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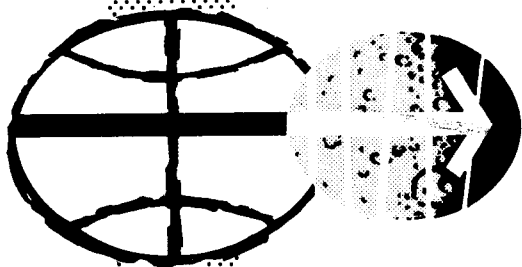
MSC-03991
Revision B



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 15
LUNAR ROVER VEHICLE (LRV)

LUNAR SURFACE EQUIPMENT
STOWAGE LOCATION AND CRITERIA



MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

June 16, 1971

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. This is essential for ensuring the integrity of the financial statements and for providing a clear audit trail.

2. The second part of the document outlines the various methods used to collect and analyze data. These methods include direct observation, interviews, and the use of specialized software tools.

3. The third part of the document describes the results of the study. It shows that there is a significant correlation between the use of accurate records and the reliability of the financial statements.

4. The fourth part of the document discusses the implications of the findings. It suggests that organizations should invest in training and technology to improve their record-keeping practices.

5. The fifth part of the document concludes the study and provides a summary of the key findings.

LUNAR ROVER VEHICLE (LRV)
LUNAR SURFACE EQUIPMENT
STOWAGE LOCATION AND CRITERIA

APOLLO 15
(J-1 MISSION)

Prepared by The Boeing Company

for

Spacecraft Design Office
Engineering and Development Directorate

Manned Spacecraft Center
Houston, Texas

Submitted by: W. K. Zollman 2/25/71
W. K. Zollman
The Boeing Company

Approved by: G. Franklin 2/25/71
G. Franklin, CF131

Approved by: G. W. Miller 2/25/71
G. W. Miller, EW3

Approved by: J. F. Goree, Jr.
J. F. Goree, Jr., PG


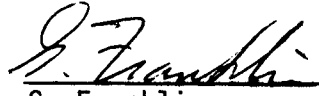
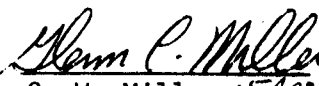
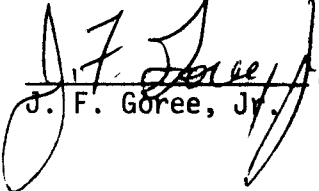
REVISION NOTICE SHEET

REVISION LETTER	DESCRIPTION OF CHANGE	APPROVAL
A	<p><u>Page 4 and 5</u></p> <p>Code A1 - P/N Defined</p> <p>Code A2 - P/N Defined</p> <p>Code A3 - Item Deleted</p> <p>Code A6 - P/N Defined</p> <p>Code A7 - P/N Changed</p> <p>Code A8 - P/N Changed</p> <p>Code A9 - P/N Changed</p> <p>Code A10 - P/N Defined</p> <p>Code A11 - P/N Defined</p> <p>Code A12 - P/N Defined</p> <p>Code A13 - Color Chart Removed from List. Part of Gnomon</p> <p>Code A13 - Gnomon P/N Changed</p> <p>Code B1 - Changed to Code C4</p> <p>Code B2 - Quantity Changed</p> <p>Code C2 - P/N Defined</p> <p>Code C3 - P/N Defined</p> <p>Lunar Surface Maps Removed from List</p> <p>Code A14 - Item Added</p> <p>Code A15 - Item Added</p> <p>Code B3 - Item Added</p> <p>Code B4 - Item Added</p> <p>Code C5 - Item Added</p> <p>Code D2 - Item Added</p> <p><u>Page 6</u></p> <p>Code A15 - Added</p> <p><u>Page 7</u></p> <p>Coded A15 - Added</p>	

REVISION NOTICE SHEET

REVISION LETTER	DESCRIPTION OF CHANGE	APPROVAL
A	<p><u>Page 8</u> Code A3 - Deleted Code A14 - Added</p> <p><u>Page 9</u> Code A3 - Deleted Code A14 - Added Code A5 - Strap Rerouted Over Brush Body</p> <p><u>Page 13</u> Code A13 - Drawing Revised (Damper and Chain Deleted)</p> <p><u>Page 19</u> Code A1 - Drawing Revised (Alignment Marks Added)</p> <p><u>Page 20</u> Code B1 - Deleted Code B3 - Added Code B4 - Added</p> <p><u>Page 21</u> Code B1 - Deleted Code B3 - Added Code B4 - Added Velcro Strap Added to Front Seat Support and Outboard Handhold Seat Belt Revised Velcro Patch Added Bottom of Payload Stowage Bag</p> <p><u>Page 22</u> Code C4 - Added Code C5 - Added</p>	

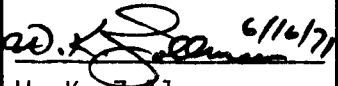


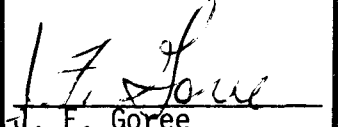
REVISION NOTICE SHEET

REVISION LETTER	DESCRIPTION OF CHANGE	APPROVAL
A	<p><u>Page 23</u> Code C4 - Added Code C5 - Added Velcro Strap Added to Front Seat Support and Outboard Handhold Seat Belt Revised R.H. Bag Assy Drawing Revised (Added Magazine Stowage Compartments)</p> <p><u>Page 24</u> Code C2 - Revised</p> <p><u>Page 25</u> Seat Belt Revised</p> <p><u>Page 26</u> Code D2 - Added</p> <p><u>Page 27</u> Code D2 - Added</p> <p><u>Page 31</u> Lower Right Drawing Revised (Locked Position Rotated Down)</p> <p><u>Page 33</u> Foldout Page Revised Per Above Changes</p>	<p> W. K. Zolman</p> <p> G. Franklin</p> <p> G. W. Miller 15 Apr.</p> <p> J. F. Goree, Jr.</p>

REVISION NOTICE SHEET

REVISION LETTER	DESCRIPTION OF CHANGE	APPROVAL
B	<p><u>Page 4 and 5</u></p> <p>Code A2 - P/N Changed Code A4 - P/N Defined Code A6 - Quantity Changed for Extra and Sample Collection Bags Code A6 - Item Added for Sample Return Bag Code A15 - P/N Changed Code B1 - Changed from Code C4 Code B2 - Quantity Changed Code B3 - Item Deleted Code C2 - P/N Changed Code C4 - Changed to Code B1 Code C5 - Combined with Code B2 Code B5 - Item Added Code D1 - P/N Changed Code D2 - Stowage Item No. Added Code E1 - Stowage Item No. Added Code F4 - Stowage Item No. Added</p> <p><u>Page 8</u></p> <p>Code A14 - Revised</p> <p><u>Page 9</u></p> <p>Code A14 - Revised</p> <p><u>Page 19A</u></p> <p>This Page Added</p> <p><u>Page 19B</u></p> <p>This Page Added</p>	

REVISION NOTICE SHEET

REVISION LETTER	DESCRIPTION OF CHANGE	APPROVAL
B	<p><u>Page 20</u></p> <p>Code B1 - Transferred from Code C4 Code B3 - Deleted Code B4 - Revised</p> <p><u>Page 21</u></p> <p>Code B1 - Added Code B3 - Deleted Code B4 - Bag for 500MM Camera System Deleted</p> <p><u>Page 22</u></p> <p>Code C4 - Transferred to Code B1 Code C5 - Deleted. Combined with Code B2</p> <p><u>Page 23</u></p> <p>Code C4 - Deleted Code C5 - Deleted</p> <p><u>Page 33</u></p> <p>Foldout Page Revised Per Above Changes</p>	<div style="margin-bottom: 10px;">  W. K. Zollman </div> <div style="margin-bottom: 10px;">  G. C. Franklin </div> <div style="margin-bottom: 10px;">  G. W. Miller </div> <div style="margin-bottom: 10px;">  J. F. Goree </div>

LUNAR ROVER VEHICLE (LRV)

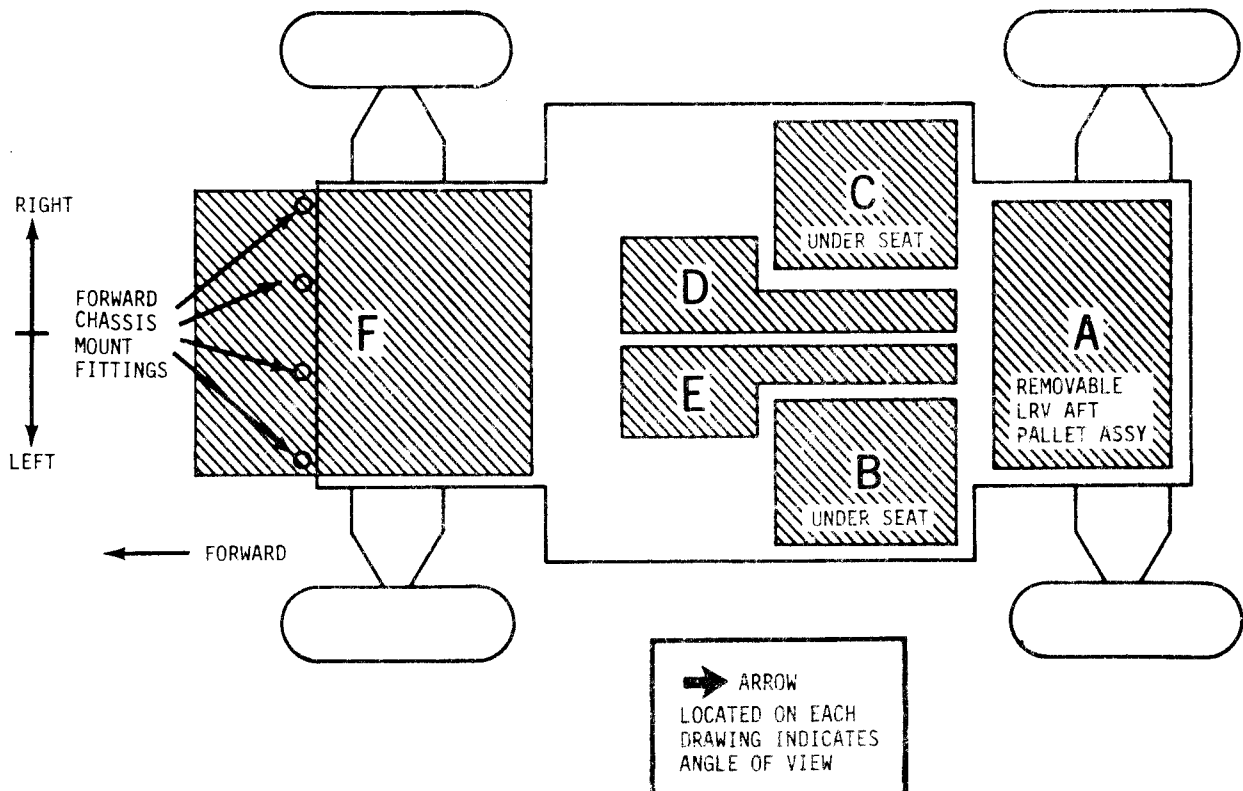
Stowage Concepts

The LRV will carry astronauts and their equipment from the lunar module to designated lunar areas. This document defines the maximum equipment, its placement and fit criteria, on the LRV for a lunar traverse. The equipment to be stowed is listed on page 4.

