DATA CHANGE NOTIFICATION FORM
CSM/LM SPACECRAFT OPERATIONAL DATA BOOK

SNA-8-D-027

VOLUME V **PART** _____ **DATE** December 1, 1972

PAGE 1 **OF** 32

AMENDMENT 15

SHORT TITLE OF CHANGE Specific changes and additions to technical data pertaining to the Apollo 17 lunar surface experiments.

CHANGE DESCRIPTION

Insert revised pages:

F-6-2
F-6-15
F-7-4
F-10-3
F-10-15
F-10-17

Insert new pages:

F-6-6.1
F-6-6.2
F-10-18 through
F-10-33 (16 graphs)
F-12-3

See Below
ASPO Systems Engineering
APPROVAL

PHONE 483-3441

Lunar Experiments Project Office
APPROVAL

PHONE 483-3827

NASA COMMENTS

James R. Bates
NASA SUBSYSTEM APPROVAL

PHONE 483-2711

ASPO Systems Engineering PD9

J. W. Mistrot 4667
CHANGE AUTHORITY PD4 EXT

ASPO APPROVAL, J. R. SEVIER,
CHIEF, OPERATIONS ANALYSIS BR.

DATE 12/1/72

MSC FORM 1794 (AUG 69) REV 2

VOLUME V

REVISIONS

REV.	AMEND. NO.	DESCRIPTION	DATE	APPROVAL
	7	Insert revised pages C-3-41, C-3-52, C-4-19, C-4-20, C-5-11, C-5-12, C-5-13	1/25/71	MOB
	8	Add Appendix D for Apollo 15 ALSEP, Array A-2	6/1/71	OAB
	9	Insert new or revised pages D-2-4, D-2-15, D-3-24, D-3-26, D-3-28, D-3-29, D-3-30, D-3-31 D-3-32, D-3-33, D-3-34, D-3-34.1, D-3-35, D-3-36, D-3-37, D-3-74, D-3-77, D-3-78, D-3-82, D-3-83, D-3-84, D-3-84.1, D-3-86.1, D-3-86.2, D-4-1, D-4-3, D-4-3.1, D-4-13, D-5-8, D-5-22, and D-5-24.	7/21/71	OAB
	10	Add Appendix E for Apollo 16 ALSEP Array D	3/8/72	OAB
	11	Insert revised pages E-2-10, E-3-16, E-3-17; add new page E-4-17.1	3/24/72	OAB
	12	Insert revised page E-3-21.2	4/1/72	OAB
	13	Add APPENDIX F for Apollo 17 Lunar Surface Experiments	10/17/72	OAB
	14	Insert revised pages F-3-14, F-3-41, F-4-20, F-5-5, F-6-11, F-7-1, F-7-4, F-7-10, F-8-8, F-8-10, F-9-9, F-10-1, F-10-3, F-10-4, F-12-1, F-12-2; add new pages F-8-10.1, F-8-10.2	11/10/72	OAB
	15	Insert revised pages F-6-2, F-6-15, F-7-4, F-10-3, F-10-15, F-10-17; add new pages F-6-6.1, F-6-6.2, F-10-18 through F-10-33 (16 graphs), F-12-3	12/1/72	OAB

SECTION 6.0 LUNAR SEISMIC PROFILING EXPERIMENT

6.1 LSP Deployment Criteria

TABLE 6-1. LUNAR SEISMIC PROFILING DEPLOYMENT CRITERIA

PARAMETER	CRITERIA
Geophone Module Site Selection	Deploy Geophone Module 9 meters (30 feet) south of the Central Station. Pick as smooth and level a site as possible for emplacement of Geophone Module and geophones. Deploy a marker flag to mark the location for orientation of the four geophones. Marker flags also serve as anchors for the geophones.
Geophone Emplacement	Deploy the four geophones so that their relative locations are as shown in Figure 6-1, based on the shadow line through this location. Deploy marker flag at each geophone location and at the geophone module package (Figure 6-2) to aid in the determination of the actual location of the four geophones. A gnomon will be emplaced within the triangle beside the third geophone. Geophones should be emplaced on flat terrain if possible, not in craters. Geophones should be deployed so that three of them comprise the vertices of an equilateral triangle with the fourth in the center of the triangle. This will be visually determined by the astronaut sighting along the marker flags and should be in a straight line.
Geophone Vertical Alignment	Vertical alignment of each geophone is very critical since complete loss of data from a geophone occurs if it is 15 degrees or more off vertical. Geophone spike should be vertical within 7 degrees.
Geophone Cables	If geophone cables are deployed over depressions more than two feet deep, the astronaut must insure that the cable has enough slack to follow the contour of the lunar surface.
LSPE Enable	After deploying the geophones, return to the Central Station and rotate Astronaut Switch #2 clockwise to enable the LSPE electronics. If left in the counterclockwise position, LSPE operation is inhibited.
LSPE Transmitter Antenna Deployment	Deploy the LSPE Transmitter Antenna 40 feet (12 meters) northwest of the Central Station. Antenna will be mounted on the HFE subpallet from ALSEP Subpackage #1. See Figure 6-3.

TABLE 6-1. LUNAR SEISMIC PROFILING DEPLOYMENT CRITERIA (Continued)

PARAMETER	CRITERIA
LSPE Transmitter Antenna Deployment (Concluded)	Extend telescoping whip antenna to full 63-inch length before mounting it in the socket on the HFE subpallet. When fully extended, the astronaut will have extracted 11 antenna sections from the stowage tube -- 5 with the first grip ring and 6 with the second grip ring.
Explosive Packages Deployment	During EVA #1, the astronauts will remove the two EP transport frames on the experiment pallet which are stowed in Quad III of the LM. All of the eight LSPE explosive packages on the two transport frames must be placed in the sun on the lunar surface for at least two hours before they are deployed and activated. This is necessary to insure that the timer within each explosive package has reached the minimum operating temperature of +40°F. See Figures 6-4 and 6-5. Explosive packages will be deployed as shown in Figure 6-6. Before starting out on the LRV geology traverse during EVA #1, the astronauts will stow on the LRV the EP pallet which contains EP's #5, #6, #7, and #4. During the EVA #1 traverse, the astronauts will deploy: EP #6 (1 lb.) EP #5 (3 lbs.) EP #7 (1/2 lb.) During the EVA #2 traverse, the astronauts will deploy: EP #4 (1/8 lb.) EP #1 (6 lbs.) EP #8 (1/4 lb.) During EVA #3, the astronauts will deploy: EP#2 (1/4 lb.) EP#3 (1/8 lb.) The #1, 6-pound EP must be deployed at the greatest distance from the geophones, but no EP should be further than 3.5 kilometers. Similarly, no EP should be deployed closer than 150 meters to the nearest geophone.

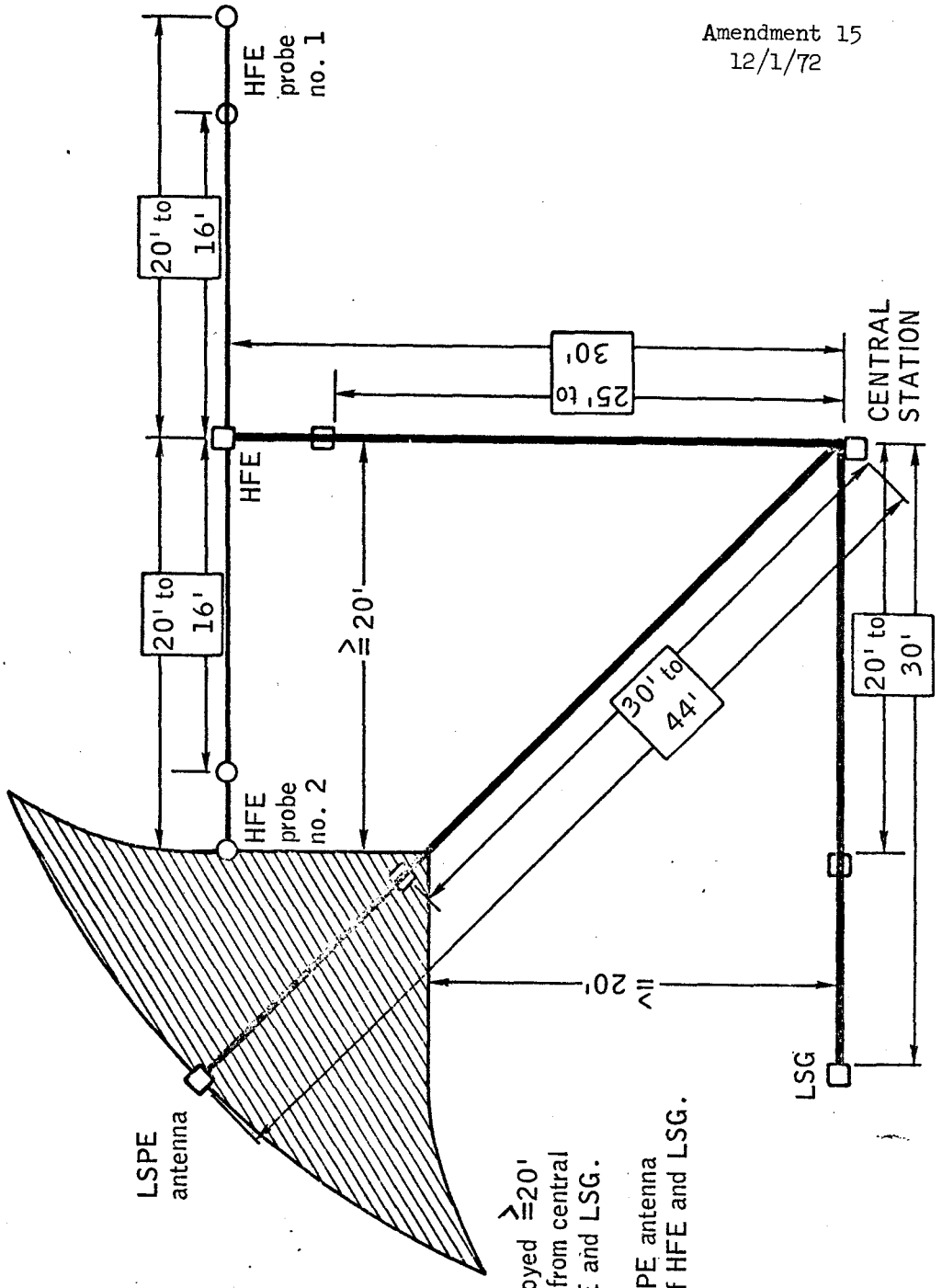
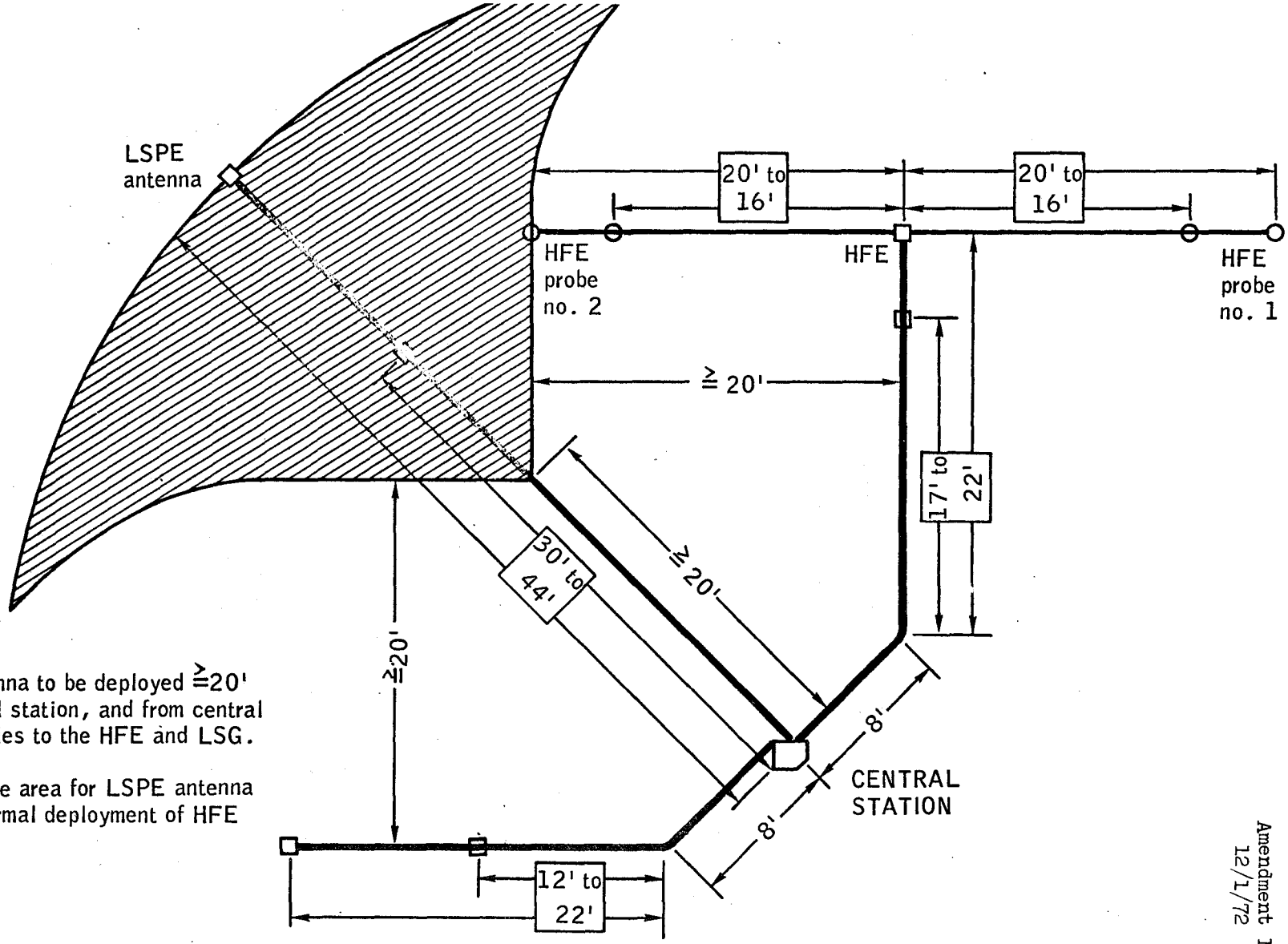


