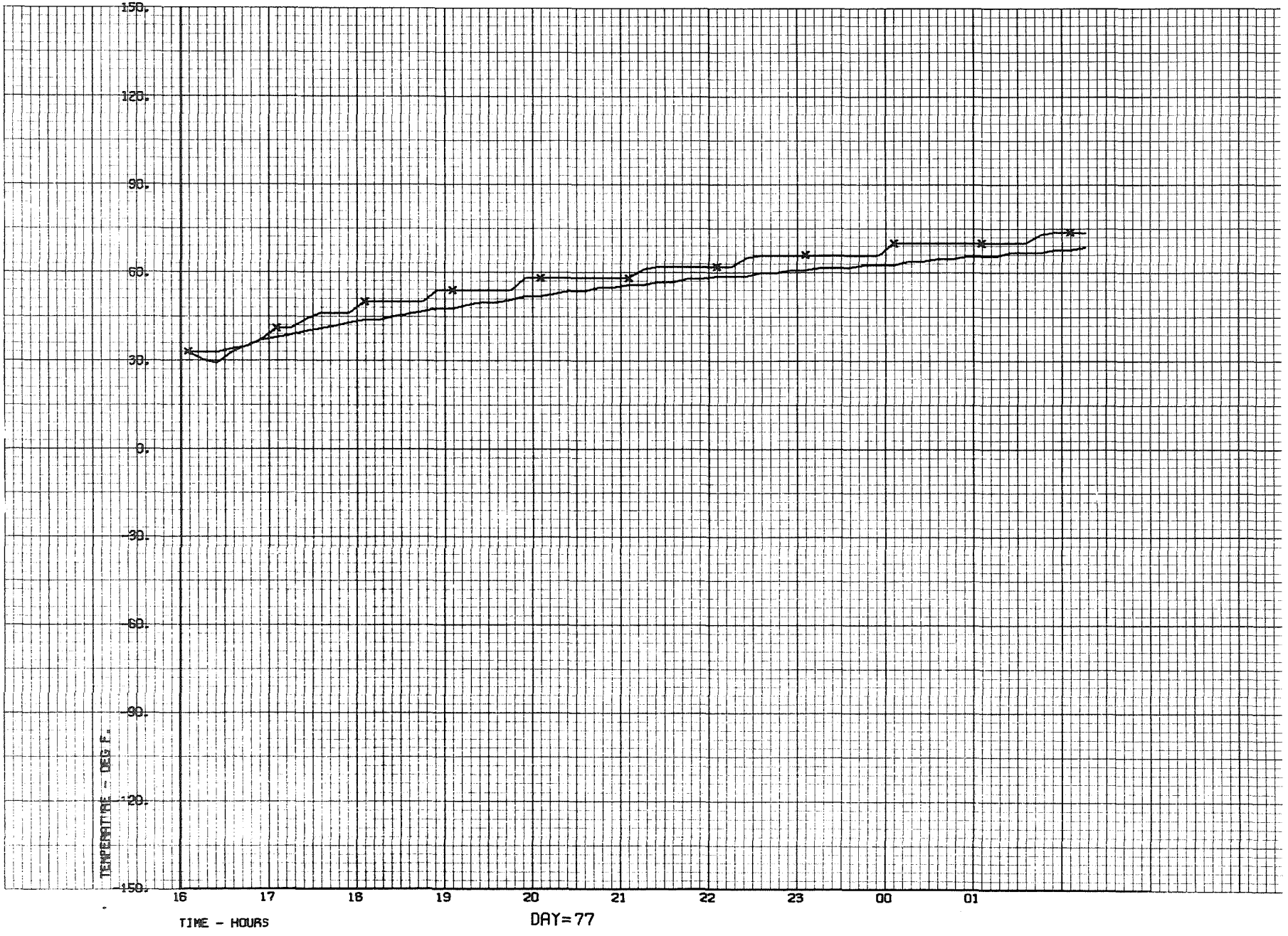
TW603


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30.
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-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
16
17
18
19
20
21
22
23
00
01
TIME - HOURS
DAY=77

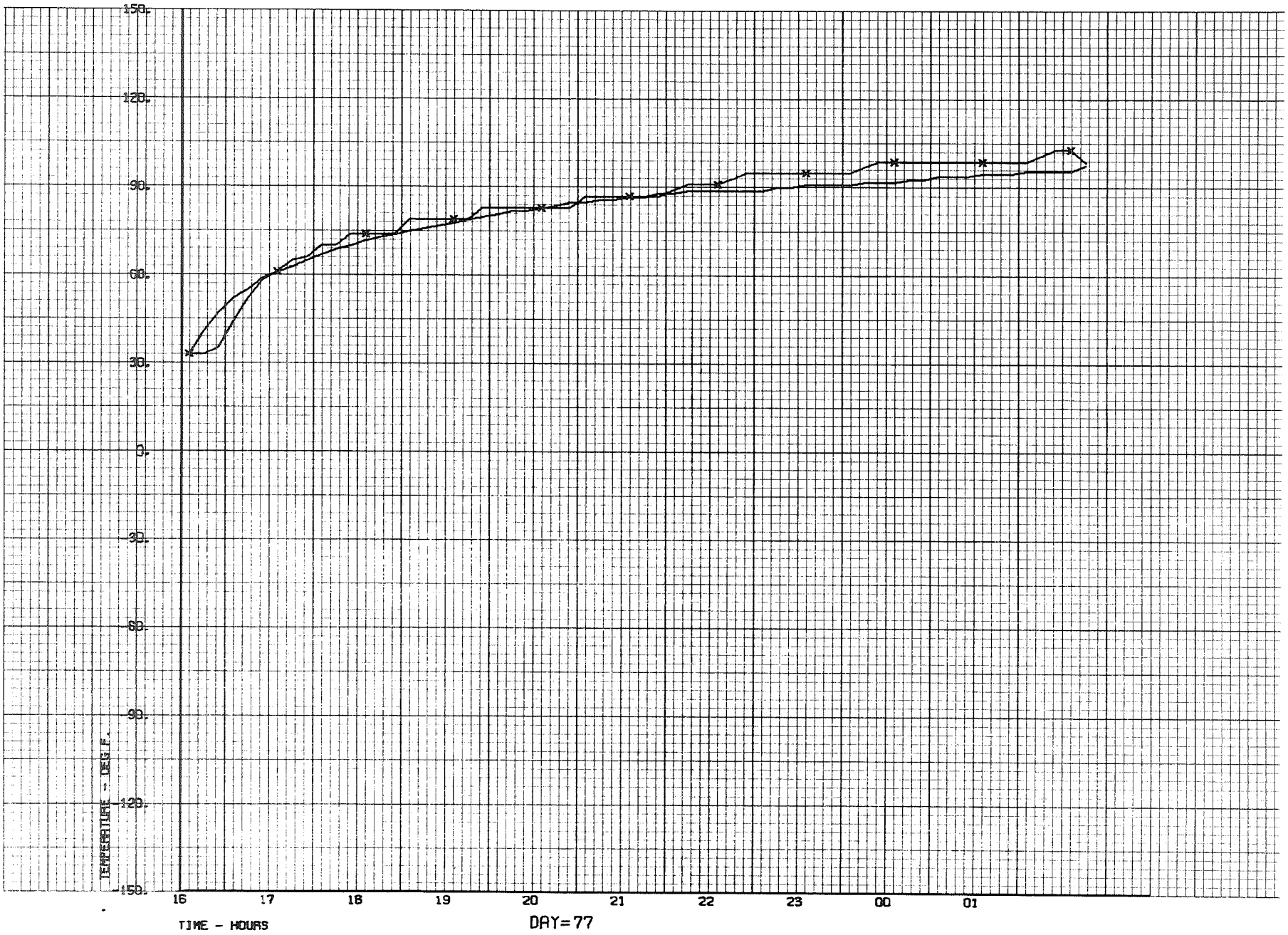
TP5138


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30.
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-60.
-90.
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-150.
TEMPERATURE - DEG F.
16
17
18
19
20
21
22
23
00
01
TIME - HOURS
DAY=77

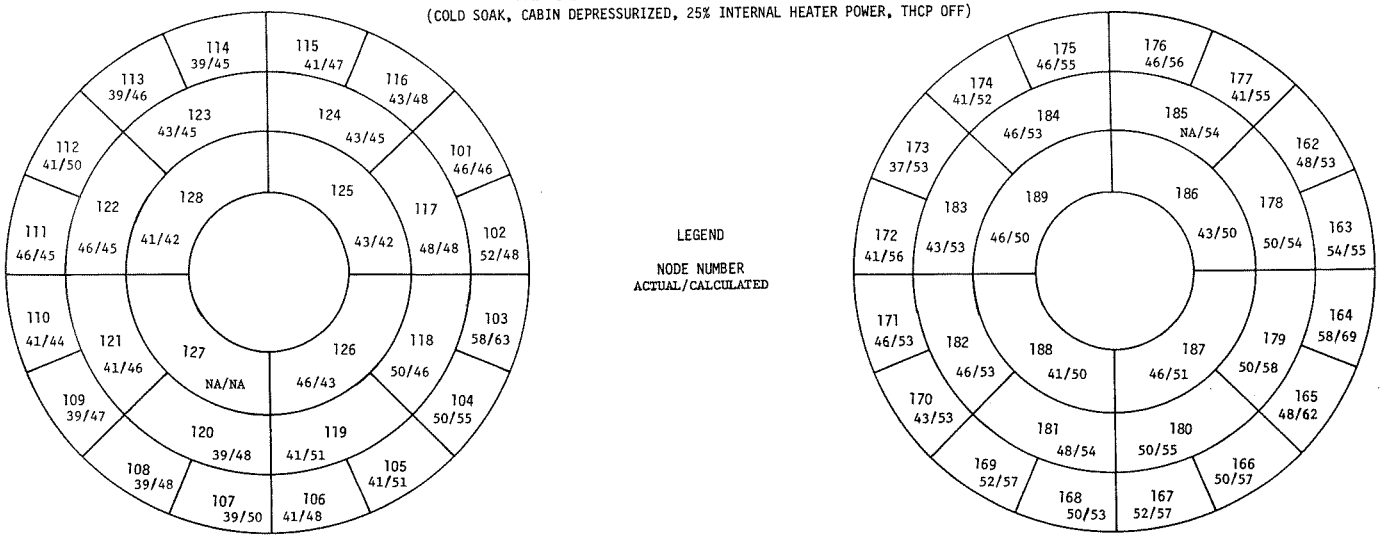
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90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
16
17
18
19
20
21
22
23
00
01
TIME - HOURS
DAY=77

TP4158


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG.F.
16
17
18
19
20
21
22
23
00
01
TIME - HOURS
DAY=77

PRESSURE SHELL TEMPERATURES AT END OF PHASE C2
(COLD SOAK, CABIN DEPRESSURIZED, 25% INTERNAL HEATER POWER, THCP OFF)

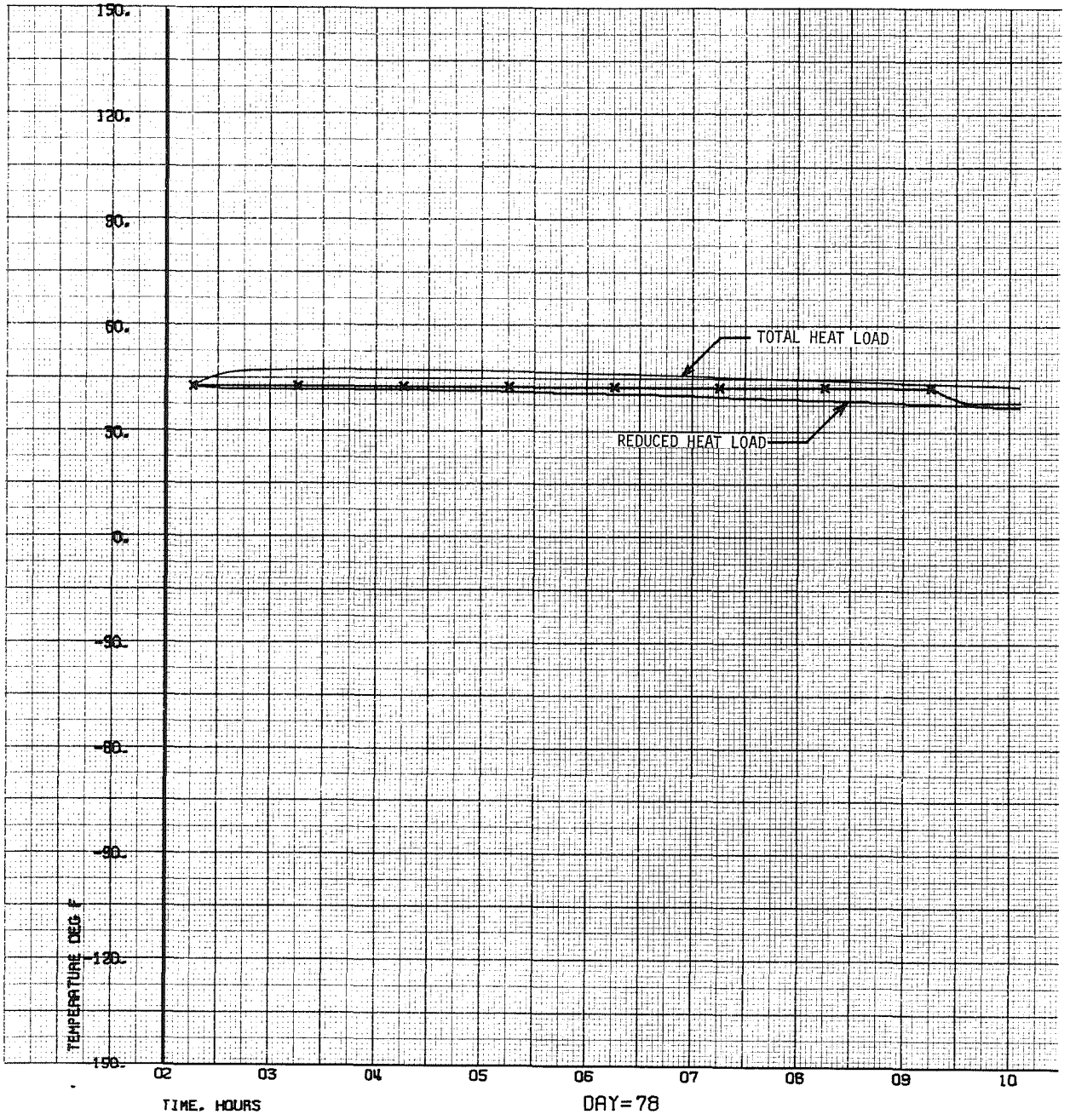


LEGEND

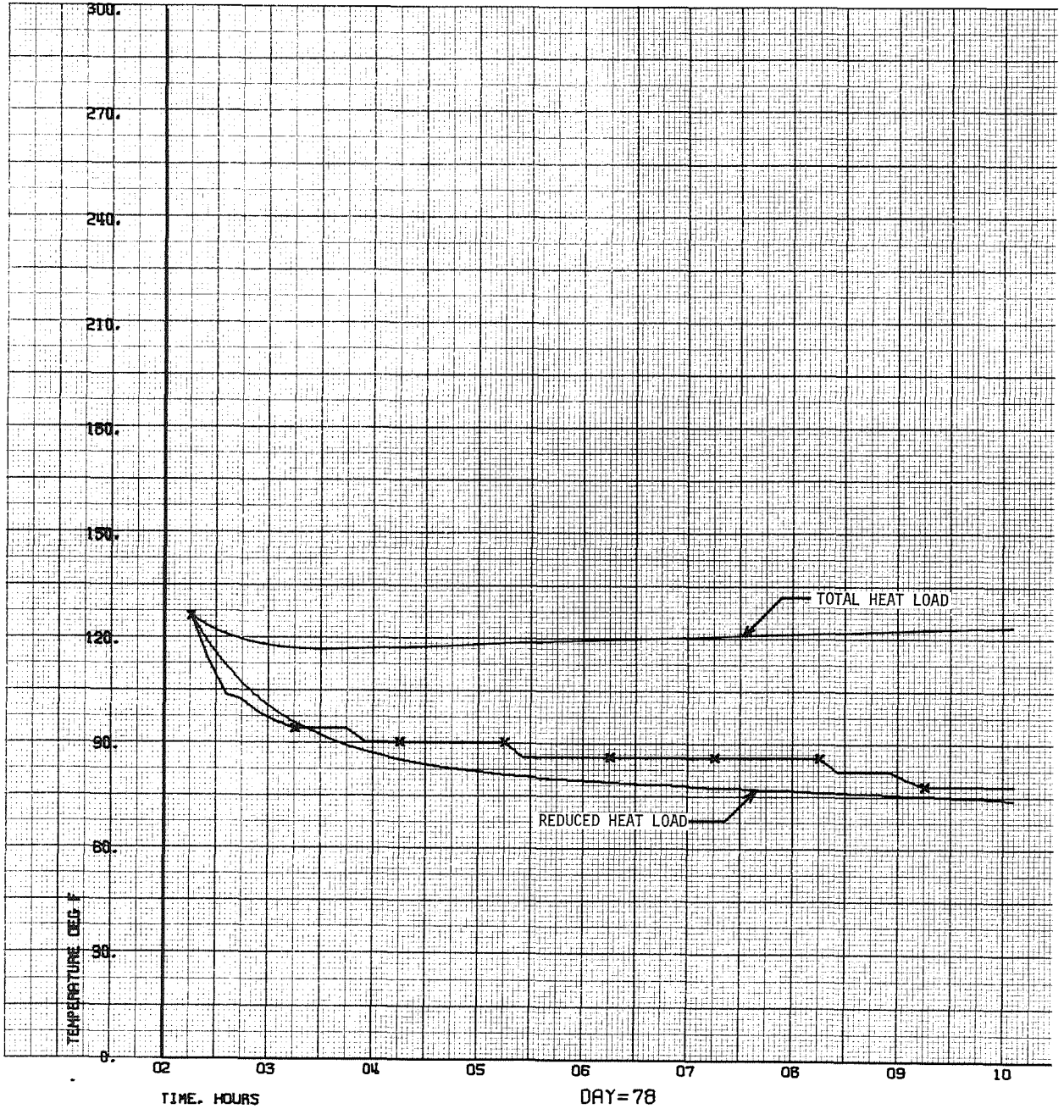
NODE NUMBER
ACTUAL/CALCULATED

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146 52/45	147 58/NA	148 83/125	149 58/68	150 54/55	151 58/76	152 50/50	153 56/78	154 54/52	155 50/49	156 50/72	157 48/52	158 50/52	159 50/74	160 50/50	161 56/76

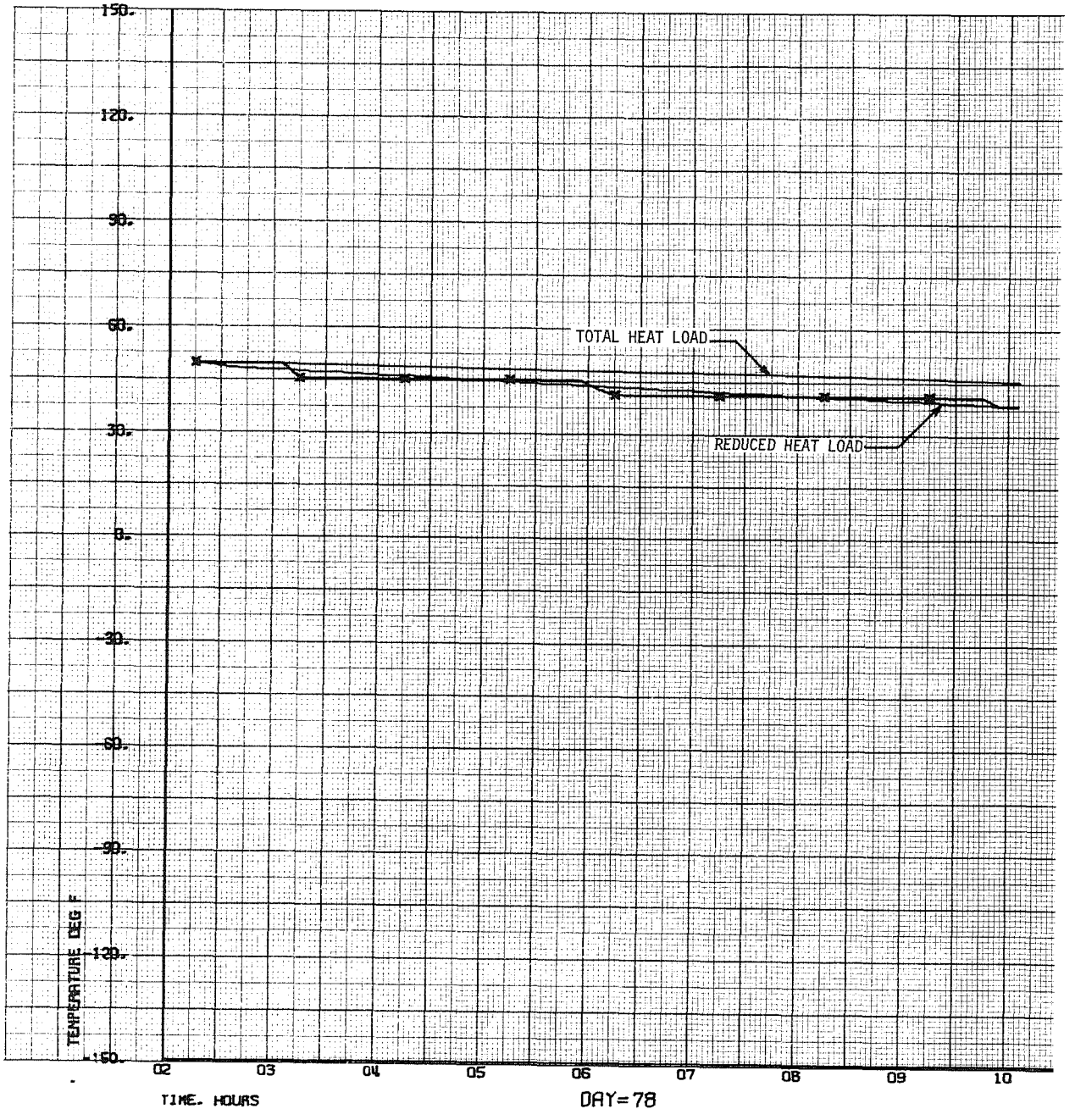
TP0109


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
02
03
04
05
06
07
08
09
10
TIME, HOURS
DAY=78

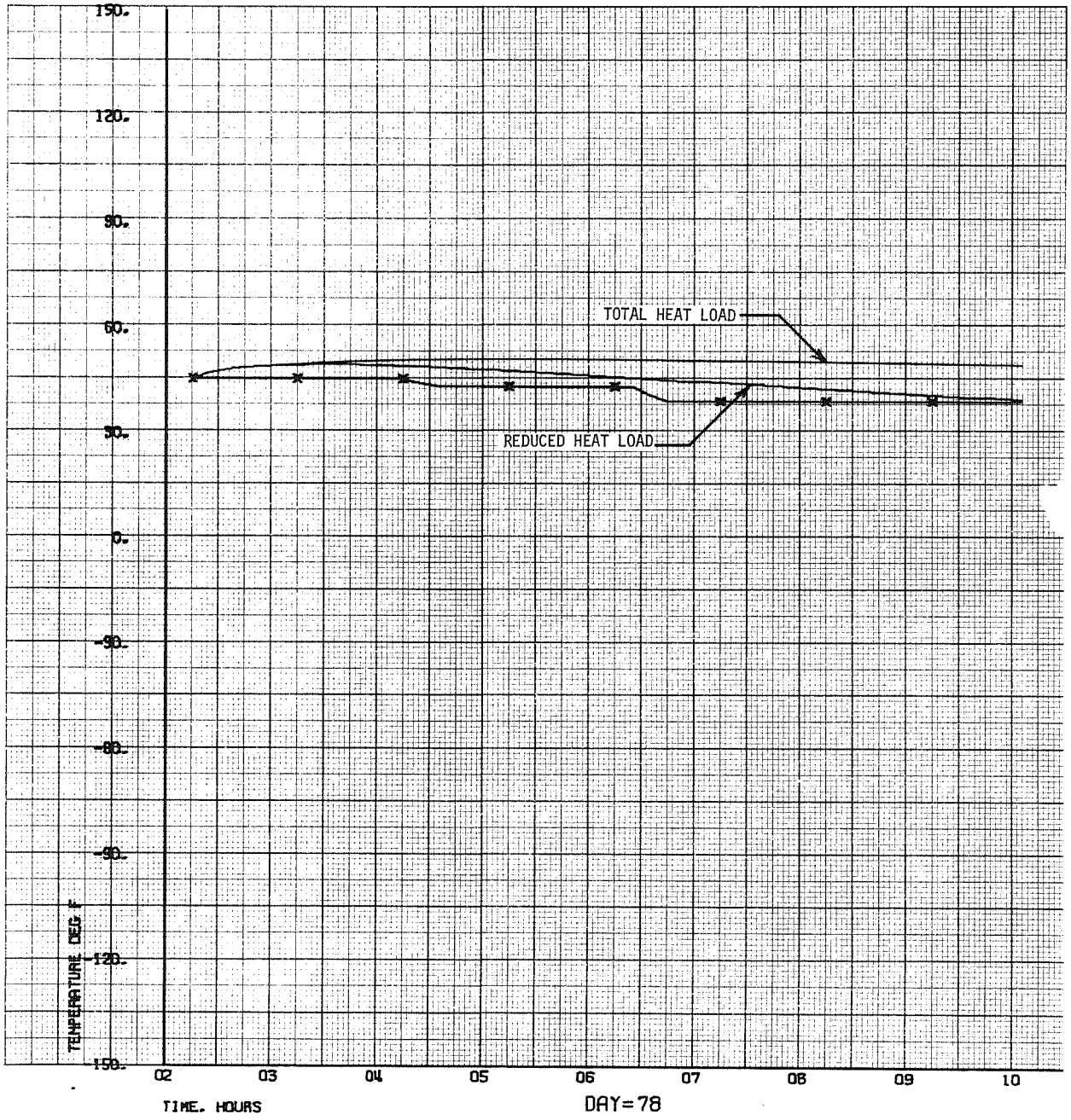
TP0132


300.
270.
240.
210.
180.
150.
120.
90.
60.
30.
0.
TEMPERATURE DEG F
02
03
04
05
06
07
08
09
10
TIME. HOURS
DAY=78
TOTAL HEAT LOAD
REDUCED HEAT LOAD

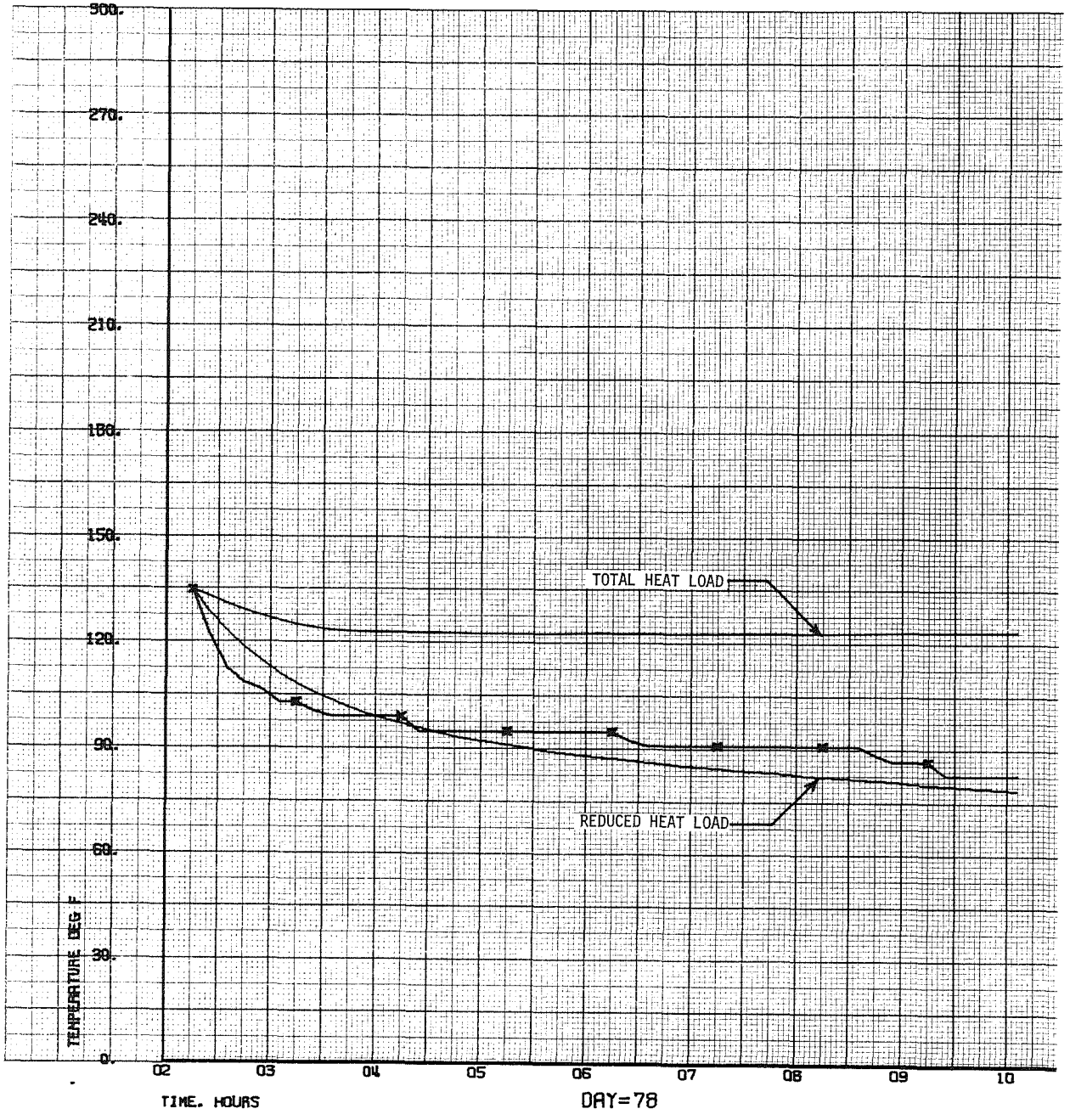
TP0138

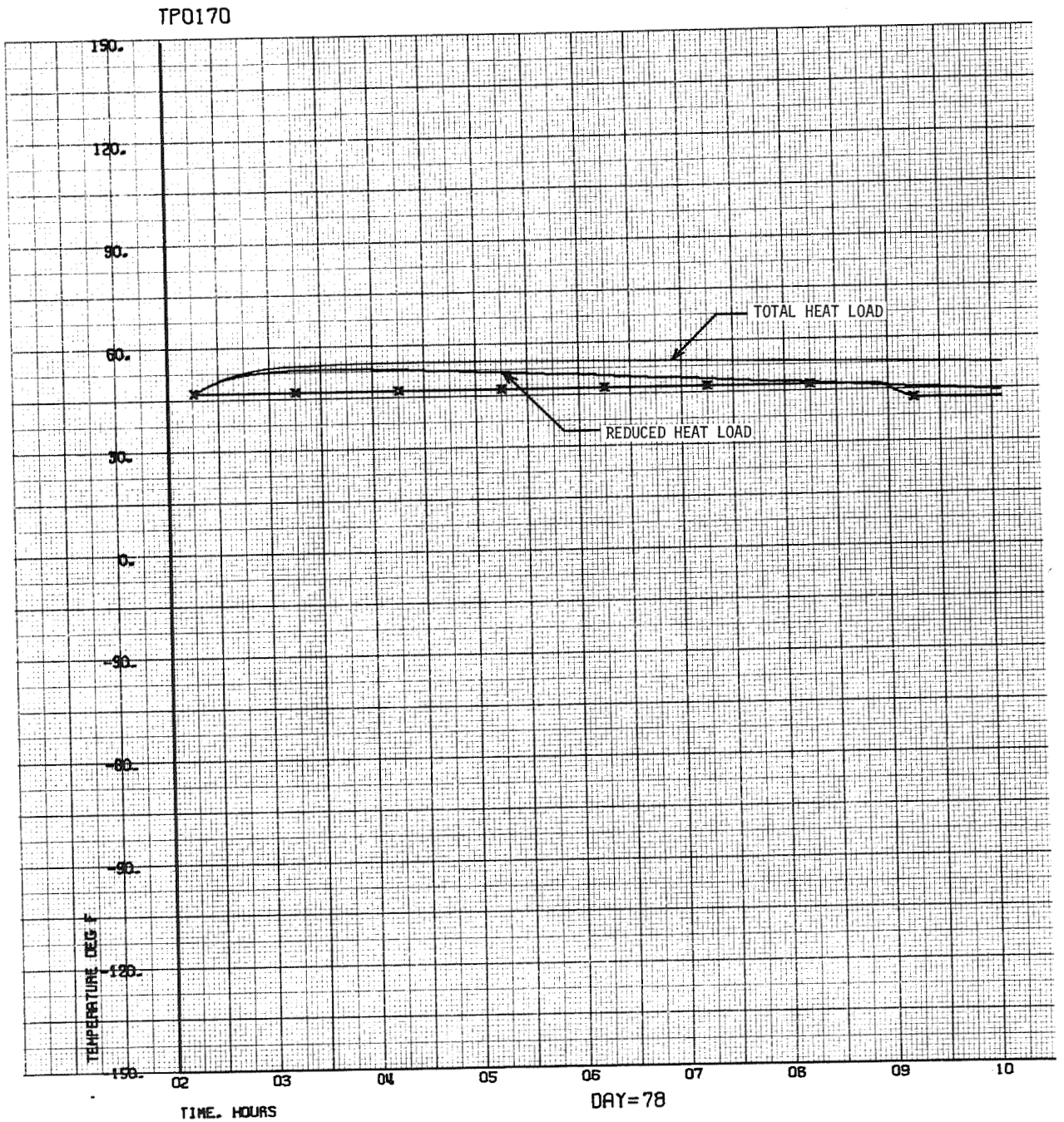

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
02
03
04
05
06
07
08
09
10
TIME. HOURS
DAY=78

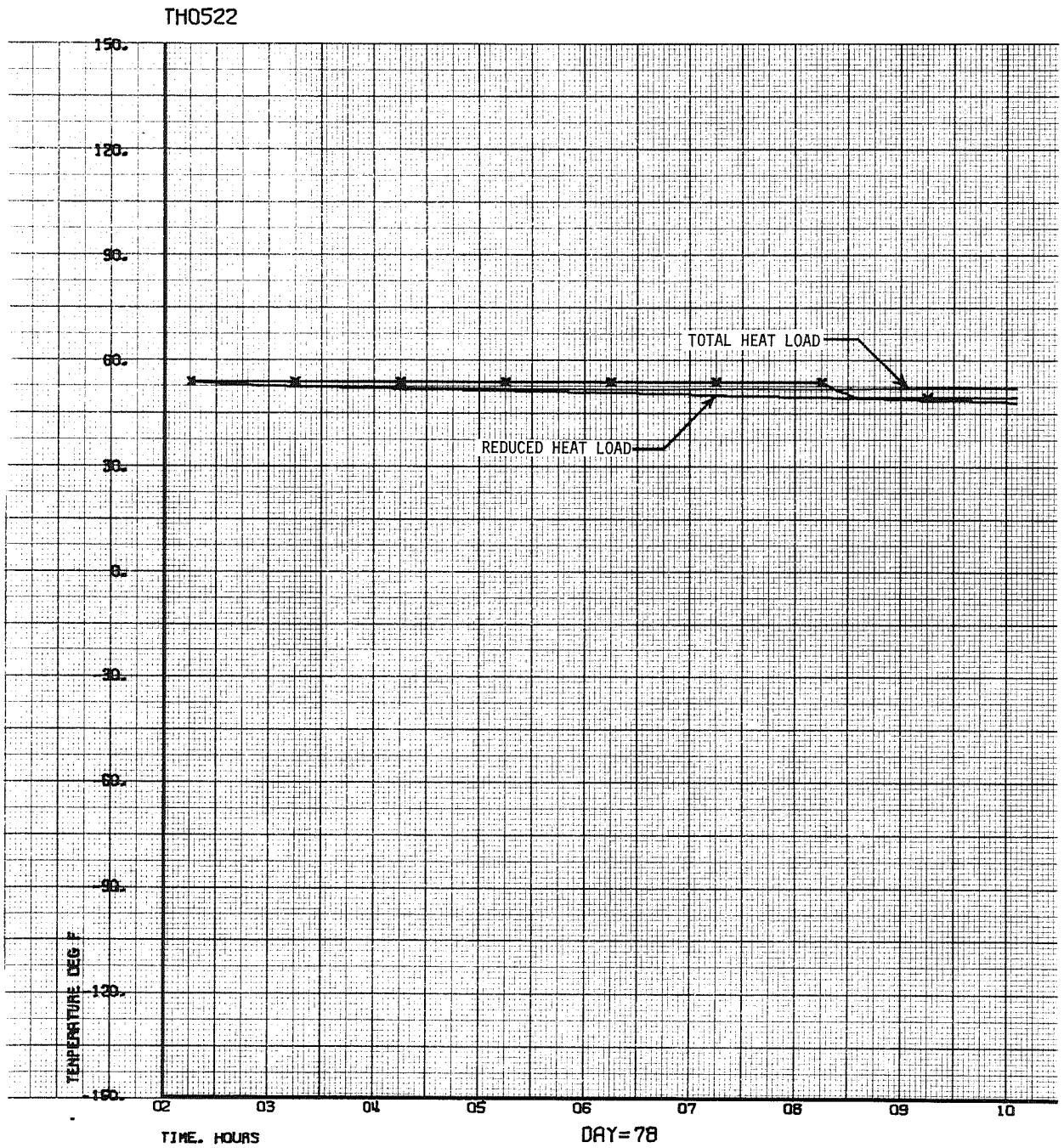
TP0142

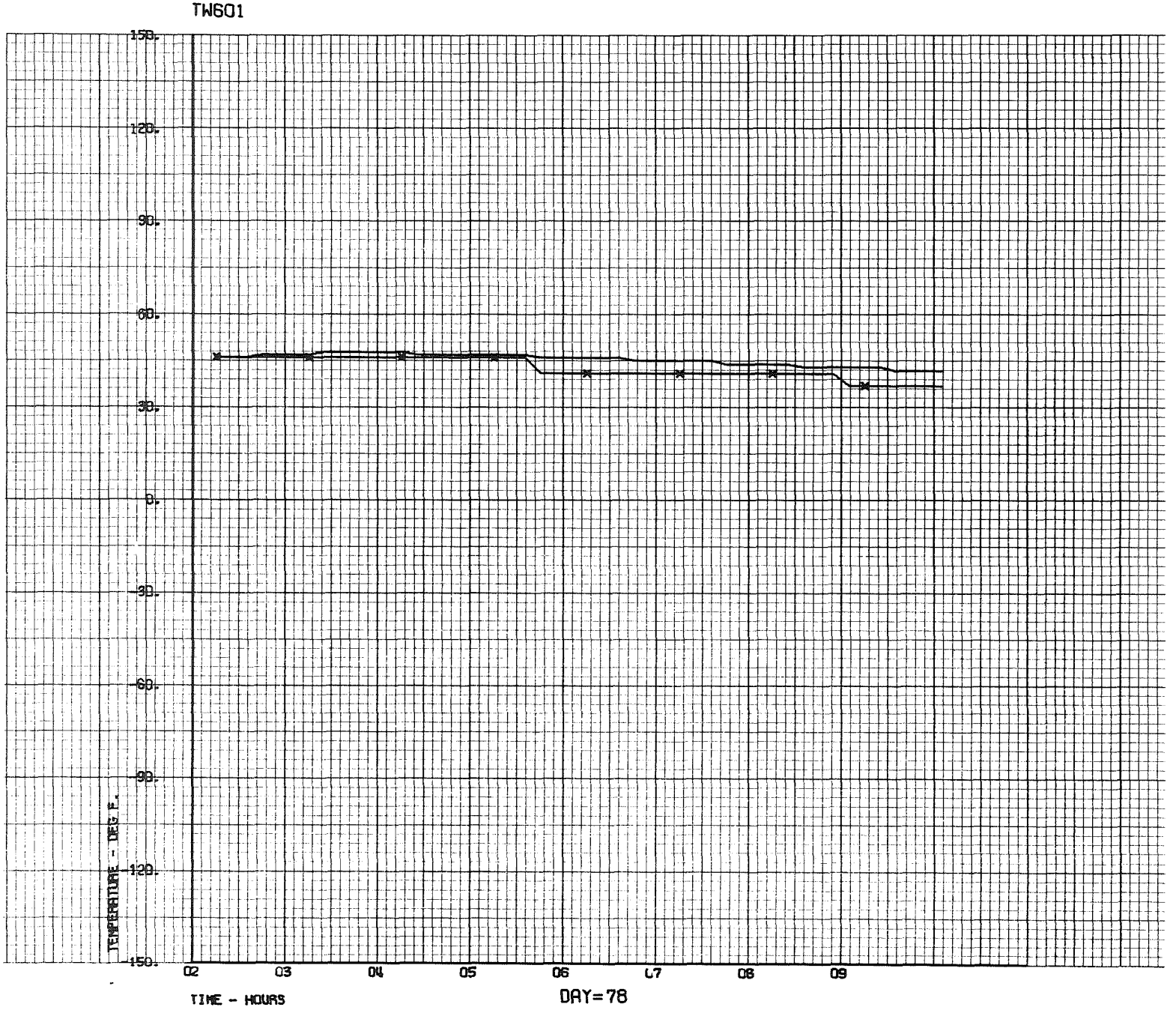

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
02
03
04
05
06
07
08
09
10
TIME. HOURS
DAY=78

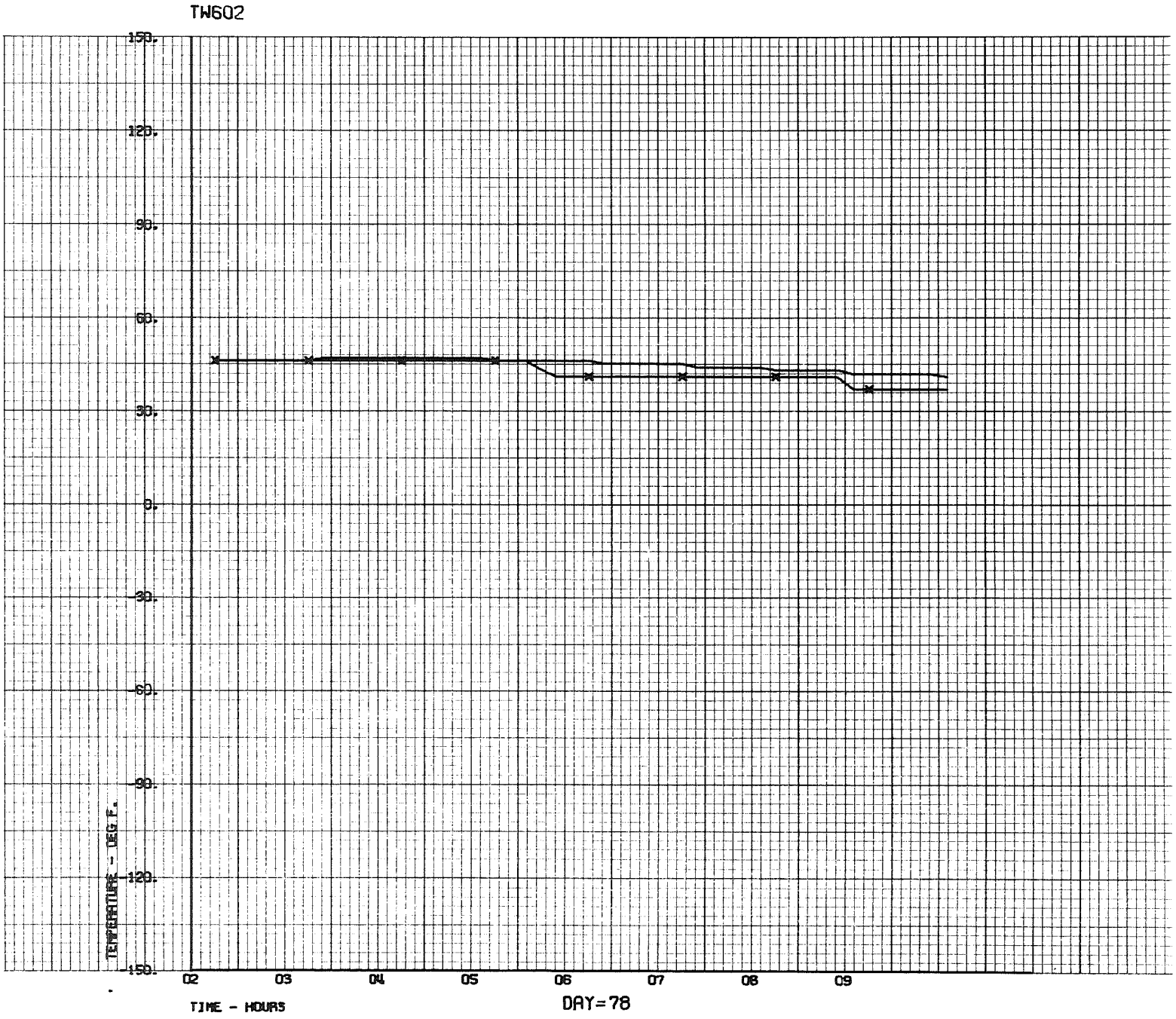
TP0148

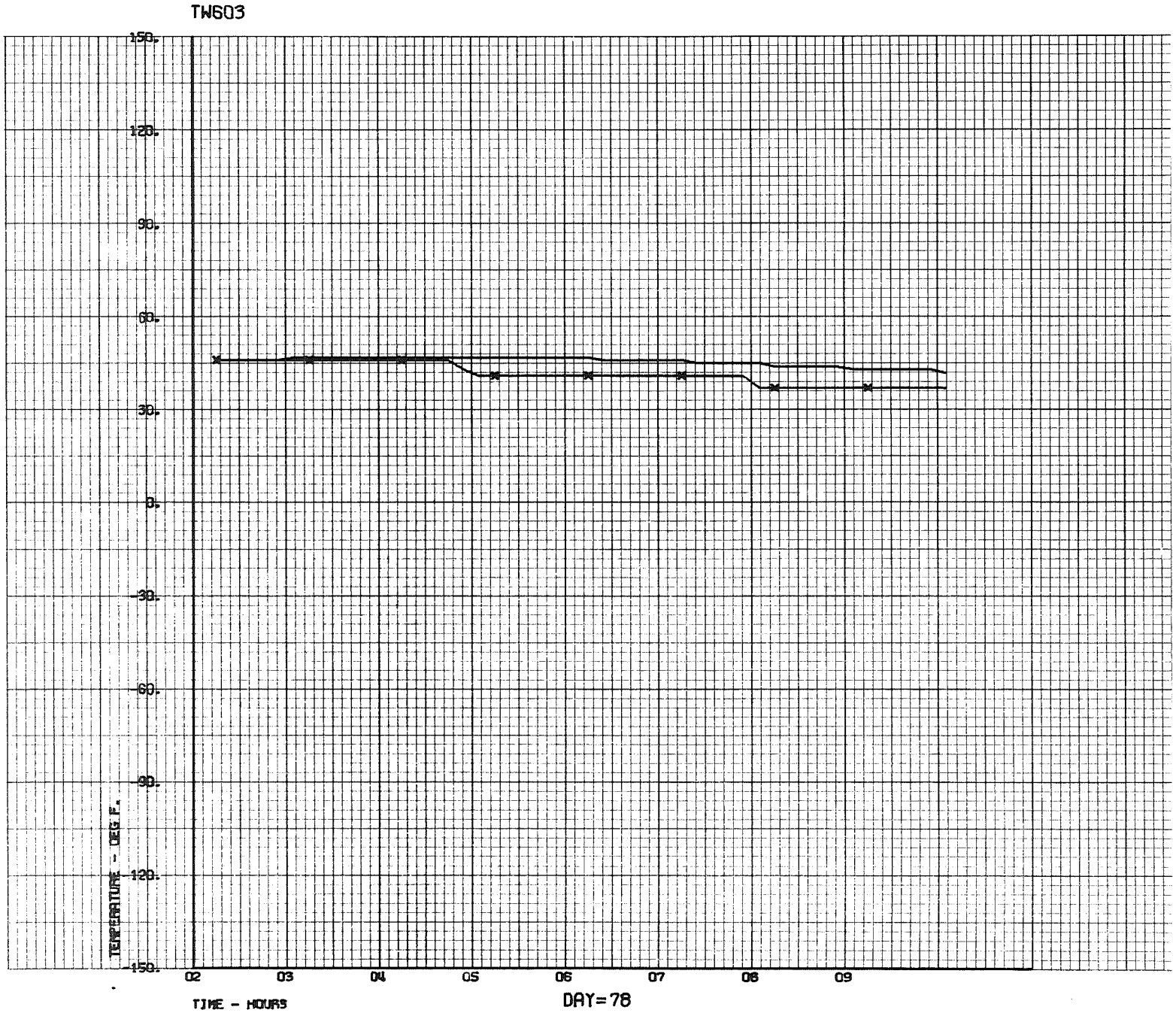

300.
270.
240.
210.
180.
150.
120.
90.
60.
30.
0.
TEMPERATURE DEG F
02
03
04
05
06
07
08
09
10
TIME. HOURS
TOTAL HEAT LOAD
REDUCED HEAT LOAD
DAY=78

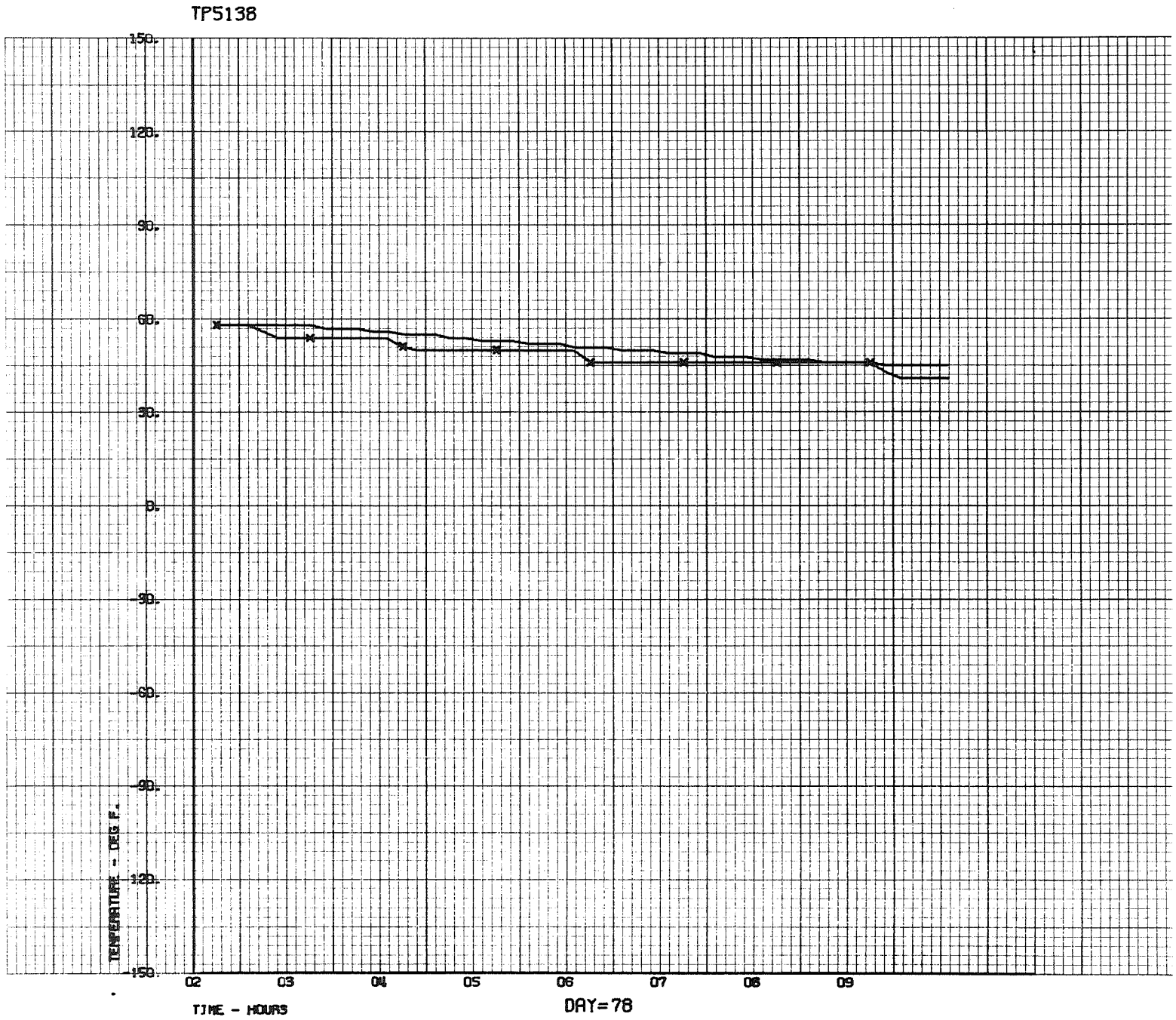

TP0170
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30.
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-60.
-90.
-120.
-150.
TOTAL HEAT LOAD
REDUCED HEAT LOAD
TEMPERATURE DEG F
02
03
04
05
06
07
08
09
10
TIME. HOURS
DAY=78


TH0522
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
TOTAL HEAT LOAD
REDUCED HEAT LOAD
02
03
04
05
06
07
08
09
10
TIME. HOURS
DAY=78

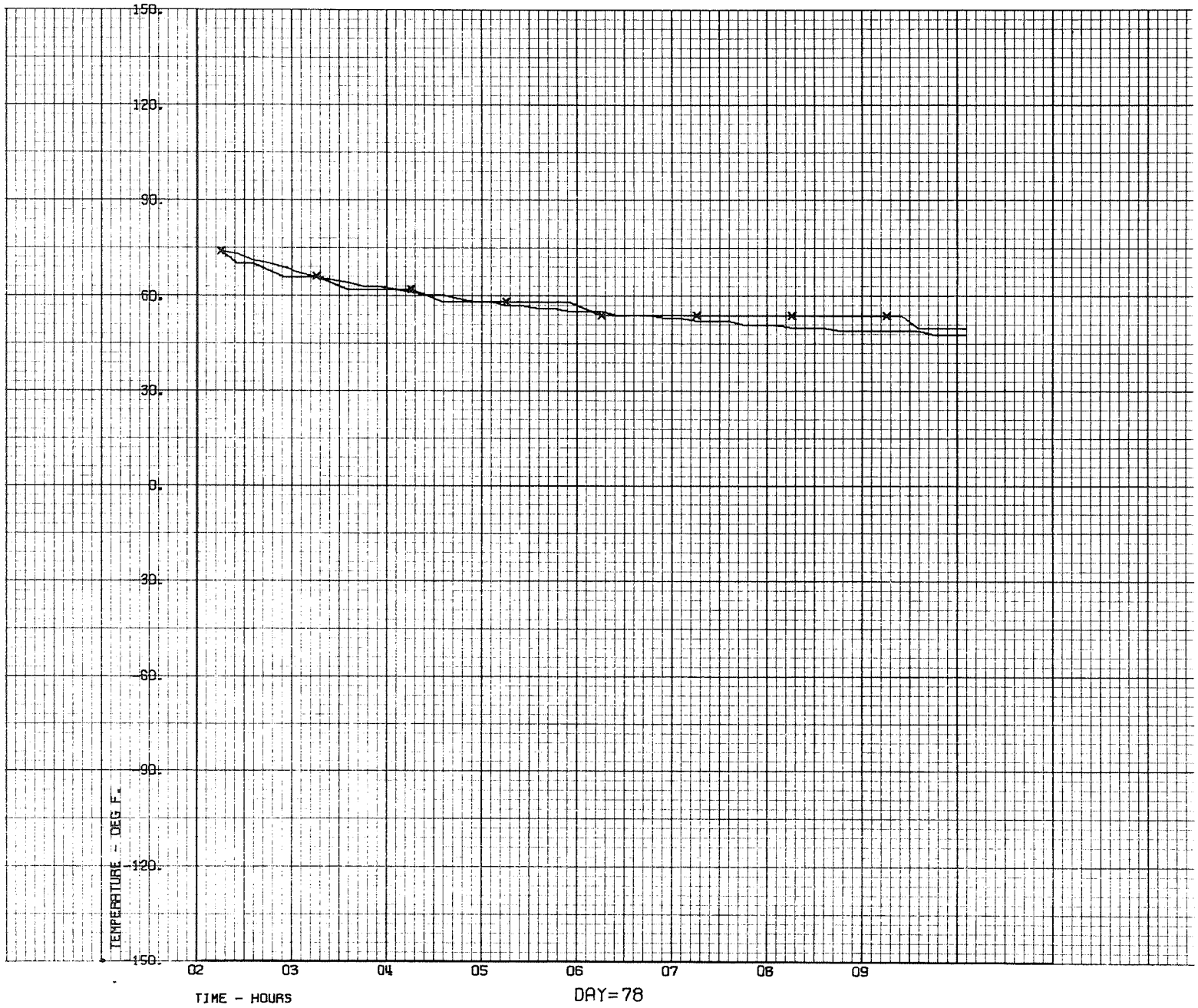

TW601
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60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78


TW602
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG.F.
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

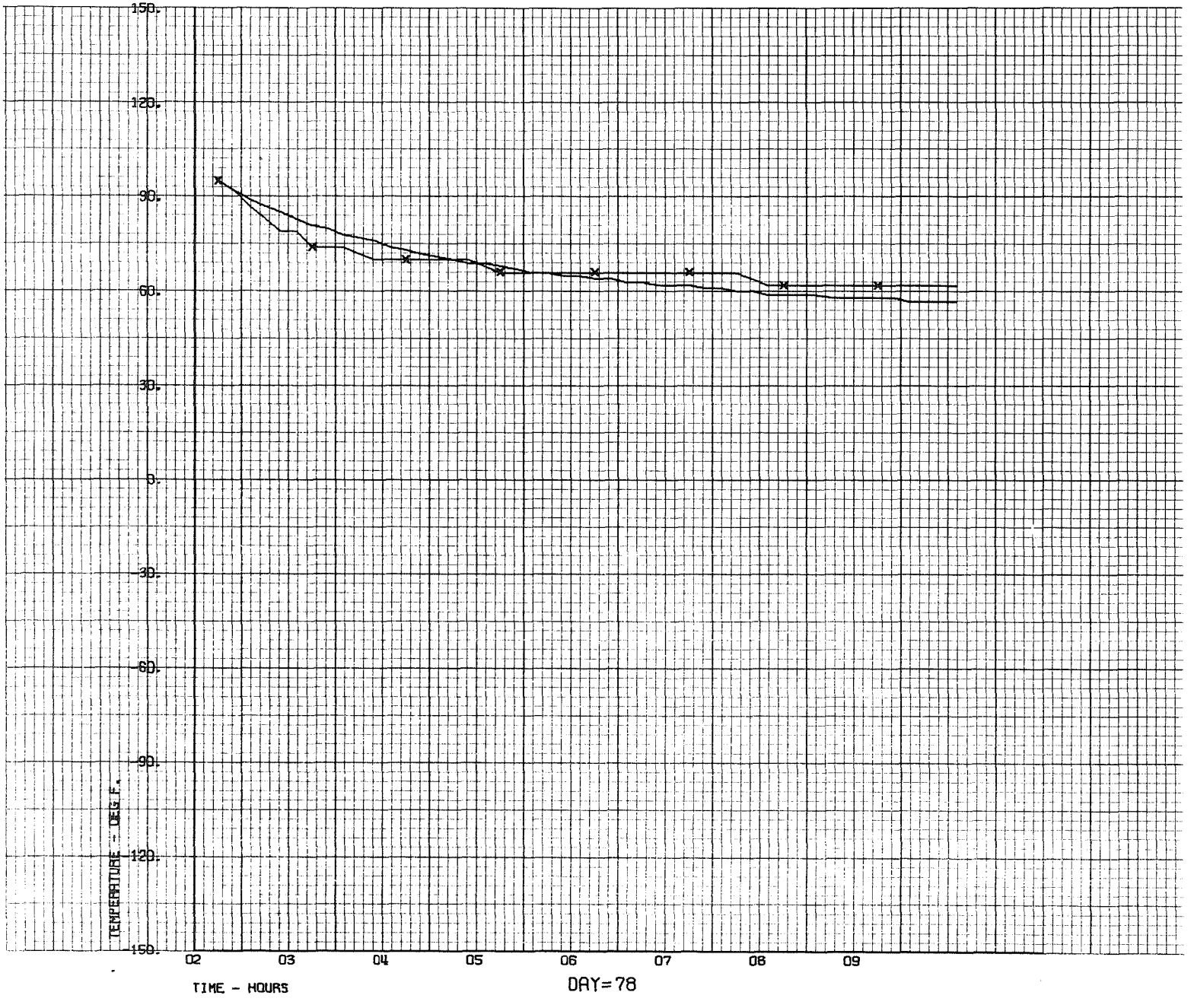

TW603
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120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78


TP5138
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

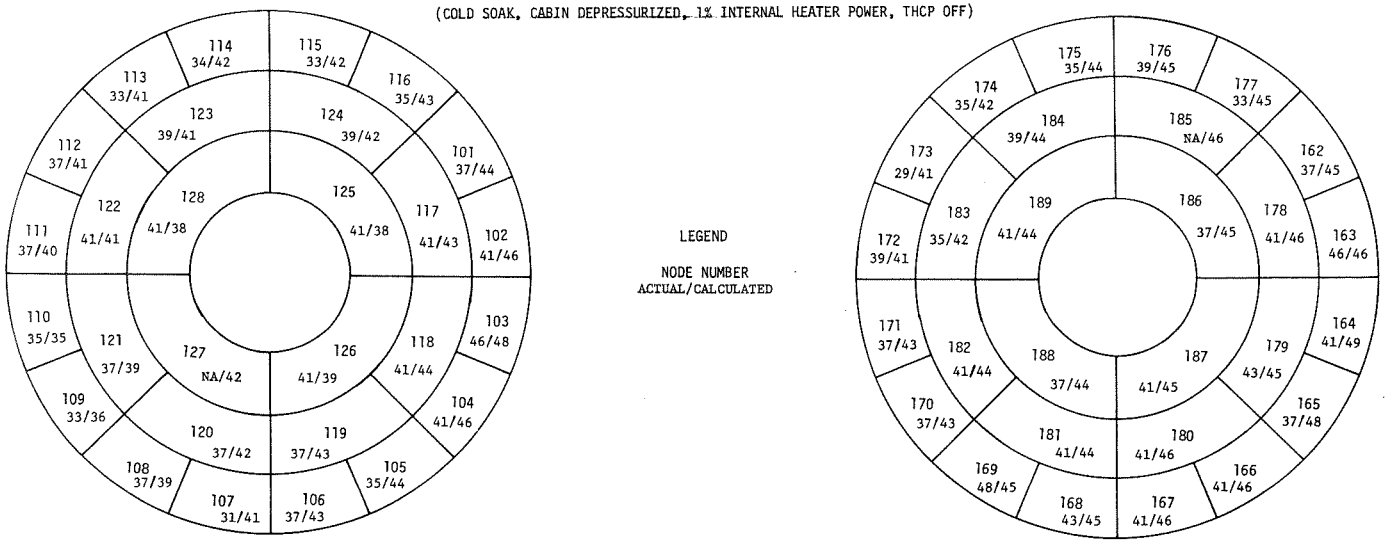
TP5139


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60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

TP4158


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

PRESSURE SHELL TEMPERATURES AT END OF PHASE C3
(COLD SOAK, CABIN DEPRESSURIZED, 1% INTERNAL HEATER POWER, THCP OFF)

