


BARNES

TIR # 729-S-9301(S)
SEPTEMBER 19, 1969

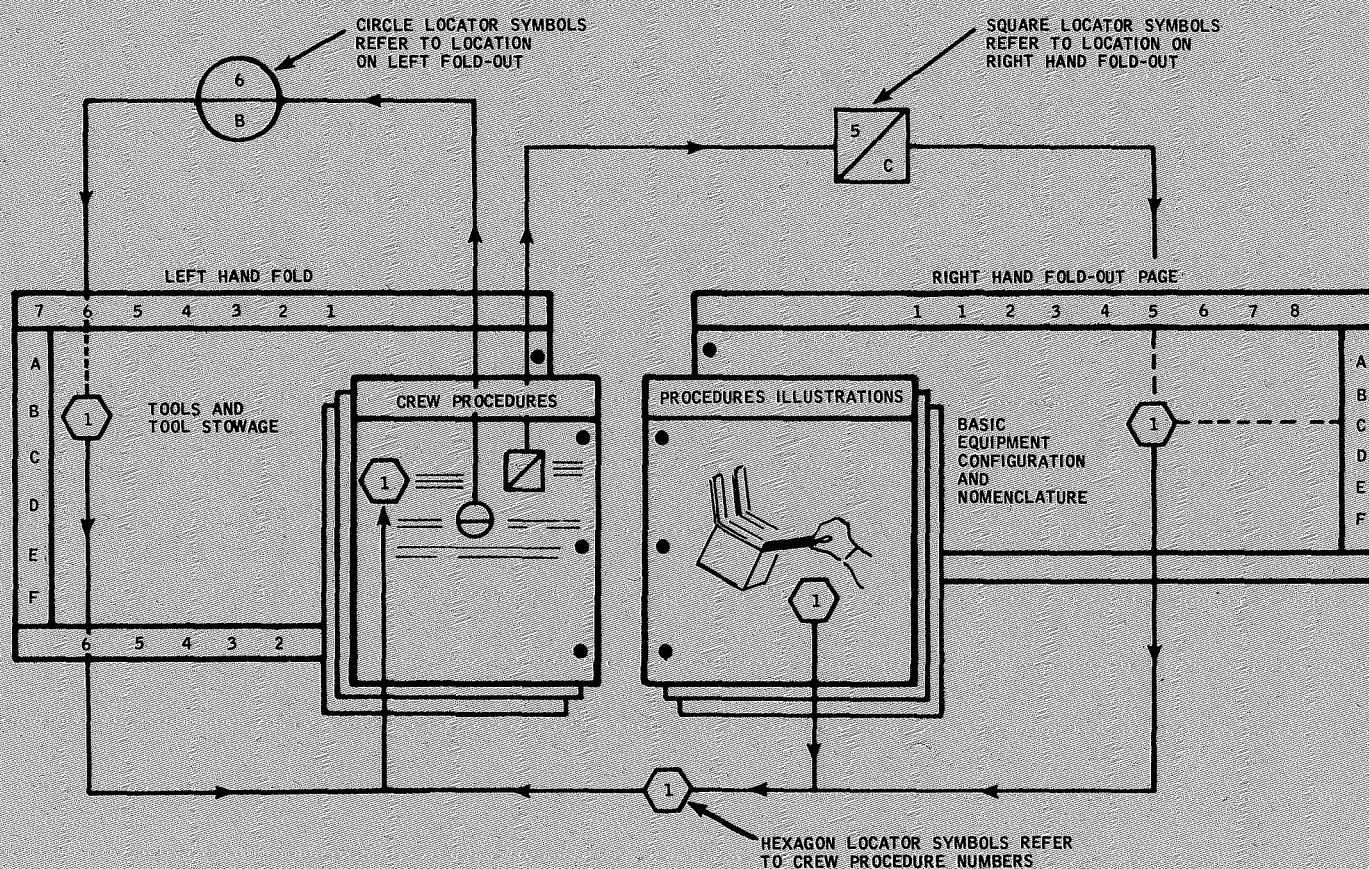
REV. A

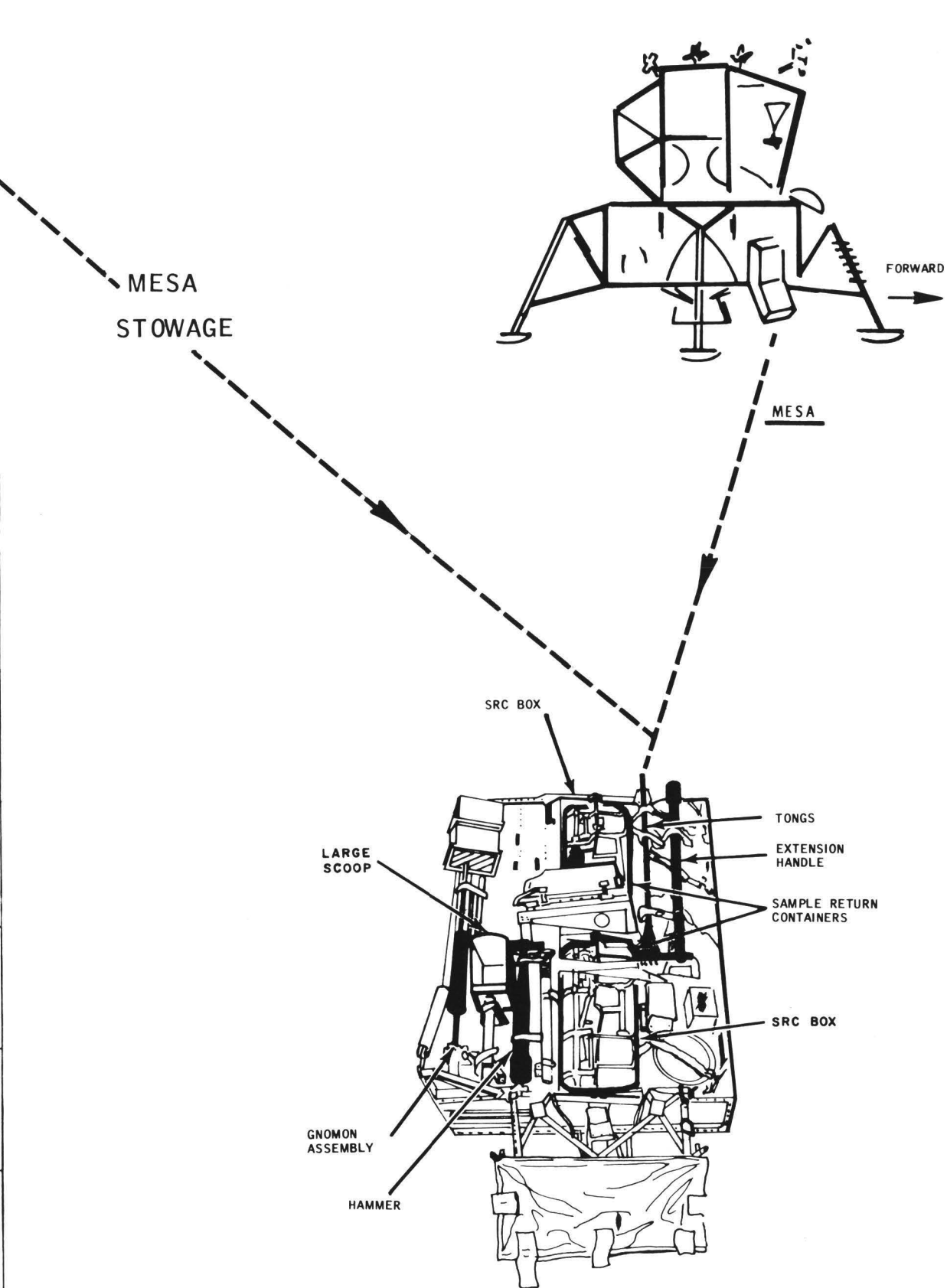
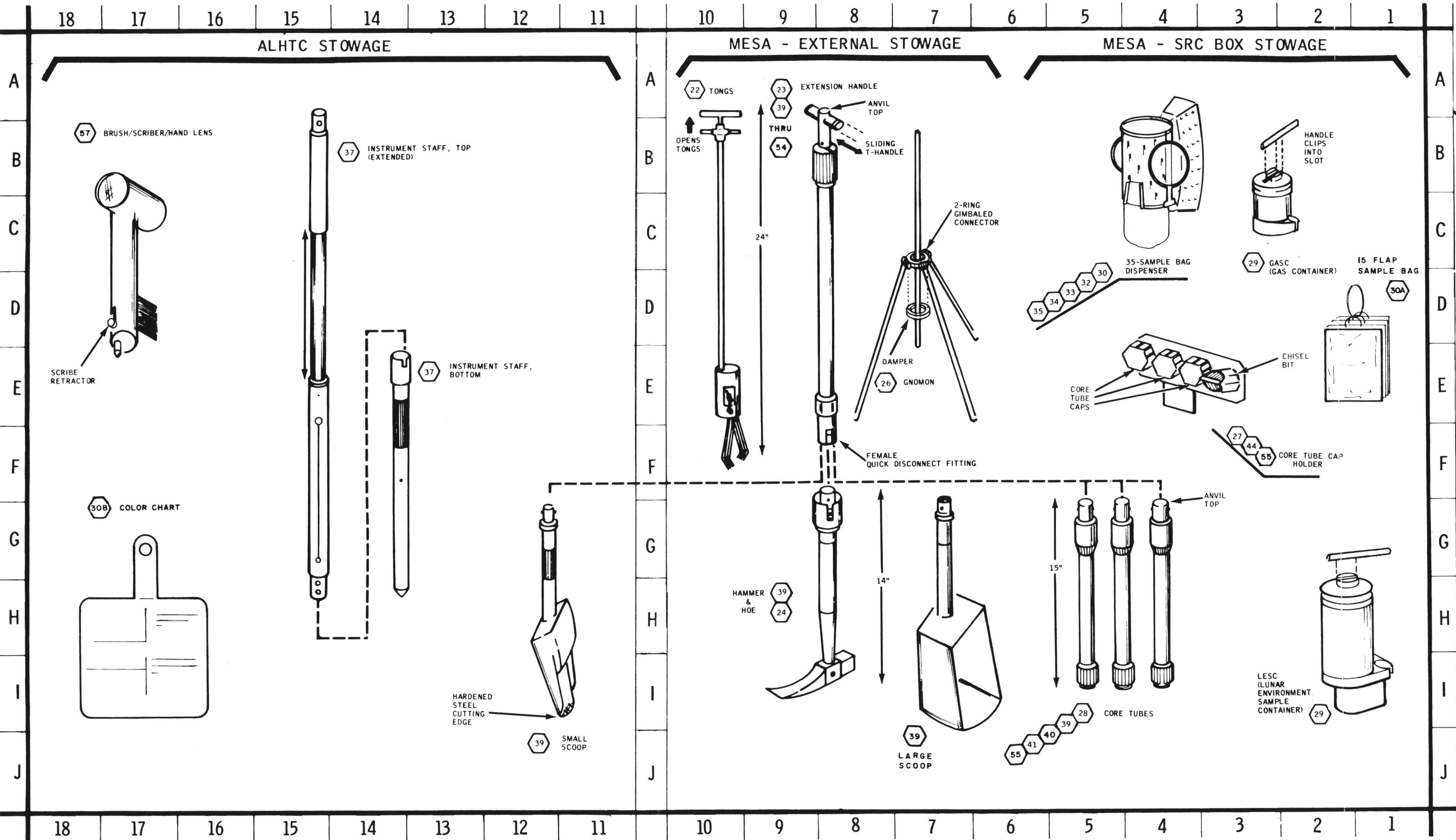
APOLLO LUNAR HAND TOOL CARRIER

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.





APOLLO LUNAR HAND TOOLS (ALHT) SUBSYSTEM

The ALHT Subsystem is a collection of tools and equipment with which the flight crew performs lunar surface observations and lunar surface geologic sampling. The ALHT consists of:

- 1) a hinged foldable carrier (ALHTC) that serves as a:
 - stowage container for tools during transit to the moon.
 - hand carrier for tools during lunar surface traverse.
 - stand to support instruments.

The ALHTC is transferred to the lunar surface in a stowed position on the ALSEP Package #2. The ALSEP is carried in the Scientific Equipment Bay (SEQ) of the LM Descent Stage.

- 2) special tools and equipment for:
 - selecting and obtaining lunar surface geologic samples.
 - containing and packaging these samples for earth return.
 - surveying and photographic activities.


Some tools are stowed in the ALHTC during lunar transit. Other tools are stowed in the Modularized Equipment Stowage Assembly (MESA) of the LM Descent Stage during lunar transit and then are transferred to the ALHTC during EVA.

