

APOLLO 13 LUNAR SURFACE PROCEDURES

(FINAL)

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MEMORANDUM TO: See List

FROM : CF72/Chief, Mission Operations Branch

SUBJECT : Apollo 13 Lunar Procedures, Revision A

Please update the Apollo 13 Lunar Procedures document (Final), dated March 16, 1970, by inserting the attached pages in accordance with the following instructions:

a. Replace the following pages with the corresponding Revision A pages: iii, iv, 16, 17, 44, 48, 50, 51, 52, 53, 54, 58, 66, 67, 76, 118, 119.

b. Add Pages: 78E, 78F, 78G, 78H, 119A, 119B, 119C, 119D, 119E, 119F, 119G, 119H, 119I.

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Enclosure

CF72:RGZedekar(RKoppa GE):fmc 4-6-70

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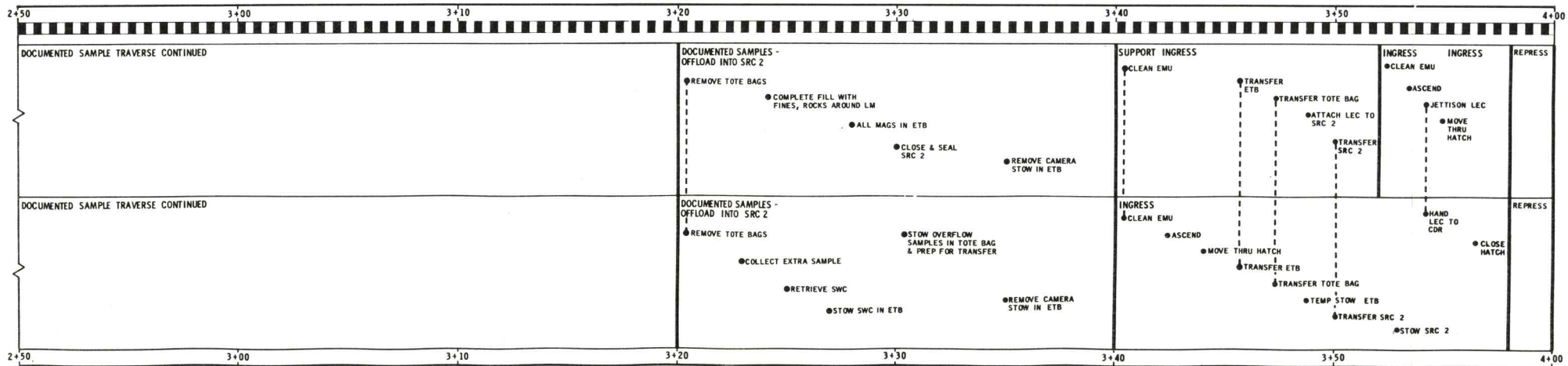
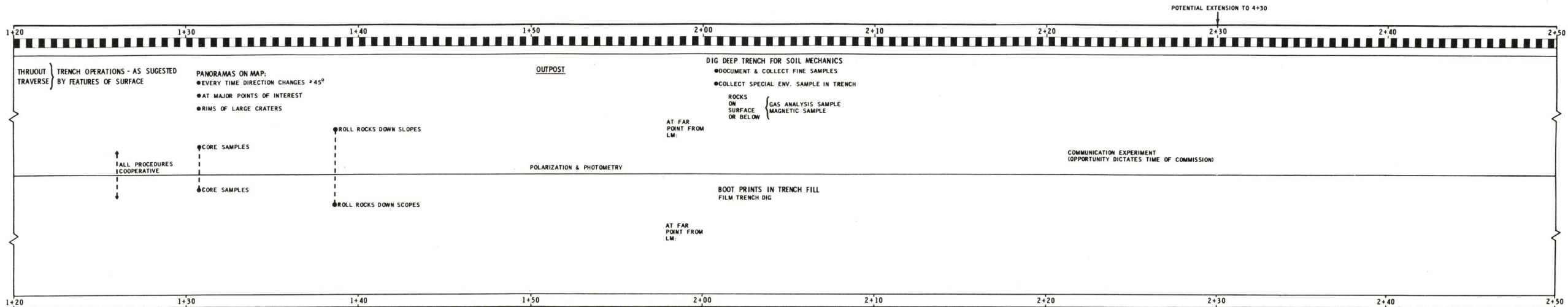
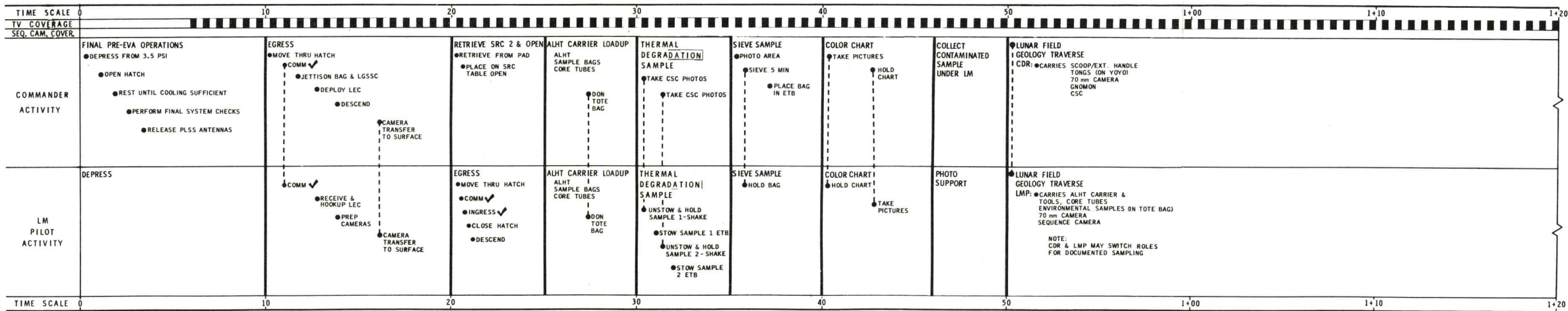
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APOLLO 13 SUMMARY TIMELINE
NOMINAL LUNAR SURFACE EVA 2

REVISION
6 APRIL 1970



LEGEND

EVENT LINE
SEPARATES MAJOR BLOCKS OF ACTIVITY

COORDINATED TASKS

SEQUENCE CAMERA COVERAGE

- 1 FRAME/SEC
- 6 FRAMES/SEC
- 12 FRAMES/SEC
- NO COVERAGE
- MAGAZINE CHANGE

TV COVERAGE

- COVERAGE
- NO COVERAGE

NOTE:
ACTIVITY TIMES WITHIN AN EVENT NOT FIXED.

NAME	INITIAL	ORIGIN	NATIONAL AERONAUTICS & SPACE ADMINISTRATION
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APOLLO 13 SUMMARY TIMELINE
NOMINAL LUNAR SURFACE EVA 2
FIGURE 3-2

REV. D APR '70
REV. C MAR '70
REV. B JAN '70
REV. A JAN '70

BAVC DEC '69

The LMP hangs the LEC pulley from the overhead handhold and attaches the ETB to the hooks on the LEC preparatory to lowering the bag to the lunar surface. The bag contains the three cameras (2-70mm data cameras and the surface sequence camera) extra/magazines, and the lunar traverse map. As soon as this transfer is effected, the LMP joins the CDR on the surface. As before, the hatch is left slightly ajar precluding pressure buildup forcing the hatch closed.

The CDR proceeds to retrieve the second SRC from the pad whence it was left on the previous EVA. It is placed on the MESA SRC table, clamped, and opened. The LMP brings the Hand Tool Carrier close by the MESA as the CDR unpacks another 35 bag dispenser, a set of three core tubes, three special sample containers, a new pair of weigh bags, and a solar wind experiment bag. The weigh bags and the solar wind bag go on the MESA, the dispenser and core tubes go onto the HTC.

Next the HTC receives its complement of tools, including a large two-piece hoe/shovel for use in digging trenches. The vertical-seeking photography reference tool, the gnomon, is also taken off the MESA and stowed on the HTC. (See Fig. 3-5).

