SECTION 2

SUBSECTION 2.12

CREW PERSONAL EQUIPMENT

2.12.1 INTRODUCTION.

This section contains the description and operation of Contractor- and NASA-furnished crew personal equipment and miscellaneous stowed equipment that is not described in other sections of the handbook. All major items are identified as Contractor-furnished equipment (CFE) or Government-furnished (NASA) property (GFP - synonymous with GFE).

The crew equipment will be presented in the general order of operational usage. A brief outline is as follows:

A. Spacesuits (paragraph 2.12.2)
   1. Intravehicular Spacesuit Assembly
      (a) Biomedical Harness and Belt
      (b) Constant Wear Garment (CWG)
      (c) Flight Coveralls
      (d) Pressure Garment Assembly (PGA)
      (e) Associated Umbilicals, Adapters, and Equipment
   2. Extravehicular Spacesuit Assembly
      (a) Liquid-Cooled Garment (LCG)
      (b) PGA with Integrated Thermal Meteroid Garment (ITMG)
      (c) Associated Equipment

B. G-Load Restraints (paragraph 2.12.3)
   1. Crewman Restraint Harness
   2. Interior Handhold and Straps
   3. Hand Bar

C. Zero-g Restraints (paragraph 2.12.3)
   1. Rest Stations
   2. Velcro and Snap Restraint Areas
   3. Straps

D. Internal Sighting and Illumination Aids (paragraph 2.12.4)
   1. Window Shades
   2. Mirrors
   3. Crewman Optical Alignment Sight (COAS)
   4. LM Active Docking Target
   5. Window Markings
   6. Miscellaneous Aids

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E. External Sighting and Illumination Aids
   1. Exterior Spotlight
   2. Running Lights
   3. EVA Floodlight
   4. EVA Handles with RL Disks
   5. Rendezvous Beacon

F. Mission Operational Aids (paragraph 2.12.5)
   1. Flight Data File
   2. Inflight Toolset
   3. Cameras
   4. Accessories & Miscellaneous
      (a) Waste Bags
      (b) Pilot's Preference Kits (PPKs)
      (c) Fire Extinguishers
      (d) Oxygen Masks
      (e) Utility Outlets
      (f) Scientific Instrumentation Outlets

G. Crew Life Support (paragraph 2.12.6)
   1. Water
   2. Food
   3. The Galley System
   4. Waste Management System
   5. Personal Hygiene

H. Medical Supplies and Equipment (paragraph 2.12.7)

I. Radiation Monitoring and Measuring Equipment (paragraph 2.12.8)

J. Post Landing Recovery Aids (paragraph 2.12.9)
   1. Postlanding Ventilation Ducts
   2. Swimmer Umbilical and Dye Marker
   3. Recovery Beacon
   4. Snagging Line
   5. Seawater Pump
   6. Survival Kit

K. Equipment Stowage (paragraph 2.12.10)

On the following pages is an alphabetical listing of the stowable Apollo crew personal and miscellaneous equipment that will be described in this section. Miscellaneous spacecraft equipment that is mounted on spacecraft structure internally or externally is described in this section but is not listed in the following chart.

SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions L	Dimensions W	Dimensions H	Total Wt (Lb)	Wt Each (Lb)	Paragraph
Adapter, CWG electrical, w bag		X	4						2.12.2
Adapter, contingency feeding		X	1						2.12.6
Adapter, gas sep drying		X	1	1.5"					2.12.6
Adapter, urine hose to UCTA		X	1	5"	1"D				2.12.6
Bag, accessory		X	3				0.60	0.20	2.12.5
Bag, helmet stowage		X	3				0.99	0.33	2.12.2
Bag, PGA stowage	X		1	32"	18"	2"		4.3	2.12.2
Bag, gas separator	X		1	7"	4"	1.5"			2.12.6
Bags, temp stowage	X		3	36"	13"	1"	5.1	1.7	2.12.5
Bag, tunnel hatch	X		1		28"D				2.12.3
Battery, voice recorder		X	5	2.0"	1.8"	0.65"			2.12.5
Bracket, 16mm DAC	X		1	7"			0.7	0.7	2.12.5
Brush, vac cleaning		X	2	1.63"	1.8"D				2.12.5
Cable, aux dump nozzle htr	X		1	108"				0.2	2.12.6
Cable, grounding	X		1						2.12.5
Camera, 70 mm electric Hasselblad		X	1	5"	4"	5"		4.04	2.12.5
Camera, 16 mm data acquisition with power cable		X	1	7"	4"	2"		1.93	2.12.5
Cap, hose screen, w bag	X		3				1.00	0.20	2.12.2
Cap, gas sep nozzle		X	1	1"					2.12.6
Cap, aux dump nozzle pressure	X		1					0.20	2.12.6

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SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions L	Dimensions W	Dimensions H	Total Wt (Lb)	Wt Each (Lb)	Paragraph
Cassette, 70 mm camera film		X	*						
Clamps, UCTA		X	3				0.03	0.01	2.12.2
Cloth, dry cleansing		X	*	2"	2"				2.12.6
Cloth, wet cleansing		X		2"	2"				2.12.6
Communication cable w control head, w bag	X X		2 2	74" 121"			7.8 8.4	3.9 4.2	2.12.2 2.12.2
Communication carrier (snoopy helmet)		X	3						2.12.2
Coupling, oxygen hose w bag	X		3				1.1	0.2	2.12.2
Container, decontamination, CU cam cassette	X		1						2.12.5
Container, decontamination, LSR	X		1						2.12.5
Container, decontamination, LSR (rock box), large	X		1						2.12.5
Container, decontamination, 70 mm Hblad mag	X		1						2.12.5
Container, Frozen Food	X		1						2.12.6
Cover, meter		X	2		3"D				2.12.4
Cover, PGA elec conn protective		X	3						2.12.3
Coveralls, inflight		X	3				9.7	3.2	2.12.2
Diaphragm, w cover	X		3	3"	3"D				2.12.6
Dishes	X		3	6"	5"				2.12.6

*Refer to spacecraft stowage list

SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions L	Dimensions W	Dimensions H	Total Wt (Lb)	Wt Each (Lb)	Paragraph
Docking target, LM active	X		1	8"	8"			1.8	2.12.4
Dosimeters, passive		X	9				0.18	0.02	2.12.8
Dosimeters, personal		X	3				1.14	0.38	2.12.8
Ducts, postlanding ventilation (PLV) w bag	X		3				0.60	0.10	2.12.9
Eartube, universal		X	3				0.03	0.01	2.12.2
Exerciser, inflight		X	1					1.22	2.12.5
Eyepatch		X	1						2.12.4
Fecal collection assy	X		30	8"	3"	1"	4.20	0.14	2.12.6
Fecal containment system		X	3				1.50	0.50	2.12.2
Filter, red (Hblad cam)		X	1					0.05	2.12.5
Filter, high density sun		X	2				2.8	1.4	2.12.4
Filter, Photar (HEC cam)		X	1					0.05	2.12.5
Filter, QD gas & liq	X		2				1.0	0.5	2.12.6
Fire extinguisher	X		1	8.5"	5"D			7.5	2.12.5
Flight data file with locker R12	X	X	*					20.0	2.12.5
Food set		X	1					40.0	2.12.6
Food set, w hygiene items		X	1					30.8	2.12.6
Food warmer	X		1	10	6	7			2.12.6
Garment, constant wear (CWG)		X	6	Folded 12"	6"	2"	5.6	0.8	2.12.2

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*Refer to spacecraft stowage list

SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions L	Dimensions W	Dimensions H	Total Wt (Lb)	Wt Each (Lb)	Paragraph
Garment, liquid cooled		X	2				8.18	4.13	2.12.2
Glareshade, MDC	X		3						2.12.4
Glareshield, floodlight w bag		X	2						2.12.4
Gloves, IV (pr)		X	1						2.12.2
Handholds	X		2						2.12.3
Handbar	X		1						2.12.3
Hand straps	X		8						2.12.3
Harness, crewman restraint	X		3						2.12.3
Harness assy, bio-instrumentation		X	3				3.3	1.1	2.12.7
Headrest, pad		X	3				3.0	1.0	2.12.5
Headset, lightweight		X	3				0.9	0.3	2.12.2
Heel restraint, pr		X	3	4"	3.5	1"	3.3	1.0	2.12.5
Helmet, shield		X	1					0.79	2.12.2
Hook, line snagging w bag	X		1				1.7	1.5	2.12.9
▌ Hose, vac cleaning	X		1	41.5"					2.12.5
Hose assy, oxygen	X		2 1	72" 119"			10.6 8.2	5.3 8.2	2.12.2 2.12.2
▌ Hot pad	X		1	9"	4"				2.12.6
Hygiene, oral assembly		X	1				1.0	0.3	2.12.6
Intervalometer		X	1					0.25	2.12.5
Kit, EMU maintenance		X	1					0.38	2.12.2
Kit, medical		X	1	7"	5"	5"		3.0	2.12.7

SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions			Total Wt (Lb)	Wt Each (Lb)	Paragraph
				L	W	H			
Kit, pilot's preference		X	3				1.5	0.5	2.12.5
Lens, 5 mm (16 mm camera (with cover)		X	1					0.68	2.12.5
Lens, 18 mm (16 mm camera)		X	1					0.56	2.12.5
Lens, 18 mm Kern (16 mm cam)		X	1					0.44	2.12.5
Lens, 75 mm (16 mm camera)		X	1					0.53	2.12.5
Lens, 75 mm Kern (16 mm cam)		X	1					0.50	2.12.5
Lens, 250 mm (70 mm Hasselblad)		X	1	6.2"	3.1"	3.1"		2.10	2.12.5
Lens, 500 mm (70 mm (Hblad)		X	1	12.5"	3.5"				2.12.5
Life vest		X	3				7.5	2.5	2.12.2
Magazines, 70 mm camera film		X	*	3.82"	3.6"	1.86"		0.76	2.12.5
Magazines, lunar surface Hasselblad		X	1					1.75	2.12.5
Magazines, 16 mm DAC		X	*					0.97	2.12.5
Masks, oxygen w hose		X	3				3.60	1.20	2.12.5
Meter, radiation survey		X	1					1.60	2.12.8
Mirror assy, internal viewing	X		3	4.25"	3.5"				2.12.4
Mirror, 16 mm camera right angle		X	1					0.16	2.12.5
Monocular		X	1	8"				0.75	2.12.4

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*Refer to spacecraft stowage list

SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions			Total Wt (Lb)	Wt Each (Lb)	Paragraph
				L	W	H			
Mount, 70 mm Hblad		X	1	9"					2.12.5
Pencil		X	3				0.15	0.05	2.12.2
Penlights		X	6	7"	1.5"		2.04	0.34	2.12.2
Pen, marker		X	3				0.15	0.05	2.12.2
Pens, data recording		X	3				0.15	0.05	2.12.2
Pouch, food retainer		X	2						2.12.6
Pump, sea water	X		1					1.60	2.12.9
QD, aux dump nozzle	X		1	4"	1"D			0.20	2.12.6
QD, water (waste) panel	X		1	4.5"	1"D			0.30	2.12.6
Restraint, sleep station	X		3				10.8	3.6	2.12.3
Ring sight		X	1	1.26"	1.2"	0.64"	0.08		2.12.5
Rollon cuff assembly		X	3						2.12.6
Ropes, sleep restraint tiedown	X		5	10'	0.3"D		3.5	0.7	2.12.3
Scissors (large)		X	3	8"	2"		1.62	0.53	2.12.2
Separator, gas		X	2	6"					2.12.6
Shades, rendezvous window	X		2	13"	8"		2.4	1.2	2.12.4
Shade, side hatch	X		1		10"D			1.4	2.12.4
Shades, side viewing window	X		2	13"	13"		3.4	1.7	2.12.4
Sight, crew optical alignment (COAS) w filter	X		1	8"	2"D			1.5	2.12.4
Spacesuit, intra-vehicular		X	1					35.61	2.12.2

SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions L	Dimensions W	Dimensions H	Total Wt (Lb)	Wt Each (Lb)	Paragraph
Spacesuit, extra-vehicular		X	2				94.72	47.36	2.12.2
Spotmeter, automatic		X	1	7"	4"			0.94	2.12.5
Straps, utility	X		13	12"			0.39	0.03	2.12.3
Strap, center couch DPS burn	X		1					0.2	2.12.3
Straps, center couch stow	X		2						2.12.3
Straps, control cable	X		4	11"					2.12.3
Straps, drogue stow	X		3						2.12.3
Straps, glareshade	X		4	5.5"					2.12.3
Straps, probe stowage	X		2						2.12.3
Straps, cable routing	X		3	5.5"					2.12.3
Sunglasses with pouch		X	3				0.6	0.2	2.12.2
Survival rucksack 1		X	1	18"	6"	6"		34.9	2.12.9
Survival rucksack 2		X	1					18.8	2.12.9
Tape cassette, voice recorder		X	5	3.9"	25"	0.4"	0.5	0.1	2.12.5
Tape (roll)		X	1	6"D				0.88	2.12.5
Timer, two speed		X	1				0.4	0.4	2.12.5
Tissue dispensers		X	7	8"	4"	3"	3.9	1.42	2.12.6
Toolset, inflight	X		1					4.6	2.12.5
Towels, utility (pack)		X	3				2.49	0.83	2.12.6
Urine collection & transfer assembly		X	3				1.29	0.43	2.12.2
Urine hose		X	1	120"	1"D		1.30	1.30	2.12.6

SYSTEMS DATA

Item	CFE	GFP	Qty	Dimensions L	Dimensions W	Dimensions H	Total Wt (Lb)	Wt Each (Lb)	Paragraph
Urine transfer system (Gemini)		X	3	12"	9"	1"		1.3	2.12.6
Urine receptacle assy	X		1						2.12.6
Vacuum brush		X	2			1.63"			2.12.5
Vacuum hose	X		1	39"					2.12.5
Vacuum QD (cabin vent)	X		1	5"	1.5"D				2.12.6
Voice recorder		X	1	5.3"			1.2	1.2	2.12.5
Watch with watchband		X	3				0.45	0.15	2.12.2
Water metering dispenser		X	1	9"				1.5	2.12.6

2.12.2 SPACESUITS (Figure 2.12-1).

A spacesuit is an enclosed unit that provides a crewman with a life supporting atmosphere and protective apparel in a space environment. It will be considered in two conditions: intravehicular and extravehicular.

In the intravehicular condition, the apparel is called the intravehicular spacesuit and consists of the bioinstrumentation harness assembly, a constant wear garment (CWG), a pressure garment assembly (PGA) with intravehicular cover (IC), and associated equipment (contained on or within the spacesuit). The adapters and umbilical hoses that connect the spacesuit to the spacecraft systems are also described in this subsection.

In the extravehicular condition, the apparel is called the extravehicular mobility unit (EMU) and consists of a fecal containment system, a urine collection and transfer assembly (UCTA), the bioinstrumentation harness assembly, a liquid-cooled garment (LCG), communications soft hat, an extravehicular spacesuit, a portable life support system (PLSS), oxygen purge system (OPS), integrated thermal micrometeoroid garment (ITMG), an extravehicular visor assembly (EV visor), and associated equipment contained on or within the EMU. The PLSS and OPS will not be described in this handbook.

2.12.2.1 Spacesuit Assembly (Intravehicular).

The intravehicular spacesuit is depicted in figure 2.12-1. The intravehicular condition has two subconditions, unsuited and suited. In the unsuited condition or "shirtsleeve environment," the crewman breathes the oxygen in the spacecraft cabin and wears a bioinstrumentation harness, a communication soft hat for communication, a constant wear garment (CWG) for comfort, flight coveralls for warmth, and booties for zero-g restraint. A CWG adapter is used to connect the communications soft hat (CSH) and the bioinstrumentation harness signals to the communications cable. The comm cable attaches to connectors between panels 300 and 301 to complete the signal flow to the audio center.

In the suited condition, the crewman wears his bioinstrumentation harness, a communication soft hat, a CWG, a pressure garment assembly (PGA) with IC, and breathes oxygen within the garment. An oxygen hose assembly delivers the oxygen to the suit and returns it to the ECS. The comm cable connects directly to the PGA for telecommunications signal flow. In this condition there are two ECS modes of operation, ventilated and pressurized.

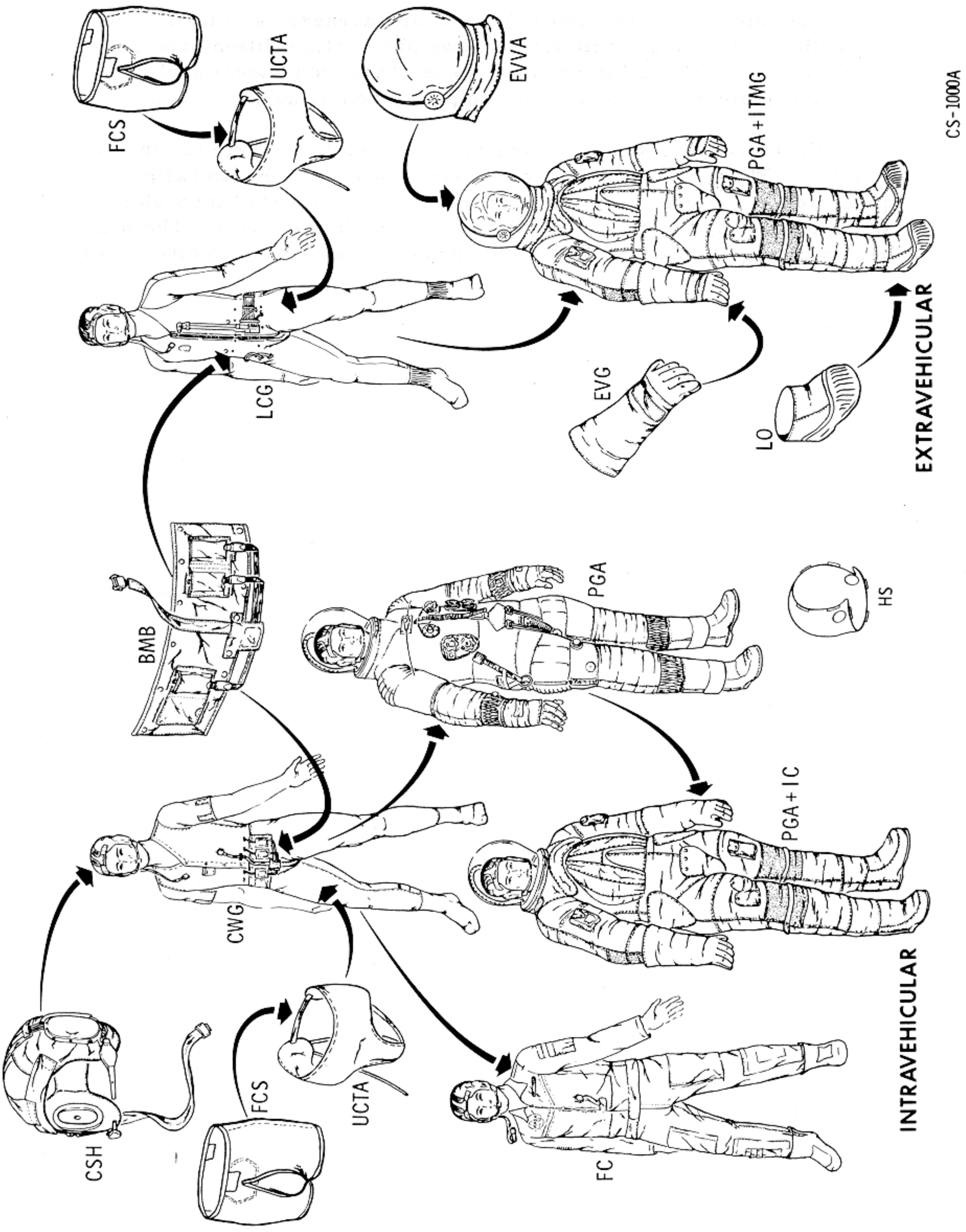

Figure 2.12-1. Spacesuits

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2.12.2.1.1 Bioinstrumentation Harness and Biomed Belt (Figure 2.12-2).

The purpose of the bioinstrumentation harness is to furnish the biomedical signals to monitor the crews physical condition, and consists of sensors, signal conditioners, a biomed belt, and wire signal carriers. For a complete description, refer to paragraph 2.12.7.

Each crewman will have sensors attached to his skin for the entire mission. These sensors have wire leads encased in plastic with a small connector at the other end. The connectors are inserted through the CWG and connected to the signal conditioners in the biomed belt. The biomed belt is cloth, has four pockets, and snaps in the corners to attach to the CWG.