This document is best used by unfolding the last page which contains a composite view of the LRV with equipment identified and coded by page numbers for the detail stowage criteria. The following defines the LRV area codes:

<u>Codes</u>		<u>General Area Descriptions</u>
A	=	Vehicle Areas Aft of Seat
B	=	Areas Under Left Seat
C	=	Areas Under Right Seat
D	=	Console Area Right Side
E	=	Console Area Left Side
F	=	Forward Vehicle Areas

LUNAR ROVING VEHICLE STOWAGE ZONES



EQUIPMENT LIST

REVISION B

LRV STOWAGE ZONE CODE	PART NOMENCLATURE	PART NUMBER & DASH NUMBER OF ITEM	MAX LRV QTY	STOWAGE LIST ITEM NUMBER (REFERENCE)	PAGE NO. OF ILLUSTRATION	REVISION LETTER
A1	LRV AFT PALLET ASSY	LDW340-60720-1	1	Ø3067	PG 7	A
A2	LUNAR HAND TOOL CARRIER	SGB39105801-402	1	G4035	PG 11	B
A4	PENETROMETER ASSY, SELF RECORDING	SEB39106050-302	1	G4049	PG 9	B
A5	BRUSH, LUNAR DUST	SEB39105185-301	1	B1045	PG 9	
A6	BAGS, EXTRA SAMPLE COLLECTION	M10543RM004-03	4	G4048	PG 15 & 19	B
A6	SAMPLE COLLECTION BAGS	M10543RM004-04	2	G4056	PG 15 & 19	B
A6	SAMPLE RETURN BAG	LDW340-58630-3-1	1	Ø3060	PG 15 & 19	B
A7	TONGS (32 INCHES)	SEB39106245-301	2	G4009	PG 13	A
A8	TOOL EXTENSION	SEB39105248-304	1	G4008	PG 13	A
A9	HAMMER	SEB39100319-301	1	G4035.3	PG 13	A
A10	20 DOCUMENTED SAMPLE BAG DISPENSER	11306EM030-00	1		PG 17	A
A11	CORE TUBE CAP DISPENSER ASSY	SEB39107125-302	1		PG 17	A
A12	AJUSTABLE SAMPLING SCOOP	SEB39105725-301	1	G4035.2	PG 13	A
A13	GNOMON	SEB39100317-302	1	G4012	PG 13	A
A14	RAKE, LUNAR SAMPLING	SEB39106380-303	1	G4054	PG 9	B
A15	DRILL STRING VISE	LDW340-60784-5	1	Ø3072	PG 7	B
B1	MAGAZINE, 16MM DAC	SEB33100125-204	3	A0101.1	PG 21	B
B2	MAGAZINE, 70MM L.S.HASSELBLAD	SEB33100082-217	3	A0108.1 A0108.2	PG 21	B
B4	500MM CAMERA SYSTEM	(SEE ITEMIZED LISTING BELOW)			PG 21	A
	CAMERA, L.S. ELEC	SEB33100040-309	1	A1045	PG 21	A
	LENS, 500MM	SEB33100284-302	1	A1046	PG 21	A
	TRIGGER, 70MM CAMERA	SEB33100294-302	1	A1027	PG 21	A
	HANDLE, 70MM CAMERA	SEB33100293-302A	1	A1028	PG 21	A
	RINGSIGHT	SEB33100031-204	1	A1047	PG 21	A
	RCU BRKT, 70MM CAMERA	SV742170-3	1	B1001.1	PG 21	A
B5	GNOMON BAG	SEB33100879-301	1	R1003	PG 19B	B

Revision A

PLACEMENT AND FIT CRITERIA

A1 LRV Aft Pallet Assy

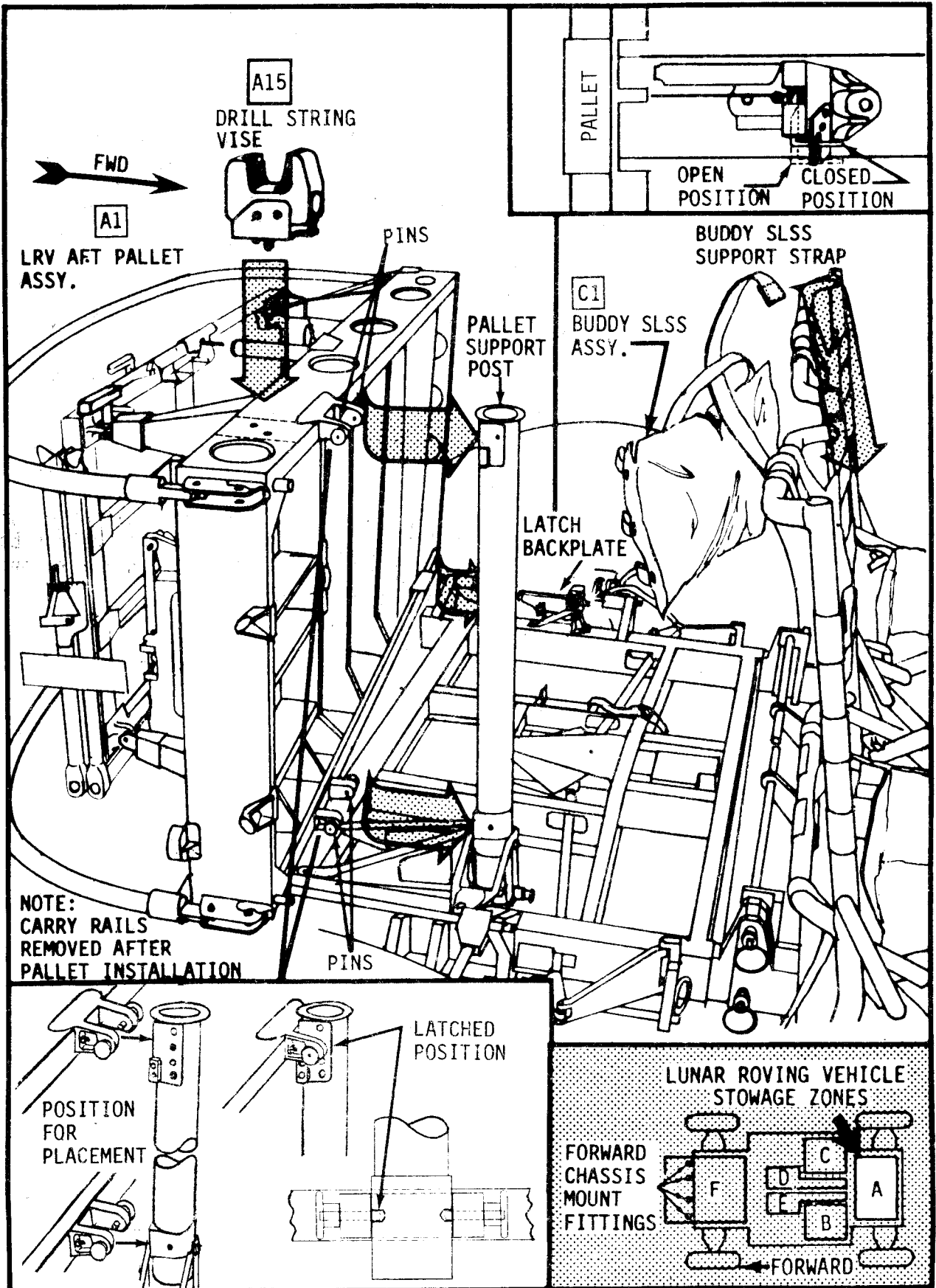
Pallet pins (4) seated in pallet support post holes, top and bottom, with lower left pallet ear against LRV latch backplate. Pallet restrained in three directions.

C1 Buddy SLSS Assy

Buddy SLSS support strap routed through buddy SLSS bag handle and strap velcro patch mated to velcro patch on front of LMP backrest. Buddy SLSS assy is loosely constrained.

A15 Drill String Vise

Vise baseplate pins inserted into pallet receptacles as shown. Vise restrained in three directions.



