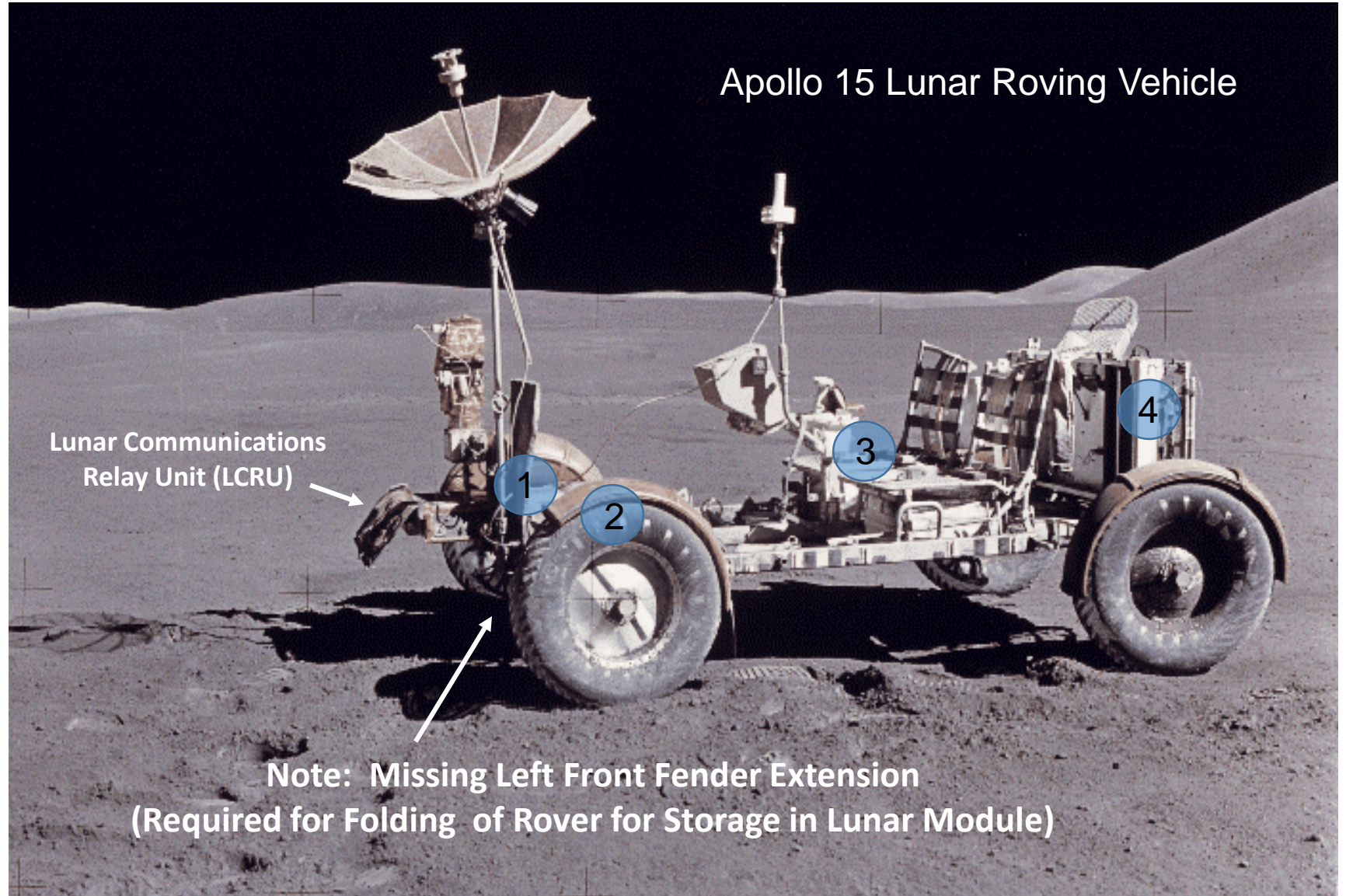


# Lunar Dust Protection for Apollo Rover Mechanisms

Ron Creel - Lead for LSIC Dust Mitigation "Isolation Technologies" Subgroup



Apollo 15 Lunar Roving Vehicle

1 - Forward Chassis

2 - Mobility Subsystems

3 - Crew Station

4 - Aft Pallet

Lunar Communications  
Relay Unit (LCRU)

Note: Missing Left Front Fender Extension  
(Required for Folding of Rover for Storage in Lunar Module)