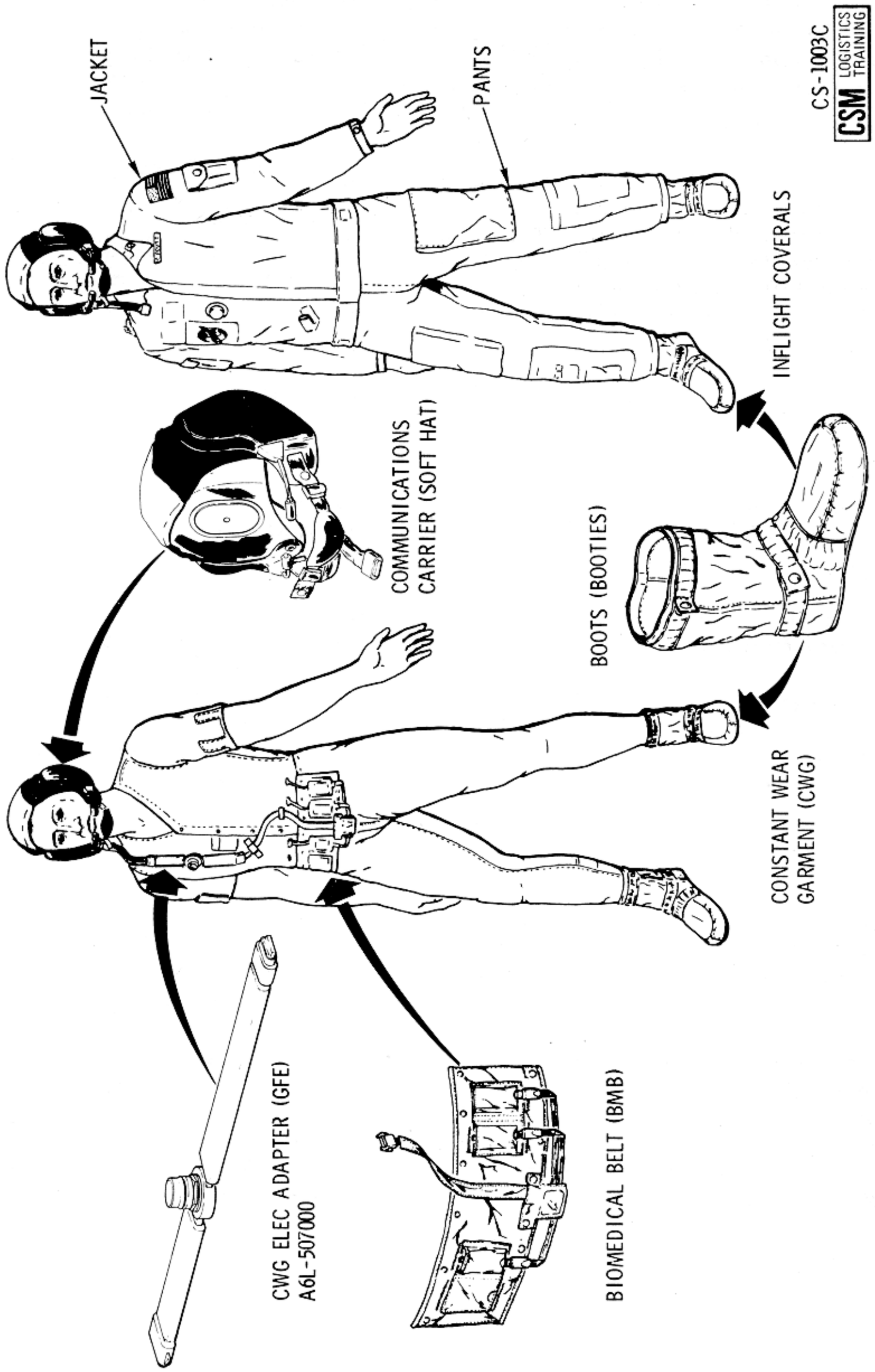

Figure 2.12-2. Shirtsleeve Environment Intravehicular Apparel

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There are three signal conditioners: one for ECG, one for the impedance pneumograph (ZP), and one dc-dc converter which fits into pockets on the biomed belt, located around the abdomen. The signal conditioners are interconnected by a wire harness which has a 9-socket connector.

2.12.2.1.2 Fecal Containment System (Figure 2.12-1).

The fecal containment system (FCS) is a chemically treated underpant worn under the LCG during periods of extravehicular activity (EVA). In the event of an uncontrolled bowel movement, the chemicals in the underpant will neutralize the feces. At launch and entry, the fecal containment systems are stowed.

2.12.2.1.3 Urine Collection and Transfer Assembly (Figure 2.12-1) and UCD Clamps

The urine collection and transfer assembly (UCTA) functions to transfer the urine from the suited crewman to the suit during emergency urinations. This condition could occur during a "hold" on the launch pad or EVA.

The UCTA consists of a belt, shaped bladder, roll-on (external catheter), and a tube leading to the spacesuit urine collection QD.

The UCTA is donned over the fecal containment system. When doffing the UCTA, the UCD clamps are used to seal urine in the tube to prevent leakage into the crew compartment. The urine in the UCTA can be drained while it is in the spacesuit or after it is removed. For the procedure, refer to section 2.12.6.

2.12.2.1.4 Constant Wear Garment (CWG) (Figure 2.12-2).

The constant wear garment (CWG) is used as an undergarment for the PGA and provides warmth for the crewman while unsuited in the shirtsleeve environment. As an additional purpose, this garment provides an attach point for the biomed belt.

The CWG is a porous cloth, one-piece garment similar to long underwear. It has a zipper from the waist to the neck for donning and doffing. An opening in front is for urination and one in the rear for defecation, without CWG removal. There are snaps at the mid-section to attach the biomed belt with signal conditioners, and pockets for film packet passive dosimeters at the ankles, thighs, and chest. It also has integral socks.

CPE

The CWG can be worn for 6 to 7 days before a change is required. Three CWGs will be worn aboard by the crew with three being stowed in a locker, allowing one CWG change each.

2.12.2.1.5 Flight Coveralls (Figure 2.12-2).

The flight coveralls help keep the CWG clean, provide additional crewman warmth, and provide stowage for miscellaneous personal equipment while in a shirtsleeve environment. It is a two-piece garment and is stowed at launch and entry. Accessories include a pair of booties with Velcro patches on the soles for restraint.

2.12.2.1.6 Communication Soft Hat, Lightweight Headset, and Eartube (Figure 2.12-2).

The communication soft hat is worn at all times, in or out of the PGA, for the purpose of communications. Alternate names for it is communications carrier (comm carrier) or "Snoopy" helmet.

The comm soft hat has two earphones and two microphones, with voice tubes on two mounts that fit over the ears. The hat or helmet is cloth and has lacing to adjust the fit to the individual crewman. A chin strap secures the hat to the head. A small pocket on the inside near the right temple will hold a passive dosimeter film packet. An electrical cable with a 21-socket connector will connect to the CWG adapter or PGA.

The lightweight headset is a single microphone and earpiece held on the head by a head band. It can be used in place of the comm carrier while in a shirtsleeve environment.

The universal ear tube attaches to the lightweight headset earphone. The ear tube is a short length of plastic tube with an ear fitting that conducts sound from the earphone to the ear. It is stowed in a pocket of the in-flight coverall.

2.12.2.1.7 Constant Wear Garment (CWG) "T" Adapter (Figure 2.12-2).

Communications and bioinstrumentation signals are transmitted to the communications cable by the CWG T-Adapter; it is used when in the shirtsleeve environment.

The CWG T-Adapter has a 61-socket connector pull in the middle, and two pigtails, one with a 9-pin connector and one with a 21-pin connector.

There are three CWG "T" Adapters which are stowed when not in use plus a spare.

2.12.2.1.8 Communications Cable With Control Head.

The communications cable, or comm cable, transmits voice communications and bioinstrumentation signals from the adapters and crew to the spacecraft bulkhead connectors. It also carries electrical power and the caution warning (C/W) system audible alarm signal.

The comm cable consists of a control head and a cable. The control head has a 61-pin connector, a rocker switch and a 37-pin connector. The cable has a 37-pin connector at one end and a 37-pin connector with a lanyard pull at the spacecraft bulkhead end. The cables for the Commander and CM Pilot are 74 inches long. The LM Pilot's cable is 121 inches in length, which allows it to be used for crew transfer through the tunnel into the LM. One spare control head and cable (121 inches) is carried in the event of a malfunction.

For further information and use of the comm cable, refer to AOH section 2.8.

2.12.2.1.9 Pressure Garment Assembly (PGA) (Figure 2.12-3).

The major component of the spacesuit is the pressure garment assembly (PGA). The A7L pressure garment assembly (PGA) provides a mobile life support chamber that can be pressurized separately from the cabin inner structure in case of a leak or puncture. The PGA consists of a helmet, gloves, and torso and limb assembly. It requires an oxygen hose for oxygen and electrical cable for telecommunications.

The blue torso has a neck ring for securing the helmet and wrist rings for securing the gloves. It is constructed of Beta cloth (a fiberglass-type material). A double zipper runs from the crotch area along the back to the neck ring for donning and doffing. Snaps are located on the upper chest for securing the life vest. The right wrist area has a pressure gage with a range of 2 to 5 psia. Two cables run laterally from the chest, around the biceps, to the spine as an anti-ballooning device, and are attached and detached at the chest. Two adjustment straps restraining the neck ring are located in the front (sternal area) and rear (spinal area).

On the right chest area is a 61-pin telecommunications connector. When not in use and during stowage, the connector is protected by a PGA electrical connector protective cover. The inside telecommunications harness splits to a 9-pin connector (bioinstrumentation) and a 21-pin connector (communications). On the left chest area is a connector for the PLSS liquid system. Inside, it has a supply hose and a return hose with connectors that connect to the liquid cooled garment (LCG) when worn in place of the CWG.