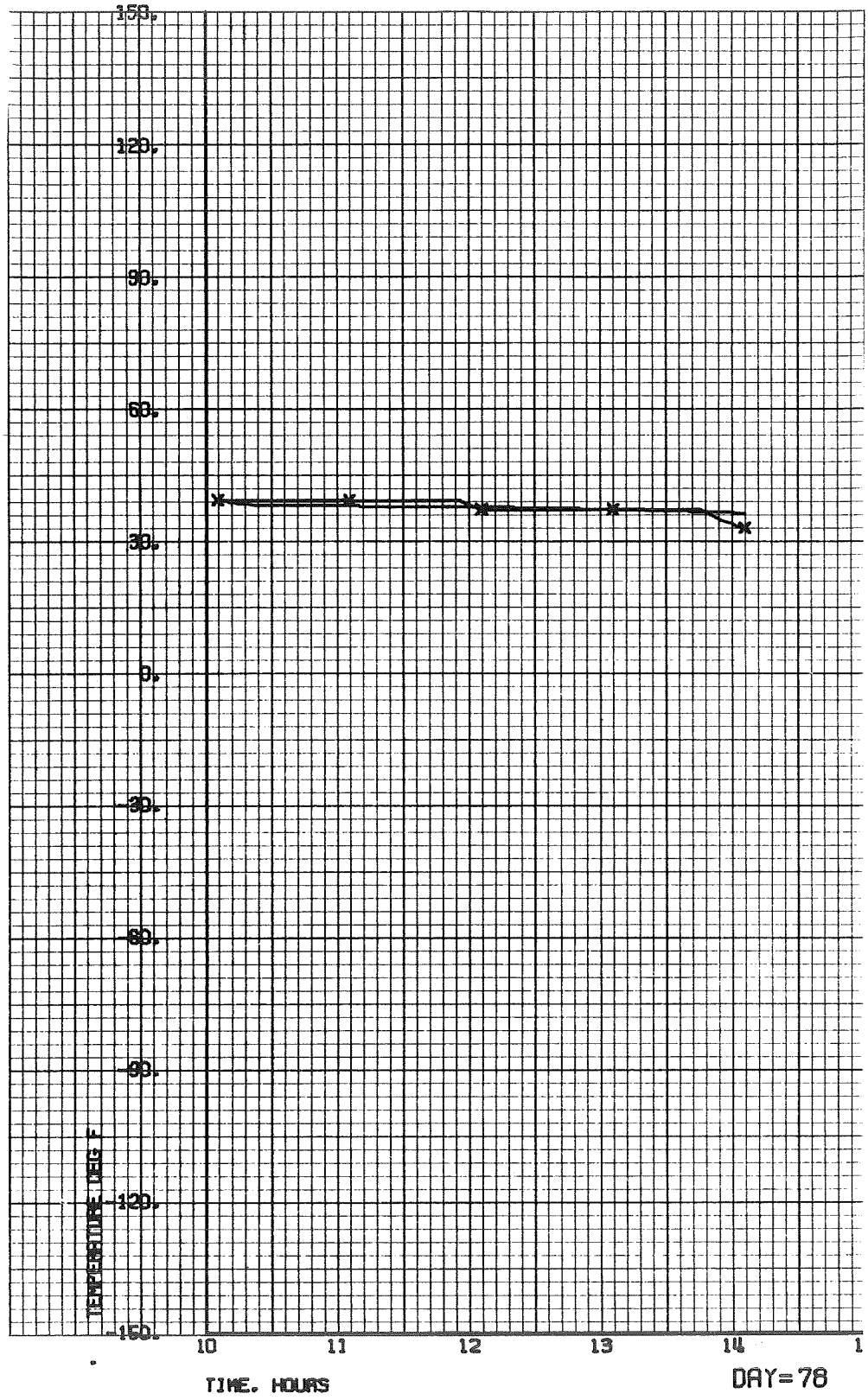


LEGEND

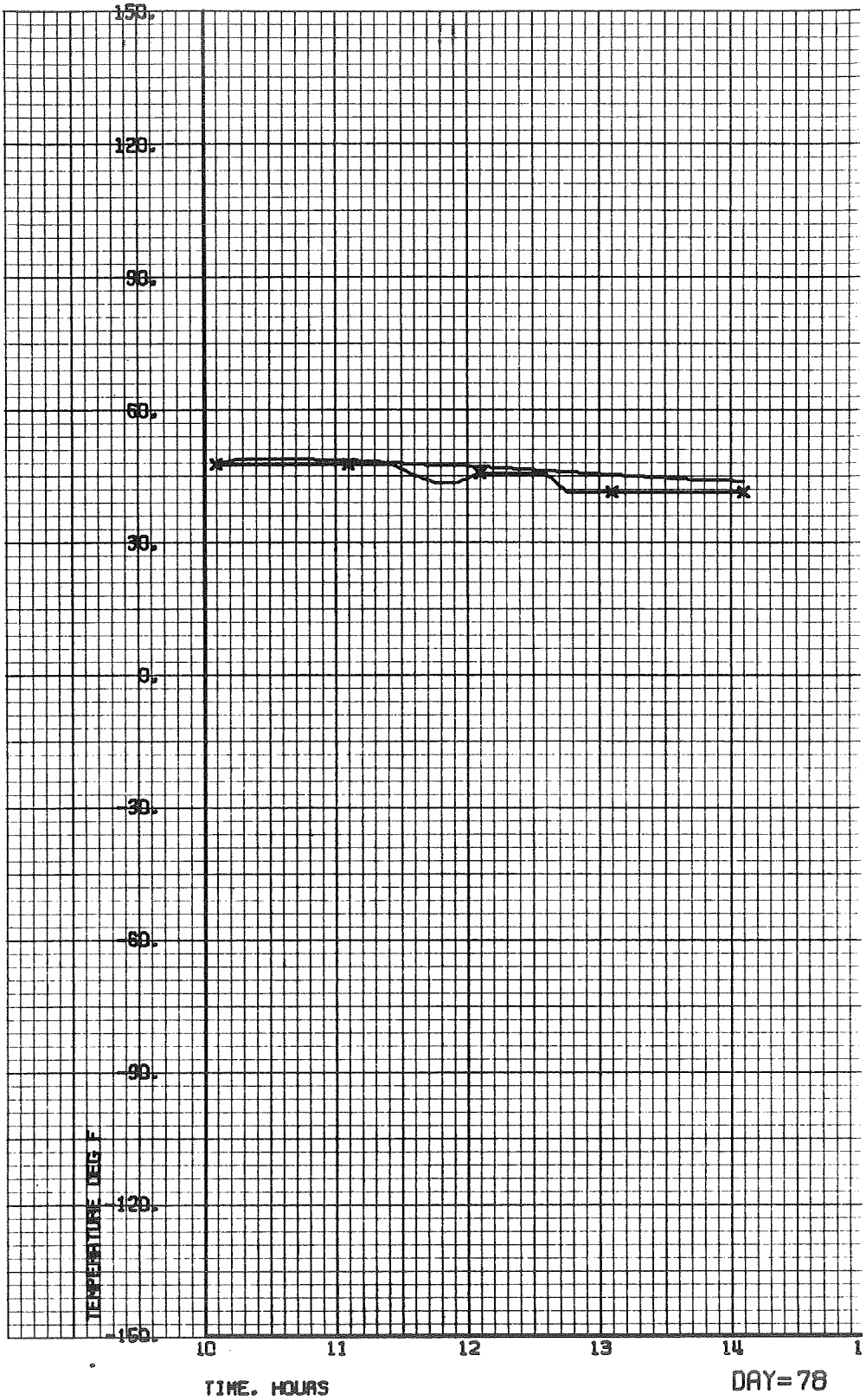
NODE NUMBER
ACTUAL/CALCULATED

130 33/38	131 37/34	132 43/40	133 37/35	134 33/38	135 37/32	136 37/43	137 37/35	138 31/35	139 35/31	140 37/32	141 37/33	142 29/36	143 37/32	144 37/43	145 37/36
146 39/36	147 39/36	148 43/46	149 39/41	150 41/38	151 46/38	152 41/41	153 41/40	154 39/39	155 39/37	156 39/36	157 37/35	158 37/36	159 39/37	160 39/41	161 41/37

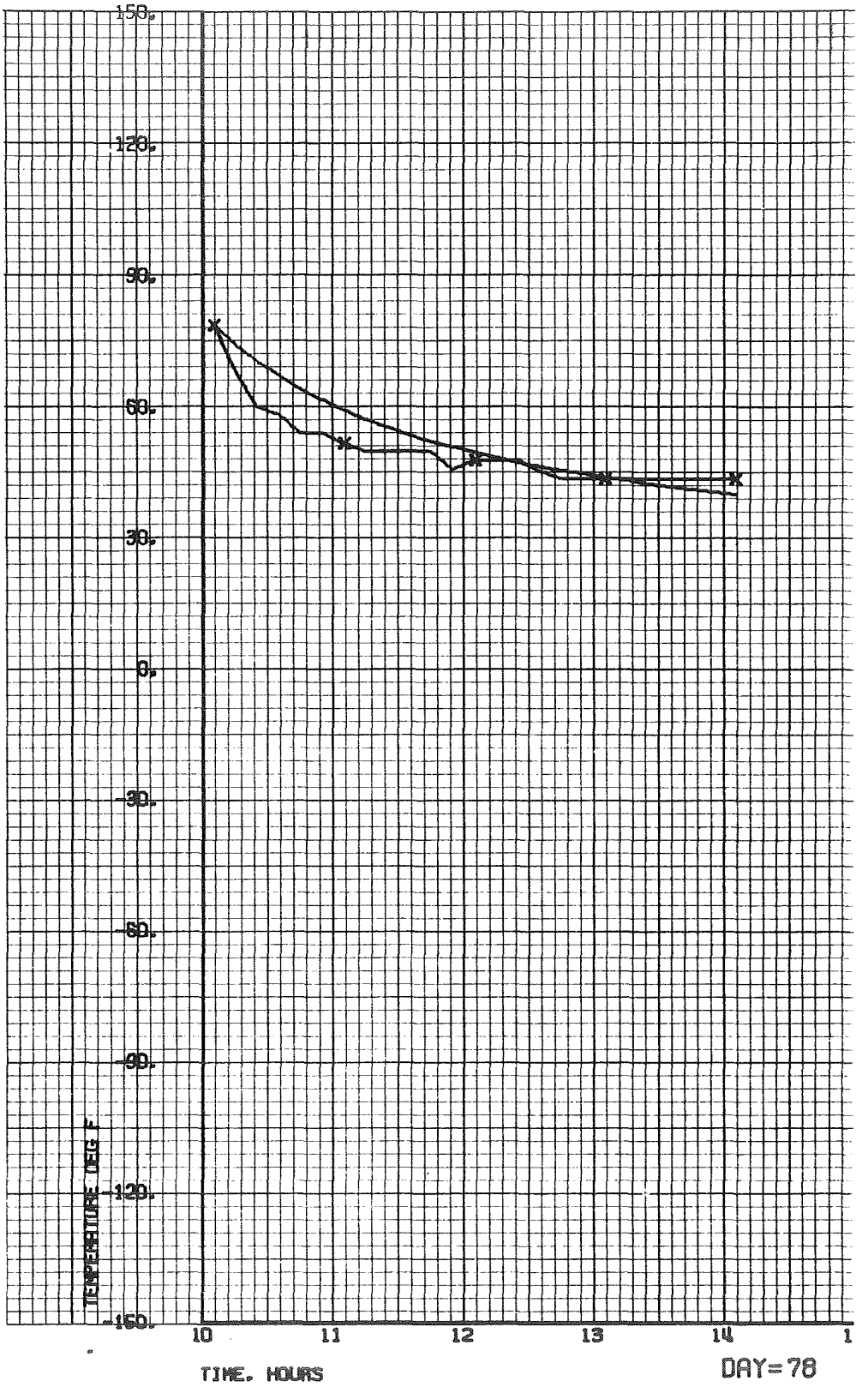
TP0109


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE, DEG F
10
11
12
13
14
1
TIME. HOURS
DAY=78

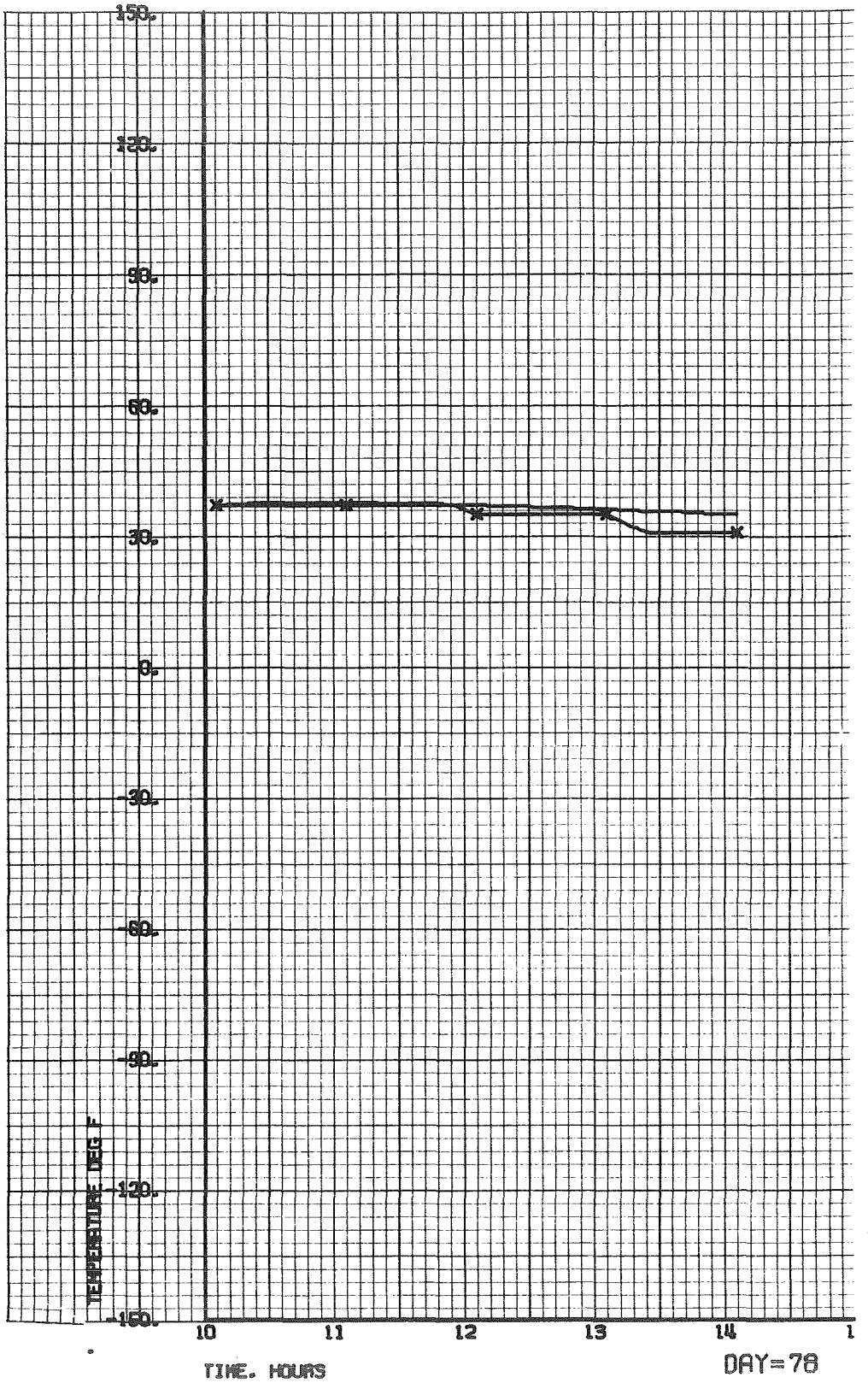
TP0117


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
1
TIME. HOURS
DAY=78

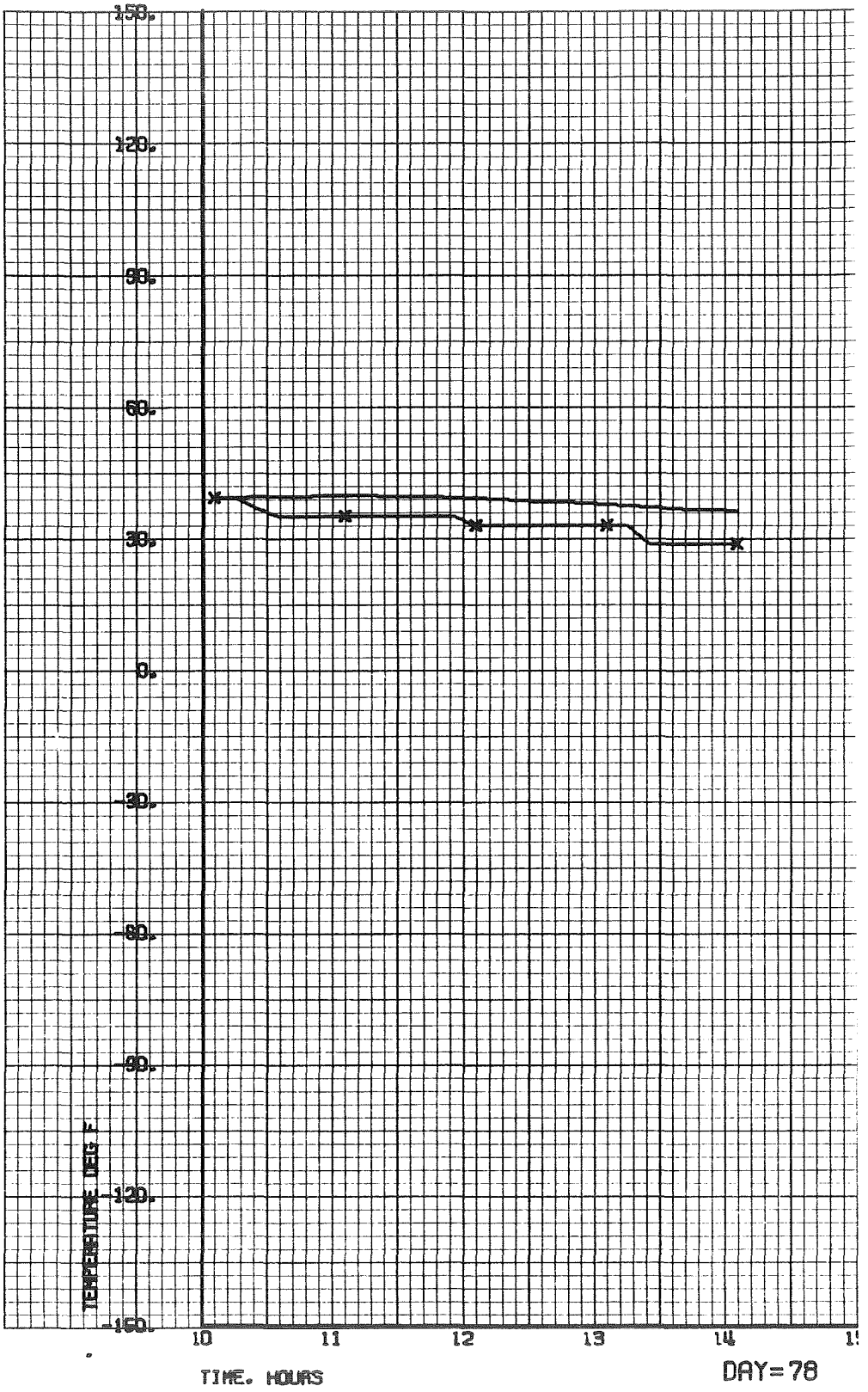
TP0132


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
1
TIME. HOURS
DAY=78

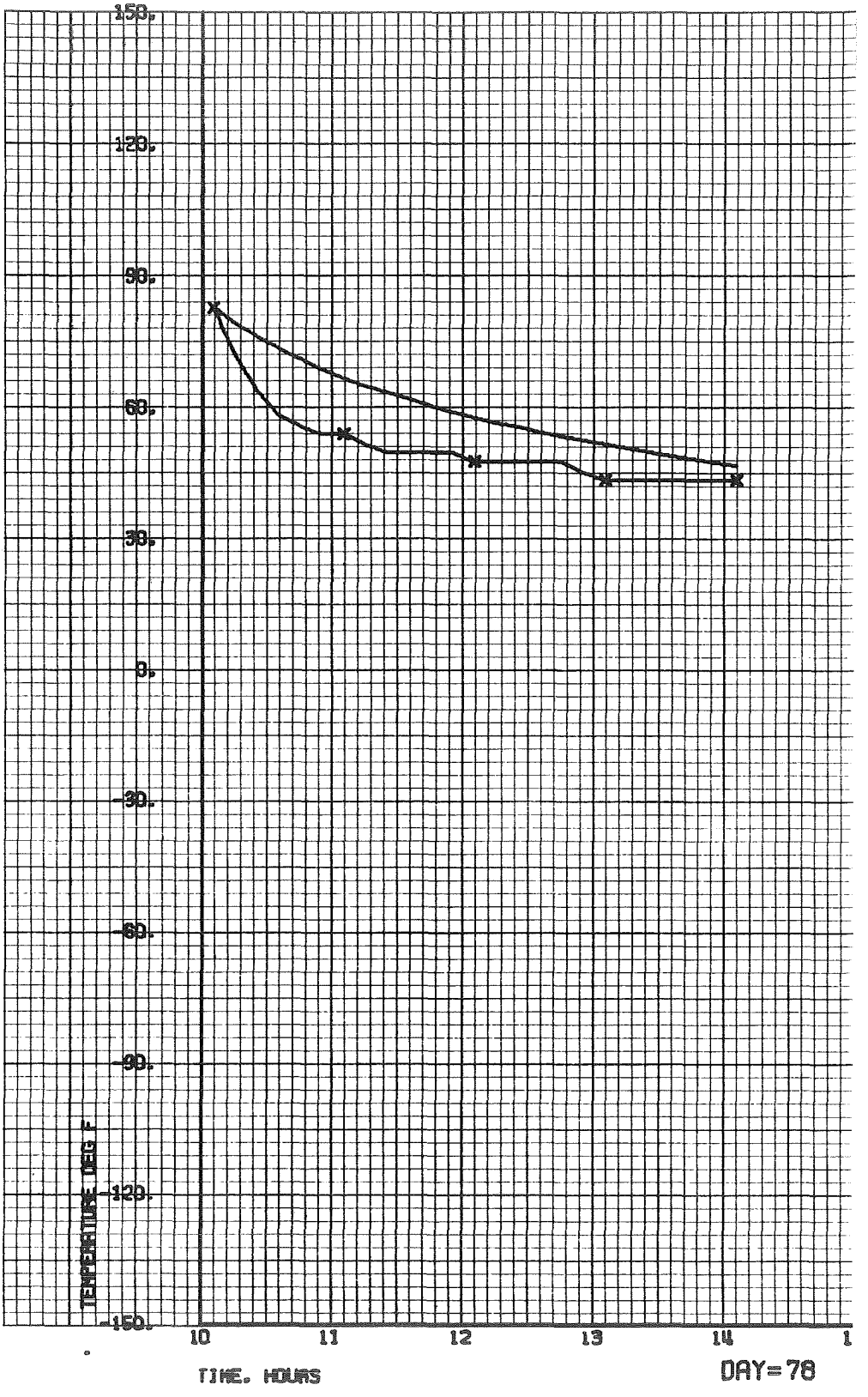
TP0138


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
1
TIME. HOURS
DAY=78

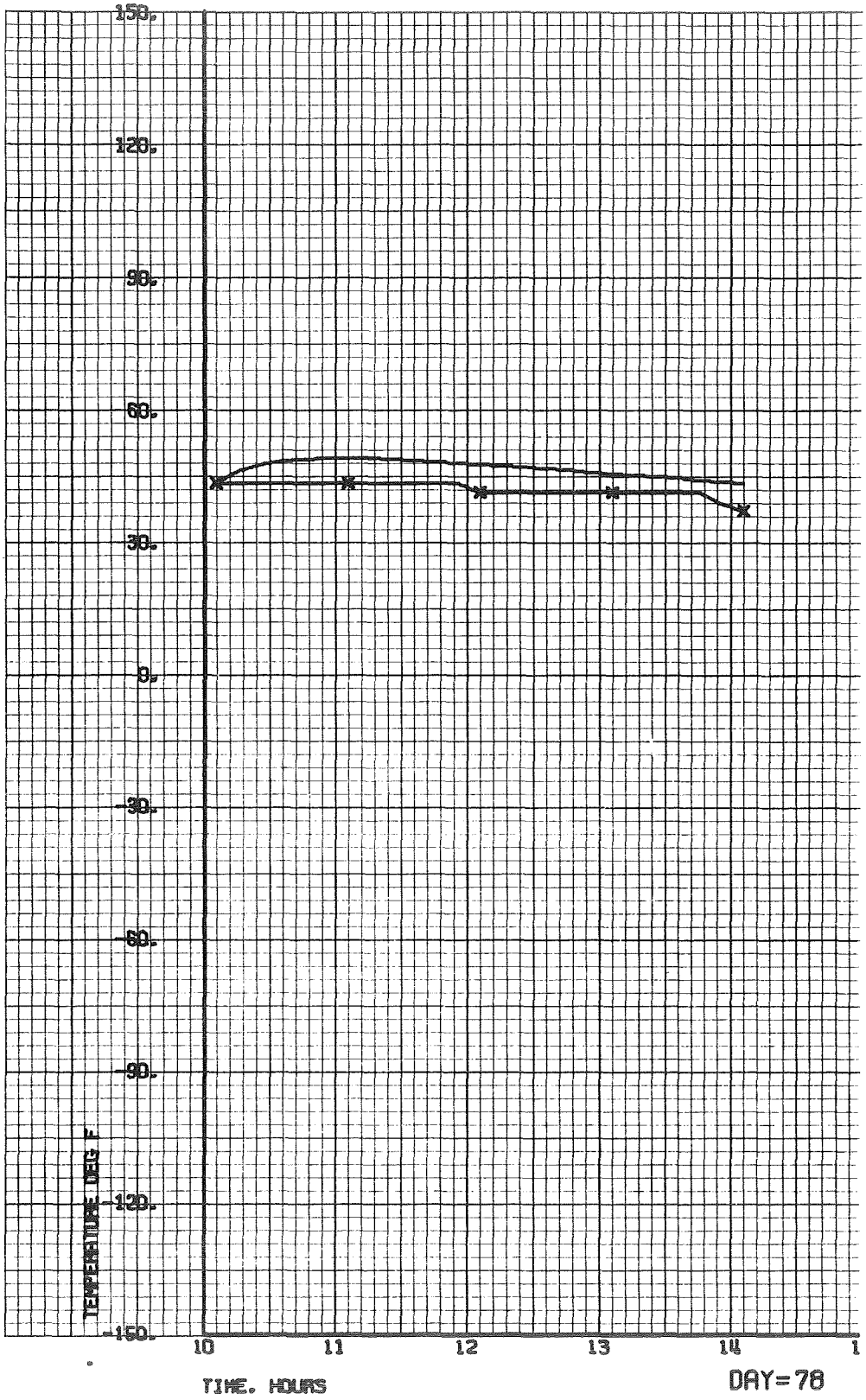
TP0142


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
TIME. HOURS
DAY=78

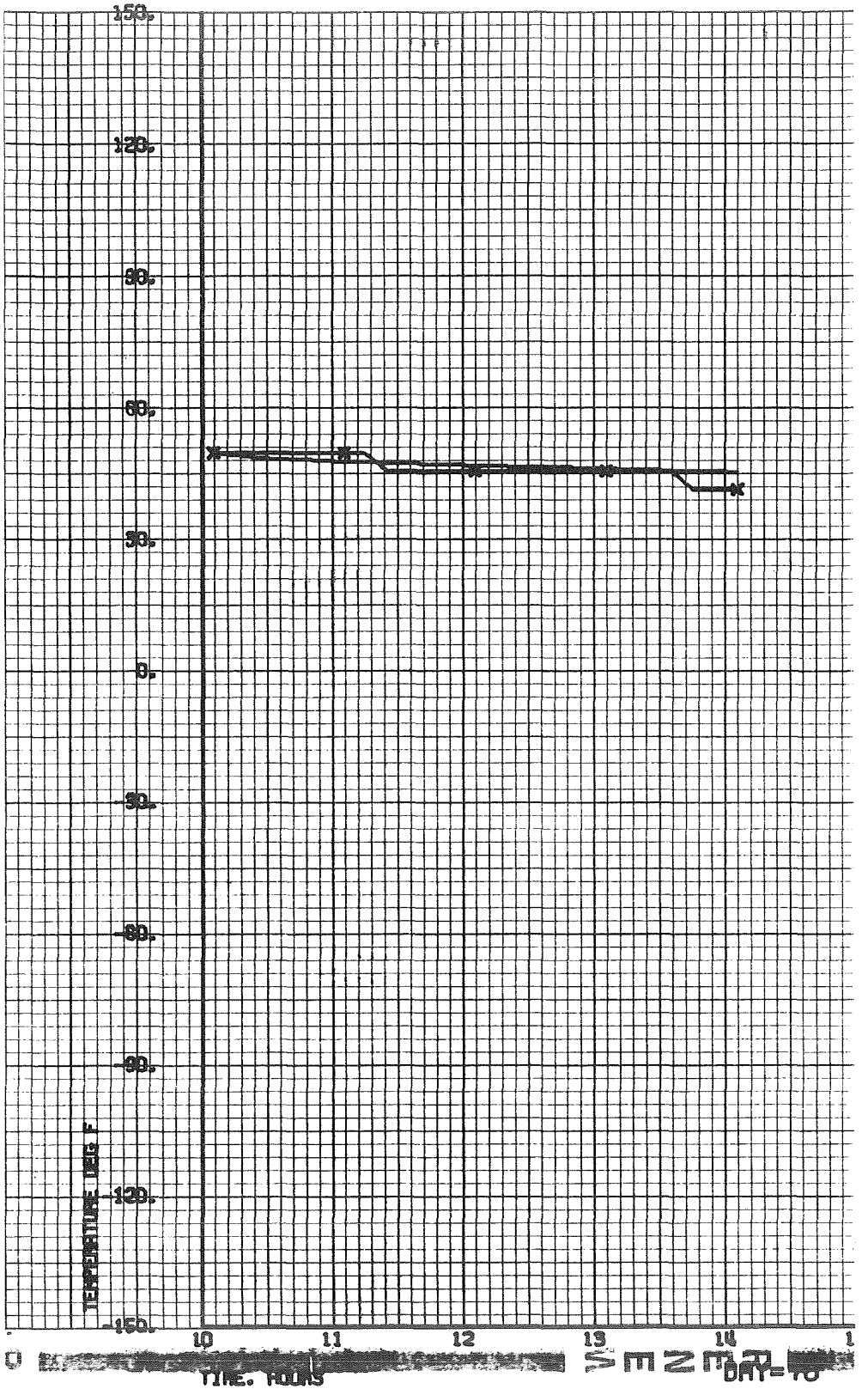
TP0148


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
1
TIME. HOURS
DAY=78

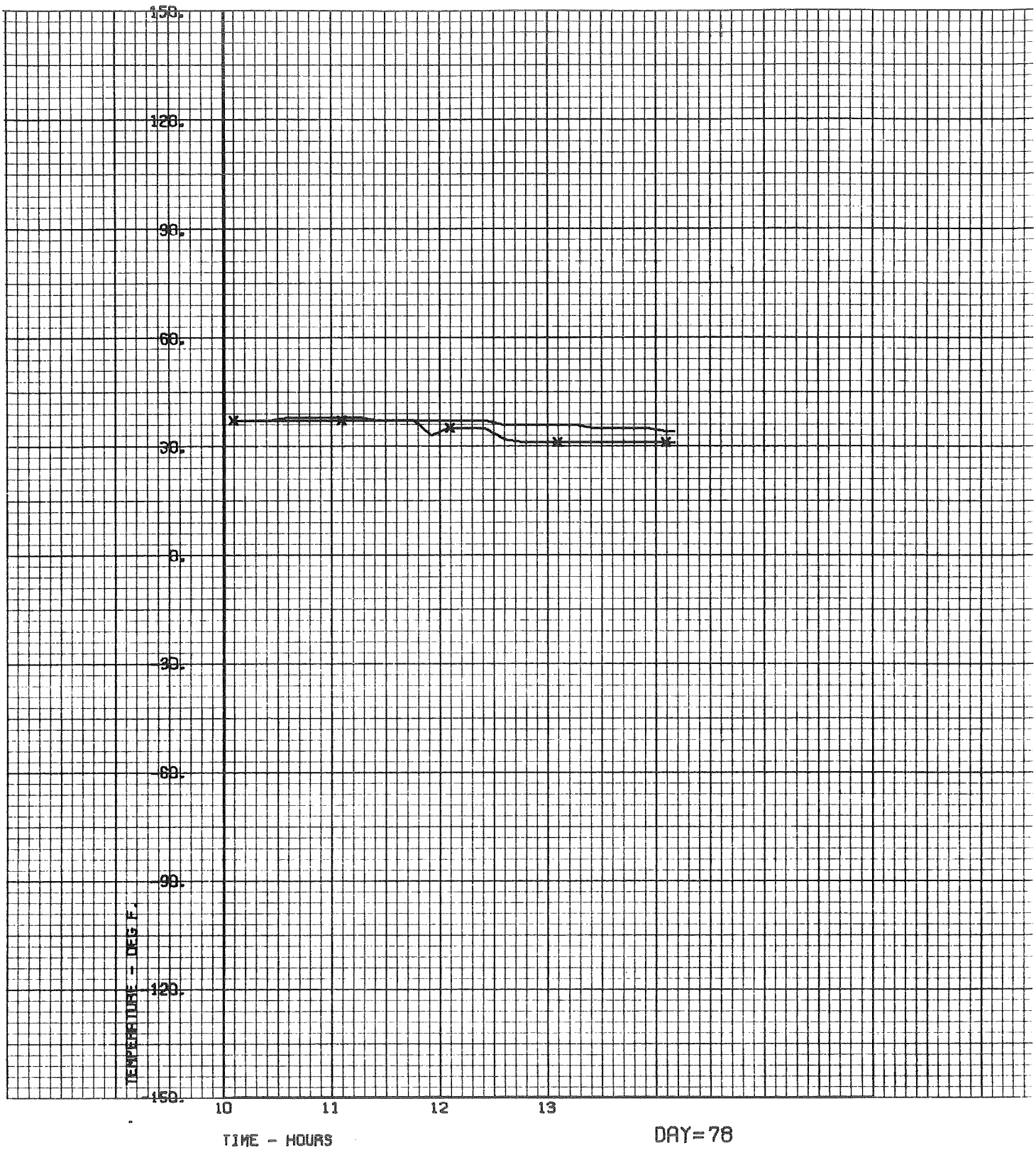
TP0170


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
1
TIME. HOURS
DAY=78

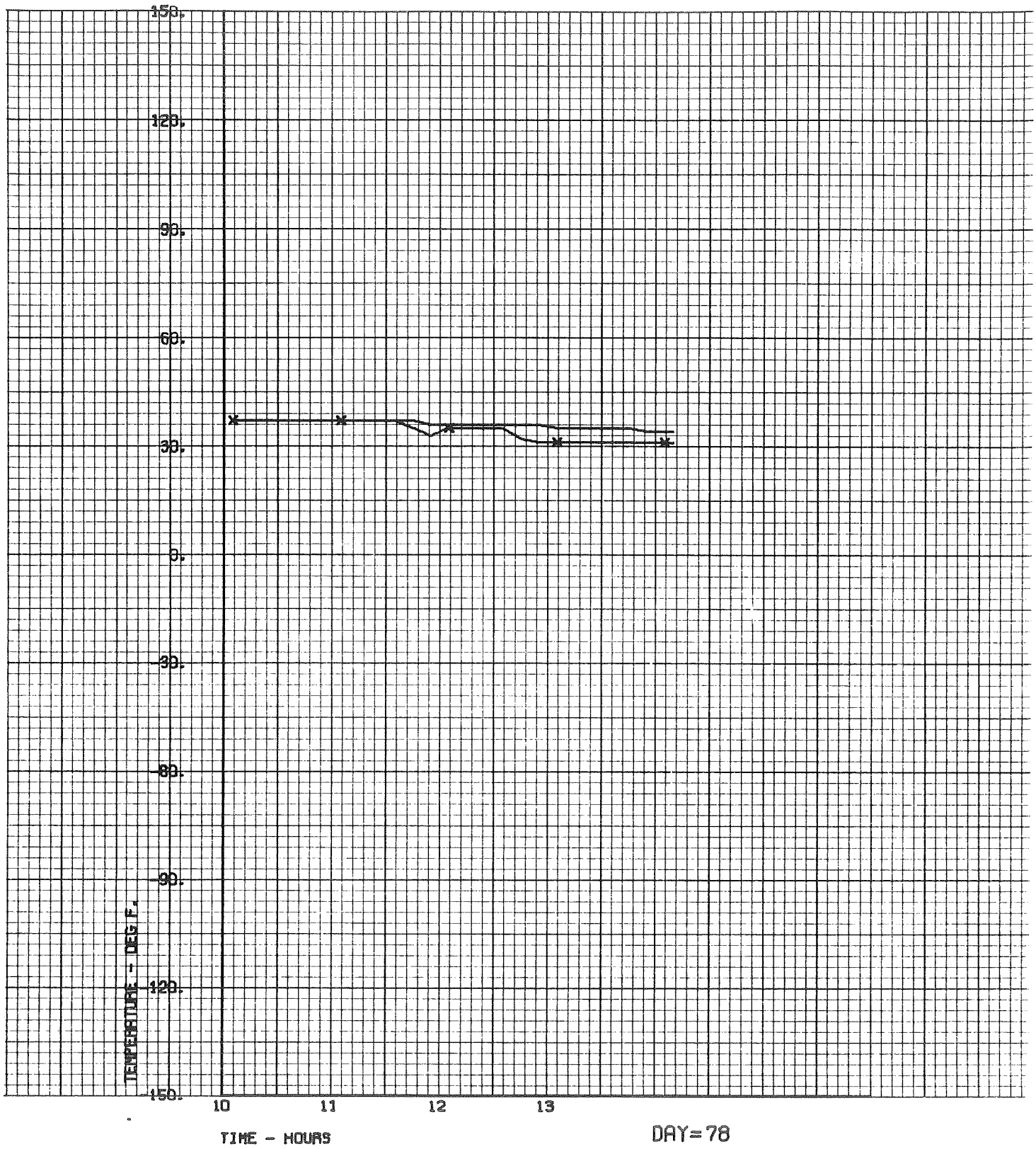
TH0522


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
TIME. HOURS
DAY-10

TW601

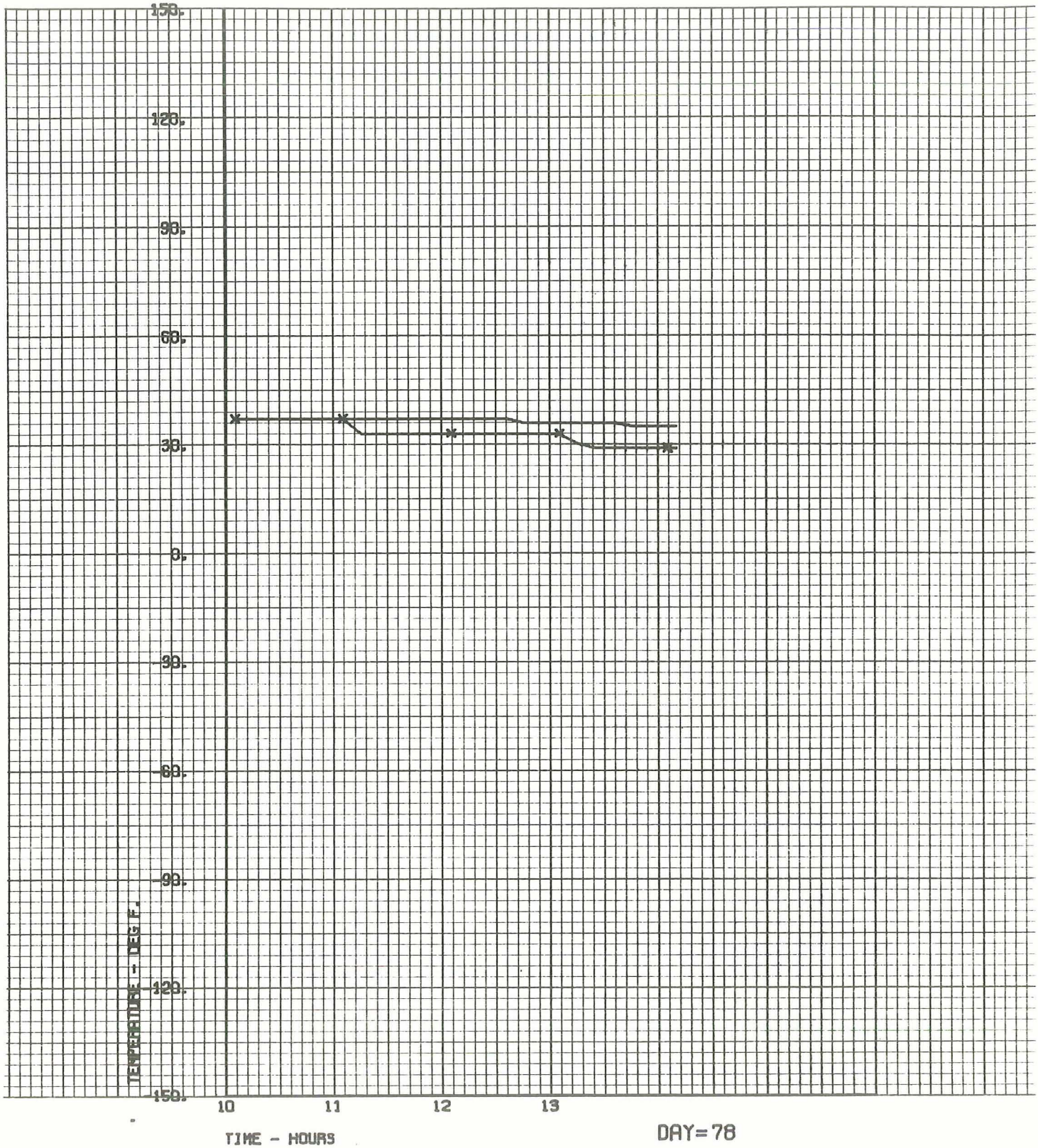

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
TIME - HOURS
DAY=78

TW602

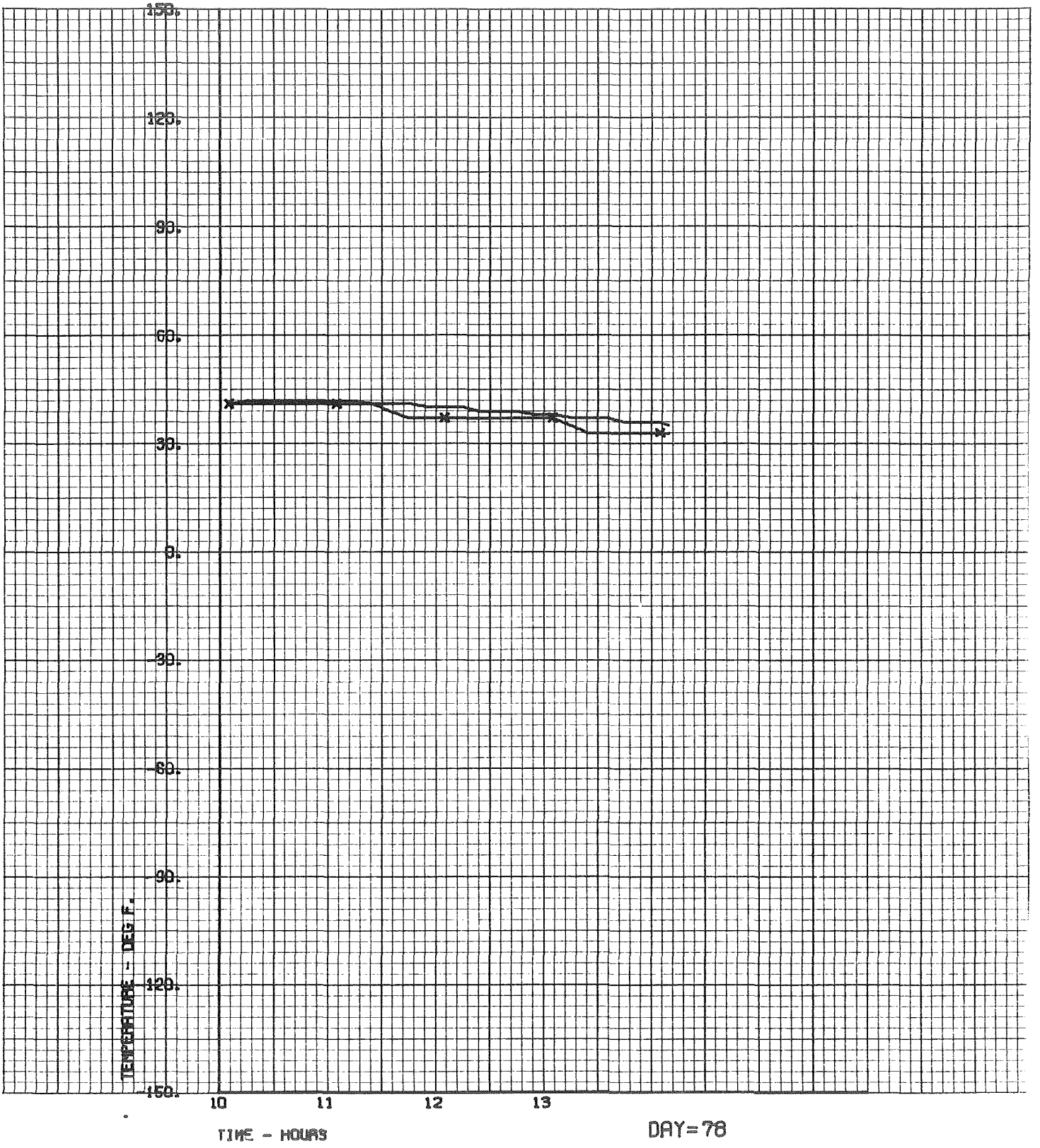

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
TIME - HOURS

DAY=78

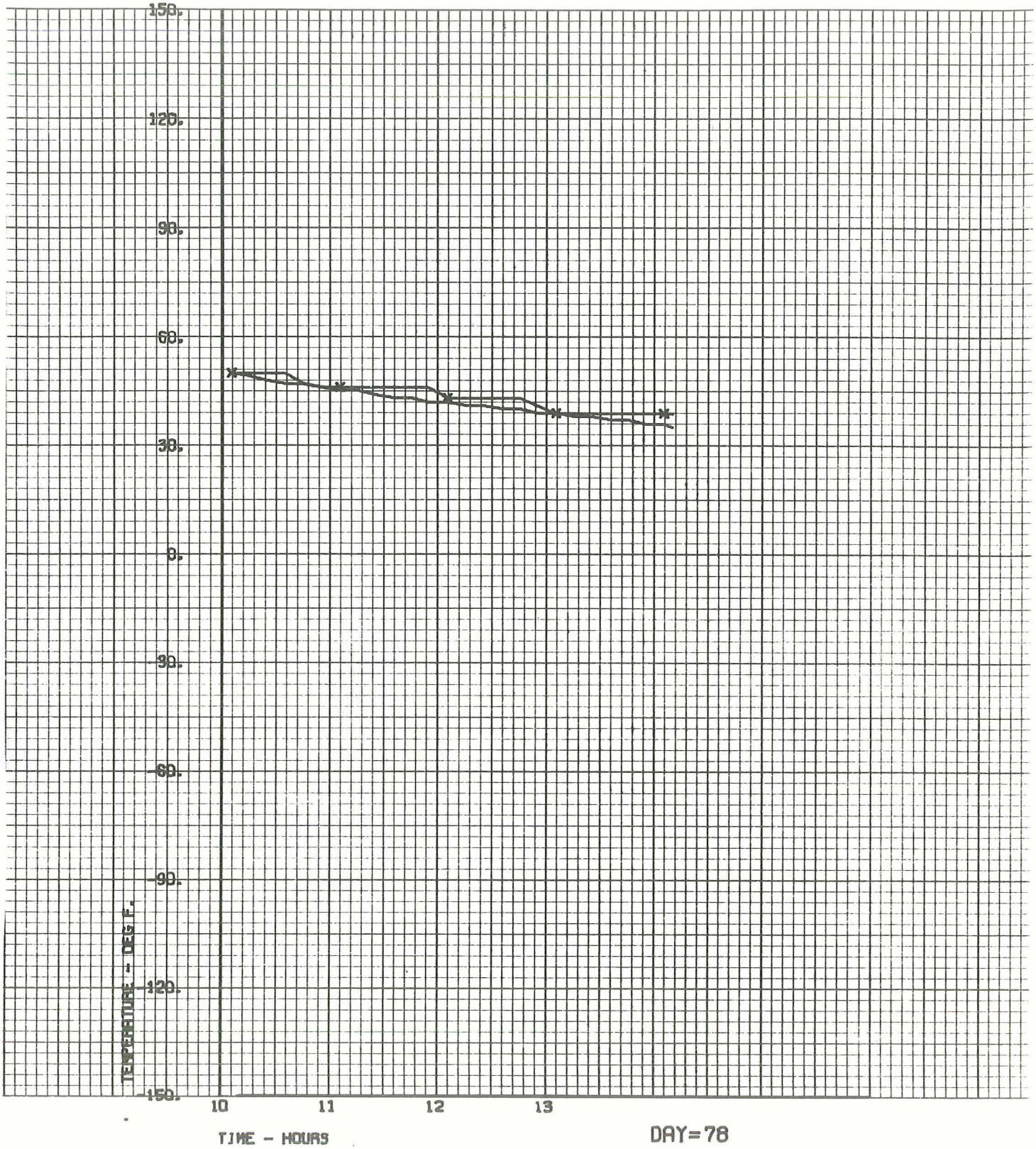
TW603


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
TIME - HOURS
DAY=78

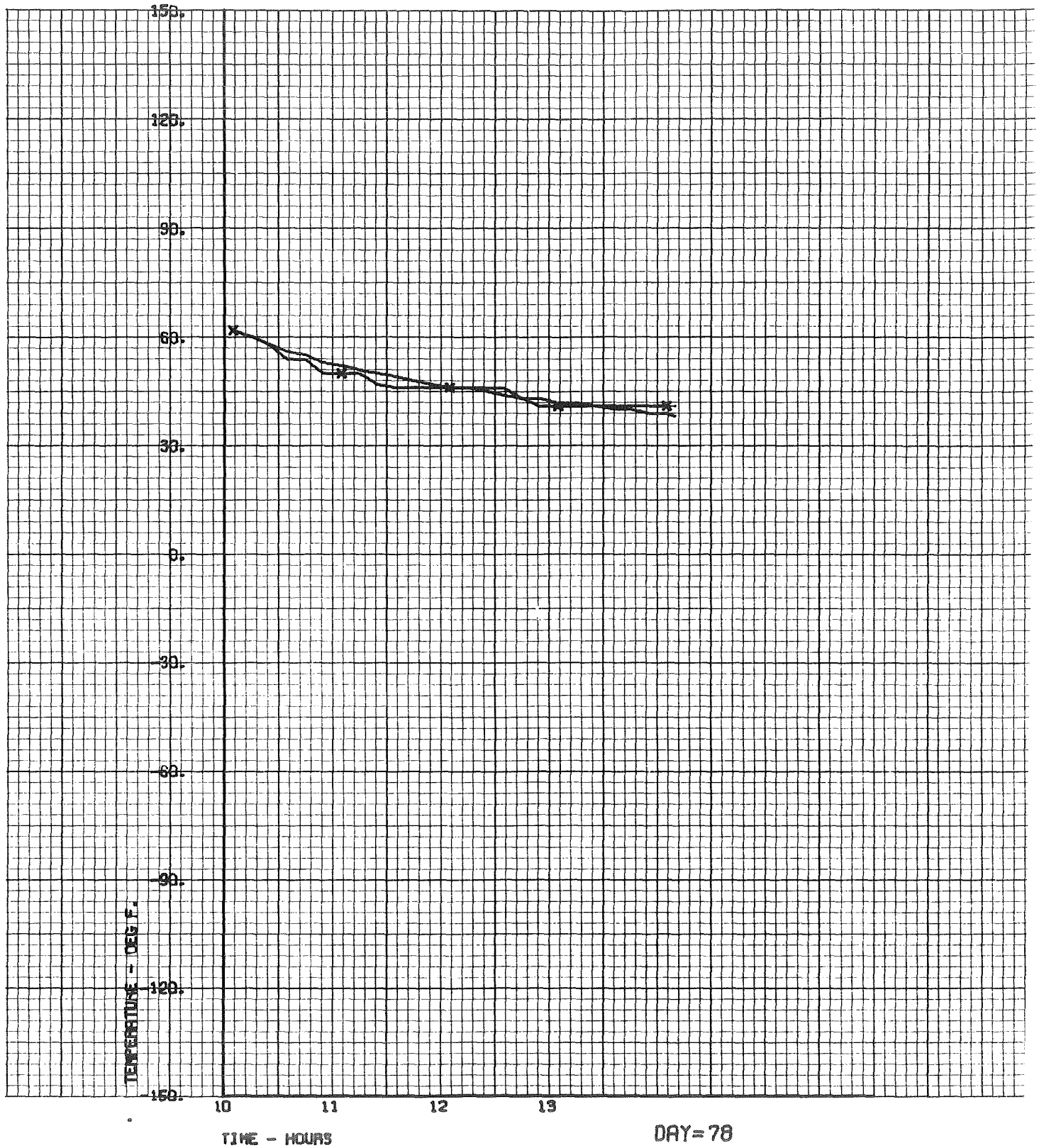
TP5138


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
TIME - HOURS
DAY=78

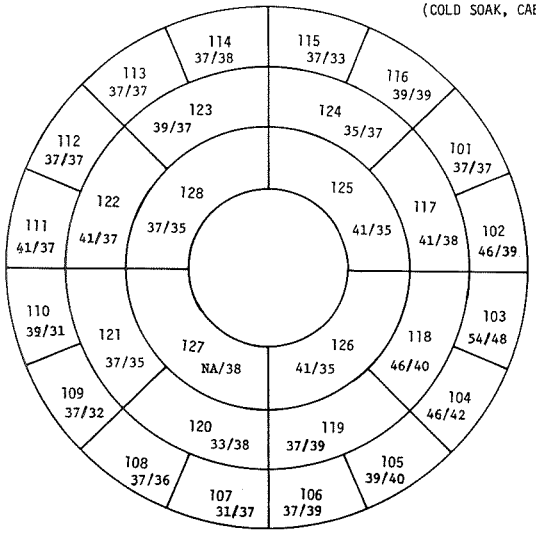
TP5139


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
TIME - HOURS
DAY=78

TP4158

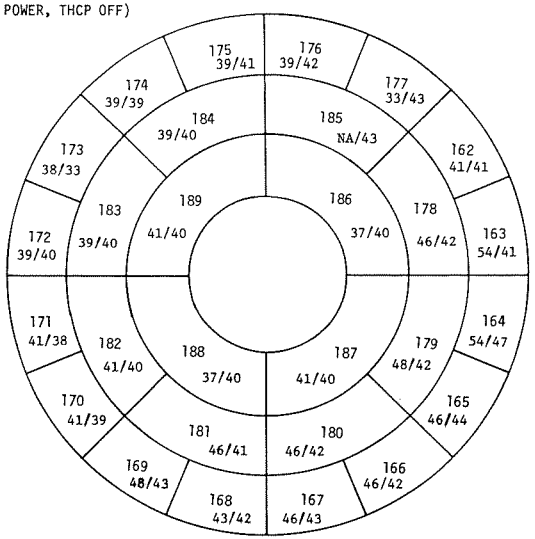

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
TIME - HOURS
DAY=78

PRESSURE SHELL TEMPERATURES AT END OF PHASE C4
(COLD SOAK, CABIN DEPRESSURIZED, 100% INTERNAL HEATER POWER, THCP OFF)



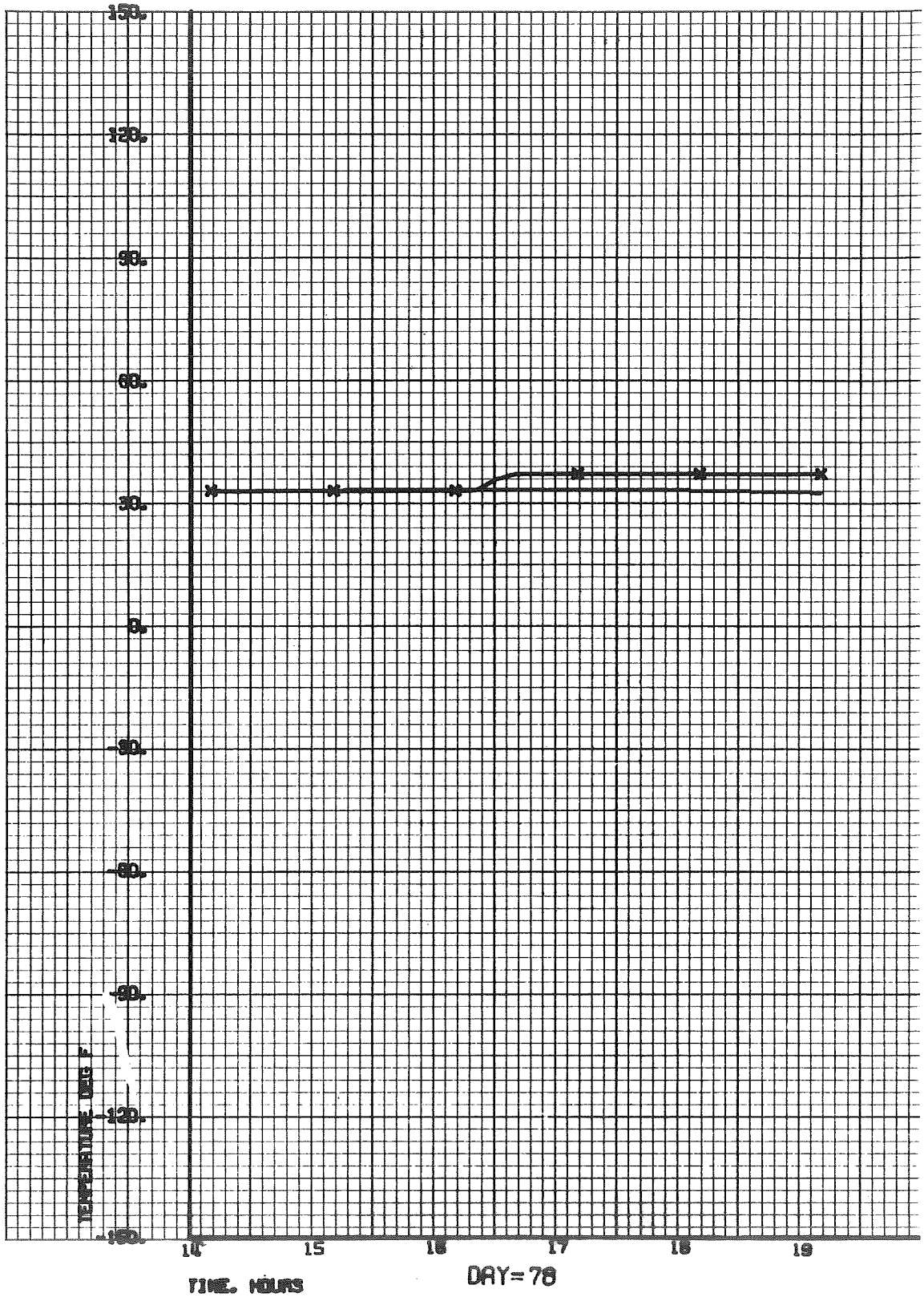
LEGEND

NODE NUMBER
ACTUAL/CALCULATED

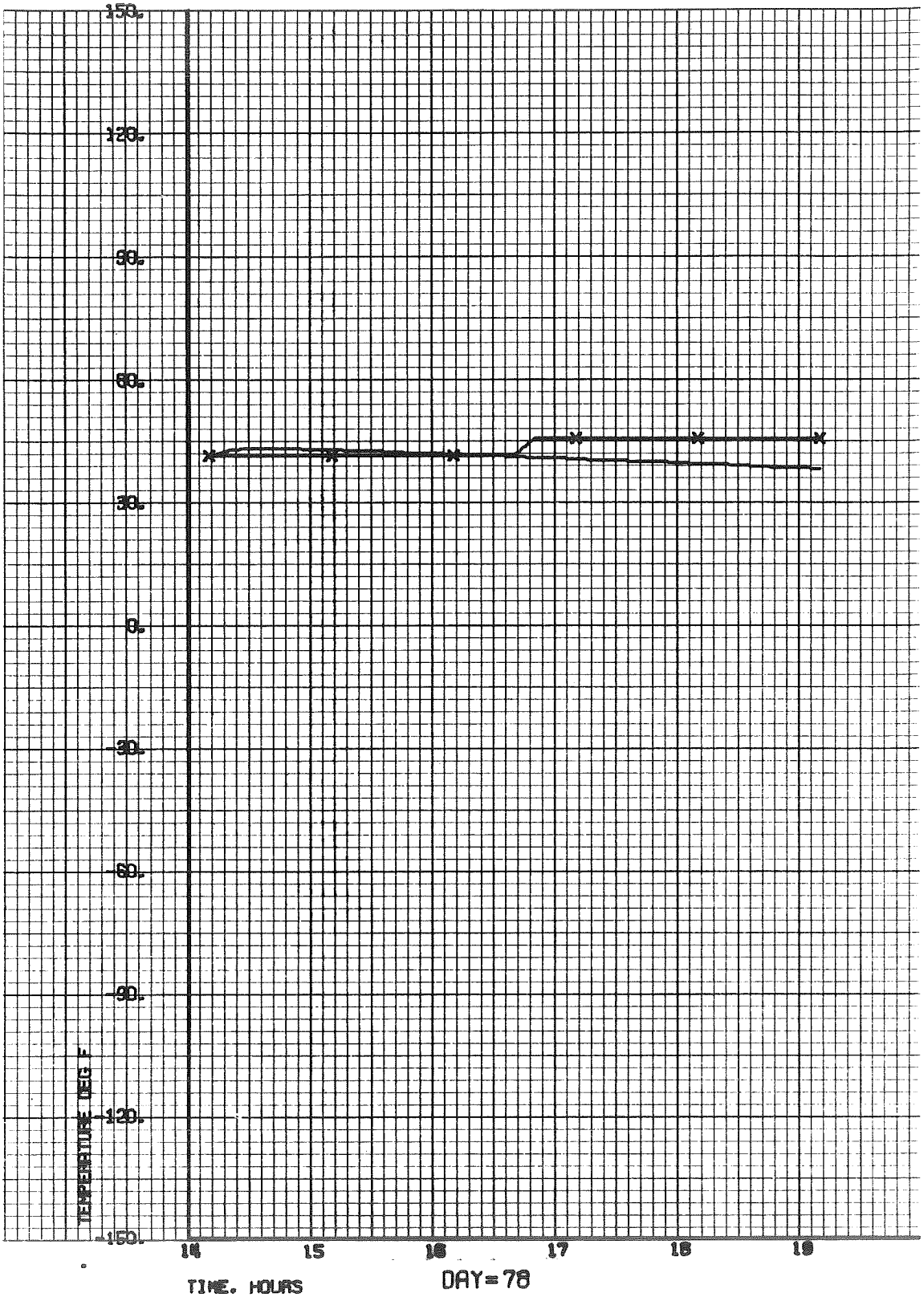


130 37/31	131 54/16	132 52/66	133 50/41	134 37/36	135 41/38	136 37/38	137 41/42	138 35/31	139 39/27	140 46/40	141 41/30	142 33/33	143 41/38	144 37/39	145 46/42
146 48/27	147 52/15	148 52/74	149 52/42	150 50/34	151 50/47	152 46/36	153 46/47	154 48/30	155 48/29	156 43/43	157 41/30	158 46/31	159 43/45	160 43/35	161 46/45

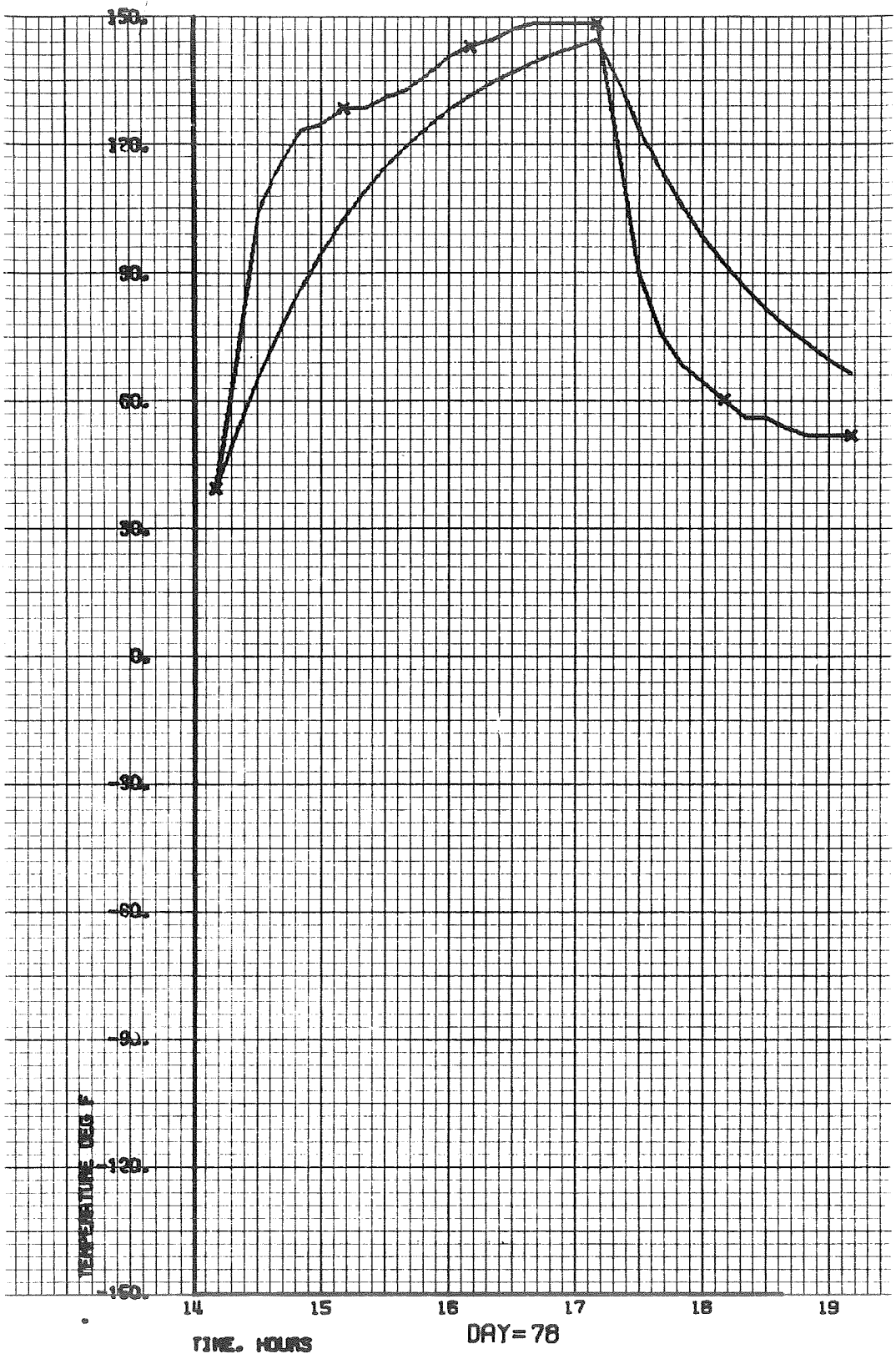
TP0109


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
14
15
16
17
18
19
TIME. HOURS
DAY=78