# 1 - Forward Chassis Dust Protection



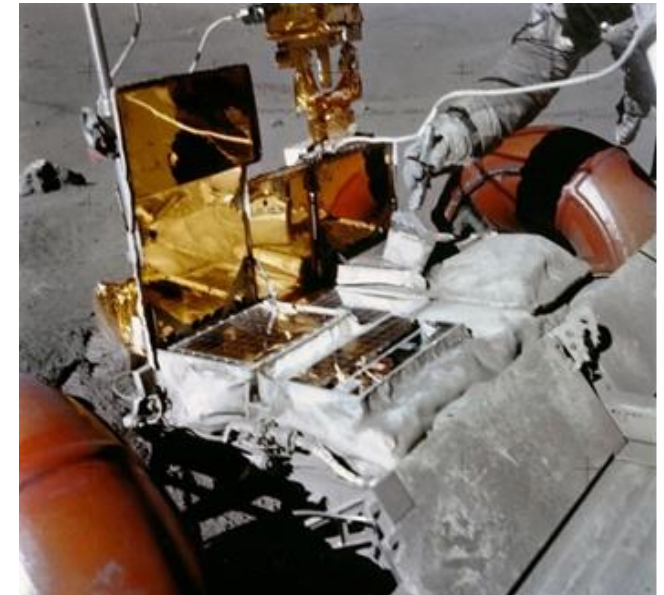
Kevlar Shield to Protect Rover from LM Lander Stirred Up Dust



Astronauts Lowered Protective Shield and Unfolded the Rover from LM Lander



Lunar Dust Brush



Astronaut Brushing Dust from LRV Thermal Radiators

Misleading Pre-Apollo 15 Earth TVAC Testing at the Manned Spacecraft Center, Using Apollo 12 Soil and Much Higher Pressure ( $10^{-6}$  Torr), Predicted Brushing Could Be Used on the Moon to Effectively Clean Thermal Control Surfaces and Crew Suits

Extensive Dust Cleaning Regrettably Did NOT Work on the Moon with Much Lower Environmental Pressure of  $10^{-12}$  Torr

## 2 - Mobility Subsystems Dust Protection

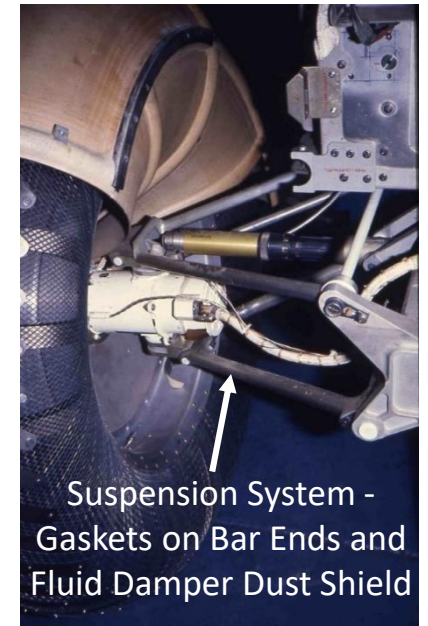
Right Rear Fender Extensions  
Knocked Off on Apollo 16 and 17



Post Mission - LRV Mission Support  
Team Presented Signed Fender  
Extension to the Apollo 17 Crew



Apollo 17 Fender Extensions Displayed at Cosmosphere Museum



Suspension System -  
Gaskets on Bar Ends and  
Fluid Damper Dust Shield

QTY	UNIT	DESCRIPTION	PART NUMBER	DESCRIPTION	SPECIFICATION
1			7553021-501	DRIVE - INSEP ASSY	
1			7553080-501	COVER - INSEP ASSY	
4	4	4	7553020-002	WASHER, CUP	
4	4	4	7553020-001	WASHER, CUP	
2	2	2	7553091-501	SPRING - INSEP ASSY	
8	8	8	7553066-001	BOOT, DUST SEAL	
1	1	1	7553195-001	BEARING SEGMENT	
1	1	1	7553078-001	SHIELD, DUST	
1	1	1	7553097-001	RIM, WHEEL	
2	2	2	7553123-001	PLATE, DECOUPLING	
1	1	1	7553022-001	SPACER	
1	1	1	7553093-001	RETAINER, BEARING	
2	2	2	7553119-001	PIN, HINGE	
2	2	2	7553085-001	PIN	
1	1	1	7553083-001	ARM, BRAKE	
1	1	1	7553033-501	BRAKE ASSY	
1	1	1	7553032-001	HOUSING, BEARING	
1	1	1	7553033-501	HOUSING - INSEP ASSY	
1	1	1	7553093-001	HUB, WHEEL	