Figure 6-3(B). LSPE Antenna Deployment



LSPE antenna to be deployed ≧20' from central station, and from central station cables to the HFE and LSG.

▨ Allowable area for LSPE antenna with off-normal deployment of HFE and LSG.

Off-normal deployment of HFE and LSG.

Figure 6-3(C). LSPE Antenna Deployment

F-6-6.2

SNA-8-D-027(V)

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I-oven: 3-watts

Battery: 1-watt

The precision oven temperature is governed by a proportional controller with a maximum power dissipation of 1.3 watts when the battery voltage is 7.5 volts.

Analysis of the power consumption of the TGE for a nominal mission has shown that the TGE need not be switched from ON to STANDBY during the rest periods between EVA's. Similarly, from a thermal standpoint, assuming a nominal mission, the TGE need not be switched from ON to STANDBY during rest periods to maintain proper thermal control. However, there should be no impact on TGE operation if such switching is performed.

10.3 TGE CONSTRAINTS AND LIMITATIONS

10.3.1 TGE Deployment Constraints

See Table 10-1 for Deployment Criteria.

It is requested that the TGE be removed from Quad III and the hardmount pins removed within 20 hours after lunar landing.

Once the pallet is removed from Quad III and placed on the LRV, the handle should be pulled away from its stowage lock position, and then the two side pins may be removed. The bottom pin may be removed before or after the TGE is placed on the lunar surface. It is necessary that this pin be removed before the TGE is replaced on the pallet. A visual check should be made to insure that the bottom pin has fallen clear.

For all measurements, the TGE must be level to within 15 angular degrees on each axis.

10.3.2 TGE Operational Constraints

There are certain operational constraints which should be adhered to in order to prevent possible TGE overheat or component degradation.

Prior to the beginning of rest periods the TGE should be removed from the LRV pallet and placed as close as possible to the middle of the LM shadow cast on the lunar surface. At this time the radiator dust cover should be flipped open (180° rotation). At the beginning of a subsequent EVA the radiator dust cover should be closed and the TGE placed on the LRV pallet again.

The READ button should not be depressed more than twice in successive 18-second intervals. If a third reading is required in successive intervals, the astronaut should wait at least two minutes.

The display cover should be opened only to read the display. At all other times (including button-pushing) the cover should be closed. When TGE Gravity measurements are made, the LRV shall be parked so that it is not inclined more than 15 angular degrees from horizontal in either direction.

Predictable numbers (610 XXX XXX or 730 XXX XXX) will result if the Phaselock Loop does not capture. The appearance of this number may require further measurements to be made on the lunar surface in a Phase-lock Loop "BYPASS" mode.

The appearance of 3 zero's in the first three display numbers would indicate that the instrument (or LRV) was bumped during a measurement. If the source cannot be found, BYPASS measurements may be recommended.

7.2 LACE/LMS OPERATIONAL DATA

7.2.1 LACE Scientific Data

The LACE provides measurements of the relative number of atoms and molecules having masses within the following ranges of atomic mass units:

1 to 4 amu.
12 to 48 amu.
27 to 110 amu.

These measurements are provided by three sensors which count the number of neutral particles which pass through associated apertures after being ionized and accelerated through a fixed magnetic field. These counts constitute the primary scientific data from the LACE and, when correlated with a complete series of accelerating voltage steps and/or with time, they permit analysis of the lunar atmospheric composition.

The three scientific measurements as telemetered from the moon are processed in Mission Control Center to provide decimal readouts of the particle counts from each analyzer. Each decimal readout can range from 0 to 1212416 and represents the number of particles having masses corresponding to the electrical and geometric configuration of each analyzer. The configurations and operating modes are listed in Section 7.2.3.

7.2.2 LACE Engineering Data

The performance and operation of the LACE is portrayed through the 16 analog measurements and the 10 status indicators provided in the engineering data. The values of the analog measurements to be expected when the LACE is operating normally are listed in Table 7-2. The status indicators are identified in Tables 7-3 and 7-4. Table 7-4 lists only those command register indications which, if executed by CMD 134, result in valid functional changes. The general command operations associated with the LACE are described in Section 7.4

TABLE 7-2.

LACE/LMS ENGINEERING MEASUREMENTS

Meas. No.	ALSEP Word 33 Channel Nos.	DESCRIPTION	Normal Operating Range Low	Normal Operating Range High	Limits See Note 1 Low	Limits See Note 1 High
AM-02	40-2	Input Current (milliamps)	220	450	8 (M)	622 (M)
AM-12	40-12	Filament 1 Current (amps). Note 2	1.18	1.43	0.2(M)	2.5(M)
AM-13	40-13	Filament 2 Current (amps). Note 2	1.18	1.43	0.4(M)	2.6(M)
AM-11	40-11	Emission Current (microamps). See Note 3	100	250	-6.1(M)	453.6(M)
AM-03	40-3	Ion Pump Current (microamps).	0.01	30	0 (M)	52 (M)
AM-44	44	Sweep Voltage	0	1420	0 (M)	1500 (M)
AM-04	40-4	Ion Pump Voltage	3000	3700	-3676 (M)	+25690(M)
AM-14	40-14	Multiplier Voltage. See Note 3	0	-3000		
AM-07	40-7	+12 VDC	11.9	12.1	0.1(M)	16.0(M)
AM-08	40-8	+ 5 VDC Supply	4.6	5.4	0.1(M)	10.5(M)
AM-09	40-9	-12 VDC Voltages	-12.1	-11.9	-20.1(M)	-0.2(M)
AM-10	40-10	-15 VDC	-15.1	-14.9	-15.8(M)	-0.1(M)
AM-41	41	Electronics Temp. -°F See Note 4	-10	+125	-14 (T) -31 (M)	+160 (T) +206 (M)
AM-05	40-5	Analyzer Baseplate Temp.-°C	-84	+ 60	-98 (T) -236 (M)	+ 69 (T) +182 (M)
AM-06	40-6	Ion Source Temp. -°C	-20	+ 68	- 98 (T) - 79 (M)	+225 (T) +277 (M)
AM-15	40-15	L.V. Pwr. Supply Temp. -°F	- 4	+121	- 14 (T) -31 (M)	+160 (T) +206 (M)

Note 1: (M) = Measurement Limits; (T) = Test Limits. See Section 3.3.9.
Note 2: Only one or neither will be active and give valid data.
Note 3: Multiple calibration measurement; depends on value of AM-41.
Note 4: Recommended Operating Limits: -20°F to +130°F.
Recommended Non-Operating Limits: -30°F to +160°F.

TABLE 10-1. TRAVERSE GRAVIMETER DEPLOYMENT CRITERIA (Continued)

PARAMETER	CRITERIA
Normal Traverse Measurements	During the EVA #1 traverse with the LRV, a Gravity measurement will be taken at each science stop with the TGE mounted on the LRV. The astronauts will report to MCC the gravity reading and the time when the measurement was initiated. See Figure 10-3. MCC should read back and confirm all readings transmitted by the astronaut. It is highly desirable that the gravity readings be transmitted prior to moving the LRV. It is preferred that the TGE Gravity measurement be taken as early as possible at the beginning of each science stop. At the end of the EVA #1 LRV traverse, a Gravity measurement will be taken, preferably on the LRV, when the LRV has been parked near the LM. Gravity measurements taken at the beginning and end of each EVA should be taken at a location within 15 meters of the base station (parked LRV) location. Before leaving the LRV, place the TGE on the lunar surface in the shade of the LM and open the radiator cover. Cover should remain open until the next traverse. During the EVA #2 and EVA #3 traverses, the TGE operational procedures will be similar to those for EVA #1 as follows: a) Press the READ pushbutton and transmit a temperature reading to MCC. b) Close both the radiator cover and the display panel cover before starting out on the LRV traverse. c) Take TGE Gravity measurements with the TGE mounted on the LRV at the LM location and at each science stop. Transmit readings to MCC. d) Upon return to the LM at the end of each traverse, take a Gravity measurement with the TGE mounted on the LRV. e) Place the TGE on the lunar surface in the shade of the LM. Open the radiator cover.

TABLE 10-1. TRAVERSE GRAVIMETER DEPLOYMENT CRITERIA (Concluded)

PARAMETER	CRITERIA
Precautions	A Bias measurement will normally be taken only once, at the beginning of the first EVA traverse. However, should an unexpected event happen to the TGE such as dropping it, insulation damage, or a shift in the Gravity reading at the LM location, a Bias measurement may have to be made after this event to determine TGE performance. When performing the first TGE measurements on the lunar surface, the GRAV measurement should be taken prior to the BIAS measurement and the reading reported to MCC. After the BIAS pushbutton has been depressed to take a Bias measurement, DO NOT turn the STANDBY-ON switch from ON to STANDBY for at least 90 seconds after the measurement is completed or damage to the sensor may result. Whenever a TGE measurement is being made with the TGE mounted on the LRV, MCC must insure that no movement of the LRV is allowed for at least three minutes after the measurement is initiated. In addition, no movement of the television camera in elevation can be tolerated. If absolutely necessary, the camera can be commanded through a smooth, continuous pan in azimuth with use of the zoom feature.

