TIR # 729-S-0014(S)
APRIL 27, 1970

MODULAR EQUIPMENT TRANSPORTER (MET)

OPERATOR'S FAMILIARIZATION MANUAL

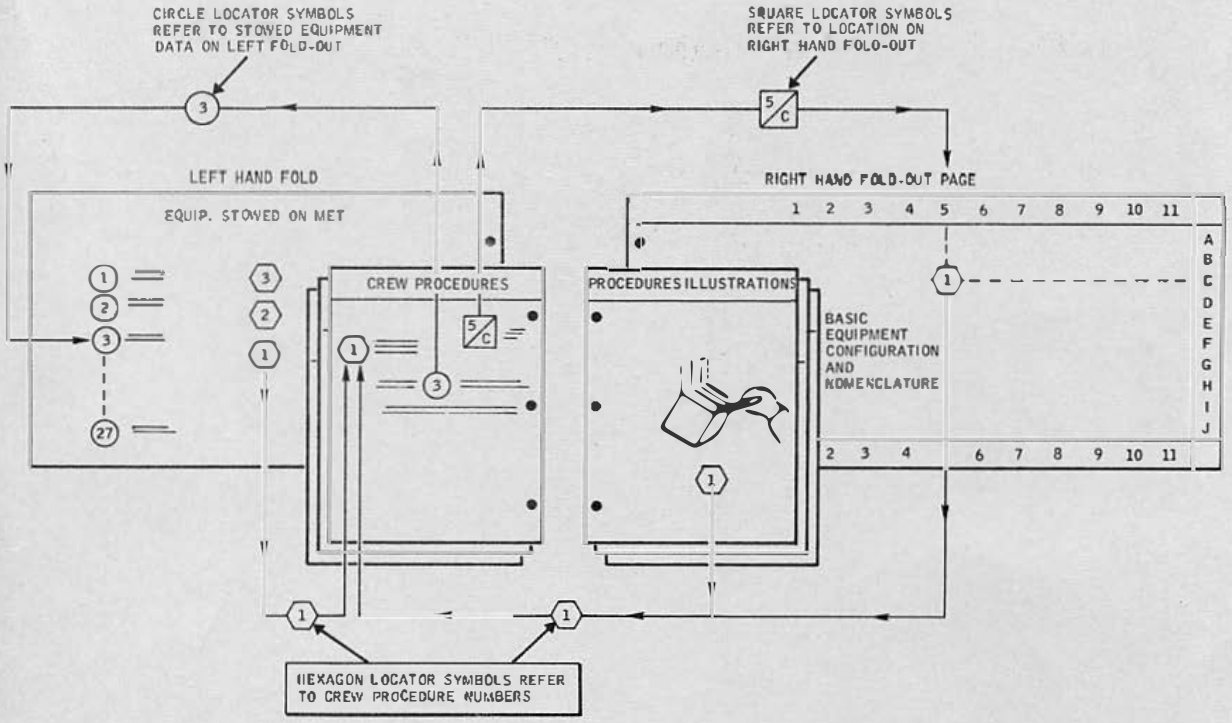
PREPARED BY

GENERAL ELECTRIC

APOLLO SYSTEMS

HOUSTON PROGRAMS

THIS IS AN OPERATING LOGIC TYPE TRAINING DOCUMENT THAT UTILIZES THE FOLLOWING FORMAT AND CROSS INDEXING SYSTEM.



STOWED ITEM #	ITEMS STOWED ON MET	QUANTITY	MET CREW PROCEDURES #	LM-8 STOWAGE STAGE ASCENT	LM-8 STOWAGE STAGE DESCENT	LM-8 STOWAGE* STOWAGE AREA CODE
1	CAMERA/POWER PACK, 16 MM	1 (ON TOOL CARRIER)	31 M	X		A4
2	MAGAZINE, 16 MM	3 (1 IN CAMERA)	30 B	X		A4
3	CAMERA, 70 MM HASSELBLAD	1	23	X		F2B
4	MAGAZINE, 70 MM	3 (1 IN CAMERA)	24	X		F2B
5	HANDLE, 70 MM CAMERA	1	23	X		F2B
6	TRIGGER, 70 MM CAMERA	1	23	X		F2B
6A	RCU/70 MM CAMERA BRACKET	1	23	X		F9A
7	CAMERA ASSY., LGEC	1	21		X-MESA	M1R
8	MAGAZINE ASSY.	2 (1 IN CAMERA)	22		X-MESA	M1F
9	MAGAZINE ASSY. COVER	1	22		X-MESA	M1F
9A	RCU/LGEC CAMERA BRACKET	1	21		X-MESA	TBD
10	CAMERA, CLOSE-UP STEREO	1	25		X-MESA	M1N
11	WEIGH BAGS	4	26 27		X-MESA	(2)-M1P(SRC)
			28 29		X-MESA	(2)-M1Q(SRC)
12	TRENCHING TOOL	1	34		X-MESA	M1W
13	SPECIAL ENVIRON. SAMPLE CONTAINER (SESC)	2	30 A		X-MESA	M1P(SRC)
14	PORTABLE MAGNETOMETER: TRIPOD & SENSOR CABLE REEL ELECTRONICS PACKAGE	1	33		X	QUAD 2 OUTSIDE LM ADJACENT TO SEQ BAY
15	ALHTC (TOOL CARRIER)	1	31		X-SEQ	AISEP
16	CAMERA STAFF	1	31 A		X-SEQ	AISEP
17	HAMMER	1	31 B		X-MESA	M1K
18	SCOOP	1	31 C		X-MESA	M1M
19	LENS/BRUSH	1	31 D		X-SEQ	AISEP
20	TONGS	1	31 E		X-MESA	M1G
21	EXTENSION HANDLE	1	31 F		X-MESA	M1H
22	CORE TUBES	5	31 G		X-MESA	IN EACH SRC
23	CORE TUBE CAP ASSY.	2	31 L		X-MESA	IN EACH SRC
24	35-BAG DISPENSER	1	31 H		X-MESA	MIT(SRC)
25	PENETROMETER	1	31 J		X-SEQ	AISEP
26	GNOMON	1	31 K		X-MESA	M1A
27	COLOR CHART & TRAVERSE MAP	1 EA.	31 N		X-SEQ	AISEP

*FIELD SITE STOWAGE DRAWINGS

MET DESIGN CRITERIA

- DEPLOYABLE WITHOUT USE OF TOOLS
- MAX. PAYLOAD CAPABILITY----------340 EARTH LBS.

  PAYLOAD CONSISTS OF TOOLS, CAMERAS, EXPERIMENT INSTRUMENTS AND LUNAR SAMPLES AS NOTED IN MET STOWAGE LIST.
- MAX. MET WEIGHT----------30 EARTH LBS.
- DIMENSIONAL LIMITS
  - WORKTABLE HEIGHT----------30"
  - STOWAGE ENVELOPE----------28" X 36" X 8" (ATTACH POINTS ARE OUTSIDE THESE DIMENSIONS)
- OPERATIONS
  - NOMINAL PULLING SPEED----------4-7 MPH
  - NOMINAL DRAW BAR PULL----------3-5 LBS.
  - DESIGN TRAVERSE----------20,000 FT.
  - CAPABLE OF TRAVERSING----------4" DIAM. ROCKS
  - TIRE TEMPERATURES:
    - MINUS 68°F AT DEPLOYMENT
    - 0°F TO 200°F WHEN PARKED
    - 70°F AVERAGE WHEN ROLLING
  - TIRE PRESSURE----------1.5 PSIA.