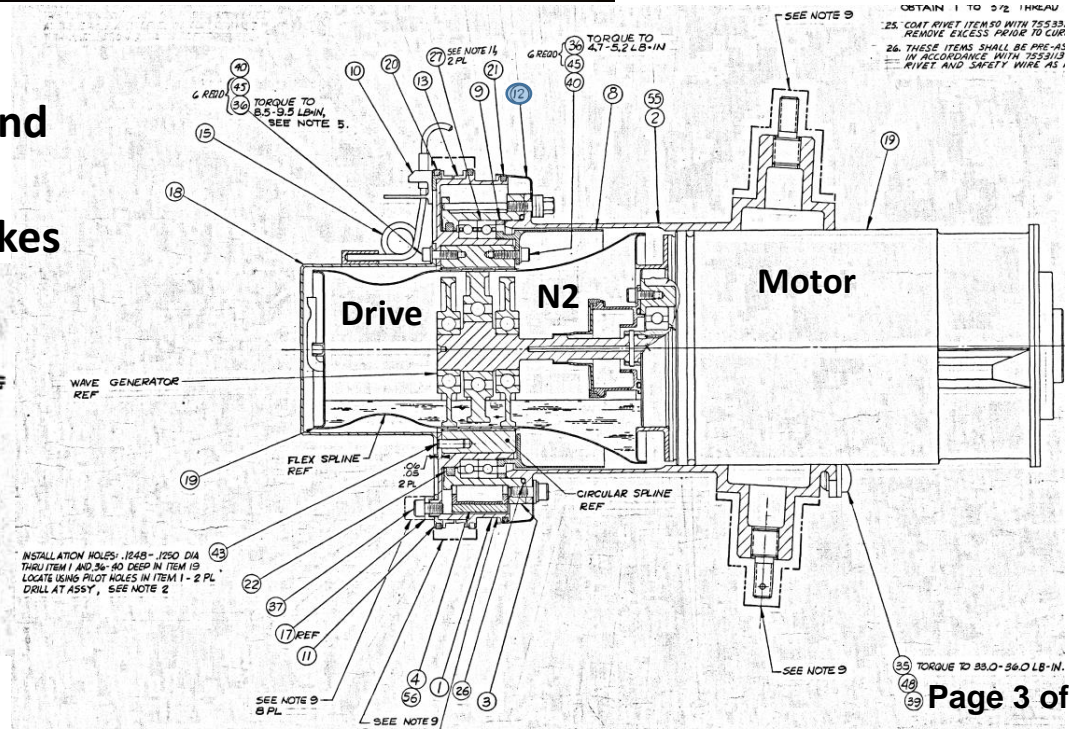
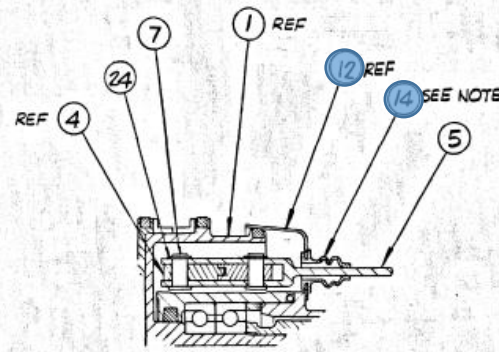
  

CONTR. NO.	DATE	BY	TITLE
AC ELECTRONICS	4/19/70	SW/20	TRACTION DRIVE ASSY, HARMONIC
DEFENSE RESEARCH LABORATORY	5-20-70	DR/20	
GENERAL MOTORS CORP.	5-25-70	DR/20	
SAINT MARYS, CALIF.			