TABLE 6-4. LSPE EP DETONATION PLAN

EP No.	Transport Module No.	EP Charge Size-Lbs	Deployment Distance - Kilometers		Nominal Deployment Time - Hr. Min.		Nominal Detonation Times**	
			Max.	Min.	EVA	EVA Time	After Deployment Hrs:Min.	After LM Liftoff - Hrs:Min.
6	2	1	1.3	0.9	1	4:20	90:45	23:42
5	2	3	2.4	2.0	1	5:31	91:45	25:53
7	2	1/2	0.9	0.7	1	5:50	92:45	27:12
4	2	1/8	0.2	0.15	2	0:57	90:45	42:49
1	1	6	2.7	2.1	2	5:17	91:45	48:09
8	1	1/4	.38	.20	2	6:12	93:45	51:04
2	1	1/4	.38	.20	3	5:59	92:45	73:21
3	1	1/8	0.2	0.15	3	6:40	93:45	75:02

Note: The times given above are based on the following planned Mission Event GET times:

Landing	113:02	Start EVA #3	162:40
Start EVA #1	116:40	LM Liftoff	188:03
Start EVA #2	139:10	TEI	236:40

**Actual Explosive Package Timer Test Values in Hours: Minutes					
EP #6	90:31 90:49 90:51	EP #4	90:31 90:28 90:36	EP #2	92:30 92:36 92:45
EP #5	91:37 91:50 91:45	EP #1	91:40 91:46 91:52	EP #3	93:50 93:56 93:57
EP #7	92:40 92:46 92:56	EP #8	93:50 93:54 93:48		

6.3 LSPE CONSTRAINTS AND LIMITATIONS

6.3.1 LSPE Deployment Constraints

The constraints on the deployment of the LSPE components are given in Section 6.1.

The antennas on the LSPE Explosive Packages must be fully extended prior to being emplaced on the lunar surface. It is also important that the 3 pull rings (see Figure 6-5) be removed from each package before final deployment. The crew is required to report to MCC when pull ring #3 on each package is pulled so that the time of detonation may be forecast (see Figure 6-7).

One of the safety devices provided in the LSPE experiment is an Astronaut Switch located above the carry handle on the Central Station. This switch controls the power to the LSPE and is initially set in the counterclockwise DISABLE position. It is mandatory that this switch be rotated clockwise to the ENABLE position or the LSPE can never be activated. The actual decal markings are DSBL/ENBL.

The LSPE RF link constraints require that the maximum distance between the LSPE transmitting antenna and any deployed Explosive Package be no more than 3.5 kms (2.18 miles). The minimum separation between any deployed Explosive Package and the LM or the ALSEP is 152 meters (500 feet).

6.3.2 LSPE Operational Constraints

It will be essential, during the initial operational phase of Array E to maintain an accurate log of the times of activation of each Explosive Package (see Figure 6-7). The success of the LSPE operational support (having ALSEP and Mission Control Center properly configured) is entirely dependent on the proper forecasting of the time of detonation of each Explosive Package.

To maintain adequate surveillance on total system performance during the explosive detonation period, it is recommended that Array E be restored to normal mode to monitor equipment performance and status, if the forecast time of next detonation exceeds two hours.

The LSPE transport modules with their Explosive Packages must be stowed in the sun for at least 1.8 hours prior to EP deployment. This can be accomplished either mated to the LRV pallet or the Quad III pallet on the lunar surface. This warm-up time is necessary to insure that the timers within each EP reach a minimum operating temperature of 40°F prior to deployment and activation.

If the Level/Measure light flashes and then goes out without having been on steadily, the TGE needs to be placed on a more level location (within 15° of horizontal). The display, if it were to be read at this point, would be 000 000 0xx (xx temperature data).

10.3.3 TGE Temperature Constraints

If at the beginning of the first EVA it is observed that a 6 or a 7 appears in the 8th display digit, the TGE should not be taken on that traverse. Rather it should undergo normal rest period cooling in the LM shadow.

Figures 10-7 A through P are 16 graphs which show the thermal response of the TGE to various off-nominal operating conditions.

If a 6 or 7 is observed in the 8th display digit during any traverse, the TGE should be switched to Standby at the end of the traverse and placed in the shade.

If LM landing occurs later than 120 hours GET, the TGE should be switched to Standby during each rest period between traverses.

10.3.4 Phaselock Loop Bypass

A Bypass measurement is performed by depressing the GRAV and READ pushbuttons simultaneously. Additional Bypass measurements can be made by simply depressing the GRAV pushbutton.

To put the TGE back in the normal mode, toggle the switch from ON to STANDBY and back to ON.

A Bypass measurement is indicated by a "0" in the first digit.

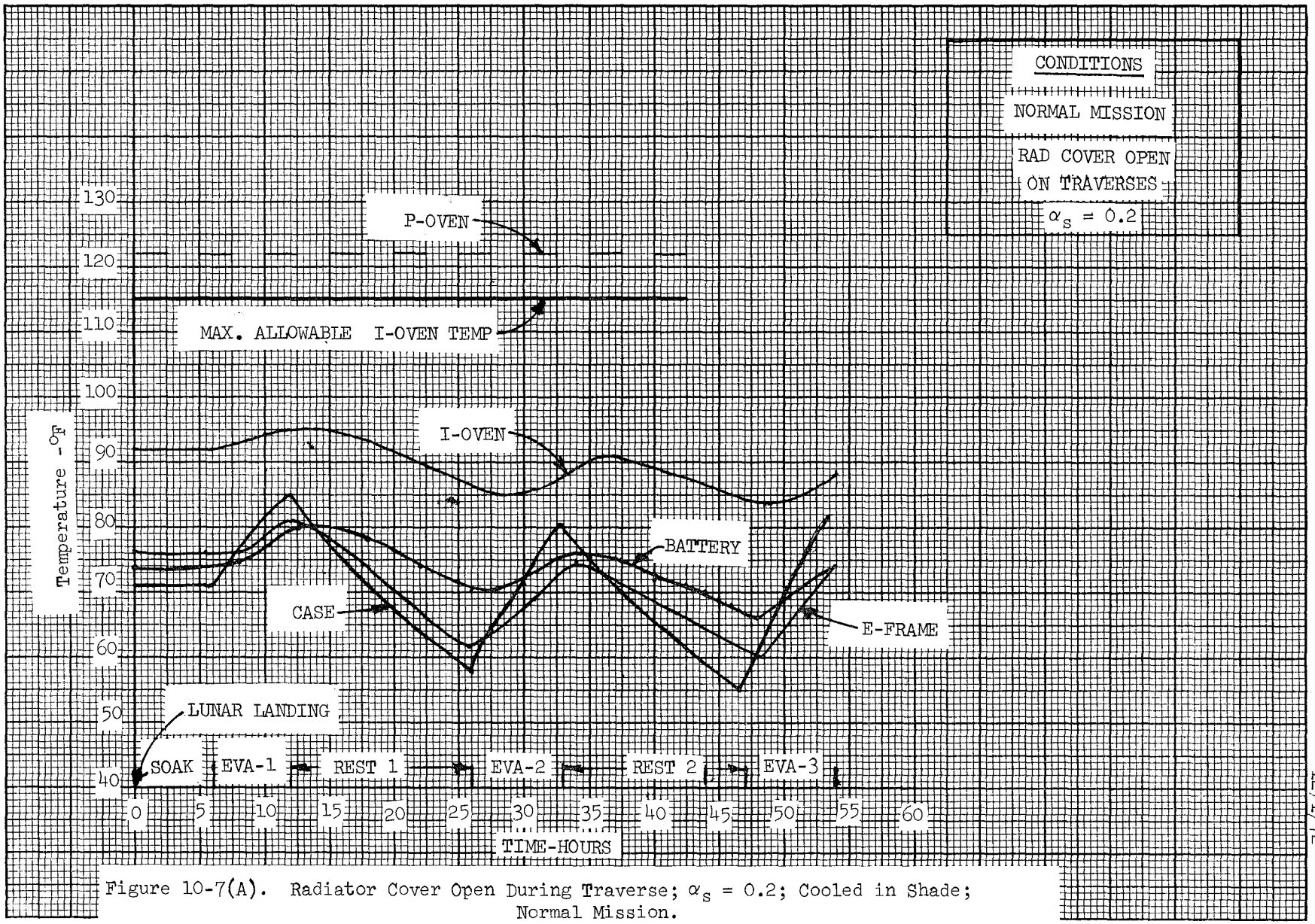

Figure 10-7(A). Radiator Cover Open During Traverse; α_s = 0.2; Cooled in Shade; Normal Mission.

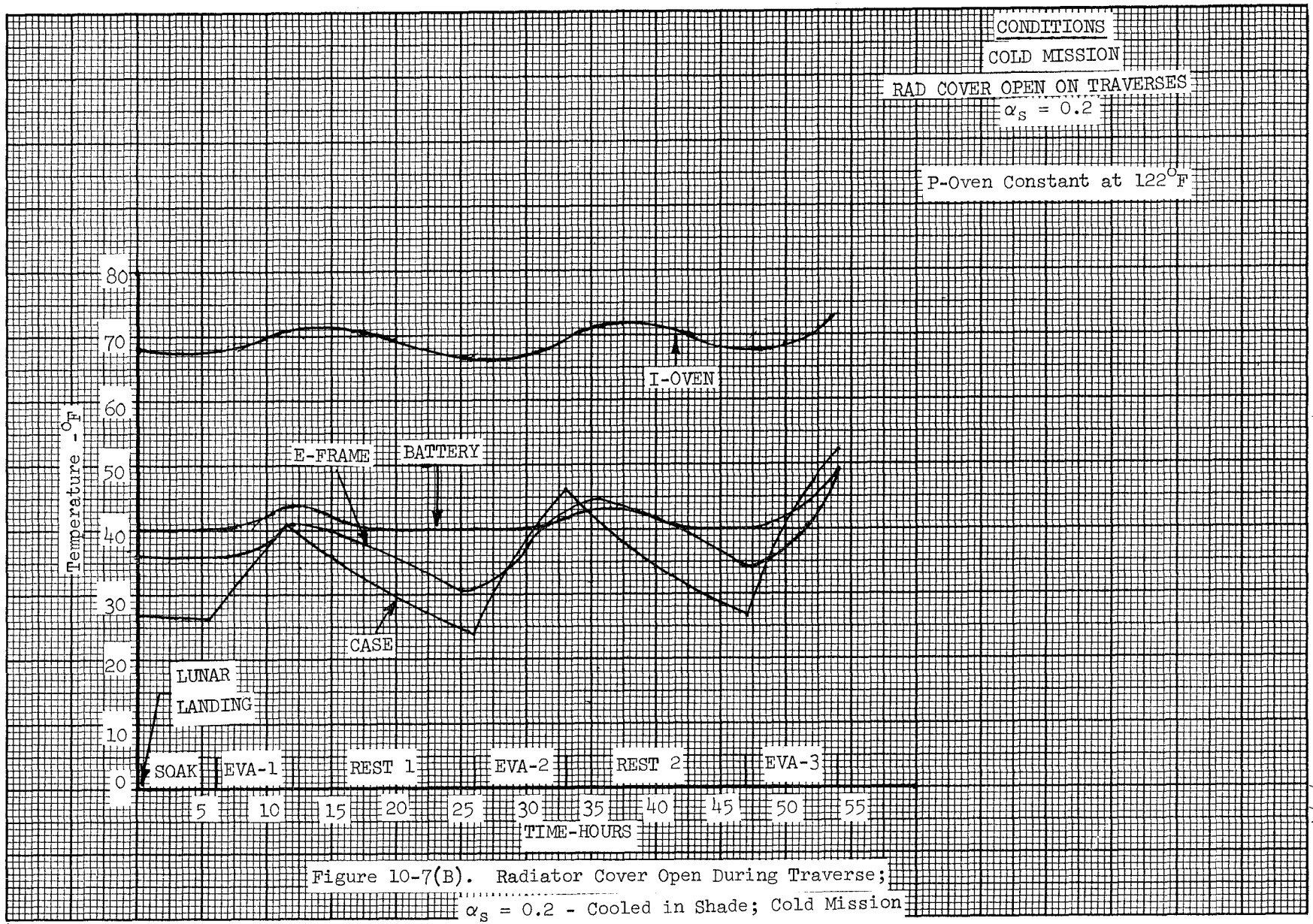

Figure 10-7(B). Radiator Cover Open During Traverse; α_s = 0.2 - Cooled in Shade; Cold Mission