PLACEMENT AND FIT CRITERIA

A4 Self Recording Penetrometer Assy

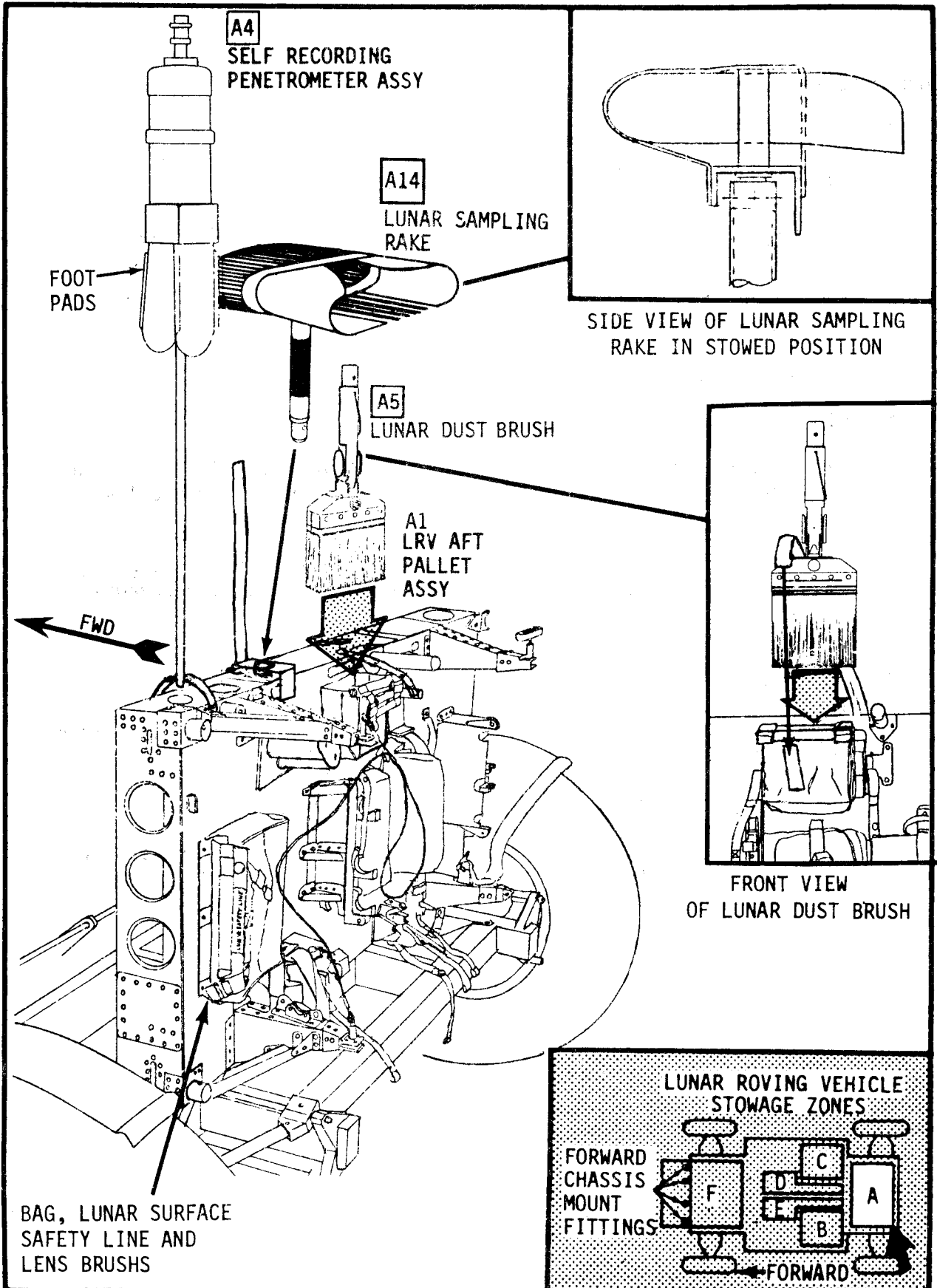
Penetrometer shaft should be bottomed-out in first hole from left-hand side of LRV aft pallet assy. Penetrometer ground plane foot pads are clear of top pallet. Velcro strap mated with velcro on pallet. Penetrometer can be moved vertically but is snug in hole when velcro strap is properly mated.

A5 Lunar Dust Brush

Brush in bag, strap over brush body and mated with velcro on bag. Brush is restrained in all three directions.

A14 Lunar Sampling Rake

Rake handle should be bottomed-out in third hole from left-hand side of LRV aft pallet assembly. Pallet strap routed over the rake's back, top and through front tines. Velcro on strap mated with velcro on pallet. Rake is restrained in three directions.



PLACEMENT AND FIT CRITERIA

A2 LUNAR HAND TOOL CARRIER (HTC)

A. HTC Removal from Pallet

- 1) Remove lower right pallet launch restrain pin.
- 2) Pull top right pallet HTC handle up until pin clears right HTC ear.
- 3) Pull pip pin lanyard upward until two pins clear left HTC hinge halves (ears).
- 4) HTC can be removed.

B. HTC Installation on Pallet

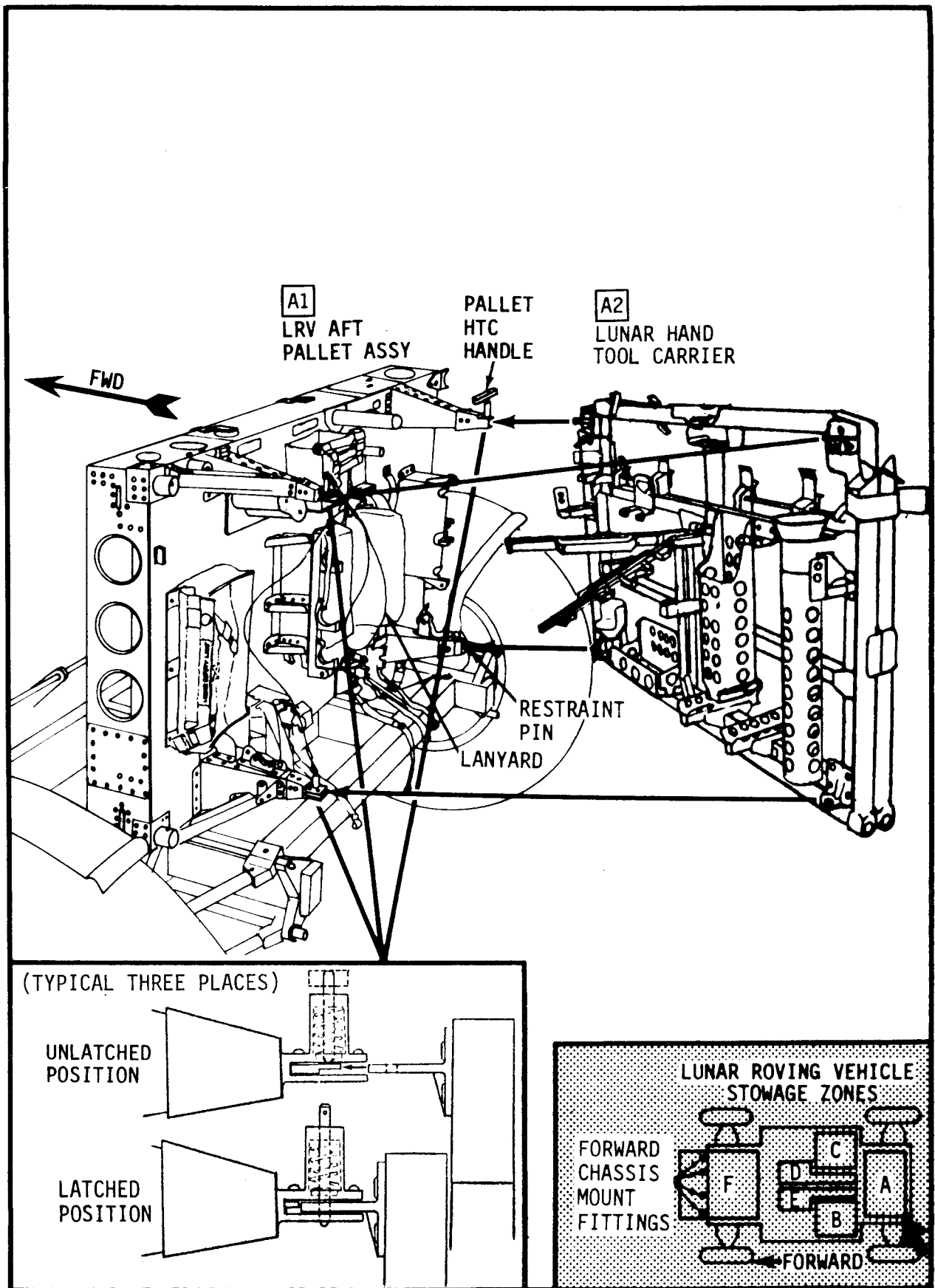
- 1) Left HTC hinge halves (ears) are inserted into pallet clevises, pip pins automatically engage HTC ears, pins protrude below clevises.
- 2) Top right HTC latch keeper (ear) is inserted into top right pallet clevis, pallet HTC handle latch automatically engages.
- 3) HTC restrained in three directions.

C. HTC Pivot - Open

Right pallet HTC handle is pulled upward until pin clears HTC latch keeper ear. HTC can now be swung to the left.

D. HTC Pivot - Closed

Right HTC latch keeper ear is inserted into pallet clevis, pallet HTC handle latch automatically engages. HTC restrained in three directions.



PLACEMENT AND FIT CRITERIA

A8 Tool Extension

Tool extension is inserted as shown and is bottomed-out in hand tool carrier (HTC) interim stowage retainer (tube). Loose fit. Vertically restrained by retention bar.

A7 Tongs (32 Inches)

Tongs "T" handle is inserted into HTC tray and handle is enclosed (over-center) in HTC clip retainer bracket slot. Snug fit. Restrained by retention bar.

A12 Adjustable Sampling Scoop

Scoop is inserted into HTC retention bucket as shown. Loose fit. Restrained by retention bar.

HTC Retention Bar (left)

HTC retention bar latch pin secured by latch on HTC frame. Bar locked by HTC latch.

A9 Hammer

Hammer face inserted into HTC tray as shown and handle is enclosed (over-center) in HTC clip retainer bracket slot. Snug fit. Restrained by retention bar.