MODULAR EQUIPMENT TRANSPORTER (MET)

The MET is a two-wheeled vehicle that is used as an equipment hauling device on traverses across the lunar surface. Small items of crew and scientific equipment are stowed on the MET to free the astronaut from the cumbersome crew activities required if carrying this equipment by hand. The MET serves as a portable workbench with a place for handtools and their carrier, cameras, spare camera magazines, rock sample bags, environmental sample containers, and the portable magnetometer with its sensor and tripod.

The MET is stowed during lunar transit on the exterior of the MESA that is located in Quad 4 of the LM descent stage.

On the lunar surface the MET is removed from the MESA. Depending on timeline, it may be immediately deployed or placed temporarily in the sun on the LM +Y footpad with the MET thermal blanket-shroud covering the MET. When required, the MET is then deployed and loaded for the lunar surface traverses.

The following MET related crew procedures provide familiarization data on the MET, the stowed equipment, and related loading techniques. The procedures are presented in the following general groupings:

	Crew Proced. #'s
A. Removal of the MET from the MESA	(1) — (6)
B. MET Deployment----------	(7) — (19)
C. Loading of MET for traverse-----	(20) — (34)

A. REMOVAL OF MET FROM THE MESA

(1) PULL MESA D-RING [2/A] TO DEPLOY MESA.

(1A) (THIS RELEASES MESA AND IT DEPLOYS TO A "DOWN" POSITION OF APPROXIMATELY 120° FROM THE LM DESCENT STAGE.) [2/F]

AFTER DESCENT TO SURFACE:

(2) ADJUST MESA STRAP [1/C] UNTIL FRONT OF MESA IS APPROXIMATELY 40" ABOVE LUNAR SURFACE. (THIS ALLOWS CLEARANCE FOR MET TO SWING OUT AND CLEAR SURFACE.)

FROM RIGHT SIDE OF MESA:

(3) PULL MET BLANKET LOOP [11/I] DOWN AND FORWARD TO REMOVE MET BLANKET DOOR [8/I].

FROM LEFT SIDE OF MESA:

(4) PULL YELLOW LANYARD #1 [14/A] TO RELEASE PIP PIN #1 [10/B].

(4A) (THIS RELEASES THE MET AND MET BLANKET FROM REAR ATTACHMENT POINT AND ALLOWS UNIT TO SWING FORWARD TO FRONT OF MESA.)

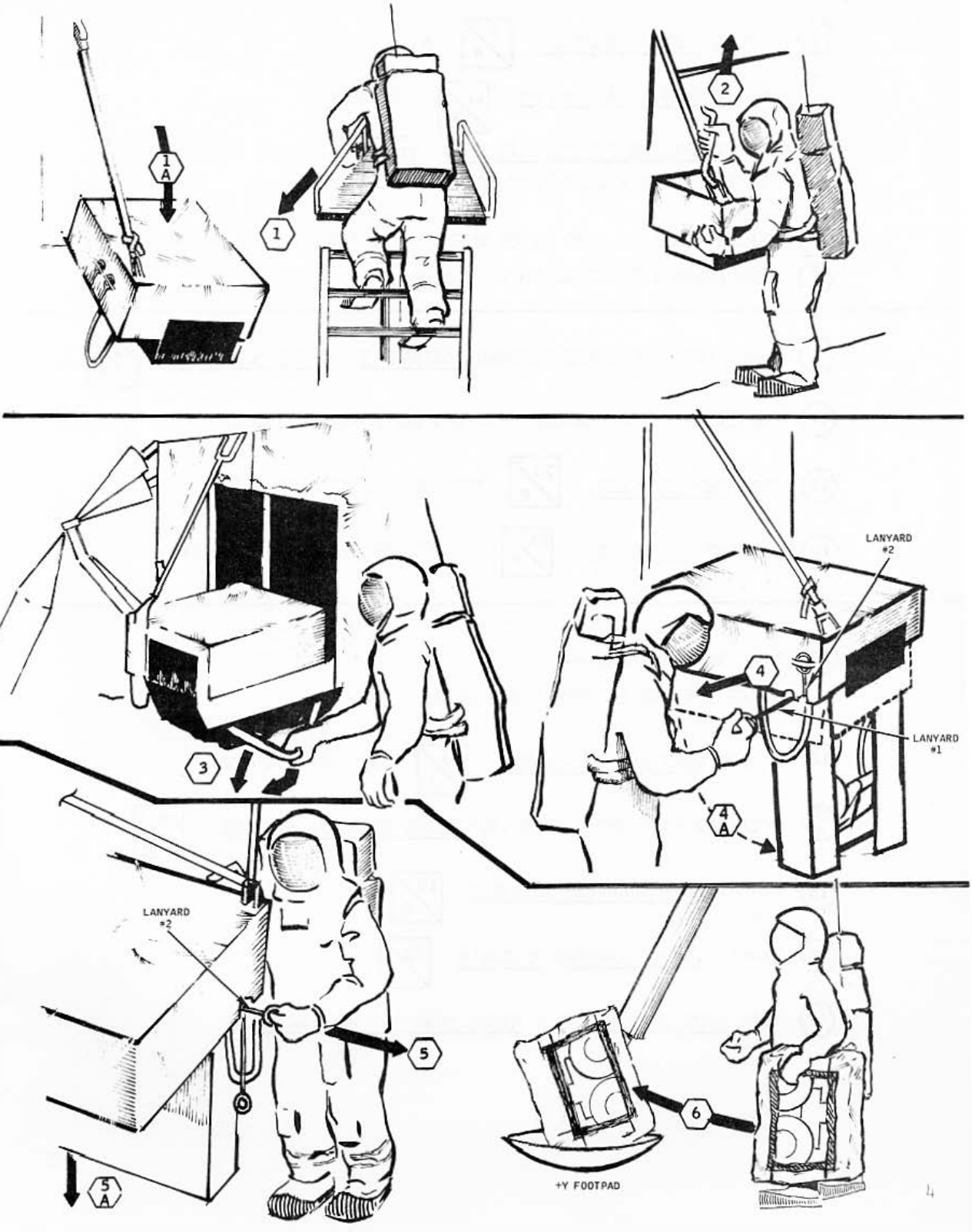
NOTE: IF TIMELINE PERMITS OR IF IMMEDIATE USAGE OF THE MET IS REQUIRED, IT COULD BE DEPLOYED ((7) - (9)) AT THIS POINT IN PROCEDURES. NOMINALLY IT WILL BE LEFT ON SURFACE UNTIL NEEDED LATER IN EVA.

(5) HOLD MET WITH RIGHT HAND, PULL LANYARD #2 [17/A] TO RELEASE PIP PINS #2 & 3 [17/B].

(5A) (THIS SEPARATES MET AND MET BLANKET FROM MESA. RIGHT HAND HOLDS MET TO KEEP FROM FALLING FLAT ON LUNAR SURFACE.)

(6) STOW THE MET TEMPORARILY IN THE SUN ON THE +Y FOOTPAD [1/C].

PROCEDURES ILLUSTRATIONS



B. MET DEPLOYMENT

(7) REMOVE THERMAL BLANKET [7/A] AND . . .

(7A) PULL WHEELPIN LANYARD #3 [11/F] AND REMOVE BOTH WHEELLOCK PIP PINS #4 & #5 [12/H] . (THIS UNLOCKS WHEELS FROM FRAME.)

(8) DEPLOY WHEELS: LIFT UPPER WHEEL UNTIL LOCKED.

(8A) PUSH LOWER WHEEL DOWN UNTIL LOCKED.

(9) GRASP LOOP, PULL AND DISCARD LEG/HANDLE PIP PIN & BRACKET [21/D] .

