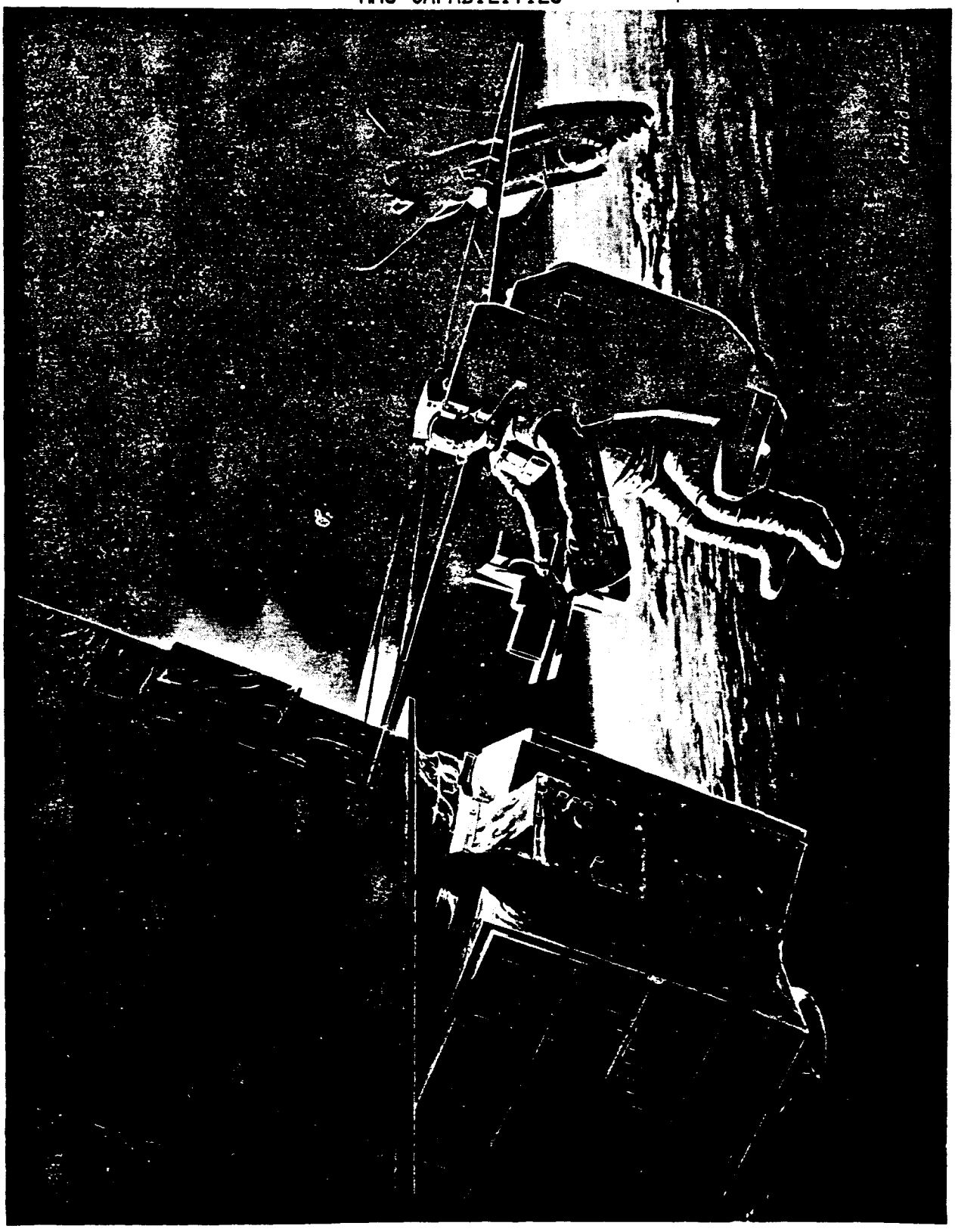