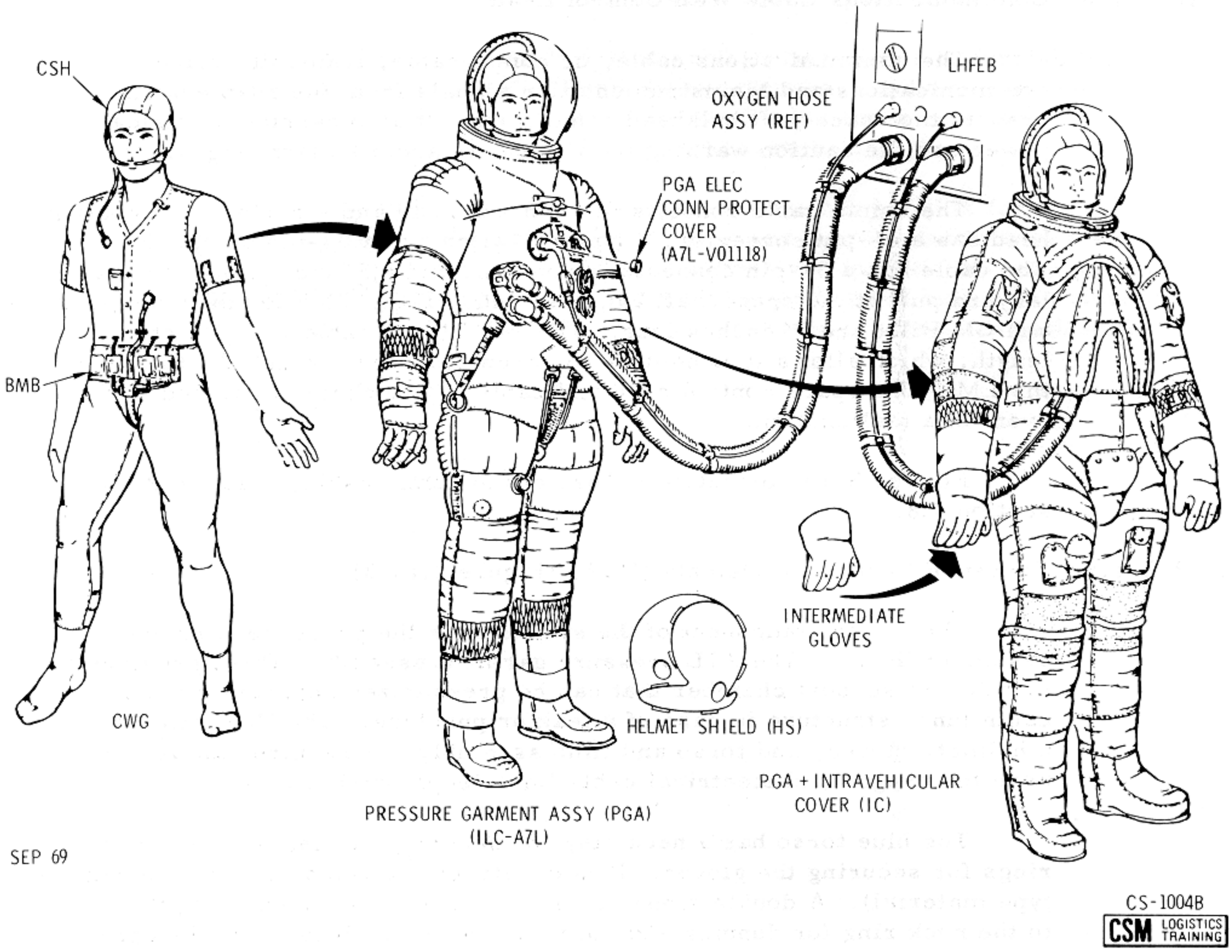

Figure 2.12-3. Intravehicular Spacesuit

Two sets of oxygen hose connectors are located on the left- and right-lower rib cage area. A set consists of a blue supply connector and red return connector. The left connector set is normally for the PLSS hoses and the right set for the CM ECS hoses, but the oxygen hose connectors will fit either set. To prevent an alien object from entering and damaging a spacesuit O_2 hose connector, a PGA gas connector plug (figure 2.12-3) is inserted when an O_2 connector is not in use. The gas connector plugs are color coded red and blue to match the O_2 connectors. To insert, fit the plug into the connector and press until it clicks. It mechanically locks in place. To remove, unlock the plug by pressing the

gold lockpin, then lift the locking tabs, rotate the locking ring, and pull the plug. The intravehicular PGA or spacesuit has only one set of hose connectors on the right side as there is no extravehicular or PLSS requirement.

Leg pockets are placed in accordance with the defined locations. These are used to contain the numerous personal items. Additional pockets are strapped on the legs to hold other miscellaneous items. The boots are integral to the torso and the soles have Velcro patches for restraint. The boot heels have partial steel plates to wedge in the couch footpan cleats for restraining the feet. The gloves secure to the wrist ring with a slide lock and rotate by means of a ball bearing race.

The intravehicular cover (IC) is for added wear protection of the torso. It is also Beta cloth, with external teflon patches at maximum wear points. The cover will be laced over the torso and limbs for operational use and intravehicular (IV) gloves will be worn to protect the PGA gloves when performing rough handling tasks. The PGA with the intravehicular cover is commonly called an intravehicular spacesuit. The PGA with the integrated thermal micrometeoroid garment (ITMG) is termed the extravehicular spacesuit. For mission or operational purposes, the spacesuit includes the PGA and the IC or ITMG.

The helmet is a plastic bubble. It secures to the torso neck ring with a slide lock. A slot channel at the rear of the neck ring receives oxygen from the torso ventilation duct and directs it to a one-half-inch-thick foam plastic manifold. The manifold lays on the aft quarter of helmet, terminating at the top. Numerous slits in the manifold direct the oxygen across the face, purging the helmet of carbon dioxide. On the left side, near the mouth, is a feed port and a feed port cover. A contingency feeding valve adapter is provided with the food set and will attach to the feed port to provide a method of emergency nourishment. Only drinks will pass through. The helmet shield (HS) (figure 2.12-3) is a plastic cover to be used during intravehicular activities (remove/replace probe or tunnel hatch) to prevent damage to the PGA helmet. Only one shield is provided per spacecraft.

Additional subassemblies or accessories are donning lanyards for doffing/donning, a neck dam for restricting water during post recovery CM egress, and strap-on leg pockets for scissors, checklists, and data lists.

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After attaining earth orbit, the PGA is stowed in two parts: torso (with gloves) and the helmet. The torso (with gloves) fits into an L-shaped, expandable bag (3 PGA capacity), and is attached to the aft bulkhead and the center couch by hooks. (See figure 2.12-4). The helmet shield and inflight coveralls are also stowed in the PGA stowage bag.

The PGA helmet stowage bag is made of Beta cloth. The "dome" end is closed, and the open end has a draw string for closure. Four straps with snaps and Velcro are attached for restraints (figure 2.12-5). At launch, the helmet bags are collapsed and stowed. When the helmet is doffed it is placed in a helmet bag, the draw strings are tied and attached to the right- and left-hand equipment bays by the snaps on the straps. For entry, the helmet bags are again collapsed and stowed after the helmet is donned or left on the stowed helmet in the event of an unsuited entry.

PGA Donning and Doffing. In the event the command module inner structure loses pressure, the ECS can maintain a pressure of 3.5 psia for 15 minutes to allow the crewmen to don their PGAs.

To don the PGA, clear the legs and arms of obstructions, and verify the zippers are run to the neck ring with lanyards attached and oxygen hoses are connected. Place the legs in the boots and legs of the torso and connect the bioinstrumentation and communication harness. Place arms

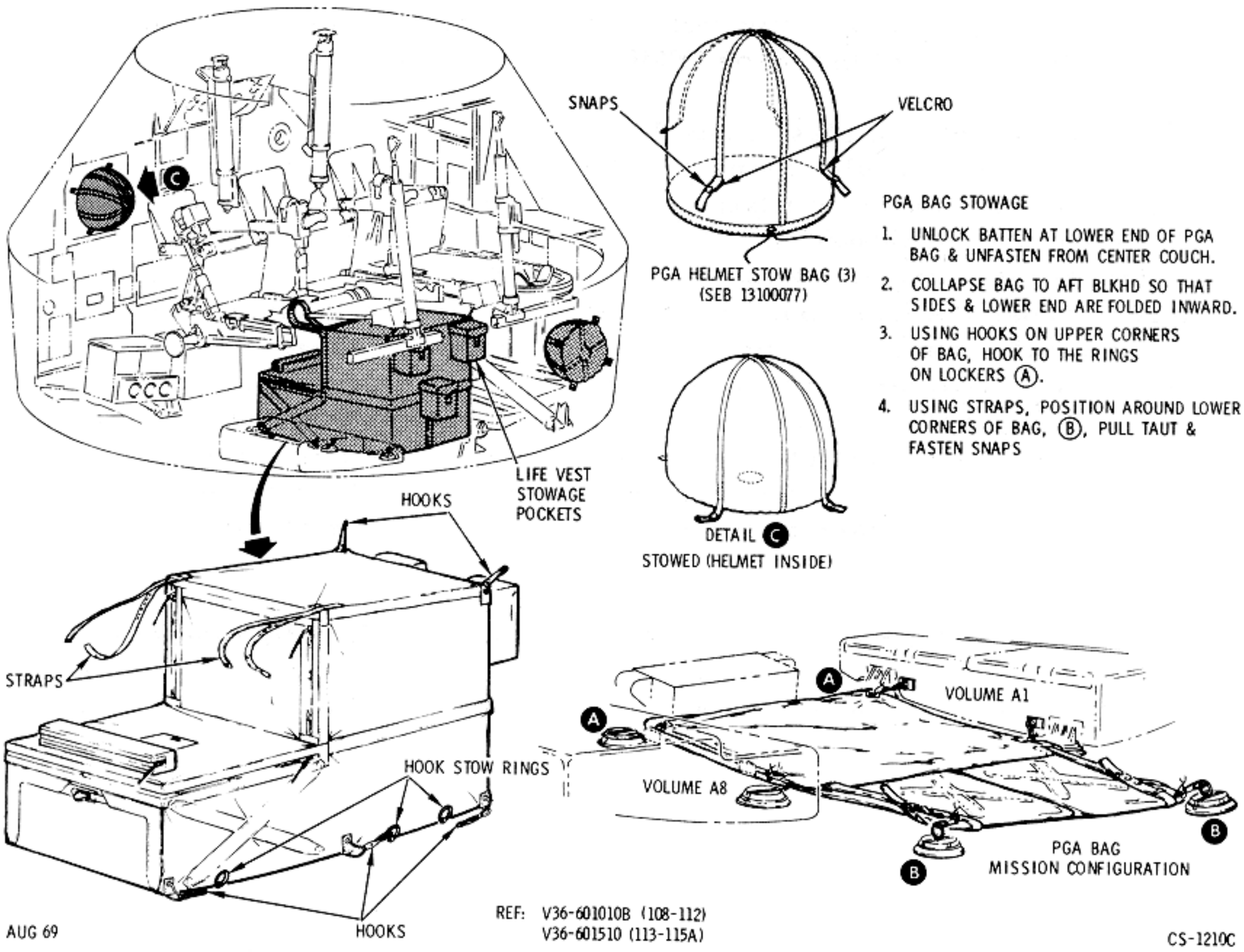

Figure 2.12-4. PGA and Helmet Stowage Bags

in torso arms and the head through neck ring. Pull the lanyard connected to the inner zipper and outer zipper to crotch, closing the stress relieving and pressure seals. Connect and lock shoulder cables.