(10) PARTIALLY DEPLOY HANDLES FOR LEG DEPLOYMENT CLEARANCE.

(11) PULL MET LEFT LEG [20/F] "UP" UNTIL LOCKED IN PLACE.

(13) PUSH MET RIGHT LEG [21/F] "DOWN" UNTIL LOCKED IN PLACE.

(13) TURN MET OVER AND---
PLACE UPRIGHT ON WHEELS AND LEGS.

(14) ROTATE DRAW BAR Δ -HANDLE [19/J] INTO POSITION AND . . .

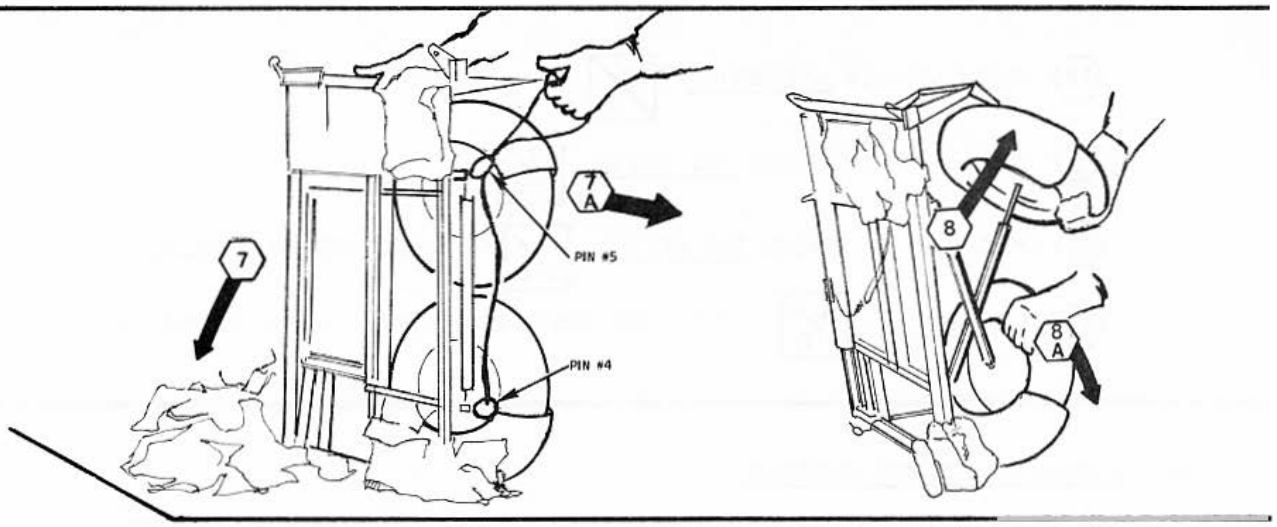
(14A) FOLD AND LOCK INTO PLACE INTO RIGHT DRAW BAR ASSEMBLY [20/G] .

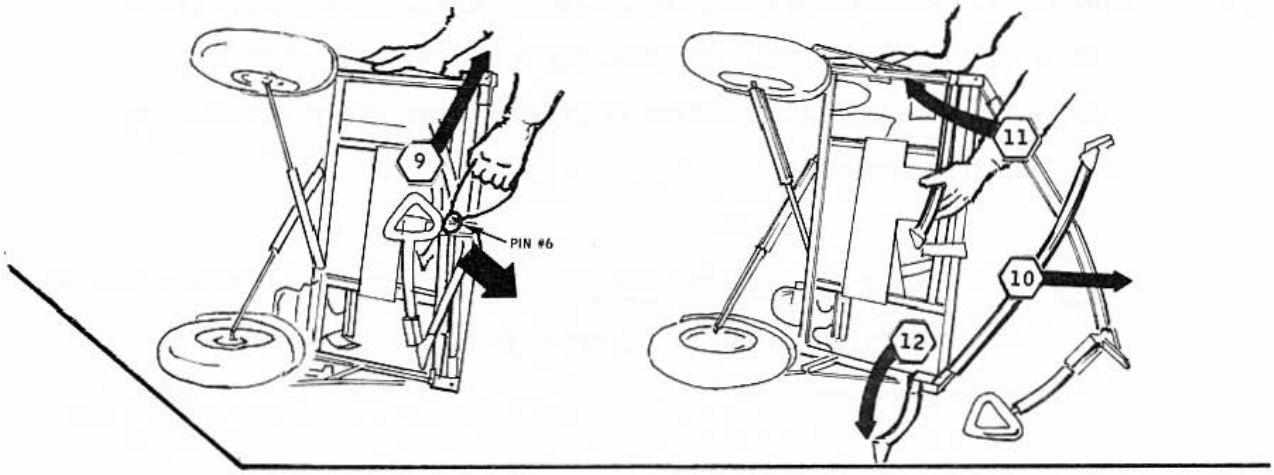
(13) UNFOLD LEFT DRAW-BAR ASSEMBLY [19/G] .

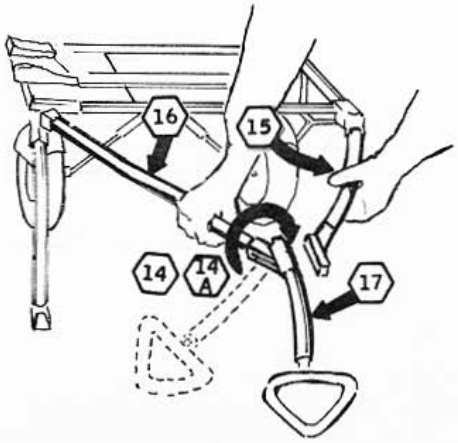
(16) UNFOLD RIGHT DRAW-BAR ASSEMBLY [20/G] .

(17) LOCK LEFT DRAW BAR INTO RIGHT DRAW-BAR AND HANDLE.

PROCEDURES ILLUSTRATIONS







B. MET DEPLOYMENT (CONTINUED)

(18) GRASP LOOP IN LANYARD #4. [12/D] .

(18A) PULL RIGHT TO REMOVE PIP PIN #7 [14/D] . . .

(18B) PULL LEFT TO REMOVE PIP PIN #8 [11/D] . (THIS UNLOCKS TABLE.)

(19) PULL TABLE [10/D] "UP" INTO EXTENDED POSITION UNTIL LOCKED IN PLACE.

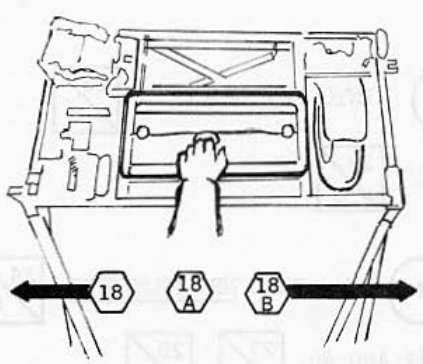
C. LOADING OF MET FOR TRAVERSE

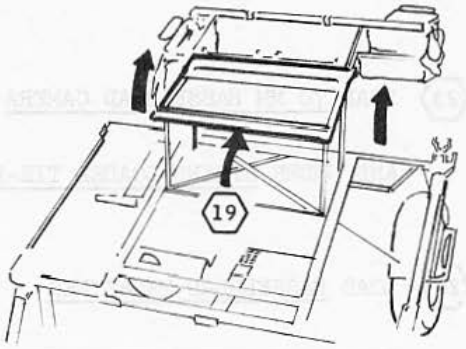
(THE SEQUENCE OF STOWAGE OF THE FOLLOWING ITEMS WILL BE DICTATED BY THE SPECIFIC MISSION TIMELINE. HOWEVER, THE FOLLOWING PROCEDURES ILLUSTRATE INDIVIDUAL TASK ELEMENTS INVOLVED IN STOWING ITEMS ON THE MET PRIOR TO THE GEOLOGY TRAVERSES.)