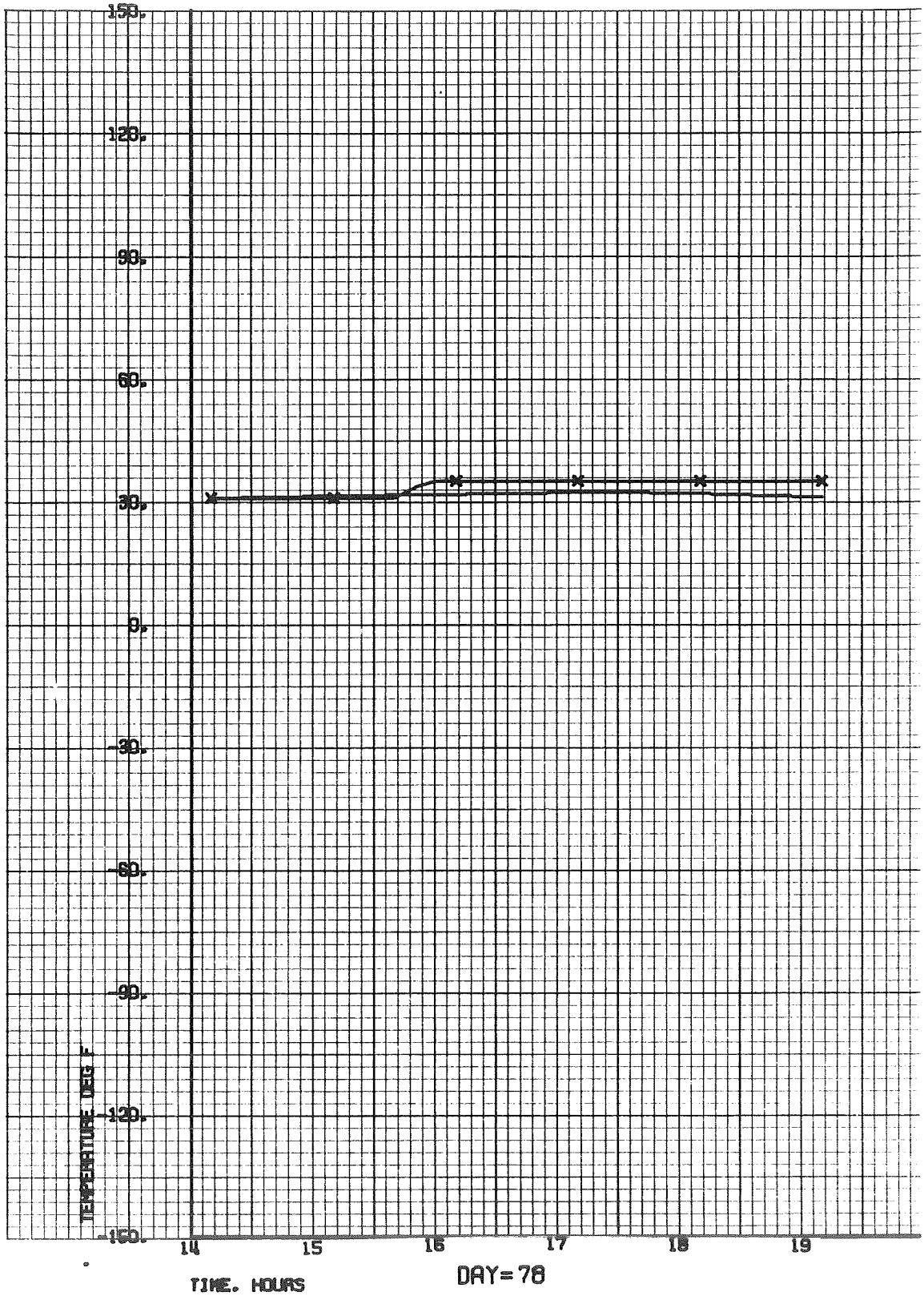
TP0117


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
14
15
16
17
18
19
TIME. HOURS
DAY=78

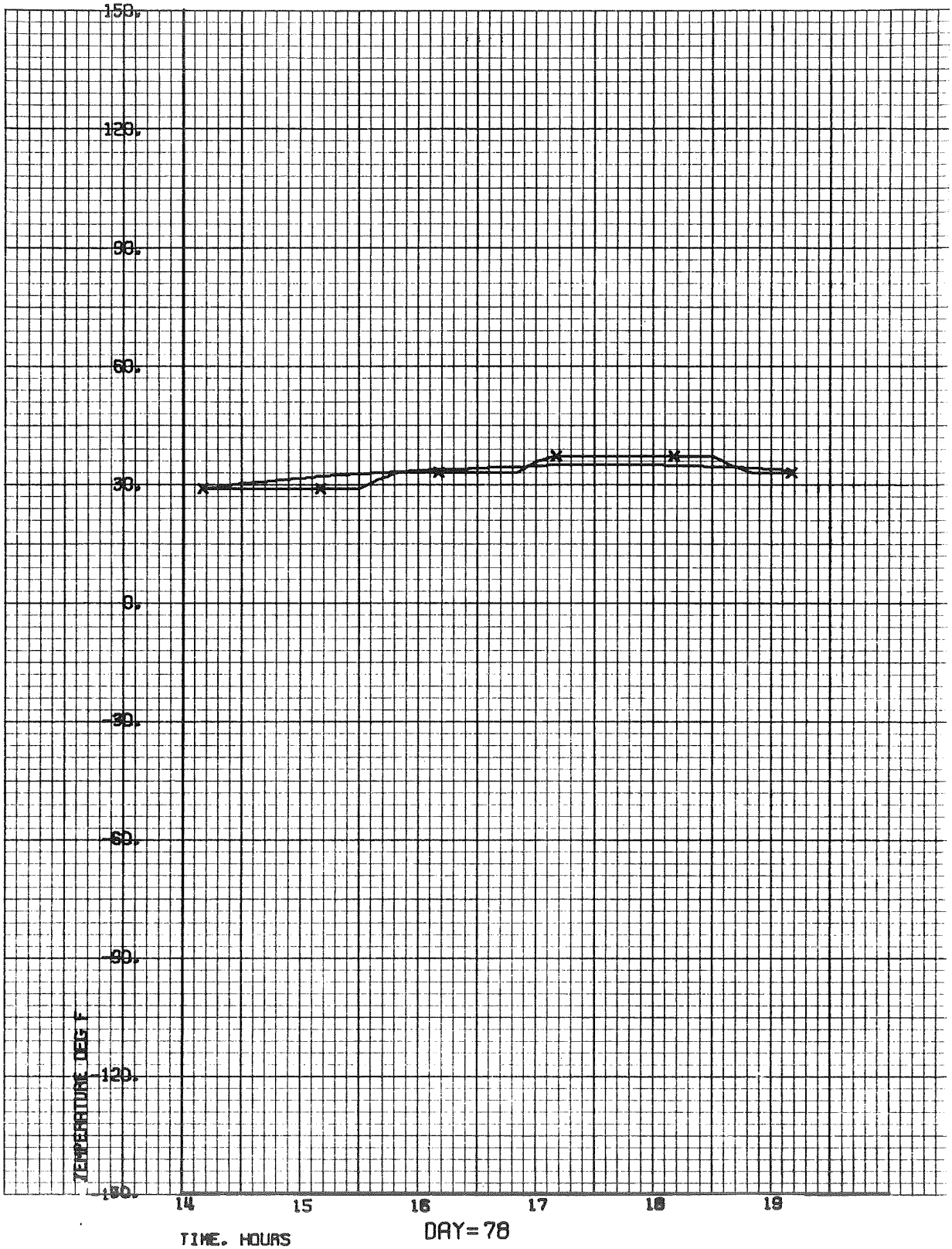
TP0132


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
14
15
16
17
18
19
TIME. HOURS
DAY=78

TP0138

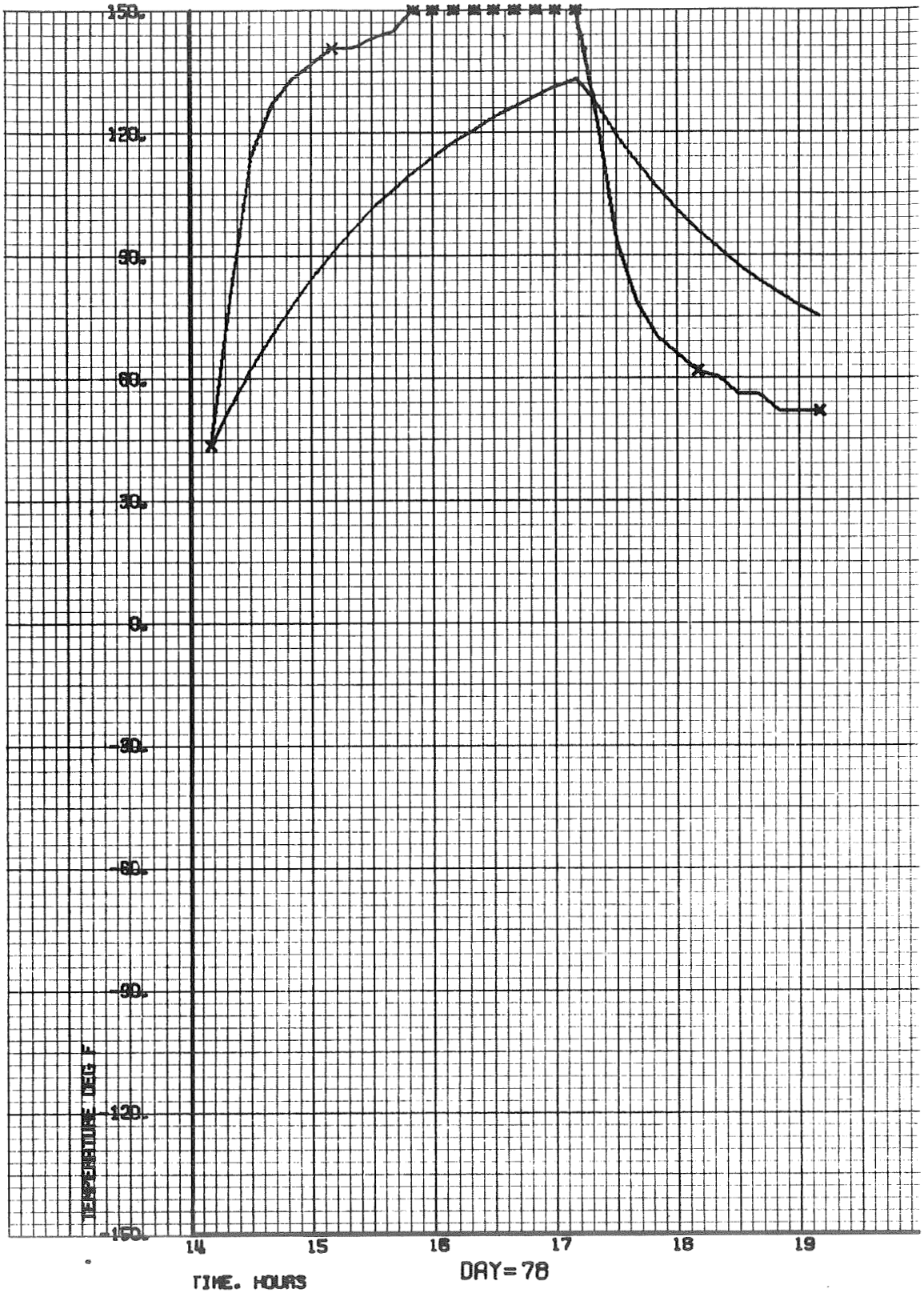

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
14
15
16
17
18
19
TIME. HOURS
DAY=78

TP0142

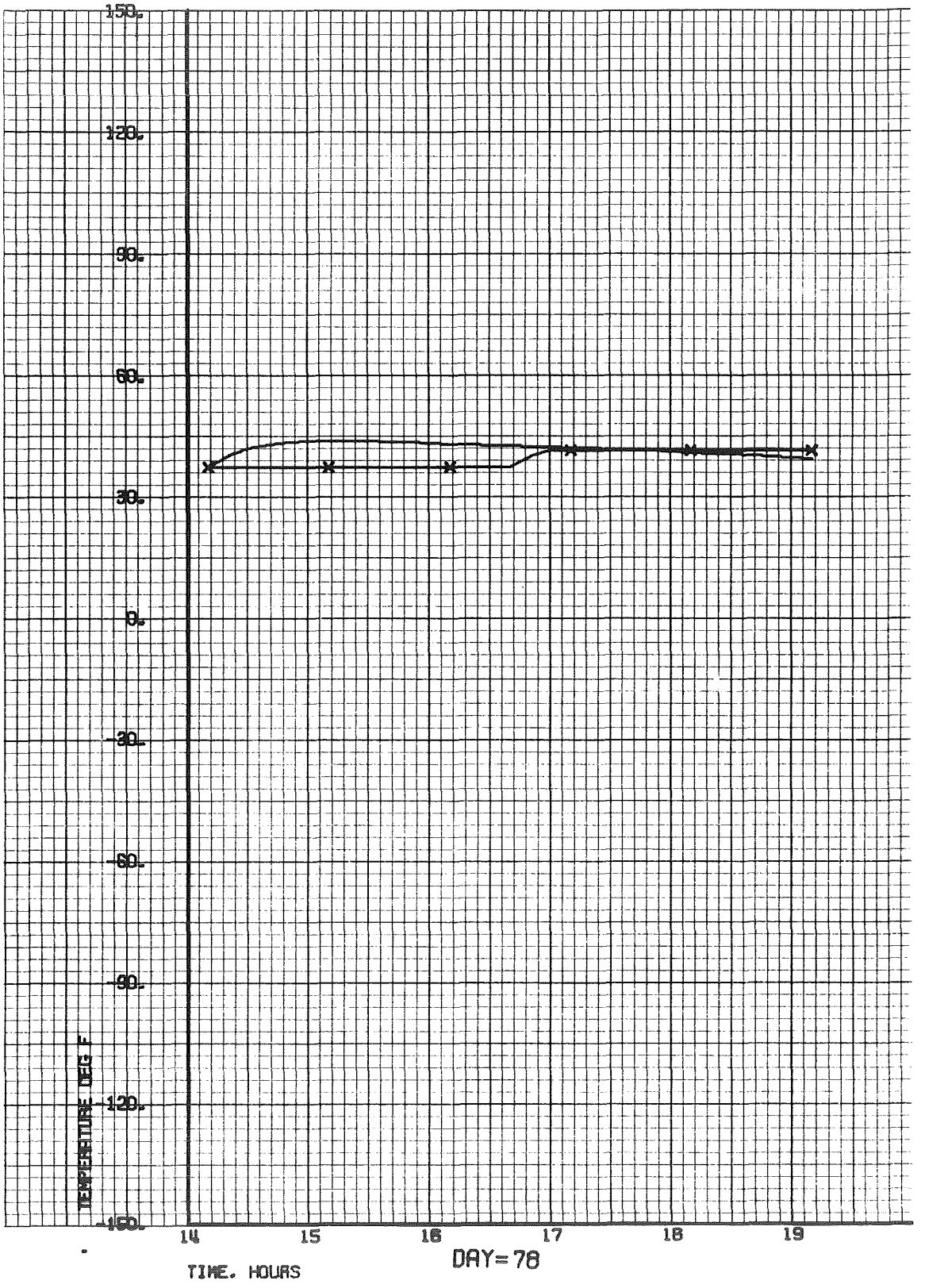

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
14
15
16
17
18
19
TIME. HOURS
DAY=78

TP0148

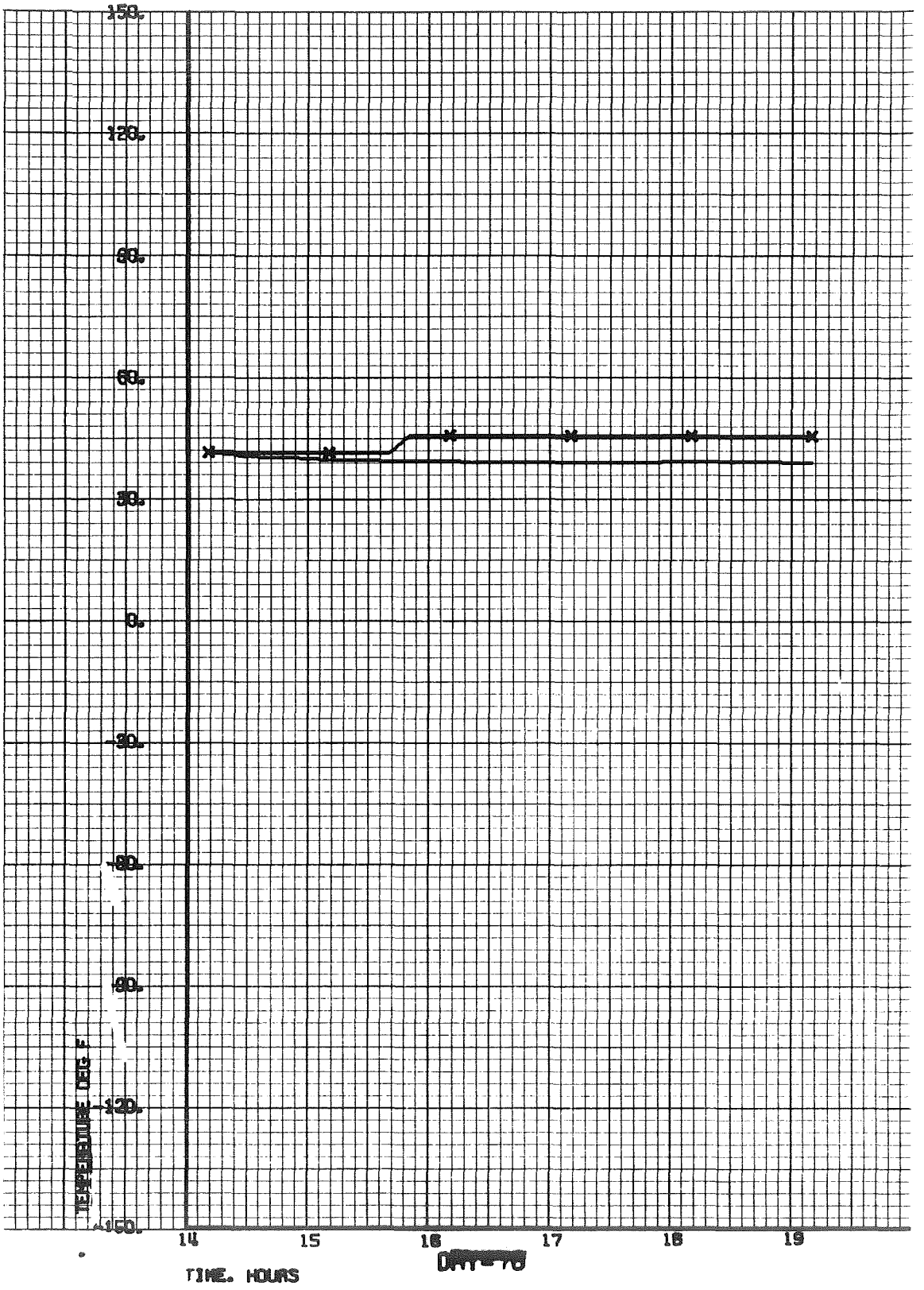
Maximum temperature reached-165°



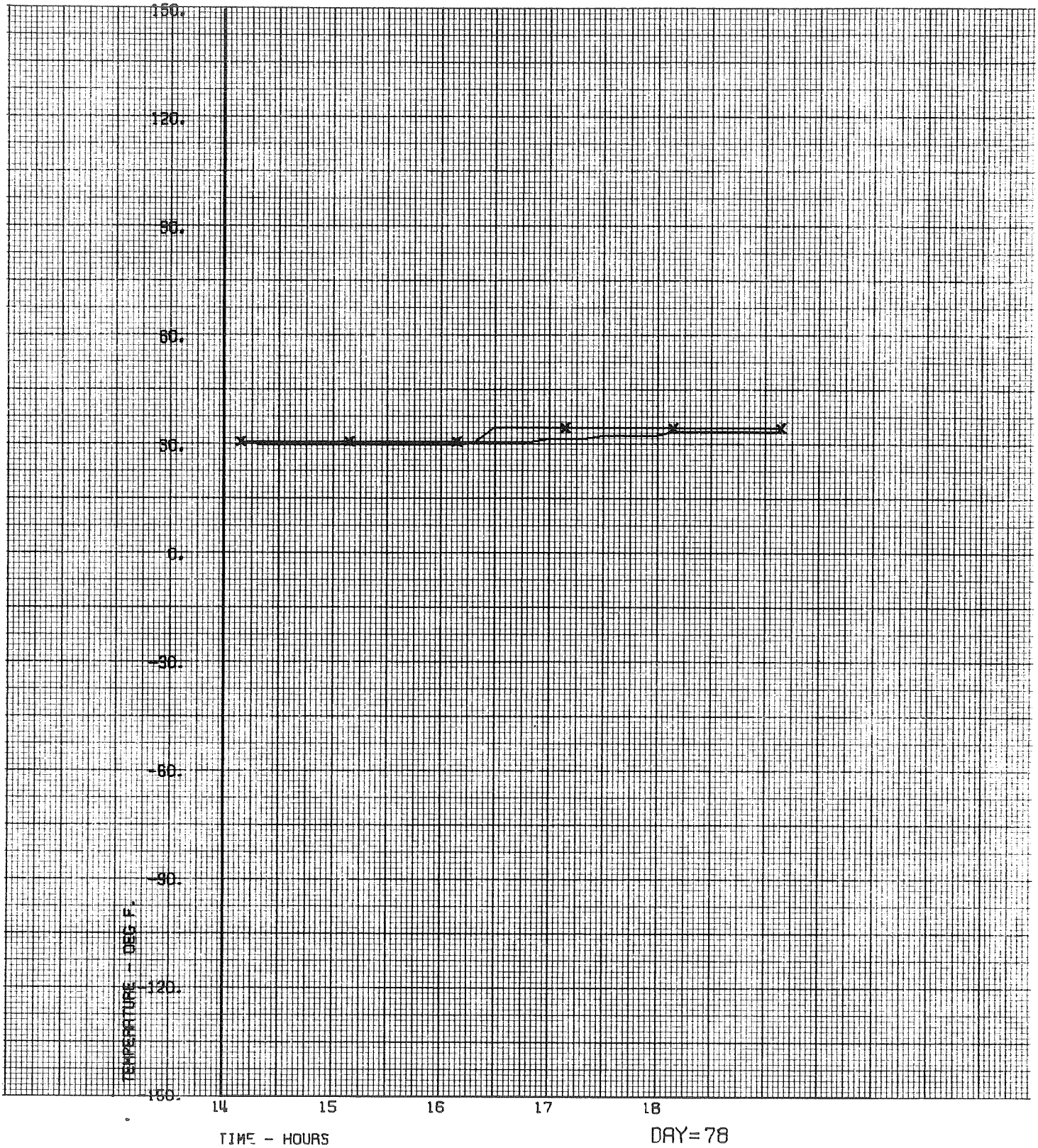
TP0170


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
14
15
16
17
18
19
TIME. HOURS
DAY=78

THO522

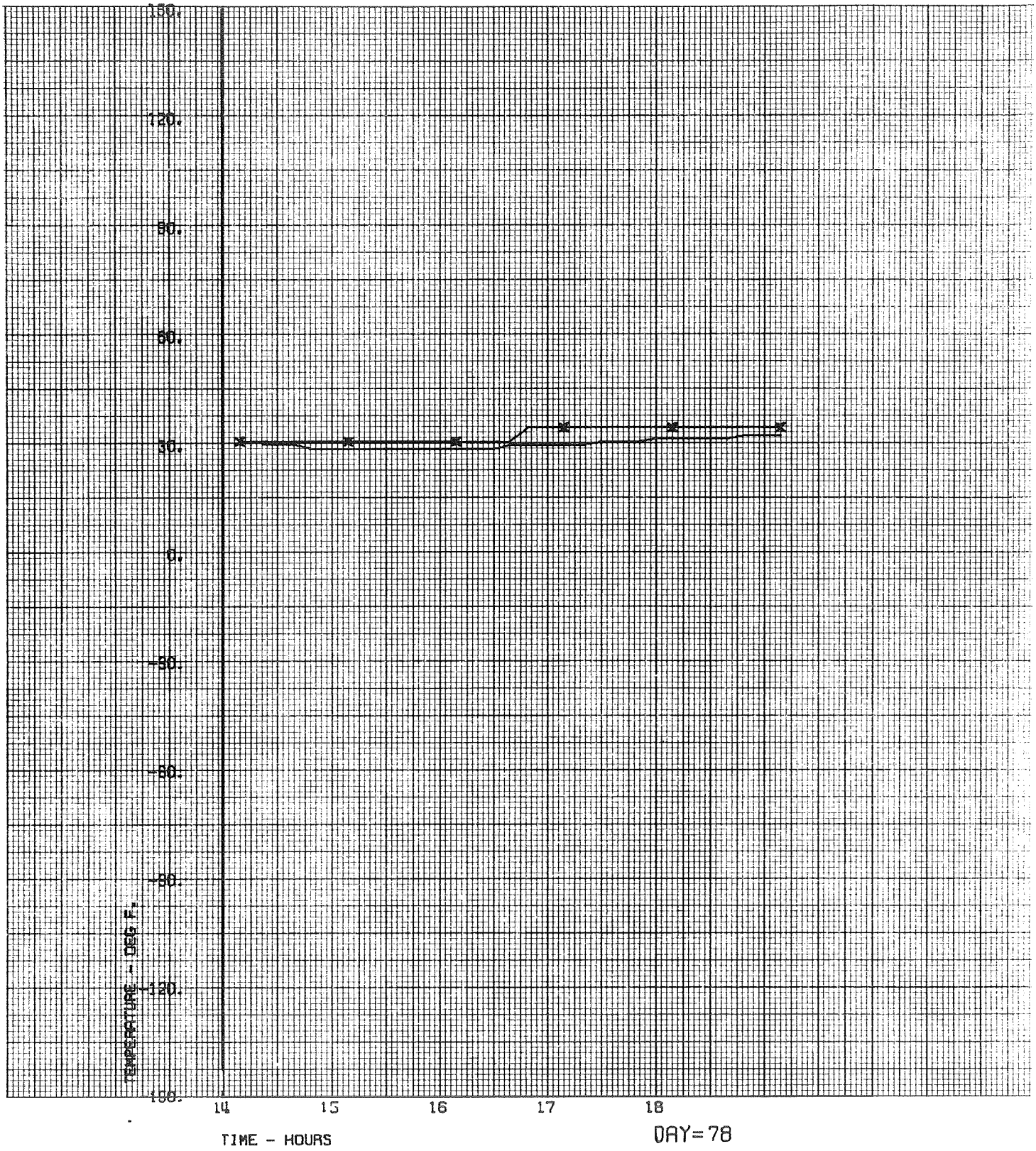

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
14
15
16
17
18
19
TIME. HOURS
DAY-70

TW601

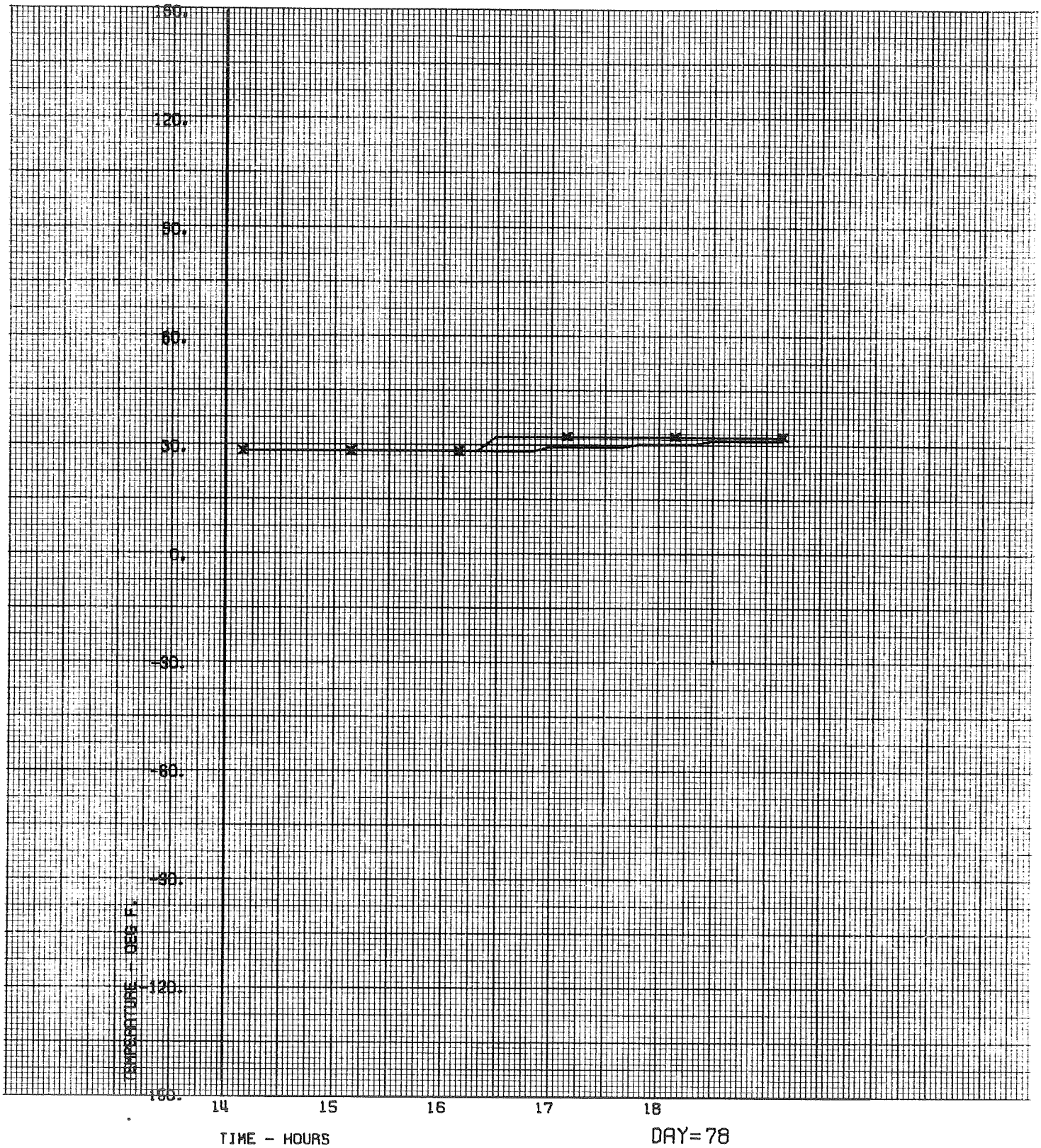

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
14
15
16
17
18
TIME - HOURS

DAY=78

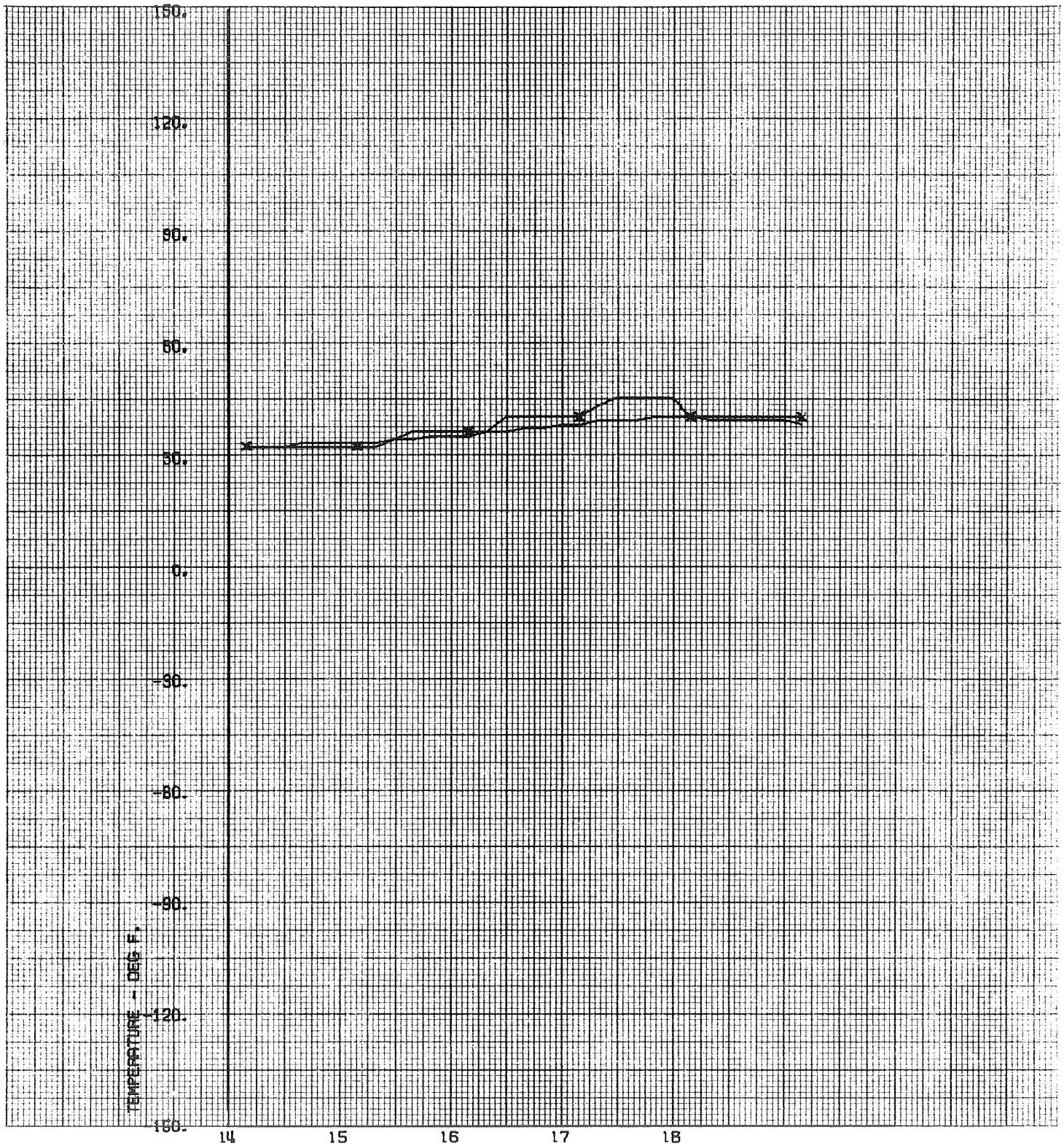
TW602


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
14
15
16
17
18
TIME - HOURS
DAY=78

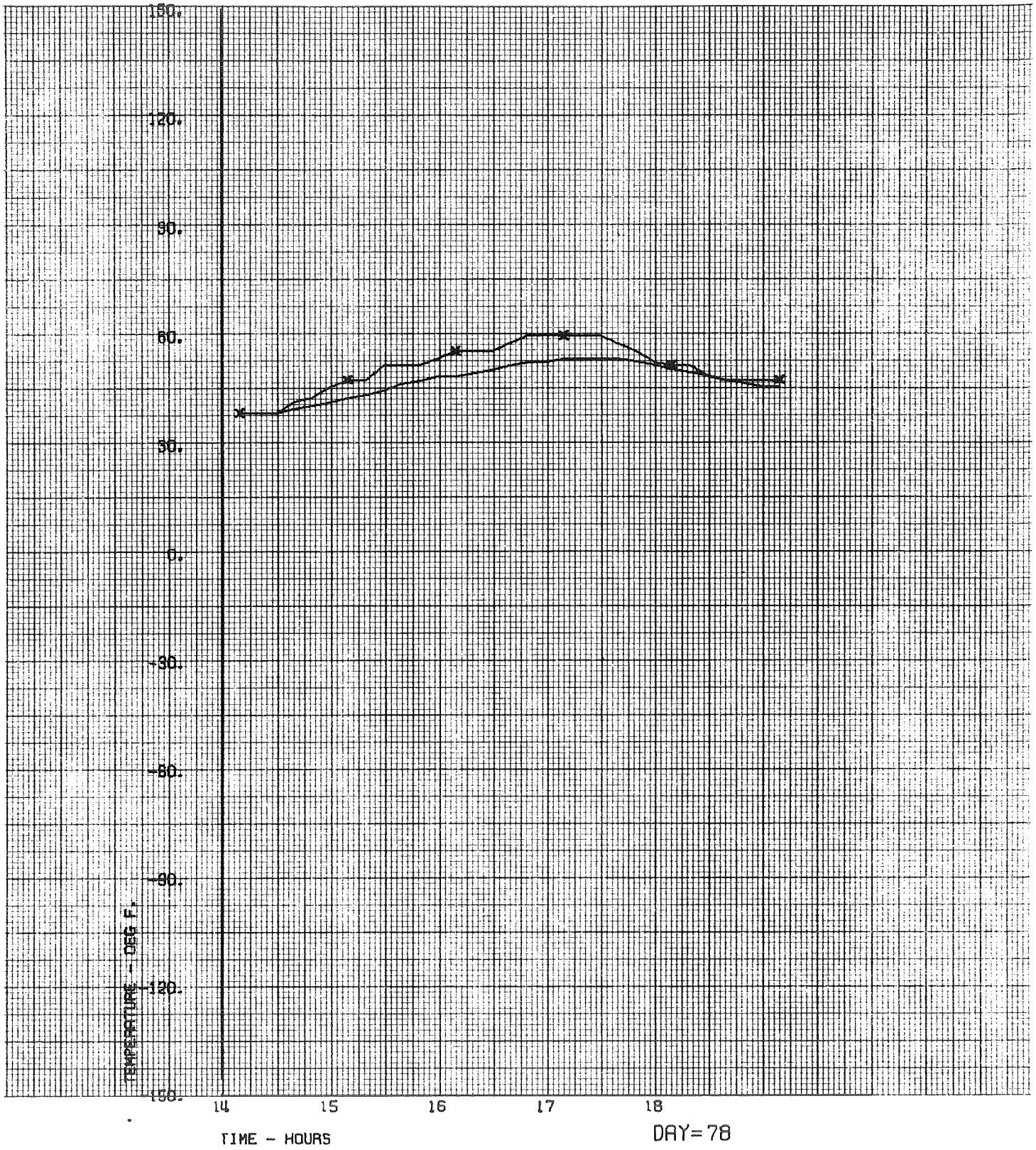
TW603


180.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG. F.
14
15
16
17
18
TIME - HOURS
DAY=78

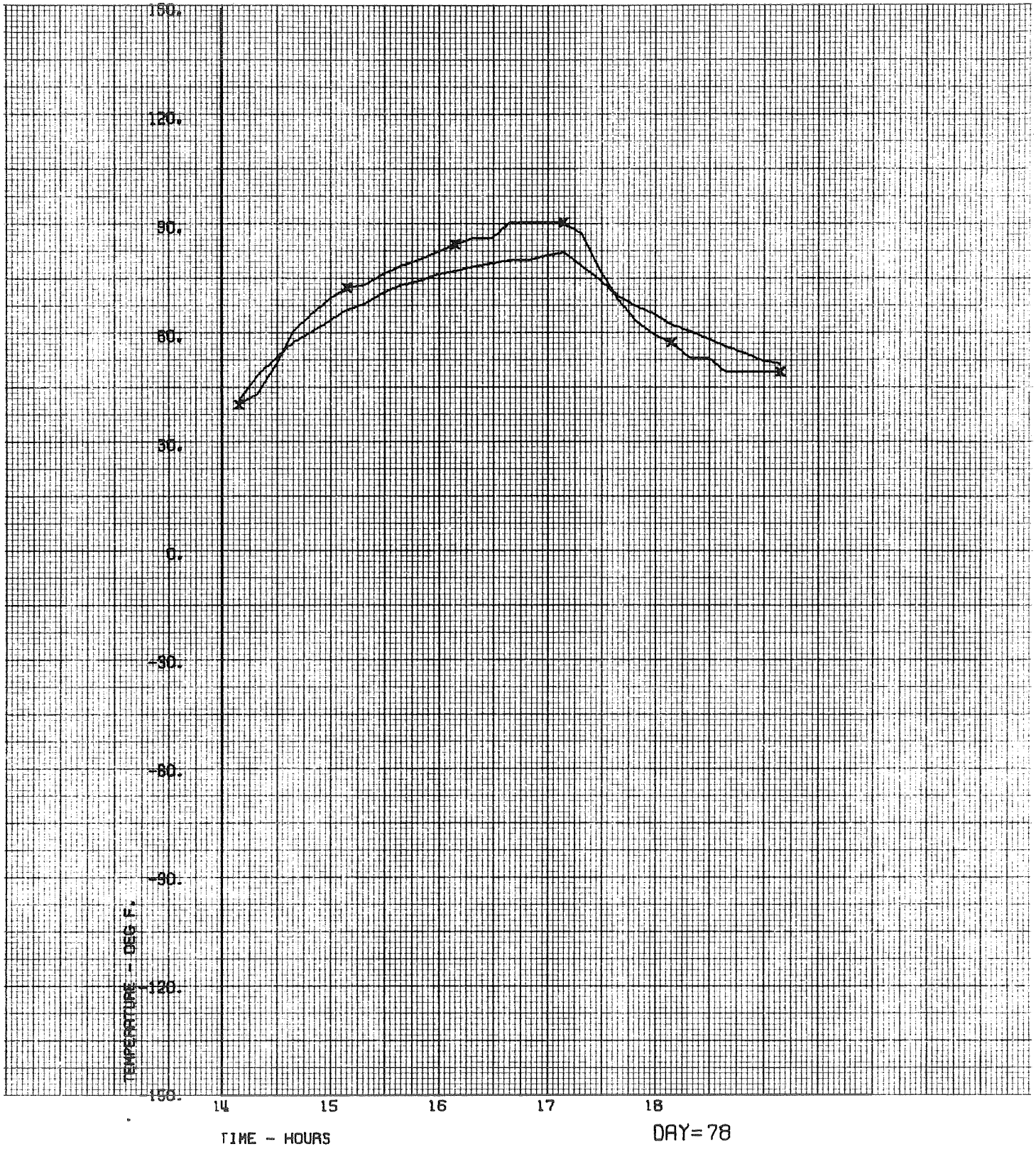
TP5138


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
14
15
16
17
18
TIME - HOURS
DAY=78

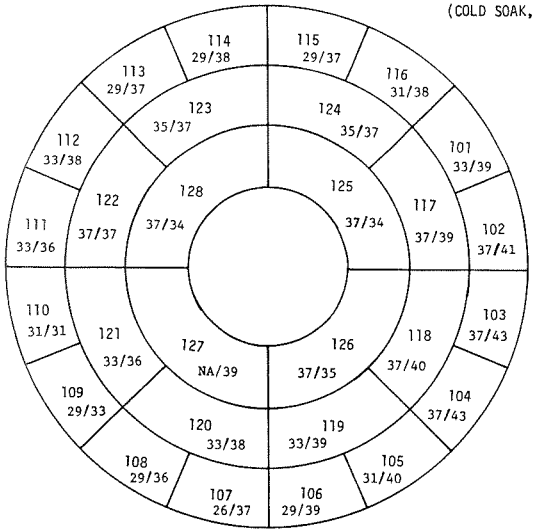
TP5139


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
14
15
16
17
18
TIME - HOURS
DAY=78

TP4158

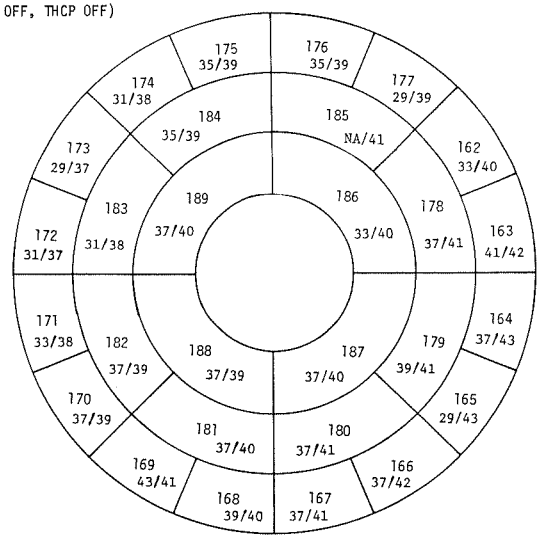

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
14
15
16
17
18
TIME - HOURS
DAY=78

PRESSURE SHELL TEMPERATURES AT END OF PHASE C5
(COLD SOAK, CABIN DEPRESSURIZED, INTERNAL HEATERS OFF, THCP OFF)



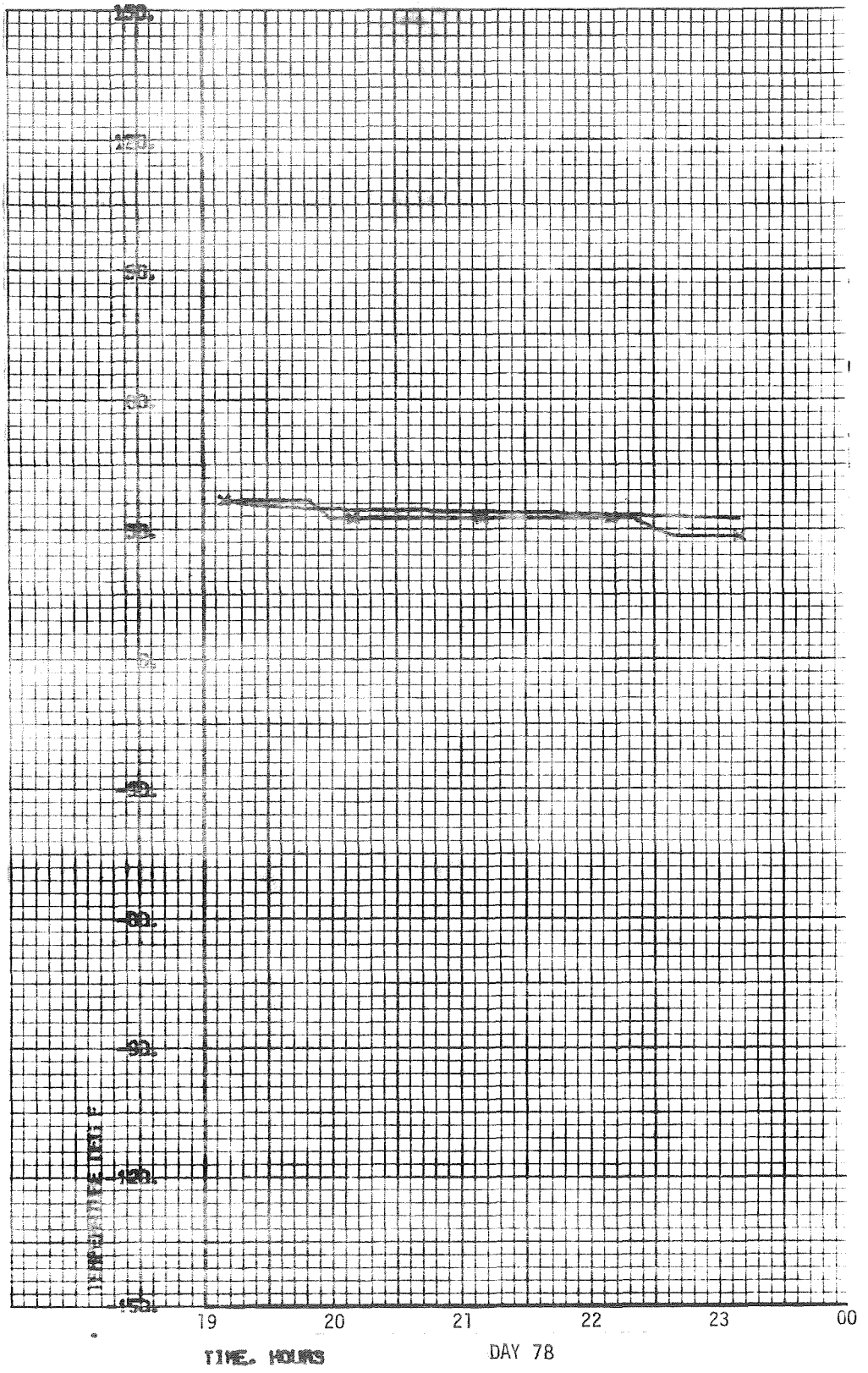
LEGEND

NODE NUMBER
ACTUAL/CALCULATED

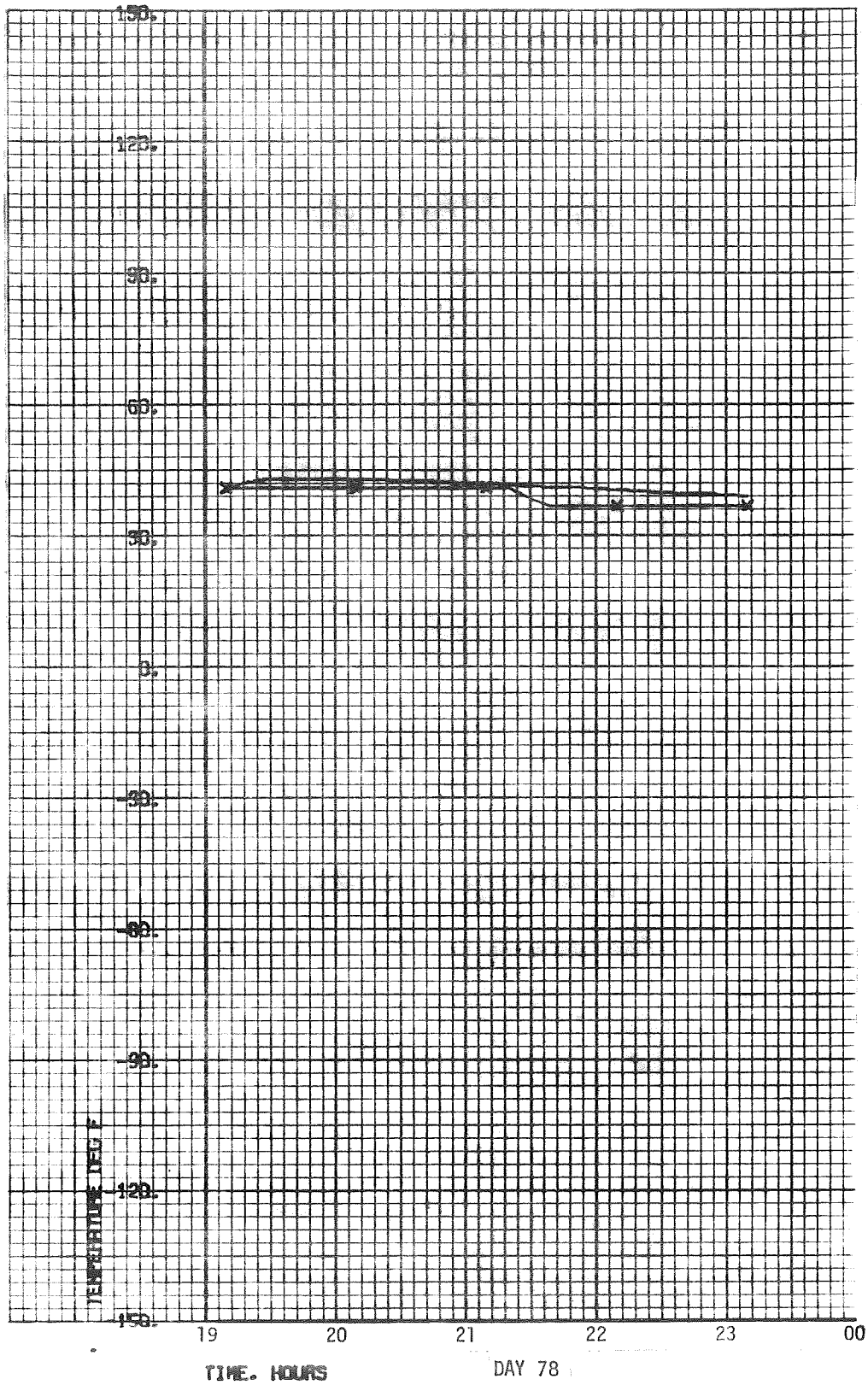


130 24/35	131 33/33	132 35/31	133 33/30	134 24/33	135 29/27	136 33/38	137 33/30	138 26/31	139 31/27	140 33/27	141 33/28	142 24/31	143 29/27	144 33/37	145 33/31
146 31/32	147 35/35	148 35/35	149 35/34	150 33/32	151 37/32	152 37/36	153 37/33	154 35/34	155 35/33	156 35/31	157 33/29	158 33/30	159 35/31	160 35/35	161 37/30

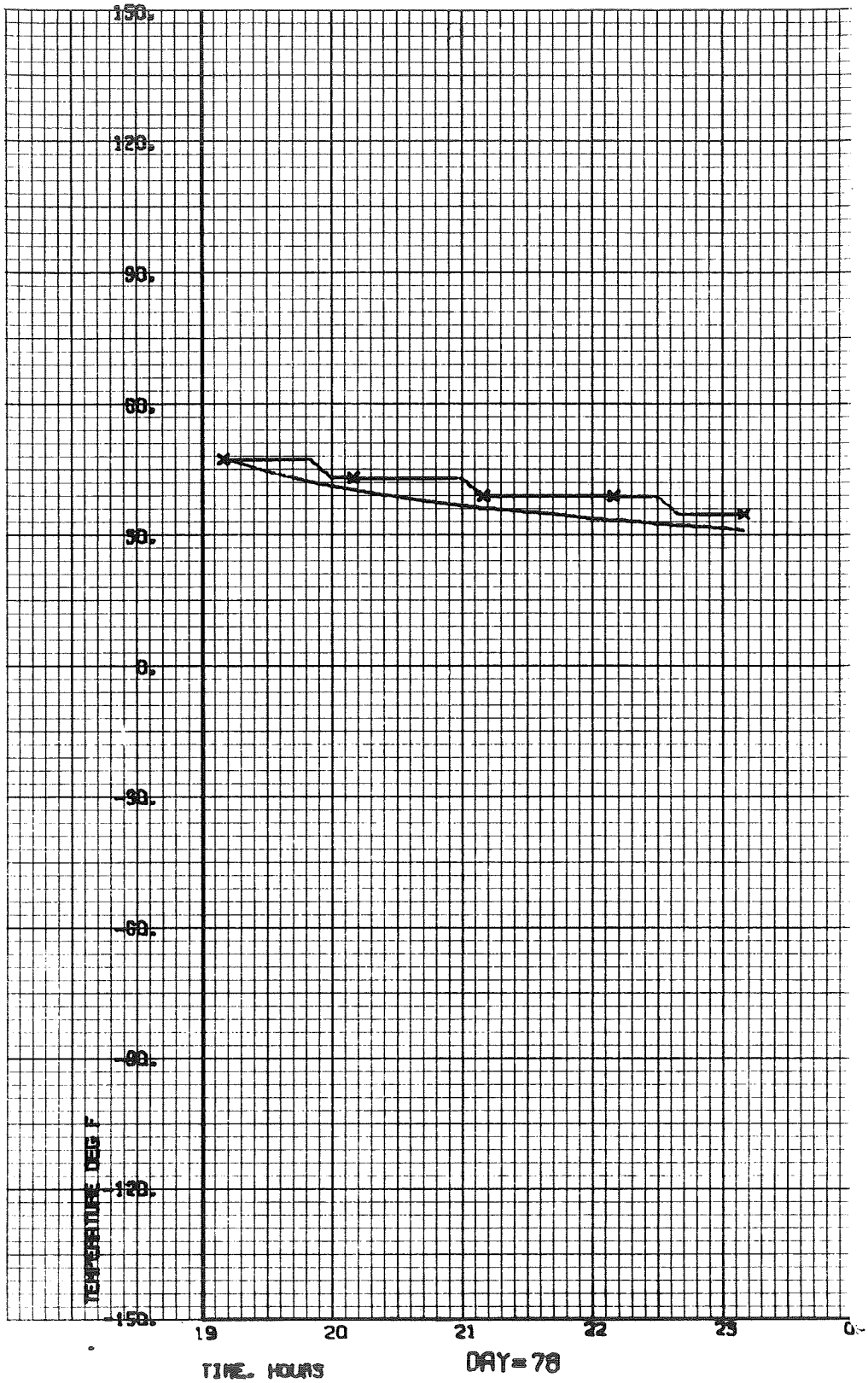
TP0109



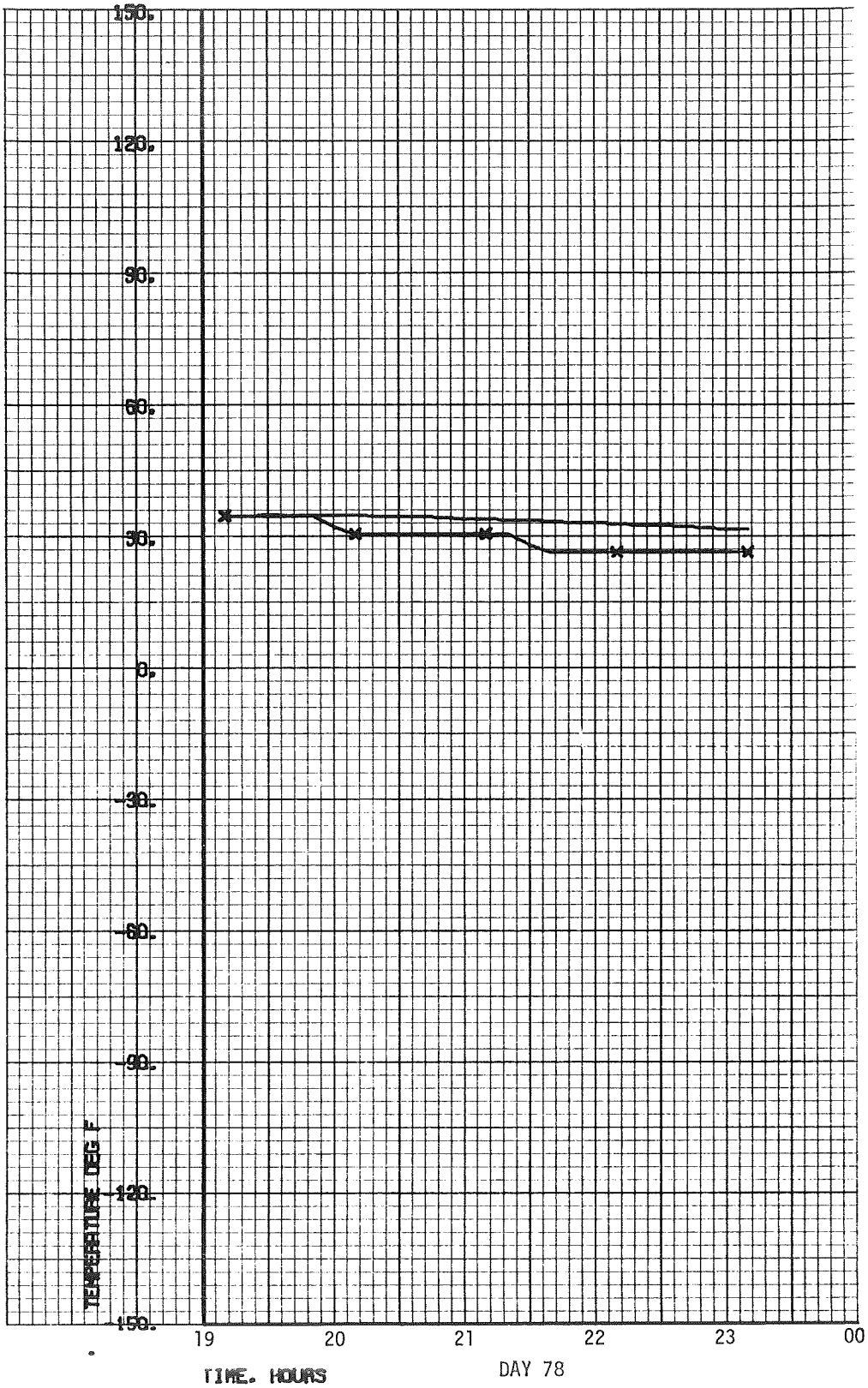
TPC117


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
19
20
21
22
23
00
TIME. HOURS
DAY 78

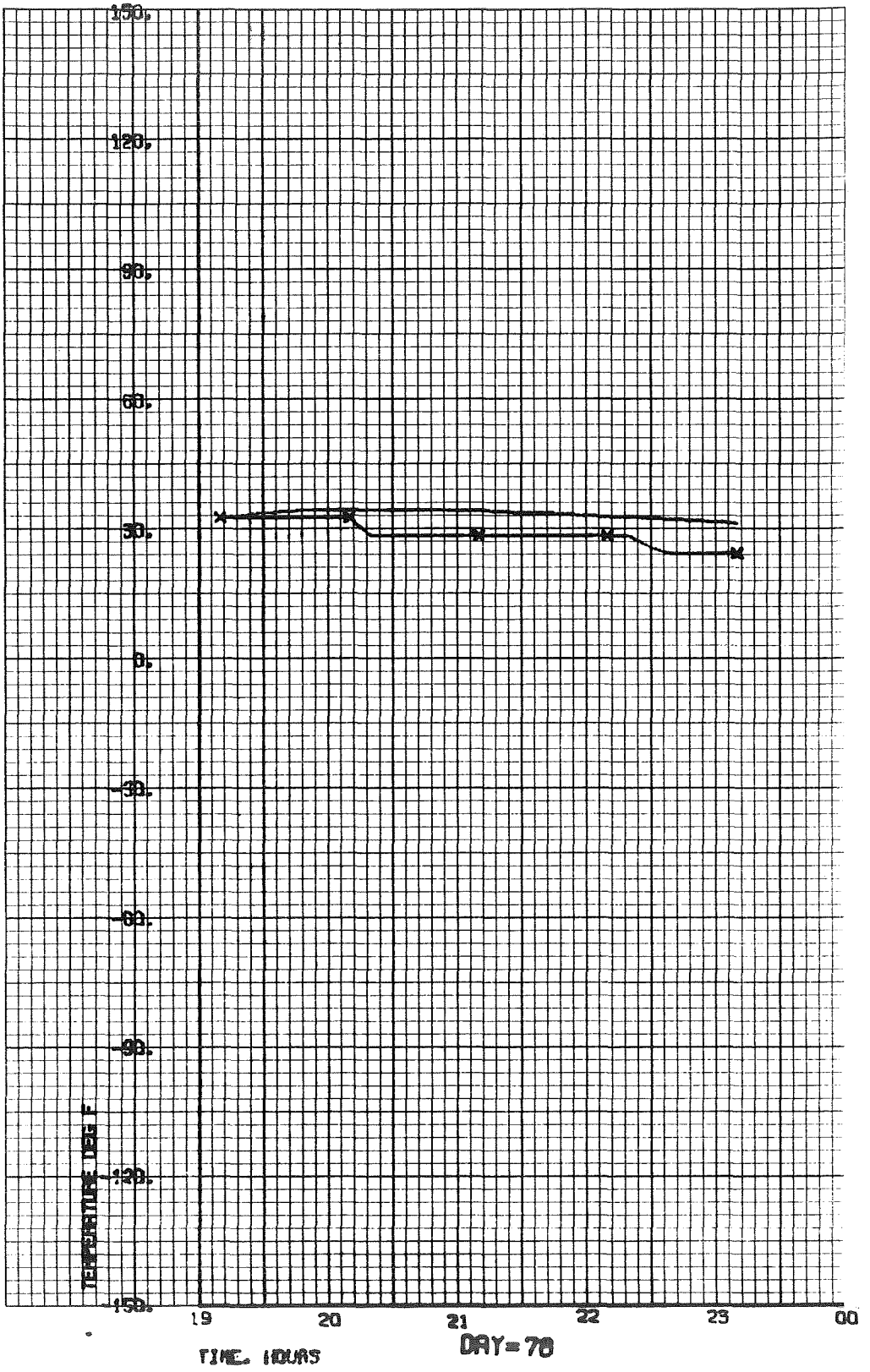
TP0132


150.
120.
90.
60.
30.
0.
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-60.
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-120.
-150.
TEMPERATURE DEG F
19
20
21
22
23
0
TIME. HOURS
DAY=78