Crew Procedures associated with the ALHTC are included and specifically cover:










- A. Removal of the ALHTC from ALSEP - Procedures # 1 - 6 .
- B. Unfolding of the ALHTC - # 7 - 17 .
- C. Removal of Tool Retainer Assemblies - # 18 - 21 .
- D. Tool transfer to ALHT - # 22 - 26 .
- E. Equipment transfer to ALHT - # 27 - 30 .
- F. Tool and equipment usage - # 31 - 58 .



CREW OPERATING PROCEDURES





THESE PROCEDURES ASSUME:

- a. ALSEP PKG. #2 HAS BEEN OFF-LOADED FROM THE LM DESCENT STAGE.
- b. THE ALSEP "HOCKEY STICK" SUSPENSION SUPPORT  HAS BEEN REMOVED.


A. REMOVAL OF THE ALHTC FROM ALSEP PKG. #2

-  PULL ALHTC-ALSEP PIP PIN #1 .
-  -ROTATE GREEN ALSEP LOCK KEY #1  CCW TO UNLOCK ALHTC AND REMOVE KEY.
- DISCARD KEY #1 AND PIP PIN #1 THAT ARE TIED TOGETHER FOR ALTERNATE REMOVAL PROCEDURE. (THIS RELEASES LEFT SIDE OF THE ALHTC FROM THE ALSEP.)
-  PULL ALHTC-ALSEP PIP PIN #2 .
-  -ROTATE GREEN ALSEP LOCK KEY #2  CCW TO UNLOCK ALHTC AND REMOVE KEY.
- DISCARD KEY #2 AND PIP PIN #2 AS IN STEP .
- (THIS RELEASES RIGHT SIDE OF THE ALHTC FROM THE ALSEP. THE ALHTC SHOULD DROP DOWN FROM THE ALSEP BASE.)

-
-  GRASP RACK "A" TOOL RETAINER HANDLE  WITH ONE HAND, STEADY ALHTC WITH OTHER HAND.

-  -LIFT ALHTC FROM ALSEP BY:
- FIRST PUSH ALHTC FORWARD SO THAT THE ALHT GUIDE PINS  &  CLEAR BASE,
- THEN LIFT ALHTC STRAIGHT UP TO CLEAR ALHT BASE PINS  ON ALSEP.