Both crewmen proceed to install the PLSS-mounted packs, called "tote bags", on each other. The LMP's carry pouch (a pocket attached to the tote bag) contains the 100-ft safety tether, a filter, and the special sample containers. The CDR's pouch receives the extra 70mm and 16mm film magazines.

While the CDR was loading the HTC, the LMP retrieved the Closeup Stereo Camera (CSC) from its place in the sun where it rested between EVA's, deployed the skirt, or light shroud, and took some trial pictures in the vicinity of the LM. The CDR will nominally hand-carry this unit out on the geology traverse.

Both crewmen check the HTC and their packs for completeness. The surface sequence (16mm) camera is stowed in the HTC pouch. The traverse map is placed in a special pocket on the HTC. The HTC is usually carried by the LMP.

Next, the crew performs the Thermal Degradation Sample evaluation. The LMP takes one of the two samples stowed in the CDR tote bag pouch, unbags it, and holds it out for the CDR. The sample consists of a hinge-like double plate on which are mounted several surface coating material chips. The CDR sprinkles the sample with lunar material (he used the small scoop) and then brushes it off with the MESA brush. The same is done with the other sample, except no brushing is done. The evaluation is documented with CSC. Samples are rebagged and stowed in the ETB.

The crew then proceeds to assemble the large scoop to the extension handle, take one of the two spare weigh bags (stowed in the ETB at launch) and go to a representative area of ground near the LM. The large scoop has a 0.5 cm sieve attachment. The crew sieves material for 5 minutes and deposits residual rocks and chips in the weigh bag. This bag is sealed and stowed in the ETB.

The crew proceeds to calibrate their film (Black and white SO 267) and obtain photometric data by taking a series of photographs of a special contrast chart carried on the HTC.

The next sample taken is the so-called "contaminated sample" under the LM itself. This is a sample of fine material scooped by the CDR with the small scoop. The sample is photographically documented and placed in a small bag, the number of which is reported to Houston. This is rebagged inside another small bag and the sample is also deposited in the ETB.

The events of the next three hours or so are dependent upon the sites and traverse selected between the crew and the geology team supporting the flight. The number and kinds of samples taken, and sites visited, are governed by the traverse map if the landing site is known. Although much depends on on-the-spot decisions by the crew, the nominal traverse is shown in Fig. 3.7 .

During the traverse, the crew carries on a running commentary on what they are seeing and doing. They report all movements between samples, noting directions and distance with regard to the LM. Every now and then the LMP and CDR read each other's film counter to Capcom to permit those keeping track of the film budget and records to update and correct their records.

Changes of direction, or advance to a new leg of the traverse occasion a 12 to 14 picture photo panorama, which serves to satisfy the backsite-to-the LM requirement as well.

When an area is encountered in which obstructions exist between the two crewmen and the LM, the CDR (who, it will be remembered, has the relay link with the LM) attempts to test the communication capability of the EMU EVCS system by moving behind or into this obstruction. This could be a fault escarpment, crater wall, large boulder, hill, or other surface feature.

During the traverse the astronauts dig several small holes or trenches to gain an understanding of surface structure, mechanical properties, and to obtain subsurface samples (See Fig. 3-5). They also take several core samples. These samples are taken by attaching a core tube to the extension handle and driving the tube into the ground by striking the extension handle end with the hammer.

MISSION: APOLLO 13, H-2
EVA: 1

DATE: 16 MARCH 1970

[illegible]

CREW EVA CUFF CHECKLIST

CDR

DATE: 3/12/70	3+35	<u>CLOSE SRC 1</u>	
		RETURN ITEMS & SAMPLES IN CDR TOTE BAG	
		HANG LMP TOTE BAG ON MESA	
	3+40	CLEAN EMU'S	[INGRESS
		<u>LEC TRANSFERS</u>	
		TRANSFER ETB	[ETB, TOTE
		TRANSFER CDR TOTE BAG	[BAG & SRC
		TRANSFER SRC 1	[STOW
		TONGS IN HTC	
		HTC IN SUN	
	3+52	<u>EVA TERMINATION</u> - CAP TV	
		CLEAN EMU	
		ATTACH LEC TO PORCH	[LEC TO CDR
		INGRESS	
		RAISE EV VISOR	
	4+00	<u>REPRESS</u>	

CLOSEOUT

I A

LMP

CLOSEOUT		<u>EVA TERMINATION</u>	
		CLEAN EMU	[TRANSFER PREP
		TONGS IN HTC	
	3+40	INGRESS	
		RAISE EV VISOR	
		LEC PREP	
		<u>LEC TRANSFERS</u>	
		STOW ETB & TOTE BAG	
		STOW SRC 1	
			[ASCENT
		HAND OUT LEC TO CDR	
	3+52		[INGRESS
	4+00	REPRESS	

DATE: 3/12/70

3.2.2 EVA 2

The detailed timeline procedures for EVA 2 are shown on the following format sheets.

The crew EVA cuff checklist pages which correspond approximately to the timeline increment are shown on the lefthand facing sheets.

CREW EVA CUFF CHECKLIST

<u>DISTANCE ESTIMATION</u>	
IF LM TOP TO PAD: WIDE AS EARTH - 620 FT. ECLIPSED BY THUMB - 350 FT. (ARM'S LENGTH)	
IF LM CLUSTER TO CLUSTER: WIDE AS EARTH - 350 FT. ECLIPSED BY THUMB - 200 FT. (ARM'S LENGTH)	
IF ASCENT STAGE - TOP TO INTERFACE: WIDE AS EARTH - 280 FT. ECLIPSED BY THUMB - 160 FT. (ARM'S LENGTH)	DIST

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REVISION A
6 APRIL 1970

EVA: 2

DATE: 16 MARCH 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	S E Q C A M.	TASK FUNCTION
				L M P C D R
	0+00 DEPRESS CABIN FROM 3.5psi			
	NOTE: DETAILED PROCEDURES ARE PRESENTED IN "LUNAR SURFACE CHECKLIST" "EQUIPMENT PREP EVA 2" SECTION			
	OPEN HATCH			
	0+10 MOVE THRU HATCH			

CREW EVA CUFF CHECKLIST

CDR

EVA 2

DATE: 3/12/70	CDR - EVA 2	EGRESS	SRC	0+25 <u>SRC OFFLOAD</u> GAS, SPEC ENVIRON, MAG SAMPLES IN LMP TOTE BAG POUCH CORE CAPS IN CLIP HTC 35 BAG DISPENSER IN HTC CORE TUBES IN HTC RACK CLOSE ORG. SAMPLE - BACK IN SRC <u>ITEMS FOR HTC</u> FOXHOLE SHOVEL, HAMMER, GNOM, MAP <u>PUT TOTE BAG ON LMP</u> SAFETY LINE & FILTER IN POUCH TONGS ON YOYO [TOTE BAG 70 MM CAMERA ON RCU [ON CDR ASSEMBLE SMALL SCOOP & EXT HANDLE GET CSC & HAVE MESA BRUSH NEAR <u>THERMAL DEGRADATION SAMPLE</u> SAMPLE 1: CSC 1 SIDE, THEN DIRT ON SAMPLE. CSC BOTH SIDES. BRUSH OFF SAMPLE, CSC BOTH SIDES	DATE: 3/17/70
	0+10 CDR EGRESS <u>JETTISON BAGS</u> HAND LEC TO LMP DESCEND ETB TRANSFER DOWN PUT 70 MM CAMERA ON RCU 0+20 GET SRC 2 [LMP EGRESS PLACE ON TABLE & OPEN BRING HAND TOOL CARRIER TO MESA				