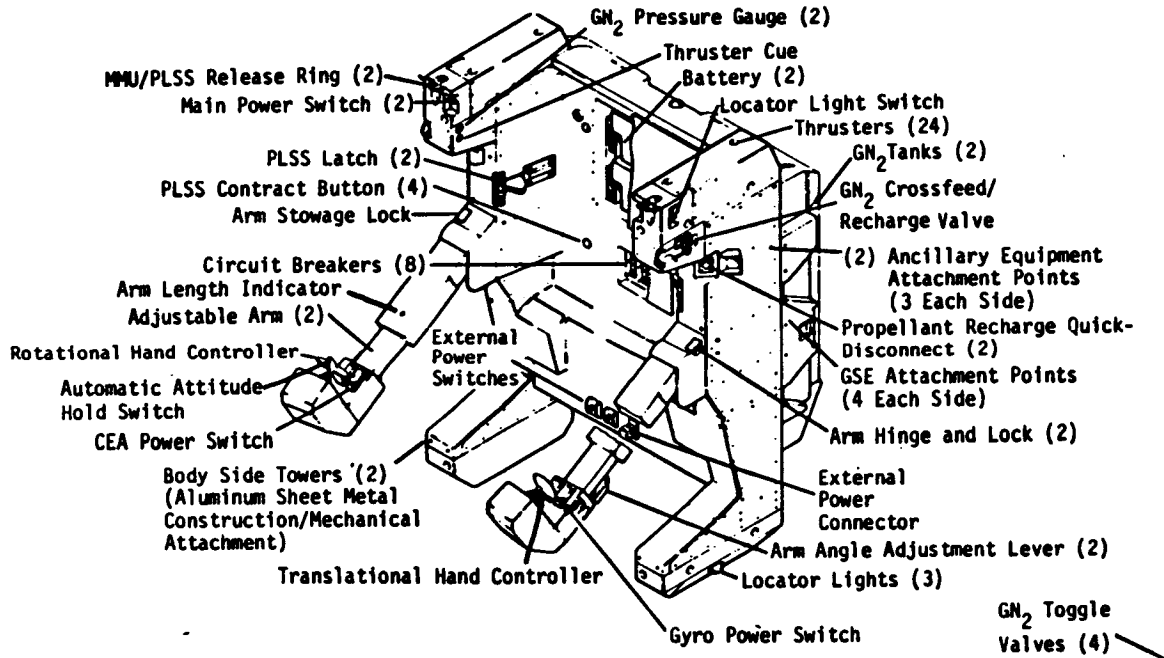
Fran Bergonz
Martin Marietta