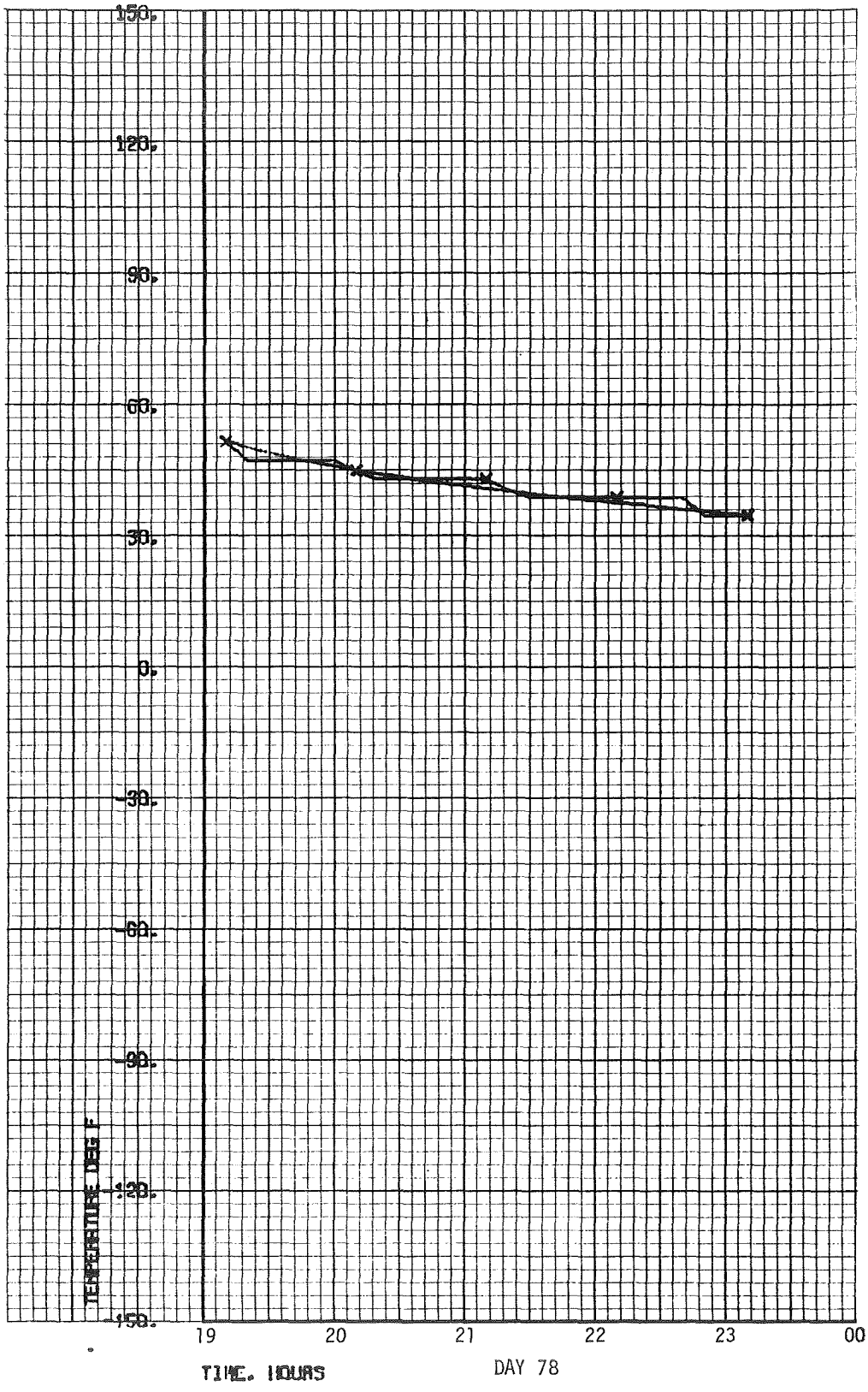
TP0138


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90.
60.
30.
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-60.
-90.
-120.
-150.
TEMPERATURE DEG F
19
20
21
22
23
00
TIME. HOURS
DAY 78

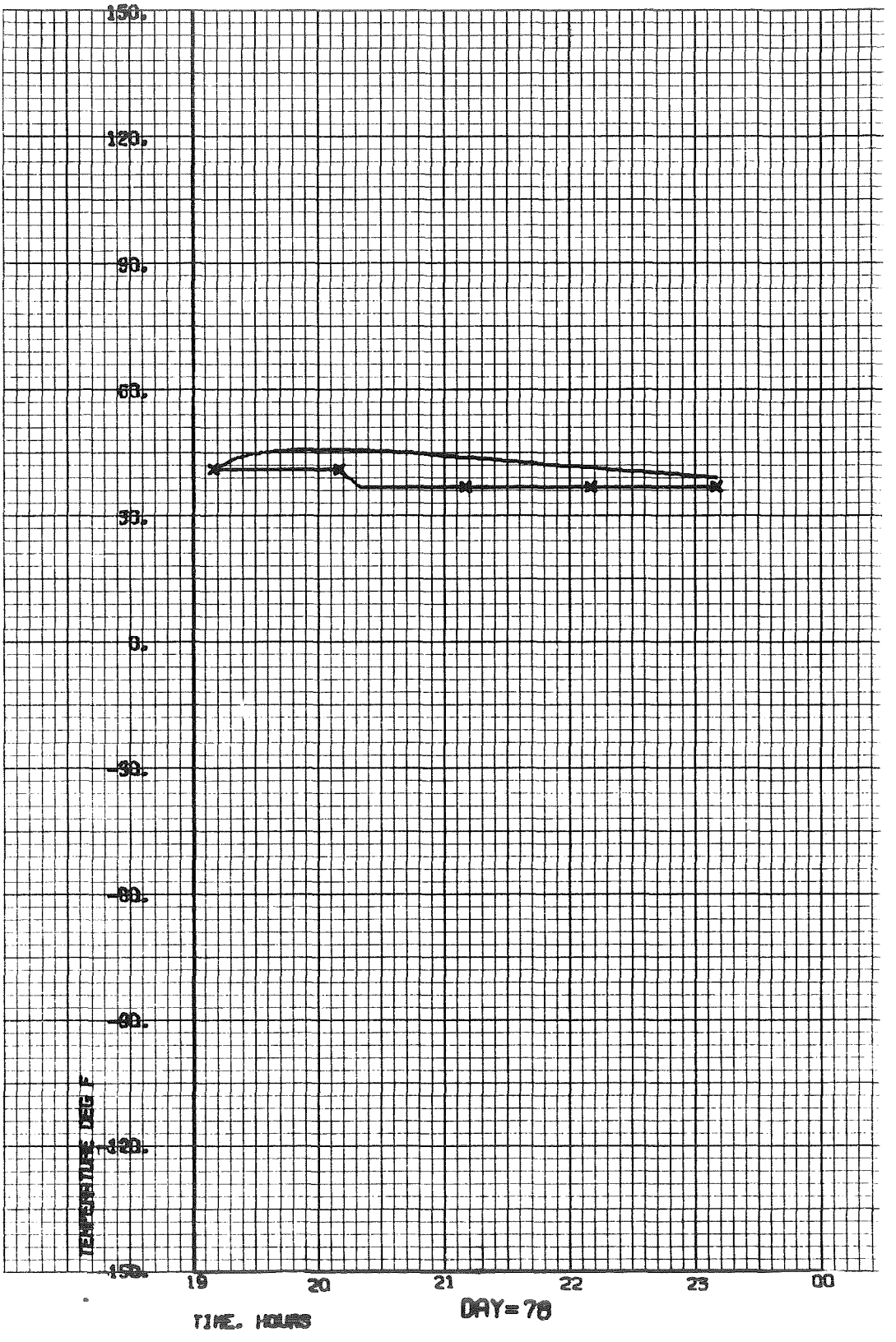
TP0142


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60.
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-120.
-150.
TEMPERATURE DEG F
19
20
21
22
23
00
TIME, HOURS
DAY=78

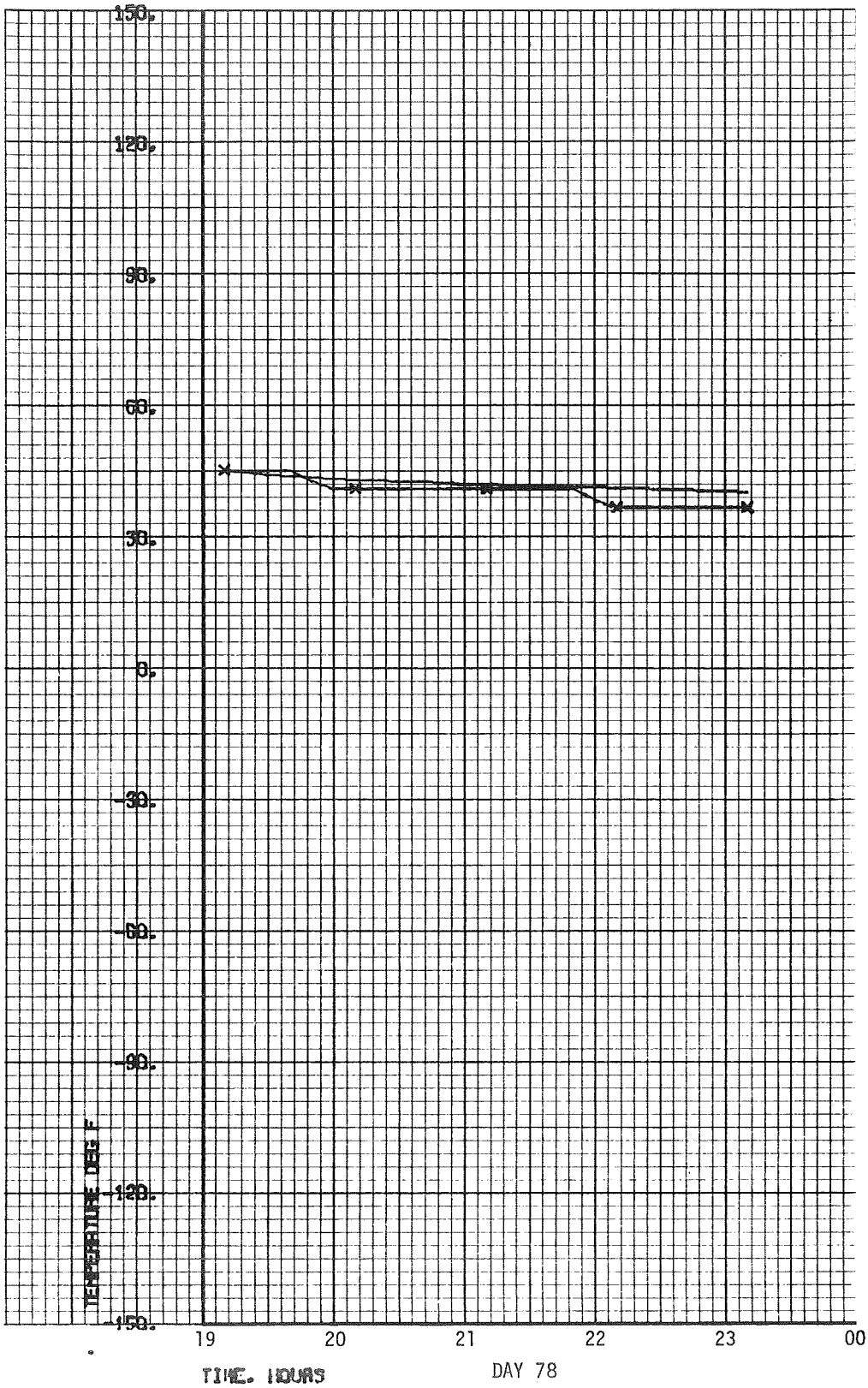
TP0148


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120.
90.
60.
30.
0.
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-120.
-150.
TEMPERATURE DEG F
19
20
21
22
23
00
TIME. HOURS
DAY 78

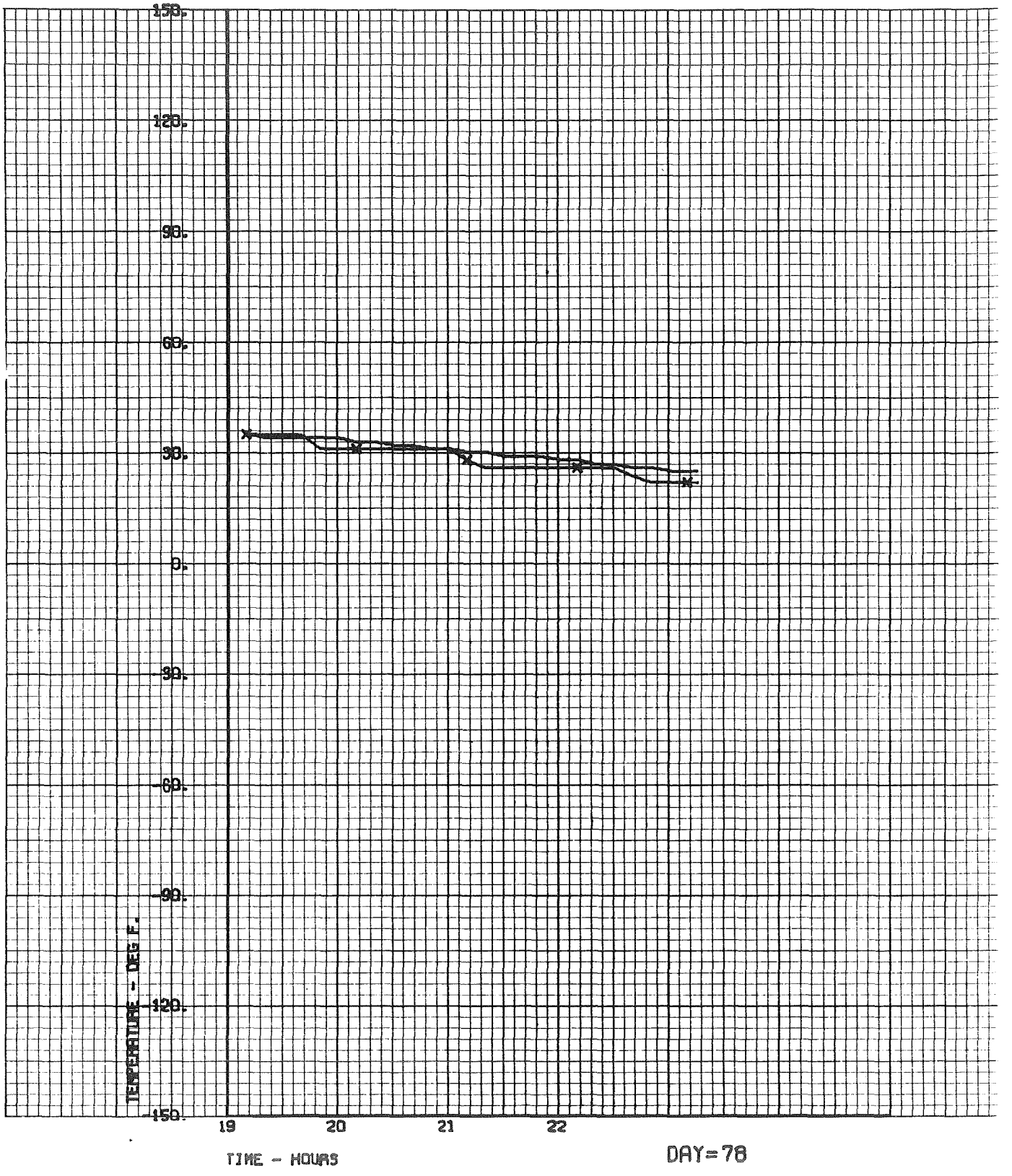
TP0170


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120.
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60.
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0.
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TEMPERATURE DEG F
19
20
21
22
23
00
TIME. HOURS
DAY=78

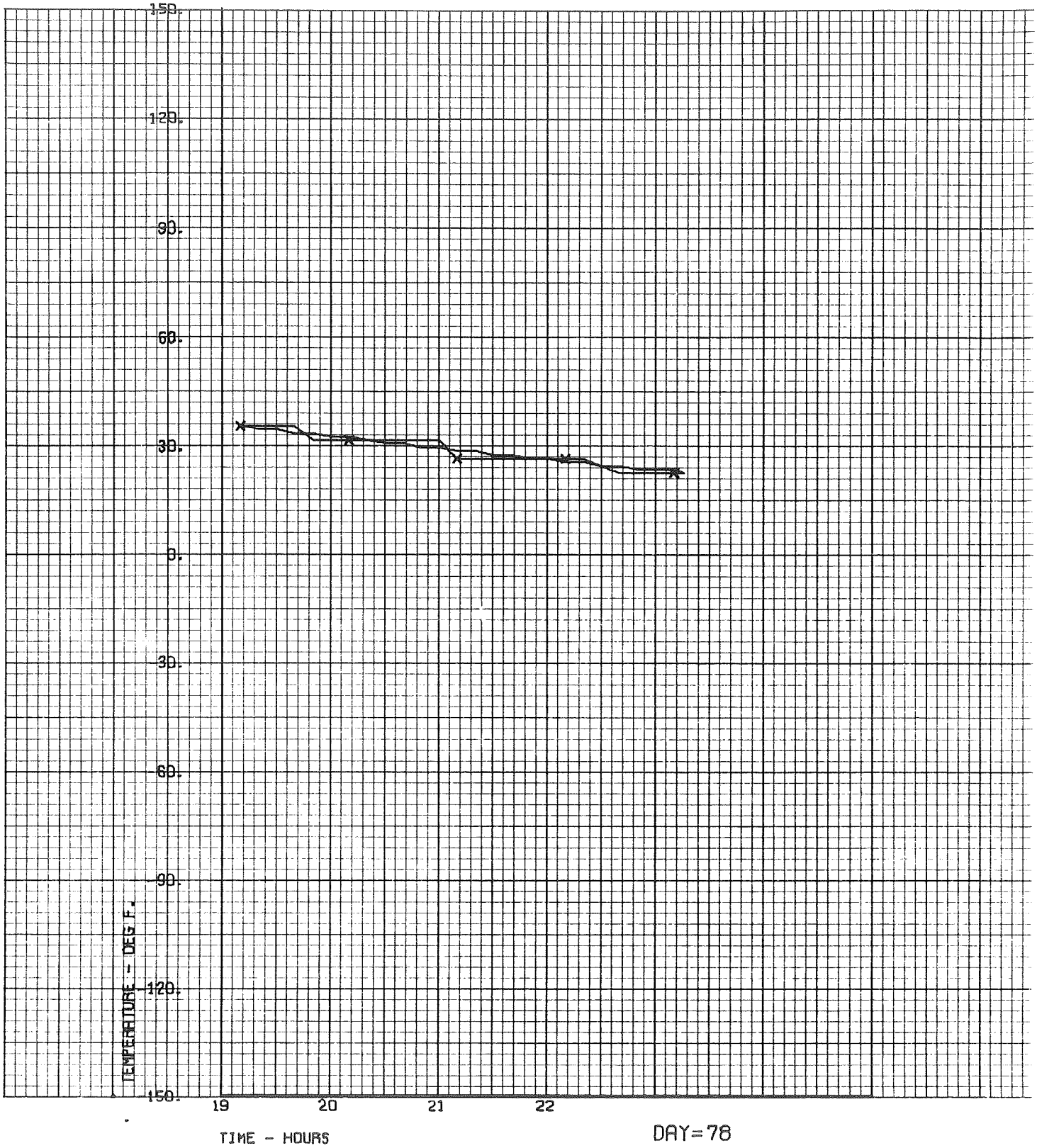
TH0522


150.
120.
90.
60.
30.
0.
-30.
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-90.
-120.
-150.
TEMPERATURE DEG F
19
20
21
22
23
00
TIME. HOURS
DAY 78

TW601

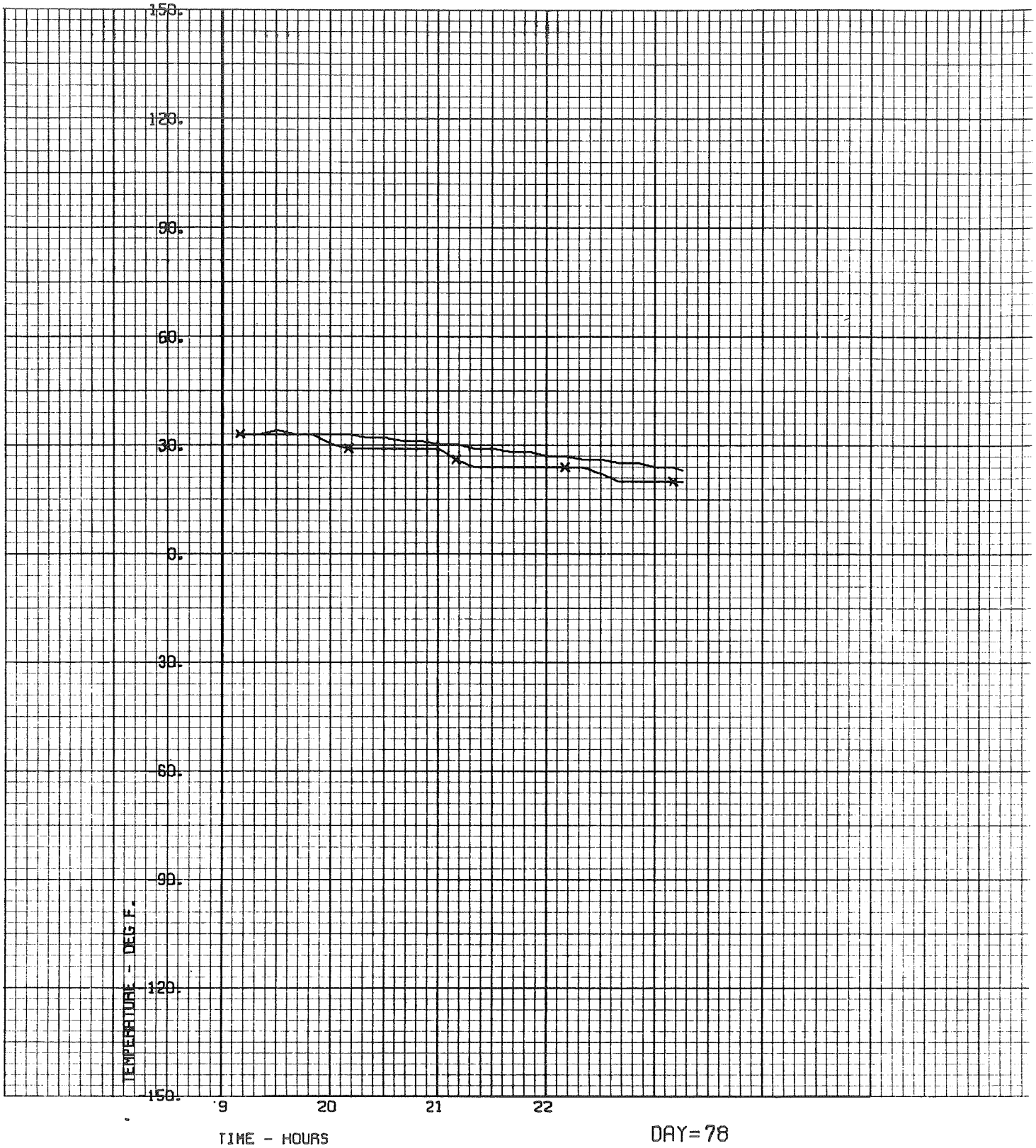

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
19
20
21
22
TIME - HOURS
DAY=78

TW602


150.
120.
90.
60.
30.
0.
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-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
19
20
21
22
TIME - HOURS

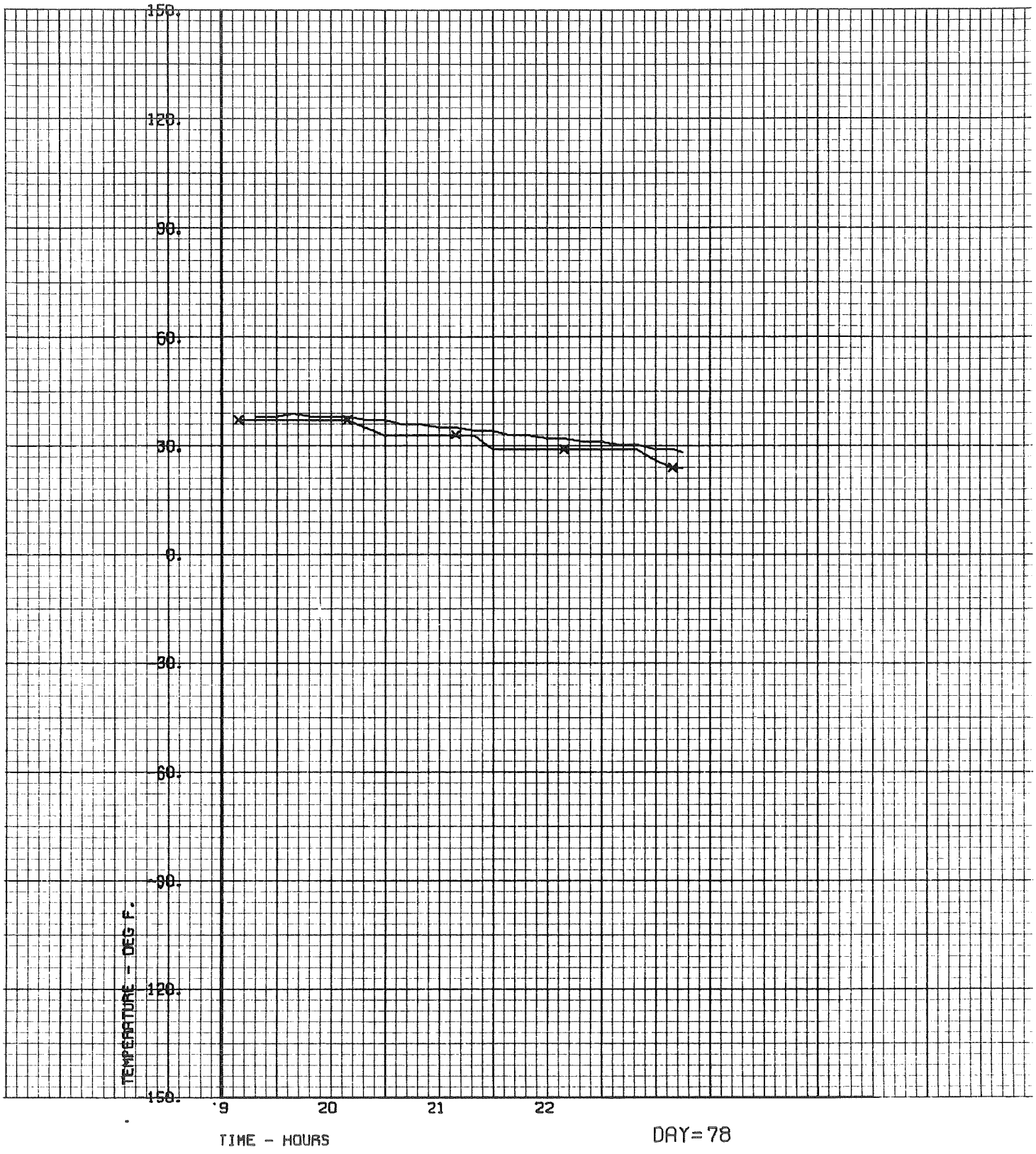
DAY=78

TW603

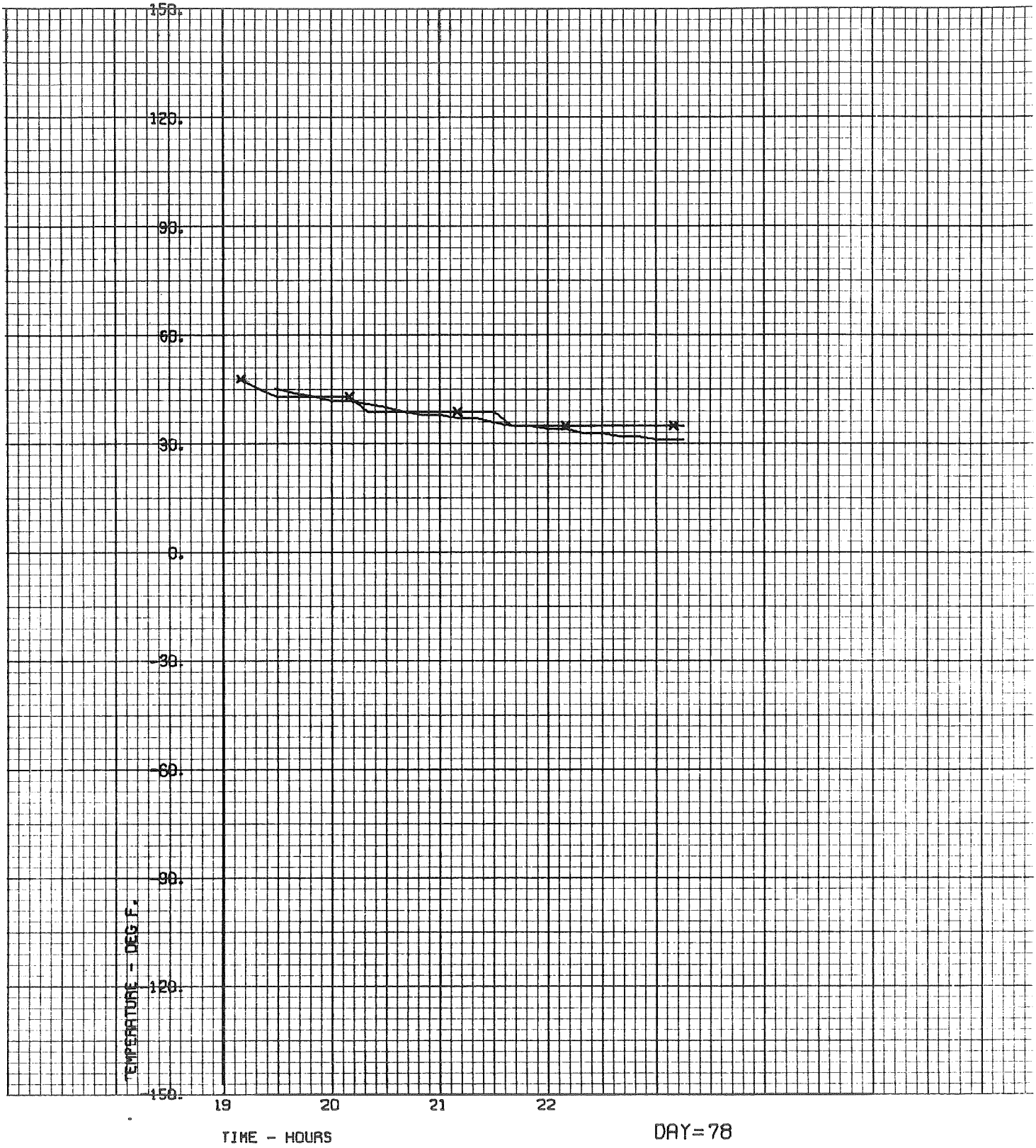

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120.
90.
60.
30.
0.
30.
60.
90.
120.
150.
TEMPERATURE - DEG F.
19
20
21
22
TIME - HOURS

DAY=78

TP5138

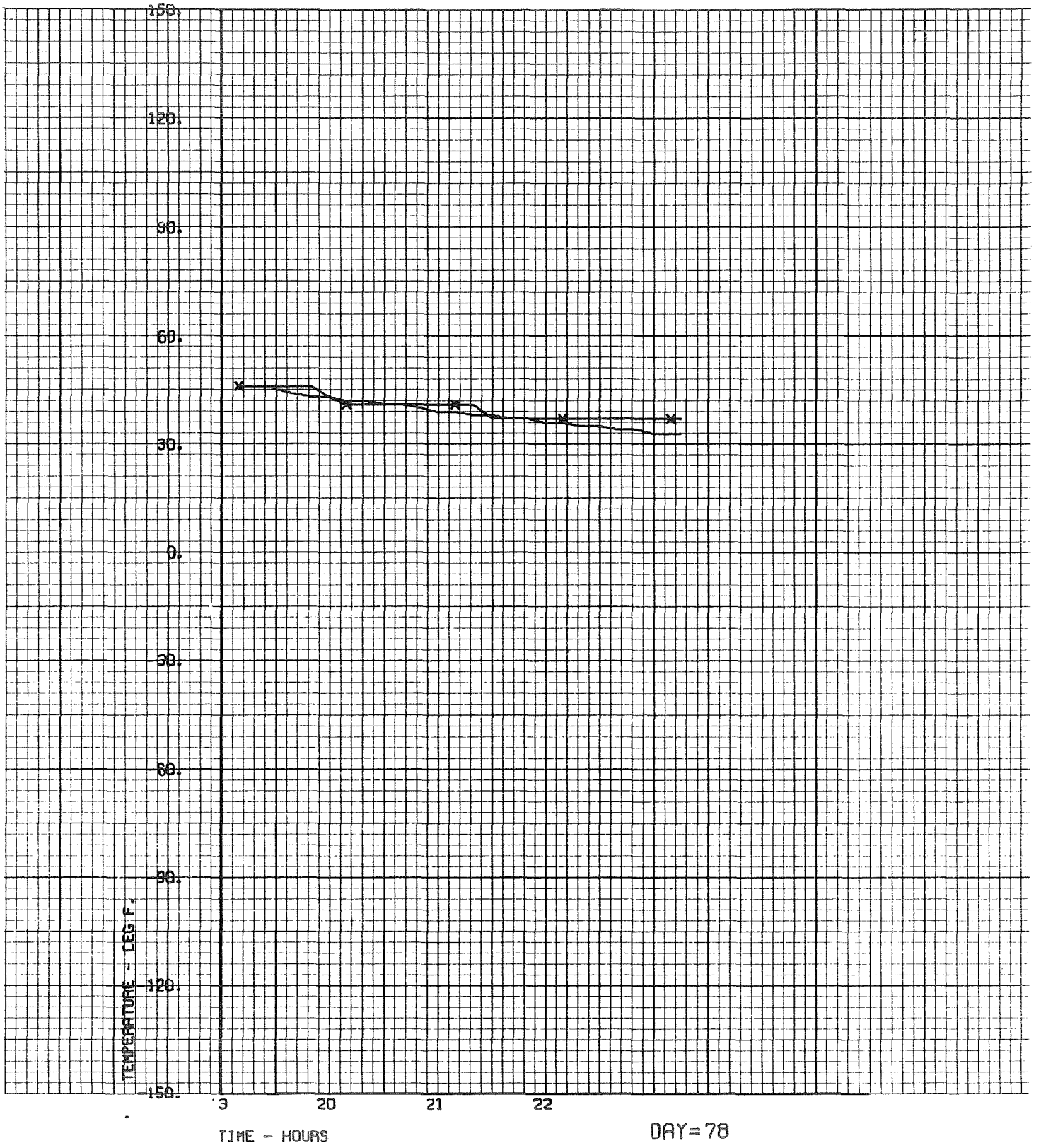

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120.
90.
60.
30.
0.
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-90.
-120.
-150.
TEMPERATURE - DEG F.
9
20
21
22
TIME - HOURS
DAY=78

TP5139



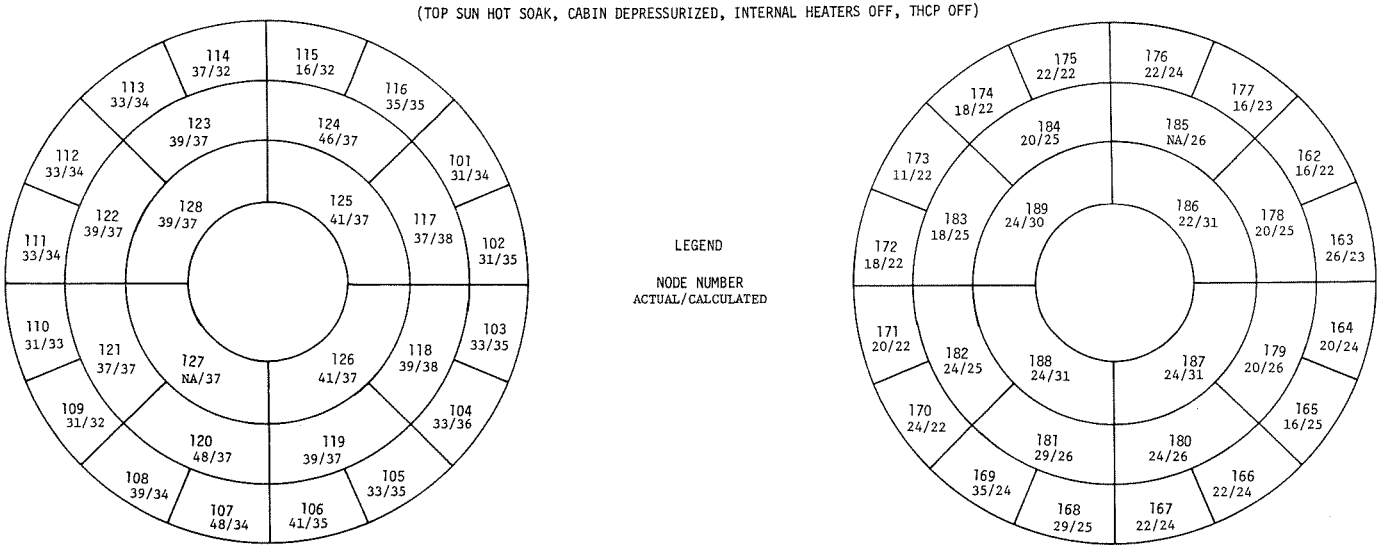
DAY=78

TP4158



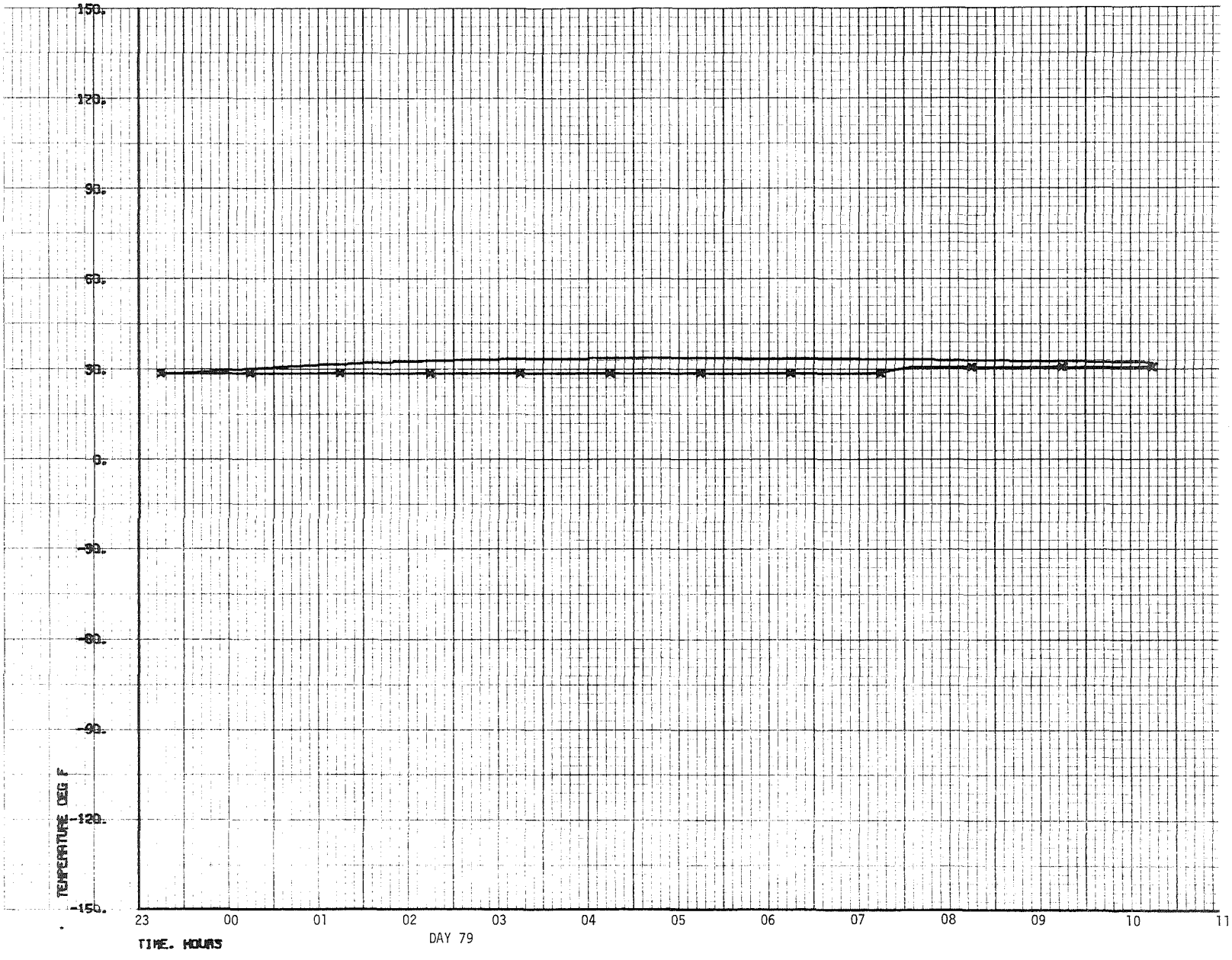
DAY=78

PRESSURE SHELL TEMPERATURES AT END OF PHASE D
(TOP SUN HOT SOAK, CABIN DEPRESSURIZED, INTERNAL HEATERS OFF, THCP OFF)

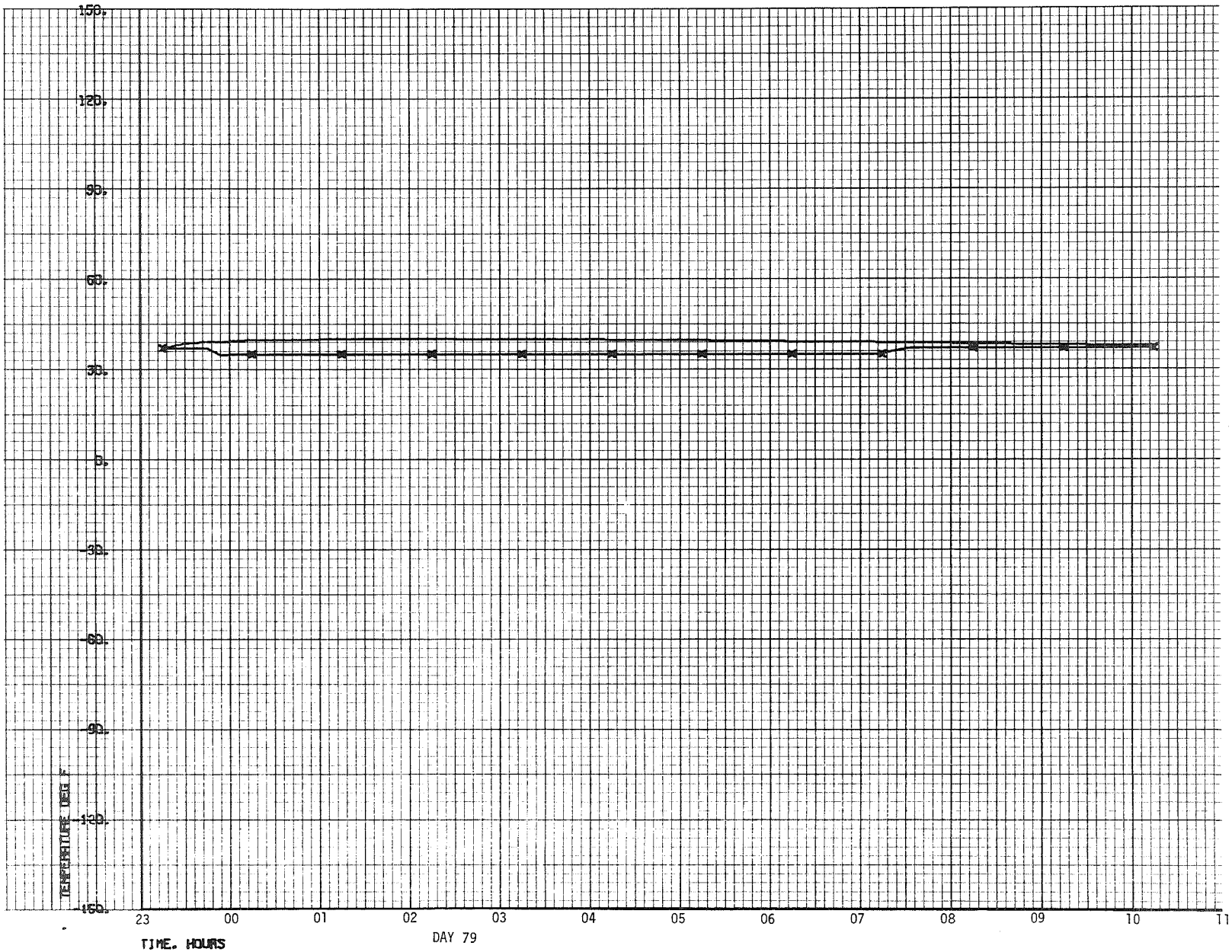


130 20/24	131 24/21	132 26/18	133 24/16	134 20/23	135 26/16	136 33/28	137 31/20	138 22/22	139 24/16	140 24/14	141 24/15	142 20/21	143 24/15	144 37/28	145 24/20
146 20/13	147 18/16	148 24/16	149 20/12	150 22/12	151 24/10	152 26/18	153 24/13	154 20/14	155 22/12	156 20/11	157 20/10	158 22/12	159 22/12	160 20/18	161 24/11

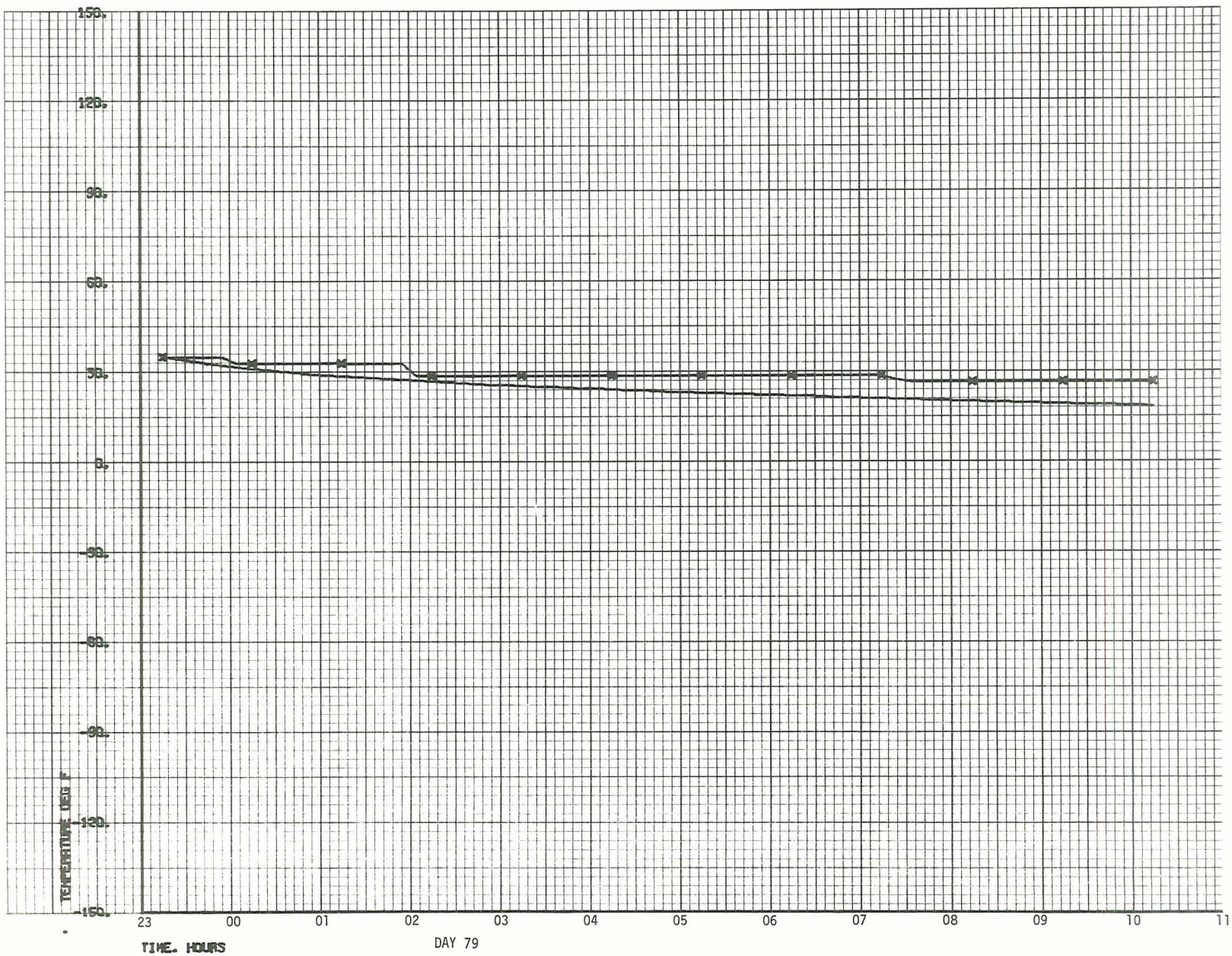
TP0109


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

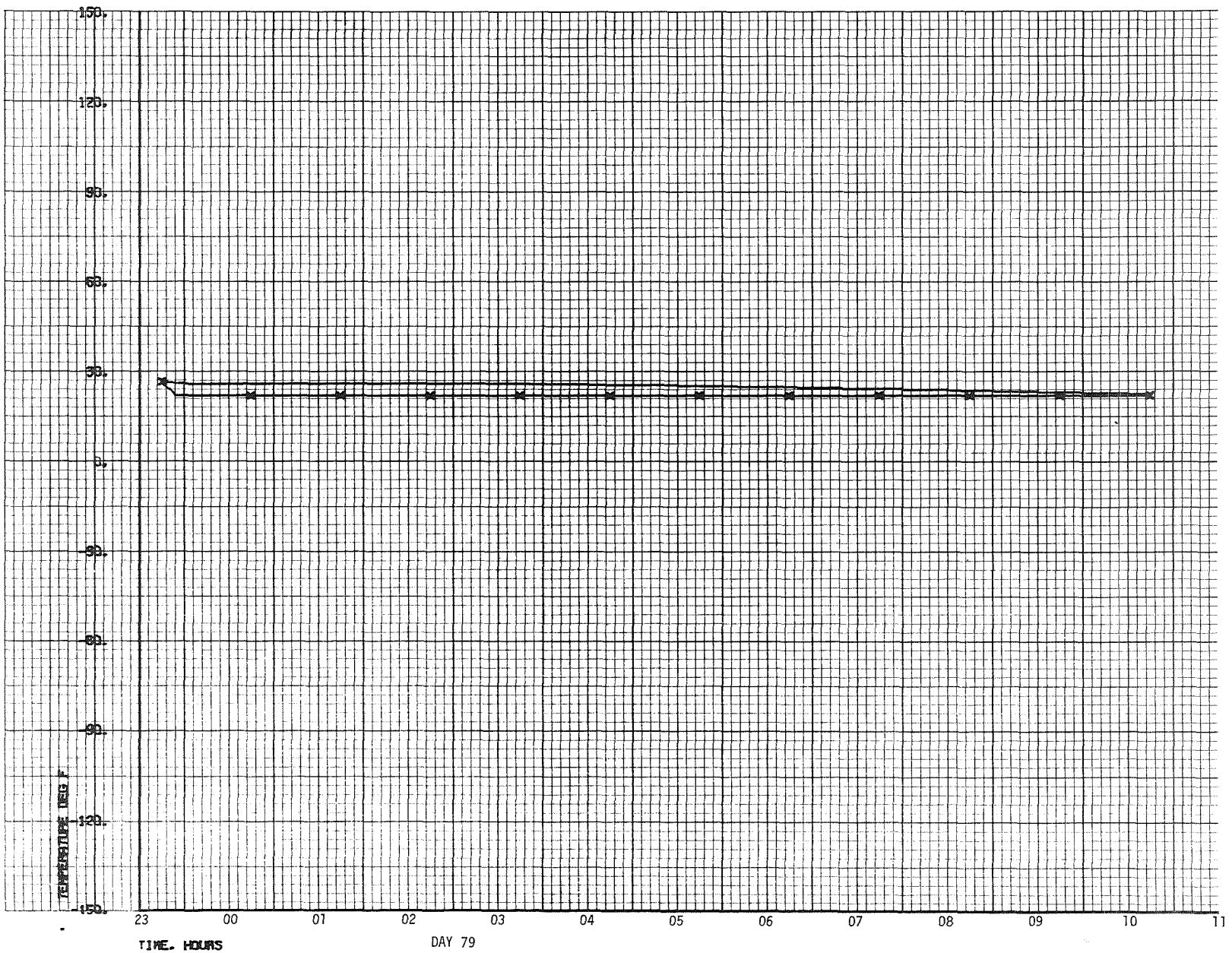
TP0117


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

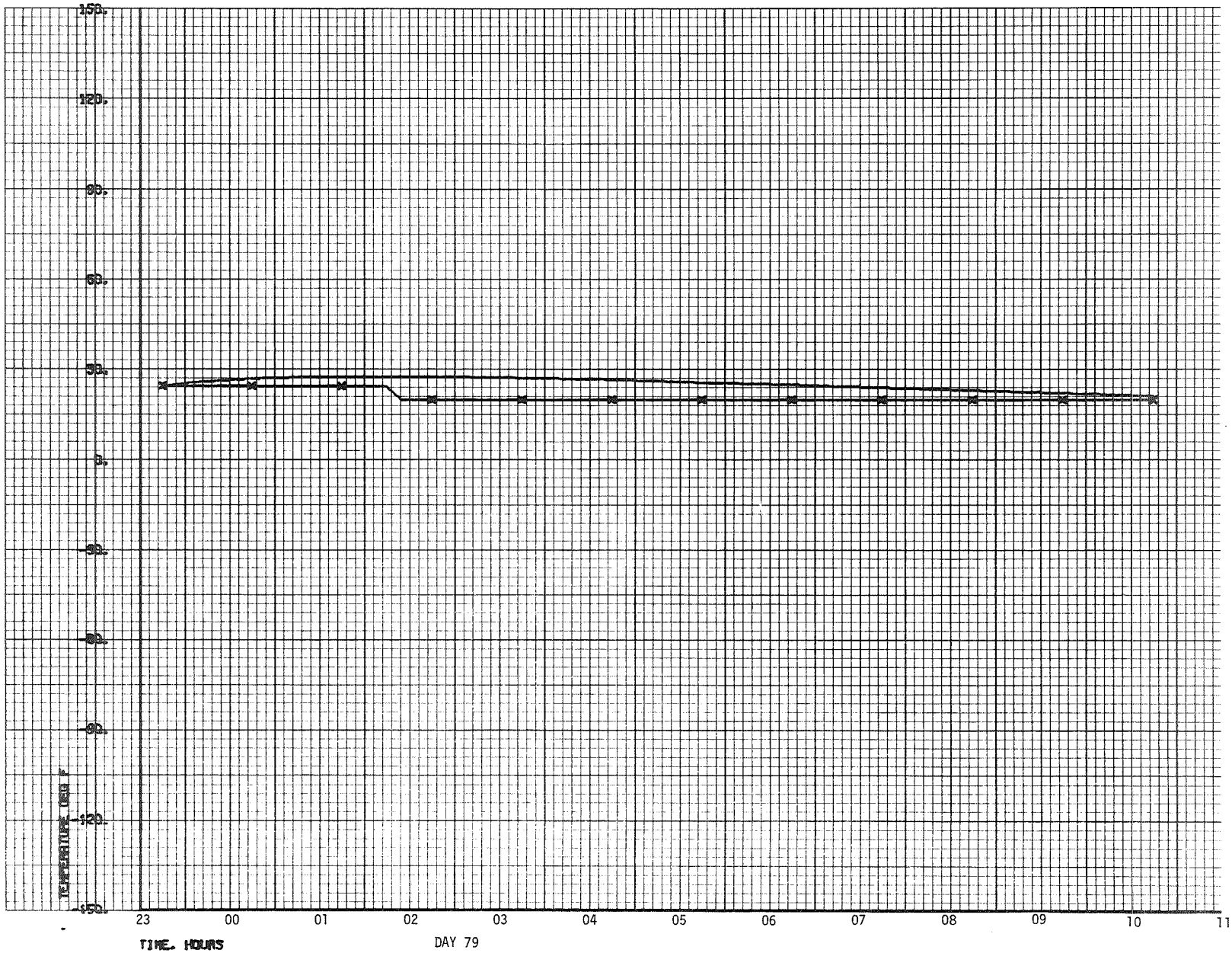
TPQ132


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90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

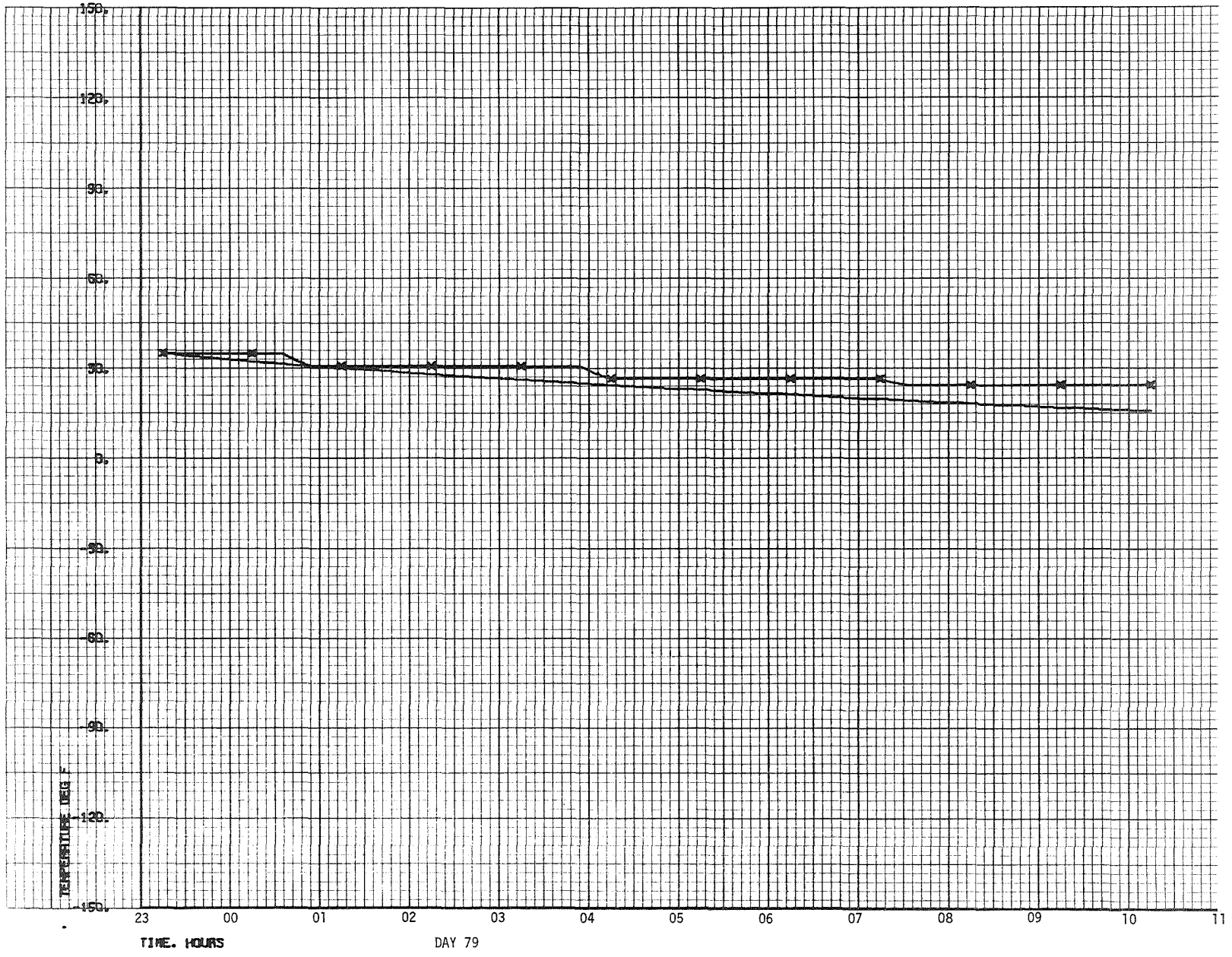
TP0138


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120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

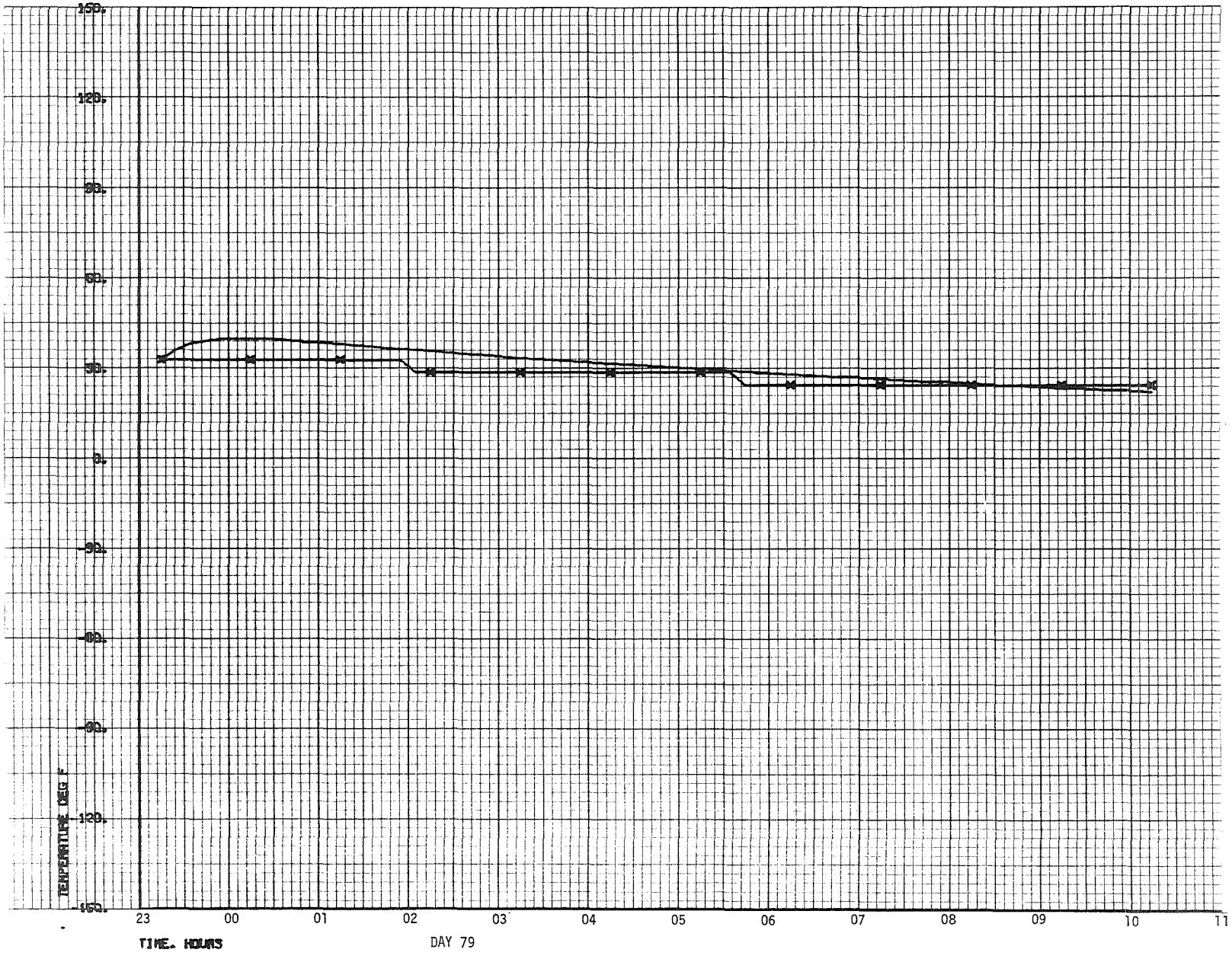
TP0142


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120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