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LMP

DATE: 3/12/70	LMP - EVA 2 <u>ETB CONTENTS</u> 2 CAMERAS, 3 MAGS (B&W) 1 MOVIE CAMERA, 3 MAGS POLARIZING FILTER MAP JETTISON BAGS TO CDR HOOK UP LEC 0+15 <u>ETB TRANSFER DOWN</u> 0+20 EGRESS ° CLOSE HATCH ° DESCEND ° PUT 70 MM CAMERA ON RCU	EGRESS	CSC	0+25 GET CSC CAMERA DEPLOY SKIRT TAKE LM VICINITY CSC PHOTOS 0+27 PUT TOTE BAG ON CDR RIG LENS BRUSH ON HTC TONGS ON YO YO ✓ SAFETY & FILTER IN LMP TOTE 0+30 MOVIE CAMERA IN HTC <u>THERMAL DEGRADATION SAMPLE</u> SAMPLE 1: BAG IN CDR TOTE UNBAG & UNFOLD - HOLD OUT SHAKE WHEN DIRTY - HOLD OUT HOLD WHEN BRUSHED & CSC [CSC REFOLD & REBAG [BRUSH SAMPLE 2: UNBAG & UNFOLD SHAKE WHEN DIRTY - HOLD OUT REFOLD & REBAG [CSC BAG IN ETB	DATE: 3/17/70

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MISSION: APOLLO 13, H-2
EVA: 2

DATE: 6 APRIL 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ CAM	TASK FUNCTION	
				LMP	CDR
	0+10	CDR			
		MOVE THRU HATCH			
PASS JETTISON BAG & LHSSC TO CDR		JETTISON BAG & HLSSC			
HOOK-UP LEC		HAND LEC TO LMP			
CHECK ETB CONTENTS-2 70 MM CAM, 1 SEQ CAM, 2 70 MM MAG, 2 16 MM		DEPLOY LEC			
ATTACH ETB TO LEC		DESCEND TO LUNAR SURFACE			
ETB TRANSFER		ETB TRANSFER - DOWN			
STOW LEC					
VERIFY CB CONFIGURATION AND VOX SENSITIVITY		STOW ETB ON MESA			
		PUT 70MM CAM ON RCU			
EGRESS	0+20	GET SRC 2 FROM FOOTPAD			
MOVE THRU HATCH		PLACE SRC 2 ON MESA TABLE			
PULL HATCH TO		RETRIEVE HAND TOOL CARRIER & PLACE AT MESA			
DESCEND TO SURFACE		OFF LOAD SRC 2			
PUT 70MM CAM ON RCU		WEIGH BAGS IN LID			
RETRIEVE CSC - DEPLOY SKIRT		PLACE IN HTC:			
TAKE NEAR LM PHOTOS TO		CORE CAPS			
CHECK CAMERA		35 BAG DISPENSER			
STOW TOOLS IN HTC		CORE TUBES			
ATTACH TOTE BAG TO CDR & PLACE		CLOSE ORGANIC SAMPLE PLACE IN SRC			
70MM MAG AND 2 16MM MAGS IN POUCH		STOW TOOLS IN HTC			
TONGS ON YO-YO		ATTACH TOTE BAG TO LMP &			
16MM CAM & MAP IN		PLACE SAFETY LIN, FILTER, GAS			
HTC		ANALYSIS, SPEC ENVIRON., &			
		MAGNETIC SAMPLE CONTAINERS			
		IN BAG POUCH			
THERMAL DEGRADATION SAMPLE	0+30	TONGS ON YO YO			
		THERMAL DEGRADATION SAMPLE			

CREW EVA CUFF CHECKLIST

CDR

DATE: 3/17/70	[HOLDS SAMPLES	NEAR LM SAMPLES
	<p>SAMPLE 2: DIRT ON SAMPLE, CSC BOTH SIDES SMALL SCOOP EXT HANDLE IN HTC</p> <p>SIEVE SAMPLE 5 MINUTES SELECT & PHOTO TYPICAL AREA COLLECT INTO EXTRA WEIGH BAG SEAL BAG & STOW IN ETB</p> <p>CONTAMINATED SAMPLE (UNDER QUAD 3) TAKE X SUN STEREO BEFORE COLLECT FINES & DOUBLE BAG TAKE X SUN PHOTO & STOW IN ETB</p> <p>COLOR CHART (LMP HOLDS) PLACE GNOMON NEAR ROCK POSITION CHART DOWN SUN 5 FT. TAKE 4 PHOTOS: f:5.6, 8, 11, 16 TAKE 1 PHOTO f:11 45° AZIMUTH HOLD CHART FOR LMP TAKE CSC CAMERA & START TRAVERSE</p>	

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LMP

DATE: 3/17/70		NEAR LM SAMPLE
	<p>SPARE MAGS IN CDR TOTE SIEVE SAMPLE 5 MINUTES SELECT & PHOTO TYPICAL AREA COLLECT INTO EXTRA WEIGH BAG SEAL BAG & STOW IN ETB</p> <p>CONTAMINATED SAMPLE (QUAD 3) TAKE DOWN SUN BEFORE HOLD BAG FOR CDR & DOUBLE BAG STOW IN ETB (CDR MAY DO)</p> <p>COLOR CHART GET FROM HTC & HOLD FOR CDR GIVE TO CDR & CHANGE PLACES POSITION CHART DOWN SUN 5 FT. TAKE 4 PHOTOS: f:5.6, 8, 11, 16 TAKE 1 PHOTO f:11 45° AZIMUTH GET CHART & STOW IN HTC</p> <p>PICK UP HTC & START TRAVERSE</p>	

A

REVISION A
6 APRIL 1970

MISSION: 13

DATE: 6 APRIL 1970

EVA: 2

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	S E C O N A M	TASK FUNCTION	
				L M P	C D R
THERMAL DEGRADATION SAMPLE REMOVE TDS FROM CDR TOTE & UNBAG - HOLD OUT FOR CDR	0+30	THERMAL DEGRADATION SAMPLE ASSEMBLE SCOOP & XT HANDLE READY MESA BRUSH & CSC TAKE 1 CSC PHOTO - 1 SIDE SPRINKLE LUNAR DUST ON SAMPLE TAKE CSC PHOTO BOTH SIDES BRUSH OFF SAMPLE			
SHAKE TDS AFTER DUSTING		TAKE CSC PHOTO BOTH SIDES			
FOLD TDS & REBAG, STOW ETB		SPRINKLE LUNAR DUST ON SAMPLE TAKE CSC PHOTO BOTH SIDES			
REMOVE 2nd TDS FROM CDR TOTE & UNBAG - HOLD OUT FOR CDR		PHOTO AREA SIEVE SAMPLE - REPORT NO. SCOOP FULLS			
SHAKE TDS AFTER DUSTING FOLD TDS & REBAG. STOW ETB ASSEMBLE SIEVE/SCOOP (CDR MAY DO) TO XT HANDLE TAKE WEIGH BAG HOLD BAG FOR CDR		DEPOSIT RESIDUE IN WEIGH BAG PROCEDURE - SIEVE OPEN SCOOP CLOSE SIEVE SHAKE OPEN SIEVE DUMP INTO BAG SCOOP ETC.			
SEAL & STOW BAG IN ETB; SIEVE/SCOOP ON MESA PLACE GNOMON & HOLD OUT PHOTOMETRIC CHART	0+40	SHOOT PHOTOMETRIC CHART DWN SUN TAKE 4 PHOTOS AT 5 FT NORMAL TO CHART (F: 5.6, 8, 11, 16) 1 PHOTO F:11 AT 45° AZIMUTH RETRIEVE CHART HOLD FOR LMP			
SHOOT PHOTOMETER CHART DWN SUN TAKE 4 PHOTOS AT 5 FT NORMAL TO CHART (F: 5.6, 8, 11, 16) 1 PHOTO F:11 AT 45° AZIMUTH		GIVE CHART TO LMP ASSEMBLE SCOOP/XT HANDLE CONTAMINATED SAMPLE (UNDER QUAD 3) GNOMON			
STOW CHART IN HTC		PHOTO STEREO PR X SUN COLLECT SAMPLE			
PHOTO DWN SUN		GNOMON ON HTC			
PREPARE BAG & REPORT NO.		RETAIN SCOOP/XT HANDLE			
DOUBLE BAG SAMPLE					
PLACE IN ETB					
PICK UP HTC	0+50	PICK UP CSC			