NOTE: WATCH FOR CLEARANCE OF TOOLS AND SAMPLE CONTAINER ("DIXIE CUP")

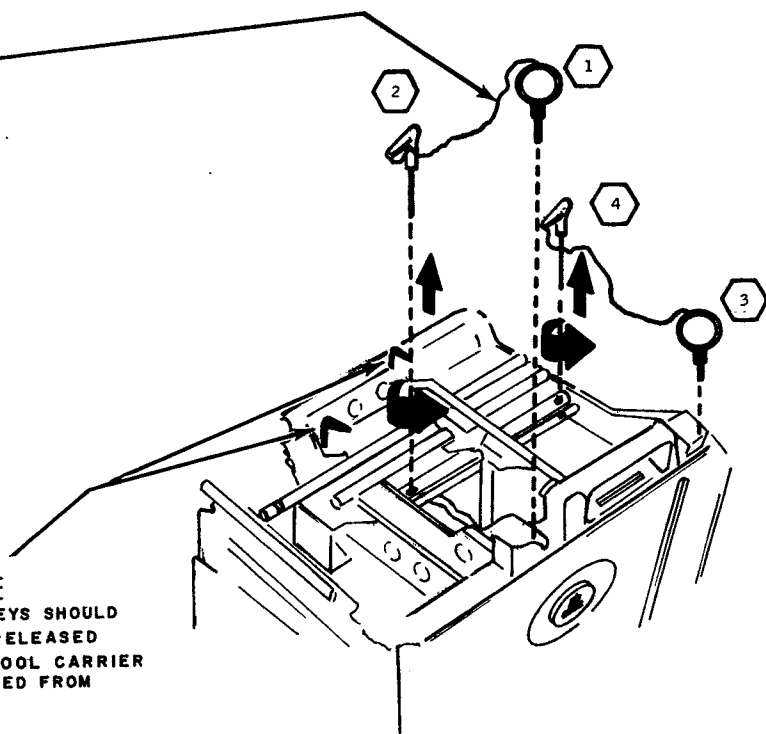
CLEAT  ON LEFT OF ALHTC AS IT IS LIFTED FROM ALSEP.

NOTE:

THE PIP PIN IS CONNECTED TO THE ALSEP LOCK KEY BY A LANYARD FOR USE IN UNLOCKING THE ALHTC FROM THE ALSEP WHILE THE ALSEP IS STILL IN THE SEQ BAY AND THE LOCK KEYS ARE OUT OF THE ASTRONAUT'S REACH FOR DIRECT REMOVAL OF THE KEYS. PULLING THE LANYARD WILL ROTATE THE LOCK KEY CCW AND RELEASE THE ALHTC.

CAUTION:

OTHER KEYS SHOULD NOT BE RELEASED UNTIL TOOL CARRIER IS REMOVED FROM ALSEP.

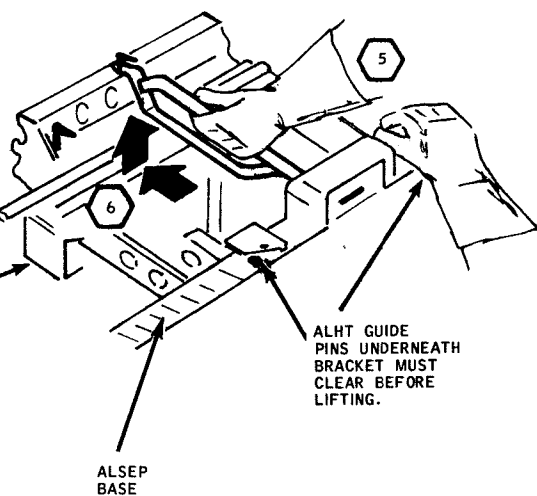


INSTRUMENT RODS




SAMPLE CONTAINER CLEAT






ALSEP BASE



ALHT GUIDE PINS UNDERNEATH BRACKET MUST CLEAR BEFORE LIFTING.





B. UNFOLDING OF THE ALHTC

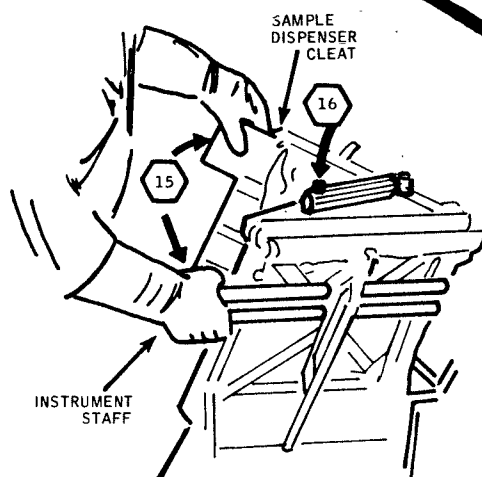
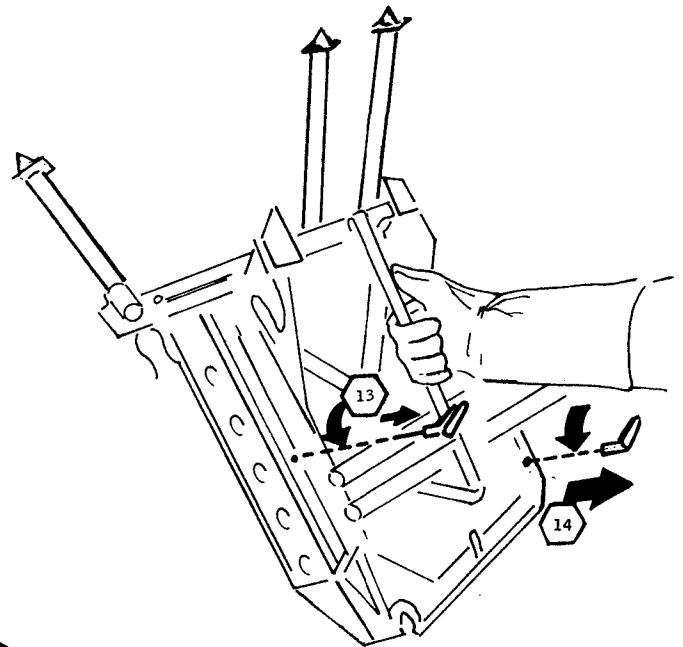
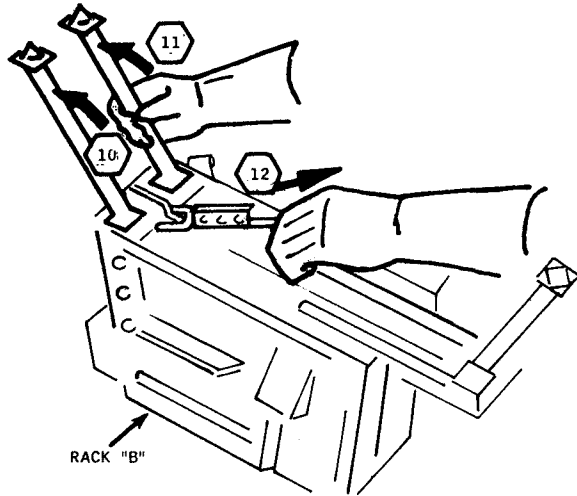
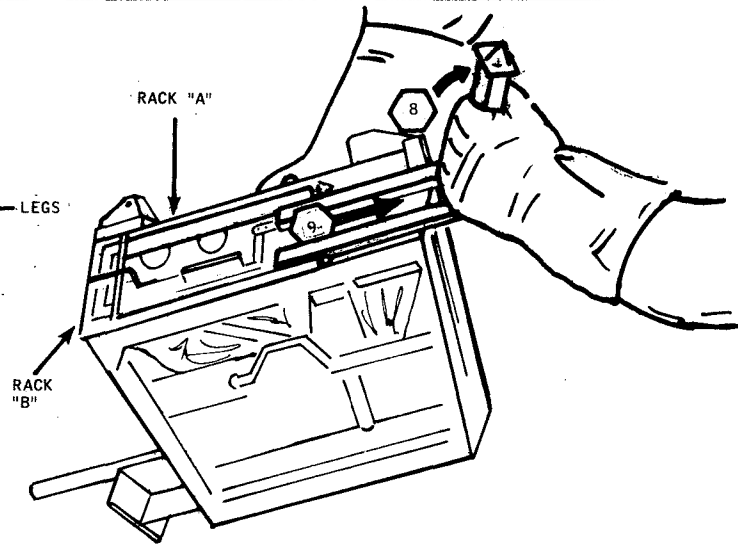
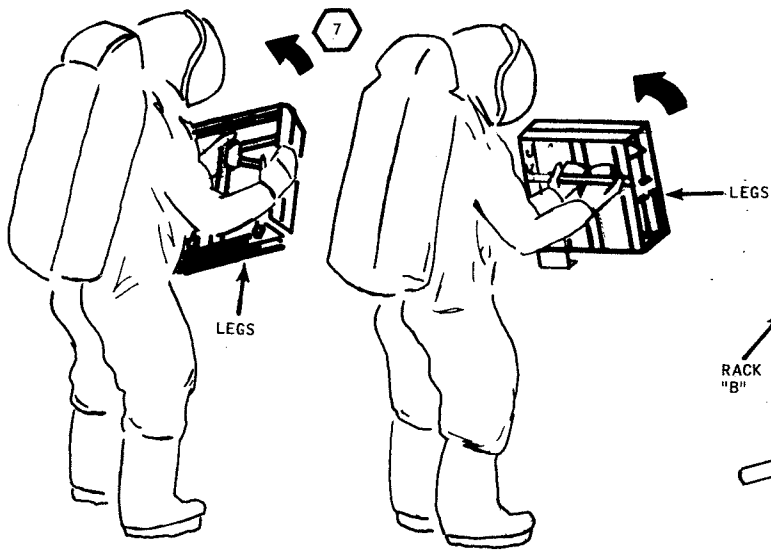
- 7 -ROTATE ALHTC SO THAT LEGS OF CARRIERS ARE FACE-UP AND VISIBLE.
 -(THIS WILL REQUIRE REVERSING THE HAND GRIP ON TOOL RETAINER BRACKET ).
- 8 UNFOLD PIVOT LEG  UNTIL IT LOCKS IN THE EXTENDED POSITION.
- 9 PULL OUT PIVOT LEG SLIDES  CAUTION: VERIFY SLIDES ARE LOCKED IN PLACE BY PUSHING IN ON SLIDES.