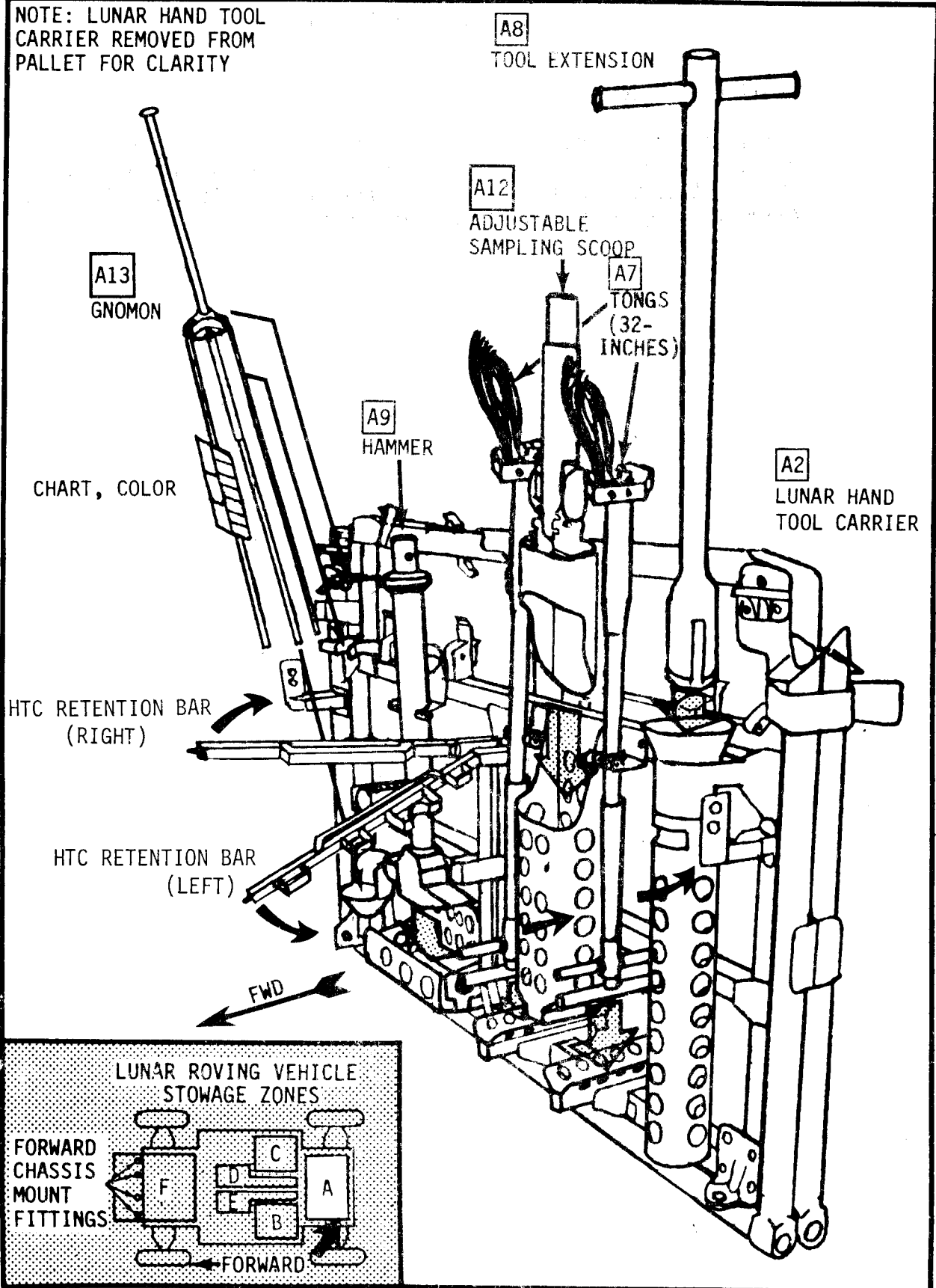
A13 Gnomon

Gnomon legs are inserted into HTC cup. Gnomon tube is enclosed (over-center) in retention clips. Snug fit. Restrained by retention bar.

HTC Retention Bar (right)

HTC retention bar latch pin secured by latch on HTC. Bar locked by HTC latch.

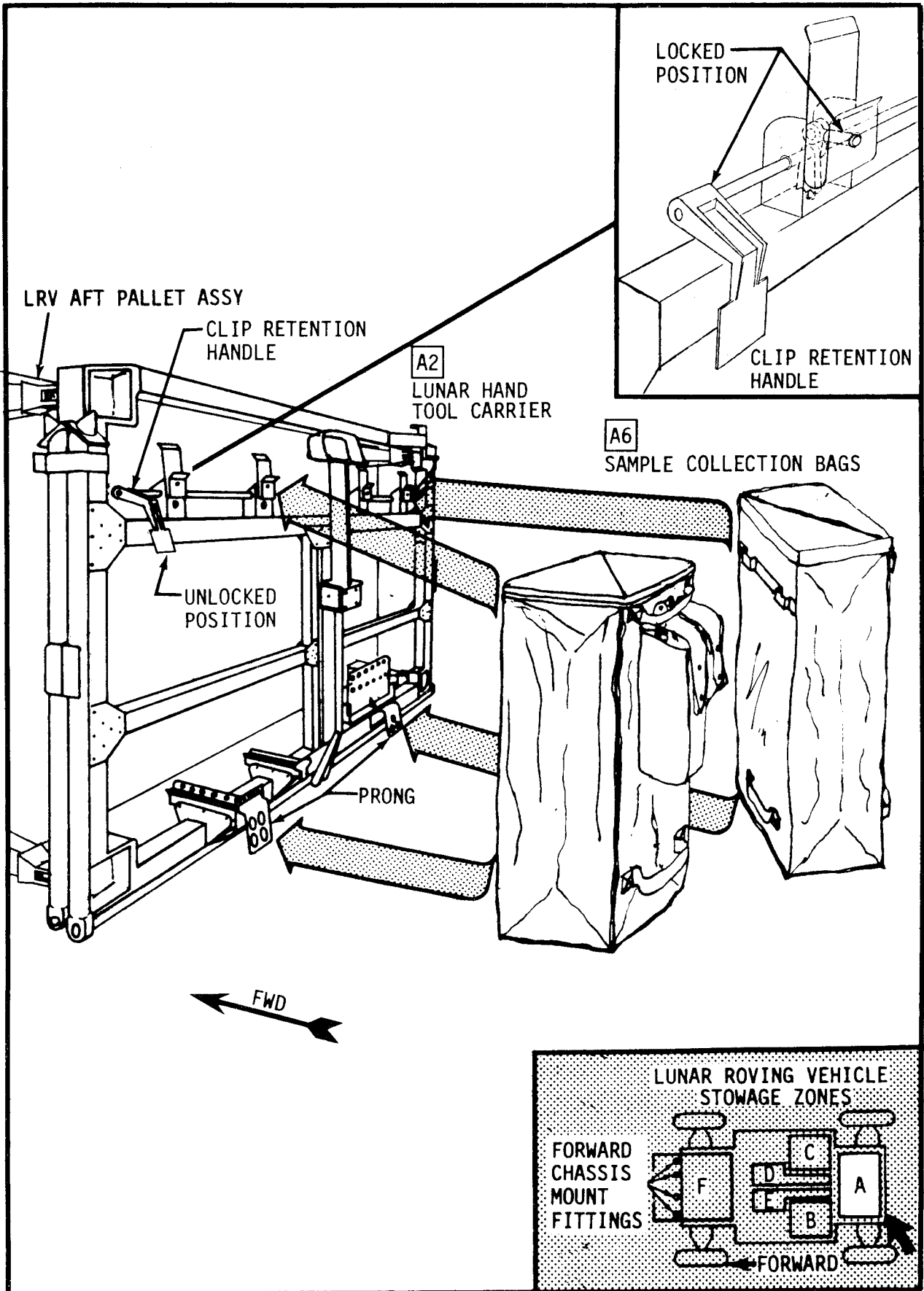
NOTE: LUNAR HAND TOOL CARRIER REMOVED FROM PALLET FOR CLARITY



PLACEMENT AND FIT CRITERIA

A6 Sample Collection Bags

Bottom collection bag strap is secured under HTC prong; clip retention handle almost vertical and clip retention pin protrudes into front clip face after top of collection bag is set into clips. Collection bag is restrained at three points.



PLACEMENT AND FIT CRITERIA

A10 20 Documented Sample Bag Dispenser (DSBD)

DSBD female shoe mated with HTC male shoe; latch handle upper ear latched above HTC male shoe vertically restraining DSBD.

A11 Core Tube Cap Dispenser Assy

Core tube cap dispenser assy female shoe mated with HTC male shoe. Latch face contacts HTC male shoe restraining core tube cap dispenser assy in three directions.

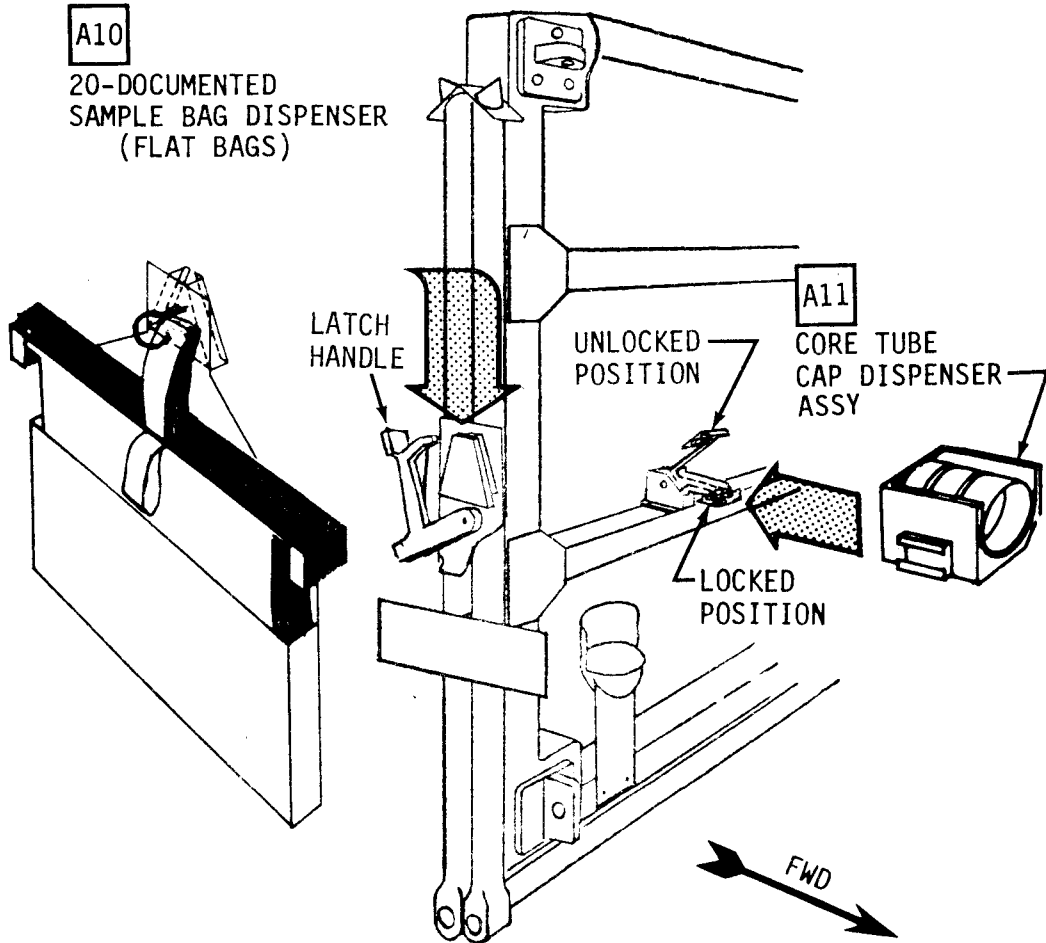
NOTE: LUNAR HAND TOOL CARRIER REMOVED FROM PALLET FOR CLARITY

A2

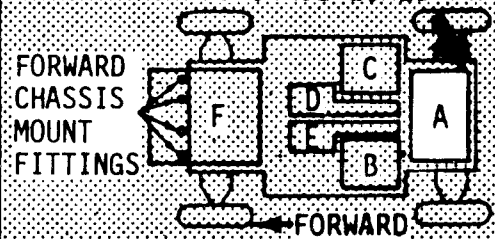
LUNAR HAND TOOL CARRIER

A10

20-DOCUMENTED
SAMPLE BAG DISPENSER
(FLAT BAGS)