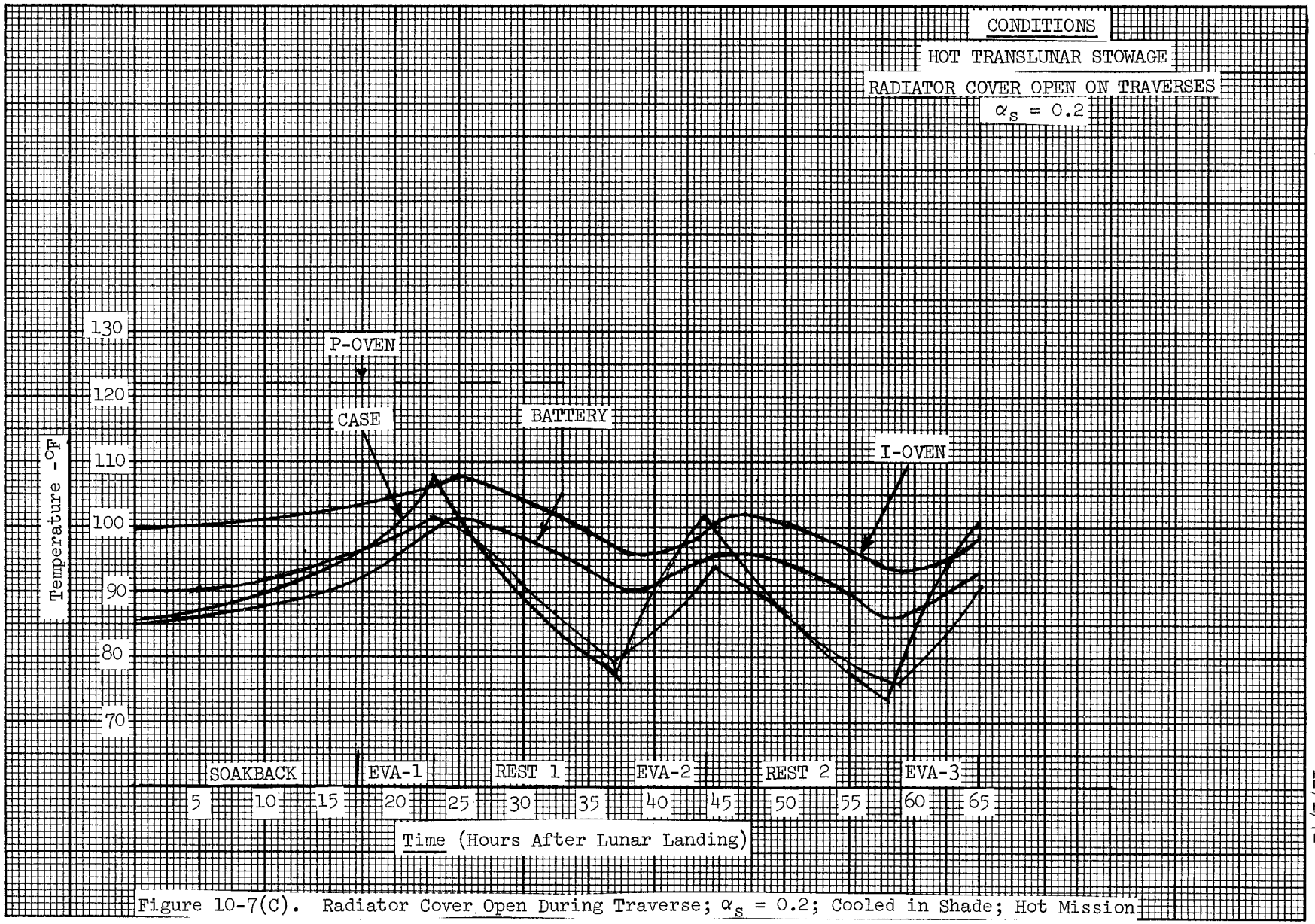

Figure 10-7(C). Radiator Cover Open During Traverse; α_s = 0.2; Cooled in Shade; Hot Mission

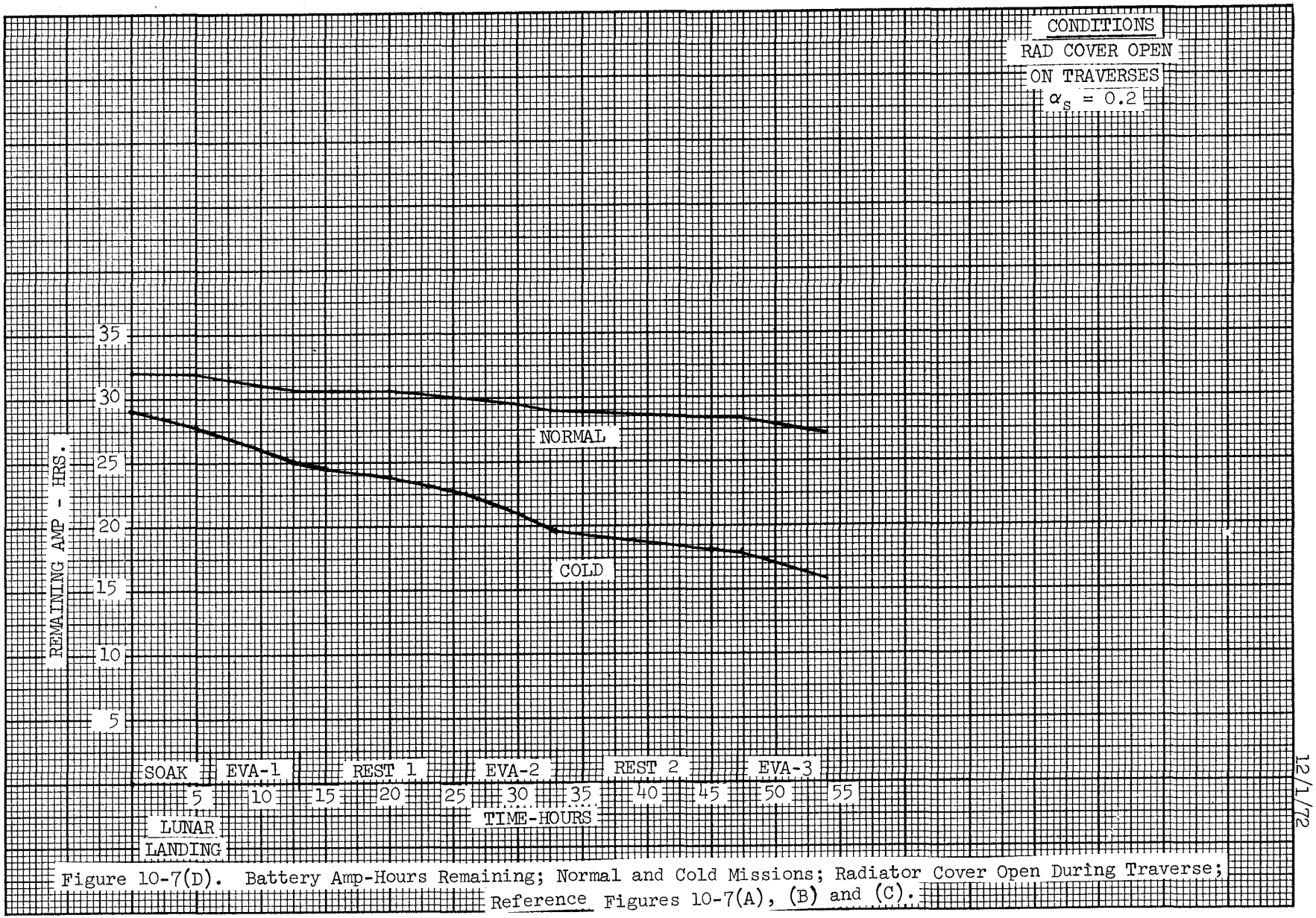

Figure 10-7(D). Battery Amp-Hours Remaining; Normal and Cold Missions; Radiator Cover Open During Traverse; Reference Figures 10-7(A), (B) and (C).

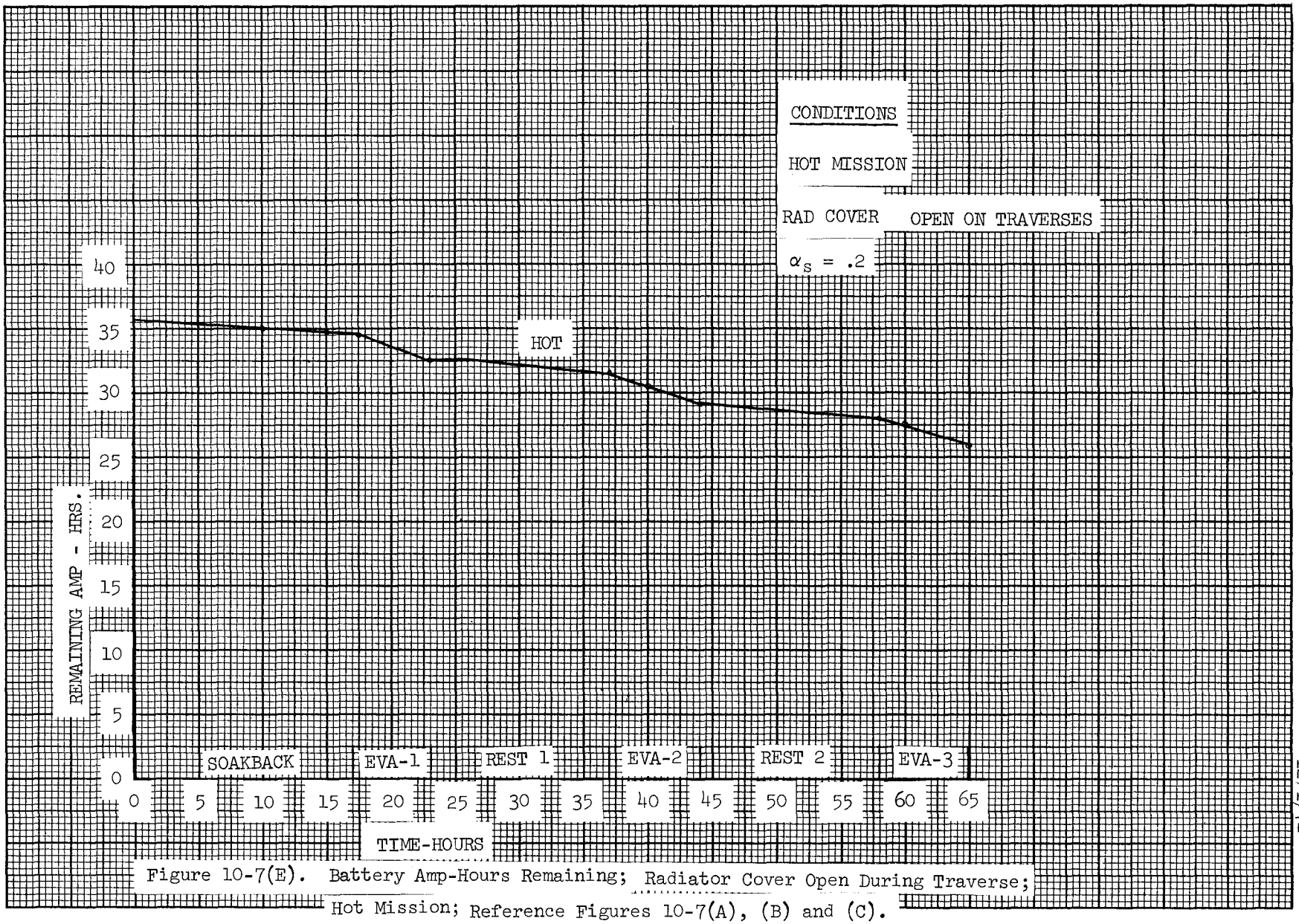

Figure 10-7(E). Battery Amp-Hours Remaining; Radiator Cover Open During Traverse; Hot Mission; Reference Figures 10-7(A), (B) and (C).