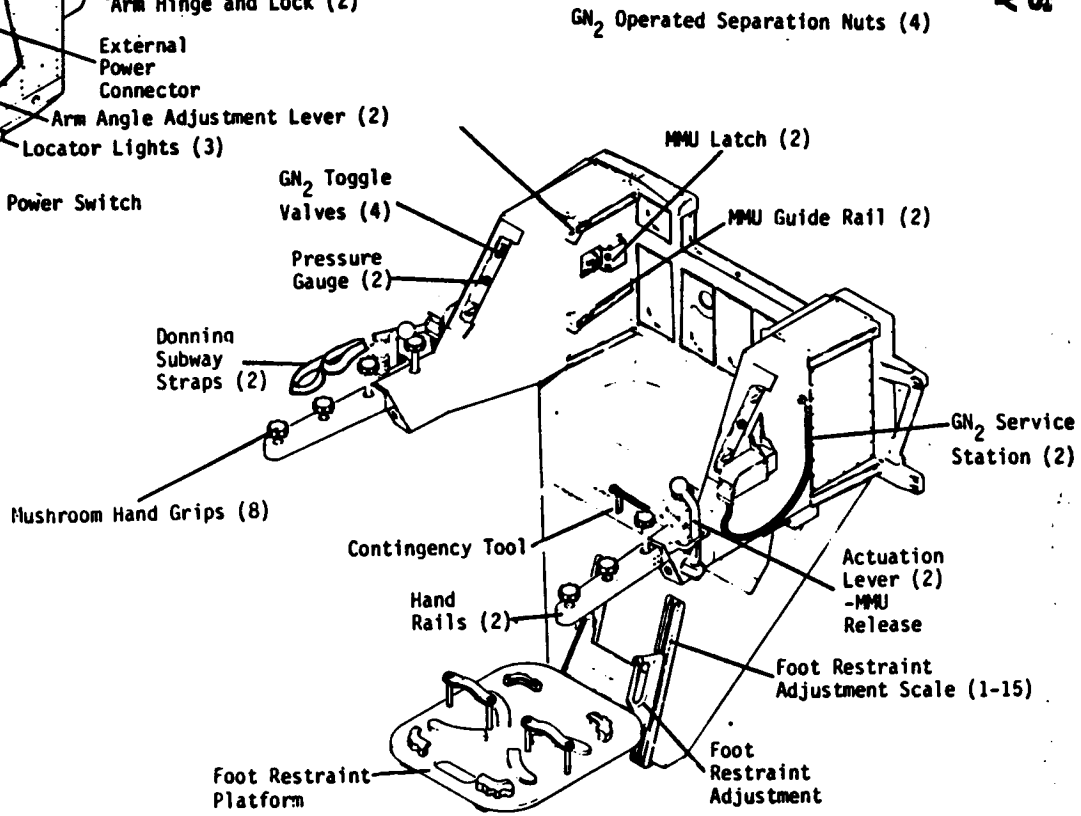
MANNED MANEUVERING UNIT