CREW EVA CUFF CHECKLIST

BOTH

TRAVERSE ROMTS	<p><u>TRAVERSE REPORT:</u></p> <p>ALL MOVEMENTS INCLUDING DIRECTIONS BETWEEN SAMPLES LOCATION WRT LM</p> <p>PHOTOS OTHER THAN NOMINAL SAMPLE BAG NUMBERS</p> <p>OBSTRUCTIONS WRT LM- GET BEHIND & TRY COMM (CDR) LMP PHOTO OBSTRUCTION, CDR, LM</p> <p><u>PHOTOS</u></p> <p>PAN AT EACH LEG, SITE, DIRECTION CHANGE--MAP SHOWS NOMINAL CSC CAMERA PICTURES-PIGGY BACK ON DOC. SAMP. AS REQUIRED</p> <p><u>REPORT ORIENT & FRAME NO.</u></p> <p><u>CRATER DOCUMENTATION</u></p> <p>SERIES OF SAMPLES RADially FROM CENTER</p>	<p>DATE: 3/12/70</p>	<p>CORE SAMPLES (SINGLE & DOUBLE) TAKE ON SURFACE ONLY(SEE MAP)</p> <p>BEFORE: REPORT S/N TUBE(S)</p> <p>DRIVE TUBE(S) & PHOTO X SUN 15 FT</p> <p>AFTER: PHOTO X SUN STEREO 5 FT</p> <p><u>TRENCHES</u></p> <p>PHOTO SITE X SUN, DOWN SUN</p> <p>DIG DOWN SUN OFF 10° f:5.6, 1/125</p> <p>DOCUMENTED SAMPLES BOTTOM-TOP</p> <p>FILL, BOTTOM, TOP, SIDES, DISCONS</p> <p>CSC CAMERA PHOTOS BOTTOM</p> <p>RESET 70 MM CAMERA 1/250</p> <p><u>COLLECT 1 LARGE ROCK- FOOTBALL</u></p> <p><u>USE COLOR CHART</u></p> <p><u>COLLECT FILLET MAT'L & ROCK</u></p> <p><u>DOCUMENT & USE CSC CAMERA</u></p> <p><u>SAMPLE ROCK TRAIL</u></p> <p><u>FINES IN & BESIDE-CHIP FROM ROCK</u></p> <p><u>USE CSC CAMERA</u></p> <p><u>SAMPLE CRATER RIM CRESTS</u></p>	TRAV
	<p>DATE: 3/12/70</p>			

BOTH

MAP		<p>DATE: 3/12/70</p>	<p><u>VALLEY:</u> DOC. SAMP, PAN 17 MIN. SURF CHARACT.</p> <p><u>SLOPE:</u> DOC. SAMP, 110 MIN. CORE PATTERNED GND COMPARE WITH VALLEY</p> <p><u>CONE:</u> 2 PANS RIM 300 FT. BASE POLARIZED PIX 130 MIN. ROLL BOULDER -24 fps MOVIE BOULDER TRACKS & RADIAL VARIATIONS, TRY COMM.</p> <p><u>FLANK:</u> DOC. SAMP & PAN 17 MIN. COMPARE ROCKS W/CONE</p> <p><u>OUTPOST:</u> DO CUFF CK LIST 130 MIN.</p> <p><u>WEIRD:</u> DOUBLE CORE MULT. EJECTA DOC. SAMP SUPERIMPOSED ORIGIN ELONG. CRATER 115 MIN.</p> <p><u>TRIPLET:</u> DOC. SAMP, PAN 17 MIN. PATTERNED GND</p>	SITES
	<p>DATE: 3/12/70</p>			

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EVA: 2

DATE: 16 MARCH 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
	1+30	
	TYPICAL TRENCH PROCEDURE	
PHOTO SITE DOWN SUN READY SEQ CAM & FILM		PLACE GNOMON UP SUN PHOTO SITE CROSS SUN ASSEMBLE SHOVEL & DIG 10° OFF DOWN SUN
	NOTE: ALL PHOTOS 70MM CAM AT F:5.6 1/125 AFTER TRENCH DUG	
	1+40	
STAND DOWN SUN AT EDGE OF TRENCH (ACT AS REFLECTOR) PHOTO UP SUN		FINISH DIGGING PHOTO STEREO PR CROSS SUN BOTH SIDES & DOWN SUN
	TAKE DOCUMENTED SAMPLES (STND 4) BOTTOM TO TOP FILL, SIDES, DISCONTINUITIES CSC CAMERA PICTURES OF BOTTOM, OTHER FEATURES	
	1+50	

S E Q C A M.

TASK FUNCTION

L M P C D R

TYPICAL TRENCH PROCEDURE

TYPICAL TRENCH PROCEDURE

CREW EVA CUFF CHECKLIST

BOTH

OUTPOST	<p><u>OUTPOST</u></p> <ol style="list-style-type: none"> 1. COLLECT GAS ANALYSIS SAMPLE (SMALL CAN): SEVERAL CLEAN ROCKS, GLASSES, SPLATTERED ROCKS, VARIETY DESIRED, DOCUMENT COLLECTION AS USUAL 2. COLLECT MAGNETIC SAMPLE (TEFLON CAN) 2-3 ROCKS MICROBRECCIA & CRYSTALLINE DOCUMENT COLLECT AS USUAL 3. DIG DEEP TRENCH (SOIL MECH.) DOCUMENT BEFORE. THEN f:5.6, 1/125 DIG 2 FT. DEEP 10° OFF DWN SUN DOCUMENT BEFORE SAMPLING: LMP STAND DWN SUN EDGE TRENCH CDR STEREO PR CROSS SUN BOTH SIDES, THEN 1 SHOT DWN SUN LMP 1 SHOT UP SUN 	DATE: 3/25/70	DATE: 3/12/70	<p>COMMENT ON SOIL PHYSICAL, MECH PROPS</p> <p>TAKE DOC. SAMPLES BOTTOM TO TOP, SIDES, DISCONS, FILL. CSC CAMERA IN BOTTOM, SIDES DOCUMENT BOOT PRINT IN FILL</p> <ol style="list-style-type: none"> 4. COLLECT SPEC. ENVIRON SAMPLE (LARGE CAN): FINE-BOTTOM DEEP TRENCH - DOCUMENT COLLECTION 5. (LMP) a. USE CSC CAMERA b. RADIAL FINE SAMPLES SW OUTPOST CRATER - 3 @ 10 FT. INTERVALS - PHOTO AFTER 6. (CDR) GO BEHIND ROCK OR INTO CRATER TO TEST COMM. 7. USE COLOR CHART WITH LARGE ROCKS, COLOR CONTRASTS 8. COLLECT FOOTBALL 	OUTPOST

A

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SCHEDULE	TASK FUNCTION	
				L M P	C D R
	3+10			END TRAVERSE	END TRAVERSE
				END TRAVERSE	
REPORT TRAVERSE COMPLETE					
EVA CLOSEOUT CAMERA IN ETB	(-40) 3+20	EVA CLOSEOUT CAMERA IN ETB PLACE WEIGH BAG ON SCALE REMOVE LMP TOTE BAG			
HOLD TOTE BAG FOR OFFLOAD		STOW SAMPLES IN WEIGH BAG			
REMOVE CDR TOTE BAG AND HOLD FOR OFFLOAD		SEAL WEIGH BAG 1 & STOW IN SRC		SRC AND ETB PREP	SRC AND ETB PREP
TAKE DOWN SOLAR WIND - BAG AND STOW SWC IN ETB		PLACE WEIGH BAG 2 ON SCALE STOW SAMPLES IN WEIGH BAG			
		SEAL WEIGH BAG 2 AND STOW IN SRC			
PLACE 16MM MAGS IN ETB PLACE 70MM MAGS IN ETB LOAD CSC CAM MAG IN ETB		STOW REMAINING SAMPLES IN TOTE BAG INCLUDING MAGNETIC SAMPLE PLACE TOTE BAG ON FOOT PAD			
	3+30				