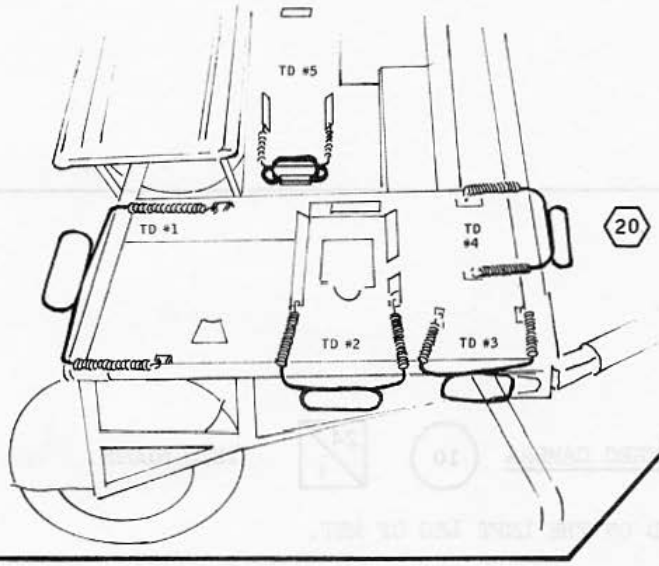
(20) UNSTOW SPRING-LOADED TIE-DOWNS #'s 1-5 AND PLACE AS ILLUSTRATED SO THAT ARTICLES MAY BE STOWED ON THE MET WITHOUT INTERFERENCE FROM ADJACENT TIE-DOWNS.

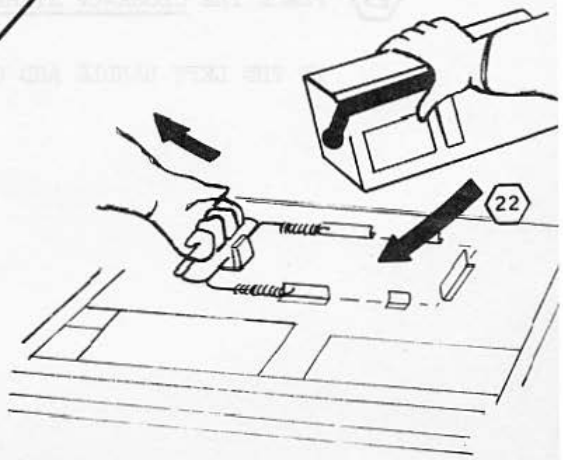
(21) LOAD 35 MM LGEC CAMERA (7) INTO MET BRACKETS [29/A] AND UNDER SPRING-LOADED TIE-DOWN #1 [29/D] .

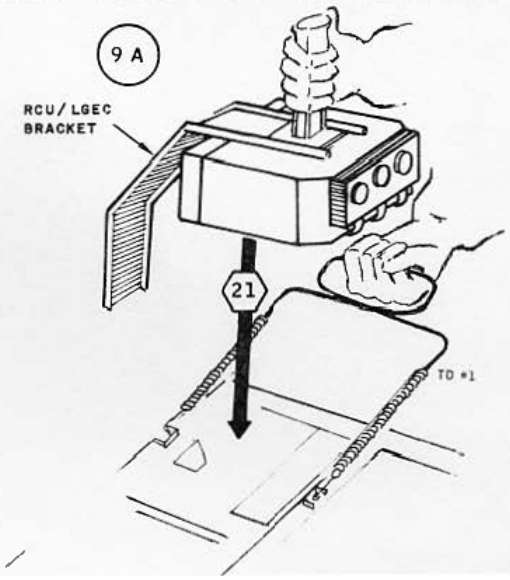
(22) LOAD LGEC CAMERA MAGAZINE (8) INTO MET BRACKETS [29/I] AND UNDER SPRING-LOADED TIE-DOWN #5 [29/F] .