SIZE	CODE	IDENT	DWG NO.	REV
E	13160		7553102	K

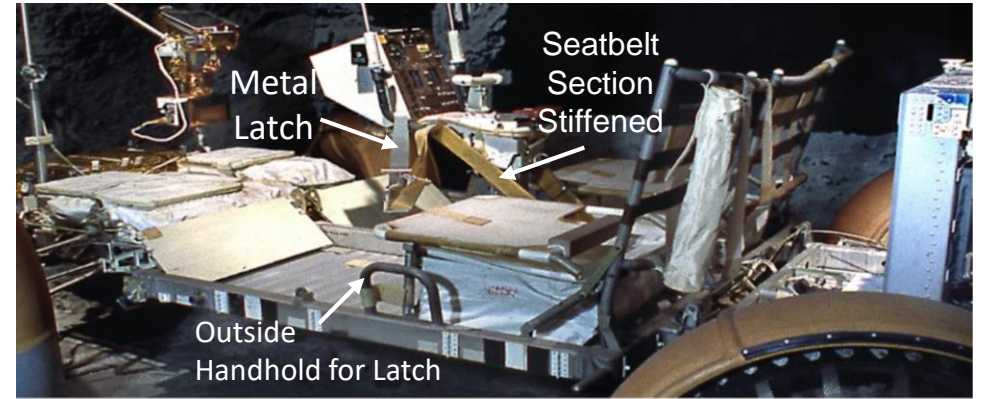
Sealed Motors/Drives and  
Dust Seals (14) and  
Dust Shields (12) for Brakes



### 3 - Crew Station Dust Protection

Commander Cernan Indicated that a 4<sup>th</sup> EVA was Not Possible Due to Dust Getting into Aft Pallet Swing Arm Hinges and Other Mechanisms

Lunar Module Pilot Schmitt encountered some difficulty in operating the Sun Shade of the Lunar Extravehicular Visor Assembly because of lunar dust in the slide mechanism

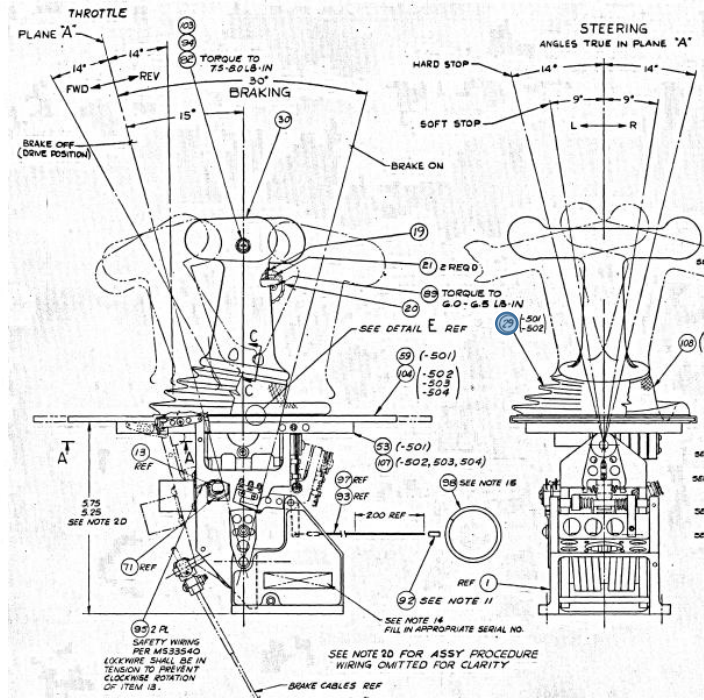
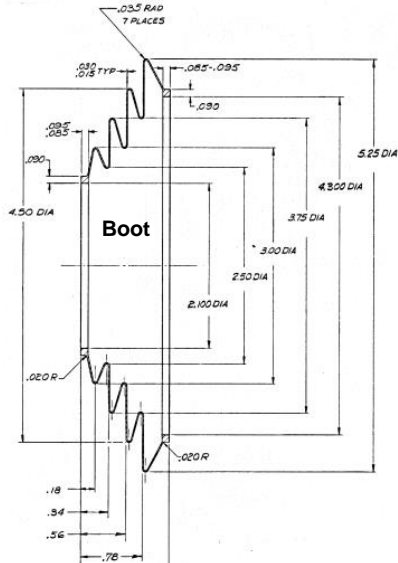
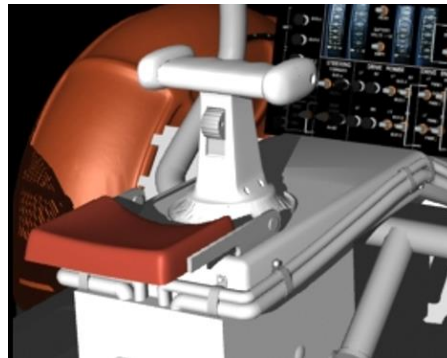