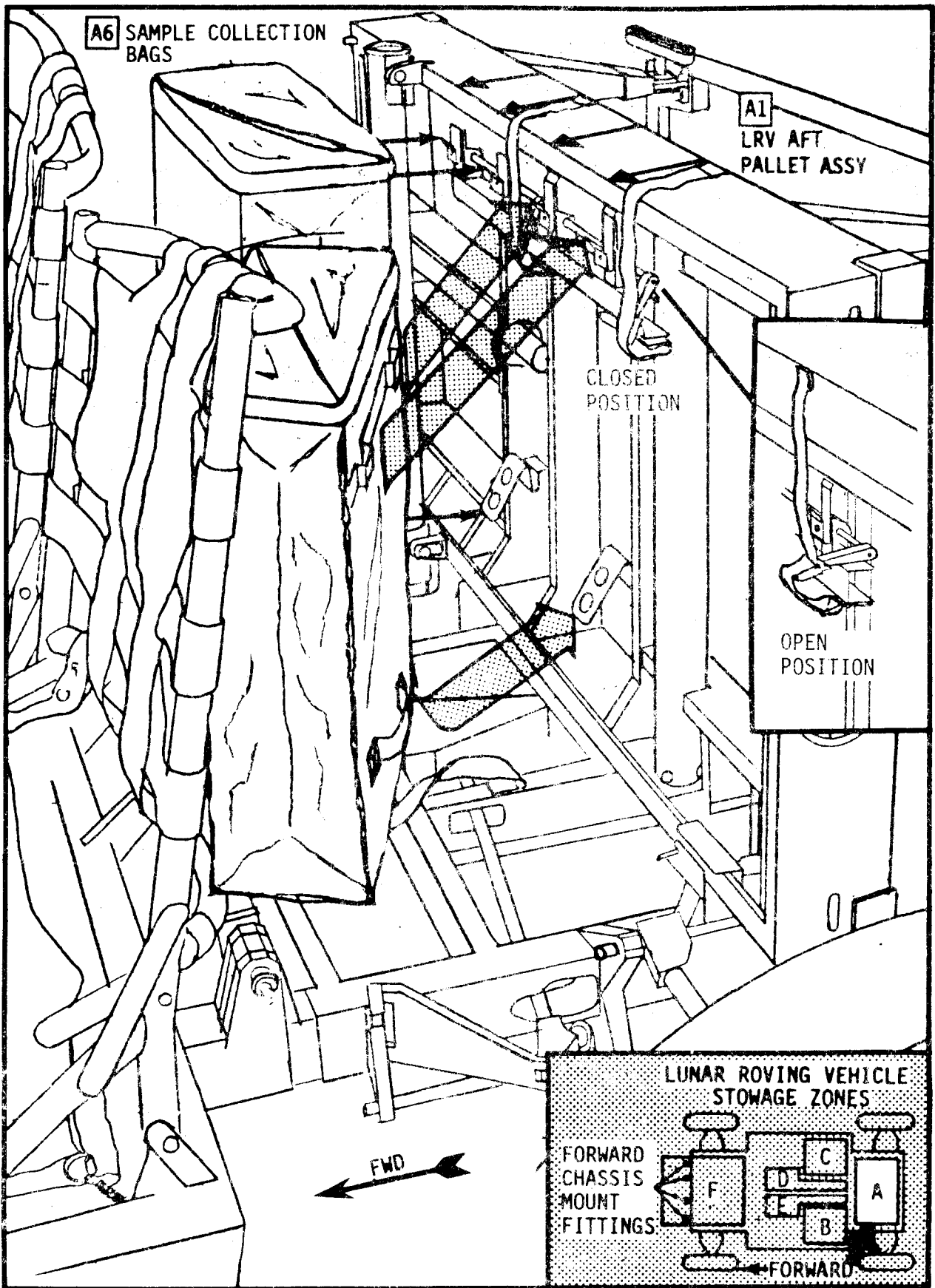
LUNAR ROVING VEHICLE STOWAGE ZONES



PLACEMENT AND FIT CRITERIA

A6 Sample Collection Bags

Bottom collection bag strap is secured under pallet prong; clip retention handle rotated upward via strap. Collection bag top bar inserted into pallet clips. Clip retention handle rotated downward; retention pin protrudes into front clip face. Collection bag is restrained at three points.



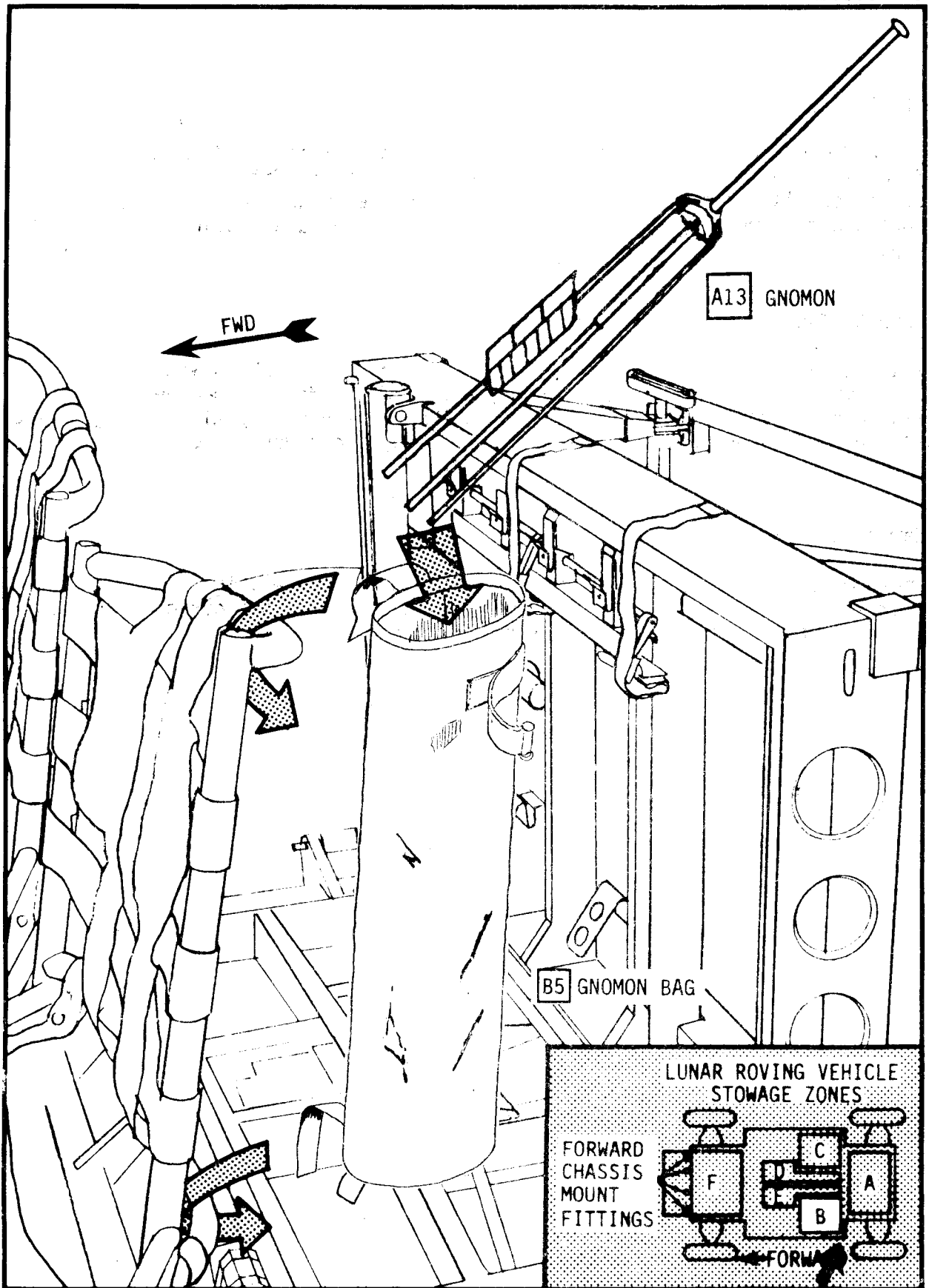
PLACEMENT AND FIT CRITERIA

A13 Gnomon

Gnomon legs inserted into bag as shown and middle strap drawn to secure gnomon. Velcro on strap mated to velcro on bag. Gnomon loosely restrained.

B5 Gnomon Bag

Bag straps routed over the upper and lower horizontal backrest bars near outboard side. Velcro on straps mated to velcro on bag. Bag loosely restrained.