Don the helmet by connecting it to torso neck ring and rotate the neck ring lock. Complete the donning by putting the gloves on and locking. Adjust the ECS suit flow regulator.

To doff the PGA, remove the gloves and helmet, unzip from the crotch to the neck ring, and withdraw neck and arms. Disconnect the bioinstrumentation and communication harness, and remove legs from the torso.

Operational Modes. In the suited condition, there are two modes: the normal or "ventilated" and "pressurized." In both cases, the helmet is on and locked.

In the ventilated mode sometimes referred to as "vented," the cabin is pressurized at 5 psi and the suit is 5.072 psi, or a positive pressure differential of 2 inches of water in the suit. This state allows comfort and maximum mobility for the crewman. The flow rate through the suit will be approximately 7 to 11 cubic feet per minute.

The oxygen is delivered by the oxygen supply hose, routed to the helmet and midsection to be purged to the extremities, and returned via ventilation tubes to the midsection return connector and oxygen hose.

In the event the cabin pressure decreases to 3.5 psia or lower, the ECS will maintain 3.7 psia in the PGA. This mode is "pressurized," and the flow rate will be more than 12.33 pounds per hour and less than 17 pounds per hour. The crewmen will have to overcome the pressurized balloon effect and mobility will be more restricted than the vented mode.

Miscellaneous Personal Equipment. Personal items of equipment that are used many times and must be immediately accessible are stowed in spacesuits, pockets or attachable pockets. These items must also be transferred to the flight coveralls after doffing the spacesuit. The following is the nomenclature and description of these items.

- Penlight - Small, two-cell unit used for portable lighting
- Sunglasses with pouch
- Personal Radiation Dosimeter - A cigarette package shaped unit, battery powered dosimeter which indicates accumulated dosage (rads) by its register readout

- Chronograph With Watchband - "Accutron Astronaut" watch featuring sweep second hand, stopwatch control, and changeable time zone dial
- Marker Pen - Felt-tip pen used for marking sanitation bag assemblies, refuse bags, and Log Book
- Pencil
- Data Recording Pens - Pressurized ball point pens for writing
- Scissors - Surgical scissors, used for cutting food bags, pouches, etc.
- Life Vest - Attached to PGA during boost and entry; stows on the PGA stowage bag during the remainder of the mission
- Slide Rule - Standard slide rule, 6 inches long, aluminum.
- Motion Sickness Bag - A plastic emesis bag in a small wrapper.

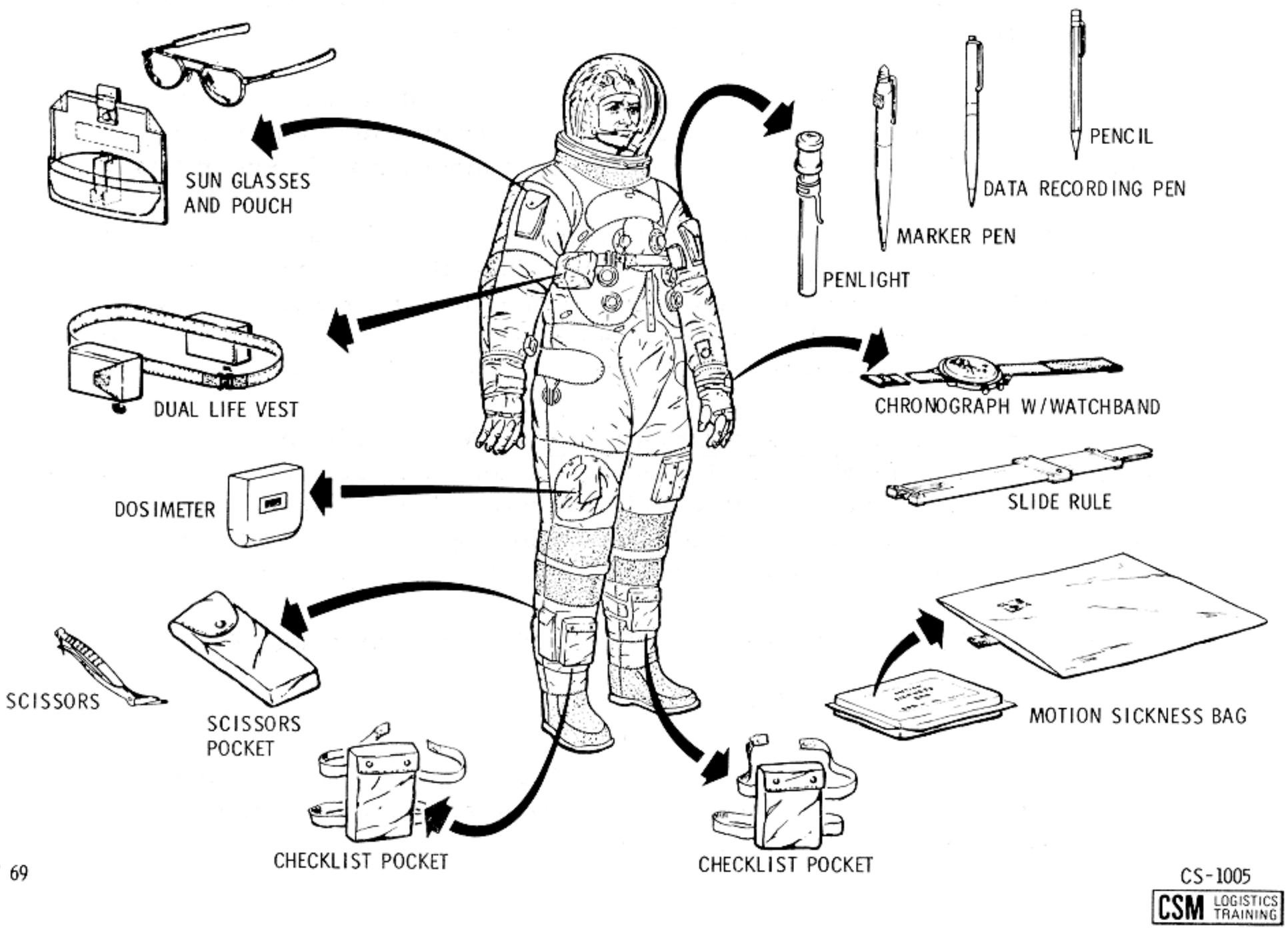

Figure 2.12-5. Personal Equipment

2.12.2.2 Spacesuit Related Equipment.

2.12.2.2.1 Oxygen Hose Assembly (Figure 2.12-6).

The oxygen hose assembly conducts oxygen to the PGA under pressure from the ECS, and returns contaminated oxygen from the suit to the ECS. A secondary use is to deliver oxygen from the ECS to the cabin atmosphere.

The oxygen hoses are flexible silicon rubber hoses with a convoluted wire reinforcement and 1.25-inch inside diameter. Each assembly has two hoses, a double "D" section and connector at the ECS end, and two separate connectors at the suit end (supply and/or return). The assembly is covered with beta cloth and the hoses are fastened together with keepers every 12 inches. Also, at 12-inch intervals along the hose, cloth straps with fasteners for securing the comm cable are provided. When coupled together as a unit, the hose and cable is referred to as an umbilical assembly.

The hoses for the left and center crewman are 72 inches long and the right crewman's hose is 119 inches in length.

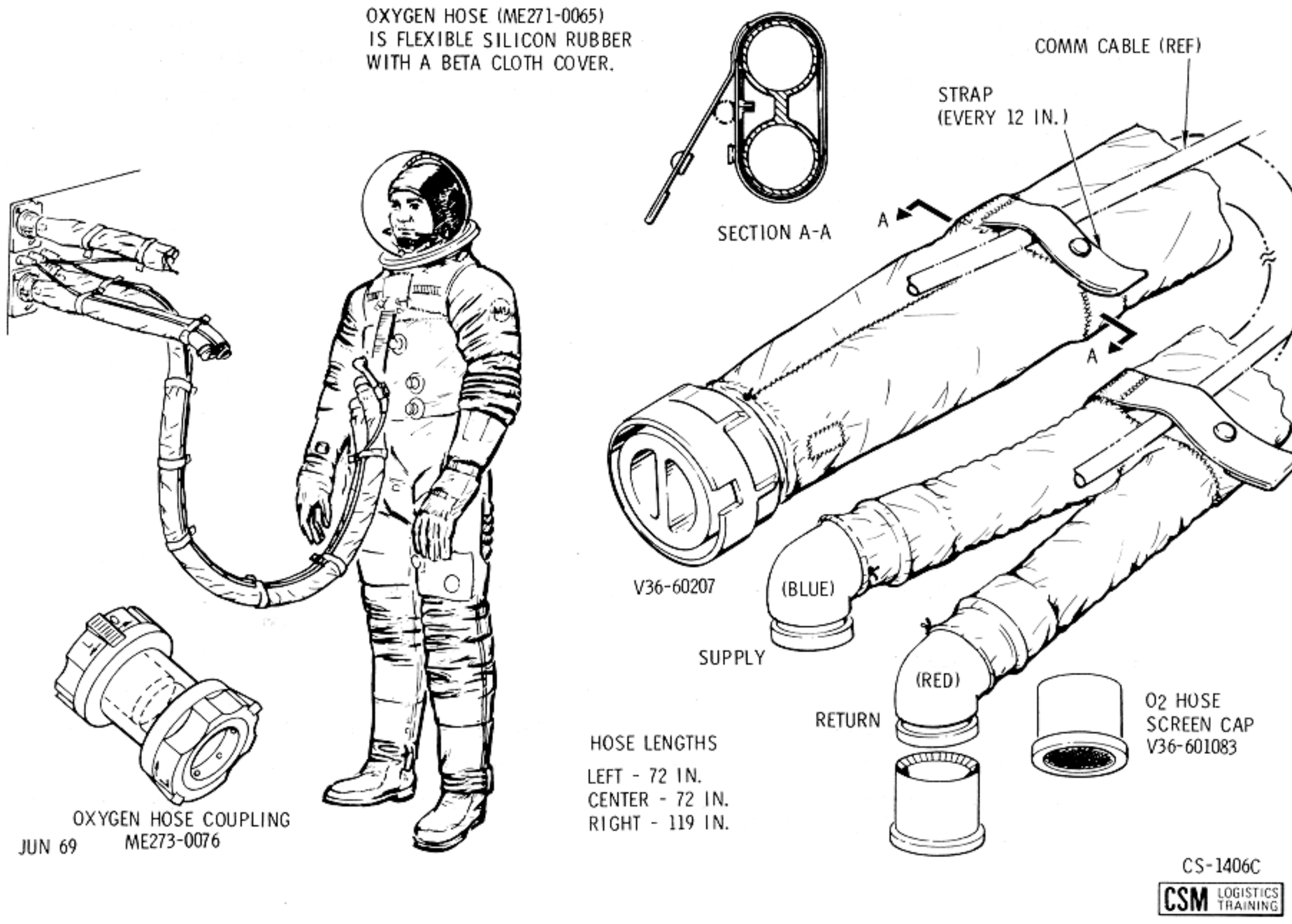

Figure 2.12-6. Oxygen Hose Assembly and Accessories

When the oxygen hose is not connected to the PGA, the ECS end will remain attached to the valve at the left-hand forward equipment bay and the oxygen hose will be stowed. Straps on the CM structure will aid in routing the hoses across the forward bulkhead and right-hand forward equipment bay.