CREW EVA CUFF CHECKLIST

CDR

CLOSEOUT	MAP IN ETB	DATE: 3/25/70
	CORE TUBES IN SRC	
	REMOVE SRC SEAL	
	CLOSE & SEAL SRC	
	COLLECT EXTRA BAG 50 FT. FROM LM	
	CAMERAS (2) IN ETB	
	EXTRA MAG IN ETB	
	SEQ CAMERA MAGS (3) IN ETB	
	3+40 CSC CAM MAG IN ETB	
	✓ETB LIST (FLAP) & PREP FOR TRANSFER	
	TRANSFER ETB & TOTE	
	TRANSFER SRC 2	
	EVA TERMINATION	
	CLEAN EMU - TAKE OFF TONGS	
JETTISON LEC		
3+52 INGRESS	[INGRESS	
4+00 REPRESS	[ETB & SRC STOW	
	[LEC TO CDR	

I A

LMP

INGRESS	TAKE OFF TONGS	DATE: 3/12/70
	3+40 EVA TERMINATION	
	CLEAN EMU	
	INGRESS	
	HOOKUP LEC	
	3+47 LEC TRANSFERS	
	STOW ETB STOW TOTE BAG	
	STOW SRC 2	
	HAND OUT LEC TO CDR	
	3+52	
	4+00 REPRESS	

MISSION: APOLLO 13, H-2
EVA: 2

DATE: 6 APRIL 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	S O C C M	TASK FUNCTION	
				L M P	C D R
	(-30) 3+30				
RETRIEVE EXTRA WEIGH BAG		STOW IN SRC: SPECIAL, GAS SAMPLES; CORE TUBES CLOSE & SEAL SRC 2			
HOLD BAG FOR CDR		TAKE SIEVE SCOOP COLLECT EXTRA SAMPLE >50 FT OF LM			
SEAL & STOW WEIGH BAG IN ETB					
DISCARD TONGS ASSEMBLE BRUSH					
EVA TERMINATION	(-20) 3+40				
CLEAN CDR EMU		CLEAN LMP EMU			
ASCEND TO PLATFORM					
INGRESS		CHECK ETB CONTENTS (LIST ON FLAP)			
CHECK EMU & LM		CLOSE ETB FLAP			
PULL ETB INTO LM		CHECK LEC-ETB HOOK UP			
REMOVE ETB FROM LEC		REST-CHECK EMU			
STOW ETB		TRANSFER ETB INTO LM			
PULL TOTE BAG INTO LM		TRANSFER LEC HOOKS TO SURFACE			
	(-10) 3+50	HOOK LEC TO TOTE BAG TRANSFER TOTE BAG INTO LM			

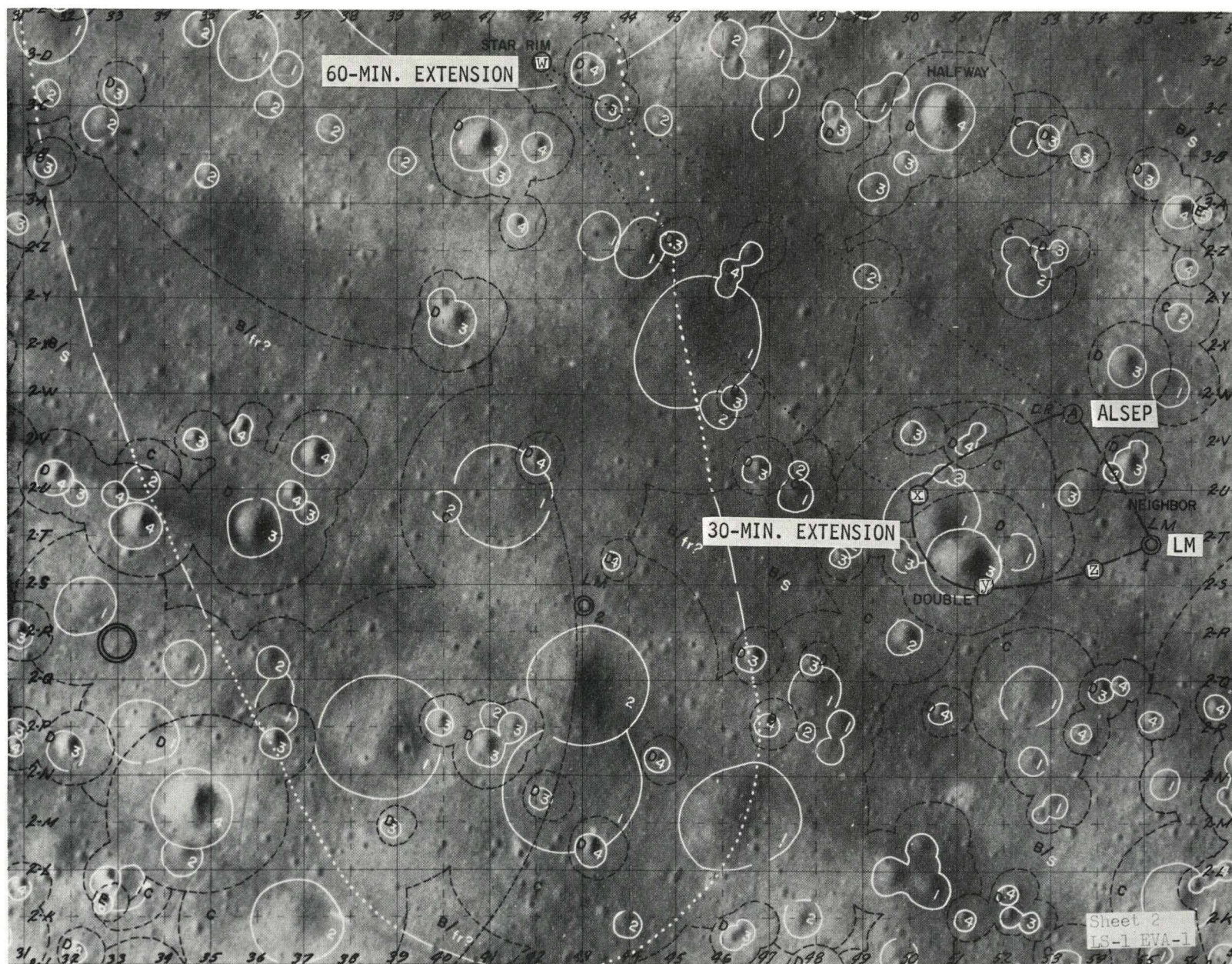


FIGURE 3-6: NOMINAL EVA 1 TRAVERSE (LANDING SITE 1, FRA MAURO) Revision A April 6, 1970

LANDING SITE #2, EVA 1

STATION	TASKS	ADDITIONAL INFORMATION
A	•Deploy ALSEP	
h	•Selected sample	•#4 crater may excavate material from Smooth unit, beneath regolith
i	•Selected sample	•#1 crater may excavate material from ridge unit, beneath regolith
j	•Selected sample	•Cluster of moderately young (#3) craters

3.8 Estimated Traverse Times

Table 3-1 provides estimated lunar surface field geology traverse times for each of the landing site maps given in section 3.7. The following assumptions were made to arrive at these estimates (which should be considered to be minimum times to accomplish each traverse):

- (a) Crewmen traveling rate, level ground, or downhill: 4 feet/sec
- (b) Crewmen traveling rate, slope upgrade $\geq 5^\circ$: 2 feet/sec
- (c) Slope and boulders near rim of cone crater make downhill rate:
2 feet/sec
- (d) Crewmen will rest 1 minute for each 4 minutes of traverse at steady rate
- (e) Crewmen do not pause significantly in moving from one station to another except to rest, nor do they deviate from paths shown

Alloted time at each station is given in Table 3-1. This time is the minimum allowable for the tasks identified on the geological data tables in section 3.7.