18
18 A
18 B


19


TD #5
TD #1
TD #4
TD #2
TD #3
20


22

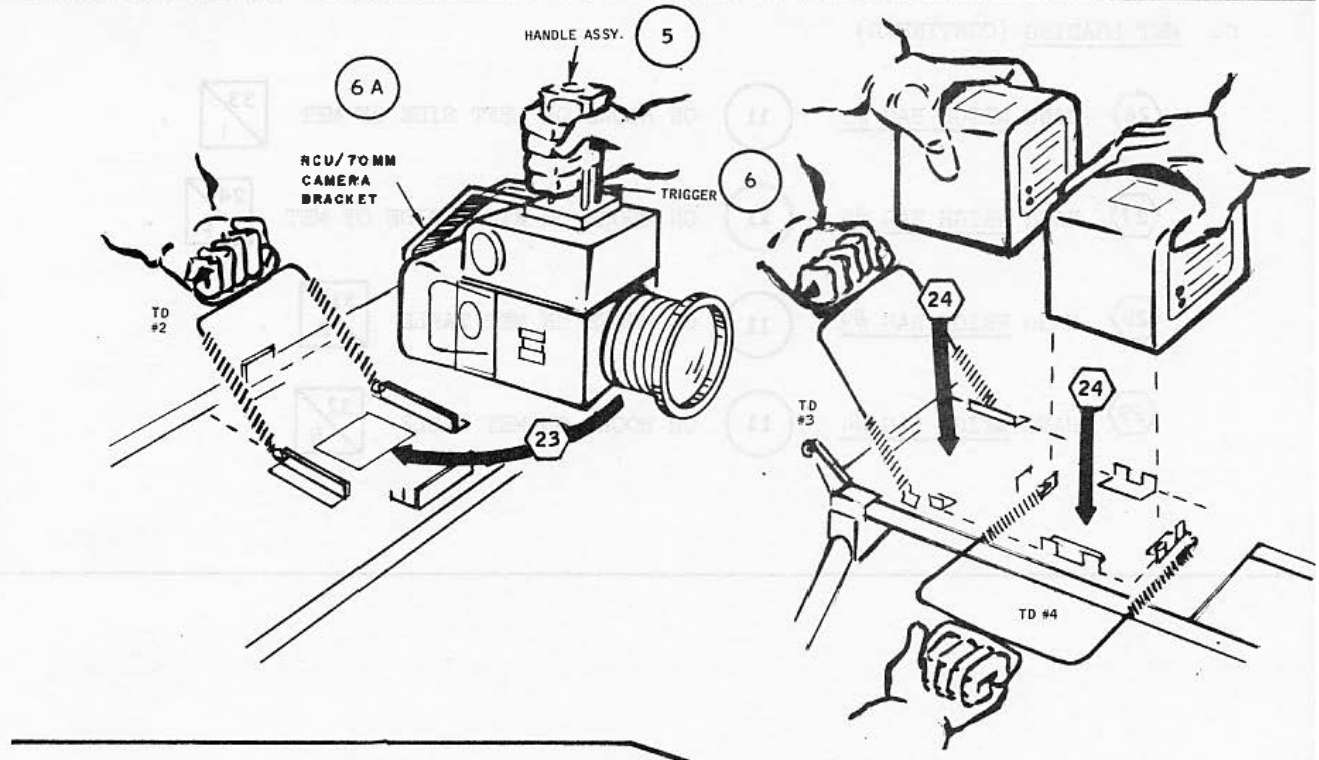

9 A
RCU / LGEC
BRACKET
21
TD #1

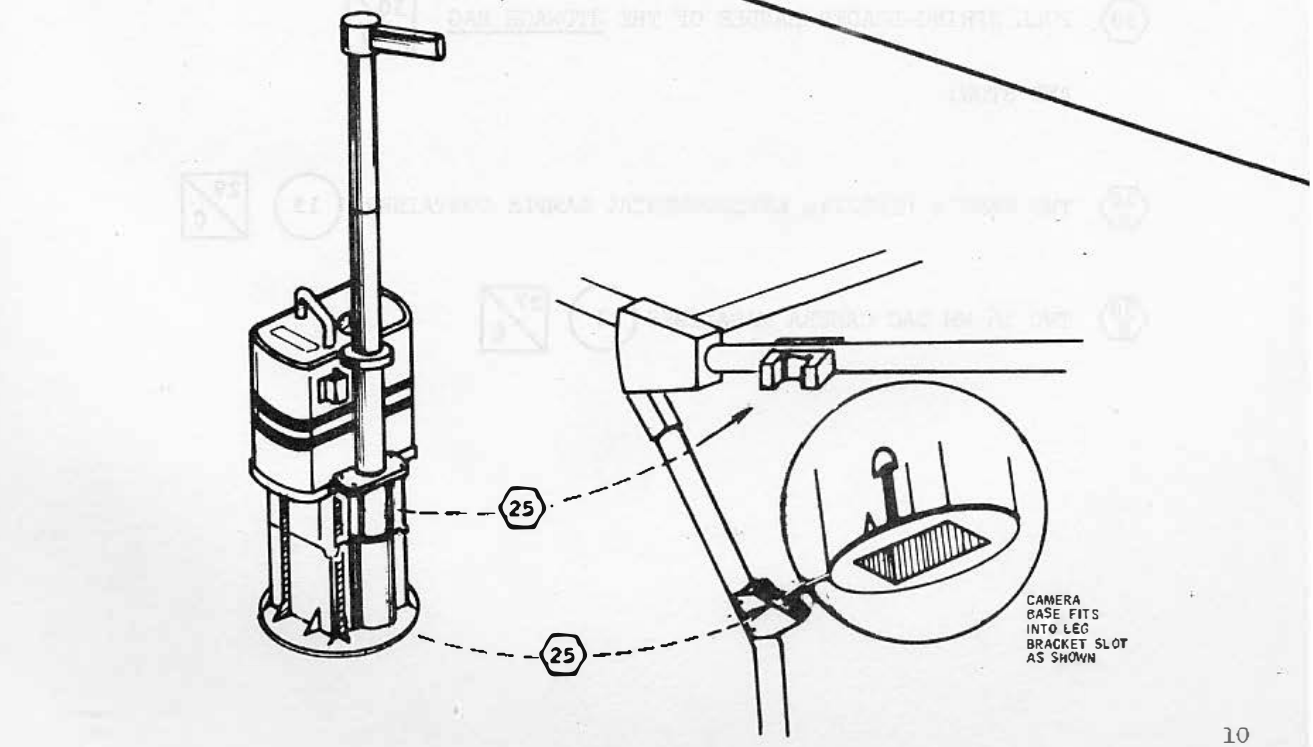
C. MET LOADING (CONTINUED)

(23) LOAD 70 MM HASSELBLAD CAMERA (3) INTO MET BRACKETS [26/B] AND UNDER SPRING-LOADED TIE-DOWN #2 [28/D].

(24) LOAD HASSELBLAD MAGAZINES (4) INTO MET BRACKETS [24/C] AND UNDER SPRING-LOADED TIE-DOWNS #3 AND #4. [27/E] [28/F].

(25) PLACE THE CLOSE-UP STEREO CAMERA (10) [24/I] INTO SLOTS IN THE LEFT HANDLE AND ON THE LEFT LEG OF MET.


HANDLE ASSY.
5
6 A
RCU/70MM
CAMERA
BRACKET
TRIGGER
6
TD
#2
23
24
24
TD
#3
TD #4


25
25
CAMERA
BASE FITS
INTO LEG
BRACKET SLOT
AS SHOWN

C. MET LOADING (CONTINUED)

(26) HANG WEIGH BAG #1 (11) ON HOOKS ON LEFT SIDE OF MET [33/I] .

(27) HANG WEIGH BAG #2 (11) ON HOOKS ON RIGHT SIDE OF MET [24/F] .

(26) HANG WEIGH BAG #3 (11) ON HOOKS ON MET TABLE [31/A] .

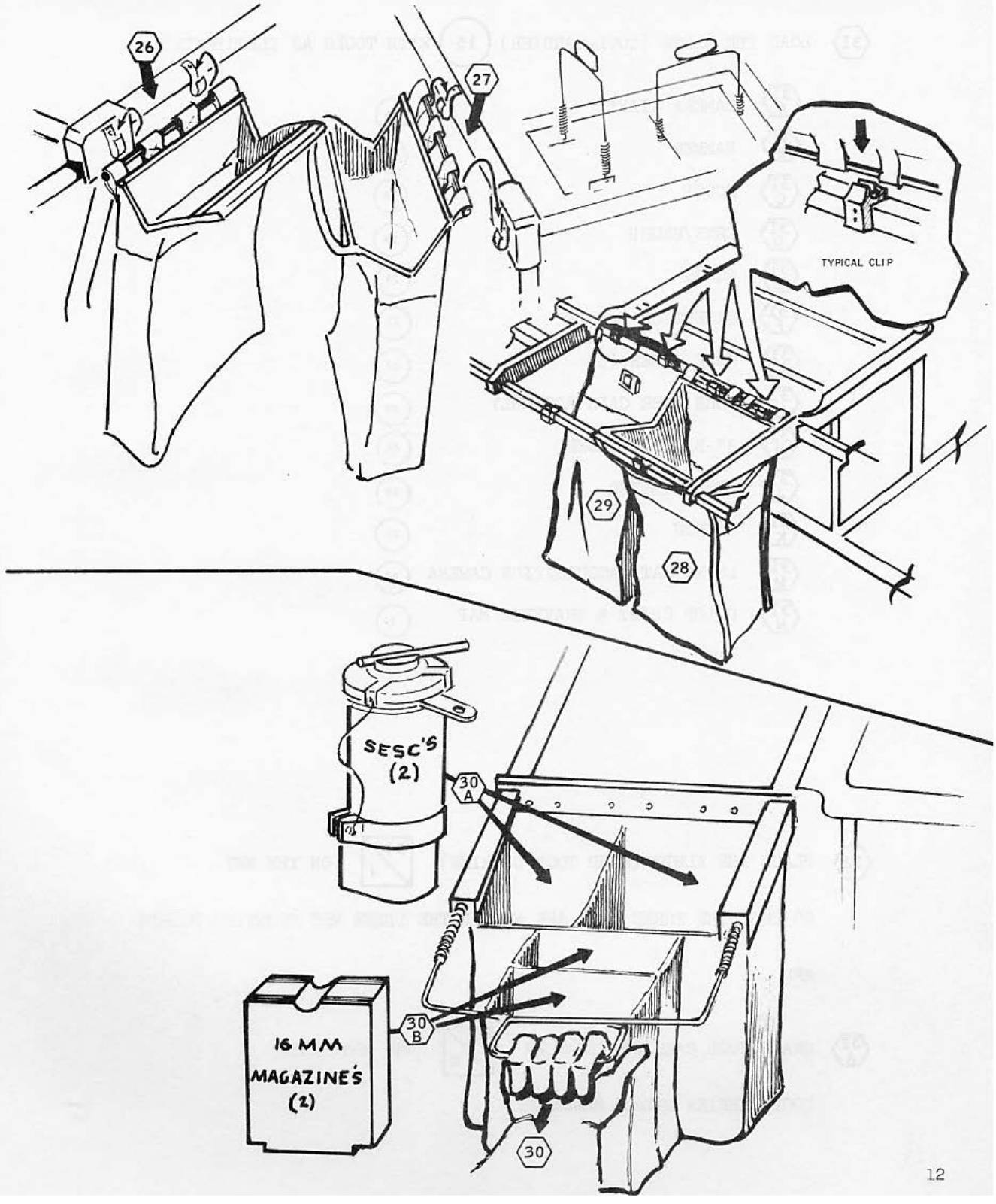
(29) HANG WEIGH BAG #4 (11) ON HOOKS ON MET TABLE [32/B] .