2.12.2.2.2 Oxygen Hose Coupling (Figure 2.12-6).

To prevent fresh oxygen from returning through the exhaust or return end of the O_2 hose while the suit circuit return valve is open, a coupling is placed over the return end. It is a 5-inch aluminum tube with a web seal in the middle and hose connectors at each end. During an EVA, both nozzles (supply and return) are plugged into the coupling connectors, thus sealing both nozzles.

2.12.2.2.3 Oxygen Hose Screen Caps (Figure 2.12-6).

In the shirtsleeve environment, the crew compartment oxygen returns to the ECS suit loop through the suit circuit return valve which has a screen cover functioning as a preliminary debris trap. The screen has to be cleaned periodically but the task is difficult because of obstructions. By placing the screen caps on the oxygen return nozzles (red), placing the flow control valves on panels 300, 301, and 302 in the CABIN FLOW position, the return oxygen is split between the oxygen hoses and the suit circuit return valve. The oxygen is screened for debris at the cap screens, which is accessible and easy to clean but also greatly reduces the flow. Therefore, the oxygen hose screen caps are used to delay the cleaning of the suit circuit return valve. A screen cap on an oxygen return hose nozzle (red) can also be used for vacuuming debris in the crew compartment.

The screen cap is a fluorel tube with a monel screen (#30 mesh) at one end and an internal ridge at the other. It slides over the return nozzle and engages a groove to retain it. There are three screen caps per spacecraft.

When the screen cap becomes clogged with debris, it can be cleaned by using a small piece of utility tape to blot the screen. The tape can be inserted in a utility bag, food bag, or waste bag for disposal.

2.12.2.2.4 EMU Maintenance Kit.

In the event the spacesuit PGA is damaged, it can be repaired by use of the EMU maintenance kit. The kit is approximately 8 x 6 x 1.5 inches and weighs 0.38 pound. There is one kit aboard the CM, stowed in a locker on the aft bulkhead.

2.12.2.3 Extravehicular Spacesuit (Figure 2.12-1).

The extravehicular spacesuit is identical to the intravehicular spacesuit with the exception of the oxygen connectors, the cover, and the substitution of the LCG for the CWG. There are two sets of oxygen connectors, on the left chest and on the right chest of the extravehicular spacesuit PGA. These are necessary because the commander (CDR) and lunar module pilot (LMP) transfer to the LM ECS while CM oxygen hoses are attached to their spacesuit.

The cover, or integrated thermal micrometeoroid cover (ITMG), is similar to the IC but is thicker and heavier. It consists of an outer protective layer with scuff patches at the knees and elbows, seven alternating layers of beta cloth felt (micrometeoroid protection) and silverized mylar (thermal protection), and a liner. The ITMG is also laced on the PGA for the mission.

2.12.2.3.1 Liquid Cooled Garment (LCG) (Figure 2.12-1).

The LCG is worn in place of the CWG when the CDR and LMP transfers to the LM or performs EVA. The LCG contains small plastic tubes (0.125-inch diameter) sewn to a netting that covers the crewman's body through which water circulates, absorbing body heat. The water is transported to the PLSS where the sublimator expells the heat. The LCG has a thin cloth lining that prevents the hands and feet from entangling the plastic tubes when donning.

Two LCGs are vacuum packed and stowed in a locker on the aft bulkhead. They are fully charged with water and, when donning, must be connected to the EV spacesuit multiple water connector. When the CDR and LMP return to the CSM after LM or extravehicular activities, the LCG must be disconnected, doffed, folded, and stowed in a locker.

2.12.2.4 Extravehicular Mobility Unit (EMU).

For clarity, the EMU will be briefly described. Most of the components, other than the EV spacesuit, are stowed aboard the LM. As stated in section 2.12.2, the EMU consists of a FCS, UCTA, bioinstrumentation harness assembly, LCG, EV spacesuit, a PLSS, OPS, EVVA, EV gloves, and a pair of lunar overshoes (LO).

The portable life support system (PLSS) is a "backpack" unit that furnishes oxygen for breathing, cooled water for the LCG, and communications while the crew is on the lunar surface or performing EVA. It has a 4-hour oxygen supply and can be recharged from the LM. One of its LiOH

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canisters will be returned in the CM for analyzing. The PLSS water subsystem is part of the heat exchanging system. The heat is lost by sublimation. The communications system allows the lunar explorer to communicate to the LM or CSM which will relay to earth.

Two PLSSs are stowed in the LM at launch. They will be donned and checked out prior to EVA. One or both PLSSs will be left on the lunar surface to lighten the LM ascent vehicle or left in the LM.

The oxygen purge system (OPS) is a small oxygen unit that furnishes emergency oxygen to the crewman during EVA. It is about the size of a 2-pound loaf of bread and has a 30-minute oxygen supply. It attaches to the top of the PLSS or in the stomach area by straps. Oxygen is delivered through a hose into the PGA oxygen connector, purges the helmet with oxygen, and exits through the suit outlet connector and purge valve.

Two OPSs are stowed aboard the LM at launch and both will be returned to the LM from lunar exploration. If not needed for extravehicular transfer, they will be left on the LM. If used for EVA transfer, the OPS will be jettisoned.

The extravehicular visor assembly (EVVA) is a double-shelled visor that fits over the PGA helmet and is used for EVA. The outer shell is vacuum deposited gold plated. The EVVA is stowed aboard the LM at launch and left aboard the LM in lunar orbit or jettisoned.

The EV gloves and lunar overshoes (LO) are used for EVA and lunar exploration. They are aboard the LM at launch and are left aboard the LM in lunar orbit or jettisoned.

2.12.3 CREWMAN RESTRAINTS.

2.12.3.1 "g" Load Restraints.

2.12.3.1.1 Crewman Restrain Harness (Figure 2.12-7).

There are three restraint harnesses per spacecraft, one for each crewman. The harnesses are attached to the crew couches. The restraint harness consists of a lap belt and two shoulder straps interfacing the lap belt at the buckle. The lap belt straps are connected to the seat pan and back pan. This configuration provides adequate hip support. The shoulder straps are connected to shoulder beam of the couch.

The lap belt buckle is a lever-operated, three-point release mechanism. By pulling a lever, the shoulder straps and right-lap belt strap will

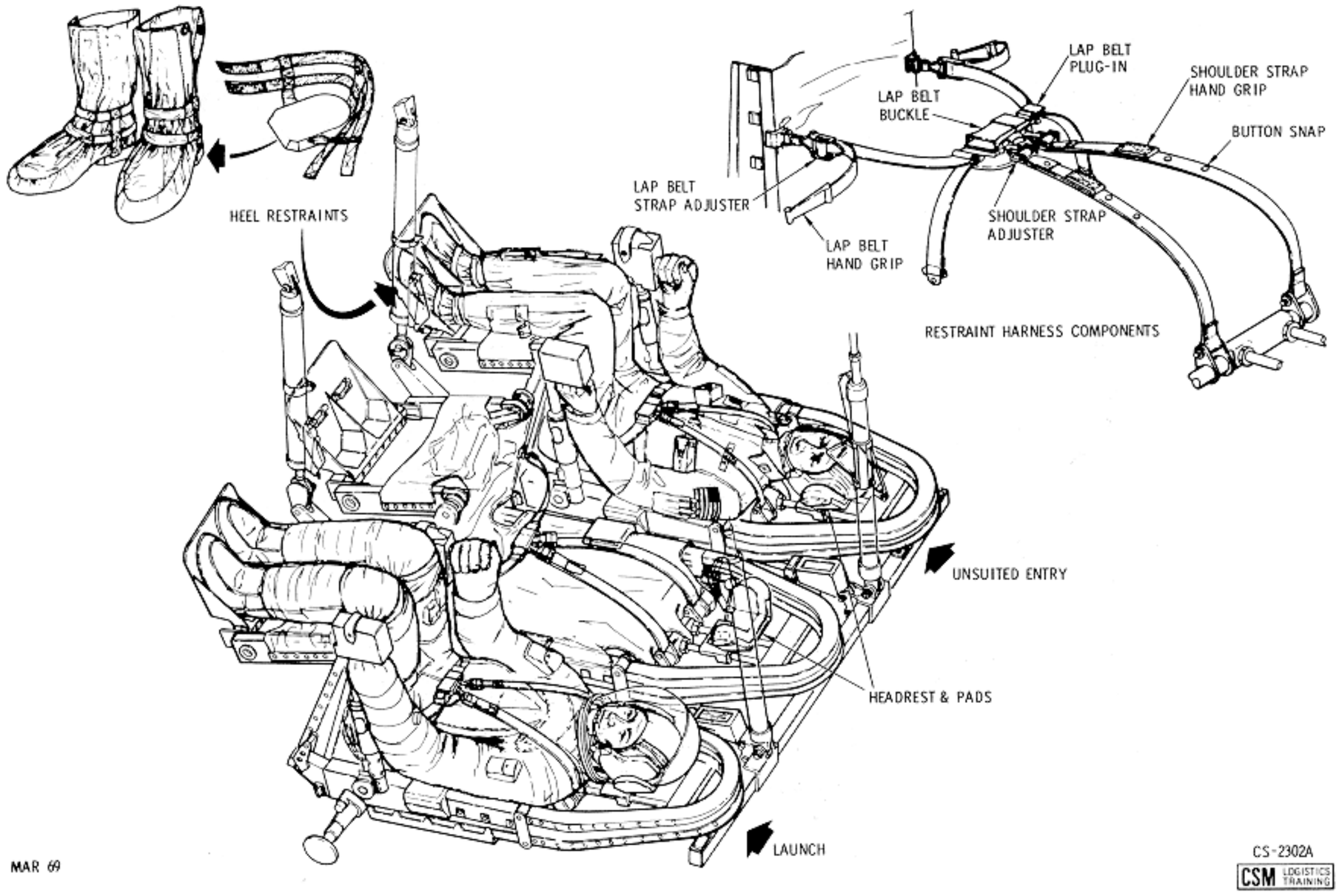

Figure 2.12-7. Crewman Restraint Harness Subsystem With Heel Restraints

be released. The strap ends are equipped with snaps which may be fastened to mating snaps on the couch and struts when not in use. The restraint harness buckle can be restrained when not in use by attaching it to the translation or rotation control stow straps (figure 2.12-8). This also prevents the buckles and attachments from floating free during zero-g and striking a crewman or equipment.