PLACEMENT AND FIT CRITERIA

B1 16MM Data Acquisition Camera (DAC) Magazine (3)

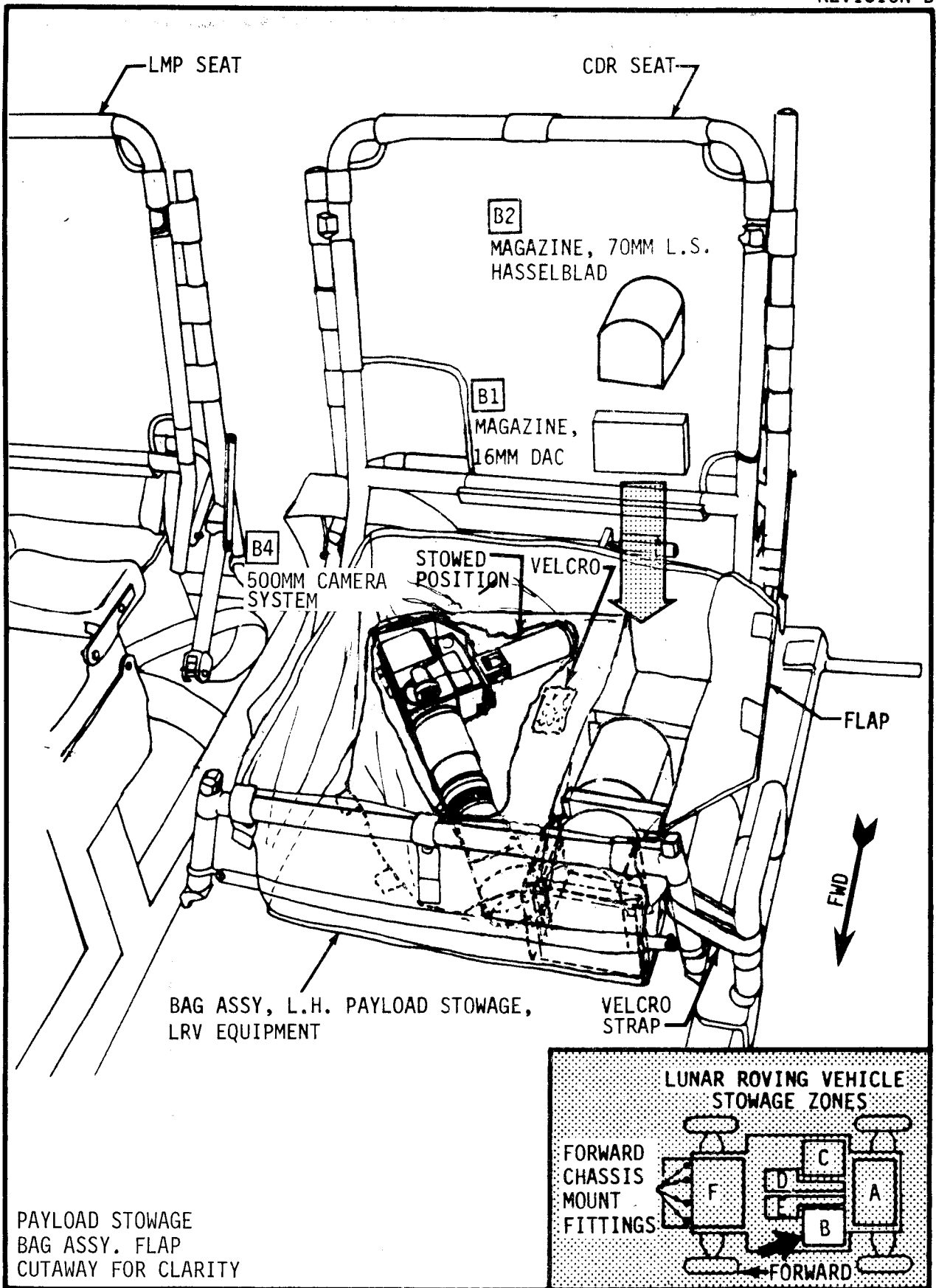
16MM DAC magazine long axis horizontal with approximately 50% of magazine showing above small pocket edge. Magazine fits loosely but is restrained by flap which folds over magazine stowage compartment and is secured by velcro to the camera cover flap.

B2 70MM Lunar Surface Hasselblad Camera Magazine (3)

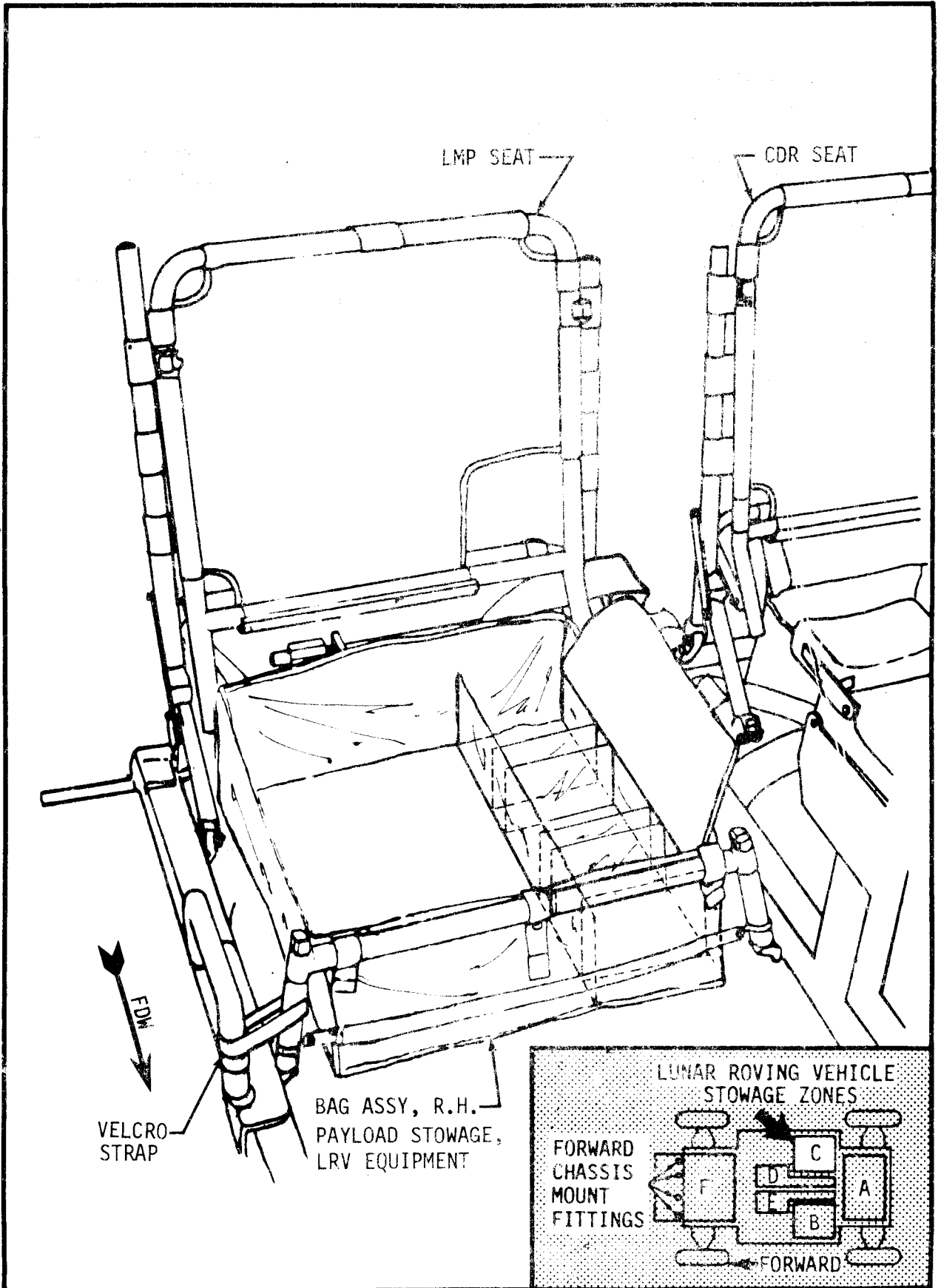
Magazine dark slide (flat side) down in large pocket as shown with approximately 50% of magazine showing above pocket edge. Magazine fits loosely but is restrained by flap which folds over magazine stowage compartment and is secured by velcro to the camera cover flap.

B4 500MM Camera System

Camera placed in the payload stowage bag assembly. Camera is restrained by stowage bag flap which covers camera and is secured to the bottom of stowage bag by velcro patches.