TABLE 3-1 :

LUNAR FIELD GEOLOGY ESTIMATED

TRAVERSE TIMES

APOLLO 13

Site 1 - EVA 1

Station	Distance From Prev.	Time @ 2 FPS	Time @ 4 FPS	Stops (Rest)	Total Trav. Time	Time at Sta.	Cum Time
<u>Long Way</u>							
A	520						
W	2300		9.6	2	11.6	7	18.6
X	2080		8.7	2	10.7	5	34.3
Y	420		1.8	0	1.8	5	41.1
Z	420		1.8	0	1.8	5	47.9
LM	210		0.9	0	.9		48.8

EVA Time Total

4 Hr. 39 Min.

(3 Hr. 50 Min. OH)

<u>Short Way</u>							
X	625		2.6	0	2.6	5	7.6
Y	420		1.8	0	1.8	5	14.4
Z	420		1.8	0	1.8	5	21.2
LM	210		0.9	0	0.9		22.1

4 Hr. 12 Min.

(3 Hr. 50 Min. OH)

<u>Site 1 - EVA 2 Nominal</u>							
a	1610		7.0	1	8.0	7	15.0
b	880	3.7	4.0	1	5.0	10	30.0
e	290	2.4		0	2.4		33.9
c	1580	13.2		2	15.2	30	79.1
d	830	3.5	1.7	1	6.2	7	92.3
e	920		3.8	1	4.8	30	127.1
f	1130		4.7	1	5.7	15	147.8
g	580		2.4	0	2.4	7	156.8
LM	1040		4.3	1	5.3		162.1

4 Hr. 9 Min.

(90 Min. OH)

<u>Detour 1</u>							
ae	As Above - Nominal						127.1
e1	540		2.3	0	2.3	5	134.4
e2	290		1.2	0	1.2	5	140.6
f	460		1.9	0	1.9	15	157.5
g	580		2.4	0	2.4	7	166.9
LM	1040		4.3	1	5.3		172.2

4 Hr. 22 Min.

(90 Min. OH)

<u>Detour 2</u>							
ag	Nominal as Above						156.8
g1	500		2.1	0	2.1	7	165.9
g2	380		1.6	0	1.6	5	172.5
LM	880		3.6	1	4.6		177.1

4 Hr. 27 Min.

(90 Min OH)

TABLE 3-1 (CONTINUED)

ag		As Detour 1 Above	<u>Detour 1 & 2</u>				4 Hr 38 Min
g ₁	500	2.1	0	2.1	7	166.9	
g ₂	380	1.6	0	1.6	5	176.0	
LM	880	3.6	1	4.6		182.5	
						188.2	

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TABLE 3-1 (CONCLUDED)

ALTERNATE SITE TRAVERSE TIMES (MIN.)

<u>Station</u>	<u>Distance From Prev.</u>	<u>Time @ 4 FPS</u>	<u>Stops (Rest)</u>	<u>Total Travel Time</u>	<u>Time At Sta.</u>	<u>Cum. Time</u>	<u>EVA Time Total</u>
<u>Site 2-EVA 1</u>							
h	1330'	5.5	1	6.5	5	11.5	4 Hr. 17 Min.
i	460'	2.0	0	2.0	5	18.5	
j	460'	2.0	0	2.0	5	25.5	
LM	540'	2.3	0	2.3		27.8	(3 Hr. 50 Min. OH)
<u>Site 2 - EVA 2</u>							
k	500'	2.1	0	2.1	12	14.1	3 Hr. 52 Min.
m	1080'	4.5	1	5.5	7	26.6	(90 Min. OH)
w	450'	2.0	0	2.0	16	44.6	
n	750'	3.1	0	3.1	15	62.7	
o	582'	2.5	0	2.5	30	95.2	
p	1375'	5.8	1	6.8	7	108.9	
q	540'	2.3	0	2.3	10	121.2	
v	666'	2.8	0	2.8	5	129.0	
s	445'	1.9	0	1.9	5	135.9	
LM	1330'	5.5	1	6.5		142.4	
<u>Site 3 - EVA 1</u>							
y	2160'	9.0	2	11.0	7	18.0	4 Hr 28 Min.
z	1710'	7.2	2	9.2	7	34.2	(3 Hr. 50 Min OH)
LM	875'	3.7	0	3.7		37.9	
<u>Site 3 - EVA 2</u>							
a	540'	2.3	0	2.3	7	9.3	3 Hr. 20 Min.
b	1040'	4.3	1	5.3	12	26.6	(90 Min. OH)
c	625'	2.6	0	2.6	7	36.2	
d	540'	2.3	0	2.3	7	45.5	
e	710'	3.0	0	3.0	30	78.5	
f	960'	4.0	1	5.0	30	83.5	
g	1170'	4.9	1	5.9	15	104.4	
LM	1120'	4.7	1	5.7		110.1	

4.3 Off-Nominal EVA Planning

Figure 4-4 depicts decision flow for modification of EVA 1 and 2 based on off-nominal times, both excessive over nominal and less than nominal. The latter is expressed as "time required over available (to perform nominal EVA). For example, if the expendables budget permits only four hour's operation EVA, and the crew is ten minutes behind on their tasks, then ten minutes more than is available is required to finish the EVA tasks without changing or dropping anything. The decision flow on EVA 1 for this situation calls for a cut in the selected sample traverse. Cuts and changes shown in Fig. 4-4 are based as much as possible on priorities, particularly for EVA 1. Thus ALSEP has priority over selected samples, and over Lunar Field Geology (of which the core stem sample is a part). However, the core sample is performed as part of the ALSEP procedure and uses the same equipment - the drill. Under contingency circumstances the core sample is attempted and selected sampling is cut or dropped, because the requirement for selected samples can be satisfied by EVA 2 documented sampling during the geology traverse, but the core sample will require much more impact, and may not be feasible, on EVA 2. Priority considerations must be tempered by operational facts.

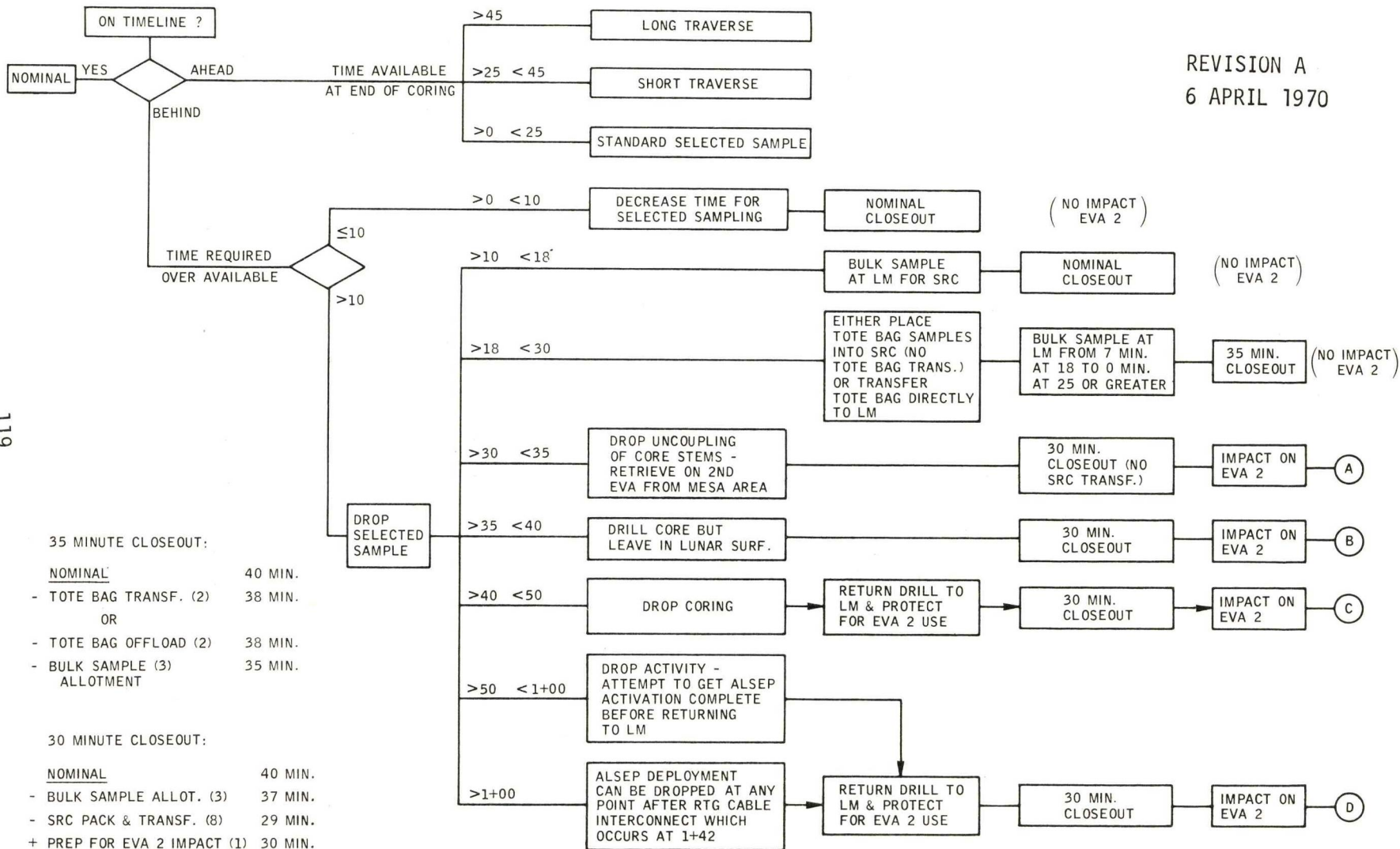
Note that any "hold" on ALSEP results on an impact on EVA 2 which is handled by re-structuring the field geology traverse and dropping some of the pre-traverse tasks such as the thermal degradation sample, sieve sample, photometric chart survey, or the contaminated sample. The choice of items to drop are shown on the EVA 2 flow chart. Decisions on which to cut, and how to modify the traverse are real time dependent on the point in the EVA at which it becomes evident that cuts must be made, what has already been accomplished by the crew, and the priorities of the tasks yet remaining.