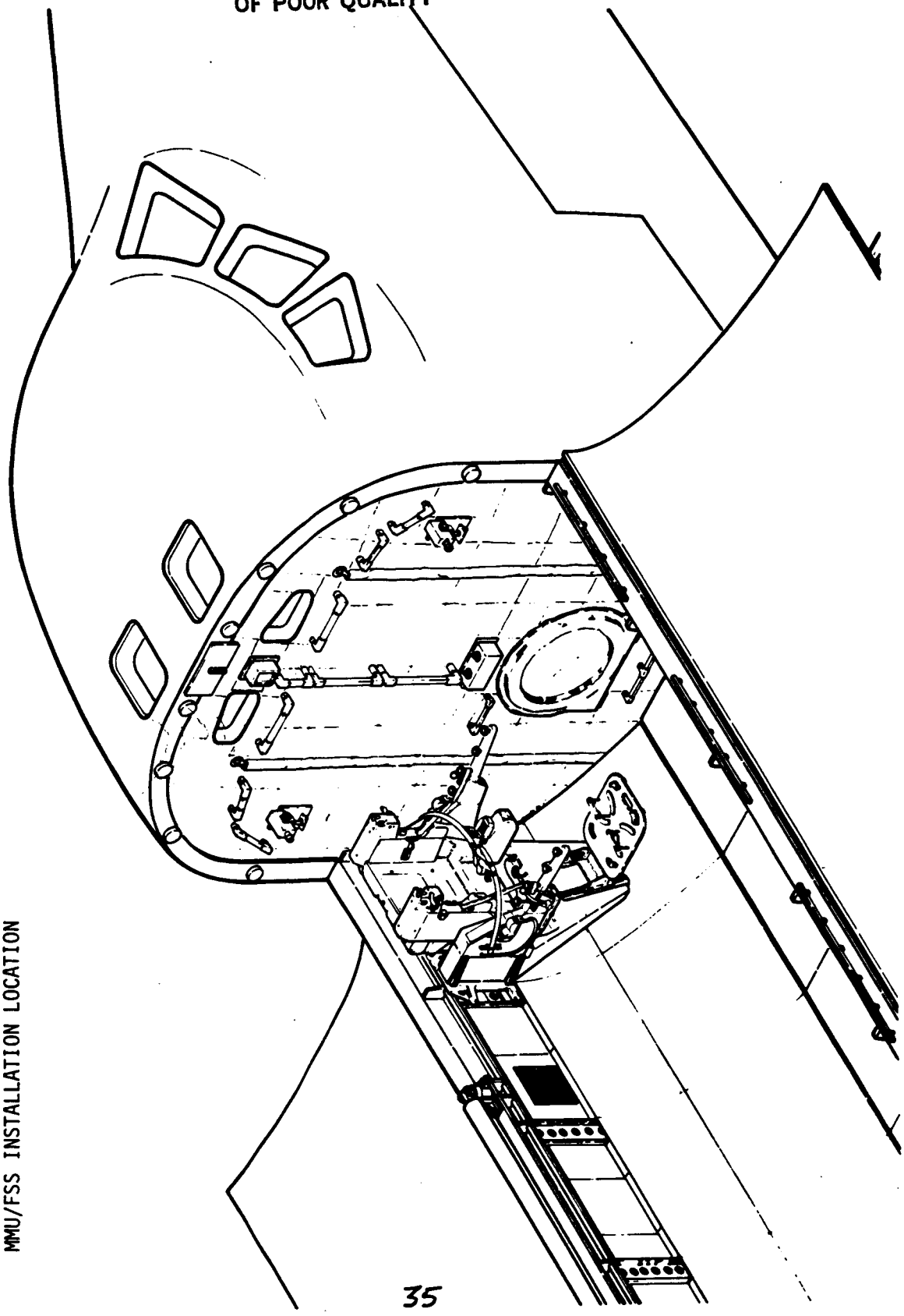
ORIGINAL PAGE
BLACK AND WHITE PHOTOGRAPH