NOTES



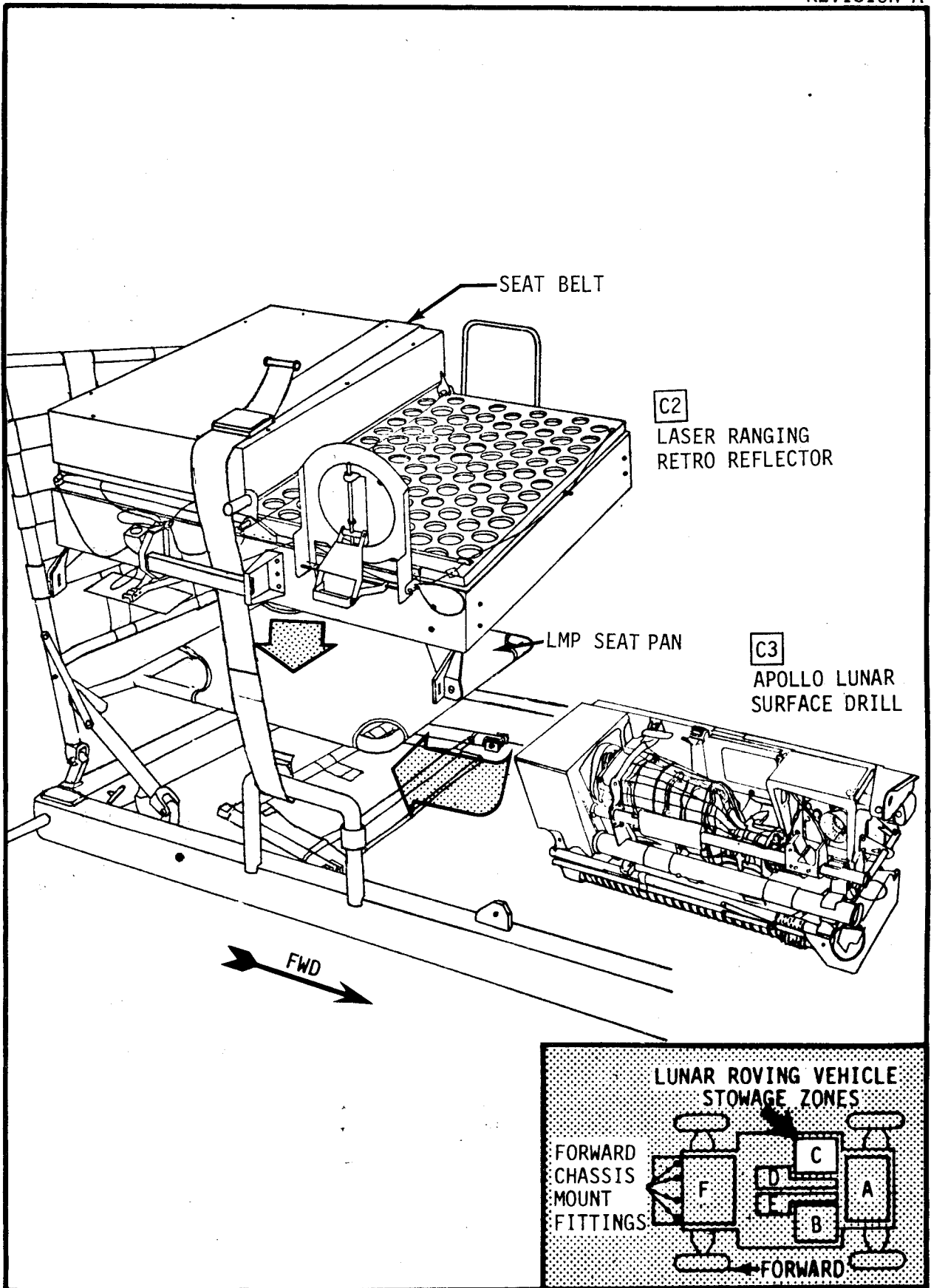
PLACEMENT AND FIT CRITERIA

C2 Laser Ranging Retro Reflector (LR³)

LR³ on LMP seat pan. Seat belt is looped over LR³ and hook attached to outboard handhold. Seat belt is snugged up and velcro patches mated. LR³ is loosely restrained on seat in all three directions.

C3 Apollo Lunar Surface Drill (ALSD)

ALSD under LMP seat pan and testing on lowered LMP from seat brace. No restraint except that provided by LRV structure.



PLACEMENT AND FIT CRITERIA

E1 LOW GAIN ANTENNA (LGA)

A. LGA Staff Installation

- 1) Staff snaps in locked position when inserted in LRV handhold receptacle.
- 2) Staff cannot be removed unless handhold button is depressed.
- 3) Staff can be rotated (fine adjustment) via an internal friction clutch or by depressing handle about 1/4" which disengages gear from spline in handhold receptacle.

B. LGA Electrical Connections (Reference pages 27 and 30)

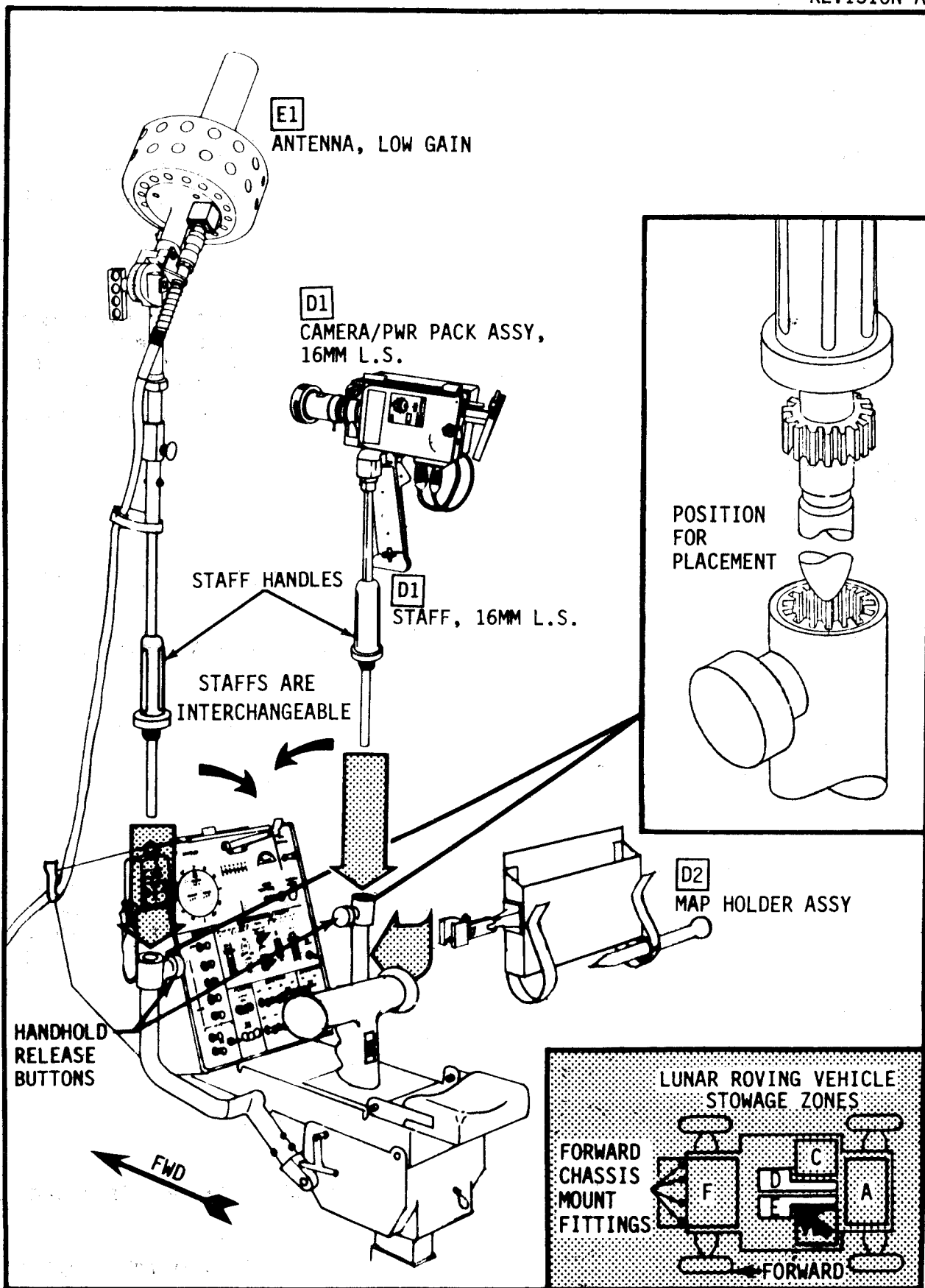
- 1) LGA cable secured by velcro strap at LRV console.
- 2) Cable inserted into two clips on front right LRV chassis (See page 30)
- 3) Connector cannot be rotated or moved outward when properly mated with blue color-coded (foremost) LCRU connector.
- 4) Cable rigging length to permit 360° azimuth rotation of LGA for any antenna elevation angle from 0° to 90°.

D1 16MM LS STAFF INSTALLATION

- 1) Staff snaps in locked position when inserted in LRV handhold receptacle.
- 2) Staff cannot be removed unless handhold button is depressed.
- 3) Staff can be rotated freely when staff handle is pushed downward approximately 1/4" which disengages gear from spline in handhold receptacle.

D2 MAP HOLDER ASSEMBLY

Map holder clamp inserted onto LRV inboard handhold (R.H.). Star wheel rotated until clamp is secured to handhold. Clamp and map holder alignment with respect to LRV console per astronaut preference.



PLACEMENT AND FIT CRITERIA

F1 Lunar Communication Relay Unit (LCRU)

A. LCRU Installation

LCRU mounted with radiator surface up (control panel to left side of LRV) and inserted onto LRV posts with lever-latches as shown. Lever-latches then rotated 90° horizontal aft. LCRU restrained in three directions.

B. LCRU Electrical Connection (Reference pages 30 and 31)

LCRU/LRV/TV cable connector (from left stowage adapter) is mated to left rear LCRU receptacle. Connector locking mechanism over-center when handle is pushed inward toward LCRU. Cable bootie pushed over connector and internal bootie velcro mated with velcro patch on connector handle. Connector cannot be rotated or moved outward.

F4 High Gain Antenna (HGA)

A. Staff Installation (Reference pages 30 and 31)

- 1) Staff inserted into left (outboard) adapter interface with lock wheel pointed outboard.
- 2) Staff bayonet locking coupler is aligned to index marks and is pushed downward and rotated clockwise.
- 3) Coupler is locked when it cannot be rotated without applying downward force.
- 4) Staff is free of play and cannot be rotated.

B. Electrical Connection

- 1) HGA cable routed as shown, red connector mated with red rear-most LCRU connector. Connector is aligned to index marks and is pushed inward and rotated clockwise. Connector is locked when it cannot be rotated without applying inward force.

F3 Television Control Unit (TCU)

A. Staff Installation (Reference pages 30 and 31)

- 1) Staff inserted into right (outboard) adapter interface with staff offset forward.
- 2) Staff bayonet locking coupler is aligned to index marks and is pushed downward and rotated clockwise.
- 3) Coupler is locked when it cannot be rotated without applying downward force.

4) Staff is free of play and cannot be rotated.

B. Electrical Connection

LCRU/LRV/TV cable routed as shown, and connector (from right LRV receptacle) is mated with upper TCU receptacle connector locking mechanism over-center when connector handle is inward toward TCU. Connector cannot be rotated or moved outward from TCU.