KC-135 Testing Required for "1/6 G" Seatbelt Redesign



Sample Return Container Seals Were Also Compromised on All LRV Missions

THE PART NUMBER IS THE DRAWING NUMBER AND THE DASH NUMBER THAT APPLIES		CONTR. NO.		AC ELECTRONICS	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON		7553446		DEFENSE RESEARCH LABORATORIES	
2 PLACE DECIMALS	3 PLACE ANGLES	CHECKER	TITLE	GENERAL MOTORS CORP. SANTA BARBARA, CA, U.S.A.	
± — ± — ± 2°		ENGR	HAND CONTROLLER ASSEMBLY		
MATERIAL AS NOTED		APPR			
REF (AC-ORL)	CHG CONTROL	DSGN/ACTIVITY	APPR	SIZE	CODE IDENT
7553105	EIR/ECO			E	13160
OTHER APPROVAL				DWG NO.	REV
				7553447	E
				SCALE 1/1	WEIGHT
				SHEET 1 OF 4	

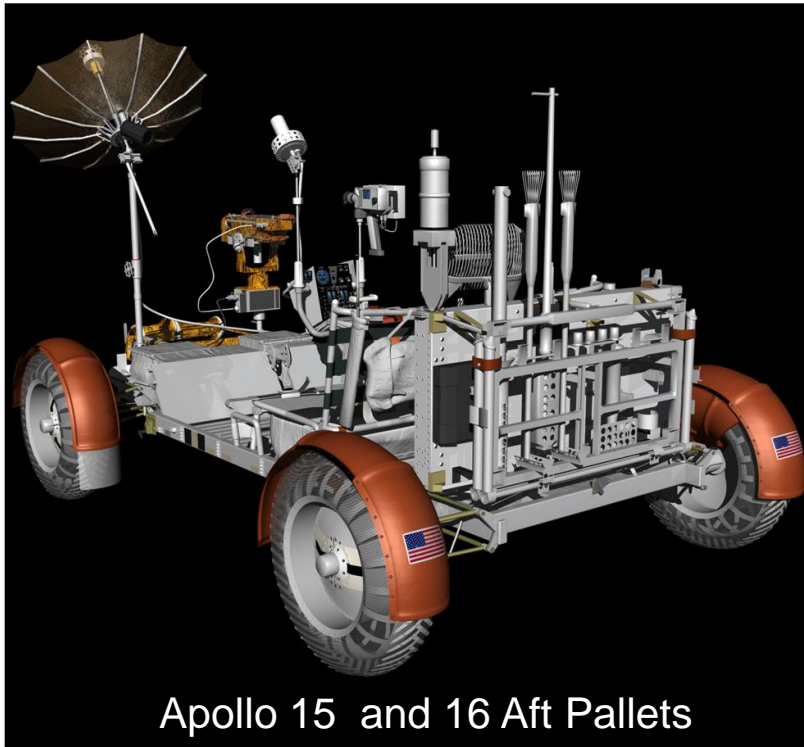


1	1	1	1	38	7553467-001	SHAFT, PIVOT
1	1	1	1	31	7553290-001	PIN, THREADED
1	1	1	1	50	7553507-001	GRIP, HAND
-	-	1	1	29	7553588-001	BOOT, DUST
2	2	2	2	28	7553446-001	RAD, BEARING
1	1	1	1	27	7553445-001	PIN, BRAKE CATCH
-	1	1	1	26	7553284-001	DETENT, THROTTLE
1	1	1	1	25	7553251-501	SWITCH BLOCK ASSY