(30) PULL SPRING-LOADED HANDLE OF THE STOWAGE BAG [30/D]

AND STOW:

(30 Λ) TWO SESC's (SPECIAL ENVIRONMENTAL SAMPLE CONTAINER) (13) [29/C]

(30 Λ) TWO 16 MM DAC CAMERA MAGAZINES (2) [27/C]


26
27
TYPICAL CLIP
29
28
SESC'S
(2)
30
A
16 MM
MAGAZINES
(2)
30
B
30

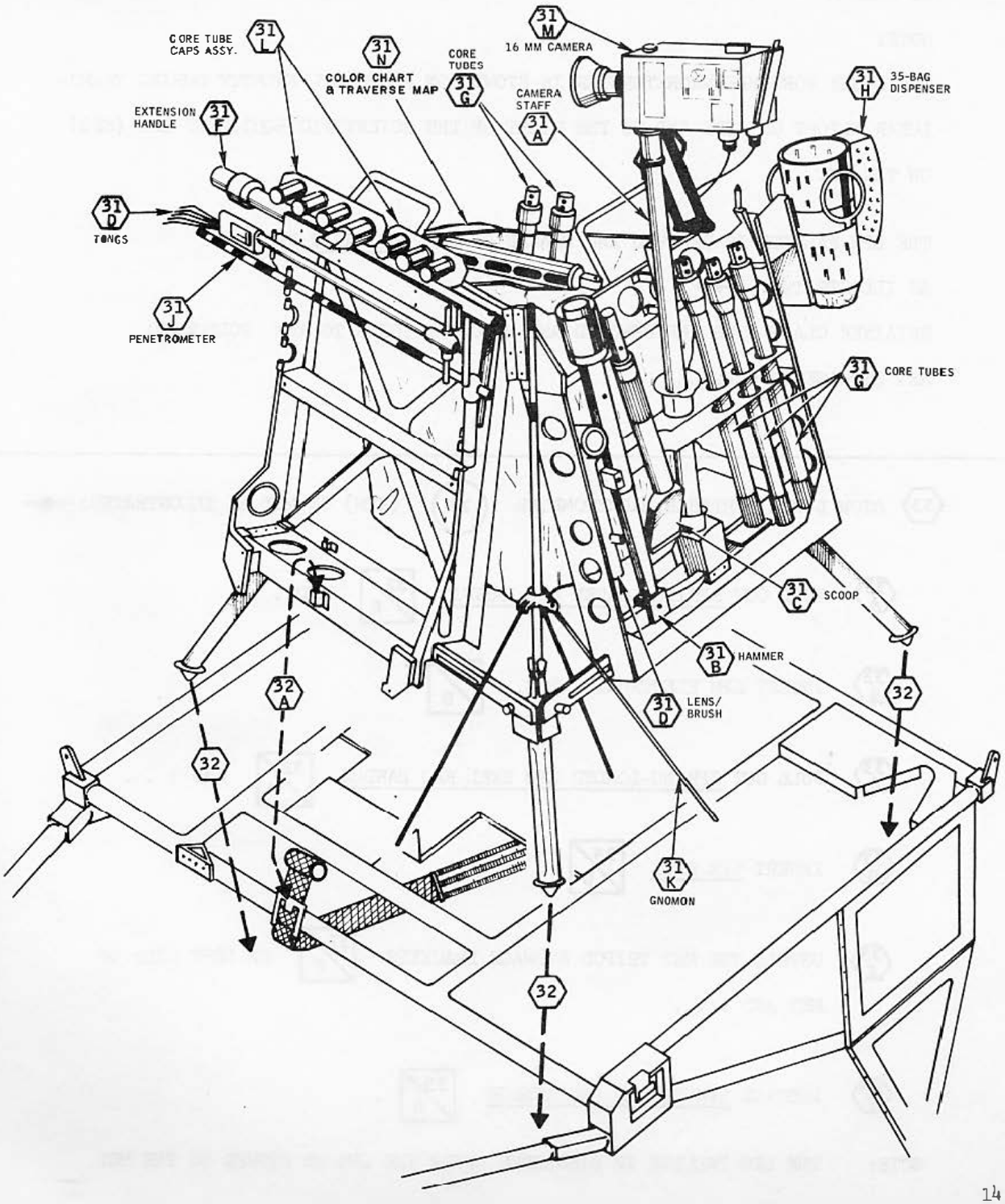
C. MET LOADING (CONTINUED)

(31) LOAD THE ALHTC (TOOL-CARRIER) (15) WITH TOOLS AS ILLUSTRATED:

(31A)	CAMERA STAFF	(16)
(31B)	HAMMER	(17)
(31C)	SCOOP	(18)
(31D)	LENS/BRUSH	(19)
(31E)	TONGS	(20)
(31F)	EXTENSION HANDLE	(21)
(31G)	CORE TUBES (5)	(22)
(31L)	CORE TUBE CAPS ASSEMBLY	(23)
(31H)	35-BAG DISPENSER	(24)
(31J)	PENETROMETER	(25)
(31K)	GNOMON	(26)
(31M)	16 MM DATA ACQUISITION CAMERA	(27)
(31N)	COLOR CHART & TRAVERSE MAP	(1)

(32) PLACE THE ALHTC (HAND TOOL CARRIER) [34/J] ON THE MET SO THAT THE THREE LEGS ARE WITHIN THE THREE MET MOUNTING POINTS AND . . .

(32A) GRASP TOOL CARRIER TIE-DOWN [28/G] AND HOOK INTO TOOL CARRIER HANDLE BRACKET.


31 L
CORE TUBE CAPS ASSY.
31 N
COLOR CHART & TRAVERSE MAP
CORE TUBES
31 G
31 M
16 MM CAMERA
31 H
35-BAG DISPENSER
CAMERA STAFF
31 A
EXTENSION HANDLE
31 F
31 D
TONGS
31 J
PENETROMETER
31 G
CORE TUBES
31 C
SCOOP
31 B
HAMMER
31 D
LENS/ BRUSH
32 A
32
32
32
31 K
GNOMON

C. MET LOADING (CONTINUED)

NOTE:

THE LUNAR PORTABLE MAGNETOMETER IS STOWED ON A SPECIAL PALETTE DURING TRANS-LUNAR FLIGHT OUTSIDE AND TO THE RIGHT OF THE SCIENTIFIC EQUIPMENT BAY (SEQ) ON THE LM.

THE LPM PALETTE IS REMOVED AND PLACED ON THE MET TABLE RACK AS ILLUSTRATED: →

RETAINER CLAMP PINS ARE REMOVED AND UNFOLDED PRIOR TO THE FOLLOWING MET STOWAGE PROCEDURES.

(33) STOW LUNAR PORTABLE MAGNETOMETER (14) (LPM) ON MET AS ILLUSTRATED: →

(33 A) PULL OUT SPRING-LOADED BAG HANDLE [32/E] AND . . .

(33 B) INSERT LPM ELECTRONICS PKG. [33/B] .