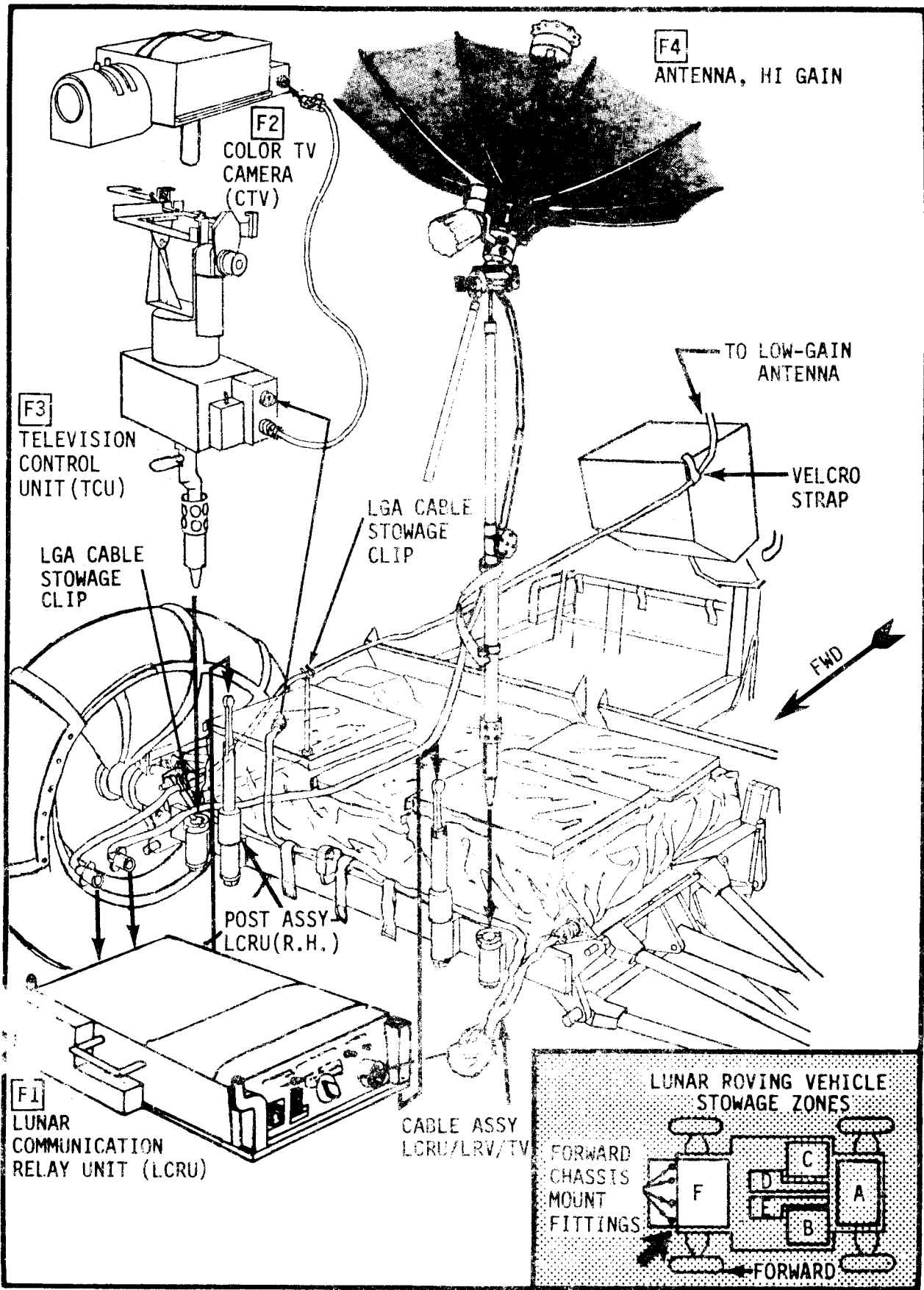
F2 Color Television Camera

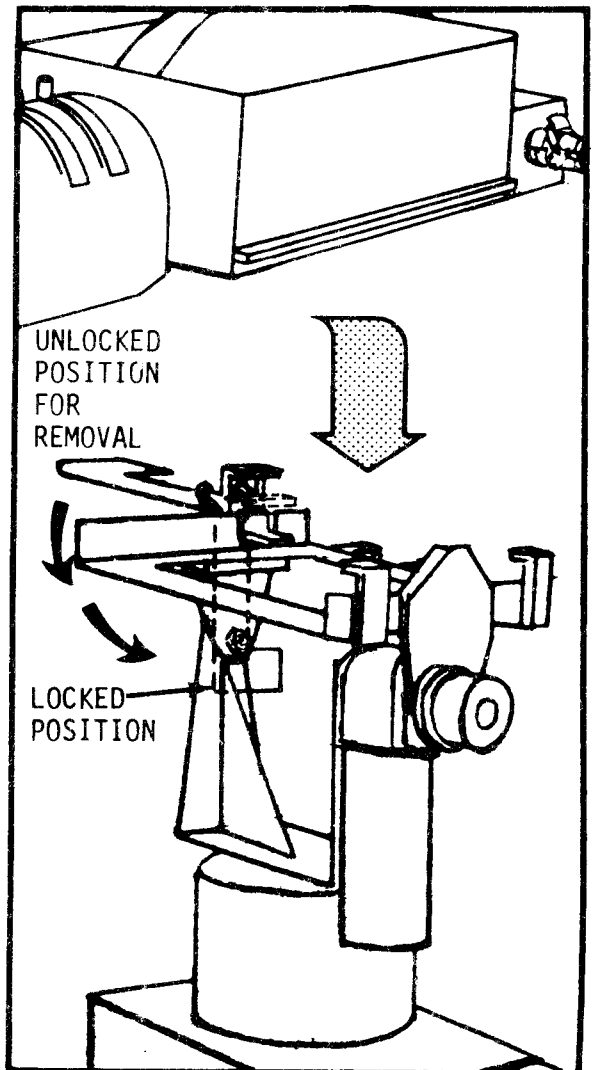
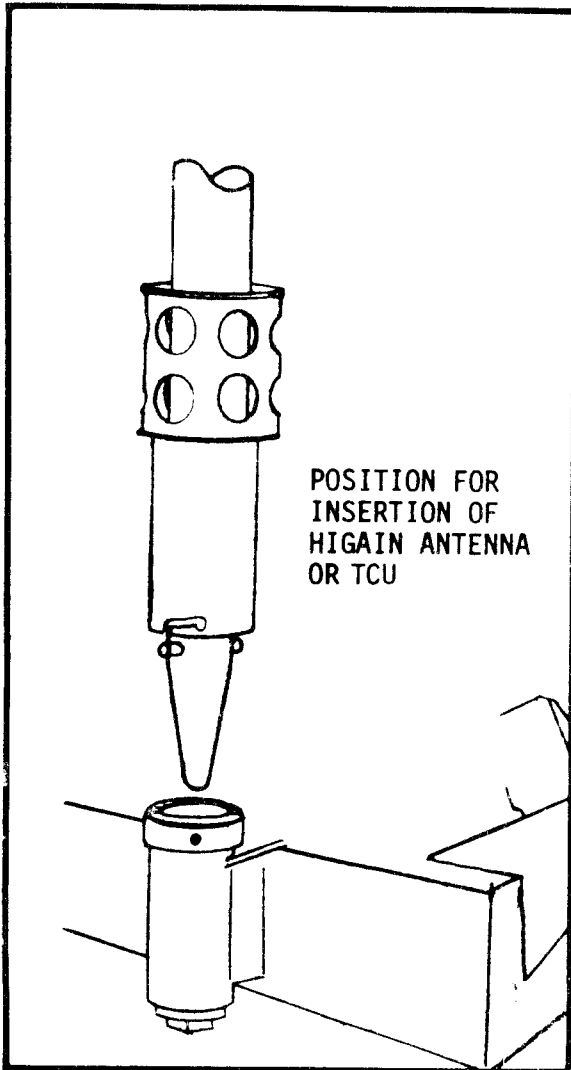
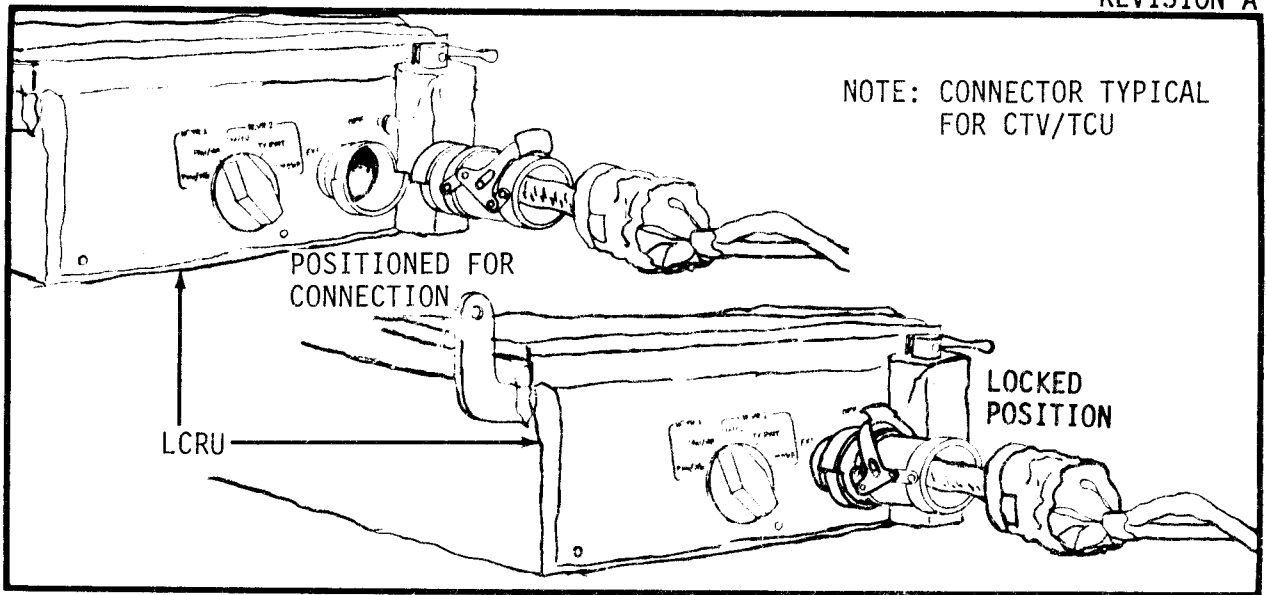
A. Installation (Reference pages 30 and 31)

Left camera slide is inserted into television control unit (TCU) ears, and right lock lever is rotated down. Camera is constrained in three directions.

B. Electrical Connection

Color TV cable is routed as shown and mated with receptacle on rear of color TV camera. Connector locking mechanism over-center when connector handle is inward toward color TV camera. Connector cannot be rotated or moved outward from color TV camera.





NOTES