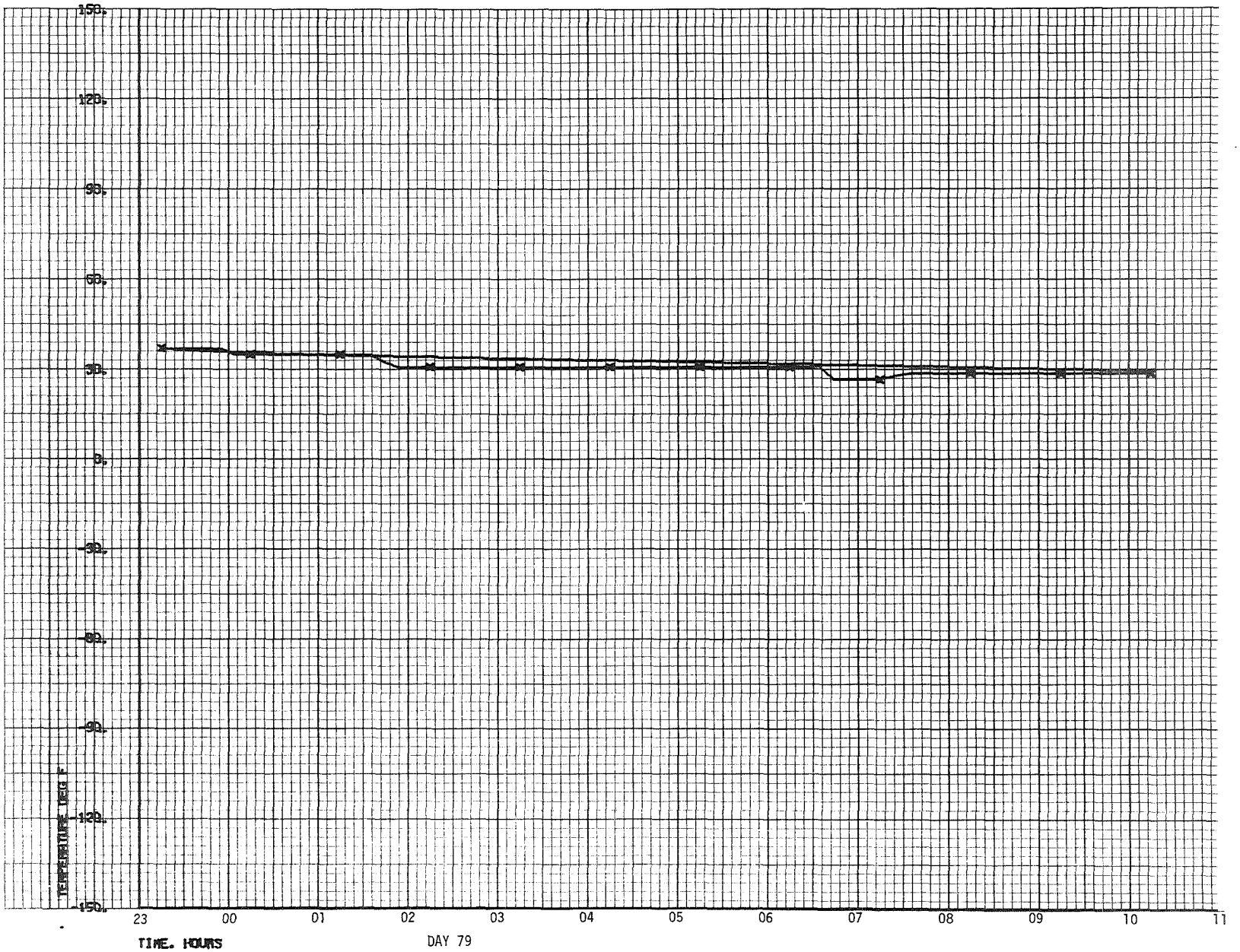
TP0148


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

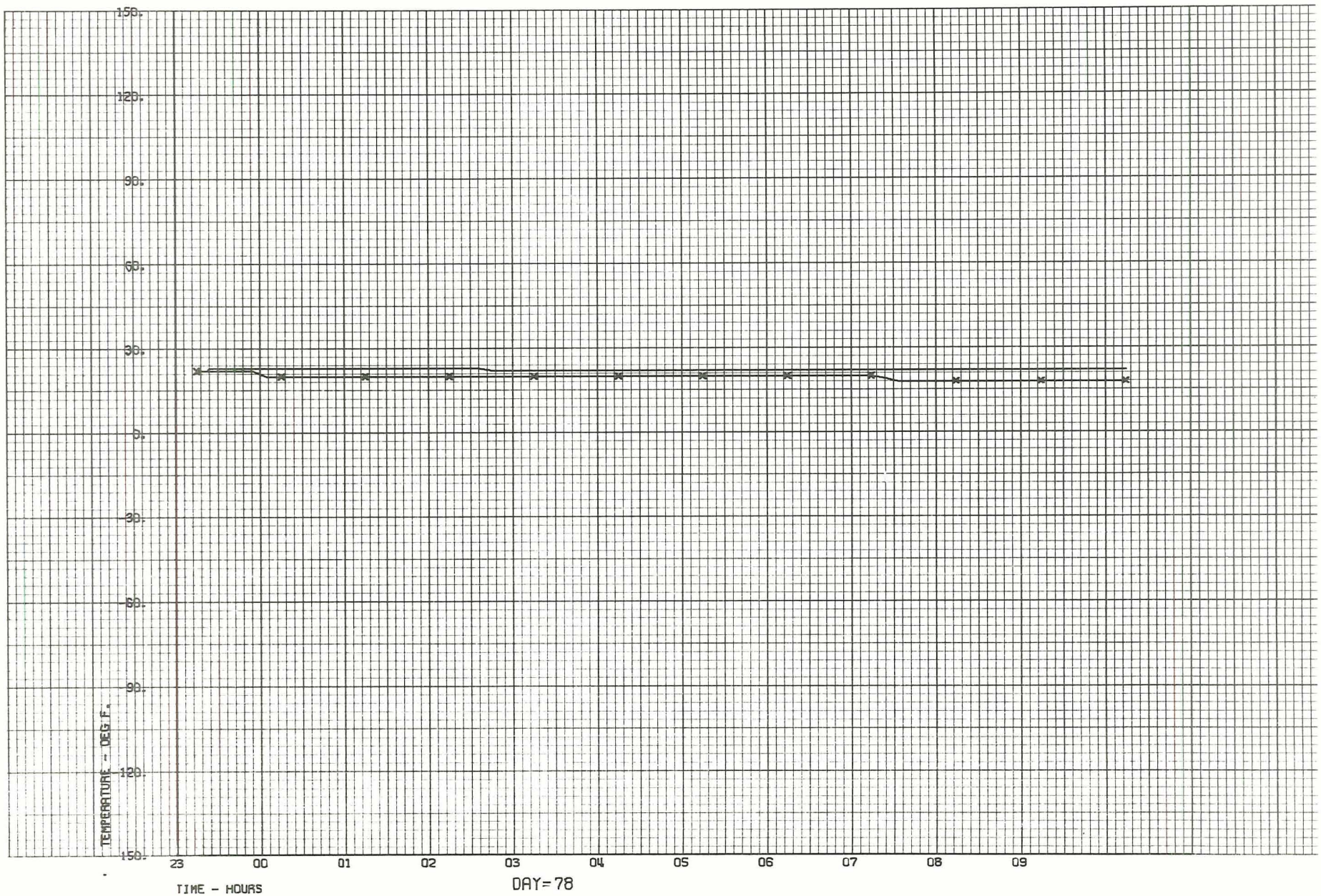
TP0170


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30.
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-30.
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-90.
-120.
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TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

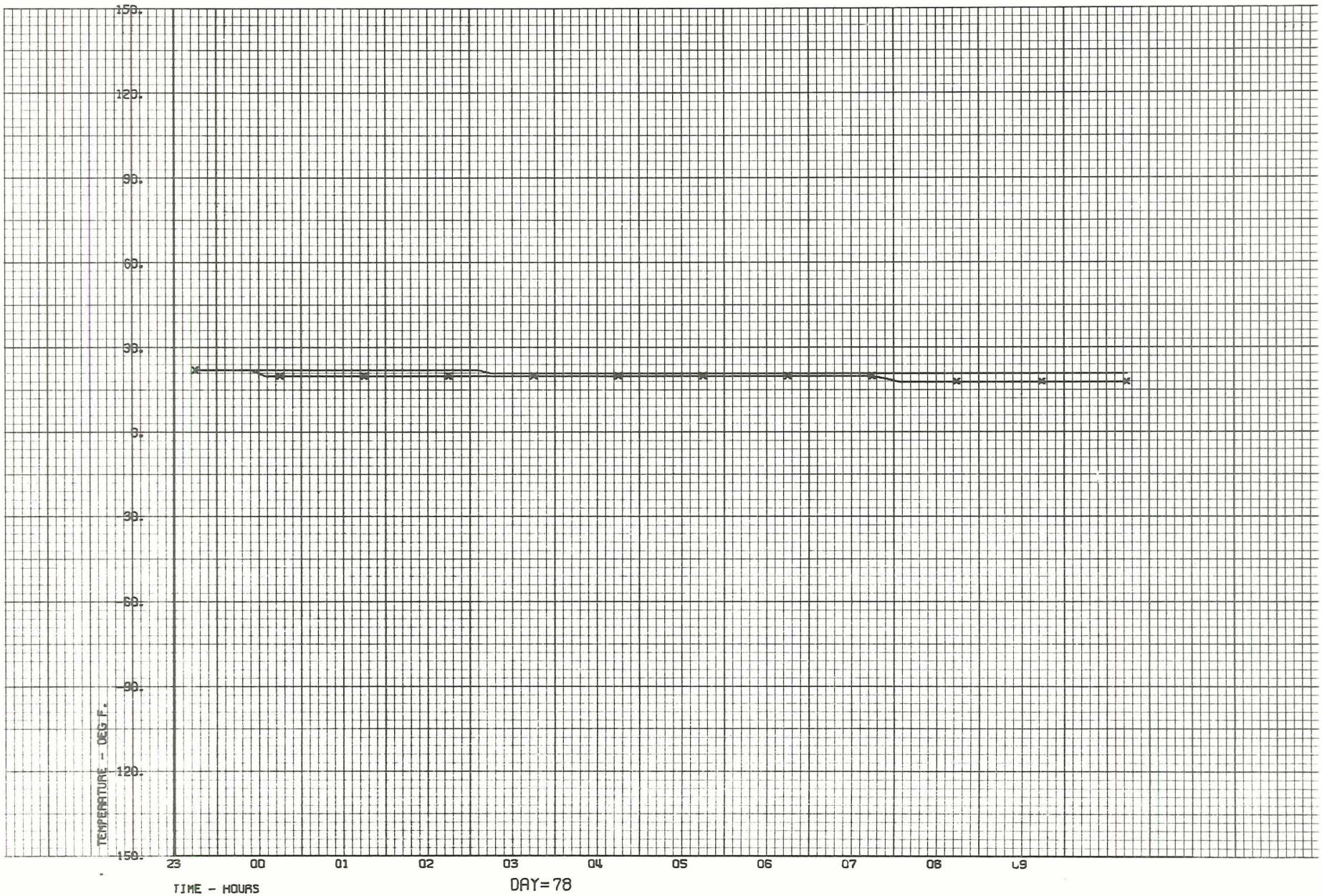
TH0522


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120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
23
00
01
02
03
04
05
06
07
08
09
10
11
TIME. HOURS
DAY 79

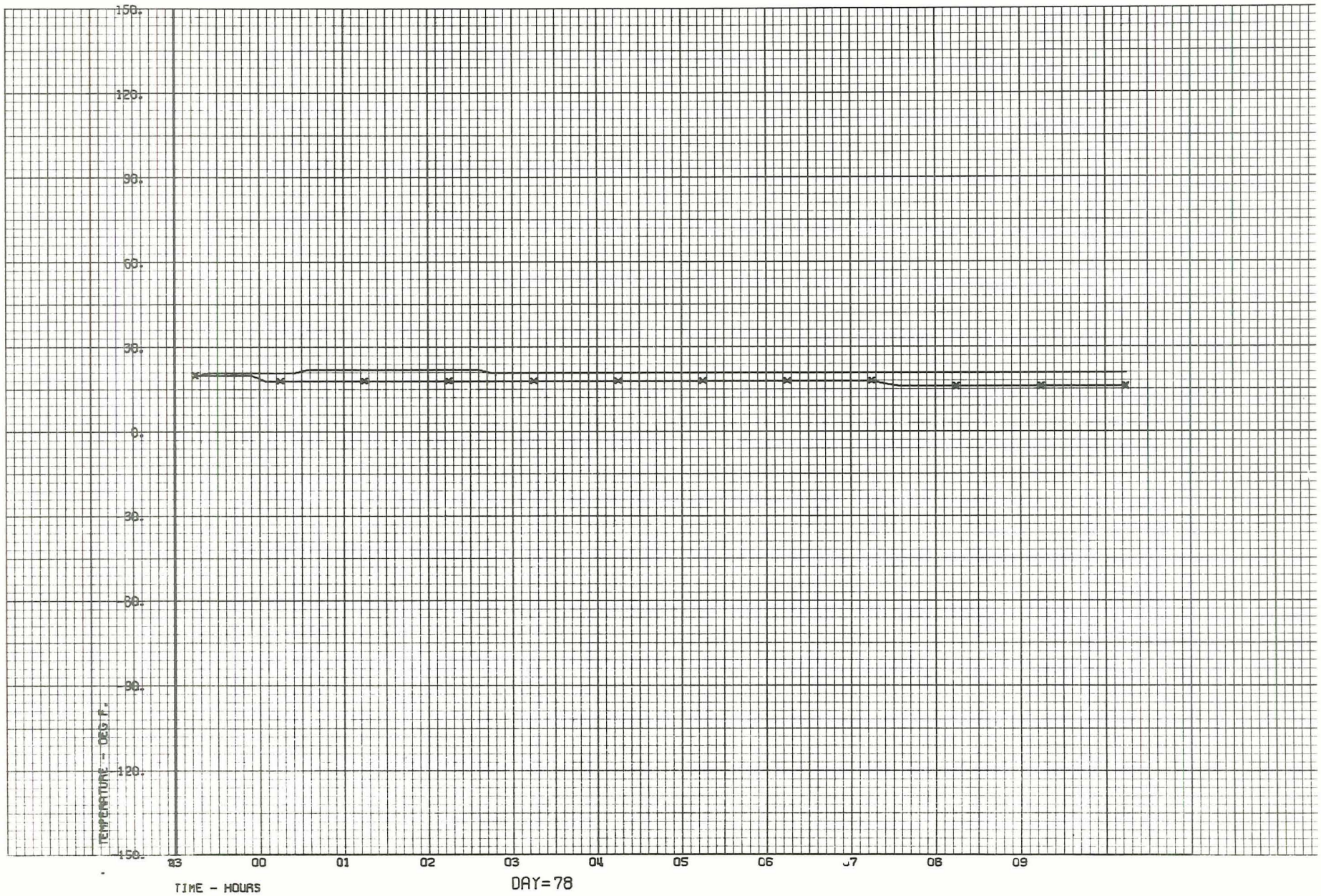
TW601


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TEMPERATURE - DEG F.
23
00
01
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

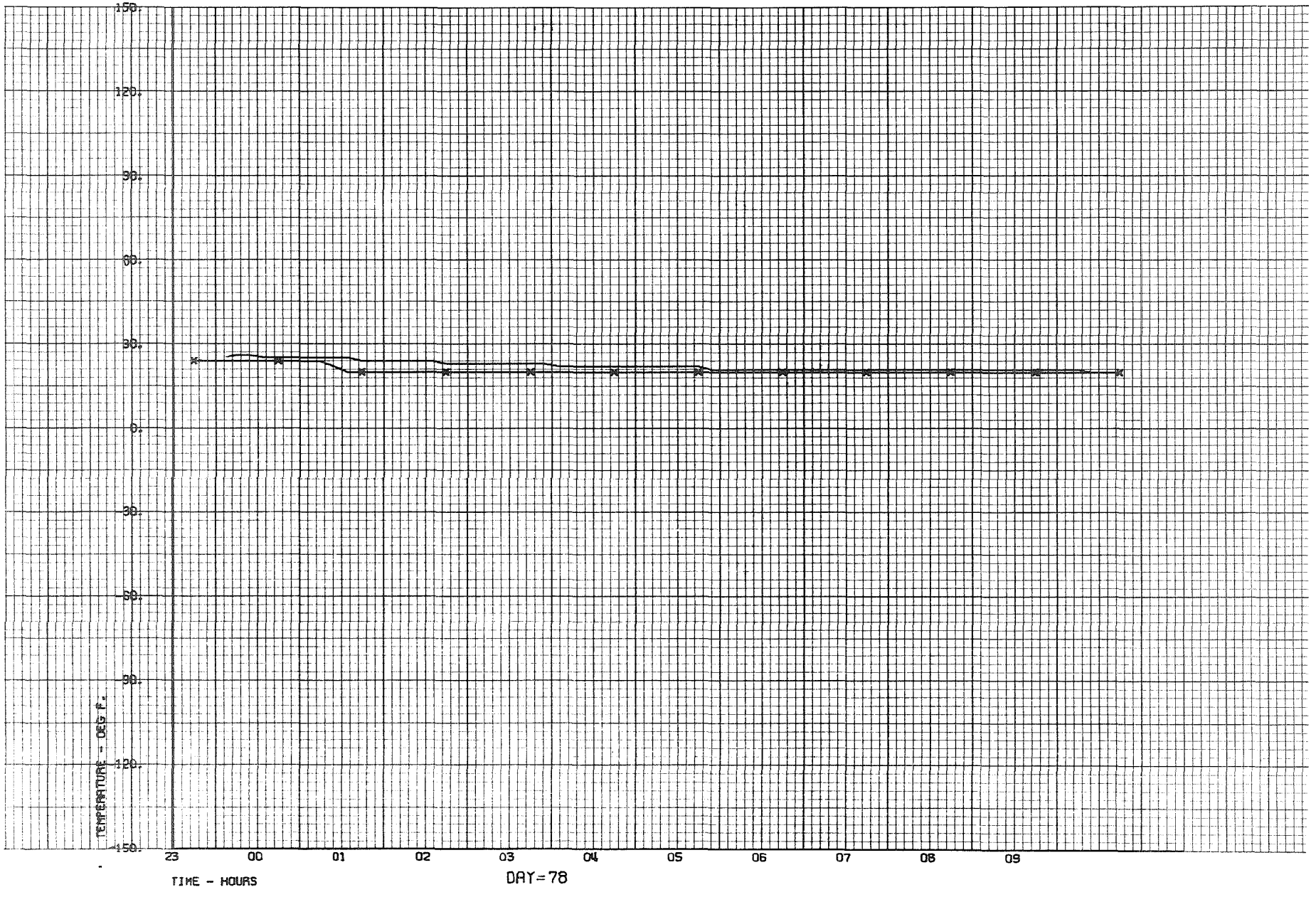
TW602


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TEMPERATURE - DEG F.
23
00
01
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

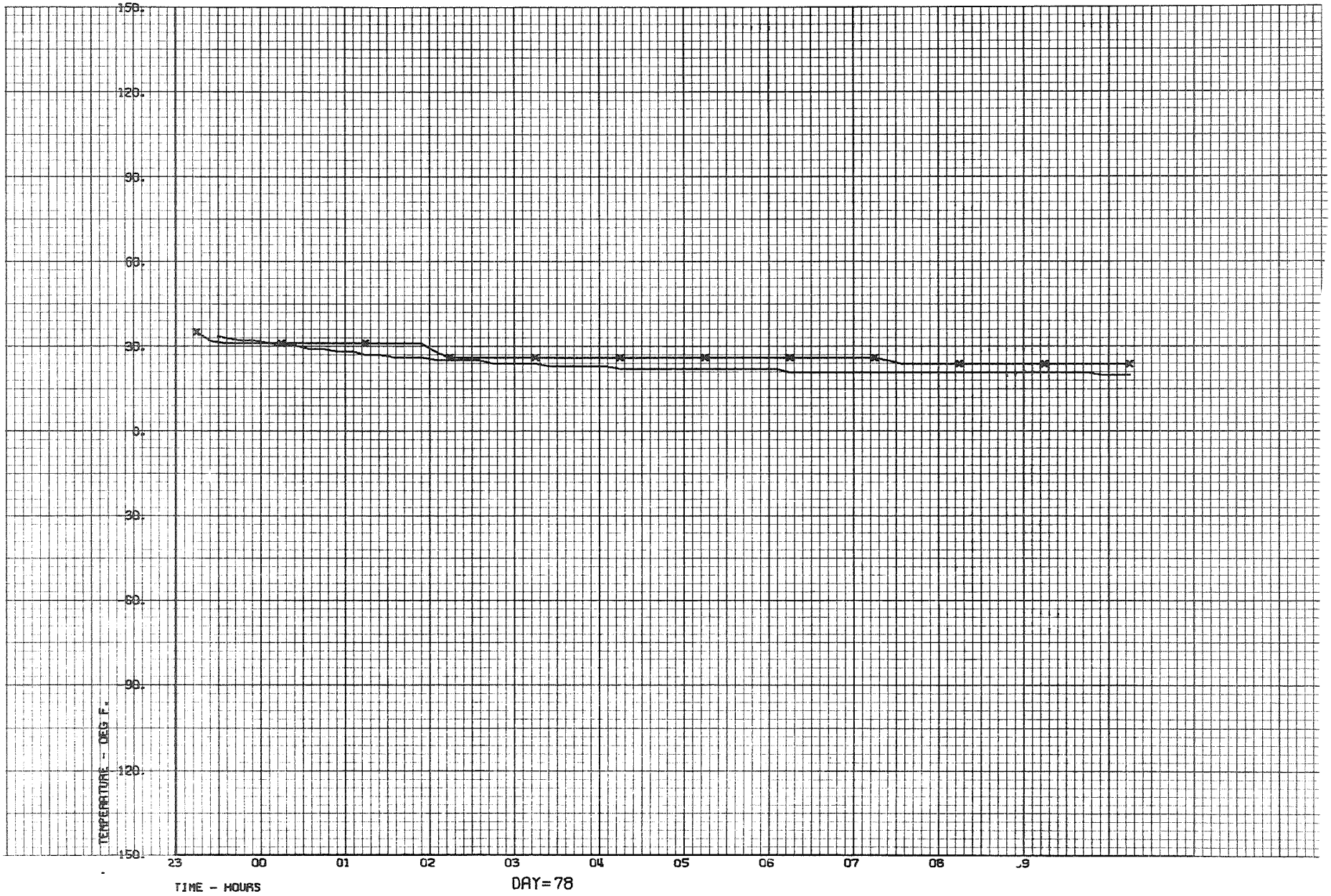
TW603


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TEMPERATURE - DEG F.
23
00
01
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

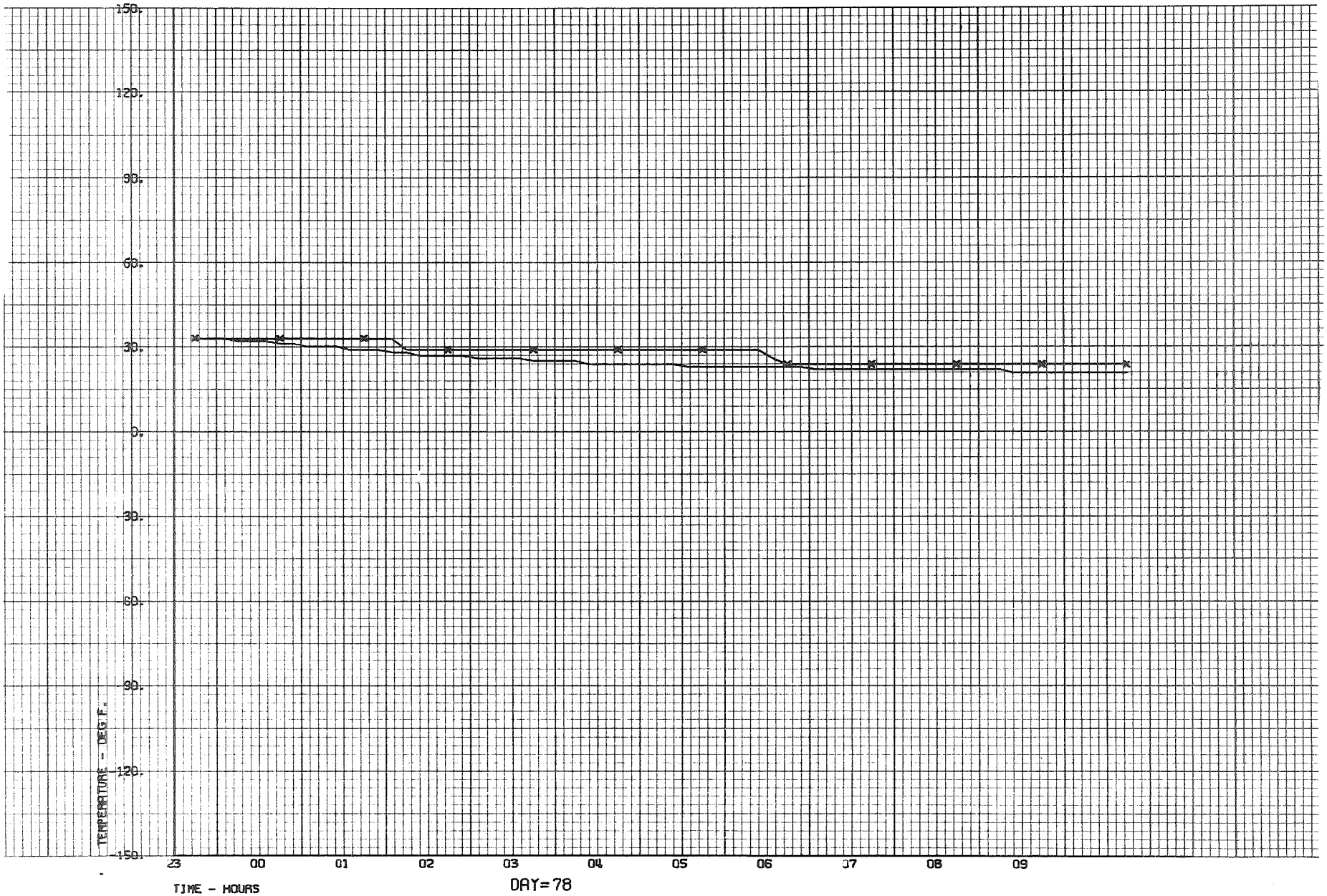
TPS138

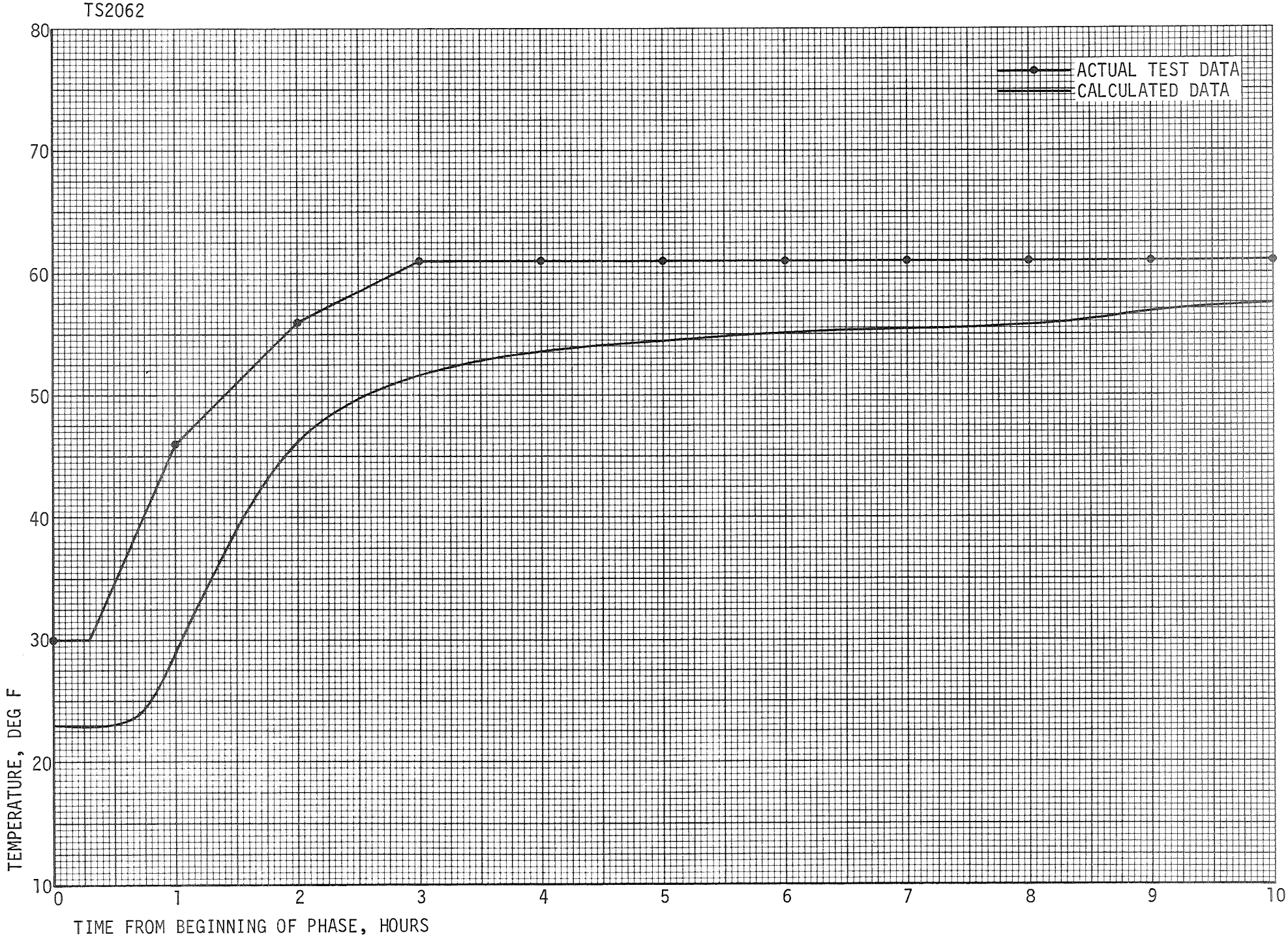

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
23
00
01
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

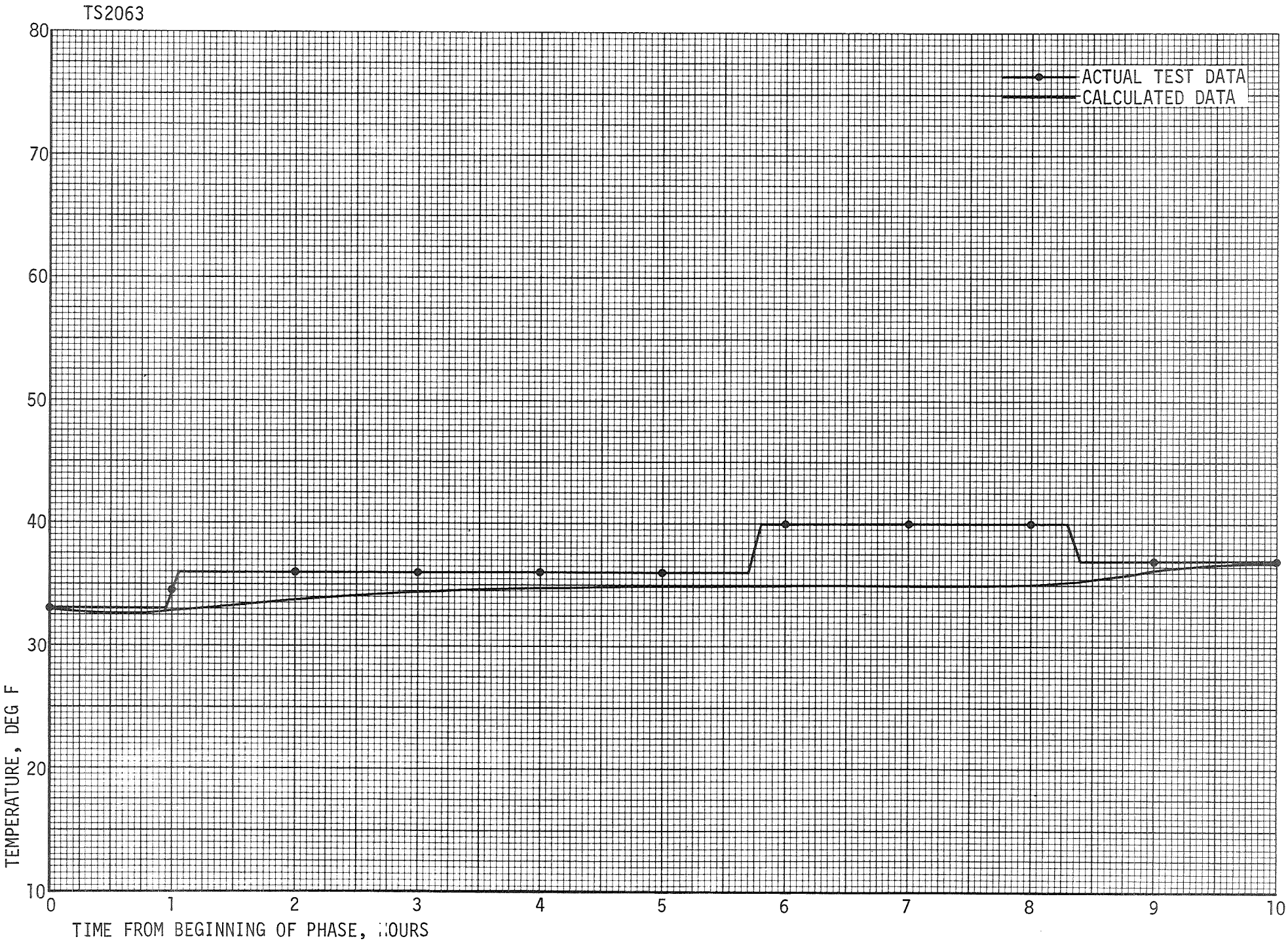
TPS139


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30.
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30.
60.
90.
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150.
TEMPERATURE - DEG F.
23
00
01
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78

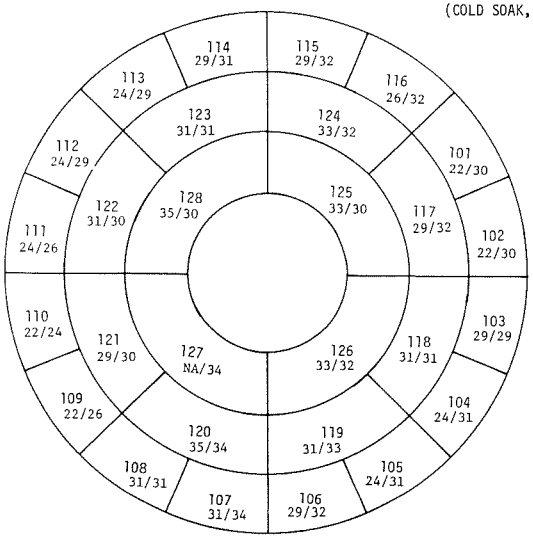
TP4158


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-90.
-120.
-150.
TEMPERATURE - DEG F.
23
00
01
02
03
04
05
06
07
08
09
TIME - HOURS
DAY=78


TS2062
ACTUAL TEST DATA
CALCULATED DATA
TEMPERATURE, DEG F
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
TIME FROM BEGINNING OF PHASE, HOURS

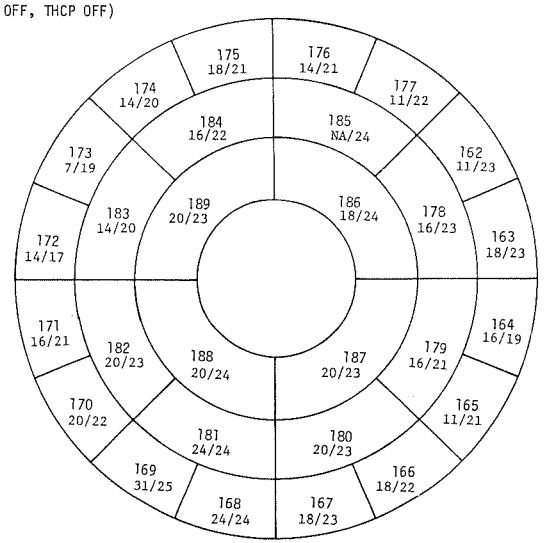

TS2063
ACTUAL TEST DATA
CALCULATED DATA
TEMPERATURE, DEG F
80
70
60
50
40
30
20
10
0
1
2
3
4
5
6
7
8
9
10
TIME FROM BEGINNING OF PHASE, HOURS

PRESSURE SHELL TEMPERATURES AT END OF PHASE E1
(COLD SOAK, CABIN DEPRESSURIZED, INTERNAL HEATERS OFF, THCP OFF)



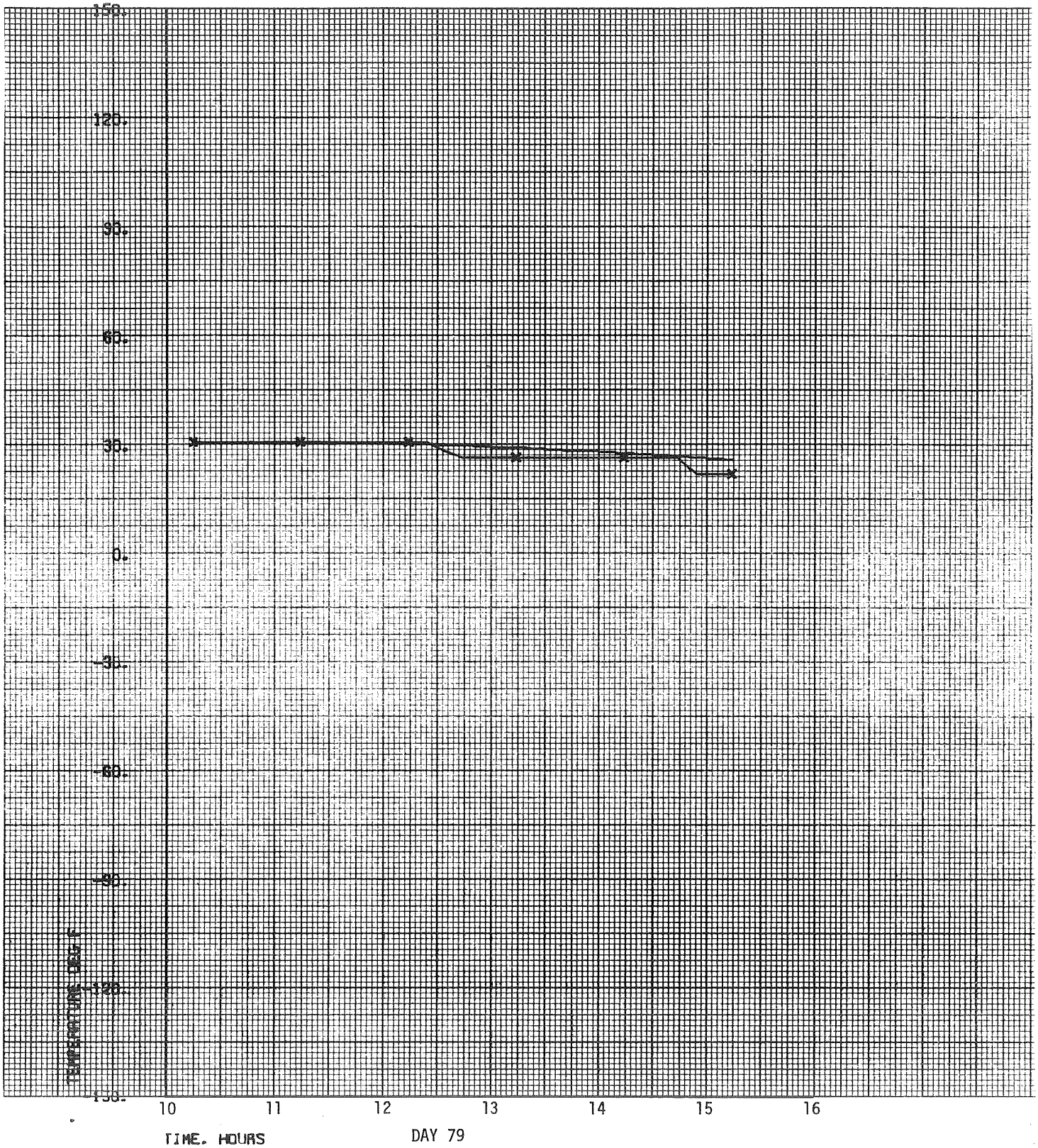
LEGEND

NODE NUMBER
ACTUAL/CALCULATED

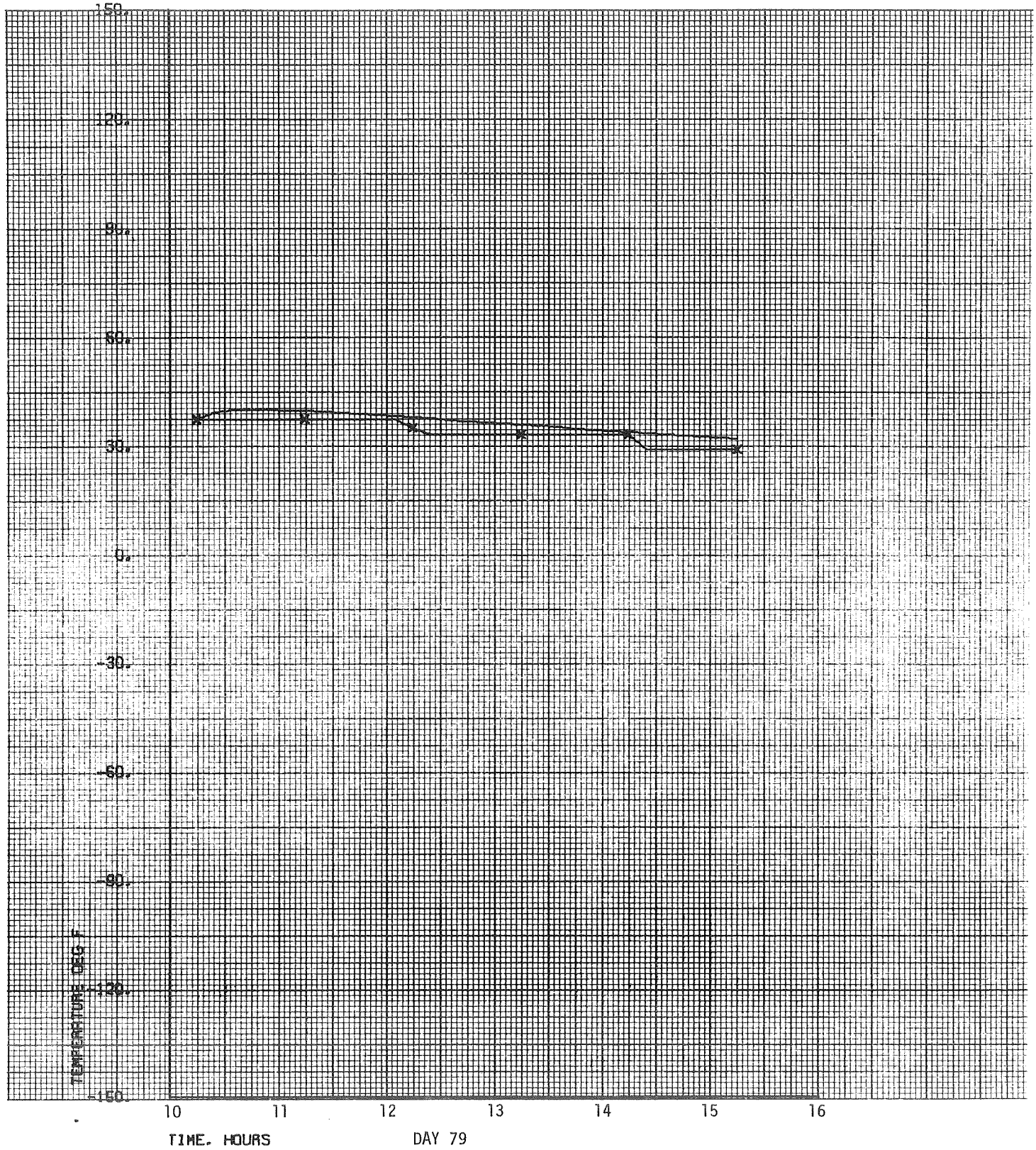


130 16/19	131 20/17	132 22/16	133 20/13	134 16/19	135 18/14	136 24/26	137 22/18	138 18/18	139 20/13	140 20/11	141 20/13	142 16/18	143 20/13	144 29/25	145 20/17
146 16/10	147 14/13	148 20/13	149 16/10	150 18/11	151 20/10	152 22/16	153 20/13	154 20/12	155 18/11	156 16/9	157 16/9	158 18/11	159 18/11	160 16/15	161 20/9

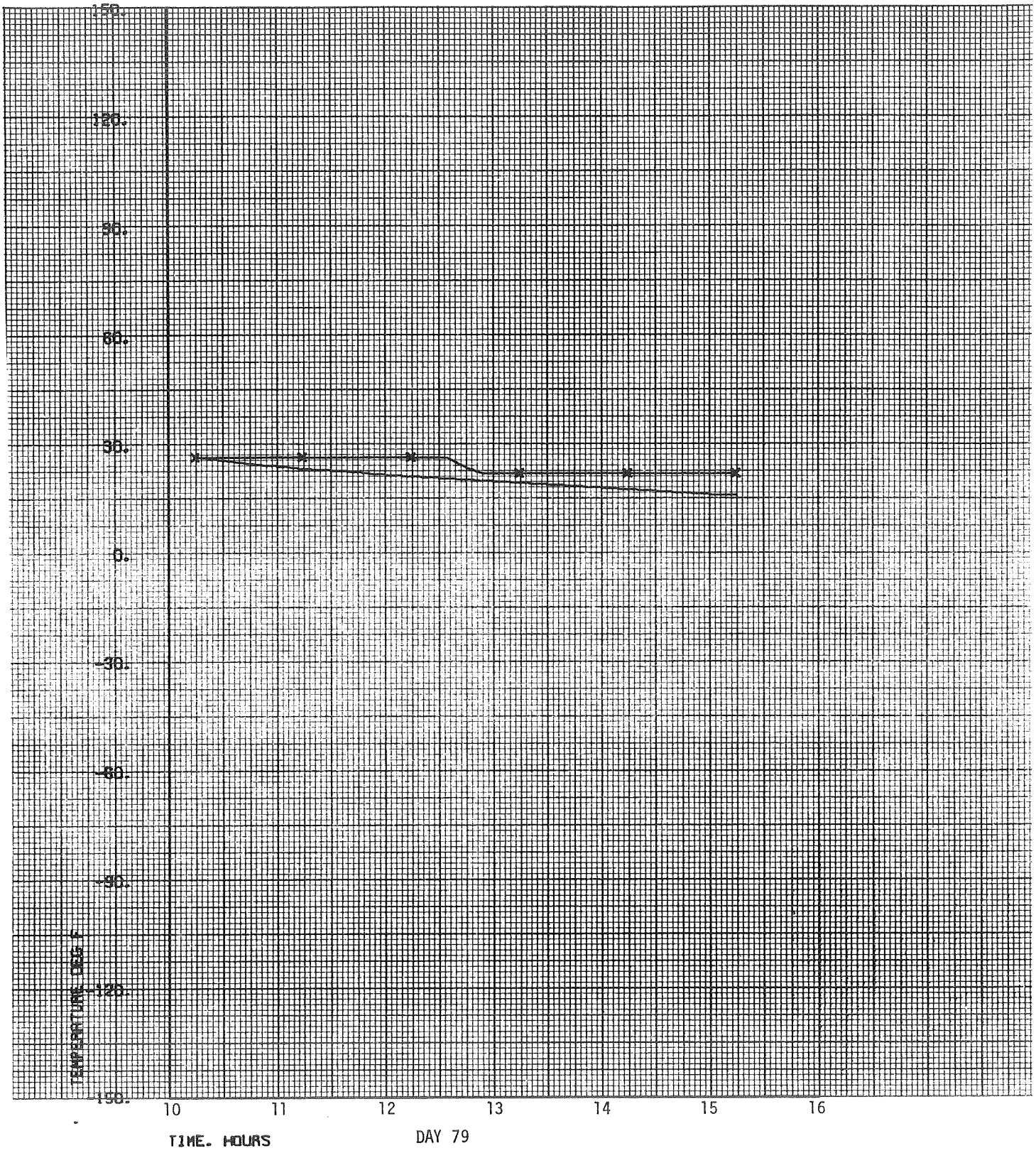
TP0109


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE, DEG F
10
11
12
13
14
15
16
TIME, HOURS
DAY 79

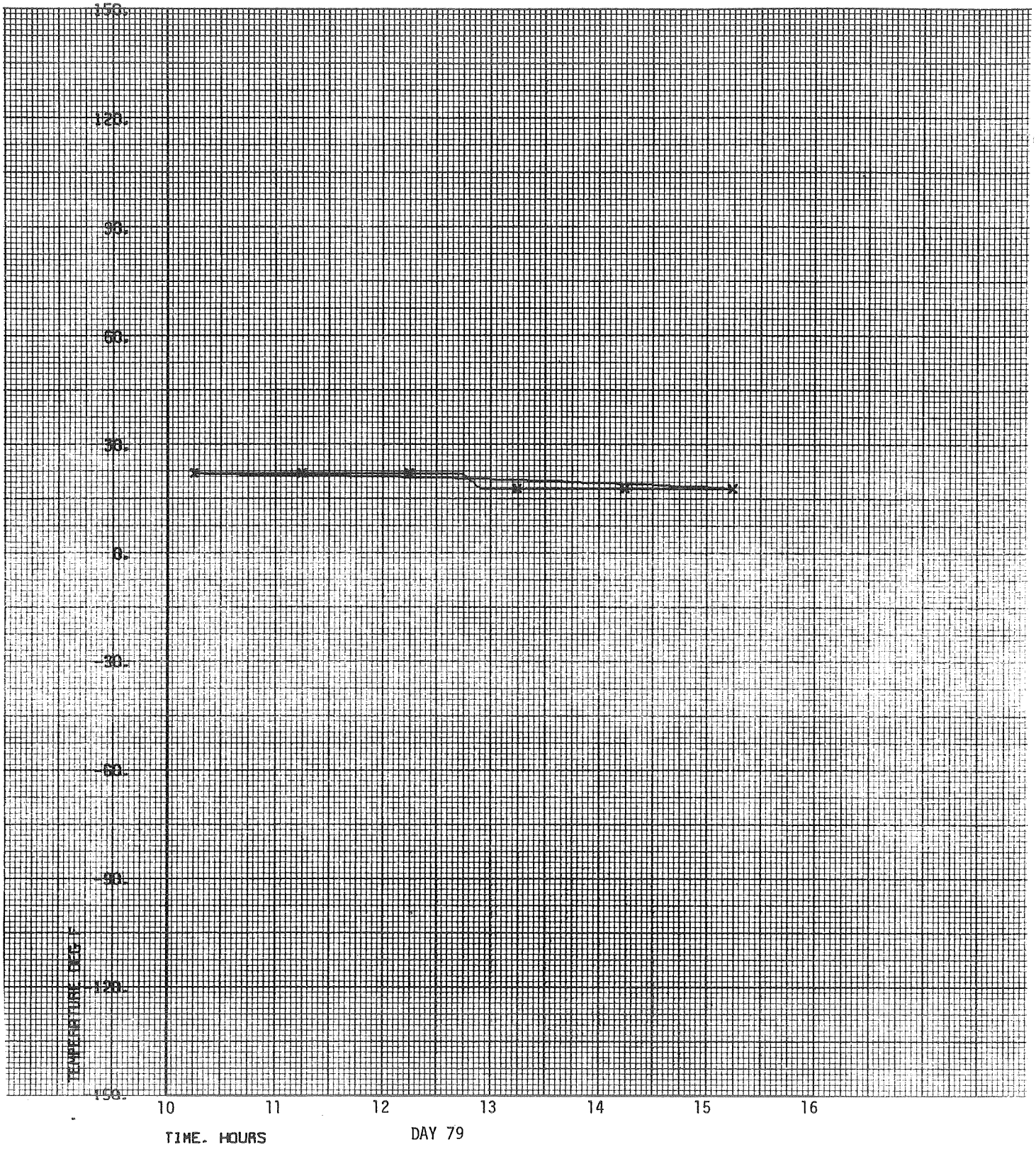
TP0117


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120.
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60.
30.
0.
-30.
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-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
15
16
TIME. HOURS
DAY 79

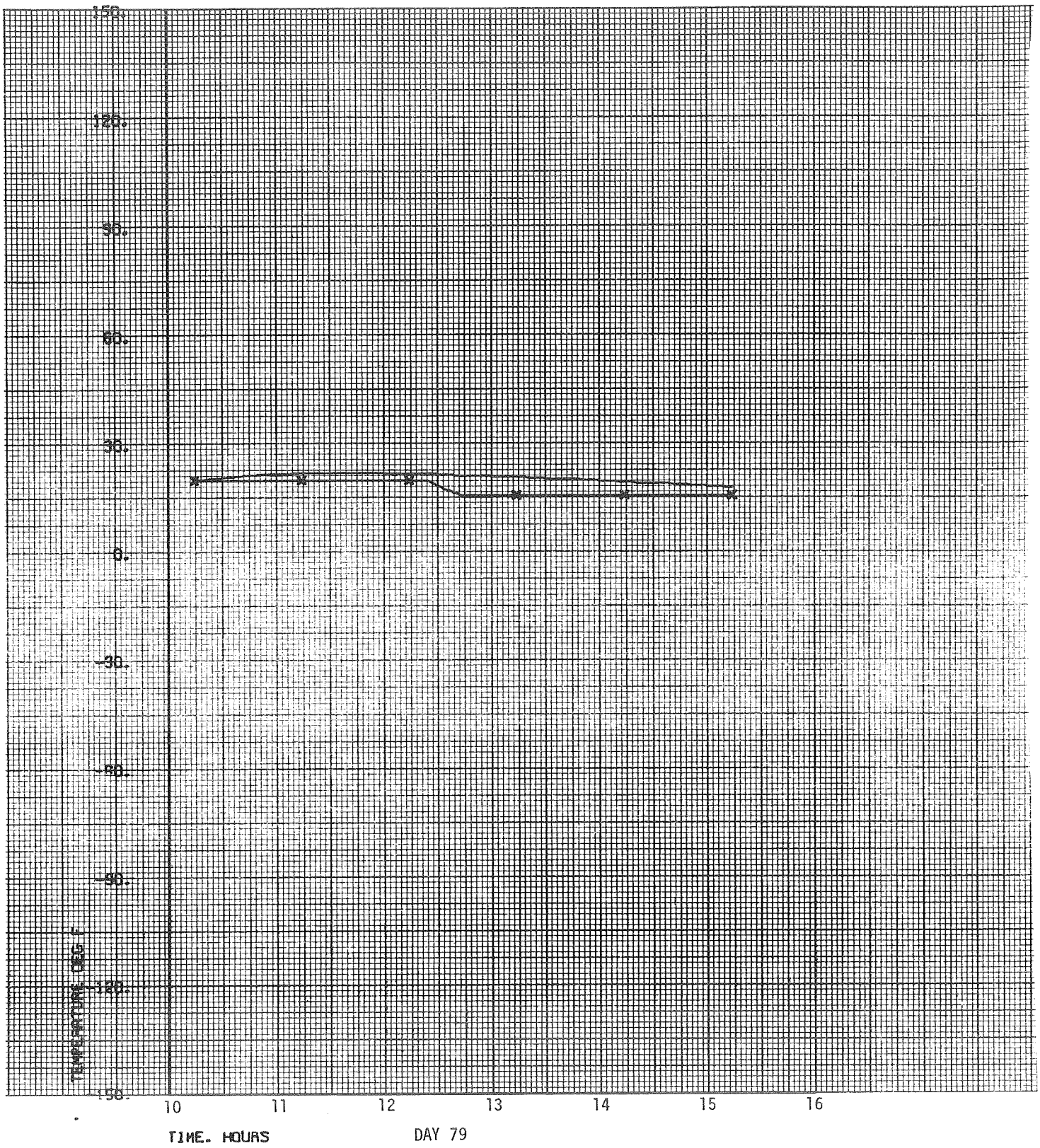
TP0132


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30.
0.
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-60.
-90.
-120.
-150.
10
11
12
13
14
15
16
TEMPERATURE, DEG F
TIME. HOURS
DAY 79

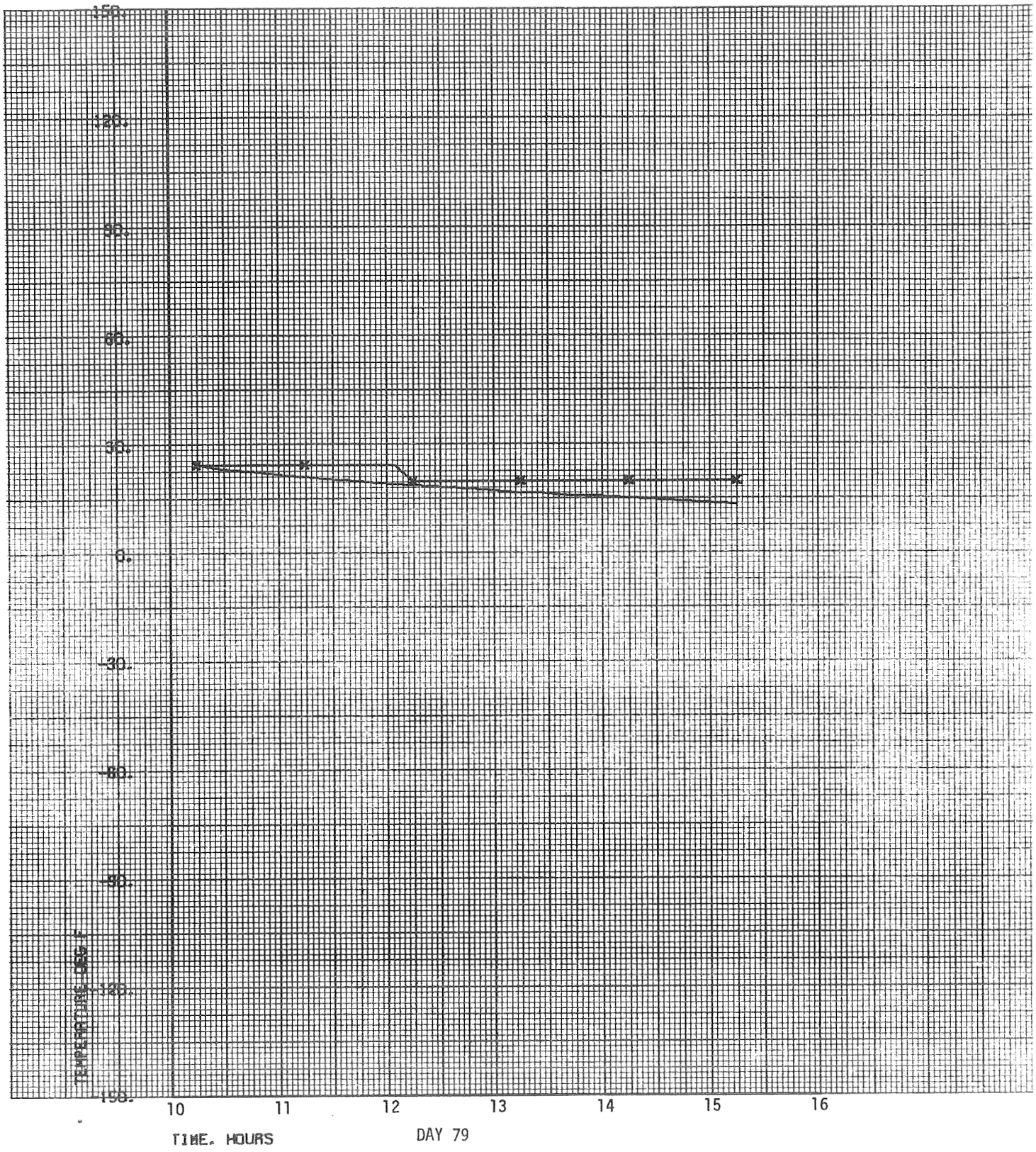
TP0138


150.
120.
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60.
30.
0.
-30.
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-120.
-150.
TEMPERATURE DEG F
10
11
12
13
14
15
16
TIME. HOURS
DAY 79

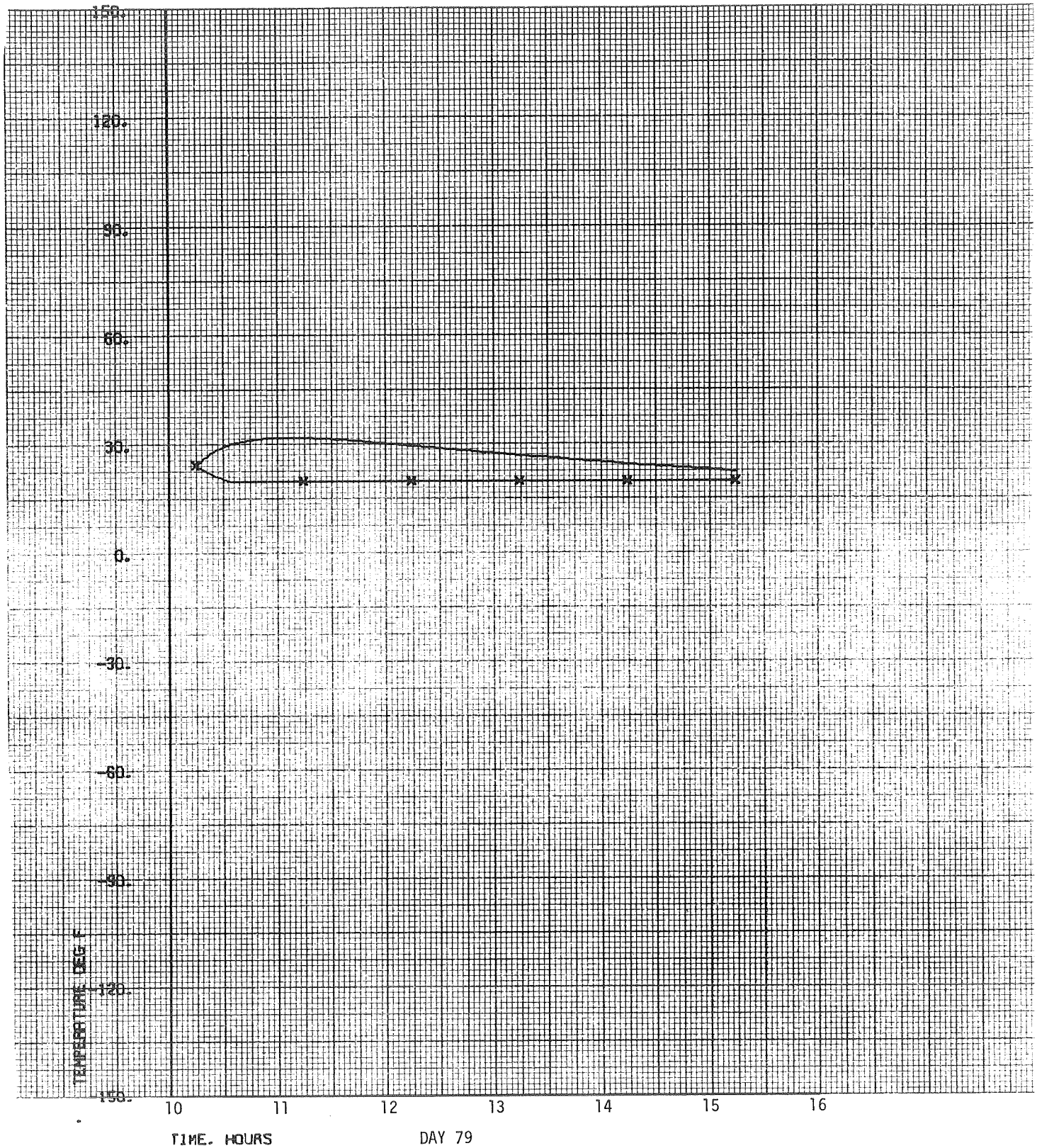
TP0142


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60.
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0.
-30.
-60.
-90.
-120.
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TEMPERATURE DEG F
10
11
12
13
14
15
16
TIME. HOURS
DAY 79

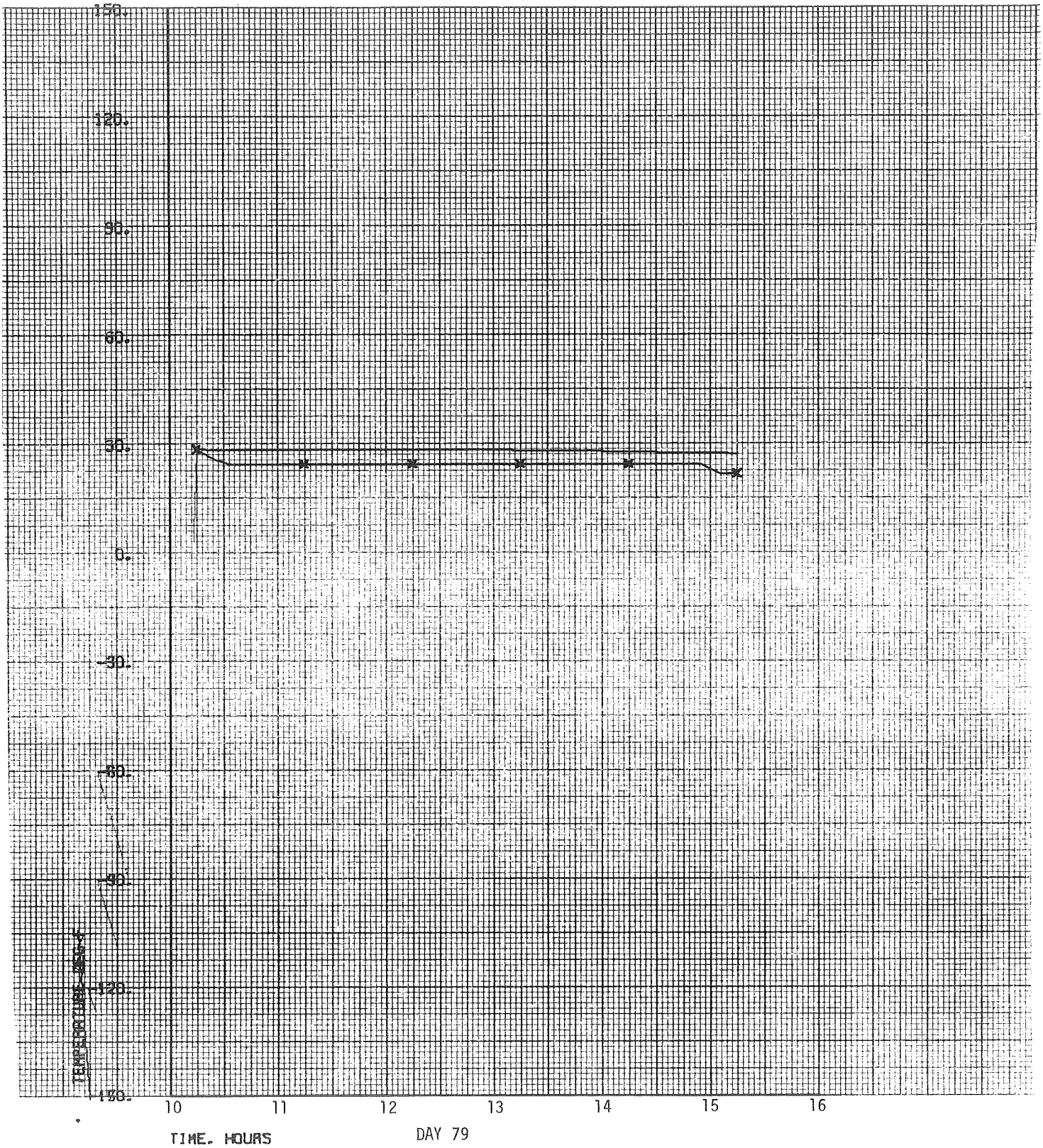
TP0148


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0.
-30.
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-150.
TEMPERATURE, DEG F
10
11
12
13
14
15
16
TIME, HOURS
DAY 79