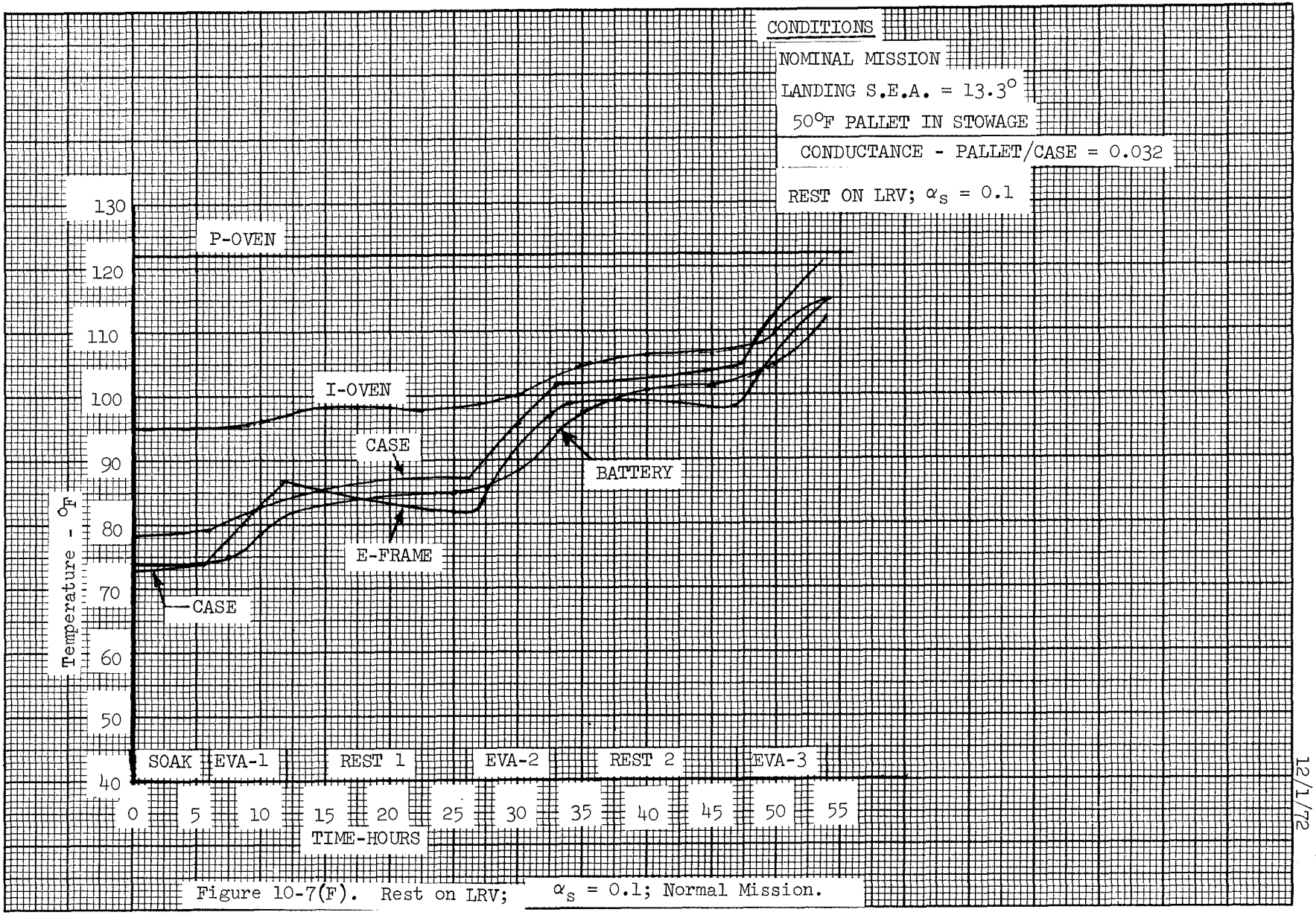

Figure 10-7(F). Rest on LRV; α_s = 0.1; Normal Mission.

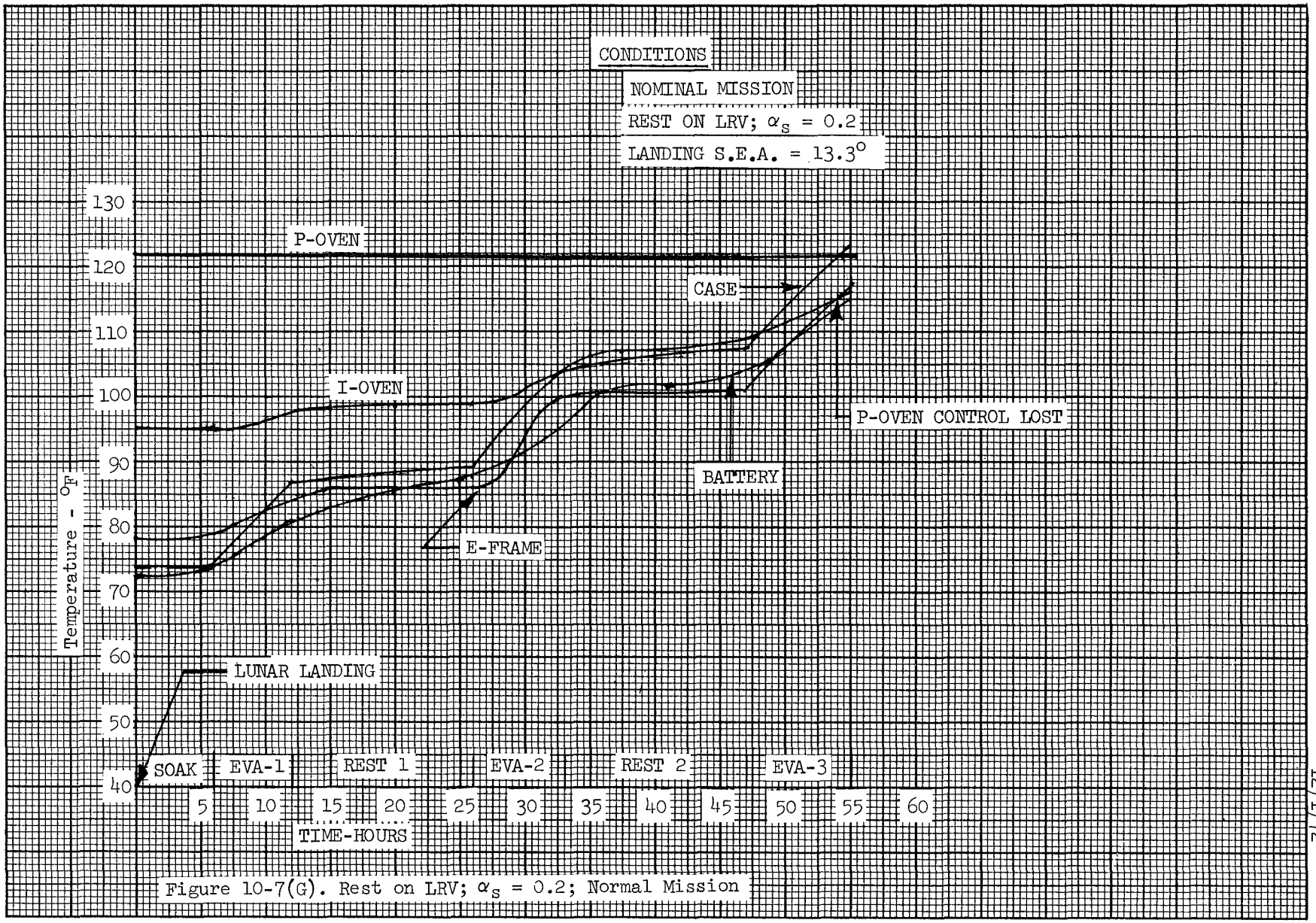

Figure 10-7(G). Rest on LRV; α_s = 0.2; Normal Mission

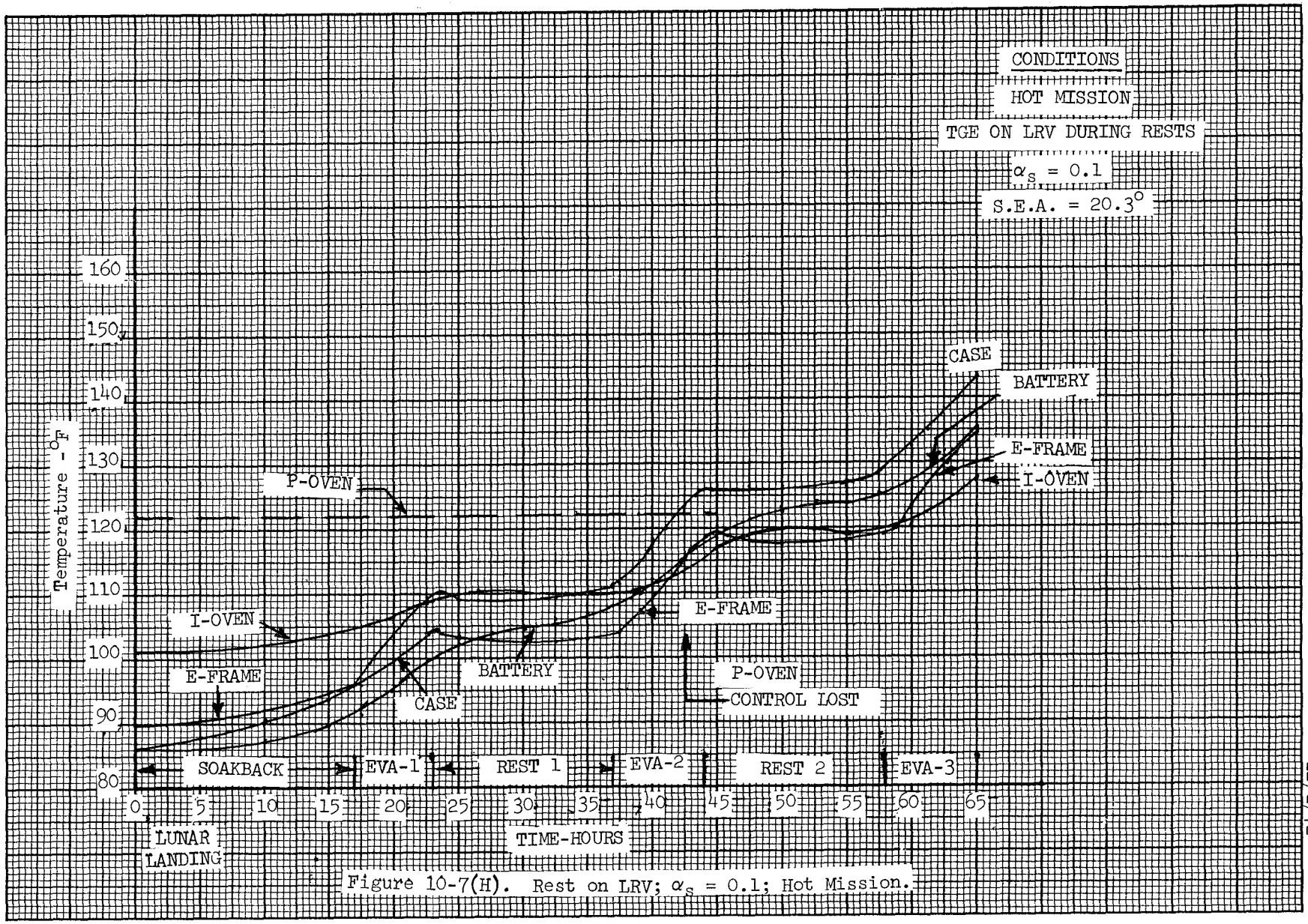

Figure 10-7(H). Rest on LRV; α_s = 0.1; Hot Mission.