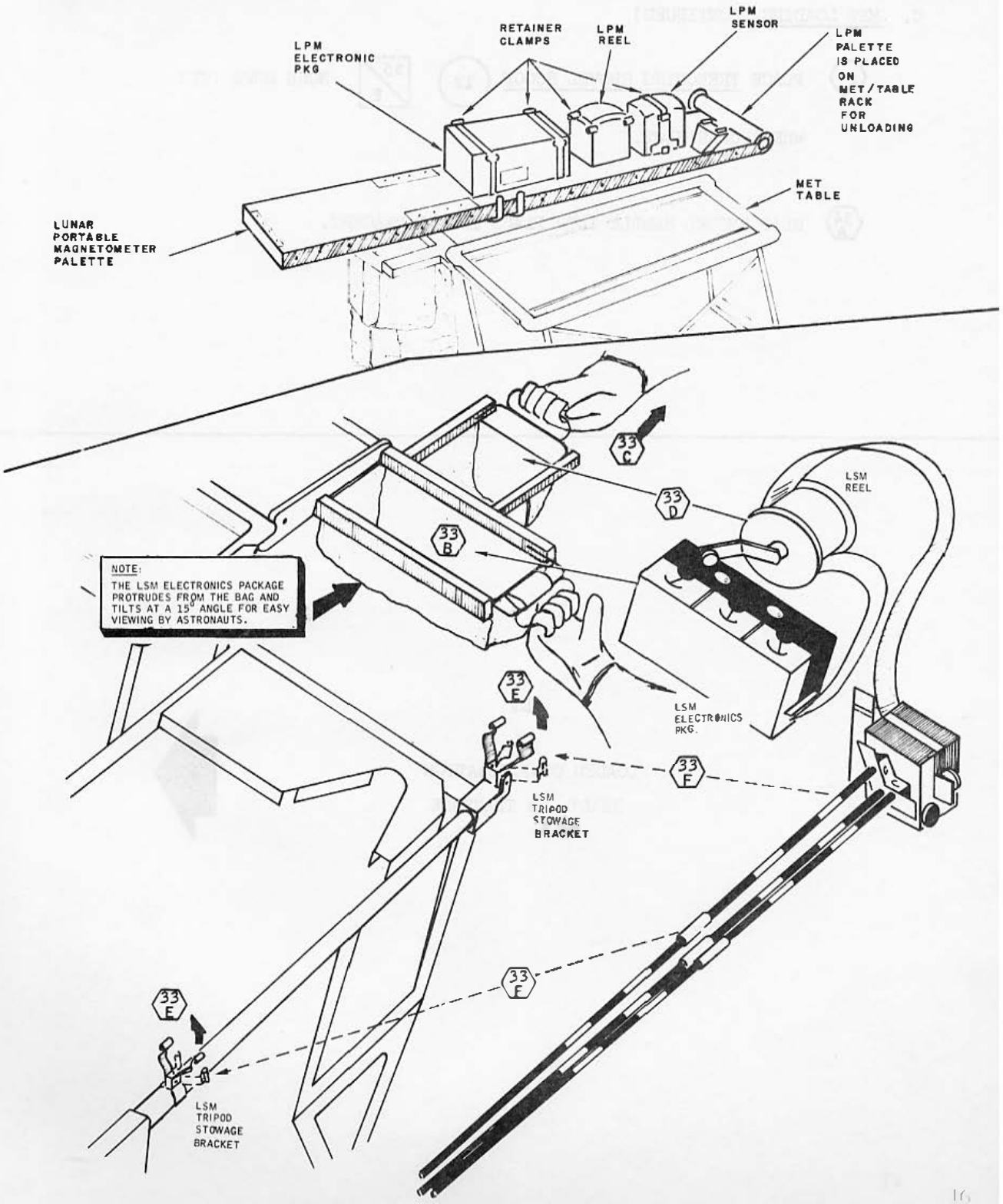
(33 C) PULL OUT SPRING-LOADED LPM REEL BAG HANDLE [32/E] AND . . .

(33 D) INSERT LPM REEL [34/D] .

(33 E) UNFOLD THE MET TRIPOD STOWAGE BRACKETS [32/F] ON LEFT SIDE OF MET AND . . .

(33 F) INSTALL LPM TRIPOD AND SENSOR [35/D] .

NOTE: THE LPM PALETTE IS DISCARDED AFTER THE LPM IS STOWED ON THE MET.

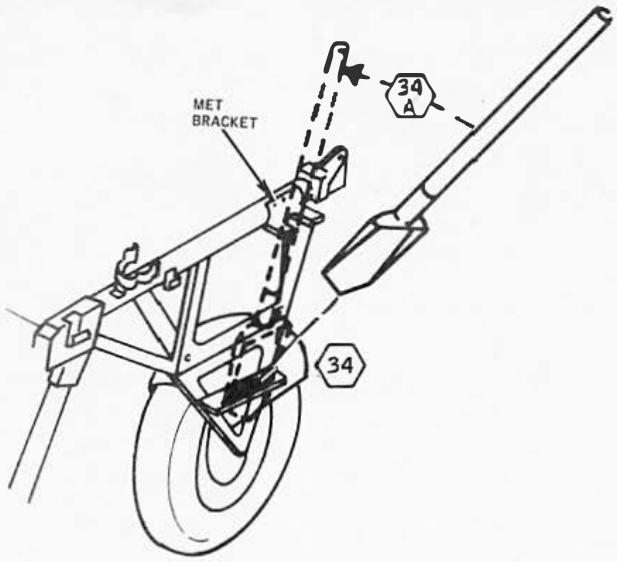

LPM ELECTRONIC PKG
RETAINER CLAMPS
LPM REEL
LPM SENSOR
LPM PALETTE IS PLACED ON MET/TABLE RACK FOR UNLOADING
MET TABLE
LUNAR PORTABLE MAGNETOMETER PALETTE
33 C
33 D
LSM REEL
33 B
NOTE:
THE LSM ELECTRONICS PACKAGE PROTRUDES FROM THE BAG AND TILTS AT A 15° ANGLE FOR EASY VIEWING BY ASTRONAUTS.
33 E
LSM ELECTRONICS PKG.
33 F
LSM TRIPOD STOWAGE BRACKET
33 E
33 F
LSM TRIPOD STOWAGE BRACKET