- 10 UNFOLD CORNER LEG  OF RACK "B"  UNTIL IT LOCKS IN EXTENDED POSITION.
- 11 UNFOLD CORNER LEG  OF RACK "A"  UNTIL IT LOCKS IN EXTENDED POSITION.
- 12 REMOVE GREEN RETAINER CLIP .

- 13 ROTATE YELLOW RACKS RETAINER KEY #1  CCW, LIFT AND DISCARD.
- 14 -ROTATE YELLOW RACKS RETAINER KEY #2  CCW, LIFT AND DISCARD.



-(THESE STEPS UNLOCK AND RELEASE RACKS FOR UNFOLDING.)

- 15 GRASP ALHT BY STOWED INSTRUMENT STAFF AND SAMPLE DISPENSER CLEAT.
- 16 UNFOLD ALHTC UNTIL CARRIER HANDLE  LOCKS IN EXTENDED POSITION.
- 17 PLACE ALHTC ON LUNAR SURFACE AS SHOWN IN THE ALHTC
"UNFOLDED CONFIGURATION" .



CREW OPERATING PROCEDURES

C. REMOVAL OF TOOL RETAINER ASSY'S (POSTPONE UNTIL JUST PRIOR TO TOOL TRANSFER)

18 ROTATE "RACK A" TOOL RETAINER LOCK KEY  &  CCW, PULL AND DISCARD.



19 REMOVE "RACK A" TOOL RETAINER ASSY  AND DISCARD.



20 ROTATE "RACK B" TOOL RETAINER LOCK KEY  CCW, . . .



21 REMOVE "RACK B" TOOL RETAINER ASSY  AND DISCARD ASSY.


D. TOOL TRANSFER TO ALHT



SOME TOOLS AND EQUIPMENT ARE STOWED IN THE MESA OF THE LM DESCENT STAGE FOR TRANSPORT TO THE LUNAR SURFACE. THESE TOOLS ARE USED DURING EARLY EVA ACTIVITIES AND THEN TRANSFERRED TO THE ALHT FOR USE DURING THE GEOLOGY TRAVERSE. THESE INCLUDE:

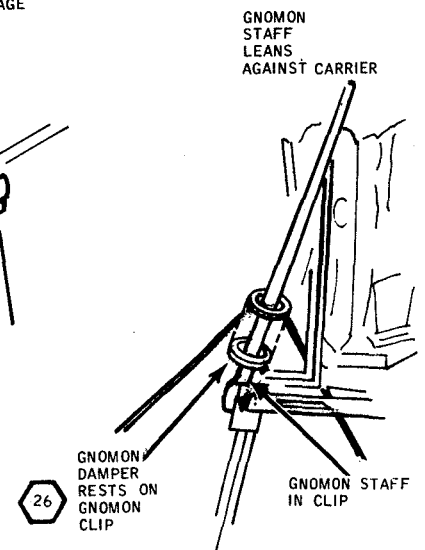
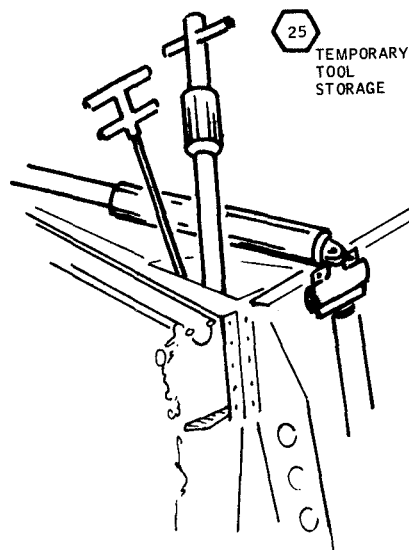
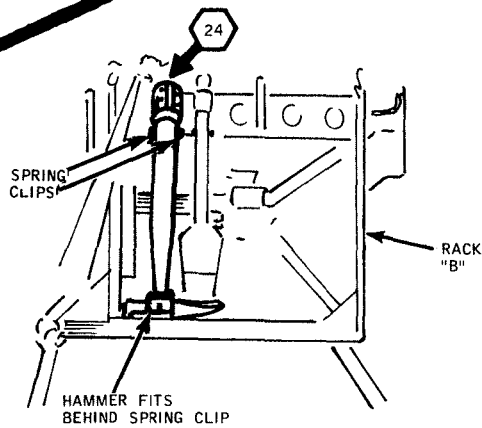
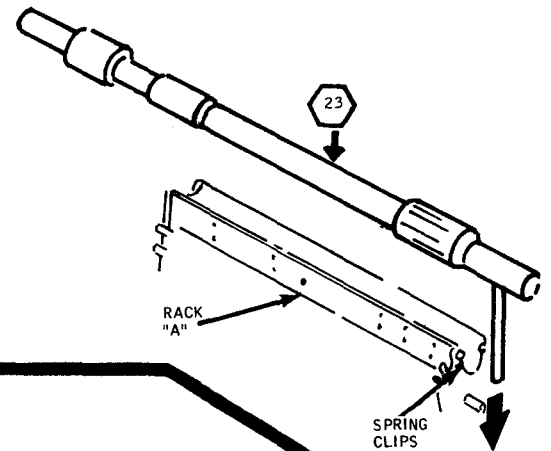
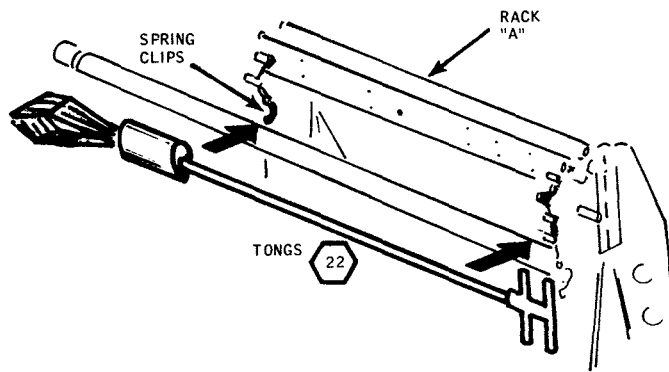
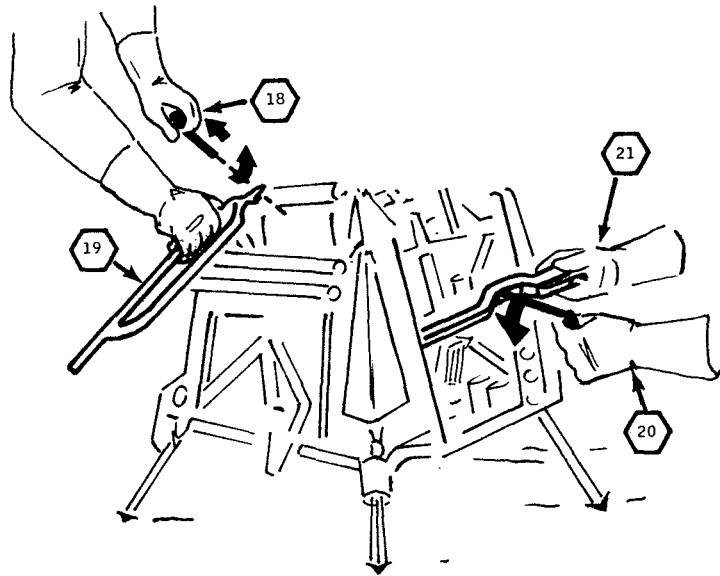
22 TONGS  ARE STOWED IN SPECIAL SLOT ON RACK "A" .