Some doubt exists as to whether the Apollo Lunar Surface Drill battery would still retain sufficient power from EVA 1 to EVA 2 to support bore stem and core stem operations. A contingency procedure exists for implanting Heat Flow Experiment probes in the event of drill malfunction, but no alternative exists for obtaining a core drill sample. Hence branch points are reflected in EVA 2 for drill operability. If the drill were returned to the LM and protected in a manner similar to SRC 2 between EVA's, the probability that the battery would not be degraded due to thermal effects would be enhanced.

EVA 2 times for ahead - of timeline are based on the estimated traverse times given in Table 3-1, page 78F.

4.4 OFF-NOMINAL EVA PLANNING CHART EVA 1

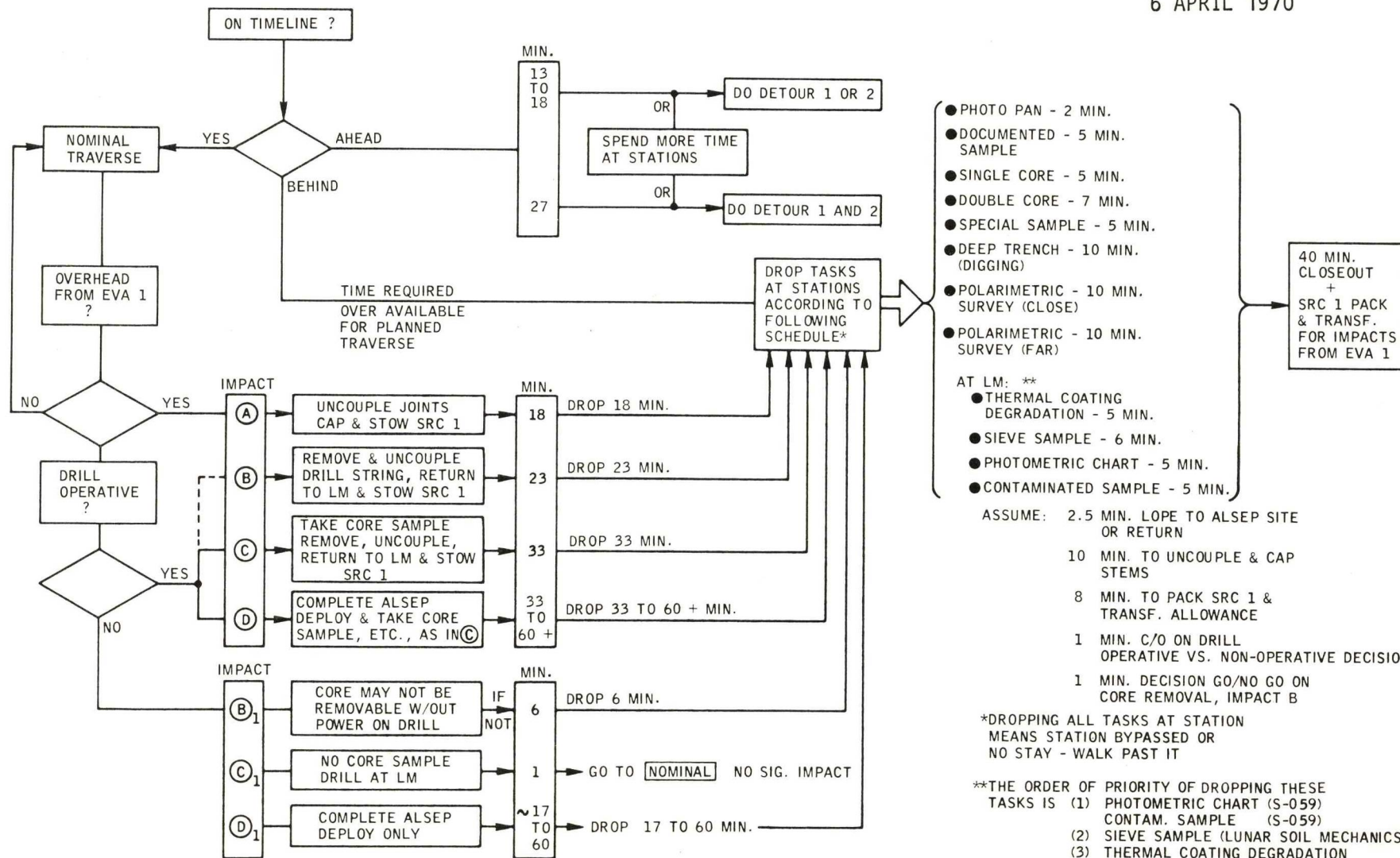
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4.4 OFF-NOMINAL EVA PLANNING CHART EVA 2

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119A



4.3.1 Off-nominal Closeout Detail Procedures

Pages 119C through 119K present detail closeout procedures for both 35 minute closeouts, the 30-minute closeout, plus a minimum time closeout. All but the last are identified in Figure 4-4, EVA 1. An option exists on the 35 minute closeout to either take the tote bag into the ascent stage without unloading anything into the SRC, or leave the tote bag on the surface until the second EVA. More than likely, the second option would be exercised only if the tote bags were nearly empty. Note that one tote bag is emptied into the other (nominally the CDR's) prior to transfer into the LM.

MISSION: 13 35 MINUTE OFF NOMINAL CLOSEOUT
EVA: 1 NO OFFLOAD TOTE BAG TO SRC

DATE: 6 APRIL 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	SEQ. CAM.	TASK FUNCTION	
				L M P	C D R
SRC 1 PACK	0	SRC 1 PACK			
PLACE HTC AT MESA		TAKE LMP TOTE BAG AND			
TAKE CDR TOTE BAG AND		PLACE ON FOOTPAD			
PLACE ON FOOT PAD		STOW CORE STEMS IN SRC			
STOW CAMERAS MAGS &					
LENS IN ETB		REMOVE SRC SEAL PROTECTOR			
OFFLOAD SRC 2		PACK AND SEAL SRC			
PLACE ON +Y FOOTPAD LID DOWN					
SUN					
RETRIEVE S-BAND COVER &		PULL DRAW STRING TO CLOSE TOTE			
PLACE OVER SRC 2		BAGS AND VELCRO FLAP.			
		TOTE BAGS ON FOOTPAD			
TONGS IN HTC					
REMOVE DUST BRUSH (MESA)		CHECK CONTENTS OF ETB & CLOSE			
& ASSEMBLE	10				
CLEAN CDR EMU		CLEAN LMP EMU			
ASCENT TO PLATFORM					
INGRESS		GUIDE LMP INGRESS			
RAISE EV VISOR					
HOOK UP LEC					
CHECK EMU & LM SYSTEMS		ETB TRANSFER			
PULL ETB INTO LM					
REMOVE ETB FROM LEC					
STOW ETB	20	TRANSFER HOOKS TO SURFACE			
		LEC HOOK-UP TO TOTE BAG			