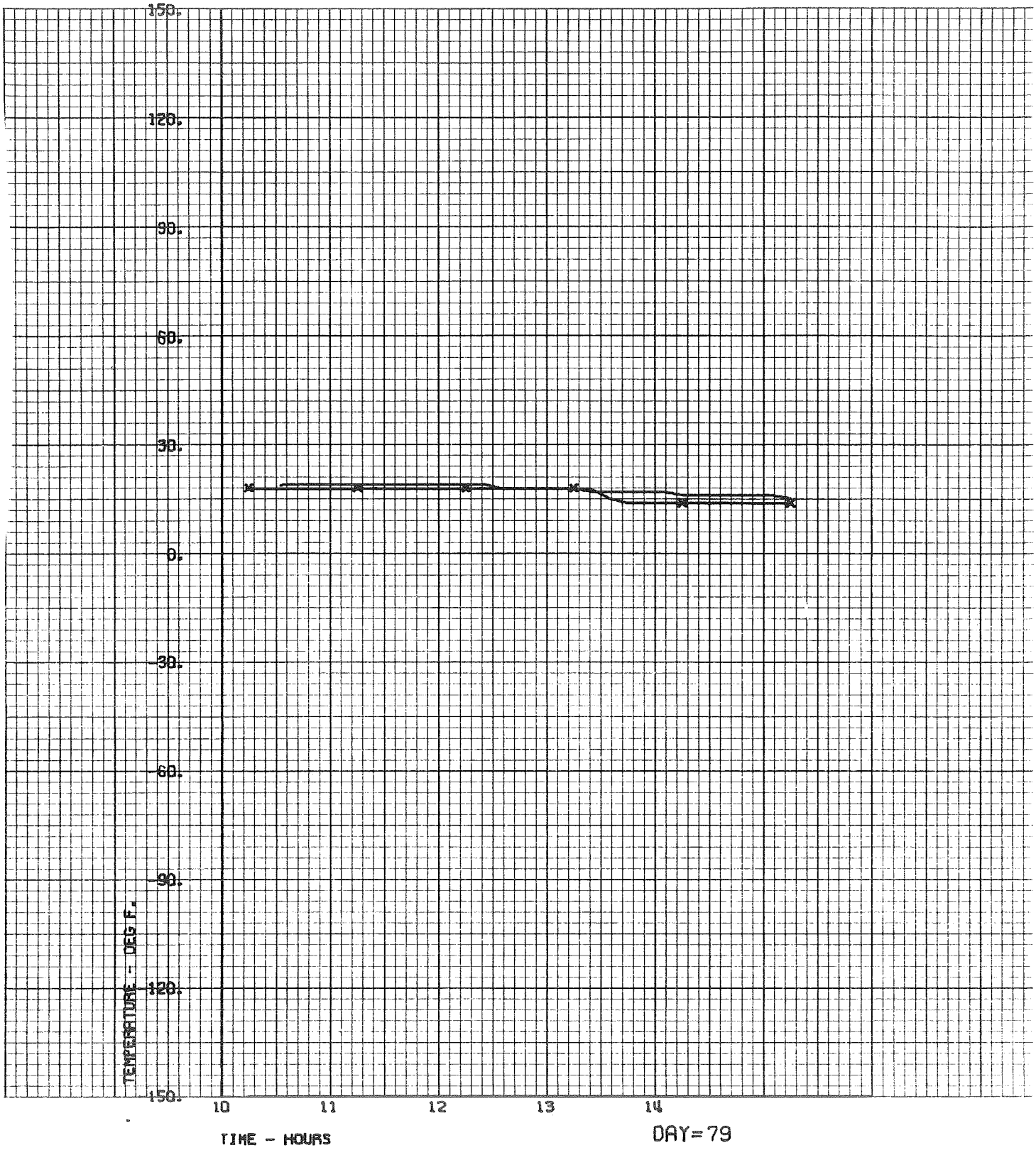
TP0170


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60.
30.
0.
-30.
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-120.
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TEMPERATURE DEG F
10
11
12
13
14
15
16
TIME. HOURS
DAY 79

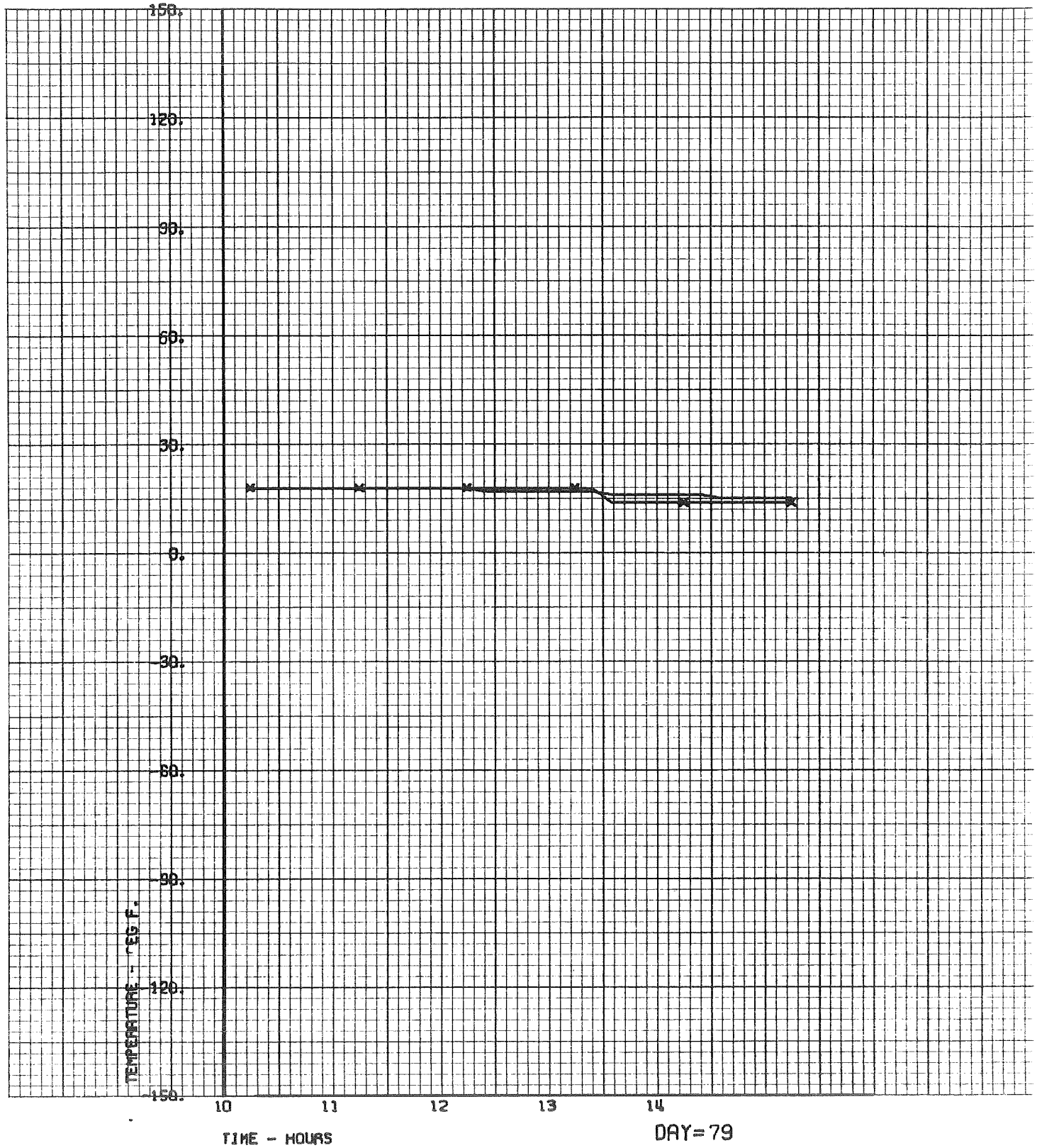
TH0522


150.
120.
90.
60.
30.
0.
-30.
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-90.
-120.
-150.
10
11
12
13
14
15
16
TIME. HOURS
DAY 79

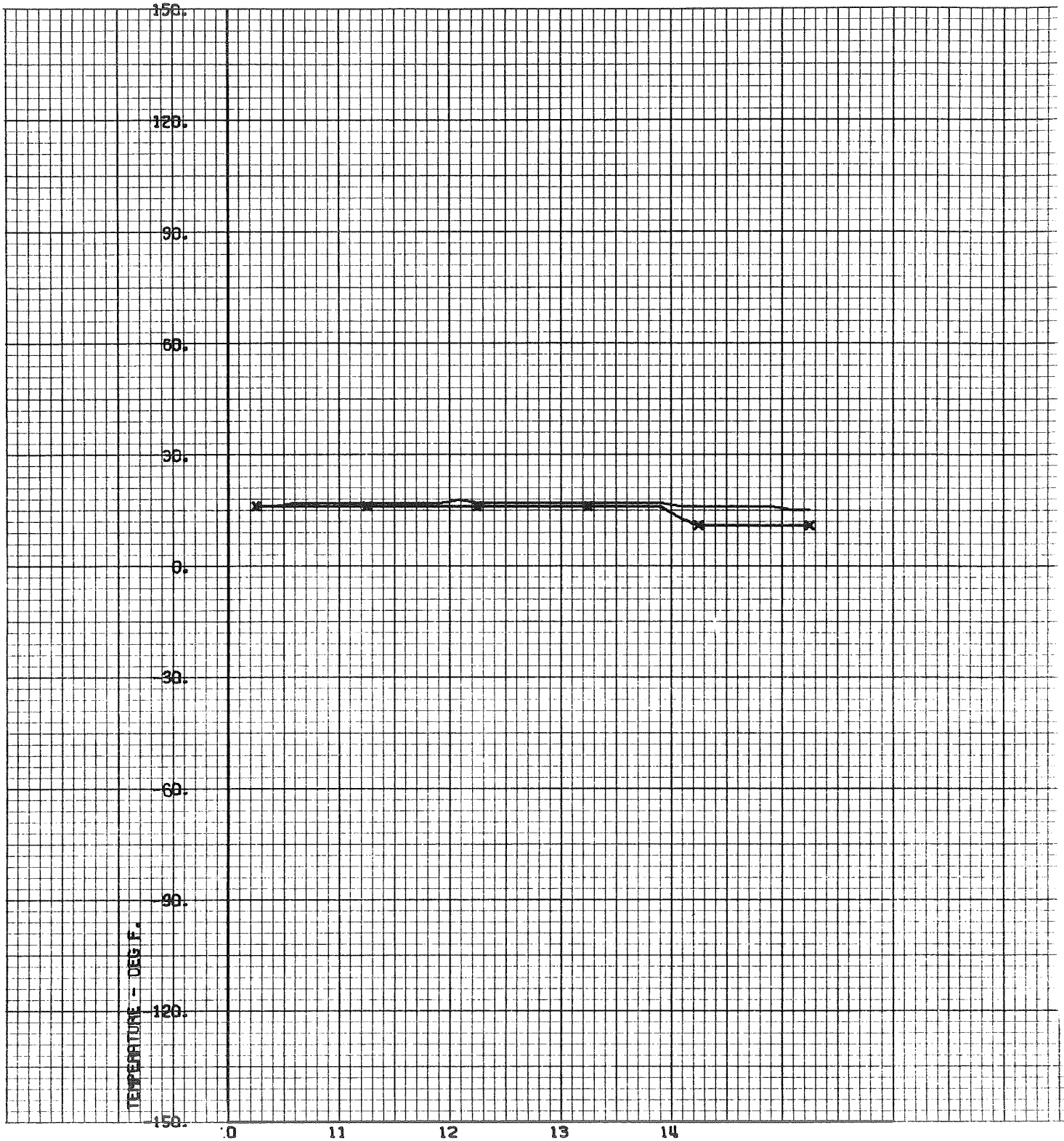
TW601


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120.
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60.
30.
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TEMPERATURE - DEG F.
10
11
12
13
14
TIME - HOURS
DAY=79

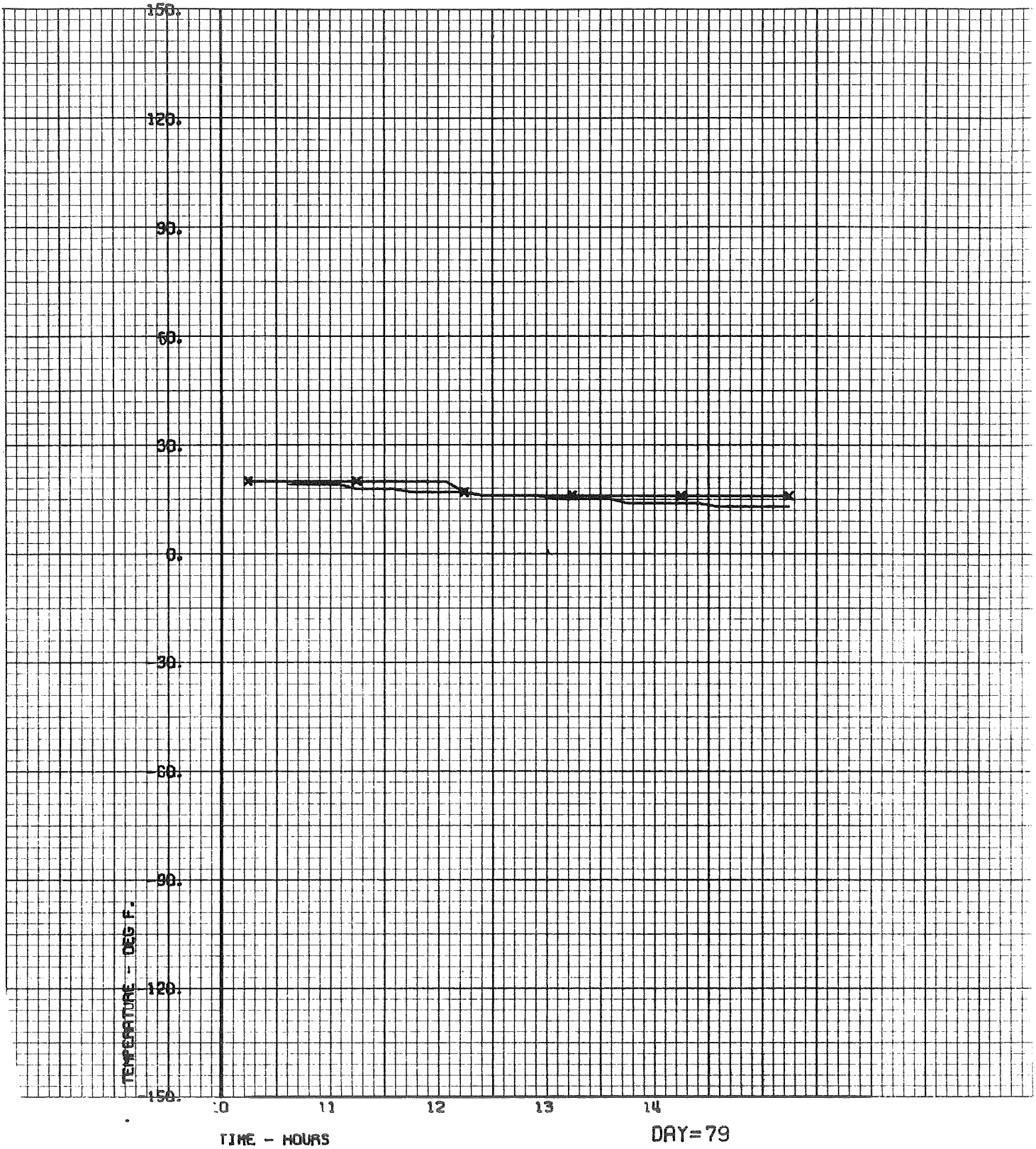
TW602


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120.
90.
60.
30.
0.
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-120.
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10
11
12
13
14
TEMPERATURE - DEG F.
TIME - HOURS
DAY=79

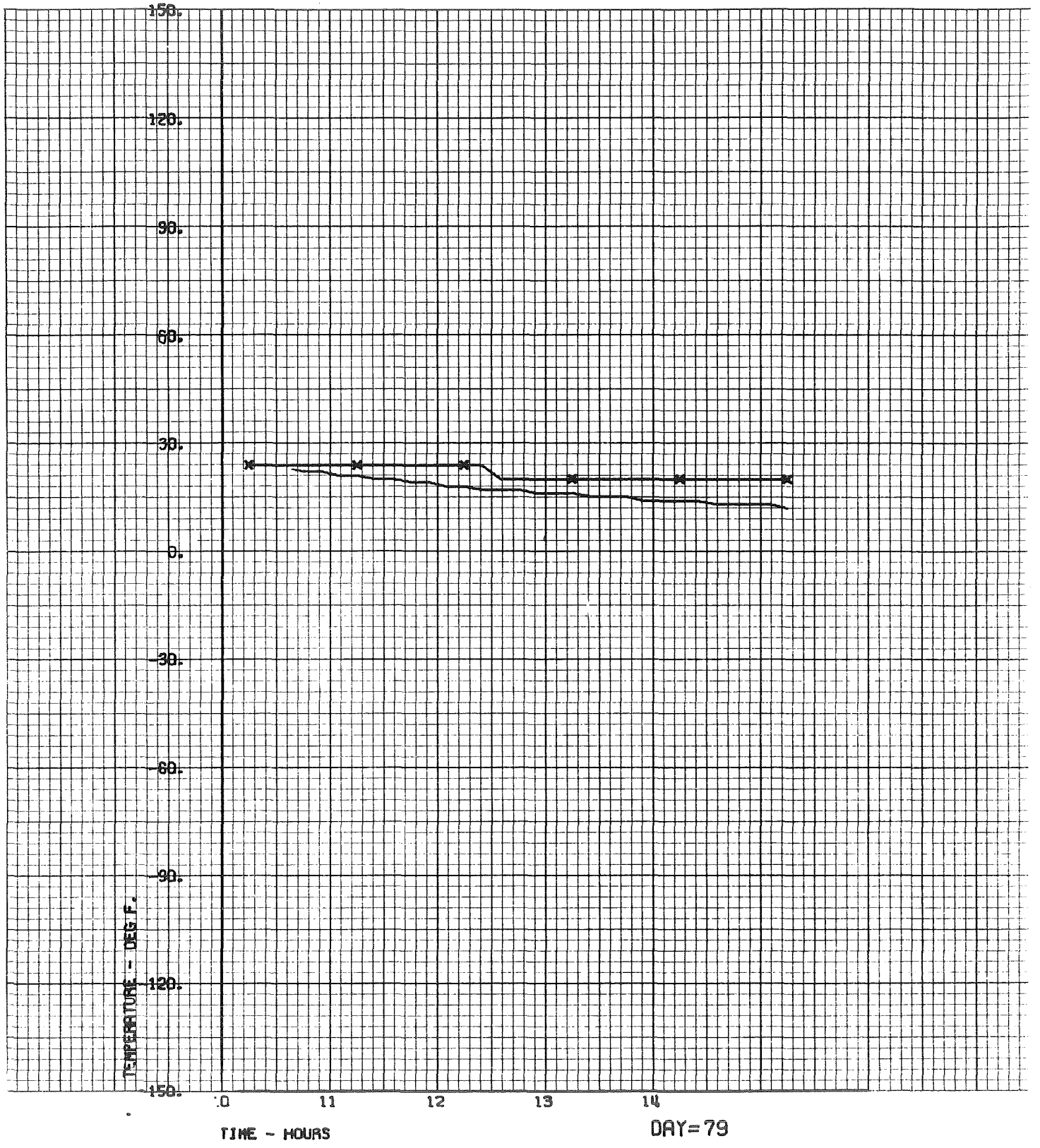
TW603


150.
120.
90.
60.
30.
0.
-30.
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-150.
TEMPERATURE - DEG F.
10
11
12
13
14
TIME - HOURS
DAY=79

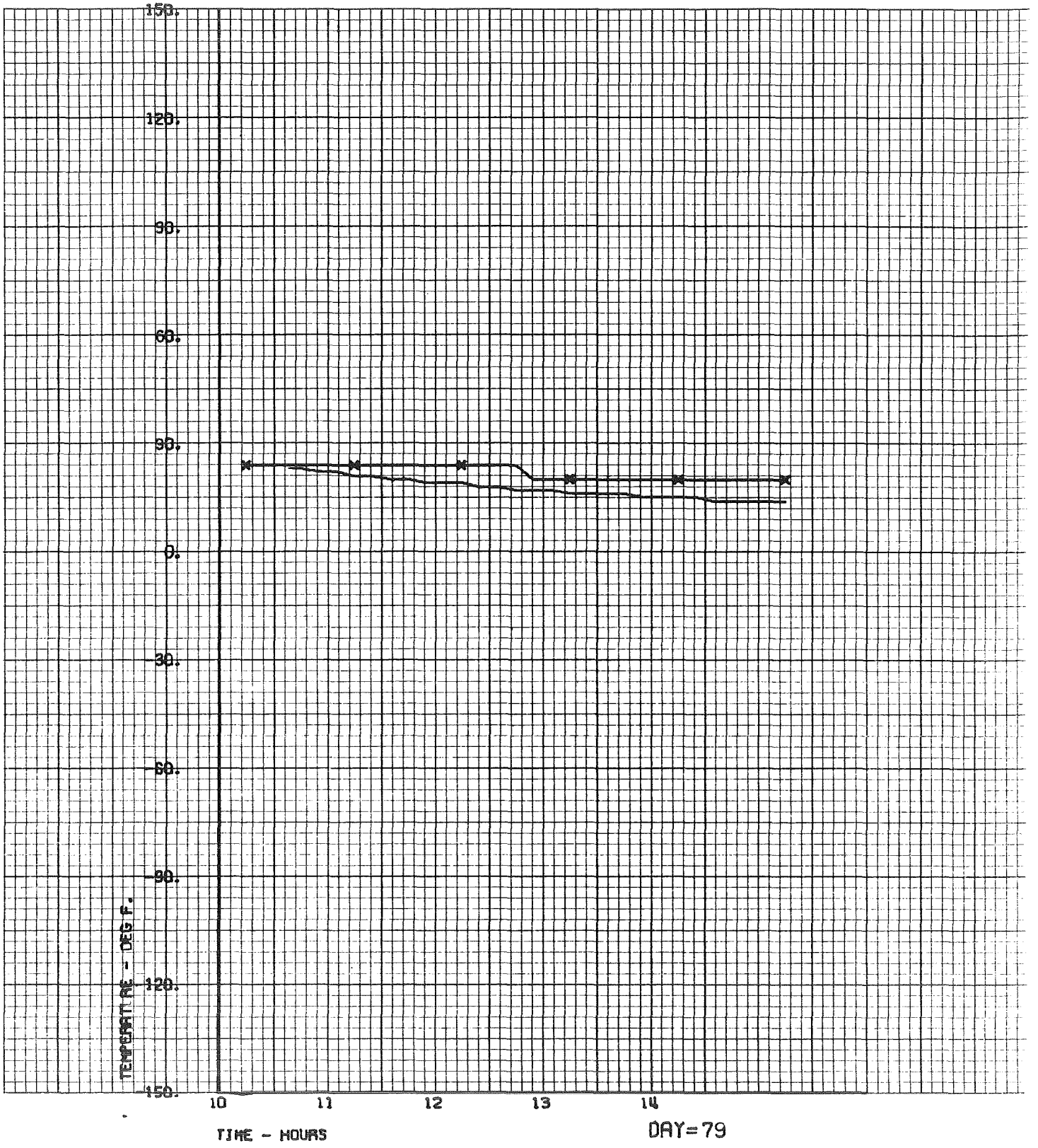
TP5138


150.
120.
90.
60.
30.
0.
-30.
-60.
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-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
14
TIME - HOURS
DAY=79

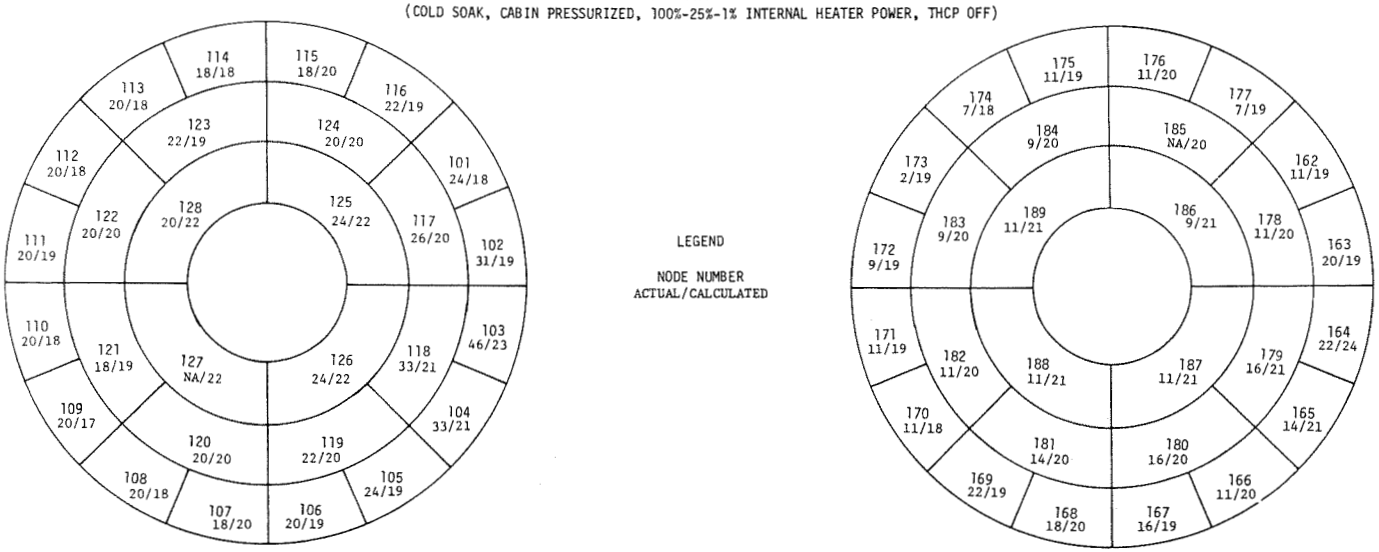
TP5139


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120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
.0
11
12
13
14
TIME - HOURS
DAY=79

TP4158


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
10
11
12
13
14
TIME - HOURS
DAY=79

PRESSURE SHELL TEMPERATURES AT END OF PHASE E2
(COLD SOAK, CABIN PRESSURIZED, 100%-25%-1% INTERNAL HEATER POWER, THCP OFF)

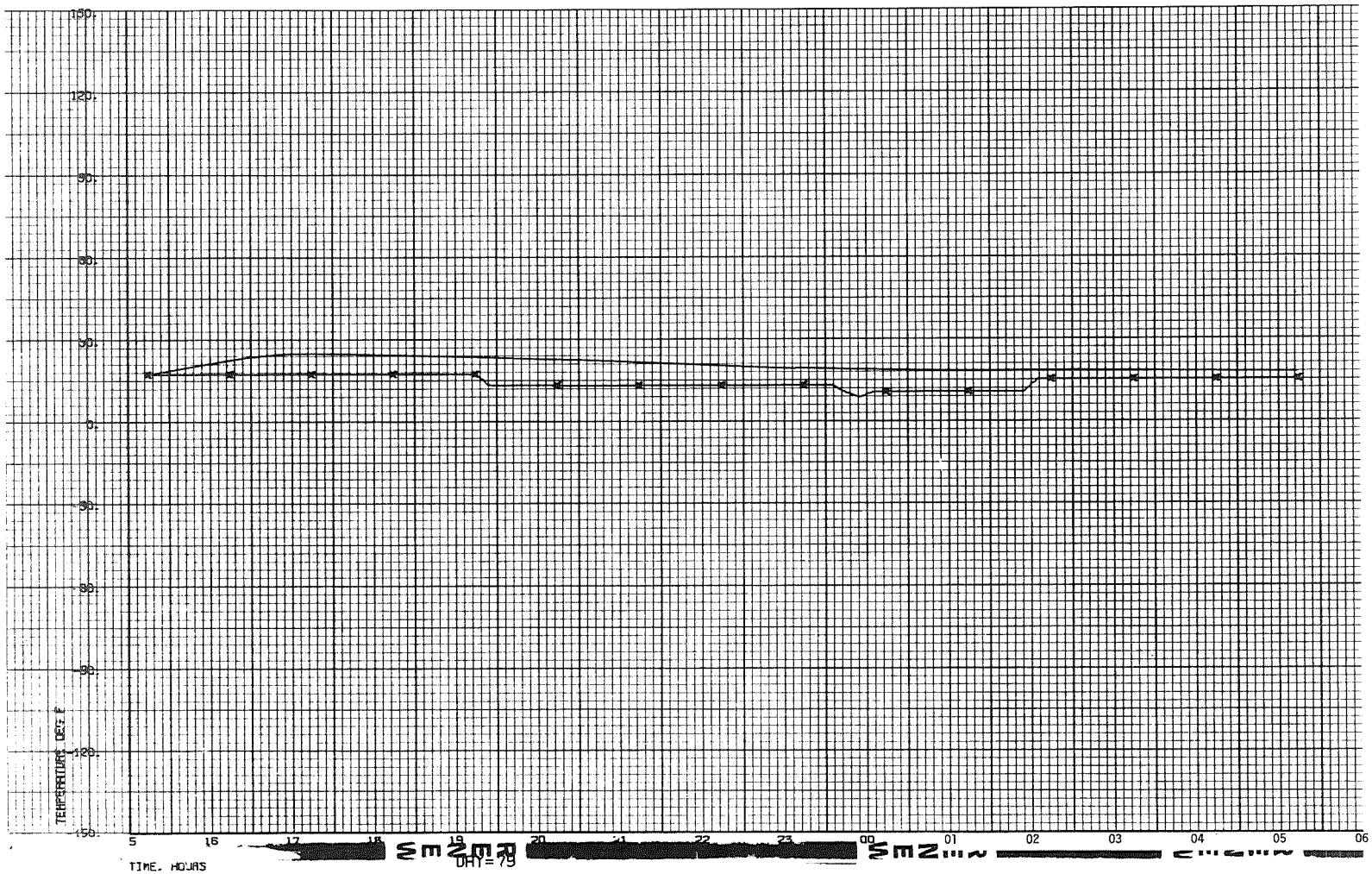


LEGEND

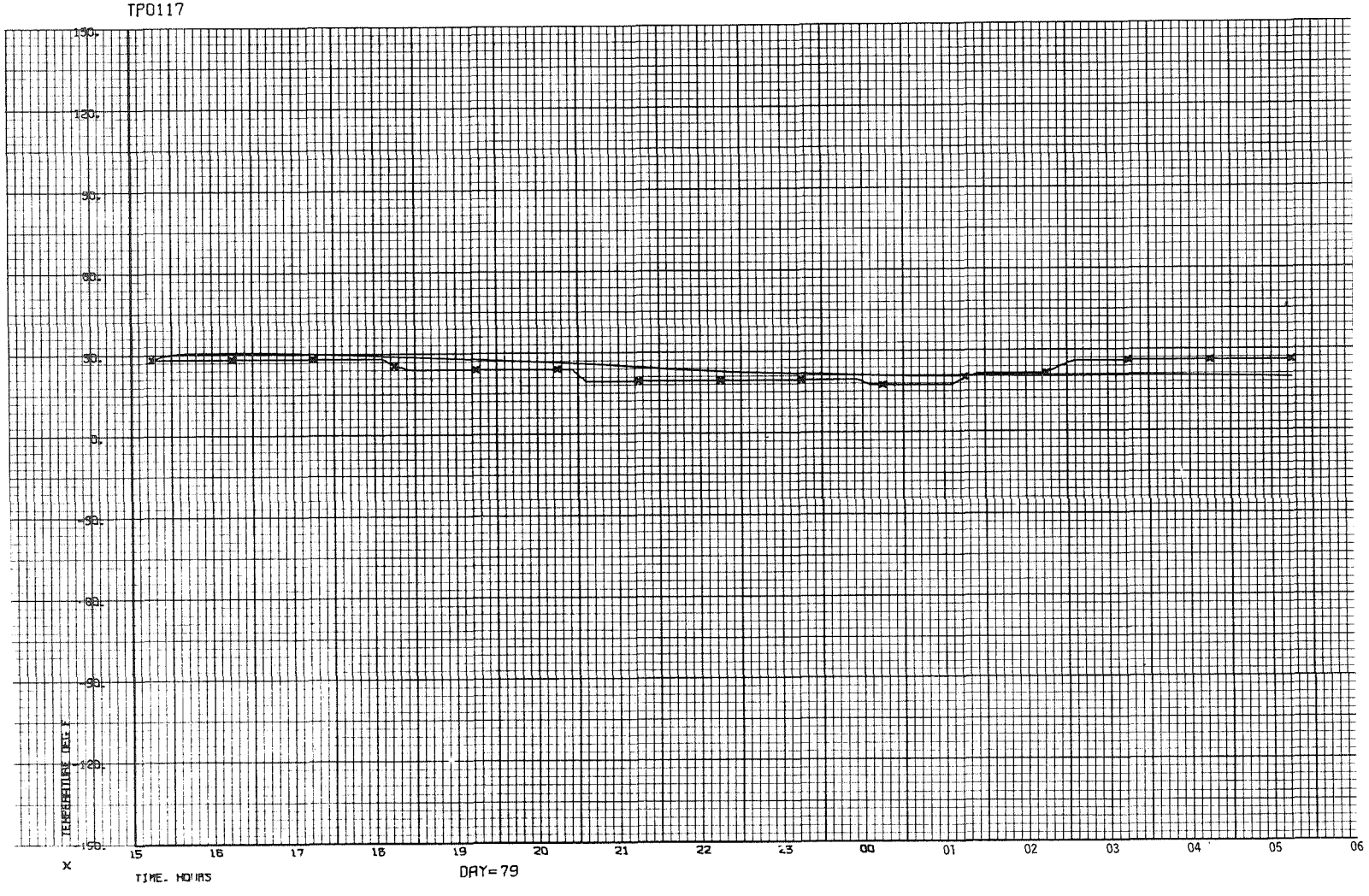
NODE NUMBER
ACTUAL/CALCULATED

130 16/18	131 31/14	132 87/61	133 29/20	134 18/19	135 18/17	136 18/20	137 18/18	138 16/19	139 16/17	140 18/17	141 18/17	142 14/18	143 20/17	144 18/20	145 18/18
146 16/17	147 22/13	148 91/59	149 26/20	150 16/17	151 20/17	152 18/18	153 18/17	154 18/17	155 16/17	156 16/17	157 16/17	158 16/17	159 16/17	160 14/18	161 16/17

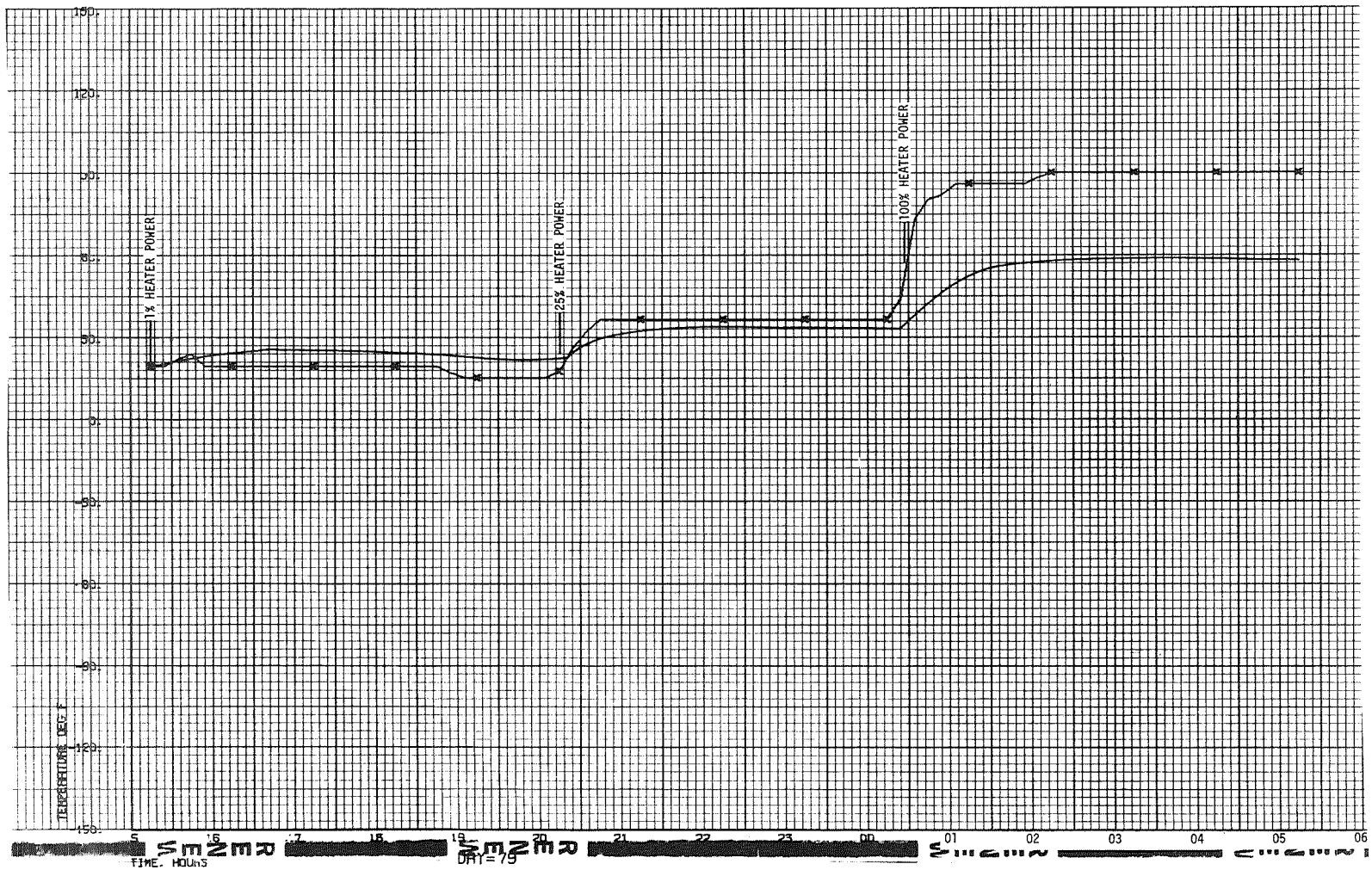
TP0138


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
5
16
17
18
19
20
21
22
23
00
01
02
03
04
05
06
TIME. HOURS

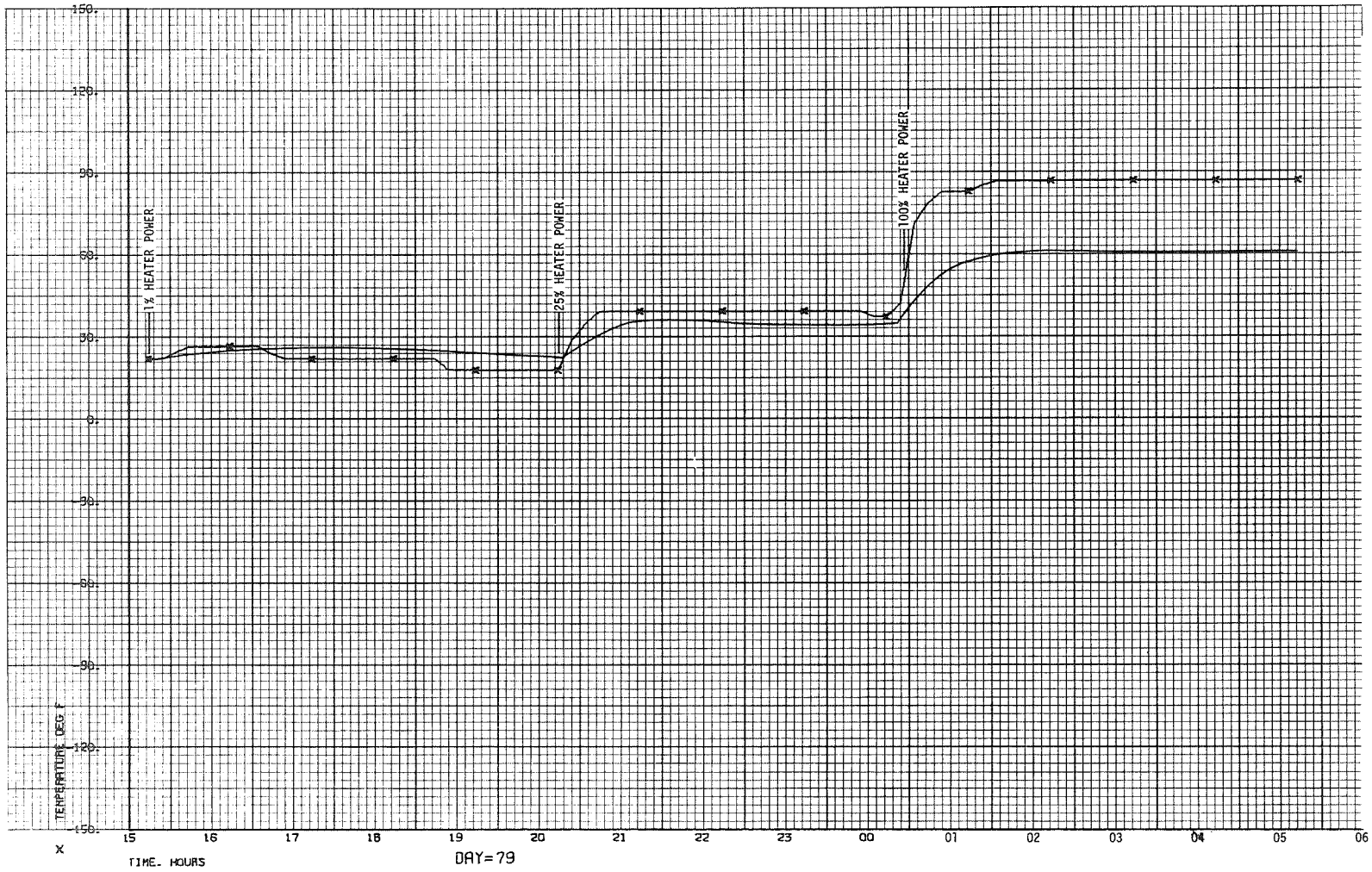
TP0117

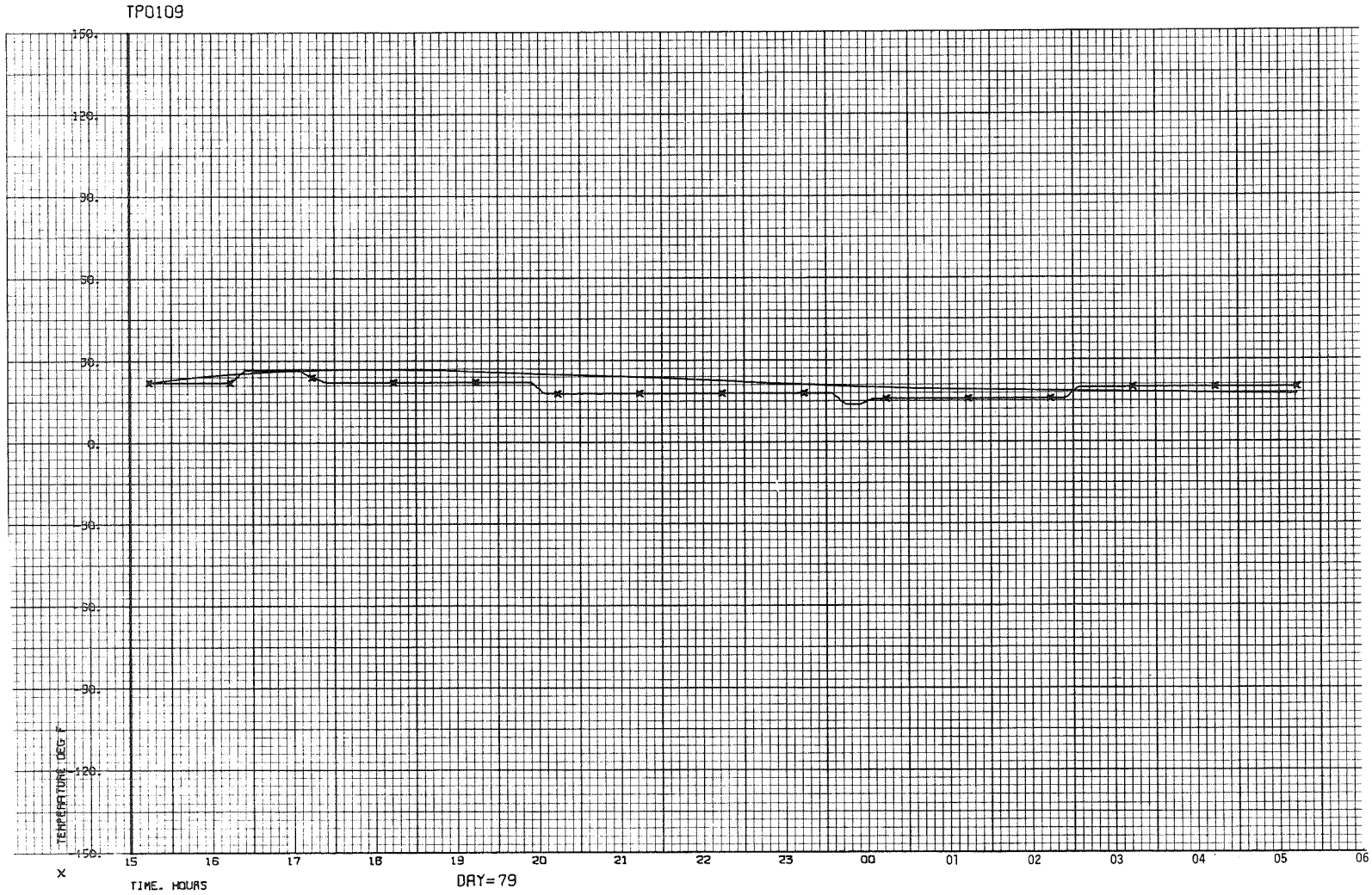

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
15
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22
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01
02
03
04
05
06
X
TIME. HOURS
DAY=79

TP0148

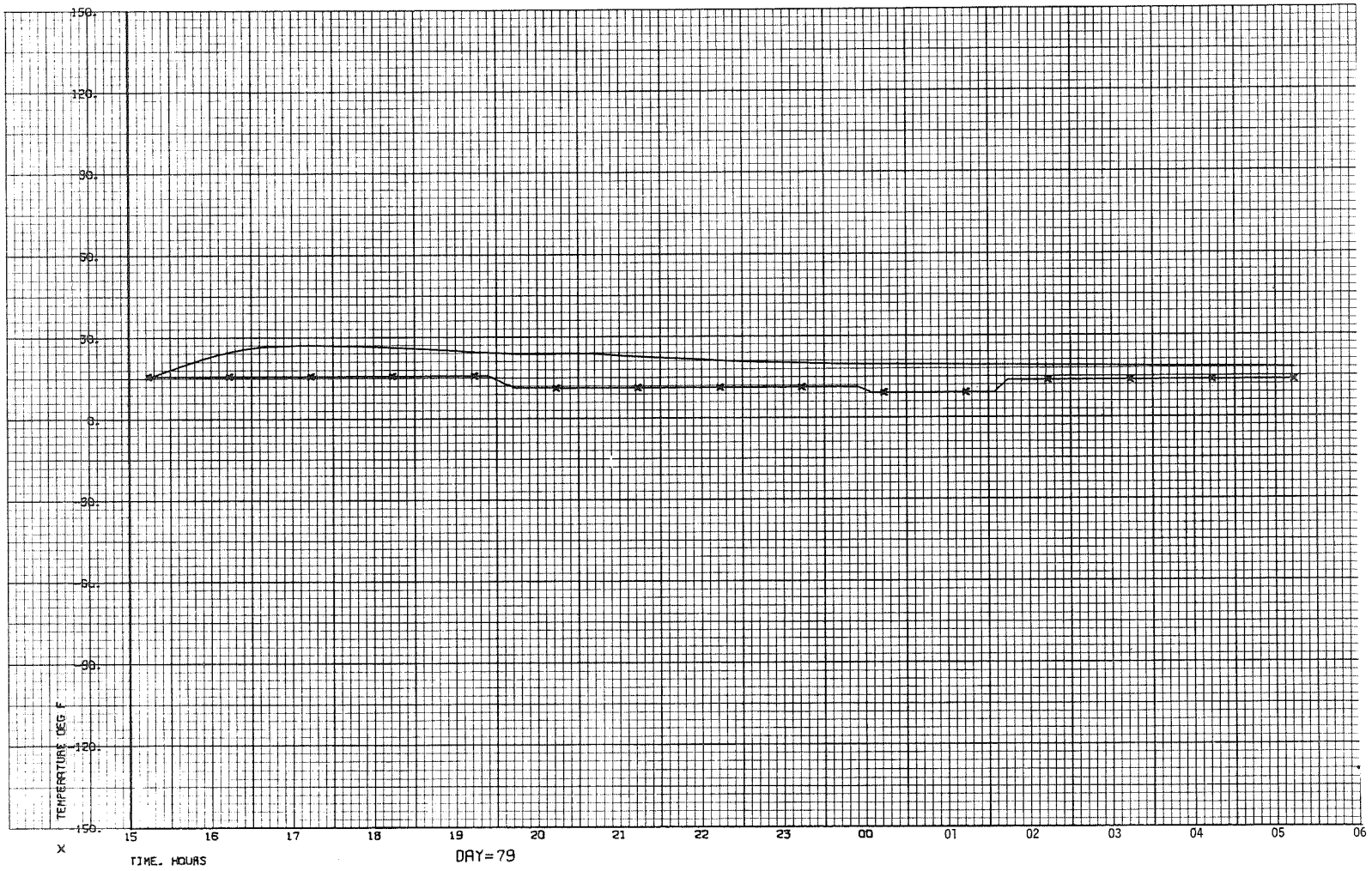

1% HEATER POWER
25% HEATER POWER
100% HEATER POWER
TEMPERATURE DEG F
TIME, HOURS
DAY = 79

TP0132

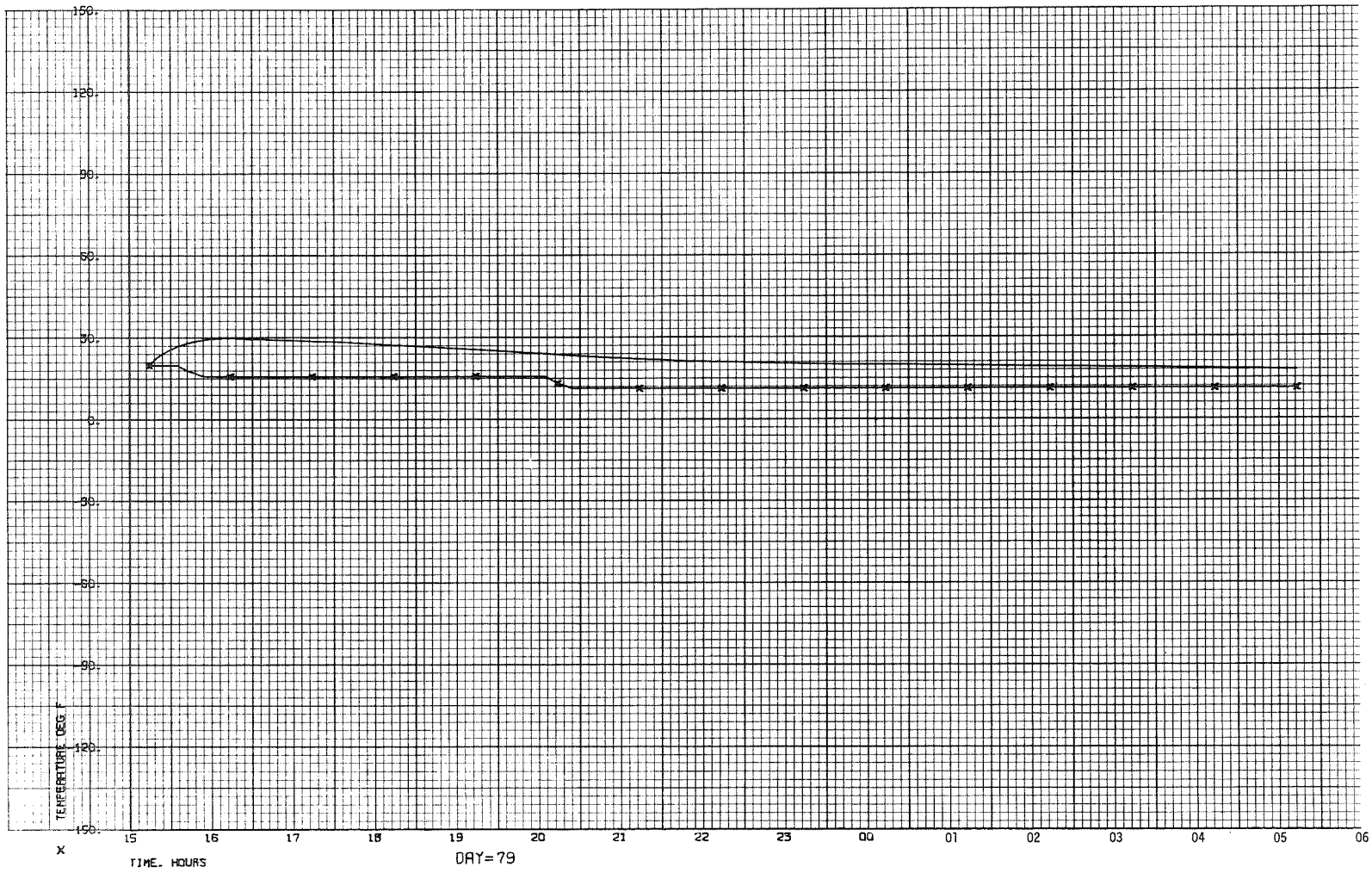

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
1% HEATER POWER
25% HEATER POWER
100% HEATER POWER
15
16
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21
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01
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05
06
X
TIME. HOURS
DAY=79


TP0109
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
15
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17
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21
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01
02
03
04
05
06
X
TIME. HOURS
DAY=79

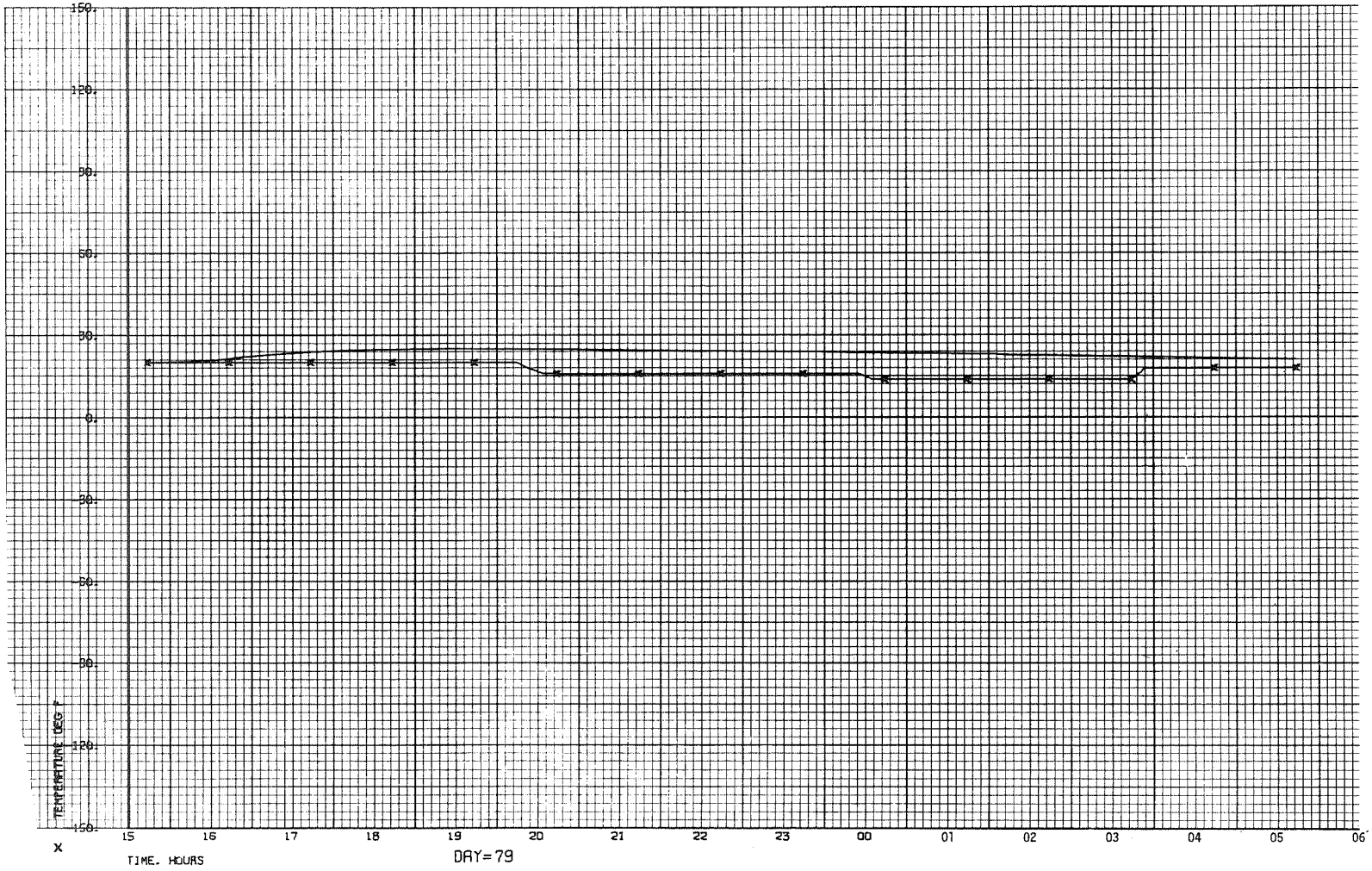
TP0142


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120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
15
16
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01
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05
06
TIME. HOURS
DAY=79

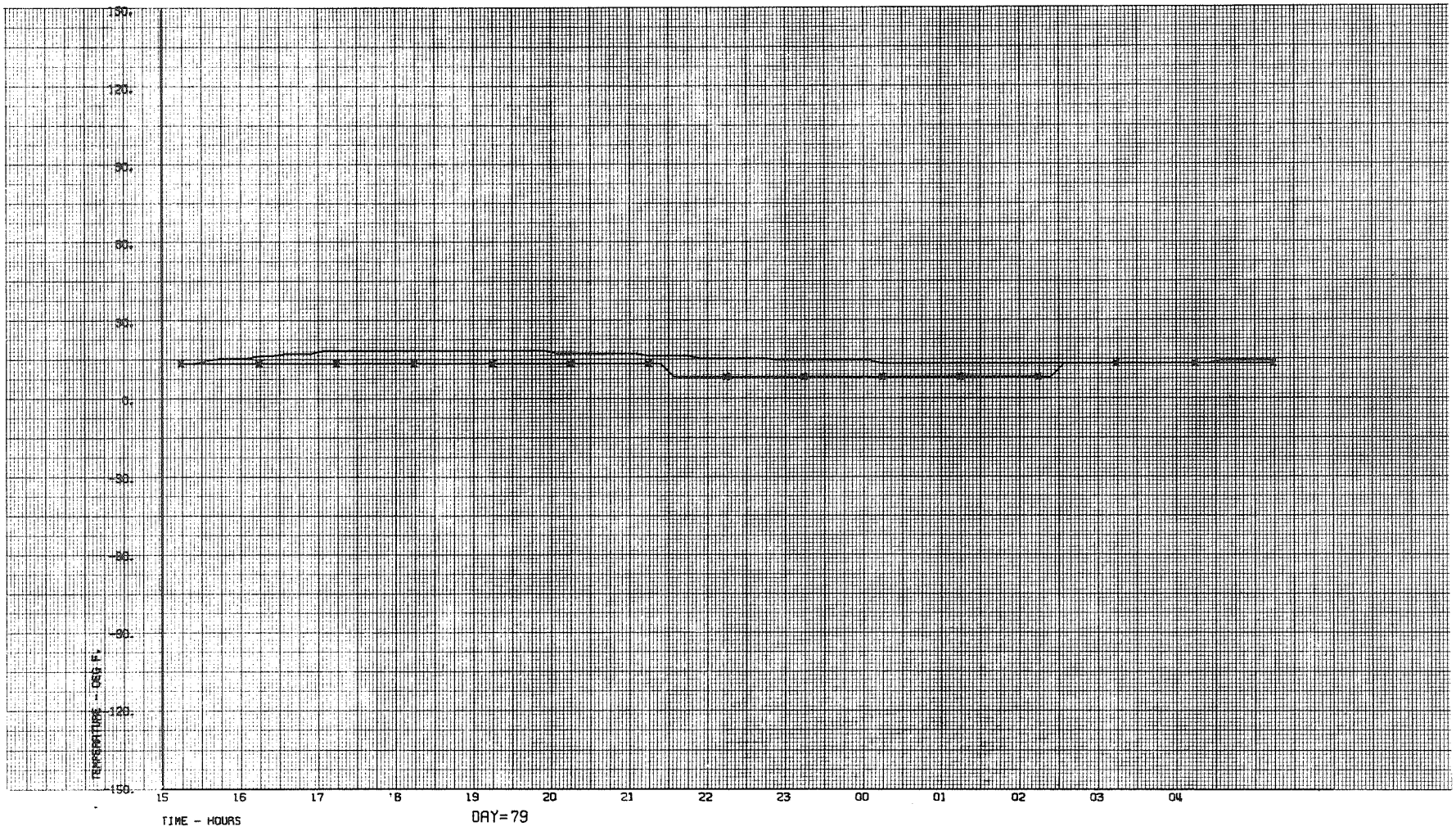
TP0170


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60.
30.
0.
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-60.
-90.
-120.
-150.
TEMPERATURE DEG. F
15
16
17
18
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23
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01
02
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04
05
06
TIME. HOURS
DAY=79

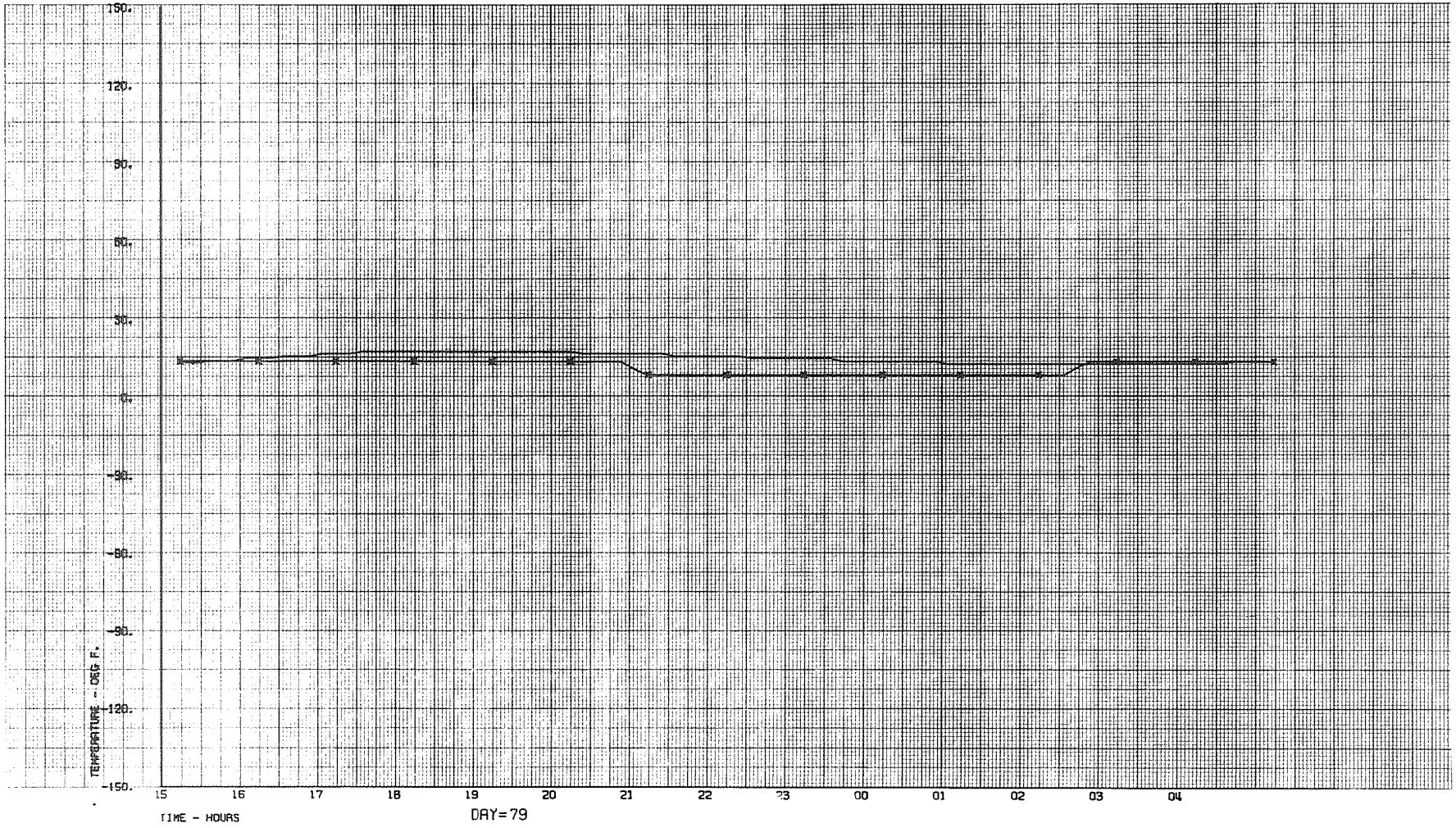
TH0522


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60.
30.
0.
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-90.
-120.
-150.
TEMPERATURE DEG F
X
15
16
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18
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23
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01
02
03
04
05
06
TIME. HOURS
DAY=79