23 EXTENSION HANDLE  IS STOWED IN SPECIAL SLOT ON RACK "A" .

24 HAMMER  IS STOWED IN RACK "B" HAMMER SLOT .

25 TONGS & HANDLE MAY BE STOWED TEMPORARILY IN THE TRIANGULAR POUCH 
OF THE ALHT COLLECTION BAG DURING EVA ACTIVITIES.

26 GNOMON  IS STOWED IN THE GNOMON CLIP .



CREW OPERATING PROCEDURES

E. EQUIPMENT TRANSFER TO ALHT

27 CORE TUBE CAP HOLDER $\frac{4}{E}$ IS INSERTED INTO RACK "A" SLOT $\frac{19}{C}$ IN
IN EXTENSION HANDLE HOLDER SLOT.

28 3-CORE TUBES $\frac{5}{J}$ ARE PLACED IN RACK "B" HOLES $\frac{24}{H}$ (BIT-END DOWN).

29 LESC CONTAINER $\frac{2}{I}$ AND GASC CONTAINER $\frac{3}{C}$ ARE PLACED IN
COLLECTION BAG MAIN POUCH $\frac{22}{C}$ FOR SAMPLE TAKING DURING GEOLOGY
TRAVERSE.

30 35-SAMPLE BAG DISPENSER $\frac{4}{B}$ IS INSTALLED ON RACK "B"
DISPENSER CLEAT $\frac{16}{C}$. THE ALHT IS NOW IN "TRAVERSE CONFIGURATION" $\frac{20}{J}$.

30 15-FLAT SAMPLE BAGS $\frac{1}{D}$ ARE INSTALLED ON CLIP ON RACK "B". $\frac{24}{E}$.

30 COLOR CHART IS CARRIED IN OUTER POUCH $\frac{18}{G}$ OF COLLECTION BAG.

F. TOOL AND EQUIPMENT USAGE

31 ALHT IS DESIGNED TO BE CARRIED IN THE RIGHT HAND FROM BAG-SIDE OF
CARRIER. WATCH CLEARANCE OF CARRIER LEGS AND GNOMON DURING TRAVERSE.
BEFORE TAKING SAMPLE:

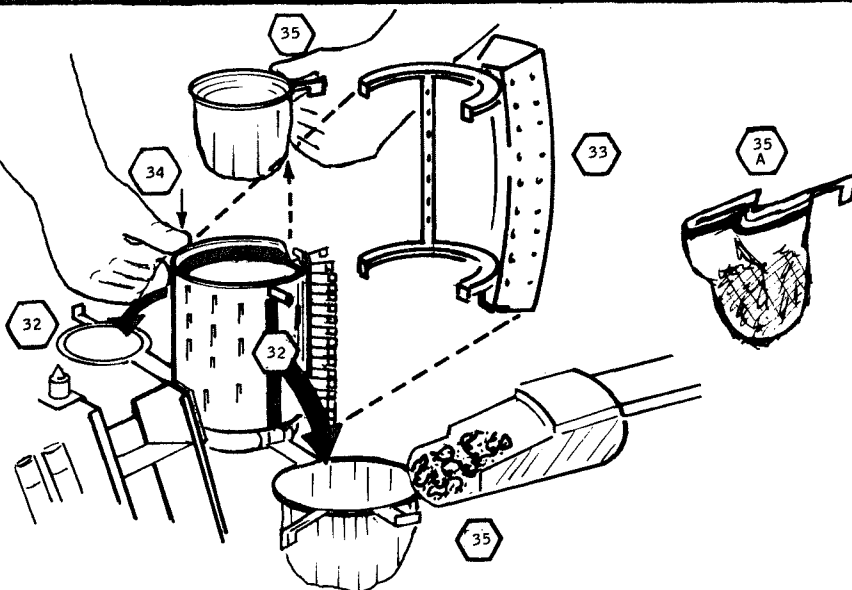
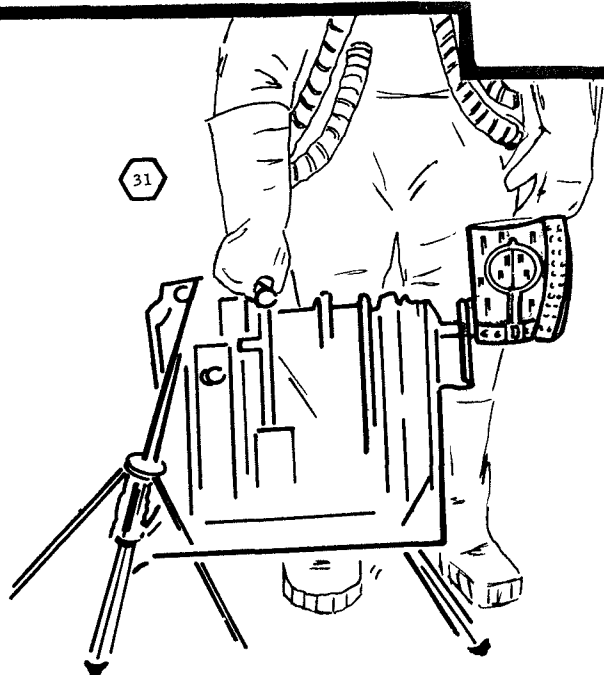
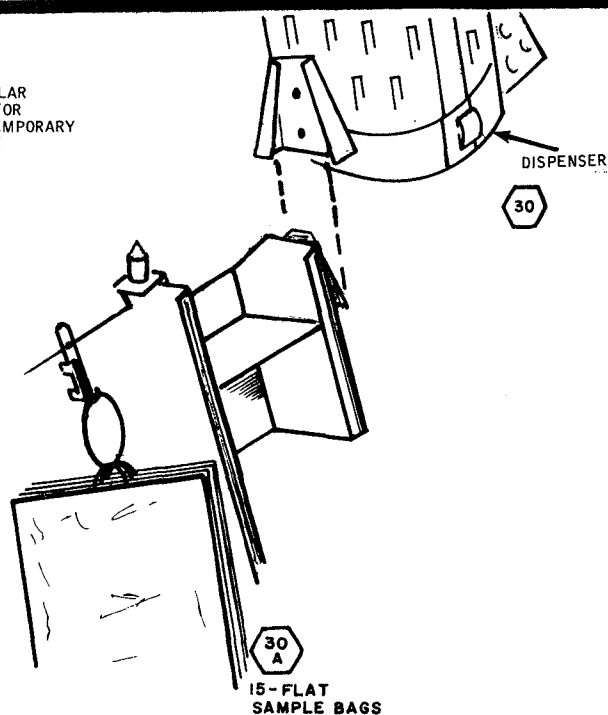
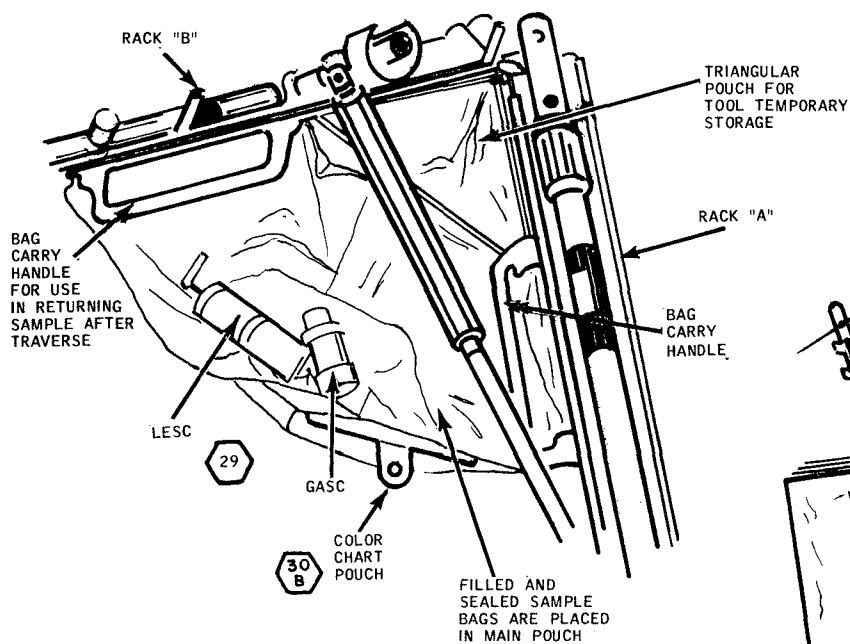
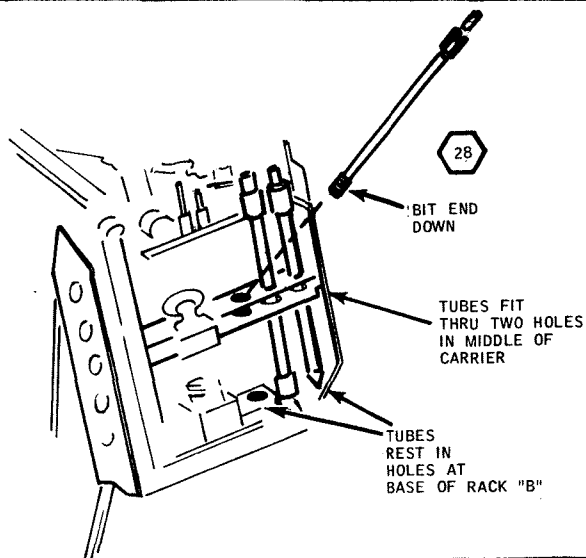
32 UNFOLD SAMPLE BAG HOLDERS.

33 REMOVE DISPENSER COVER/HANDLE FROM DISPENSER.

34 DEPRESS OUTER SHELL OF DISPENSER DOWNWARD TO POSITION TOP BAG FOR REMOVAL.




35 GRASP HANDLE OF SAMPLE BAG, REMOVE THRU DETENTED SLOT AND PLACE IN
HOLDER DURING SAMPLE TAKING.


35 AFTER TAKING SAMPLE, SQUEEZE MOUTH OF BAG TOGETHER, ROLL AND Z-CRIMP.



CREW OPERATING PROCEDURES

F. TOOL AND EQUIPMENT USAGE (CONTINUED)

- (36) REMOVE INSTRUMENT STAFF TOP  AND BOTTOM  FROM RACK "A."
- (37) ASSEMBLE BOTTOM STAFF TO TOP THEN EXTEND THE TOP STAFF.
- (38) PLACE STAFF THRU TOP AND BOTTOM HOLDER IN RACK "B" .




DUE TO THE DIFFICULTY IN STOOPING AND BENDING WHILE SUITED IN THE EMU, THE EXTENSION HANDLE  IS USED WITH OTHER TOOLS (CORE TUBES, LARGE SCOOP, SMALL SCOOP, & HAMMER).




TO MATE CORE TUBES OR SCOOPS WITH EXTENSION HANDLE:

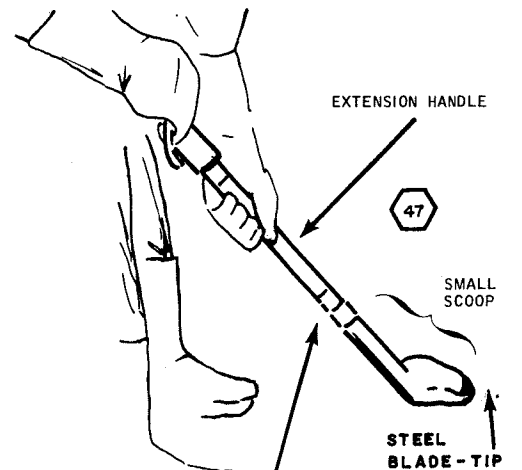
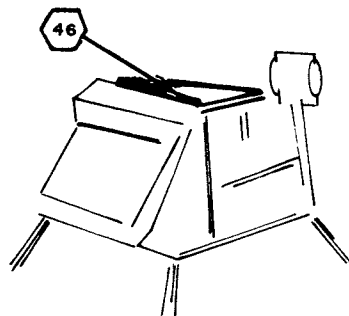
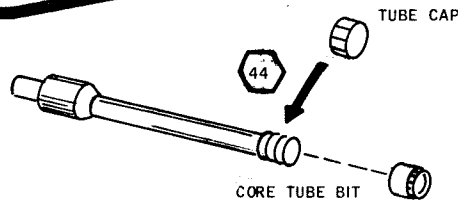
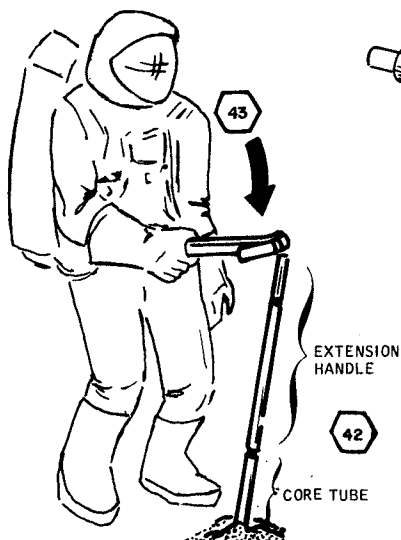
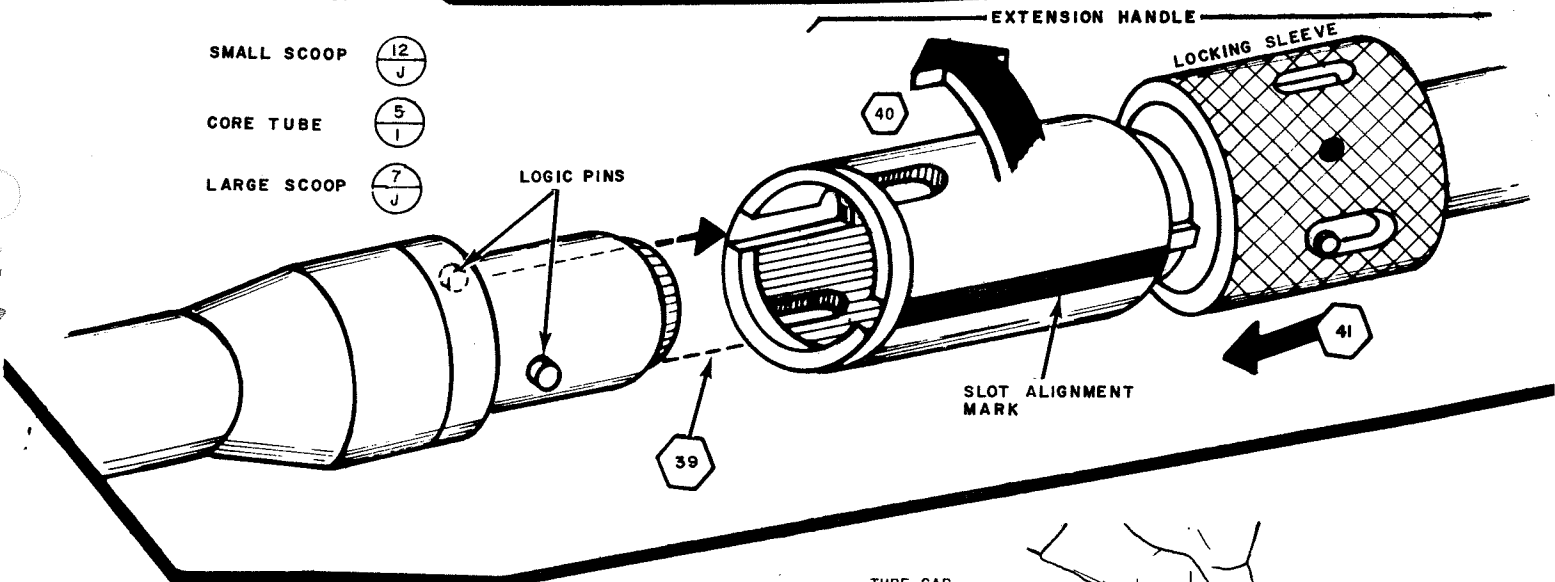
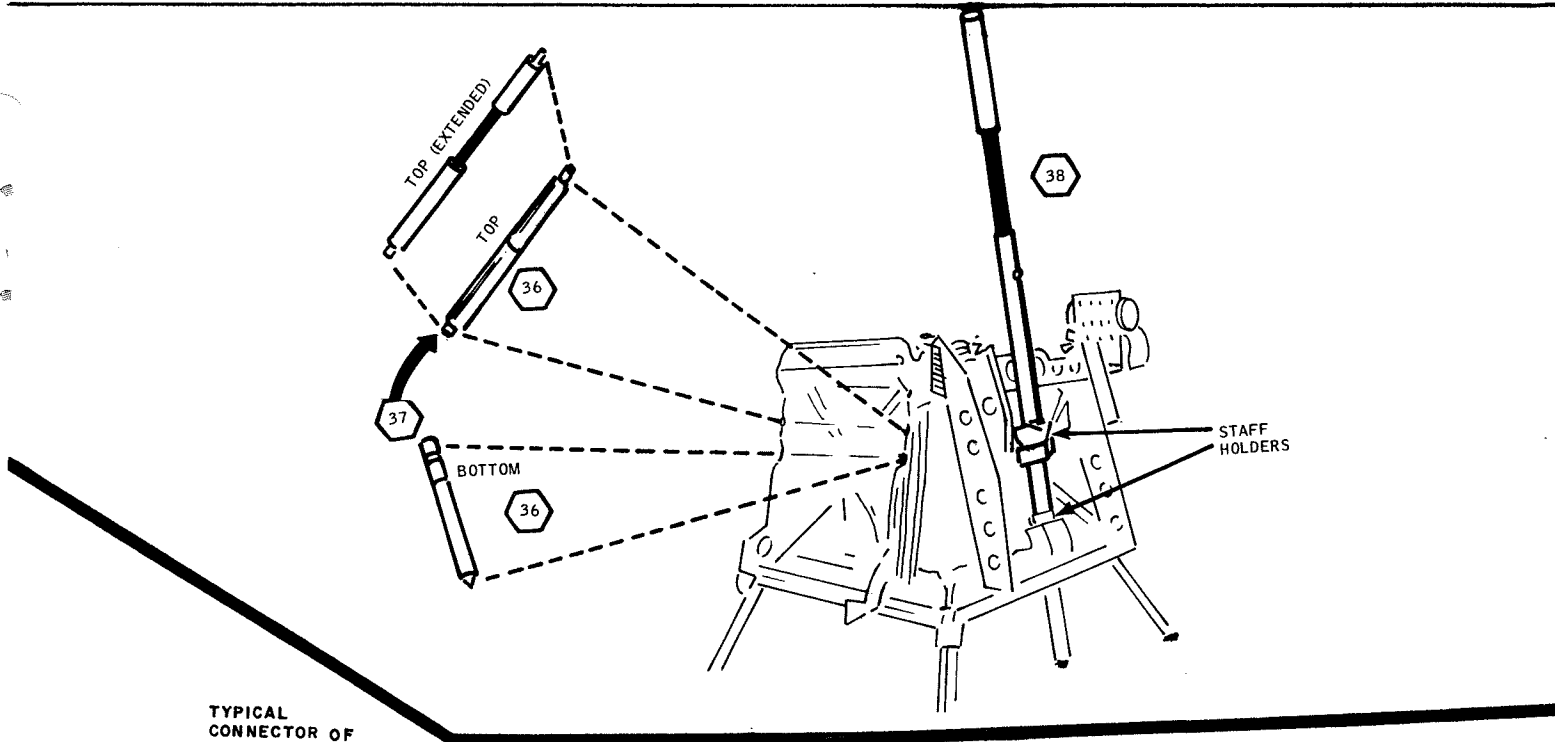
- (39) ALIGN LOCK PINS ON TUBE OR SCOOP CONNECTOR WITH SLOT ALIGNMENT MARKS ON EXTENSION HANDLE BASE, THEN MATE CONNECTOR WITH HANDLE.
- (40) ROTATE EXTENSION HANDLE CLOCKWISE TO STOPS. (THIS POSITIONS PINS IN LOCKING SLOTS IN EXTENSION HANDLE BASE.)
- (41) PUSH EXTENSION HANDLE LOCKING SLEEVE TOWARD CONNECTOR TO LOCK TOOL ASSY.

FOR CORE TUBE SAMPLING:

- (42) PUSH CORE TUBE ASSY. INTO SURFACE AS DEEP AS POSSIBLE SO THAT IT SUPPORTS ITSELF. (THIS MAY BE DIFFICULT IN SHALLOW LUNAR SOIL.)
- (43) USING FLAT SIDE OF HAMMER  FOR LARGER CONTACT AREA, DRIVE CORE TUBE ASSY. INTO SURFACE TO GET SAMPLE.
- (44) REMOVE SAMPLE FROM SURFACE, UNSCREW CORE TUBE BIT, DISCARD AND REPLACE WITH CORE TUBE CAP FROM CAP HOLDER .
- (45) DISCONNECT CORE TUBE FROM HANDLE, USE REVERSE STEPS (41), (40), (39).
- (46) PLACED CAPPED CORE TUBE IN MAIN COLLECTION BAG .