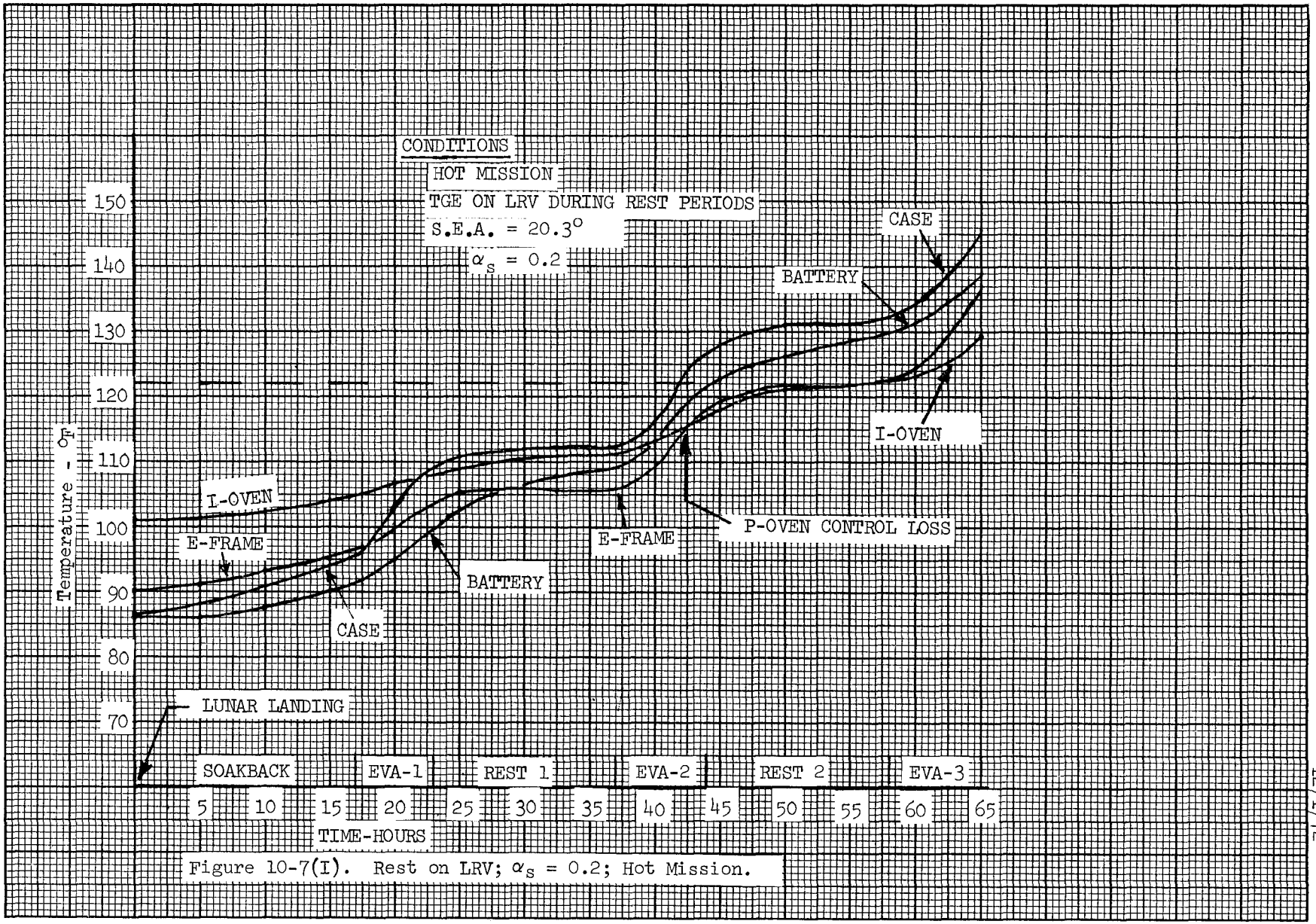

Figure 10-7(I). Rest on LRV; α_s = 0.2; Hot Mission.

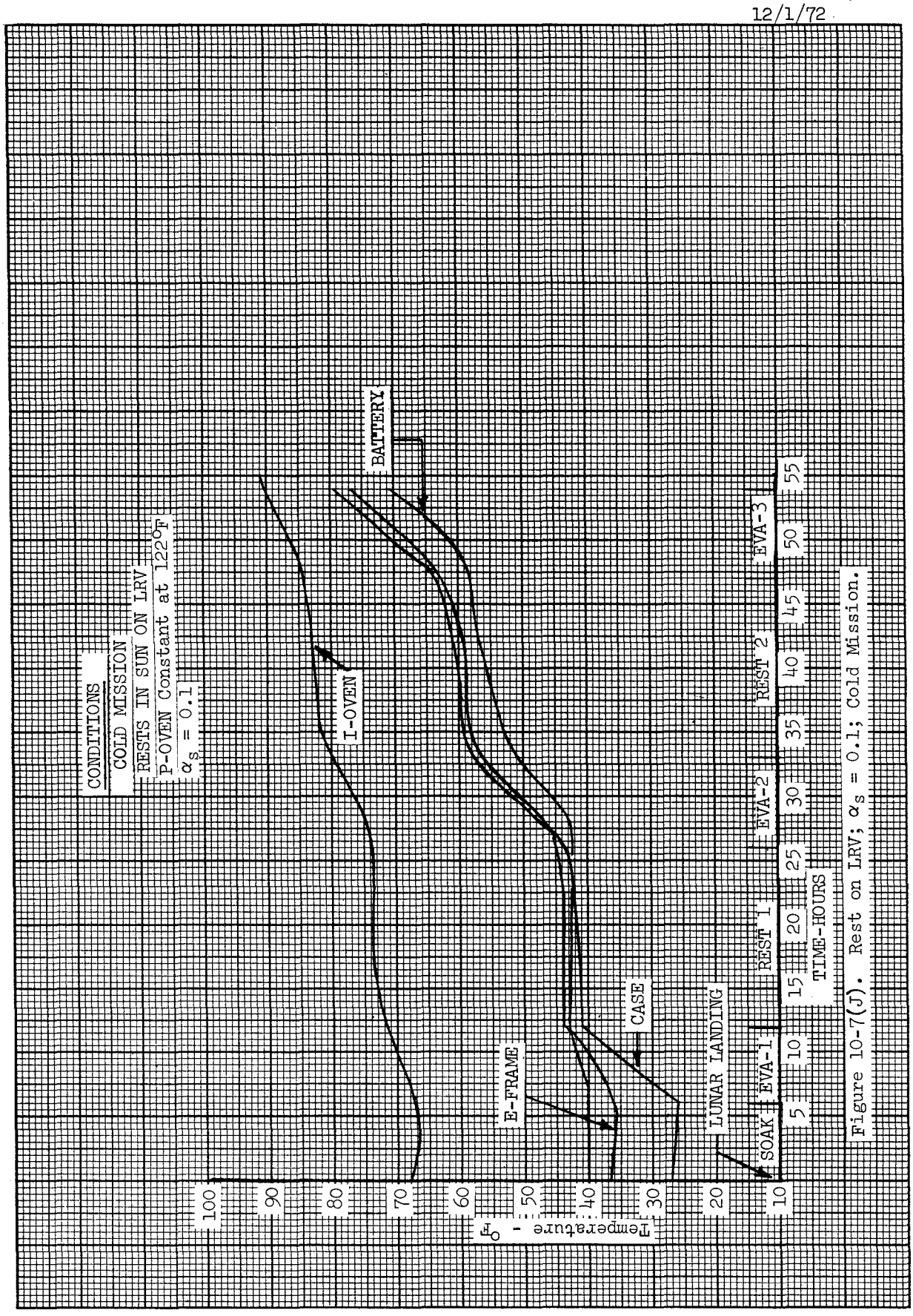

Figure 10-7(J). Rest on LRV; α_s = 0.1; Cold Mission.

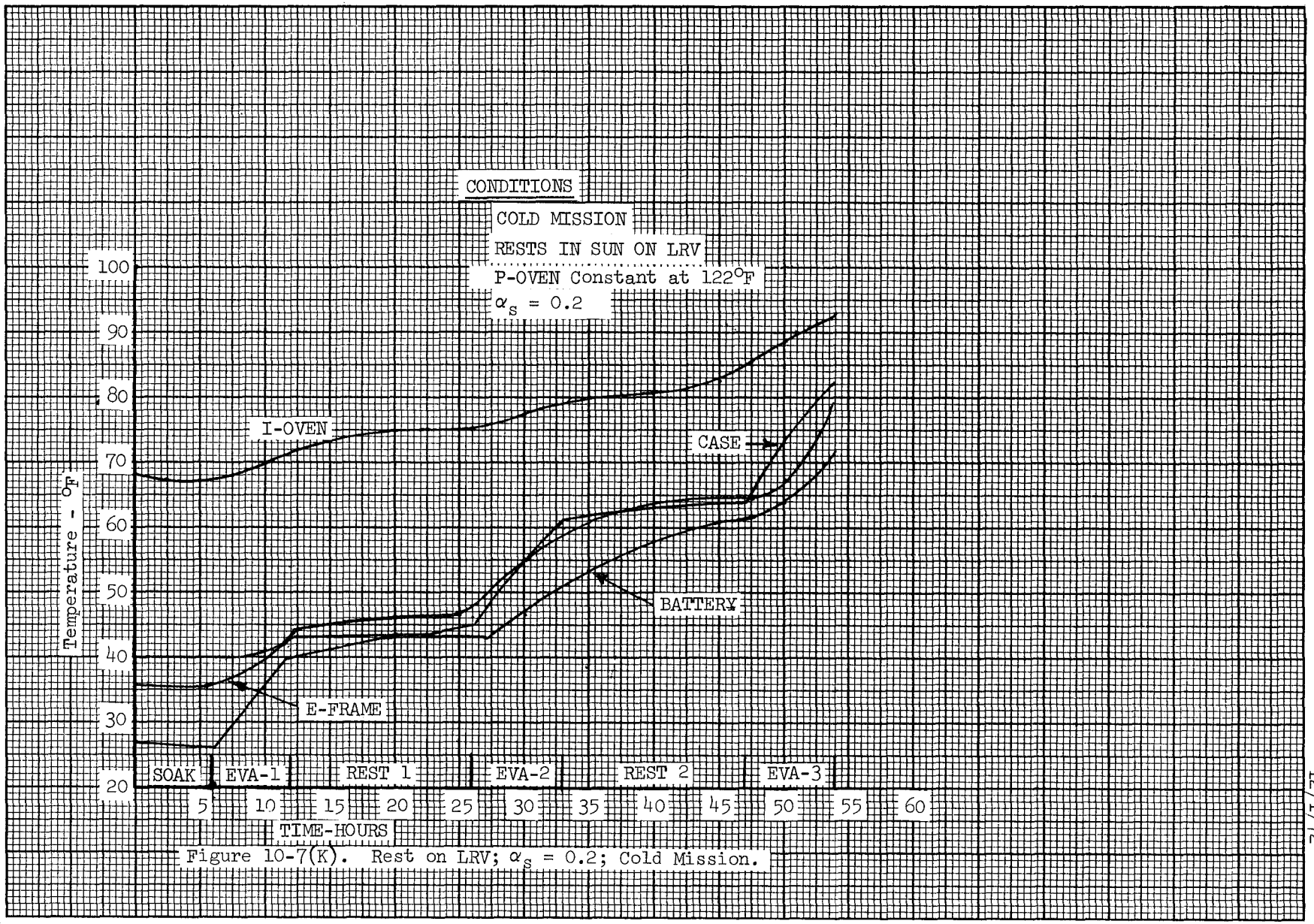

Figure 10-7(K). Rest on LRV; α_s = 0.2; Cold Mission.