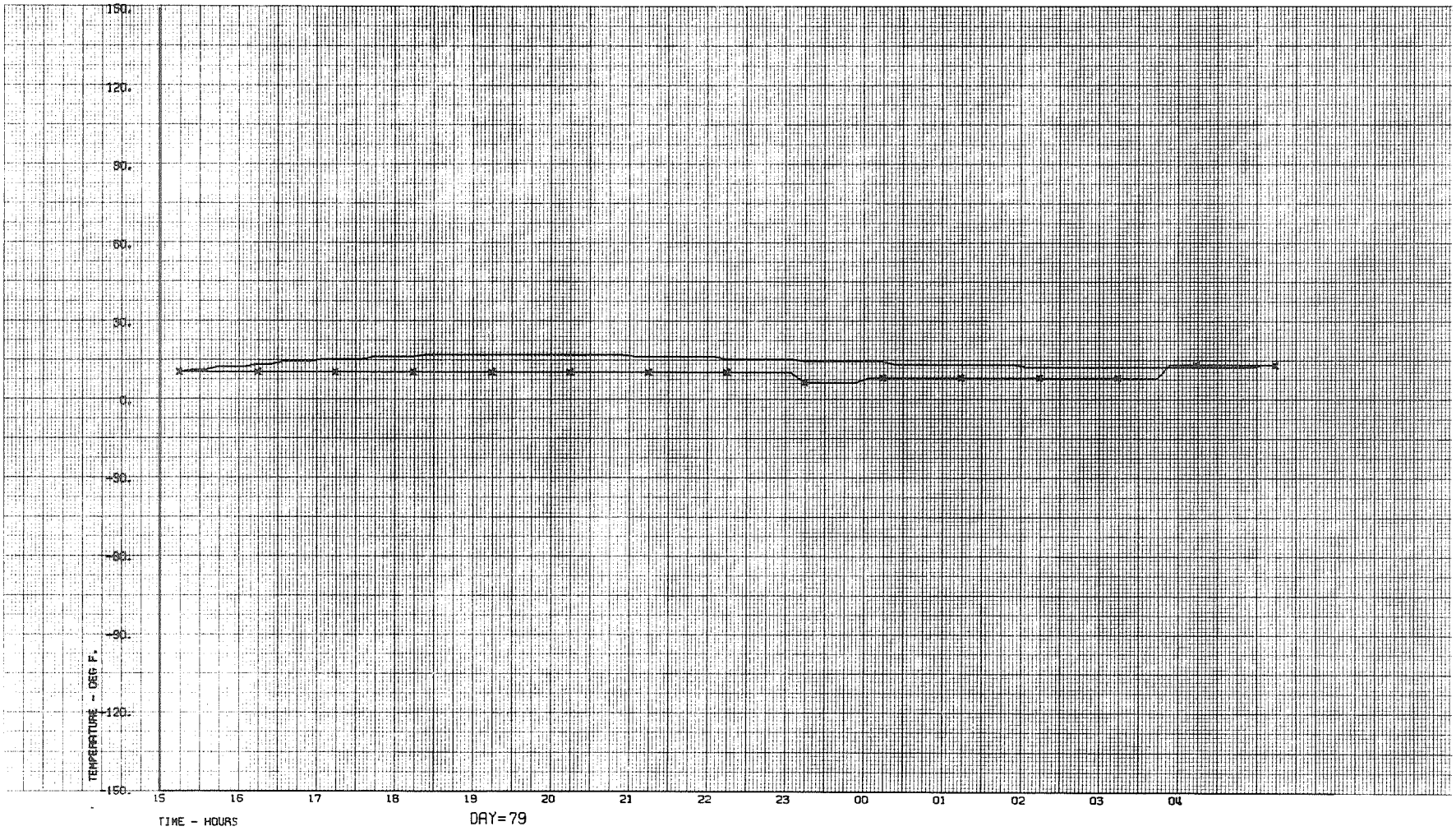
TW601


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-150.
TEMPERATURE - DEG F.
15
16
17
18
19
20
21
22
23
00
01
02
03
04
TIME - HOURS
DAY=79

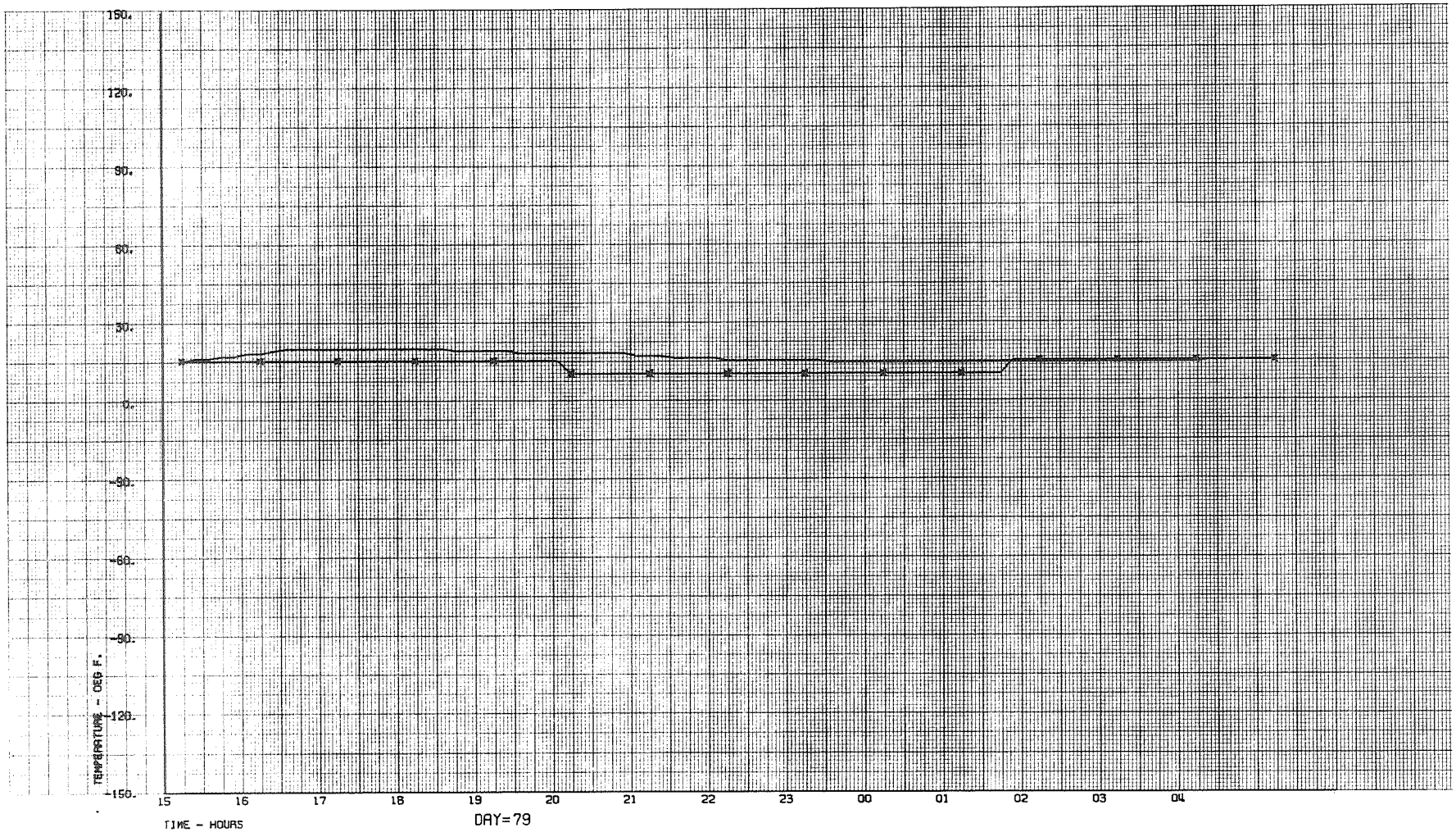
TW602


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-120.
-150.
TEMPERATURE - DEG F.
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16
17
18
19
20
21
22
23
00
01
02
03
04
TIME - HOURS
DAY=79

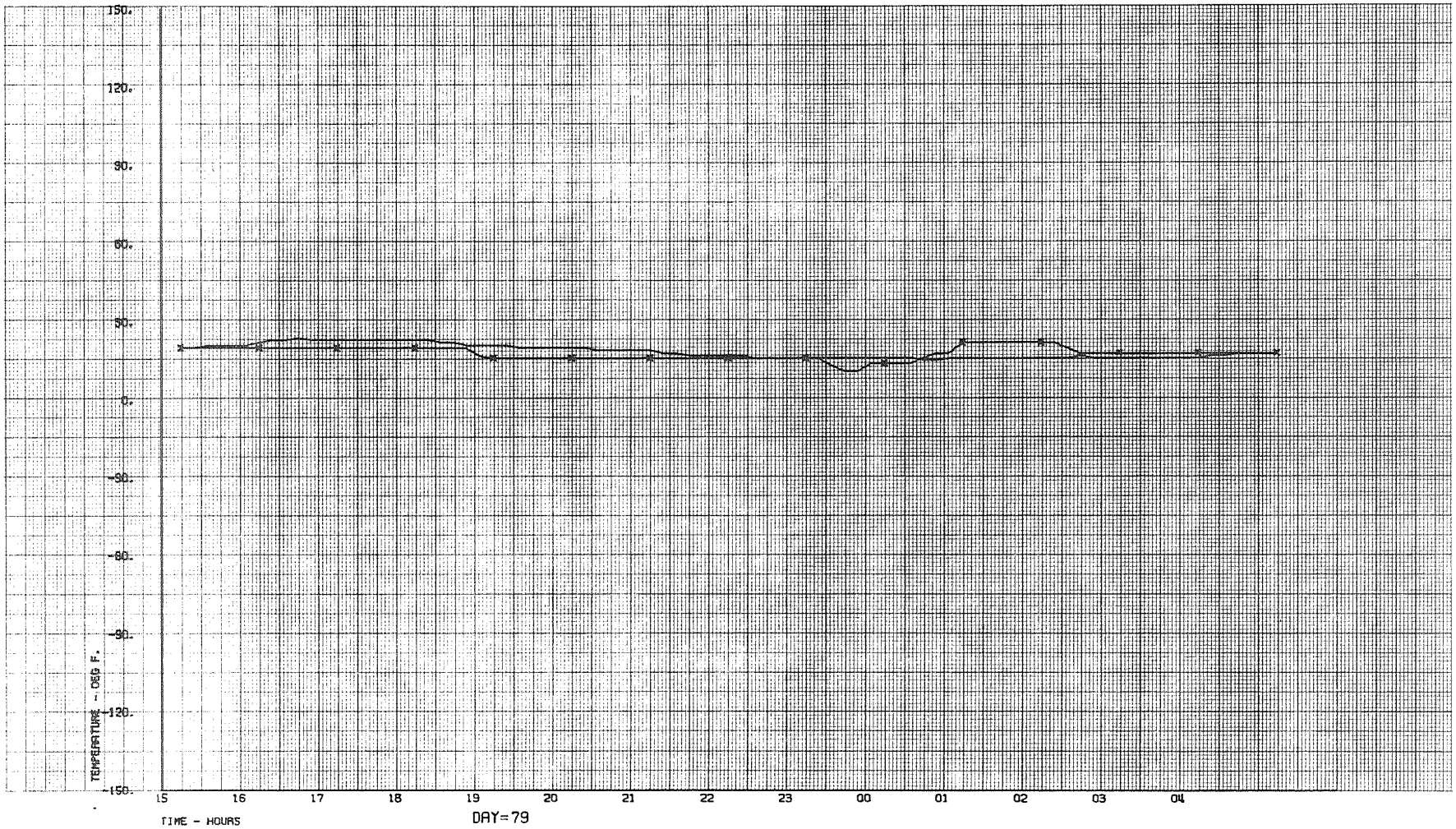
TW603


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-120.
-150.
TEMPERATURE - DEG F.
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16
17
18
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20
21
22
23
00
01
02
03
04
TIME - HOURS
DAY=79

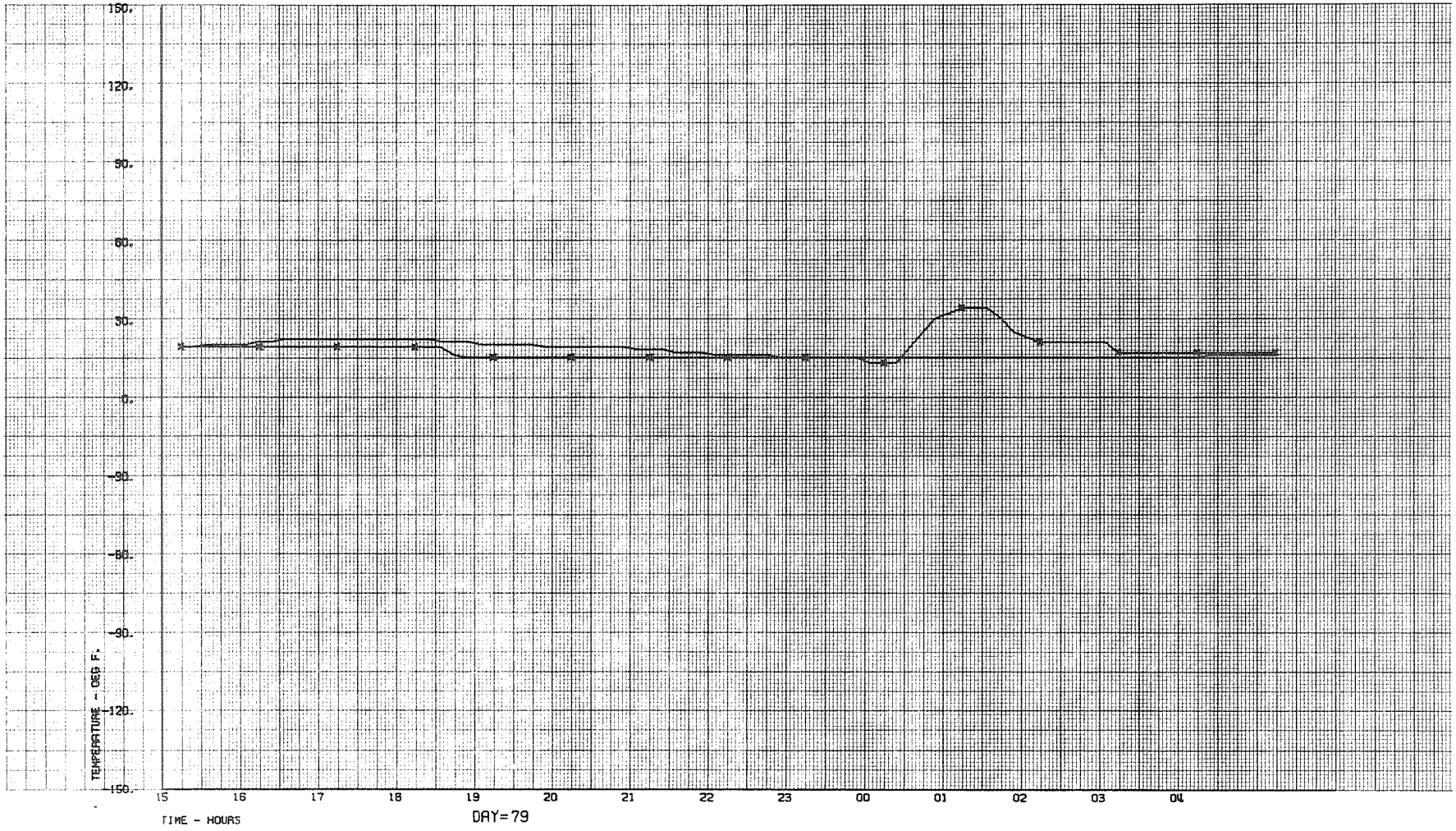
TP5138


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60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
15
16
17
18
19
20
21
22
23
00
01
02
03
04
TIME - HOURS
DAY=79

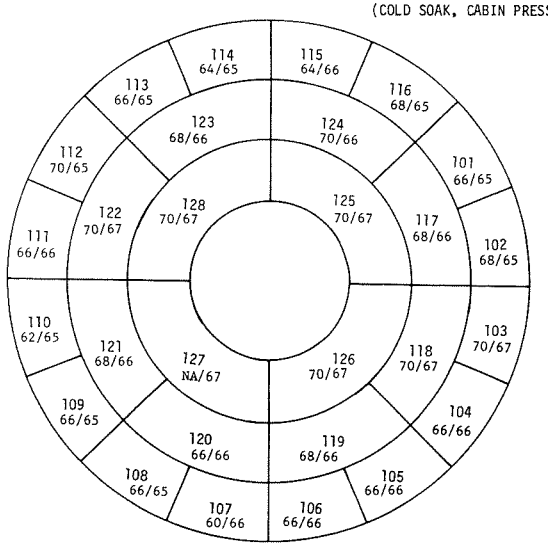
TP5139


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-90.
-120.
-150.
TEMPERATURE - DEG F.
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20
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22
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01
02
03
04
TIME - HOURS
DAY=79

TP4158

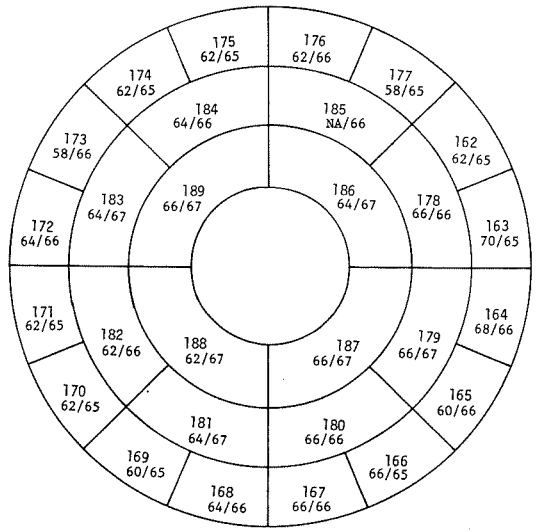

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
15
16
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04
TIME - HOURS
DAY=79

PRESSURE SHELL TEMPERATURES AT END OF PHASE F1
(COLD SOAK, CABIN PRESSURIZED, 100%-25%-1% INTERNAL HEATER POWER, MAXIMUM THCP FLOW)



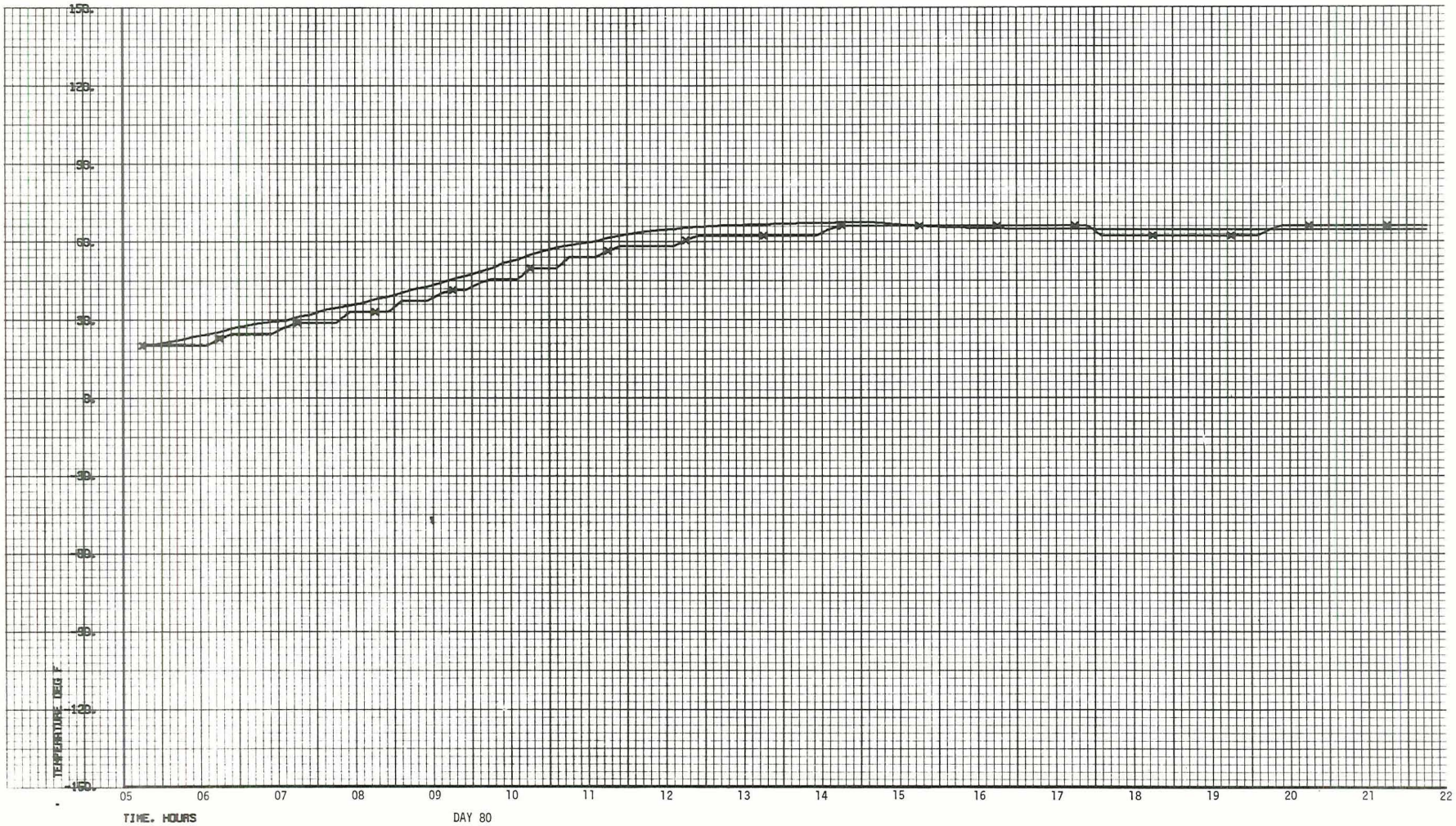
LEGEND

NODE NUMBER
ACTUAL/CALCULATED

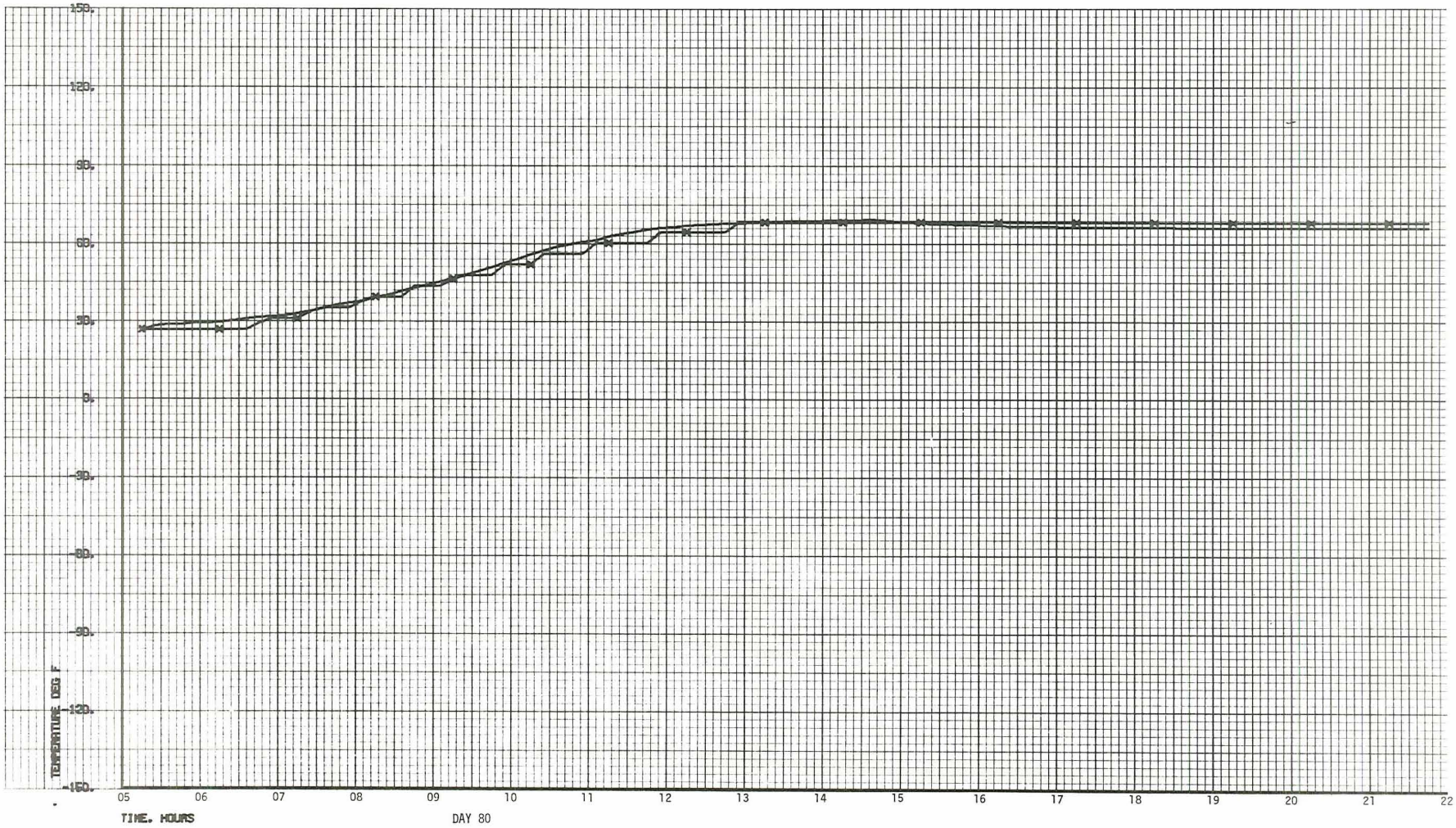


130 62/66	131 68/65	132 70/66	133 66/65	134 60/66	135 68/65	136 64/67	137 68/66	138 58/66	139 62/65	140 64/65	141 68/66	142 60/66	143 66/65	144 64/67	145 68/66
146 66/66	147 68/66	148 66/66	149 68/66	150 66/66	151 70/65	152 64/66	153 64/65	154 64/66	155 62/65	156 66/66	157 66/66	158 66/66	159 62/66	160 64/66	161 66/65

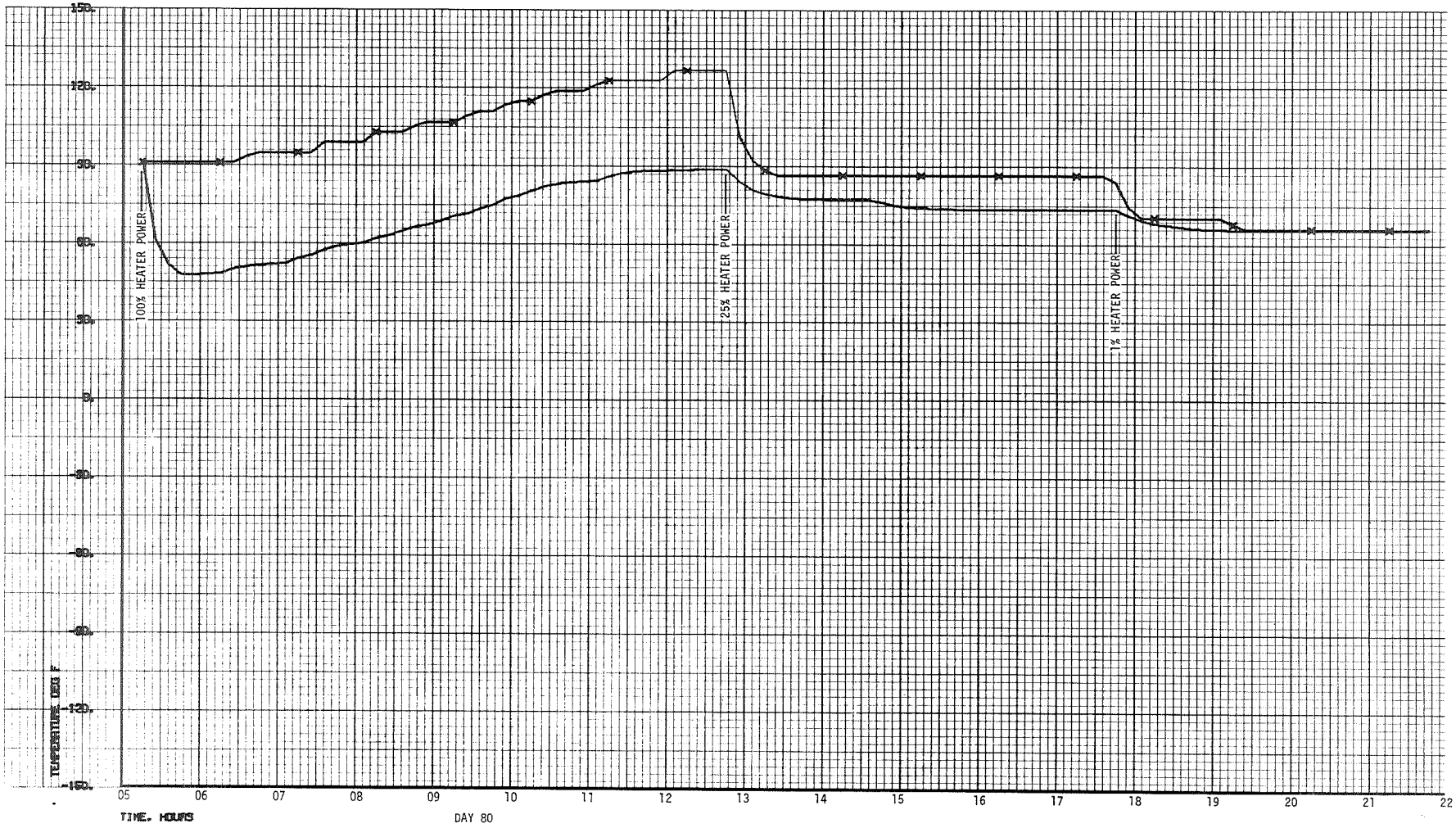
TP0109


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90.
60.
30.
0.
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-60.
-90.
-120.
-150.
TEMPERATURE DEG F
05
06
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10
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14
15
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17
18
19
20
21
22
TIME. HOURS
DAY 80

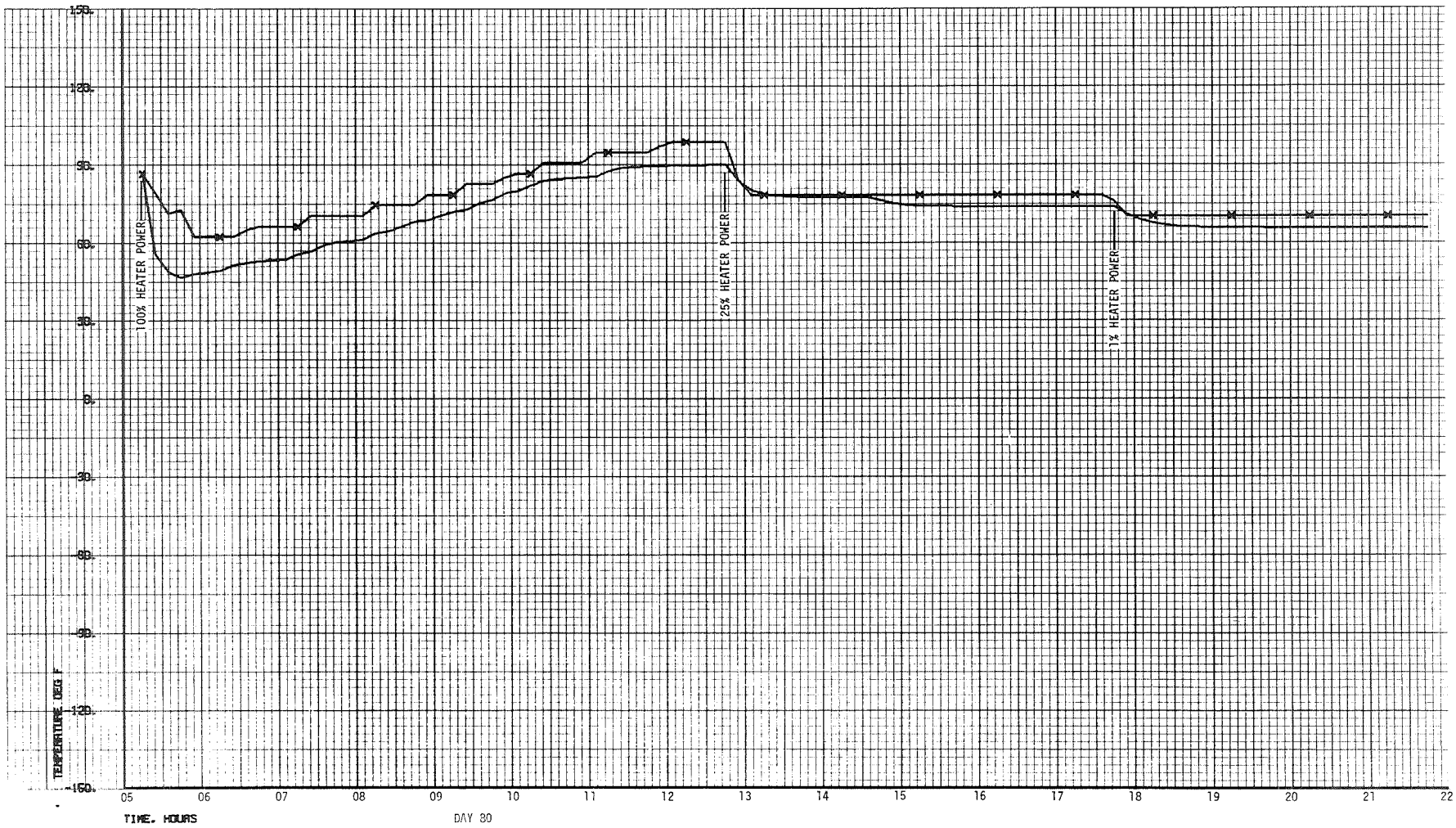
TP0117


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90.
60.
30.
0.
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-90.
-120.
-150.
TEMPERATURE DEG F
05
06
07
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10
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13
14
15
16
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19
20
21
22
TIME. HOURS
DAY 80

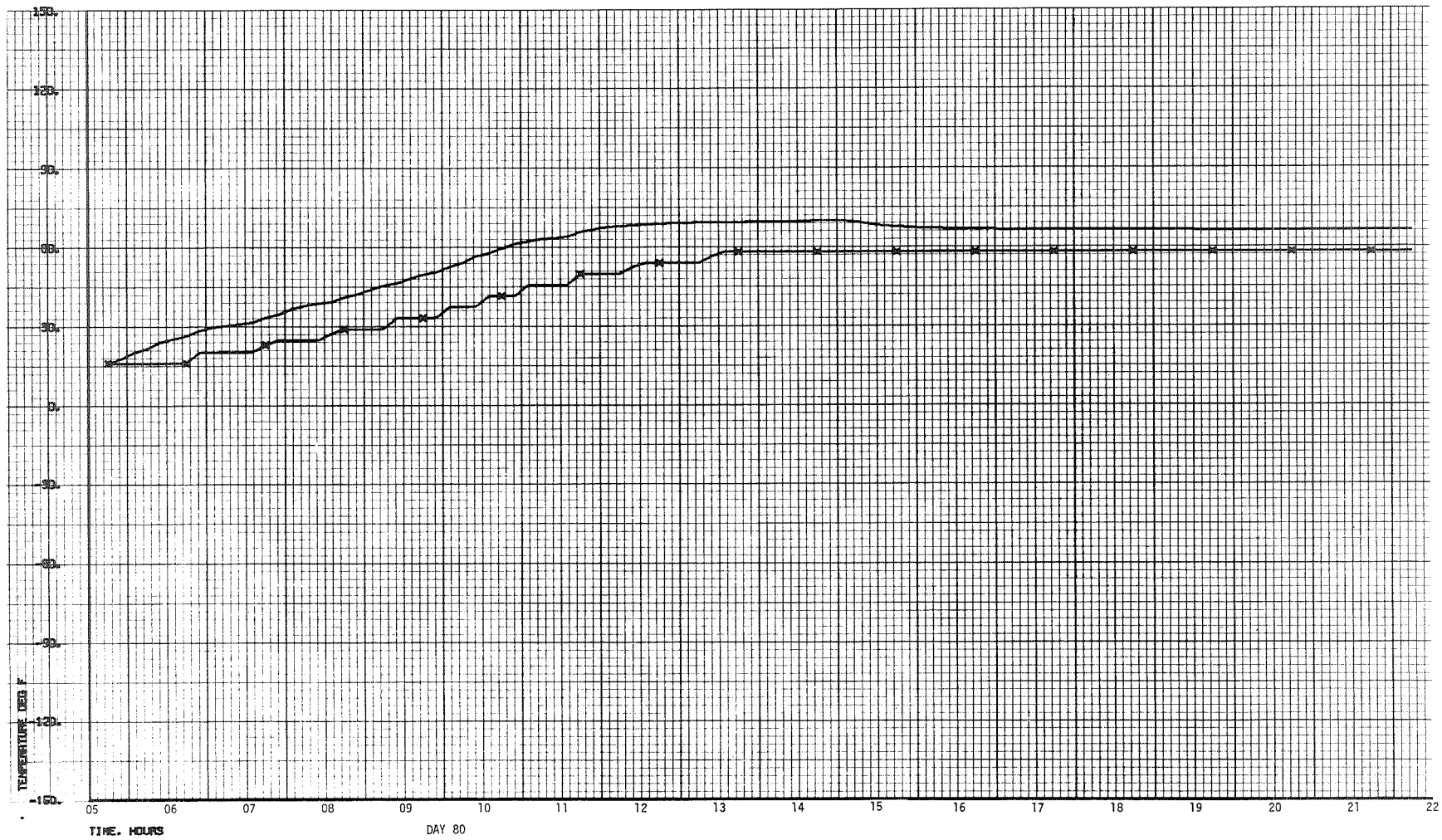
TP0148


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
100% HEATER POWER
25% HEATER POWER
1% HEATER POWER
05
06
07
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09
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12
13
14
15
16
17
18
19
20
21
22
TIME, HOURS
DAY 80

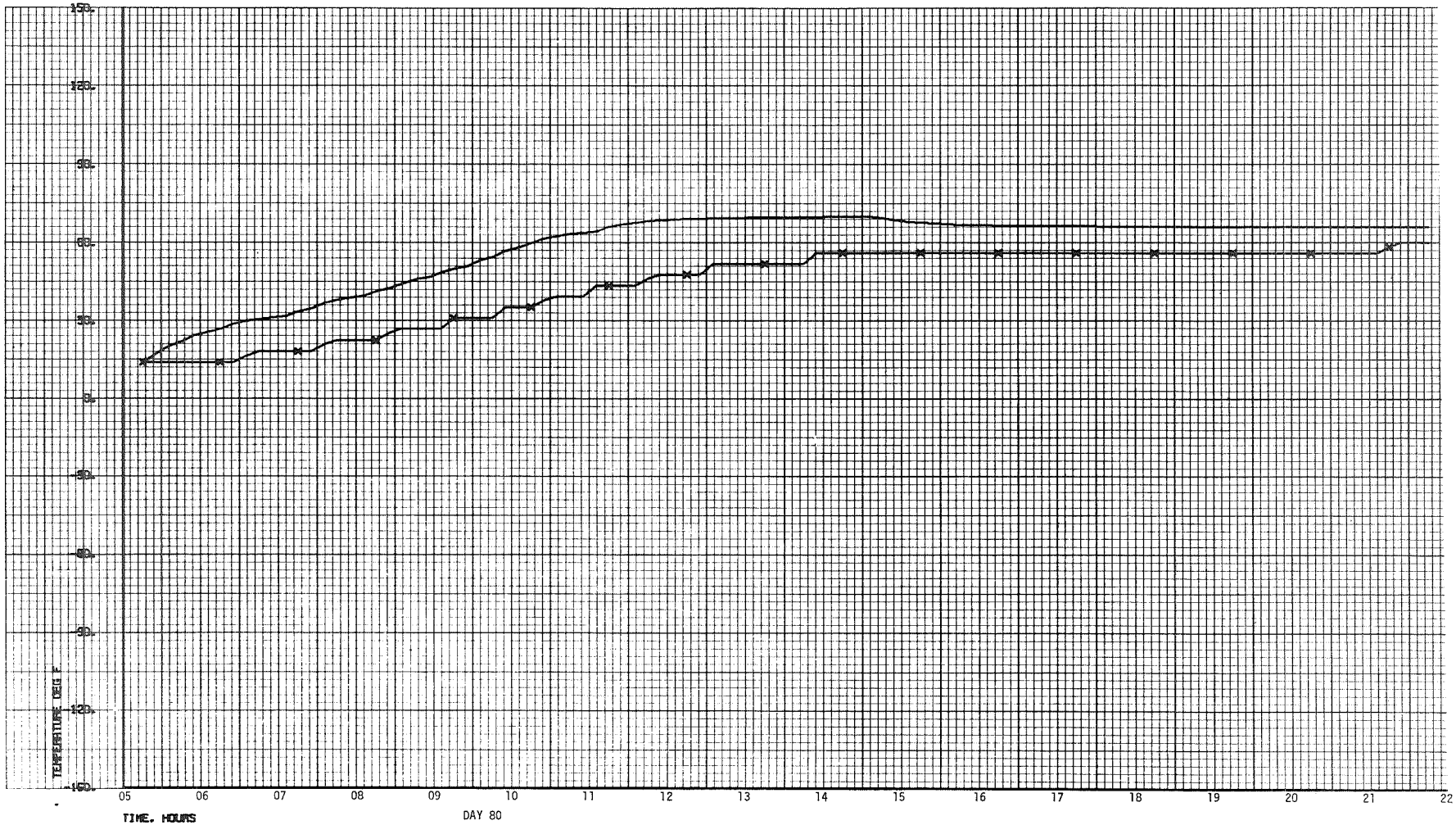
TP0132


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE, DEG F
100% HEATER POWER
25% HEATER POWER
1% HEATER POWER
05
06
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10
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12
13
14
15
16
17
18
19
20
21
22
TIME, HOURS
DAY 80

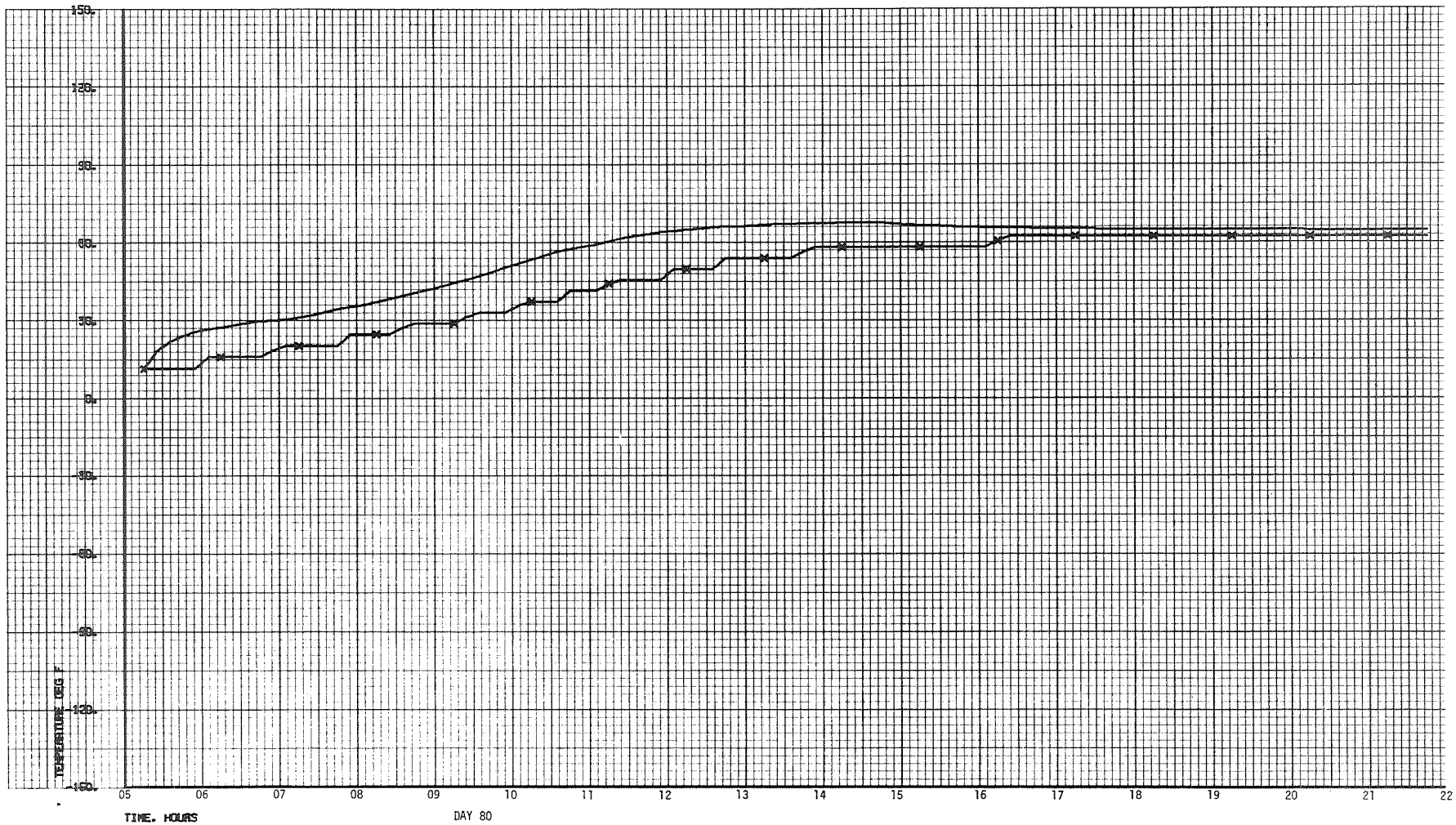
TP0138


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F.
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
TIME. HOURS
DAY 80

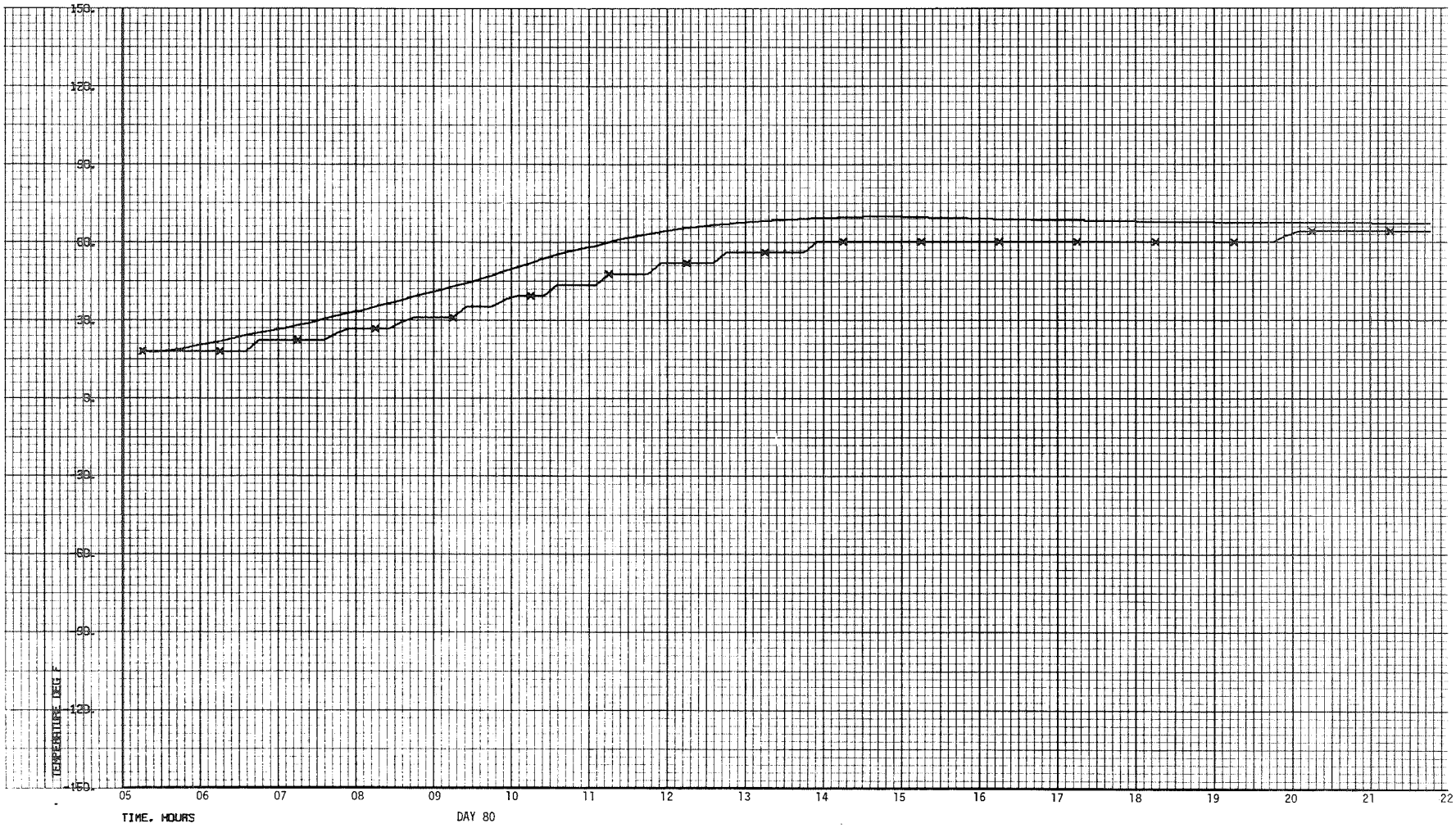
TP0142


TEMPERATURE DEG F
TIME. HOURS
DAY 80
05
06
07
08
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10
11
12
13
14
15
16
17
18
19
20
21
22

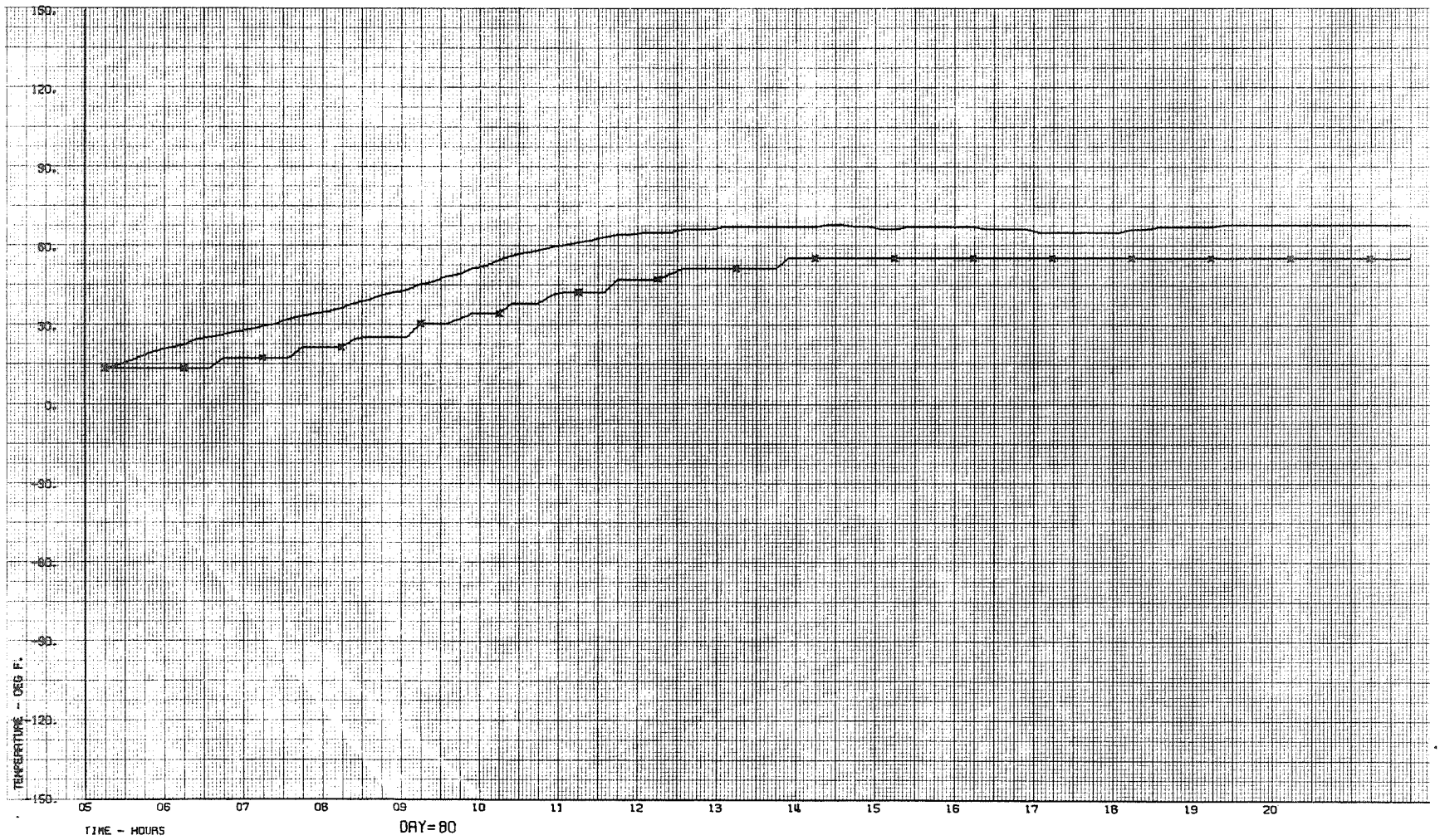
TP0170

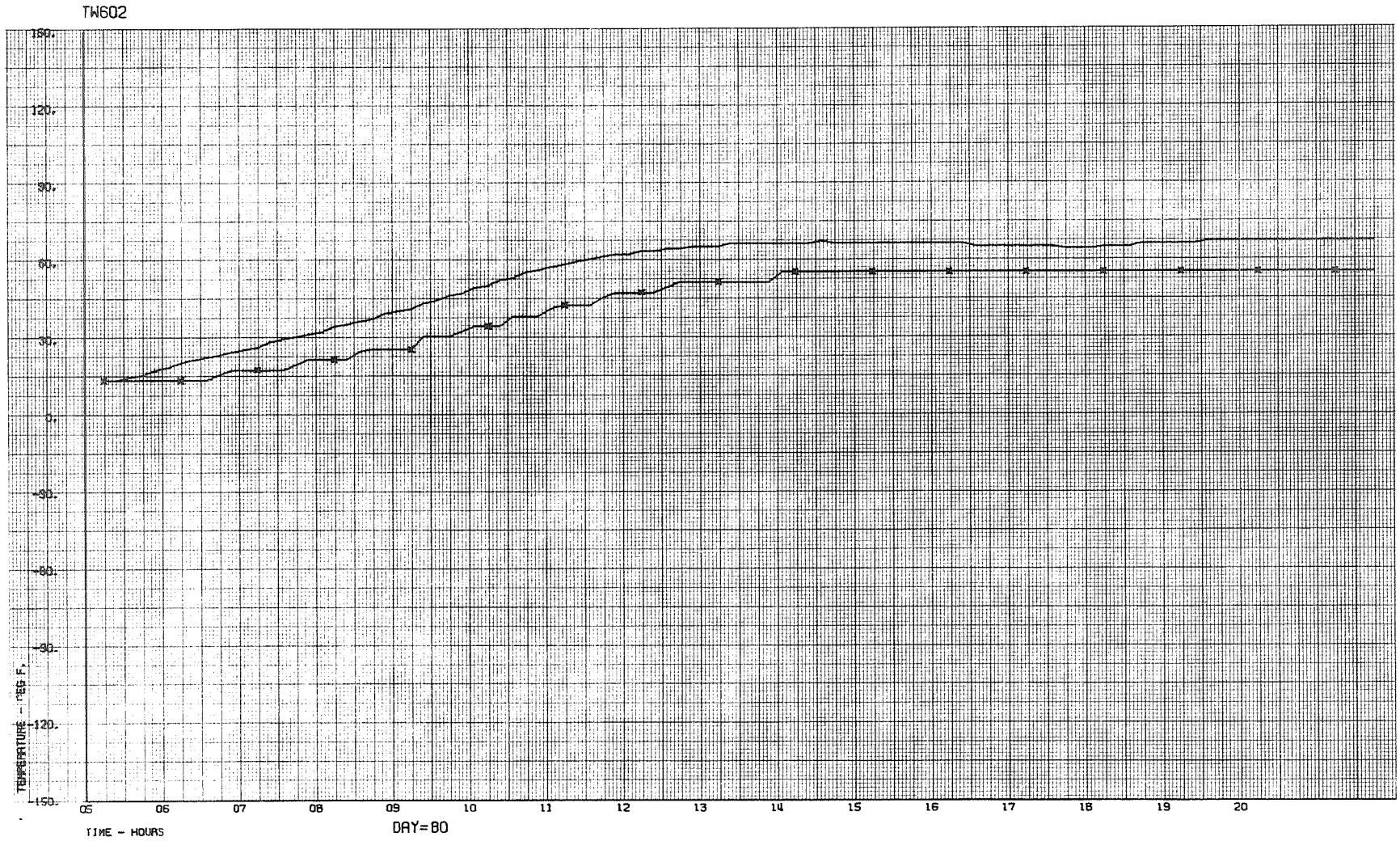

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
TIME. HOURS
DAY 80

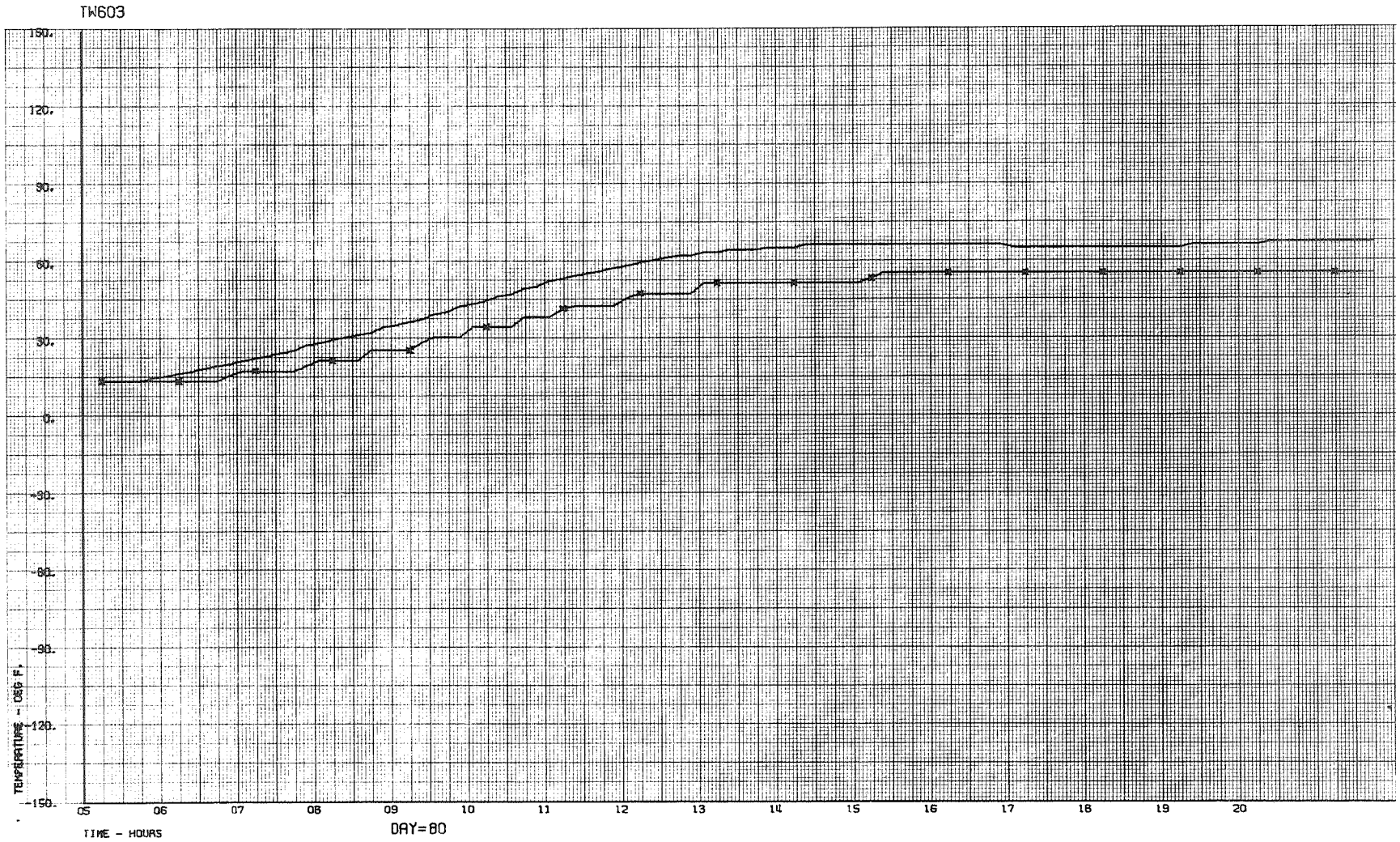
TH0522


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
TIME, HOURS
DAY 80

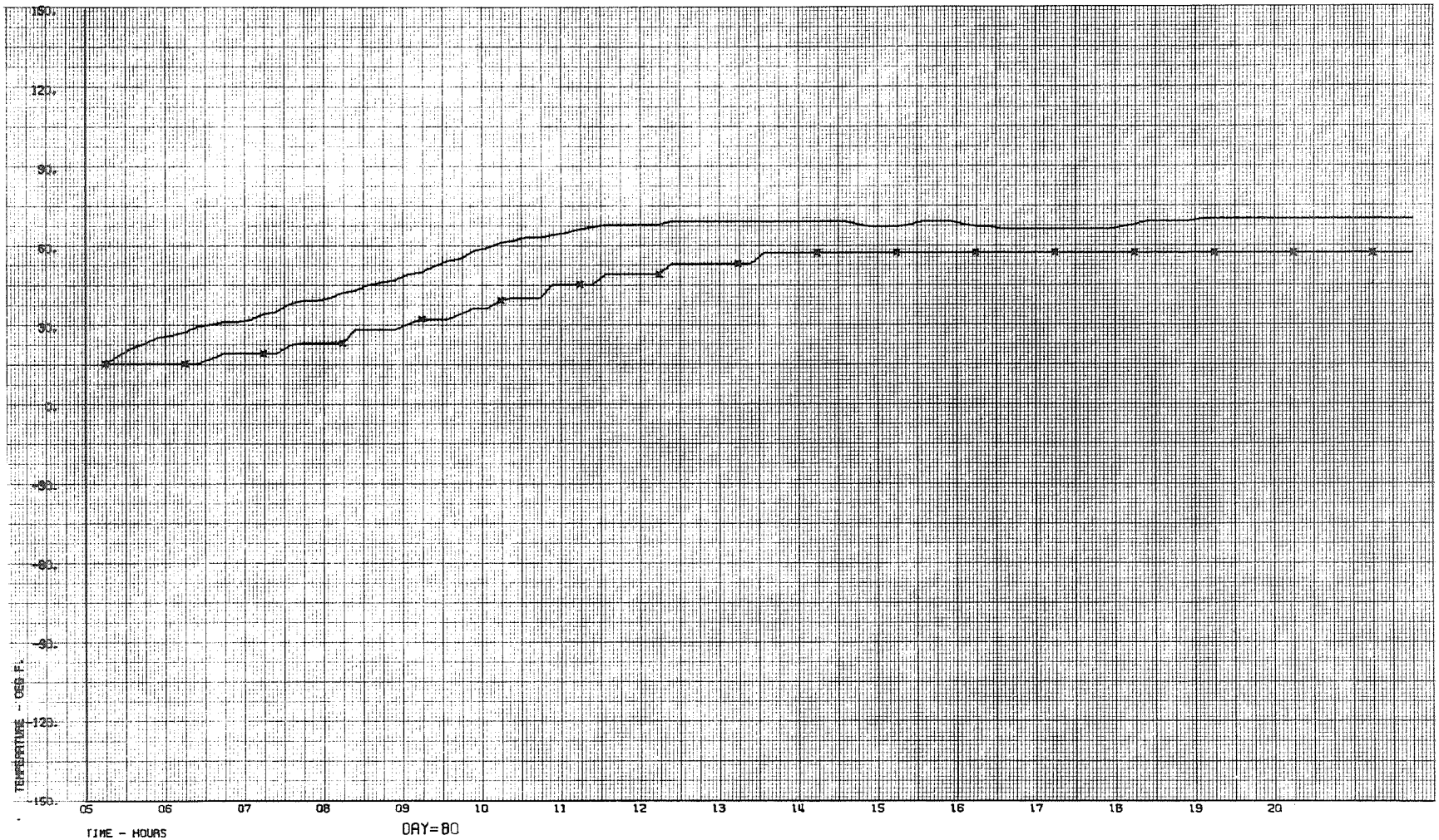
TW601


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
TIME - HOURS
DAY=80

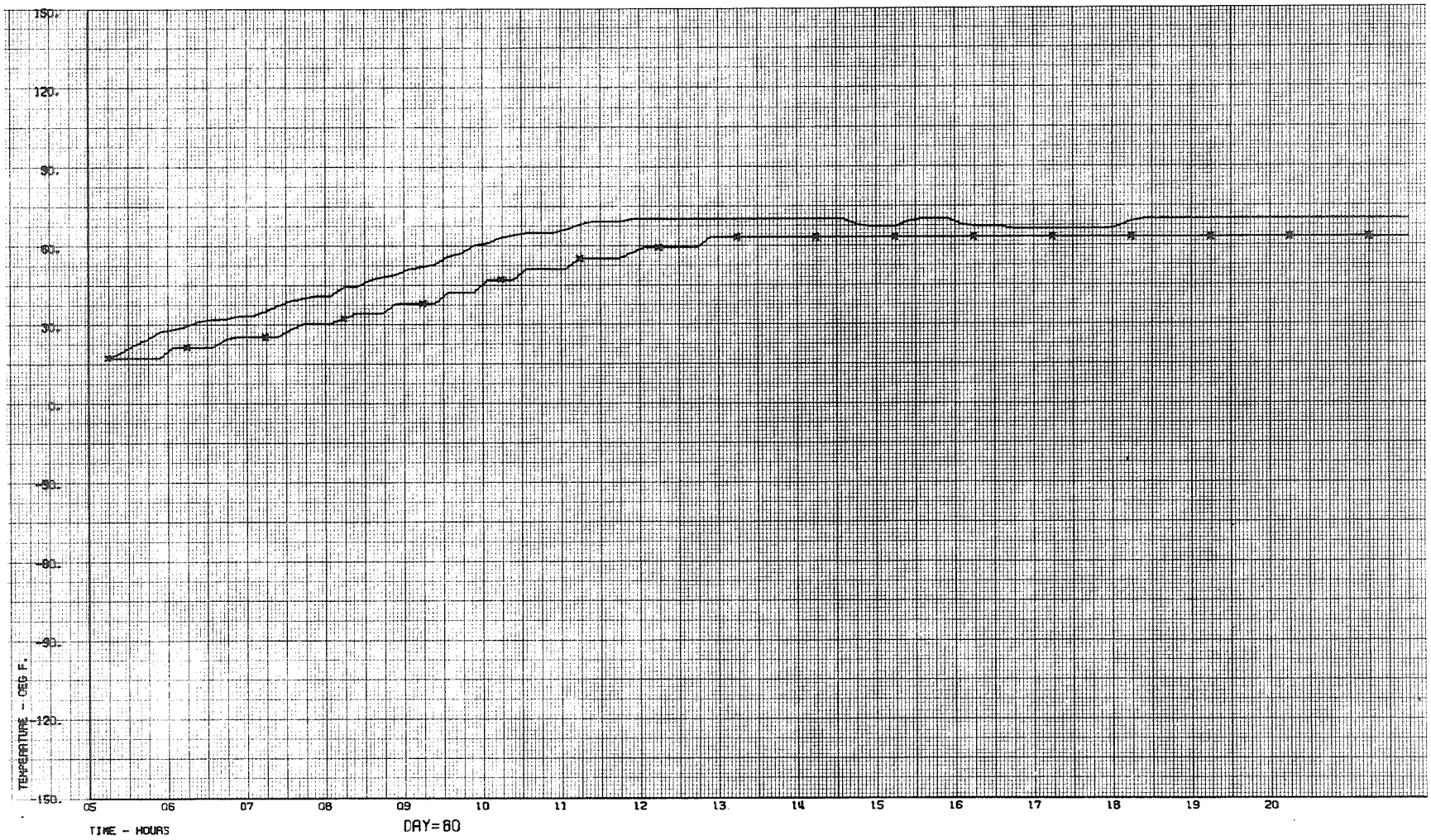

TW602
180.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
TIME - HOURS
DAY=80