MMU CAPABILITIES







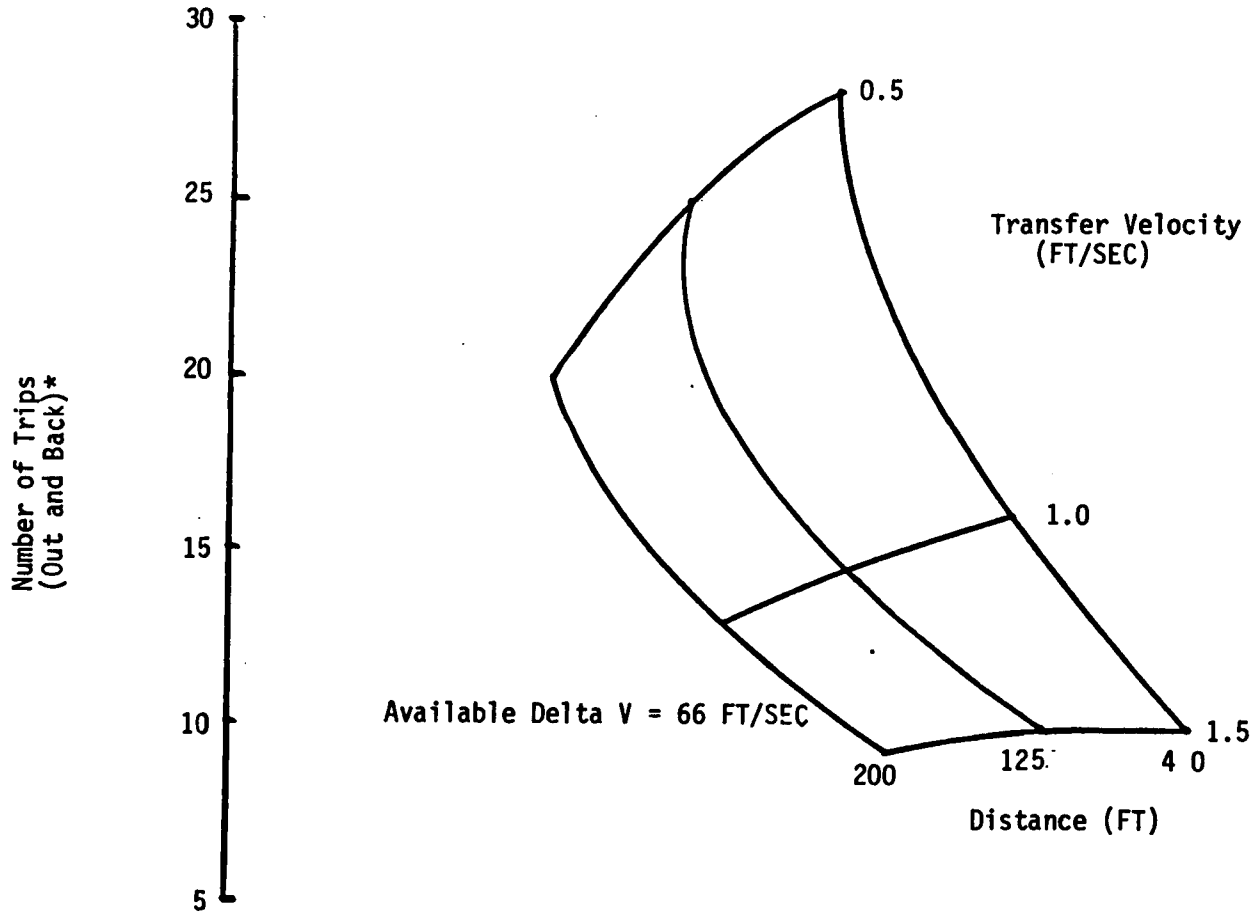


MMU/FSS INSTALLATION LOCATION

MMU PROPELLANT USAGE

- TANKS CHARGED WITH 26.2 POUNDS GN_2 FOR LAUNCH.
- AVAILABLE IMPULSE = 1593 LB-SEC.
- V = 66 FPS AT SYSTEM WEIGHT OF 755 LBS.
- AN ON-ORBIT RECHARGE PROVIDES UP TO 22.4 LBS GN_2.
- 1593 LB-SEC IMPULSE = 234 SEC OF TRANSLATIONAL COMMANDS
  (4 THRUSTERS FIRING)
  OR 468 SEC OF ROTATIONAL COMMANDS
  (2 THRUSTERS FIRING)
- ASSUMING 75% TRANSLATION, 25% ROTATION, A SINGLE CHARGE PROVIDES 267 SECONDS OF THRUST.
- FOR 300 MILLISECOND COMMANDS (SOS FLIGHT SIMULATIONS AVERAGE) THERE ARE 890 SEPARATE COMMANDS PER CHARGE.