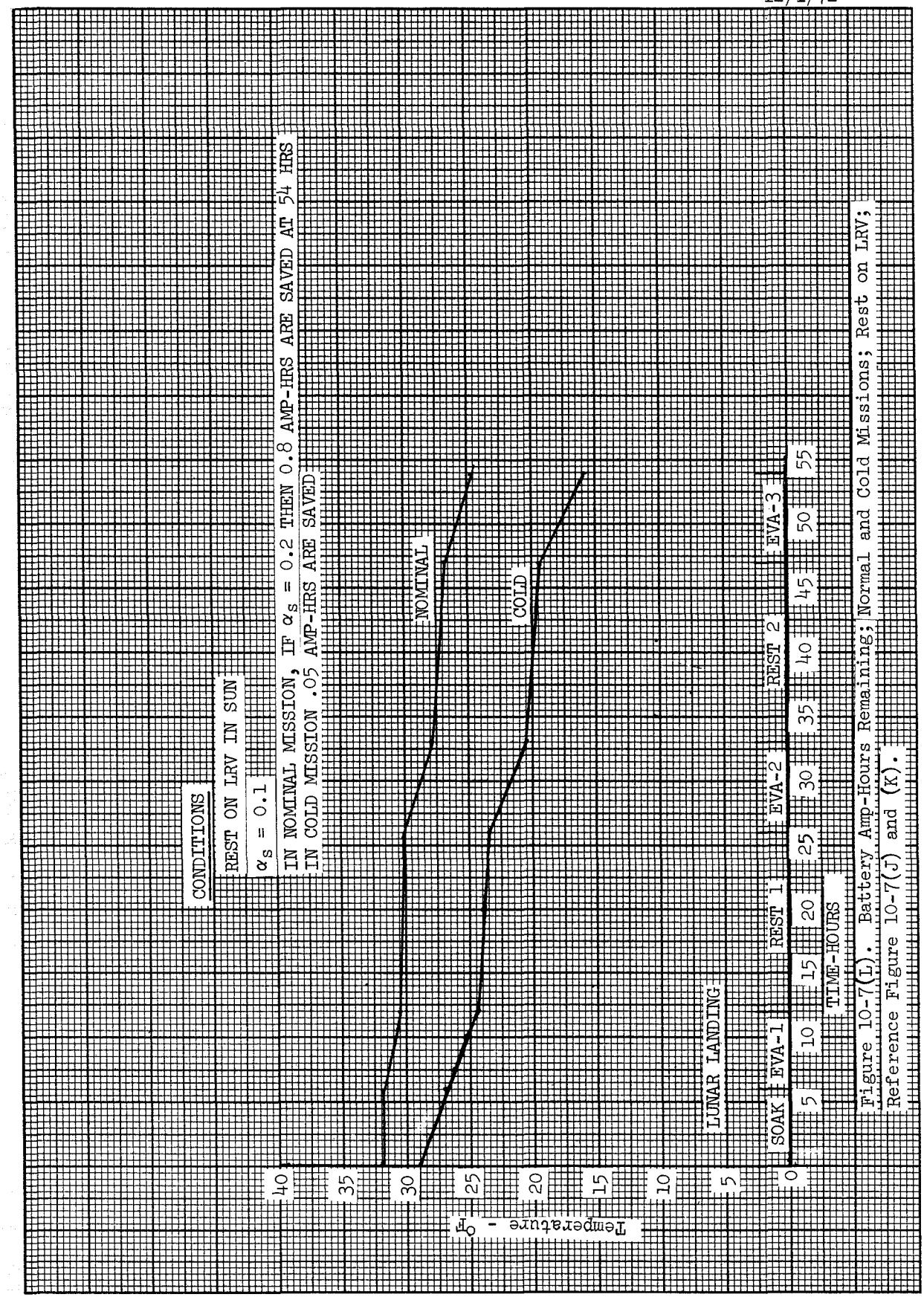

Figure 10-7(L). Battery Amp-Hours Remaining; Normal and Cold Missions; Rest on LRV; Reference Figure 10-7(J) and (K).

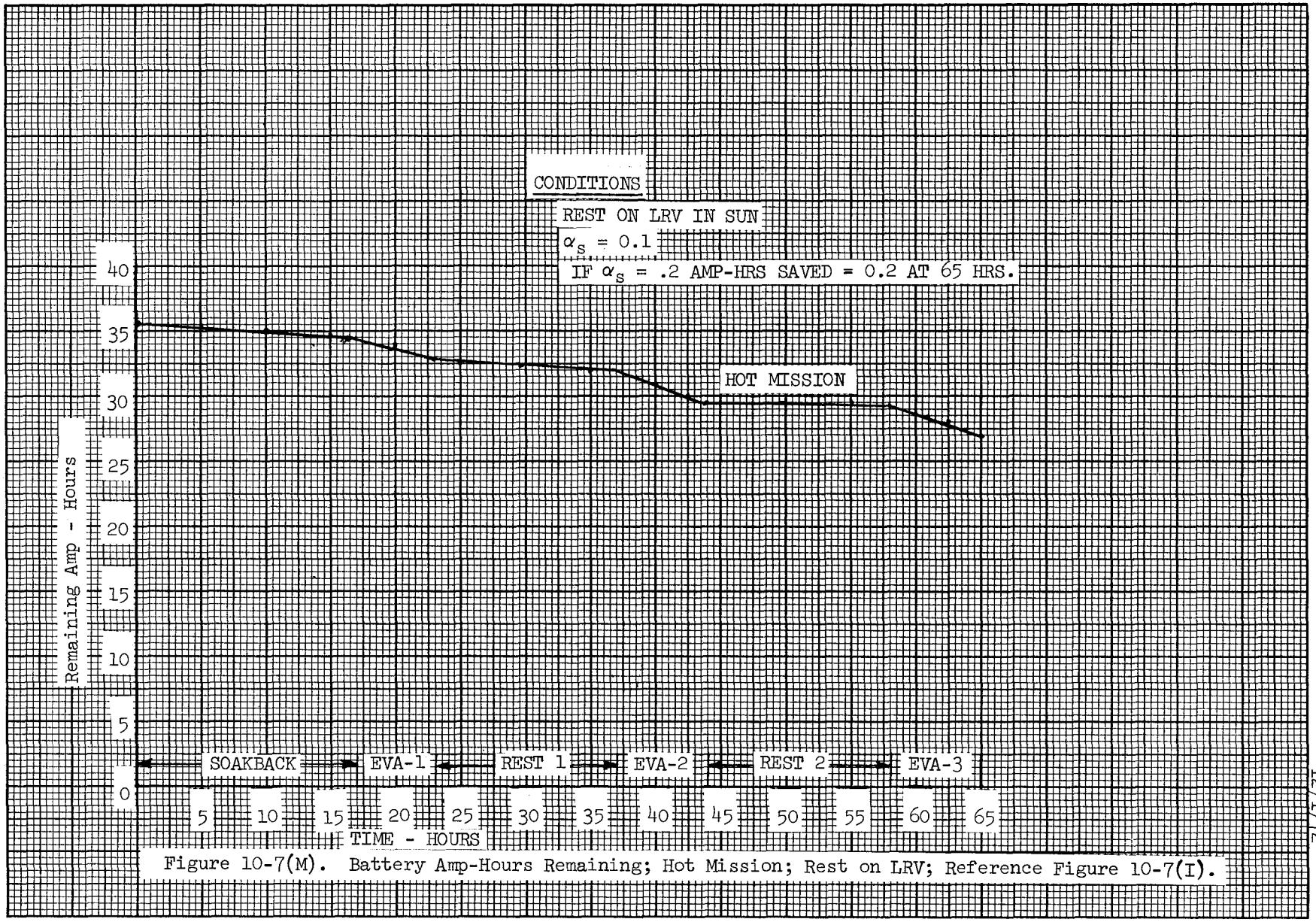

Figure 10-7(M). Battery Amp-Hours Remaining; Hot Mission; Rest on LRV; Reference Figure 10-7(I).

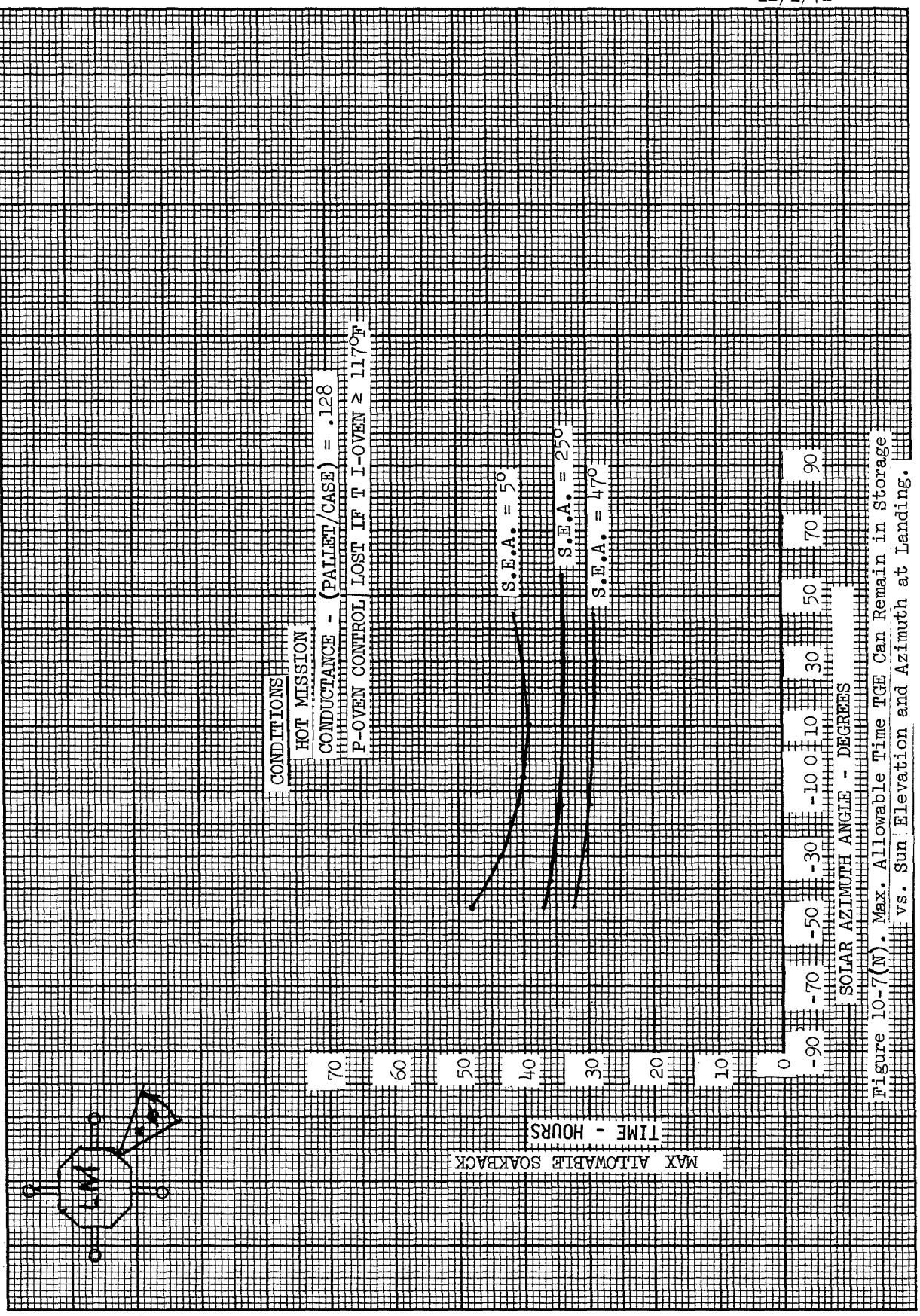

Figure 10-7(N). Max. Allowable Time TGE Can Remain in Storage vs. Sun Elevation and Azimuth at Landing.