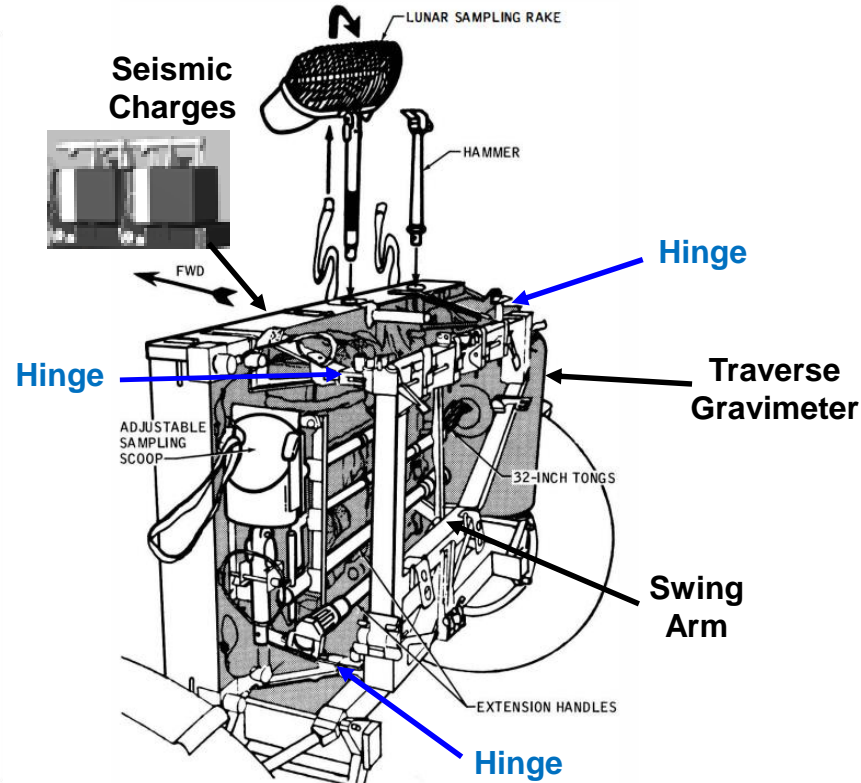
THE PART NUMBER IS THE DRAWING NUMBER AND THE DASH NUMBER THAT APPLIES		CONTR. NO.		AC ELECTRONICS	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON		7553288		DEFENSE RESEARCH LABORATORIES	
2 PLACE DECIMALS	3 PLACE ANGLES	CHECKER	TITLE	GENERAL MOTORS CORP. SANTA BARBARA, CA, U.S.A.	
± — ± — ± 2°		ENGR	BOOT, DUST AND MOISTURE SEAL		
MATERIAL SILICONE RUBBER PER 7552884-001		APPR			
REF (AC-ORL)	CHG CONTROL	DSGN/ACTIVITY	APPR	SIZE	CODE IDENT
				D	13160
OTHER APPROVAL				DWG NO.	REV
				7553288	A
				SCALE 2/1	WEIGHT
				SHEET 1 OF 1	

# 4 - Aft Pallet Dust Protection (Limited)

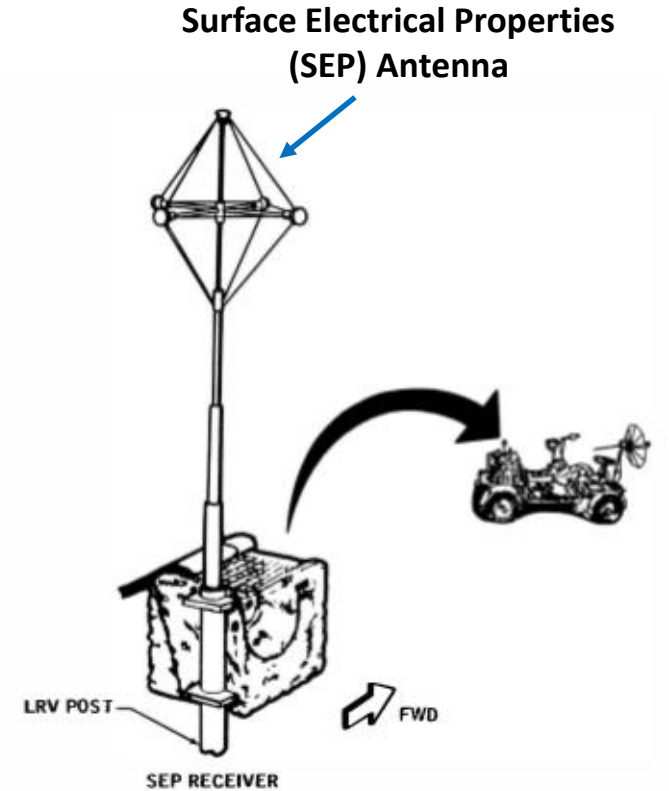
## Swing Arm Hinges Failed to Close on All 3 Rovers after 3 EVAs



Apollo 15 and 16 Aft Pallets



Geological Tools on Apollo 17 Aft Pallet



SEP receiver. The receiver is mounted on the rear of the Rover. Data, measured while the Rover moves along a traverse, are also recorded automatically on a cassette tape recorder.

SEP Receiver Mounted on Apollo 17 Aft Pallet Front Side

# Questions?