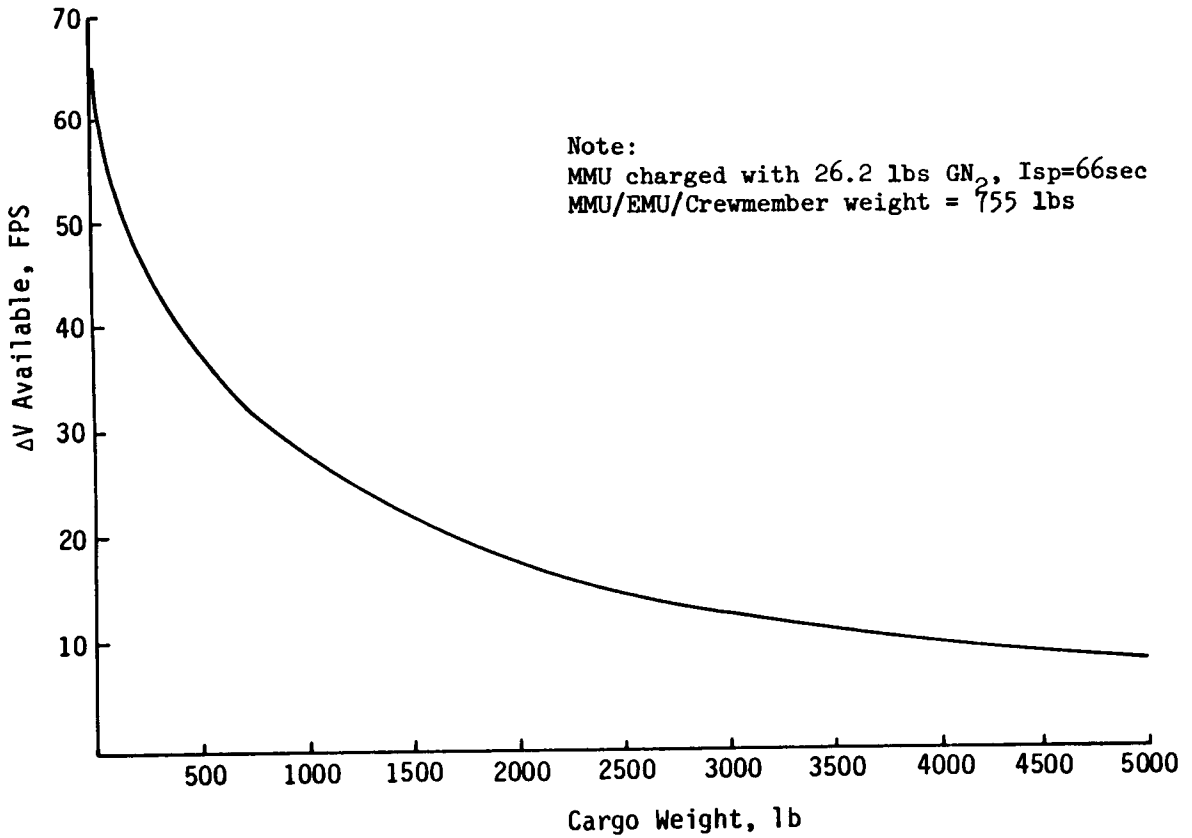
NUMBER OF ROUNDTRIPS VERSUS VELOCITY AND DISTANCE



* Assumes EVA crewmember does not depart from straightline path connecting the two endpoints by more than 3 feet.

MARTIN MARIETTA

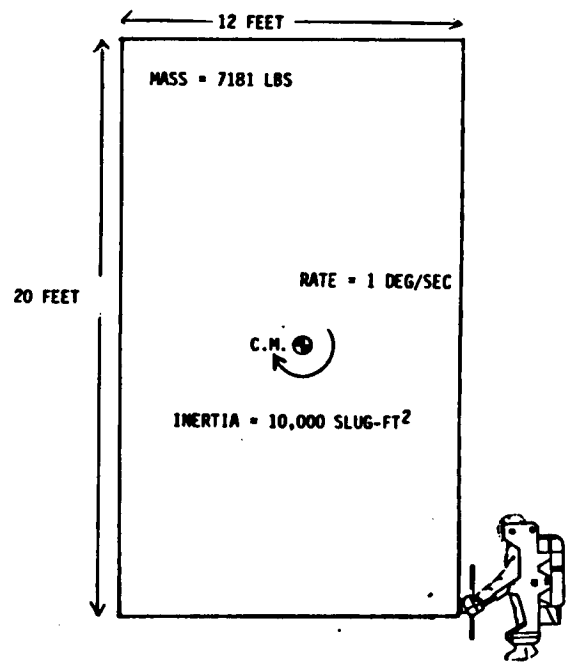
MMU DELTA V CAPABILITIES WITH LARGE CARGOES