Operation. The harness will be on and locked during all maneuvers when g-loads are expected such as launch, delta V, docking, entry, and landing. The harness can be tightened and loosened readily by adjusting the length of the strap. Pull on the hand grip to tighten. To loosen, rotate the adjuster, allowing it to unlock and the strap can be lengthened.

2.12.3.1.2 Handholds (Figure 2.12-9).

The function of the handholds is to aid in the maneuverability of the crew. The handholds are aluminum handles bolted to the longerons. There are two handholds, one on each longeron by the side windows, located close to the MDC.

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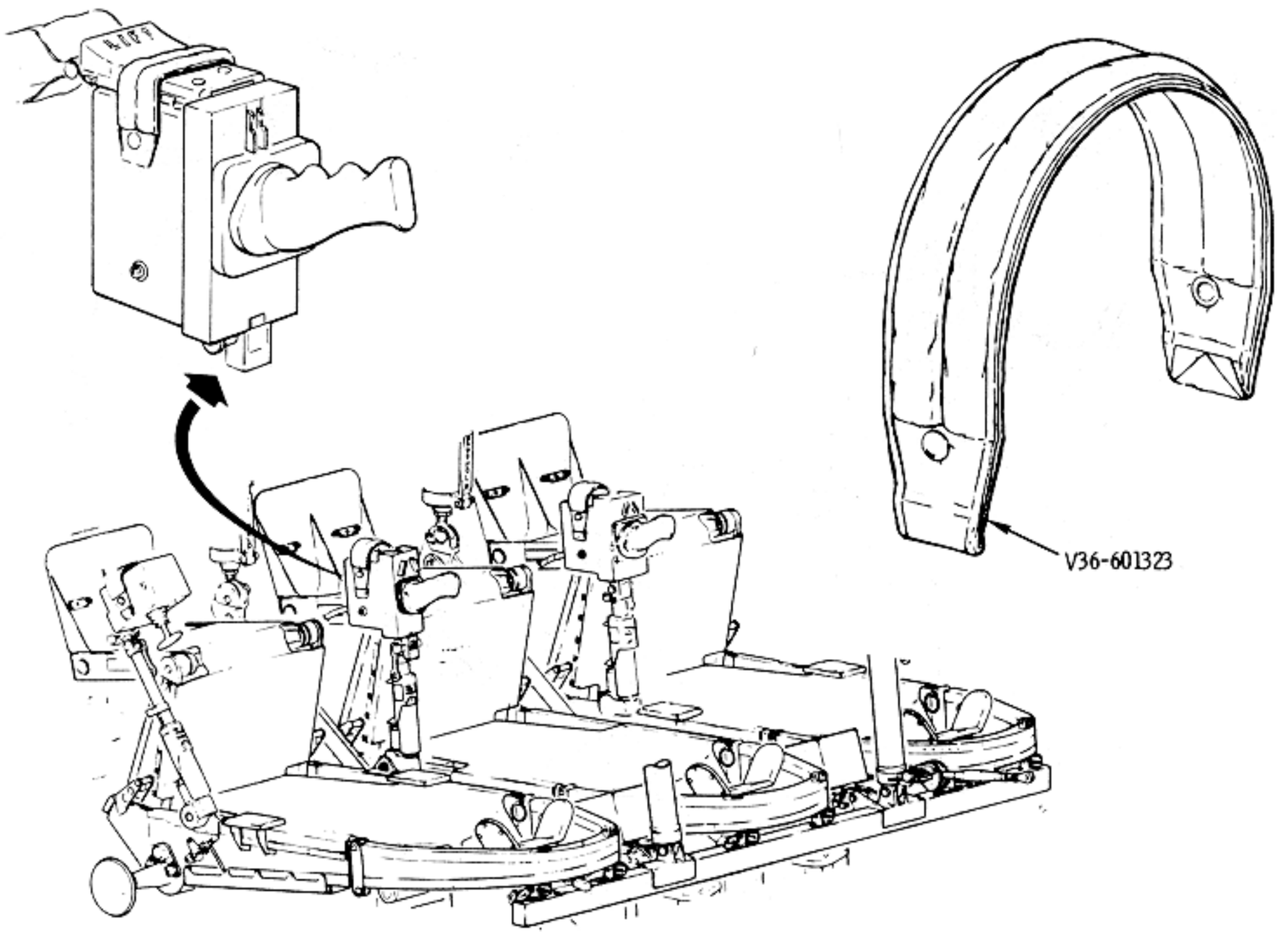

Figure 2.12-8. Restraint Harness Buckle Stowage Straps

2.12.3.1.3 Hand Bar (Figure 2.12-9).

The hand bar is located on the MDC near the side hatch and has two positions, stowed and extended. A lever at one end releases the detent for moving from one position to the other. The hand bar furnishes a place to hold when ingressing or egressing from the CM side hatch. It will support the weight of a suited astronaut in 1 g. In zero g during extravehicular activity or transfer, the hand bar can also be used for ingressing or egressing through the side hatch.

2.12.3.1.4 Heel Restraints.

During the CM landing, the legs and feet of the crewman may jostle about unless restrained to the couch footpan. If in the spacesuit, the boot heels and couch footpan interconnect and restrain the feet and legs. However, if entry and landing is in shirtsleeves, or inflight coveralls, the feet are held to the couch footpans by heel restraints.

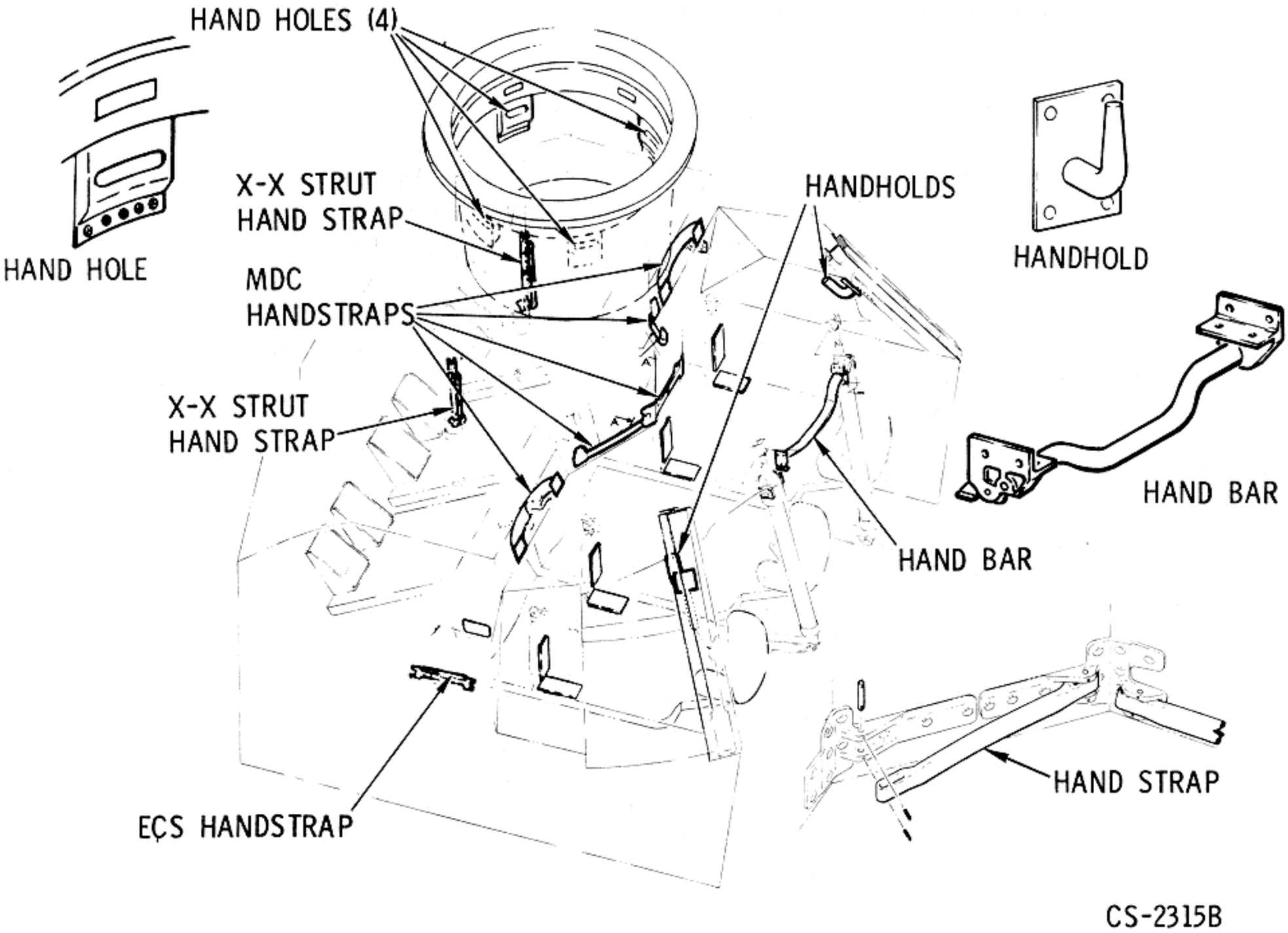

Figure 2.12-9. Handholds, Hand Straps and Hand Bar

The heel restraints are hollow aluminum blocks that attach to the heels of the crewman's booties by means of straps and Velcro. The restraints connect to the footpan in the same manner as the spacesuit booties.

2.12.3.2 Zero-g Restraint.

2.12.3.2.1 Hand Straps (Figure 2.12-9).

The hand straps serve as a maneuvering aid during a g-load or zero-g condition.

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The hand straps are of fluorel covered cloth and are attached by brackets at each end. There are five hand straps behind the MDC and one on the left-hand equipment bay over the ECS filter access panel and one each on the foot X-X struts. These straps lie flat against the structure when not in use.

2.12.3.2.3 Guidance and Navigation Station Restraint.

Two positions may be utilized at the G&N station: standing position or center couch G&N position. The astronaut will restrain himself in the standing position by fastening his booties or boots to the aft bulkhead and using the handholds on the G&N console.