FOR SCOOPING OF LOOSE LUNAR SOIL: USE SAME MATING & UNLOCKING PROCEDURES FOR SCOOP  & HANDLE AS WITH CORE TUBES & HANDLE ((39) THRU (41)).

- (47) SCOOP HAS STEEL BLADE, BUT SCOOP/HANDLE ASSY. IS ONLY FOR LIGHT DIGGING. CONNECTION BETWEEN SCOOP AND HANDLE WILL NOT WITHSTAND HEAVY DUTY CHIP-PING OR PRYING.









NOTE:
CONNECTION BETWEEN EXTENSION
HANDLE AND TOOLS IS NOT DESIGNED
FOR HEAVY DUTY HAMMERING OR
PRYING WHILE ASSEMBLED.







CREW OPERATING PROCEDURES



F. TOOL AND EQUIPMENT USAGE (CONTINUED)


TO MATE HAMMER  AND EXTENSION HANDLE:

-  SQUEEZE AND HOLD DOWN BOTH LOCKING LATCH ACTUATORS AT BASE OF HAMMER. (THIS RETRACTS LOCKING LATCHES ON HAMMER CONNECTOR.)
-  ALIGN LOCKING PINS ON INTERIOR CONNECTOR OF HAMMER WITH SLOT ALIGNMENT MARKS ON BASE OF EXTENSION HANDLE, THEN MATE HAMMER AND HANDLE. (KEEP LATCH ACTUATORS SQUEEZED.)
-  ROTATE EXTENSION HANDLE CLOCKWISE TO STOPS. (THIS POSITIONS HAMMER LOCKING PINS INTO LOCKING SLOTS IN HANDLE BASE AND LATCHES INTO LATCHING SLOTS.)
-  PUSH EXTENSION HANDLE LOCKING SLEEVE TOWARD CONNECTION TO LOCK TOOL ASSY.
-  RELEASE LATCH ACTUATORS.


-
-  HAMMER ASSEMBLY IS FOR TRENCHING AND LIGHT HOEING WITH HAMMER BLADE. (CAUTION - CONNECTION BETWEEN HAMMER/HANDLE CANNOT WITHSTAND HEAVY DUTY CHIPPING OR PRYING.)

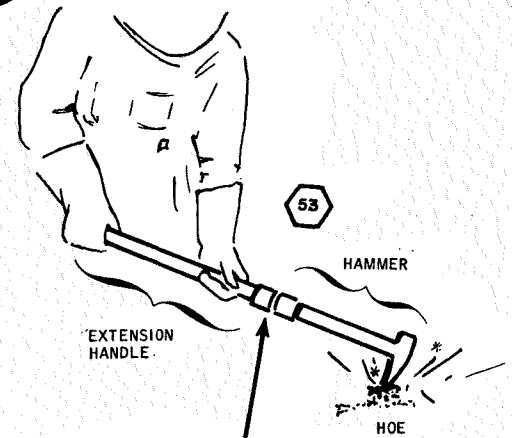
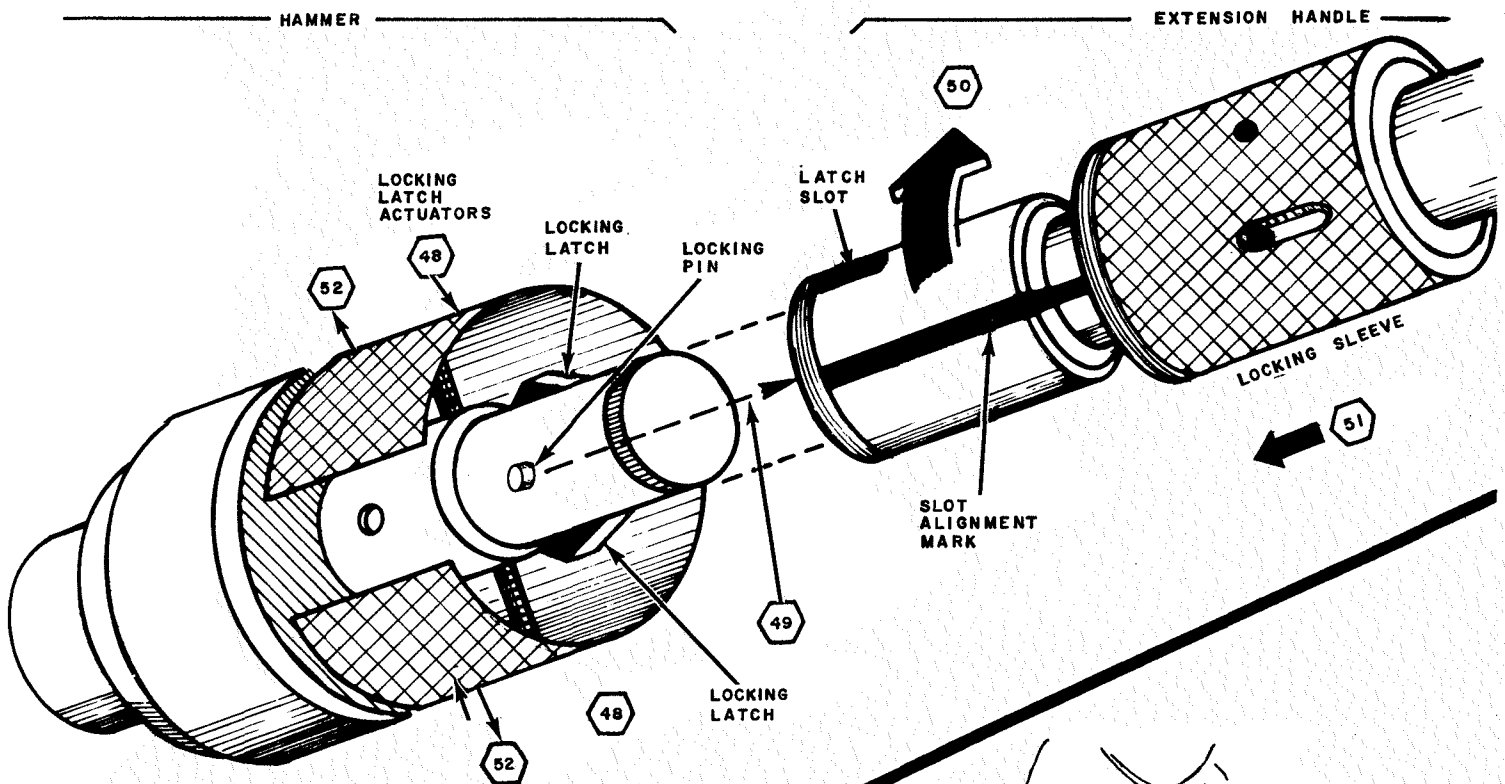
-  TO DISCONNECT HAMMER/HANDLE ASSY., REVERSE ASSY. STEPS
i.e., , , , , .

-
-  THE CORE TUBE MAY BE USED AS A CHISEL BY REPLACING CORE TUBE BIT WITH CHISEL BIT .

-  CORE TUBE SAMPLING AND CHISELING MAY BE DONE WITHOUT EXTENSION HANDLE IF ROCK OR SOIL LOCATION DOES NOT REQUIRE ASTRONAUT TO BEND OVER.

-  BRUSH/SCRIBE/LENS  IS USED FOR EXAMINING AND MARKING SAMPLES.

-  ALL SAMPLES MAY BE RETURNED FROM TRAVERSE BY USING ONLY COLLECTION BAG WITH HANDLES PROVIDED FOR CARRYING.



NOTE:
CONNECTION BETWEEN EXTENSION
HANDLE AND TOOLS IS NOT DESIGNED
FOR HEAVY DUTY HAMMERING OR
PRYING WHILE ASSEMBLED.



CHISEL BIT

55