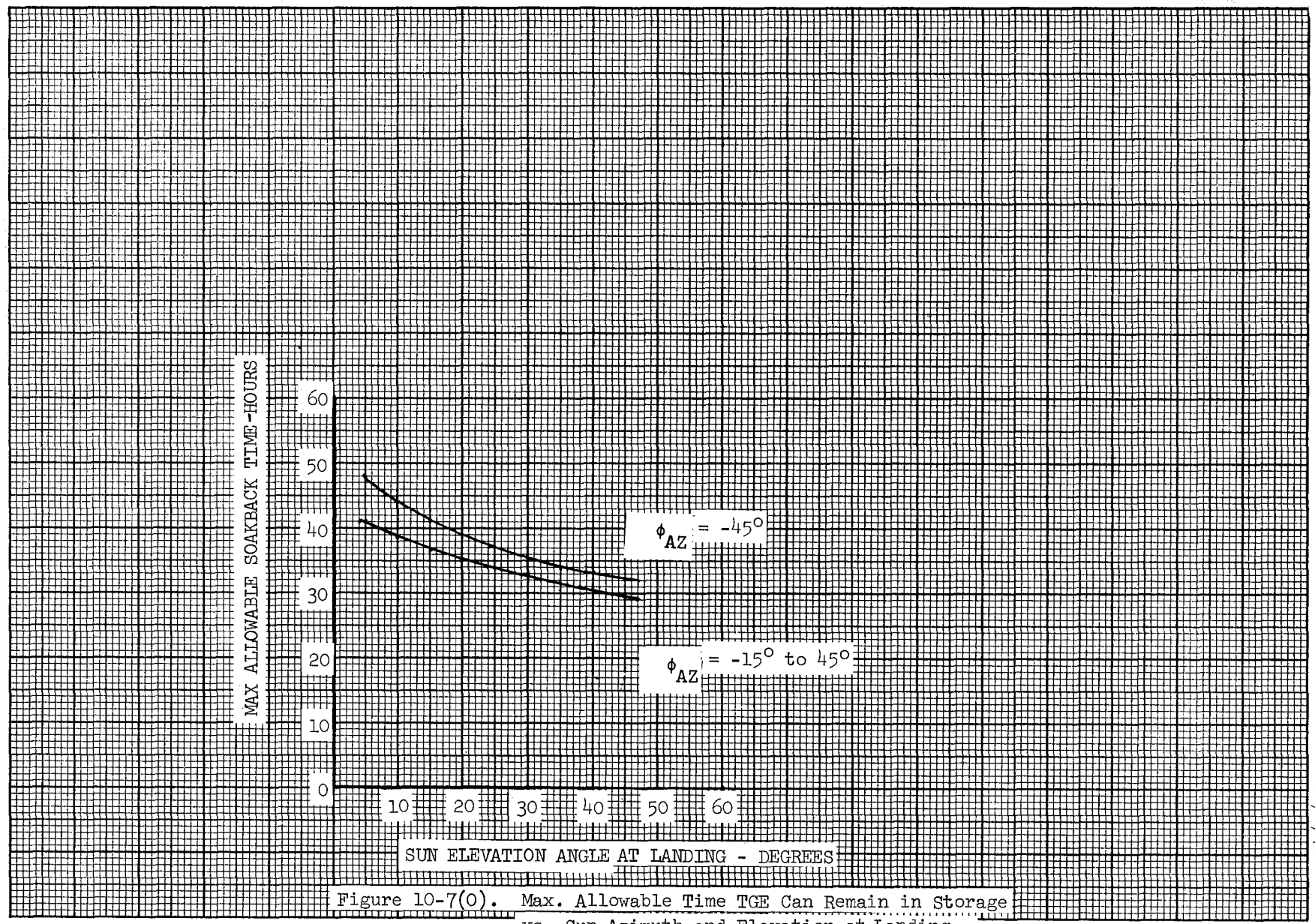

Figure 10-7(0). Max. Allowable Time TGE Can Remain in Storage vs. Sun Azimuth and Elevation at Landing.

K+E 10 X 10 TO ½ INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

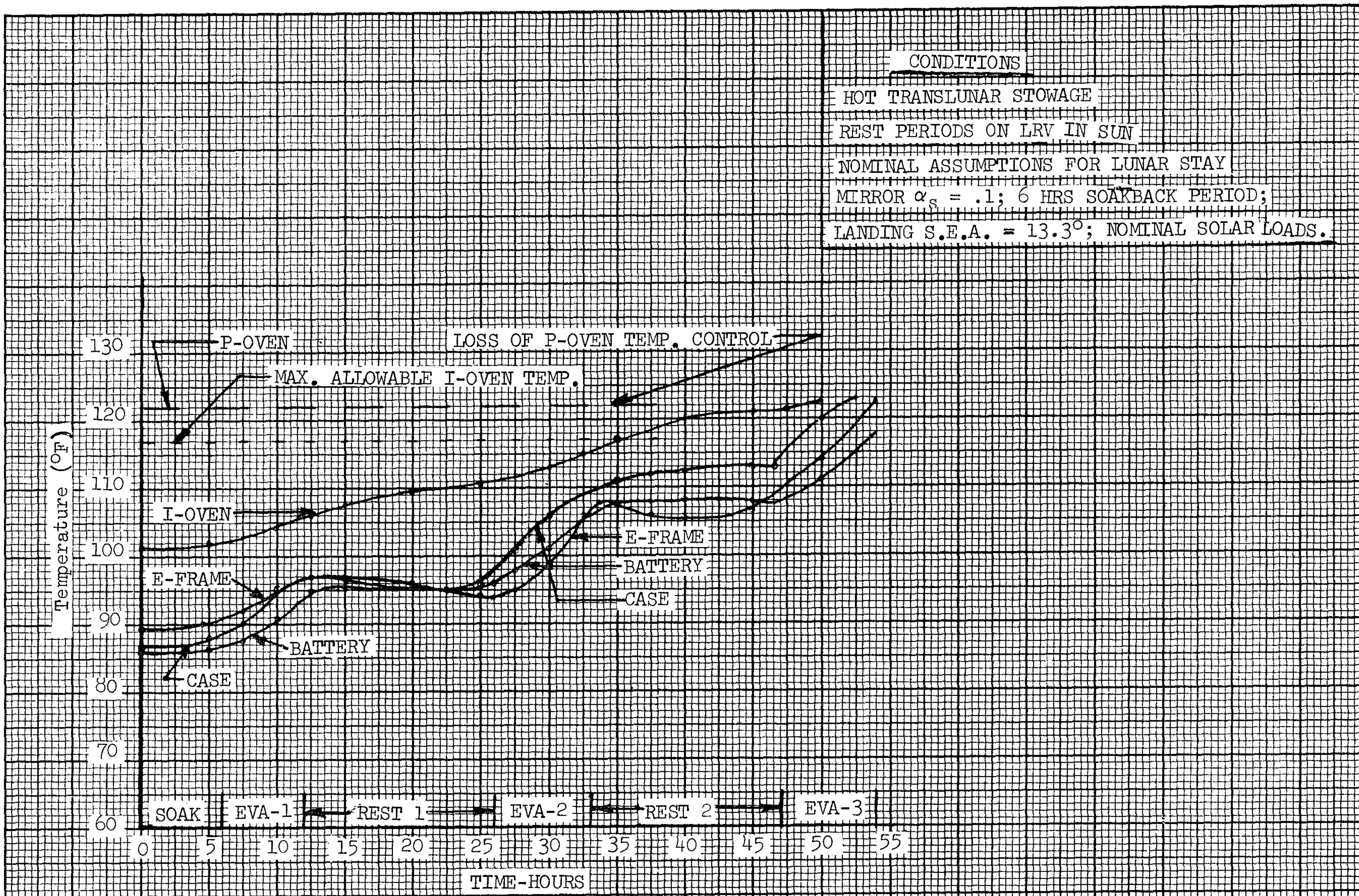

Figure 10-7(P). Hot Translunar Stowage; Rest on LRV in Sun; Normal Landing in Mission.

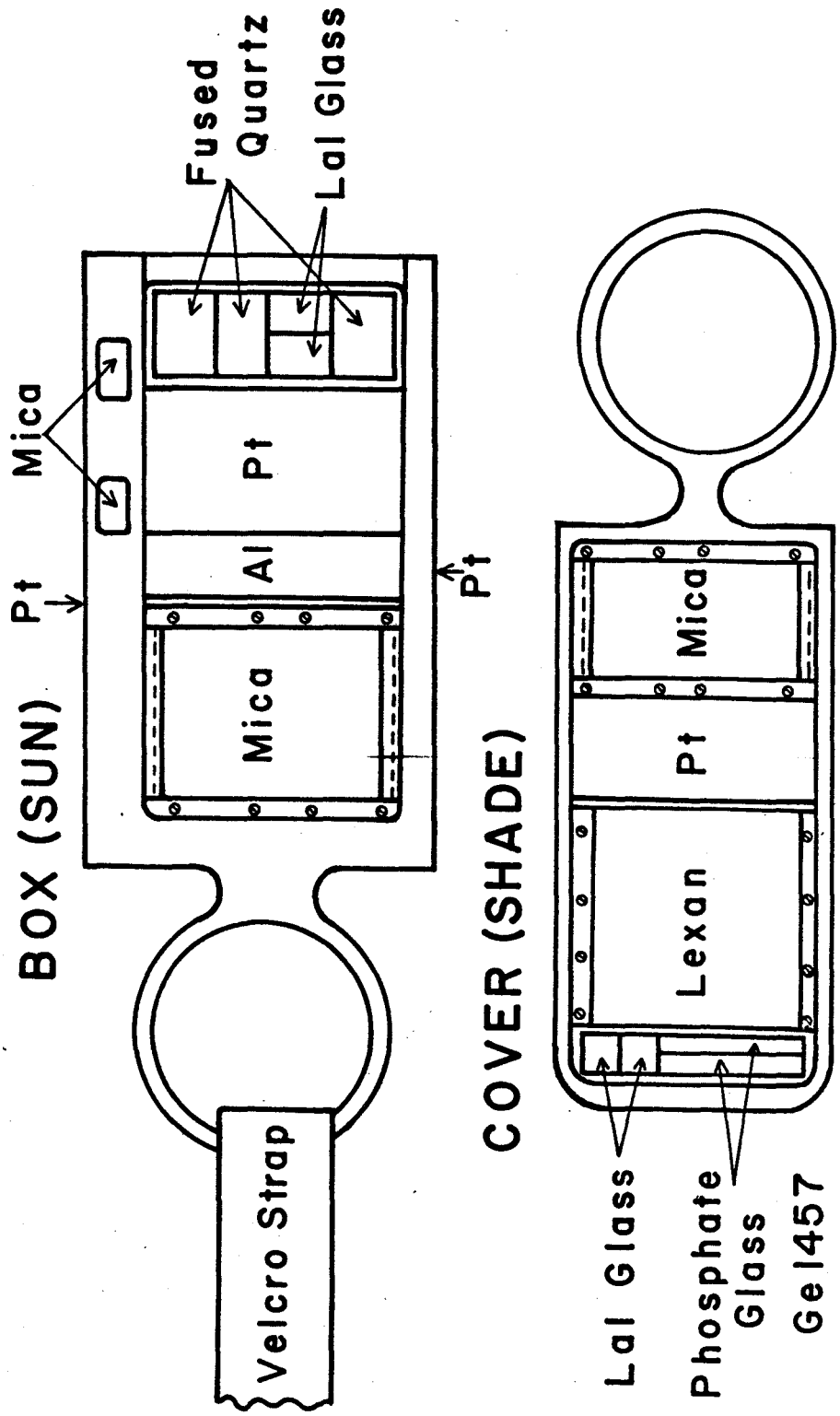

Figure 3

Figure 12-1. Cosmic Ray Detector Components