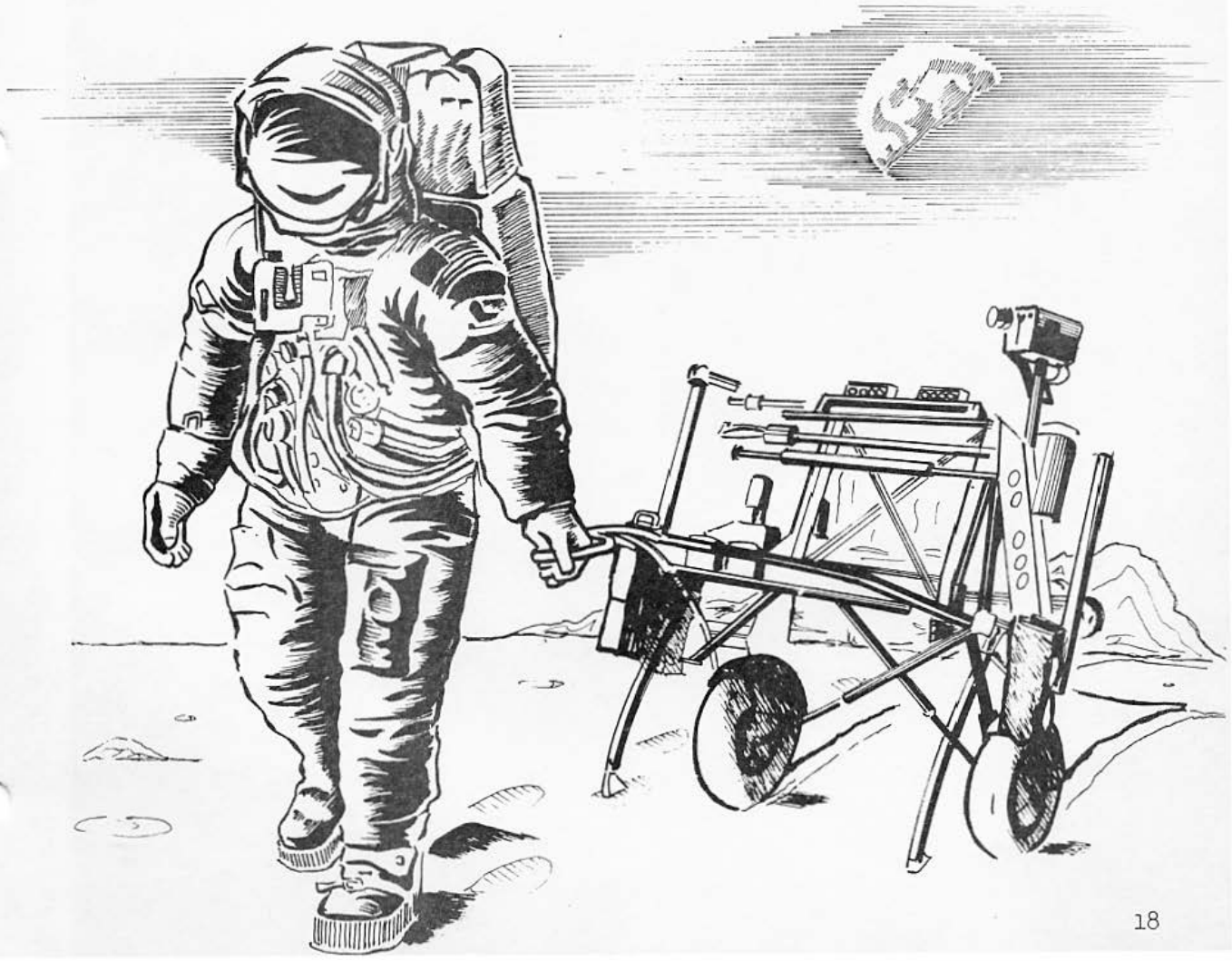
C. MET LOADING (CONTINUED)

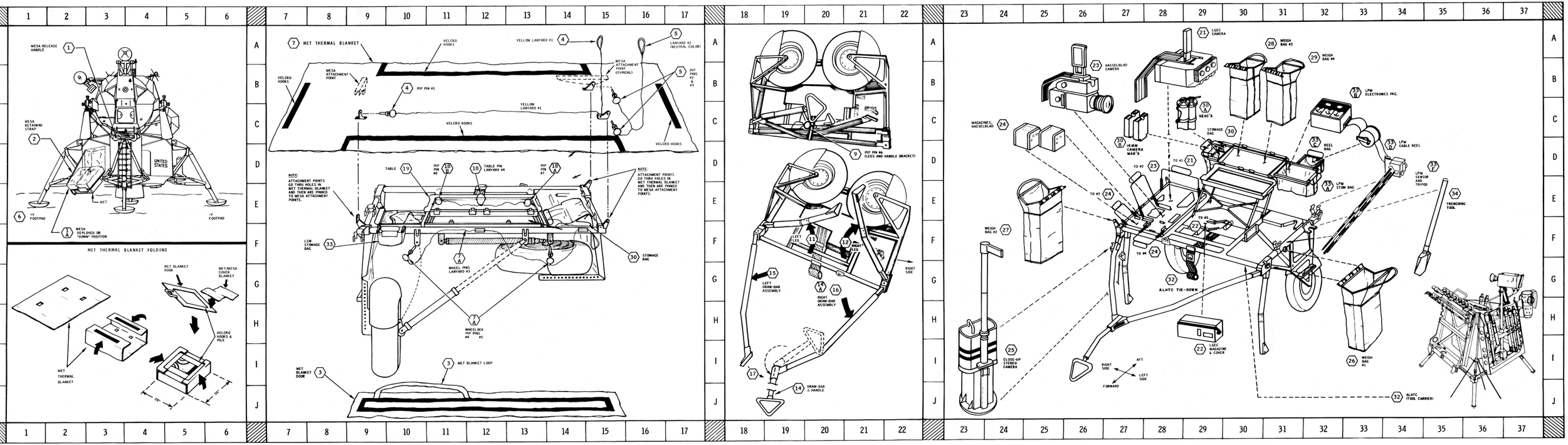
(34) PLACE TRENCHING SHOVEL SCOOP (12) [35/E] NOSE DOWN INTO WHEEL GEAR SLOT.

(34A) CLIP SHOVEL HANDLE INTO PLACE IN MET BRACKET.

MET
IN
LOADED CONFIGURATION
READY FOR TRAVERSE


MET
BRACKET
34
A
34




MESA RELEASE HANDLE
MESA RETAINING STRAP
MESA DEPLOYED OR "DOWN" POSITION
-Y FOOTPAD
+Y FOOTPAD
MET
UNITED STATES
MET THERMAL BLANKET FOLDING
MET BLANKET DOOR
MET/MESA COVER BLANKET
VELCRO HOOKS & PILE
MET THERMAL BLANKET
MET THERMAL BLANKET
VELCRO HOOKS
MESA ATTACHMENT POINT
PIP PIN #1
YELLOW LANYARD #1
LANYARD #2 (NEUTRAL COLOR)
MESA ATTACHMENT POINT (TYPICAL)
PIP PINS #2 & #3
YELLOW LANYARD #2
VELCRO HOOKS
VELCRO HOOKS
NOTE: ATTACHMENT POINTS GO THRU HOLES IN MET THERMAL BLANKET AND THEN ARE PINNED TO MESA ATTACHMENT POINTS.
TABLE
PIP PIN #8
TABLE PIN LANYARD #4
PIP PIN #7
NOTE: ATTACHMENT POINTS GO THRU HOLES IN MET THERMAL BLANKET AND THEN ARE PINNED TO MESA ATTACHMENT POINTS.
LSM STOWAGE BAG
WHEEL PINS LANYARD #3
STOWAGE BAG
WHEELOCK PIP PINS #4 #5
MET BLANKET DOOR
MET BLANKET LOOP
PIP PIN #6 (LEGS AND HANDLE BRACKET)
LEFT LEG
RIGHT LEG
RIGHT SIDE
LEFT DRAW-BAR ASSEMBLY
RIGHT DRAW-BAR ASSEMBLY
DRAW-BAR A HANDLE
LGEC CAMERA
WEIGH BAG #3
WEIGH BAG #4
HASSELBLAD CAMERA
LPM ELECTRONICS PKG.
MESC'S
MAGAZINES, HASSELBLAD
STOWAGE BAG
16MM CAMERA MAG'S
LPM CABLE REEL
REEL BAG
TD #1
TD #2
TD #3
TD #4
TD #5
LPM STOW BAG
LPM SENSOR AND TRIPOD
TRENCHING TOOL
WEIGH BAG #2
ALHTC TIE-DOWN
LGEC MAGAZINE & COVER
CLOSE-UP STEREO CAMERA
WEIGH BAG #1
RIGHT SIDE
AFT
LEFT SIDE
FORWARD
ALHTC (TOOL CARRIER)