MARTIN MARIETTA

ROTATIONAL MANEUVERS WITH LARGE CARGOES

RATE (DEG/S)	INERTIA (SLUG FT^2)	MOVEMENT ARM (FT)	REQUIRED IMPULSE (LB-SEC)	PERCENT FUEL USED
5	1,000	5	17.4	1.1
5	5,000	5	87.2	5.5
5	10,000	5	174.4	10.9
5	1,000	10	8.7	0.5
5	5,000	10	43.6	2.7
5	10,000	10	87.2	5.5
5	1,000	20	4.4	0.3
5	5,000	20	21.8	1.4
5	10,000	20	43.5	2.7
1	1,000	5	3.5	0.2
1	5,000	5	17.5	1.1
1	10,000	5	35.1	2.2
1	1,000	10	1.8	0.1
1	5,000	10	8.8	0.5
1	10,000	10	17.5	1.1
1	1,000	20	0.9	0.06
1	5,000	20	4.5	0.3
1	10,000	20	9.0	0.6



$$\text{IMPULSE} = \frac{\text{RATE (RAD/S)} \times \text{INERTIA}}{\text{MOMENT ARM}}$$

A 7181 POUND CYLINDRICAL SATELLITE, DIAMETER 12 FEET, HEIGHT 20 FEET, ATTACHED TO THE MMU AS SHOWN WOULD RESULT IN A SYSTEM INERTIA OF 10,000 SLUG FT^2 IN THE MMU PITCH AXIS. THE IMPULSE REQUIRED TO INITIATE A 1 DEG/SEC ROTATION RATE IS 17.5 LB-SEC OR 1.1% OF THE USABLE PROPELLANT LOAD.

ANCILLARY EQUIPMENT ATTACHMENT INTERFACE

- BALL FITTINGS ON INSIDE END OF CONTROL ARMS.
- MATING PART IS "TRAILER HITCH" TYPE LATCH.
- ATTACHMENT MADE BY PULLING LATCH ASSEMBLIES OVER BALL FITTINGS.
- DISENGAGED BY SIMPLE HAND LEVERS, EACH SIDE.

SATELLITE ATTACHMENT DEVICE

- ATTACHES TO MMU AT CONTROL ARM BALL FITTINGS.

- HARD CONTACT WITH SPACECRAFT TRUNNION FITTING CAUSES SPRING LOADED PADS TO GRASP EXTERIOR OF FITTING WHILE SIMULTANEOUSLY SENDING THREADED INSERT INTO INTERIOR OF FITTING.

- CREWMEMBER TURNS RATCHET HANDLE TO EXPAND INSERT TO FIT SNUGLY AGAINST INSIDE OF FITTING.

- AFTER SPACECRAFT RATES HAVE BEEN NULLED, MMU IS DISENGAGED FROM TRUNNION, LEAVING RMS GRAPPLE FIXTURE.

- SHUTTLE RMS ATTACHES TO GRAPPLE FIXTURE FOR SPACECRAFT BERTHING IN THE CARGO BAY.

SMALL PAYLOAD MANEUVERING SYSTEM (SPMS)

- o SMALL FREE FLIER BERTHED IN PAYLOAD BAY, CONTROLLED FROM AFT CREW STATION.
- o SUPPORTS SHUTTLE PROXIMITY PAYLOAD SERVICE OPERATIONS.
- o CAN BE LAUNCHED WITH PAYLOADS UP TO 800 POUNDS.
- o SYSTEM CHARACTERISTICS.
  - TV/TELEMETRY - MTV BASELINE
  - COLD GAS (GN2) PROPELLANT
  - ΔV - WITHOUT PAYLOAD, 340 FT/SEC
    - WITH 800 LB PAYLOAD, 140 FT/SEC
  - OPERATING RANGE - 10 MILES
  - CAN PROVIDE COMMAND, DATA, POWER, AND/OR PROPELLANT INTERFACES TO PAYLOAD
  - PROVIDES QUICK REACTION CAPABILITY FOR SMALL PAYLOADS

SPMS APPLICATIONS