EVA:

NO OFFLOAD TOTE BAG TO SRC

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LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES
PULL TOTE BAG INTO LM STOW TOTE BAG	20	TRANSFER TOTE BAG TO LM TRANSFER HOOKS TO SURFACE LEC HOOK-UP TO TOTE BAG
PULL TOTE BAG INTO LM STOW TOTE BAG	25	TRANSFER TOTE TAB TO LM TRANSFER LEC HOOK TO SURFACE
PULL SRC INTO LM REMOVE SRC FROM LEC		ATTACH LEC TO SRC TRANSFER SRC INTO LM RECONFIGURE TV PLACE TONGS IN HTC & HTC IN SUN
STOW SRC ON ENG COVER END UP	30	RECLEAN EMU - BRUSH ON MESA
PASS LEC TO CDR		ASCEND TO PLATFORM STOW LEC ON PLATFORM (HANG UP ON PLAT-RAIL)
CLOSE HATCH		INGRESS RAISE EV VISOR REPRESSURIZE CABIN
	35	END 1ST EVA

MISSION: 13 35 MIN OFF NOMINAL CLOSEOUT
 EVA: 1 NO TOTE BAG TRANSFER

REVISION A
 DATE: 6 APRIL 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	S E Q C A M.	TASK FUNCTION	
				L M P	C D R
SRC 1 PACK		SRC 1 PACK			
PLACE HTC AT MESA					
TAKE CDR TOTE BAG AND HOLD FOR OFFLOAD		OFFLOAD TOTE BAG TRANSFER CONTENTS TO WEIGHT BAG ON SCALE			
STOW CAMERAS MAGS & LENS IN ETB		STOW CDR TOTE BAG ON FOOTPAD			
OFFLOAD SRC 2		TAKE LMP TOTE BAG & OFF LOAD SELECTED SAMPLES INTO WEIGH BAG (USE 2nd WEIGH BAG AS REQUIRED)			
PLACE ON +Y FOOTPAD LID DOWN SUN					
RETRIEVE S-BAND COVER & PLACE OVER SRC 2		HANG LMP TOTE BAG ON MESA			
		SEAL & STOW WEIGH BAGS IN SRC			
PLACE RESIDUAL SAMPLES IN CDR TOTE BAG					
		STOW CORE STEMS SRC			
CHECK ETB LOAD	10	REMOVE SRC SEAL PROTECTOR			
		PACK AND SEAL SRC			
TONGS IN HTC					
REMOVE DUST BRUSH (MESA) & ASSEMBLE		CHECK CONTENTS OF ETB & CLOSE			
CLEAN CDR EMU					
		CLEAN LMP EMU			
ASCEND TO PLATFORM					
INGRESS		GUIDE LMP INGRESS			
RAISE EV VISOR HOOK UP LEC					
CHECK EMU & LM SYSTEMS	20				

MISSION: 35 MINUTE OFF NOMINAL CLOSEOUT
 EVA: NO TOTE BAG TRANSFER

REVISION A
 DATE: 6 APRIL 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	S E Q C A M	TASK FUNCTION	
				L M P	C D R
PULL ETB INTO LM		ETB TRANSFER			
REMOVE ETB FROM LEC					
STOW ETB		TRANSFER LEC HOOK TO SURFACE			
		ATTACH LEC TO SRC			
PULL SRC INTO LM		TRANSFER SRC INTO LM			
REMOVE SRC FROM LEC		RECONFIGURE TV			
STOW SRC ON ENG COVER	30	PLACE TONGS IN HTC & HTC IN SUN			
END UP		RECLEAN EMU - BRUSH ON MESA			
PASS LEC TO CDR		ASCEND TO PLATFORM			
		STOW LEC ON PLATFORM (HANG UP ON PLAT-RAIL)			
CLOSE HATCH		INGRESS			
		RAISE EV VISOR			
		REPRESSURIZE CABIN			
	35	END 1ST EVA			

MISSION: 13
EVA: 1

30 MIN OFF NOMINAL CLOSEOUT

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LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	S E Q C A M	TASK FUNCTION	
				L M P	C D R
PLACE HTC AT MESA	0				
TAKE CDR TOTE BAG AND HOLD FOR OFFLOAD LMP TOTE BAG		TAKE OFF LMP TOTE BAG AND DUMP CONTENTS			
STOW CAMERAS MAGS & LENS IN ETB		PULL DRAW STRING TO CLOSE BAG AND VELCRO FLAP TOTE BAG ON FOOTPAD			
OFFLOAD SRC 2					
PLACE ON +Y FOOTPAD LID DOWN SUN		HANG LMP TOTE BAG ON MESA			
RETRIEVE S-BAND COVER & PLACE OVER SRC 2		PLACE SRC 2 IN SUN, LID OPEN, ON S-BAND COVER OR AS CAP COMM DIRECTS			
ASSIST CDR		PLACE DRILL (IF RETURNED) IN CONFIG. AS CAP COMM DIRECTS			
TONGS IN HTC		CHECK CONTENTS OF ETB & CLOSE			
REMOVE DUST BRUSH (MESA) & ASSEMBLE	10				
CLEAN CDR EMU		CLEAN LMP EMU			
ASCEND TO PLATFORM		GUIDE LMP INGRESS			
INGRESS					
RAISE EV VISOR HOOP UP LEC					
CHECK EMU & LM SYSTEMS					
PULL ETB INTO LM		ETB TRANSFER			
REMOVE ETB FROM LEC					
	20				

DATE: REVISION A
6 APRIL 1970

LMP ACTIVITIES		EVA TIME	CDR ACTIVITIES	S E C O N D A R Y	TASK FUNCTION	
					L M P	C D R
STOW ETB		20	TRANSFER HOOKS TO SURFACE LEC HOOKUP TO TOTE BAG			
PULL TOTE BAG INTO LM STOW TOTE BAG			TRANSFER TOTE BAG TO LM			
			RECONFIGURE TV PLACE TONGS IN HTC & HTC IN SUN RECLEAN EMU - BRUSH ON MESA			
PASS LEC TO CDT			ASCEND TO PLATFORM			
			STOW LEC ON PLATFORM (HANG UP ON PLAT-RAIL)			
CLOSE HATCH			INGRESS RAISE EV VISOR REPRESSURIZE CABIN			
		30	END 1ST EVA			

MISSION: 13
EVA:

OFF-NOMINAL RAPID CLOSEOUT

REVISION A
DATE: 6 April 1970

LMP ACTIVITIES	EVA TIME	CDR ACTIVITIES	S E Q C A M.	TASK FUNCTION	
				L M P	C D R
MOVE TO MESA AREA CAP TV RELEASE TOTE BAG	0	MOVE TO MESA AREA RELEASE TOTE BAG			
PLACE SRC'S IN SUN ON OR NEAR +Y PAD		CAMERAS IN TOTE BAG LEAST FULL			
		CLOSE & HOOK BAGS TO LEC			
CLEAN EMU		CLEAN EMU			
ASCEND TO PLATFORM		READY LEC			
		AID INGRESS			
INGRESS					
HOOK UP LEC					
TRANSFER TOTE BAGS INTO ASCENT STAGE		TRANSFER TOTE BAGS INTO ASCENT STAGE			
	10				
STOW TOTE BAGS ASC, ENG. COVER		ASCEND TO PLATFORM			
PASS LEC TO CDR		HANG UP LEC			
		INGRESS			
CLOSE HATCH					
REPRESS		REPRESS			
END EVA	18	END EVA			
NOTE: IF TIME DOES NOT PERMIT TOTE BAG TRANSFER, ELIMINATE & SHORTEN TO ~ 13 MINUTES.					

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