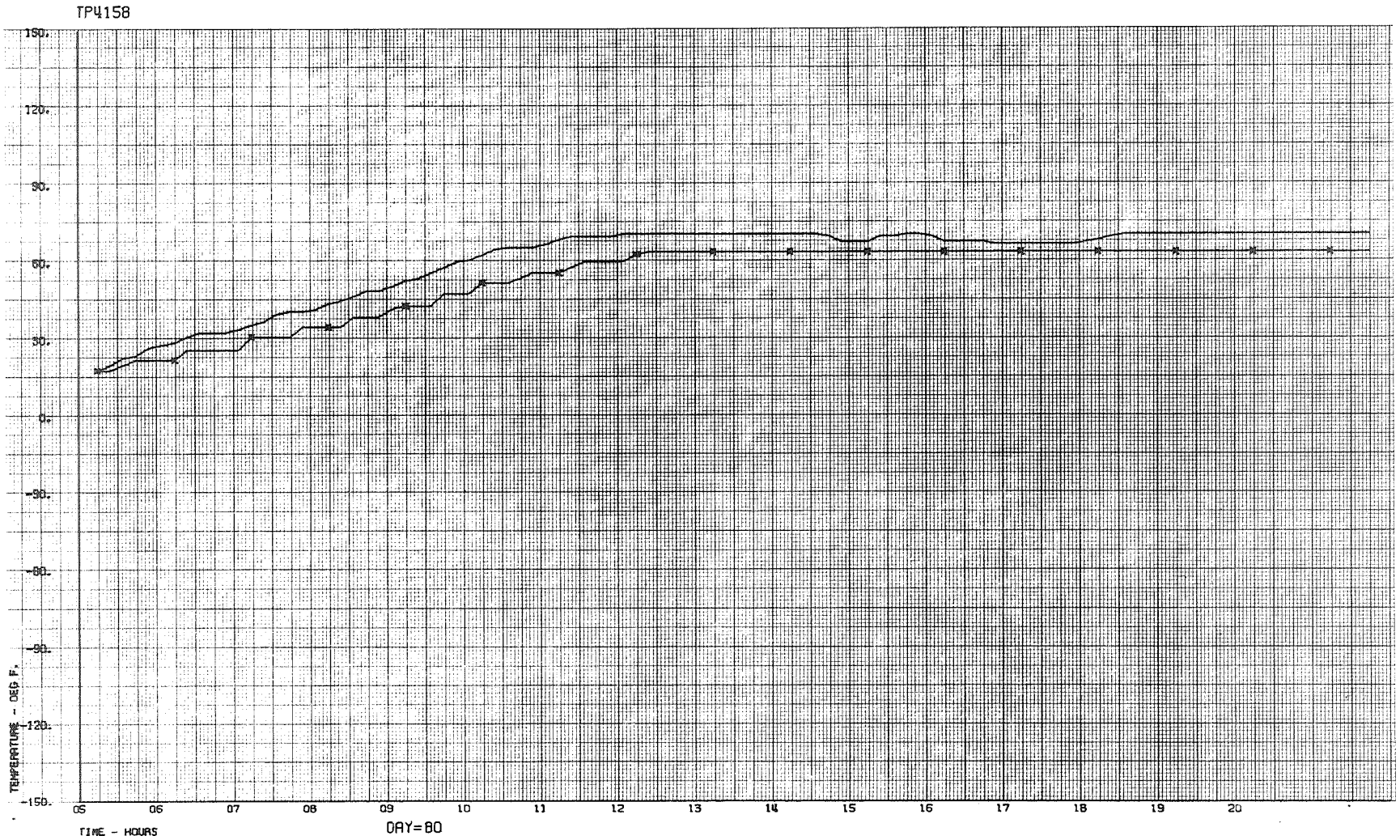

TW603
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
TIME - HOURS
DAY=80

TP5138

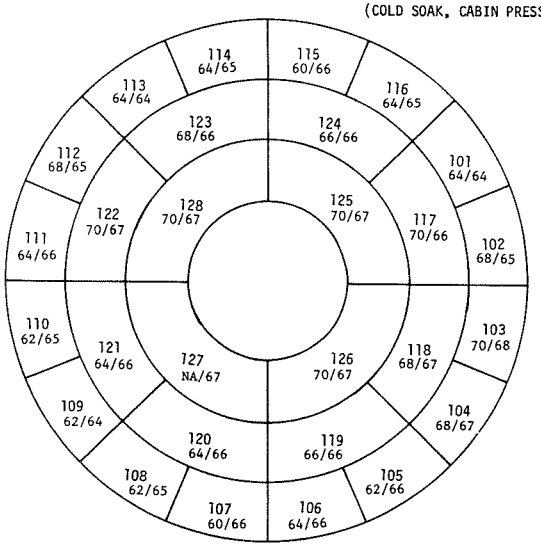

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
TIME - HOURS
DAY=80

TP5139


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
TIME - HOURS
DAY=80

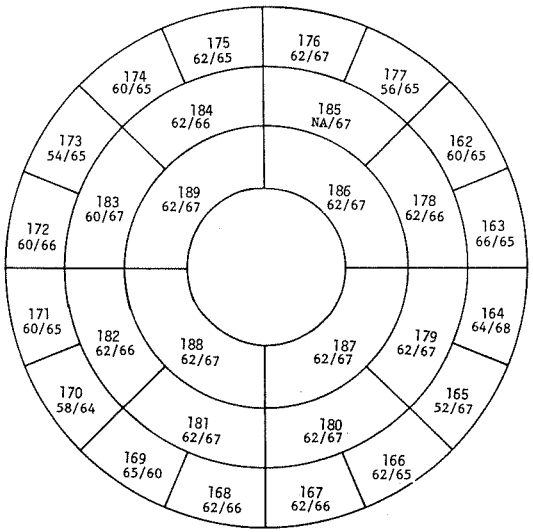

TP4158
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
TIME - HOURS
DAY=80

PRESSURE SHELL TEMPERATURES AT END OF PHASE F2
(COLD SOAK, CABIN PRESSURIZED, 100%-25%-1% INTERNAL HEATER POWER, MINIMUM THCP FLOW)

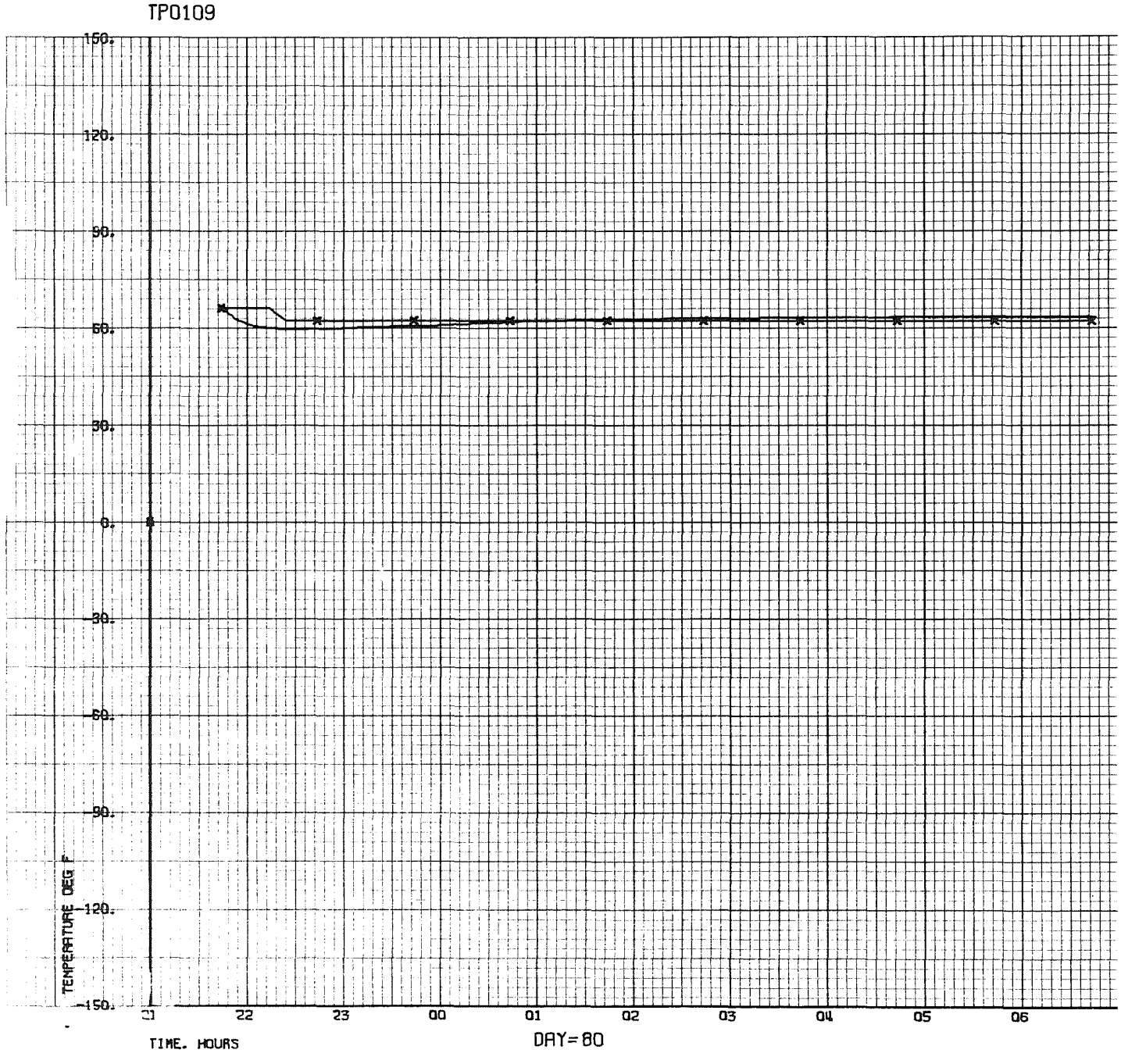


LEGEND

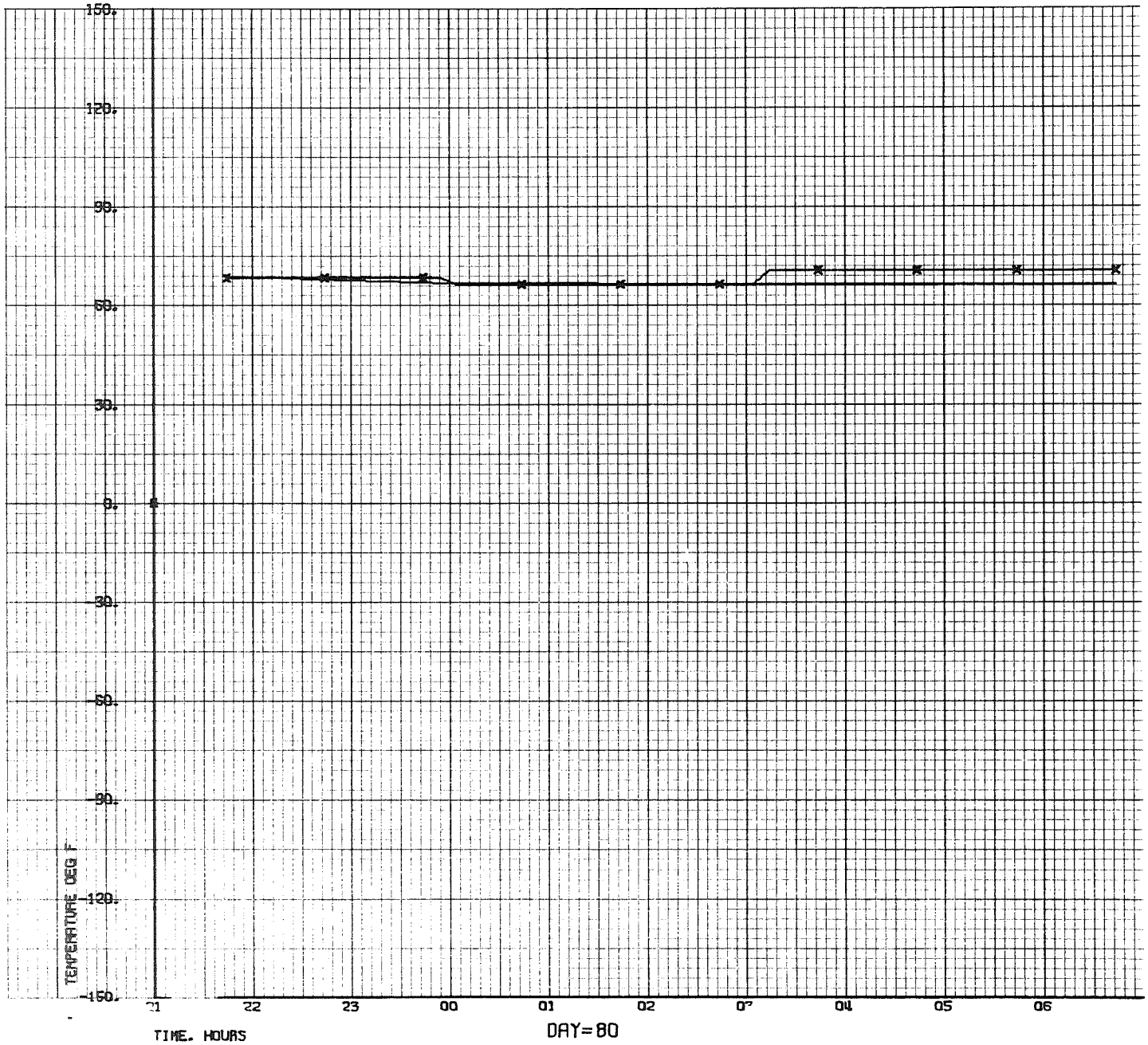
NODE NUMBER
ACTUAL/CALCULATED



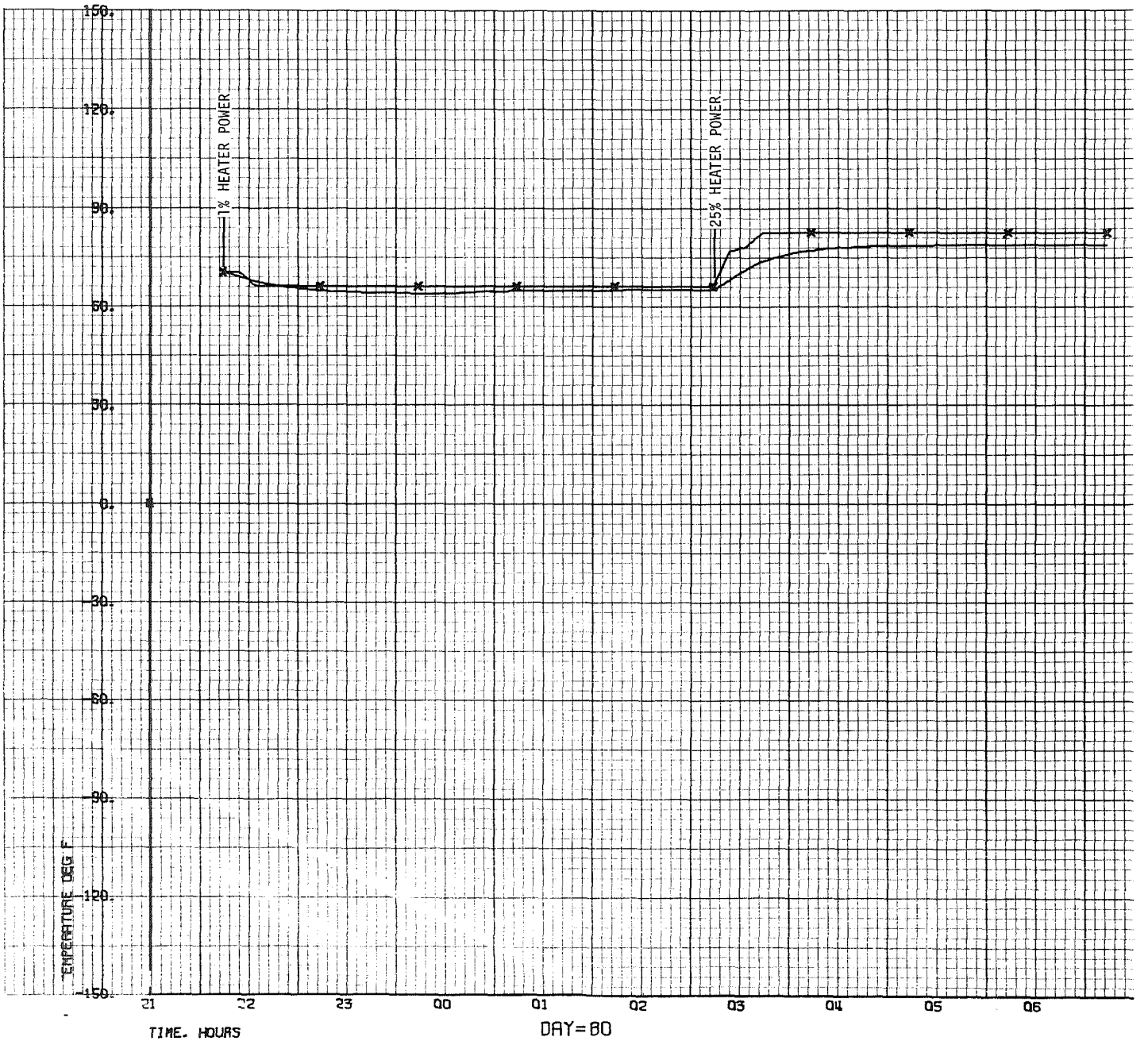
130 58/66	131 68/63	132 83/79	133 68/66	134 58/66	135 62/65	136 60/67	137 62/65	138 56/66	139 60/65	140 64/65	141 62/65	142 56/66	143 64/64	144 62/67	145 64/65
146 62/65	147 64/63	148 85/79	149 68/66	150 62/65	151 66/65	152 62/65	153 62/65	154 62/65	155 62/65	156 62/65	157 62/65	158 66/65	159 62/65	160 62/66	161 64/65


TP0109
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
21
22
23
00
01
02
03
04
05
06
TIME. HOURS
DAY=80

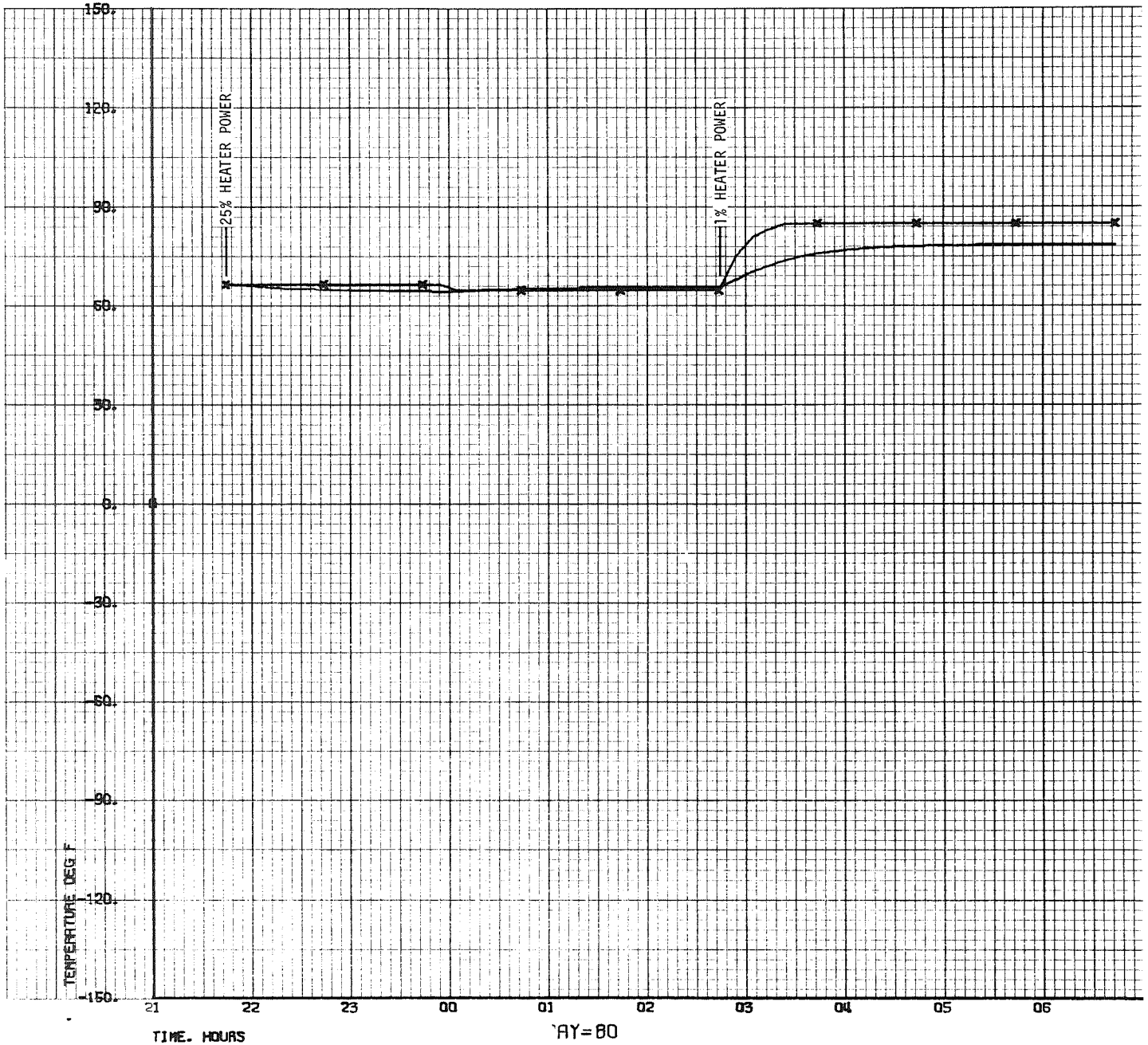
TP0117


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
21
22
23
00
01
02
03
04
05
06
TIME. HOURS
DAY=80

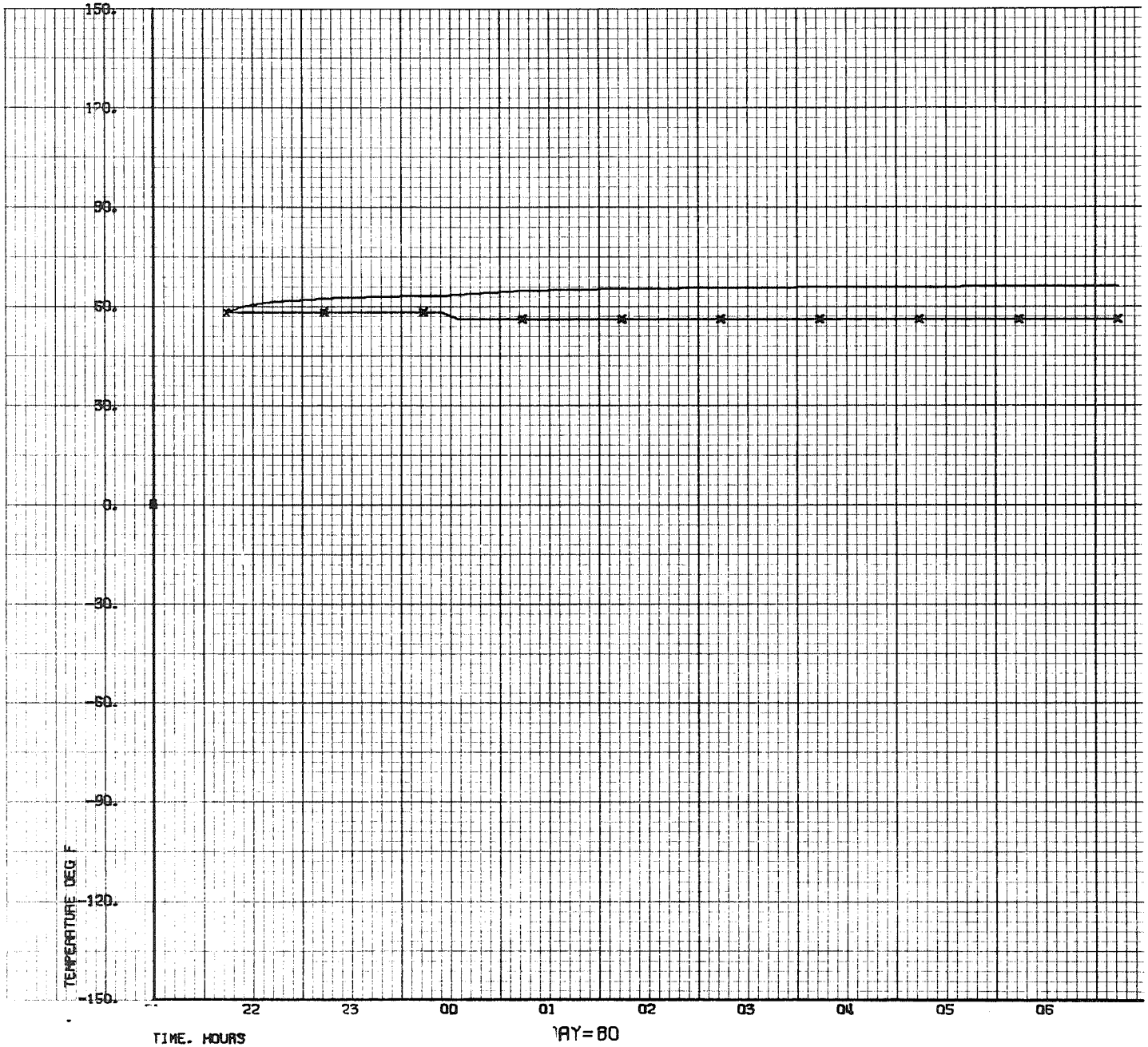
TP0132


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
1% HEATER POWER
25% HEATER POWER
TEMPERATURE DEG F
21
22
23
00
01
02
03
04
05
06
TIME. HOURS
DAY=80

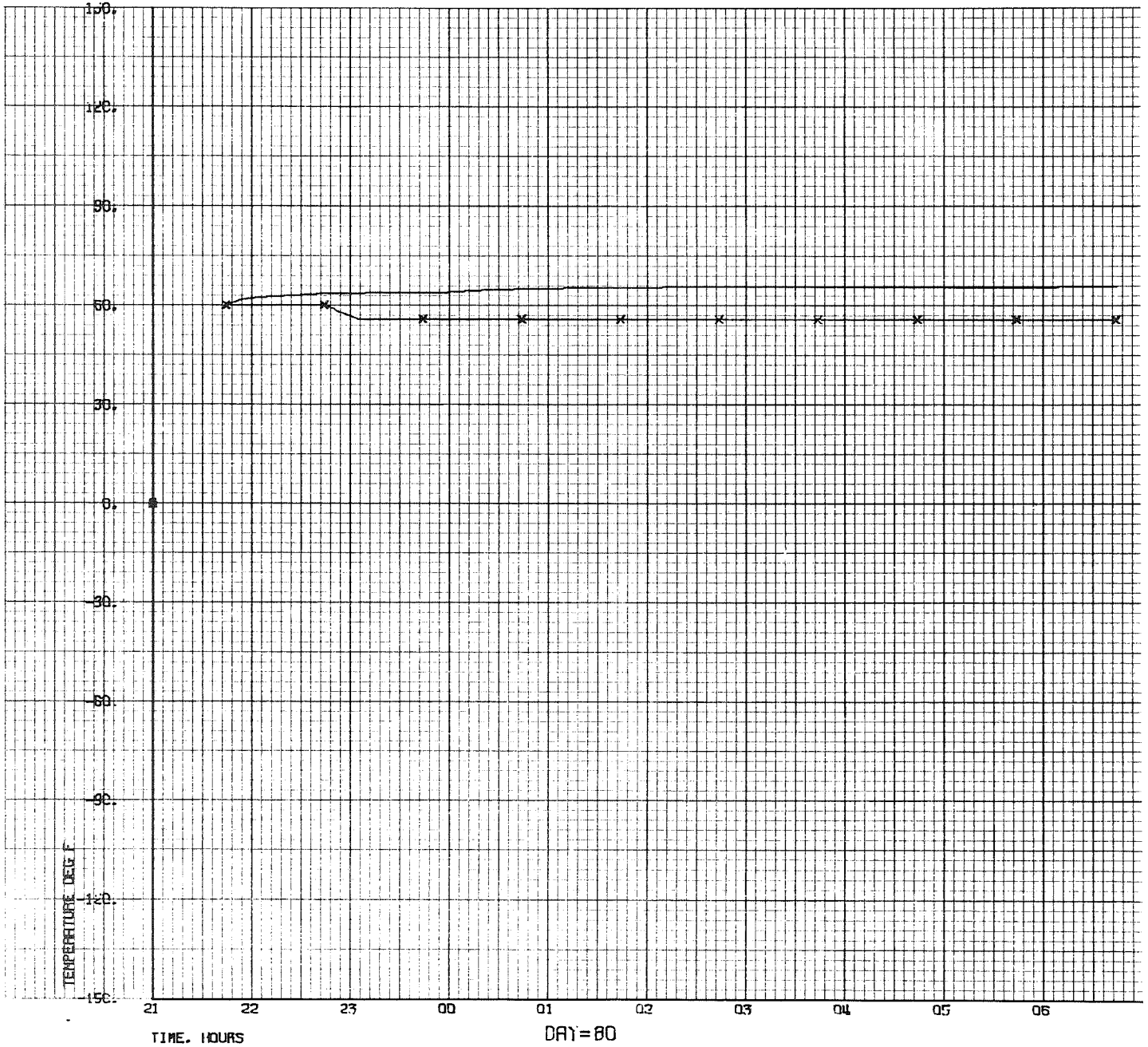
TP0148


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
25% HEATER POWER
1% HEATER POWER
TEMPERATURE DEG F
21
22
23
00
01
02
03
04
05
06
TIME. HOURS
`AY=80

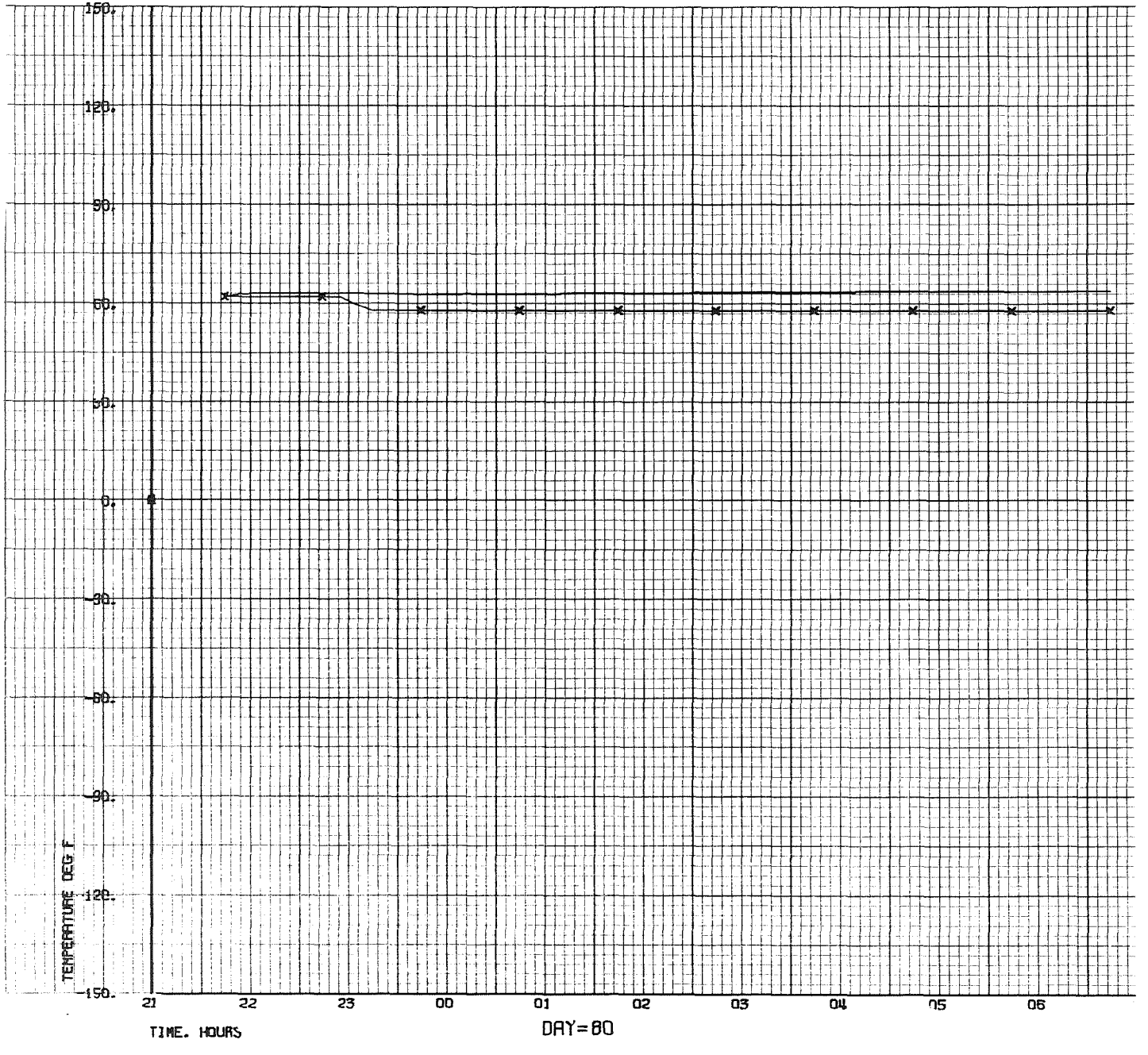
TP0138

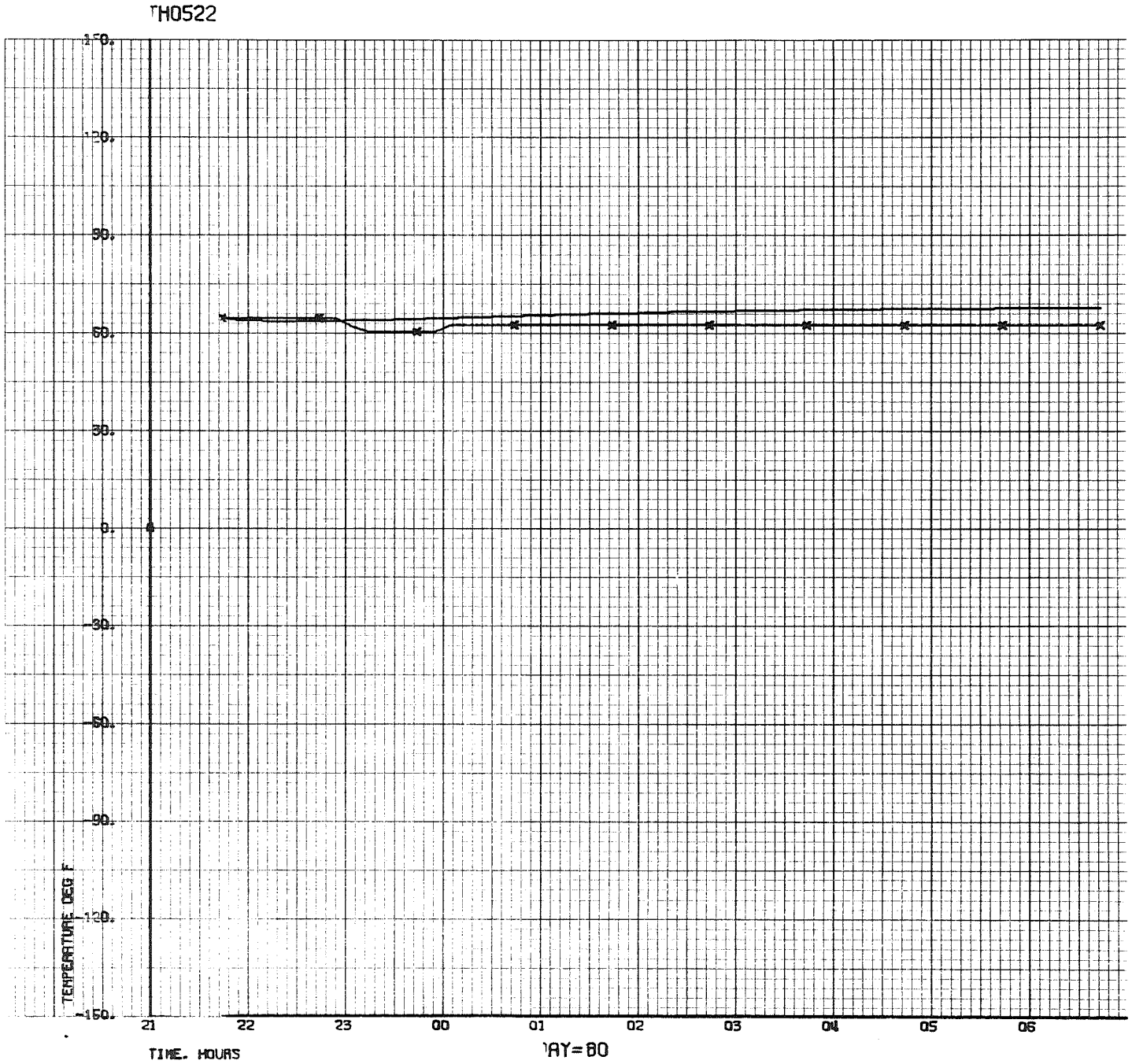

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
22
23
00
01
02
03
04
05
06
TIME. HOURS
DAY=80

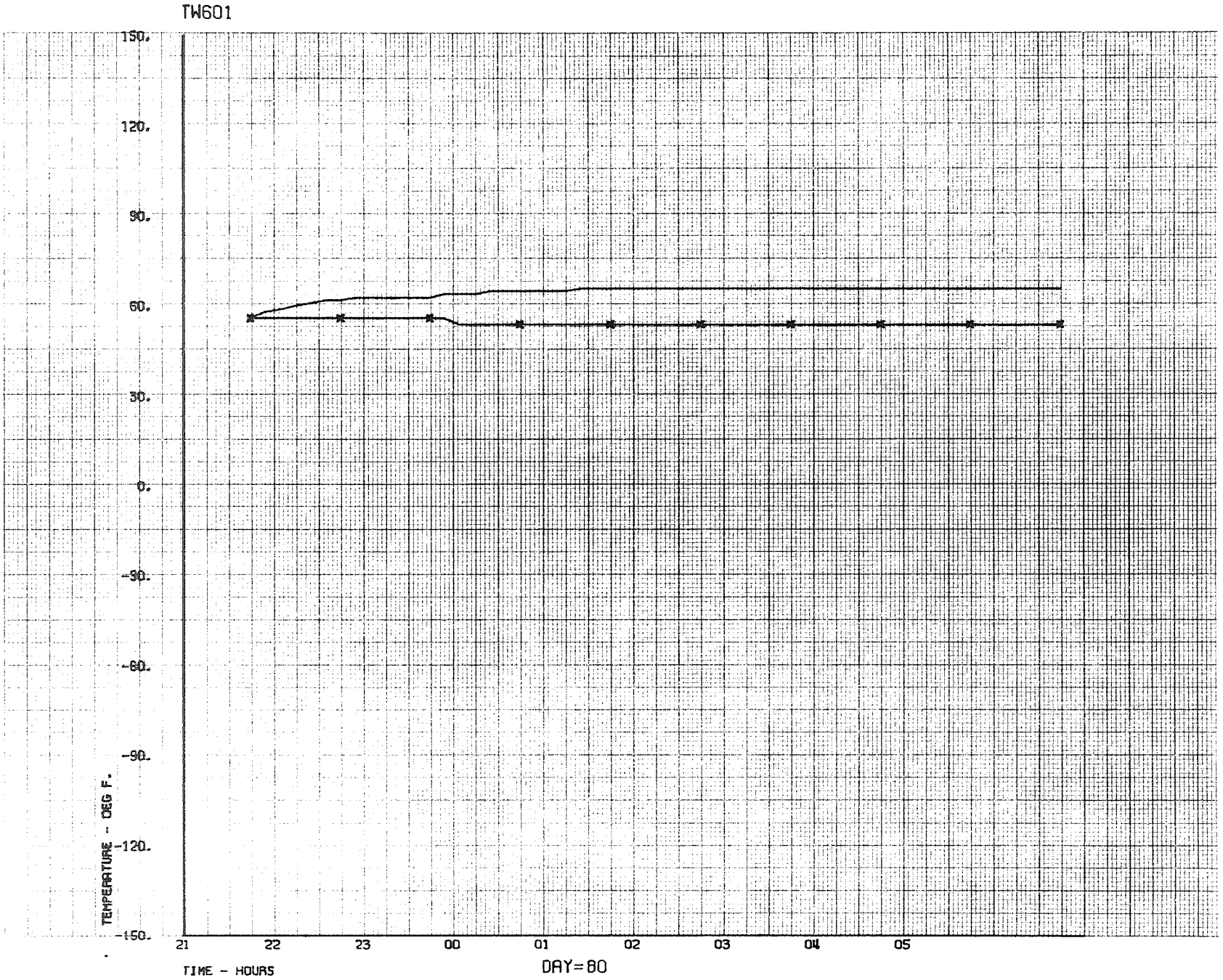
TP0142

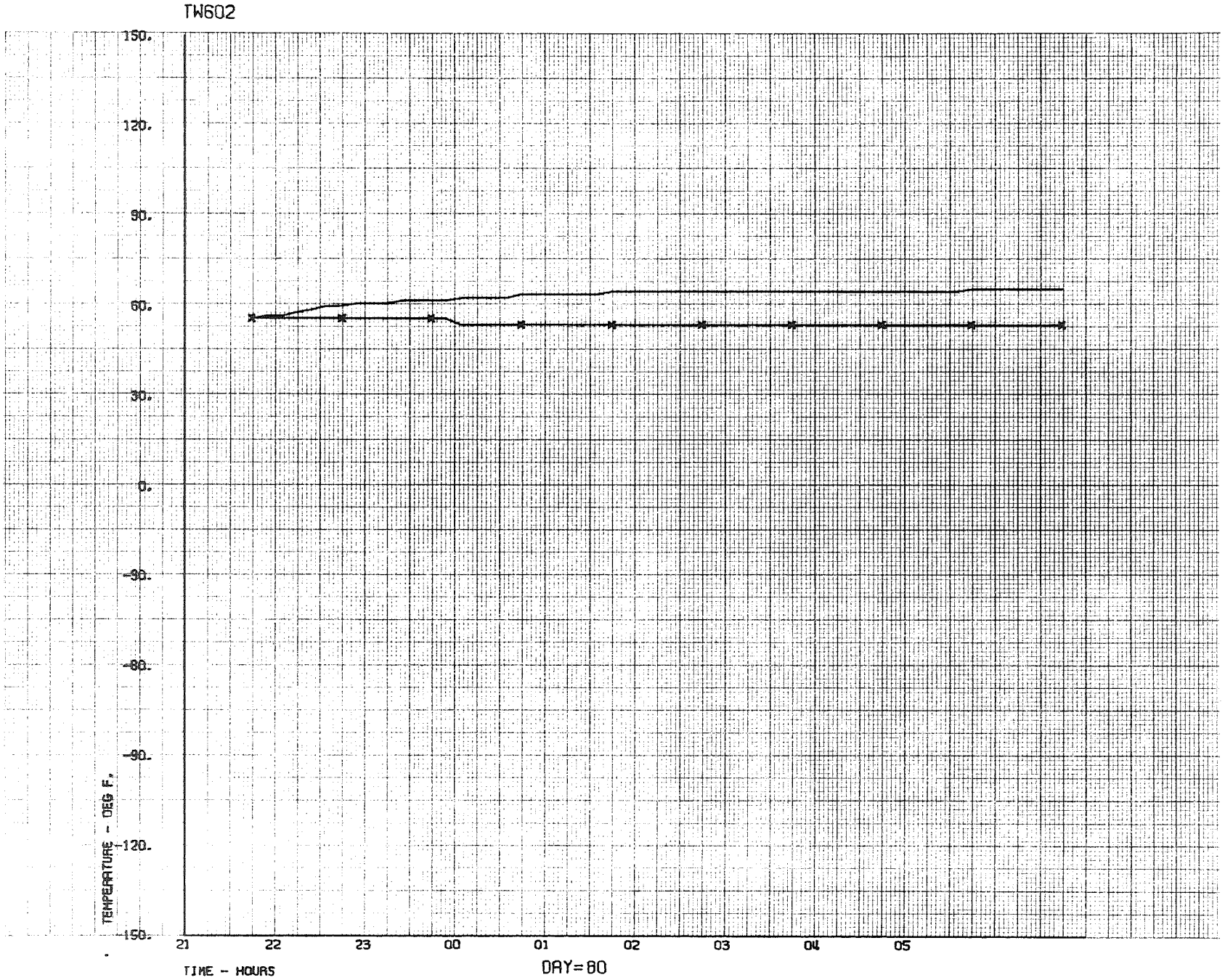

150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
21
22
23
00
01
02
03
04
05
06
TIME. HOURS
DAY=80

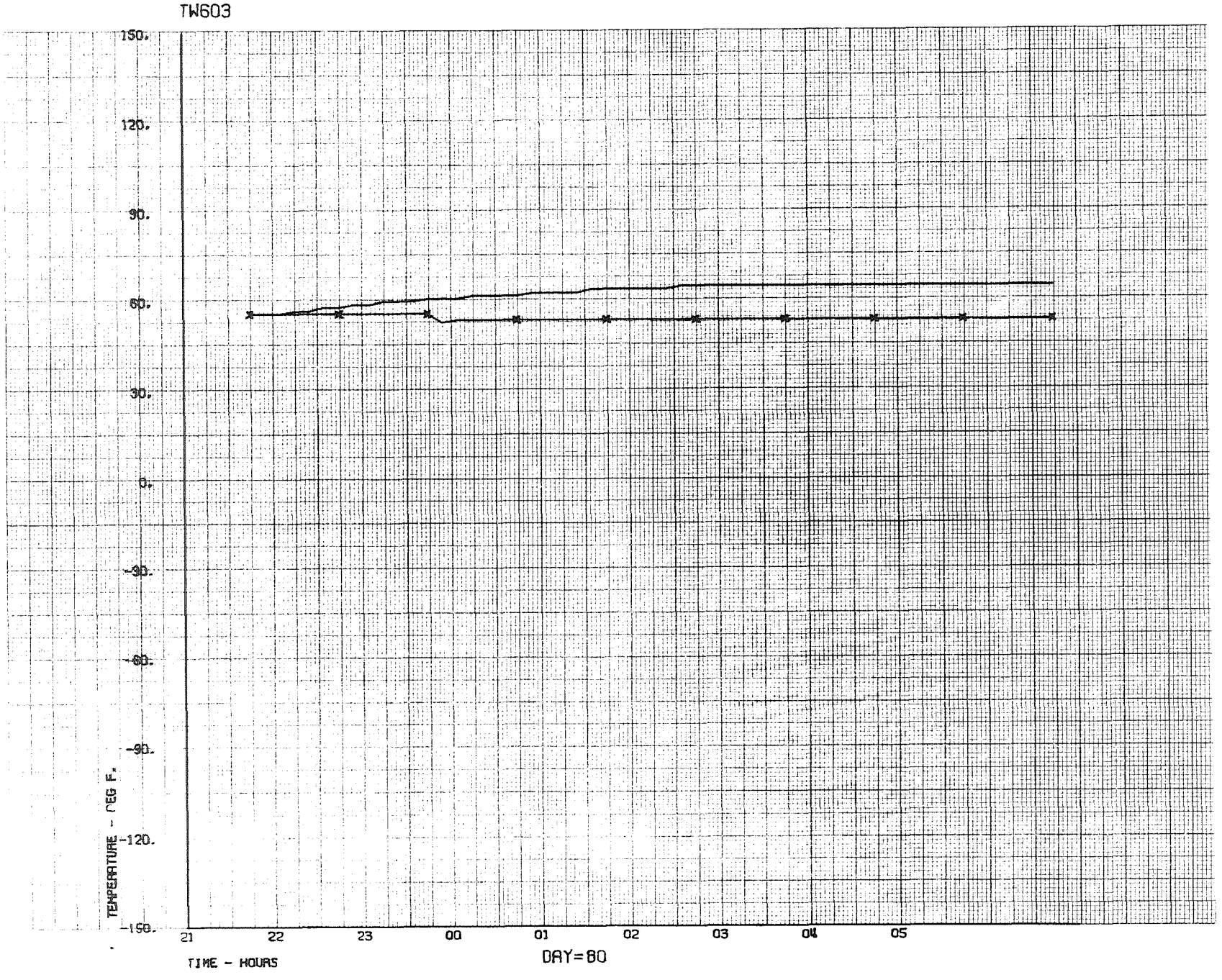
TP0170


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE DEG F
21
22
23
00
01
02
03
04
05
06
TIME. HOURS
DAY=80

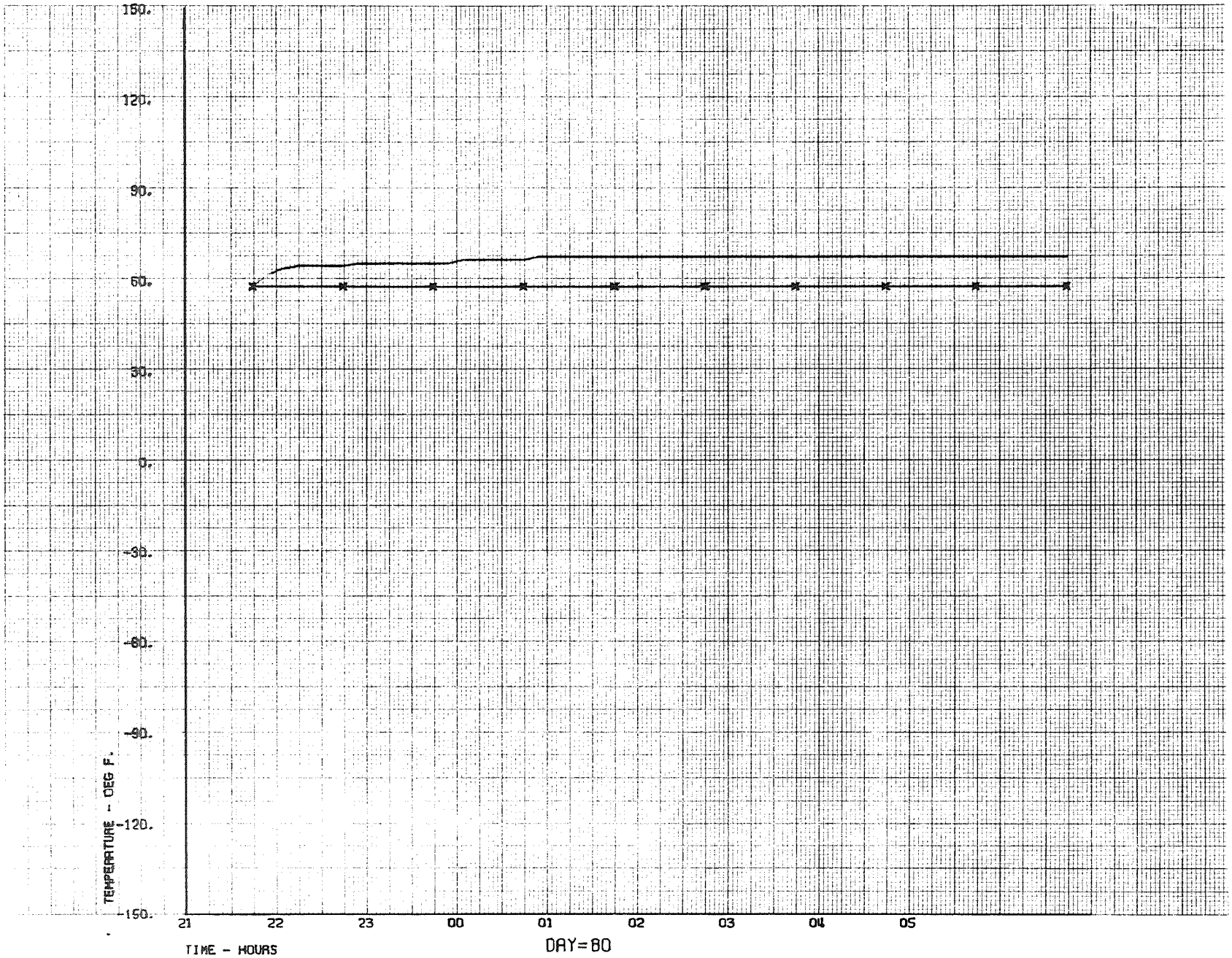

TH0522
150.
120.
90.
60.
30.
0.
-30.
-50.
-90.
-120.
-150.
TEMPERATURE DEG F
21
22
23
00
01
02
03
04
05
06
TIME. HOURS
AY=80


TW601
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
21
22
23
00
01
02
03
04
05
TIME - HOURS
DAY=80

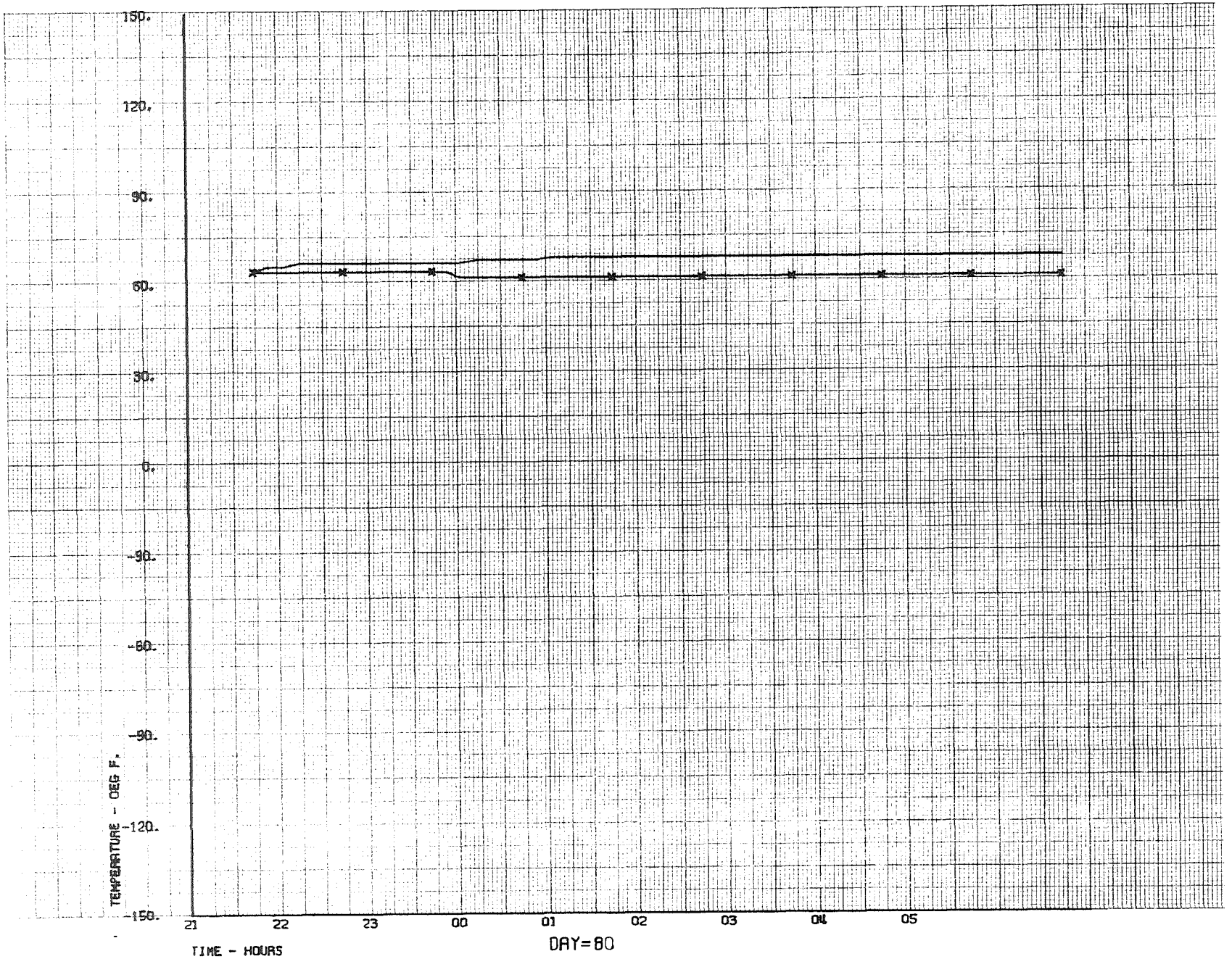

TW602
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120.
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30.
0.
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-60.
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TEMPERATURE - DEG F.
21
22
23
00
01
02
03
04
05
TIME - HOURS
DAY=80

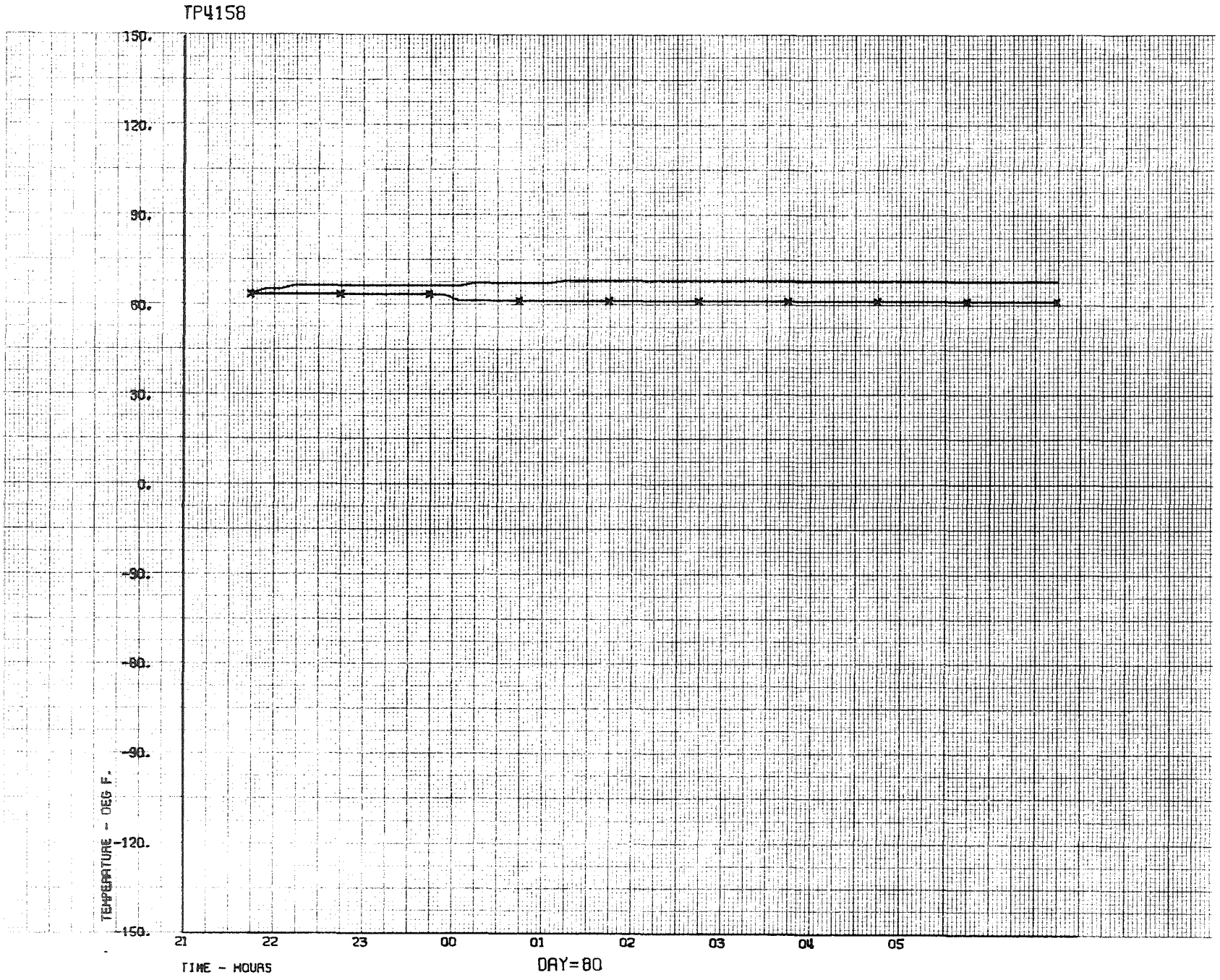

TW603
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
21
22
23
00
01
02
03
04
05
TIME - HOURS
DAY=80

TP5138


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
21
22
23
00
01
02
03
04
05
TIME - HOURS
DAY=80

TP5139


150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
21
22
23
00
01
02
03
04
05
TIME - HOURS
DAY=80


TP4158
150.
120.
90.
60.
30.
0.
-30.
-60.
-90.
-120.
-150.
TEMPERATURE - DEG F.
21
22
23
00
01
02
03
04
05
TIME - HOURS
DAY=80