The astronaut will restrain himself in the center couch at the G&N station by positioning the couch to a 170-degree hip angle and restraining his feet in the couch footpans.

2.12.3.2.4 Sleep Station Restraints (Figure 2.12-10).

The crewman's sleeping positions will be in the right couch and under the left and right couch with the head toward the hatch. He will be restrained in position by the crewman sleep station restraint.

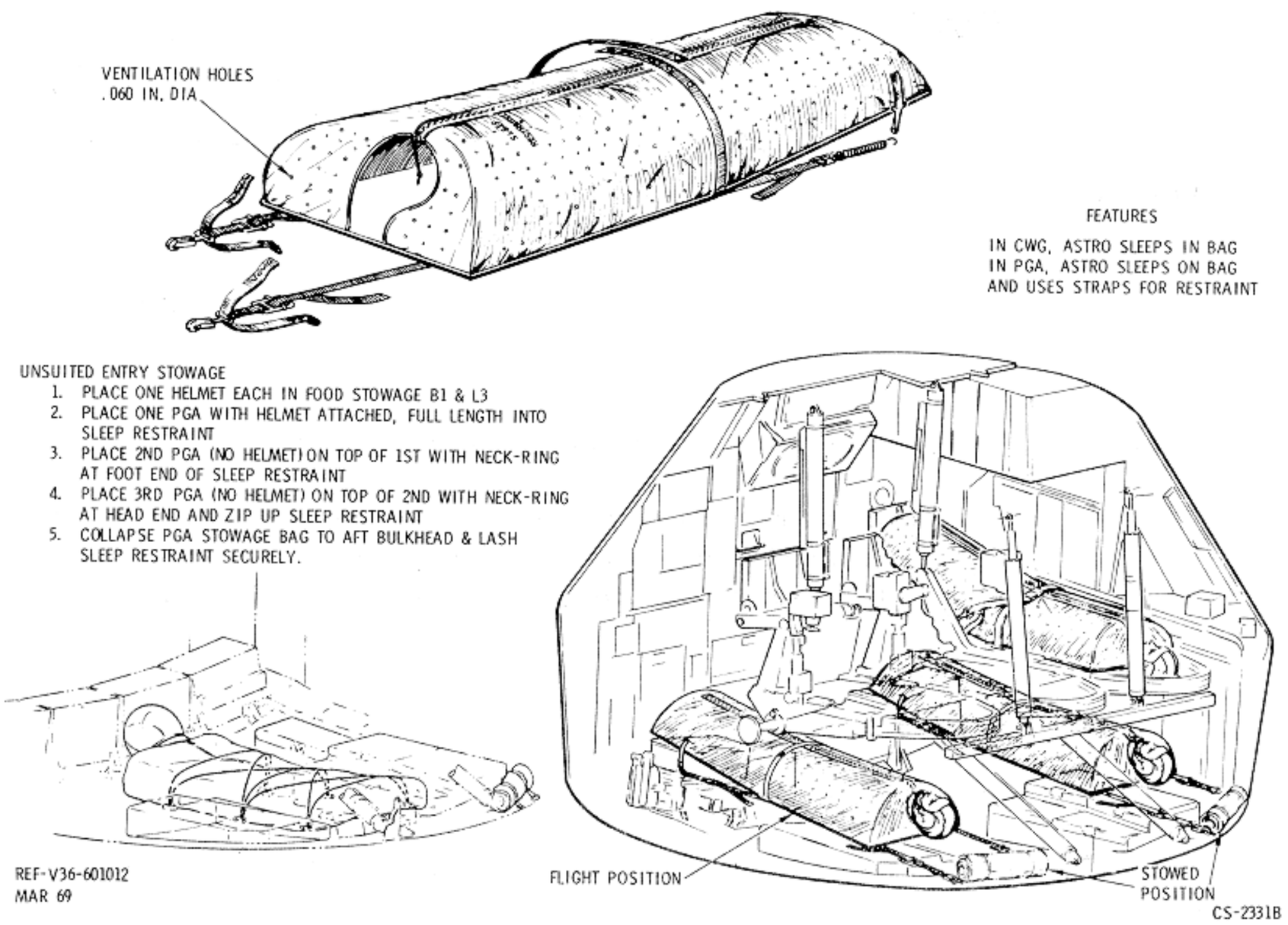

Figure 2.12-10. Sleep Station Restraints

There are four Calfax adapter plates that attach to Calfax fittings adjacent to the G&N panel 122 with the use of the E tool. Each adapter plate has two male snaps to which the snap-type bungees will connect.

A data card clip is a small, steel clip with a female snap on the rear. It attaches to a male stud on the panels or closeouts and will hold data cards.

The food door clips fasten to the B1 or L3 compartment door. Bungees can be attached to and stretched between the clips for retention of flight data.

A female snap on the data book spring clips fastens to any one of numerous male studs on the panels. The spring clip allows a rapid exchange of manuals or data.

The number of restraints may vary from spacecraft to spacecraft. The following list is approximate:

Snap bungees, short	6
Snap bungees, long	6
Hook bungees, short	2
Hook bungees, long	2
Calfax adapter plate, left	2
Calfax adapter plate, right	2
Data card clip	8
Food door clip	6
Data book spring clip	8

To verify the number, refer to the applicable spacecraft "Apollo Stowage List (NASA document)."

Small, temporary stowage pouches (2), 15 inches in length and have female snaps that attach to studs, in the crew compartment, are made of Beta cloth with a bungee-type closure, and have small plastic viewing windows. The bungees, clips, and adapter plates are stowed in the pouches prior to use and during entry.

The debris closeout with pockets has two purposes: to restrict debris from entering the gaps after the lunar return containers (rock boxes) replace the LiOH canisters in B5 and B6, and is the flight data temporary stowage position after removing the data from the compartment. The closeout is 42 inches long, has four pockets, is Beta cloth, and attaches to the LEB with snaps. When removing LiOH boxes and installing the rock boxes, remove only half of the closeout. When the temporary stowage pouches are not being used, they can be stowed in the closeout pockets with the flight data.

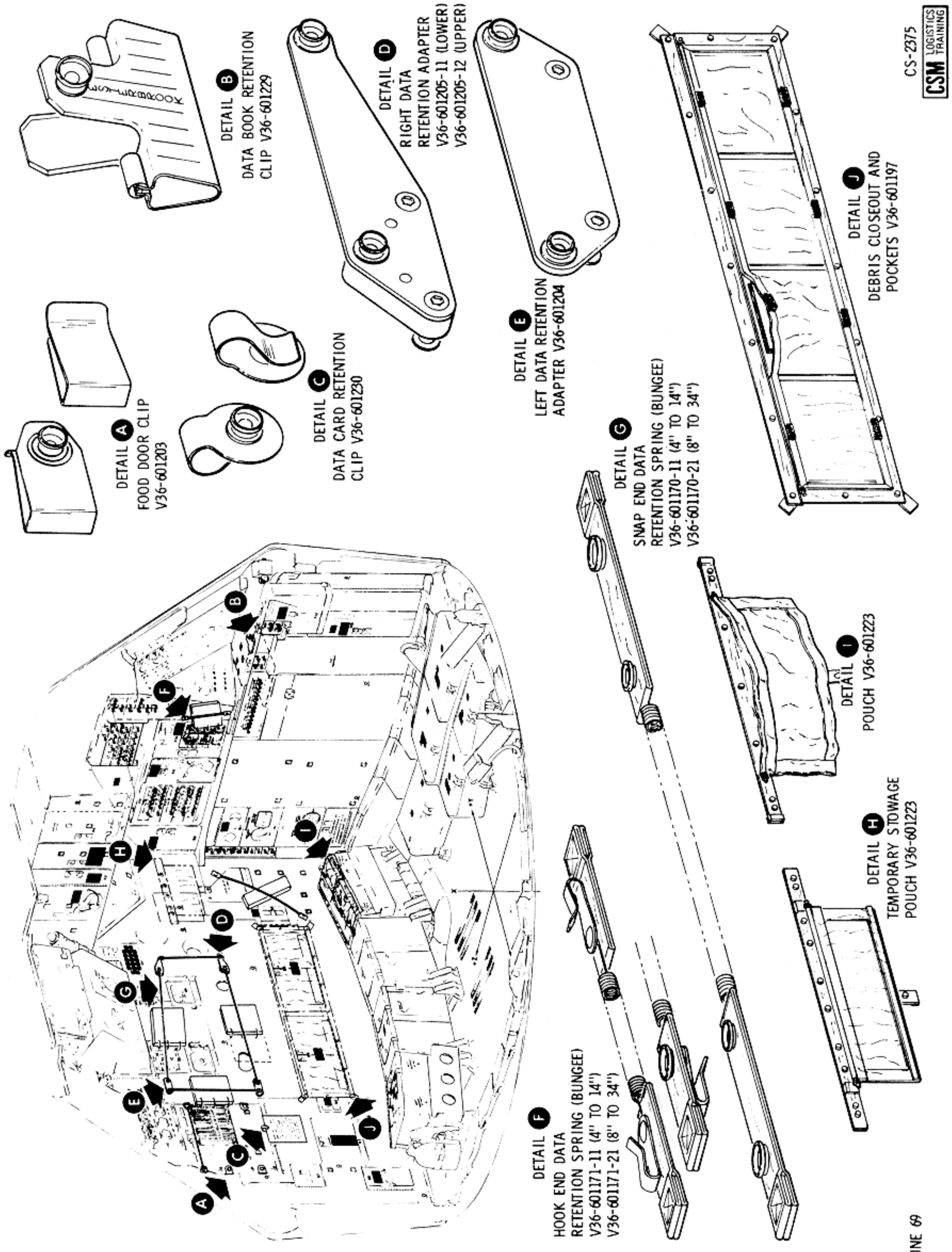

Figure 2.12-11. Flight Data Restraints

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2.12.3.2.6 Restraint Straps.

There are a number of straps used for restraint purposes during zero g. The couch, probe, drogue, glare shield, control cable, and cable routing straps have specific uses, whereas the utility straps have numerous uses. Most of the straps are made of beta cloth and use snaps as a restraining method. The snaps have a male (stud) and female (socket) component.

Control Cable Straps (Figure 2.12-12). The rotation control cables exit the junction box on the aft bulkhead and are routed along the 22 attenuator struts to the couch side stabilizer beams. The control cables are held to the 22 struts by the control cable straps, two on each strut. The straps are 1 inch wide and 11 inches long. Each has four snaps, a pair to snap around the strut and a pair to hold the cable.

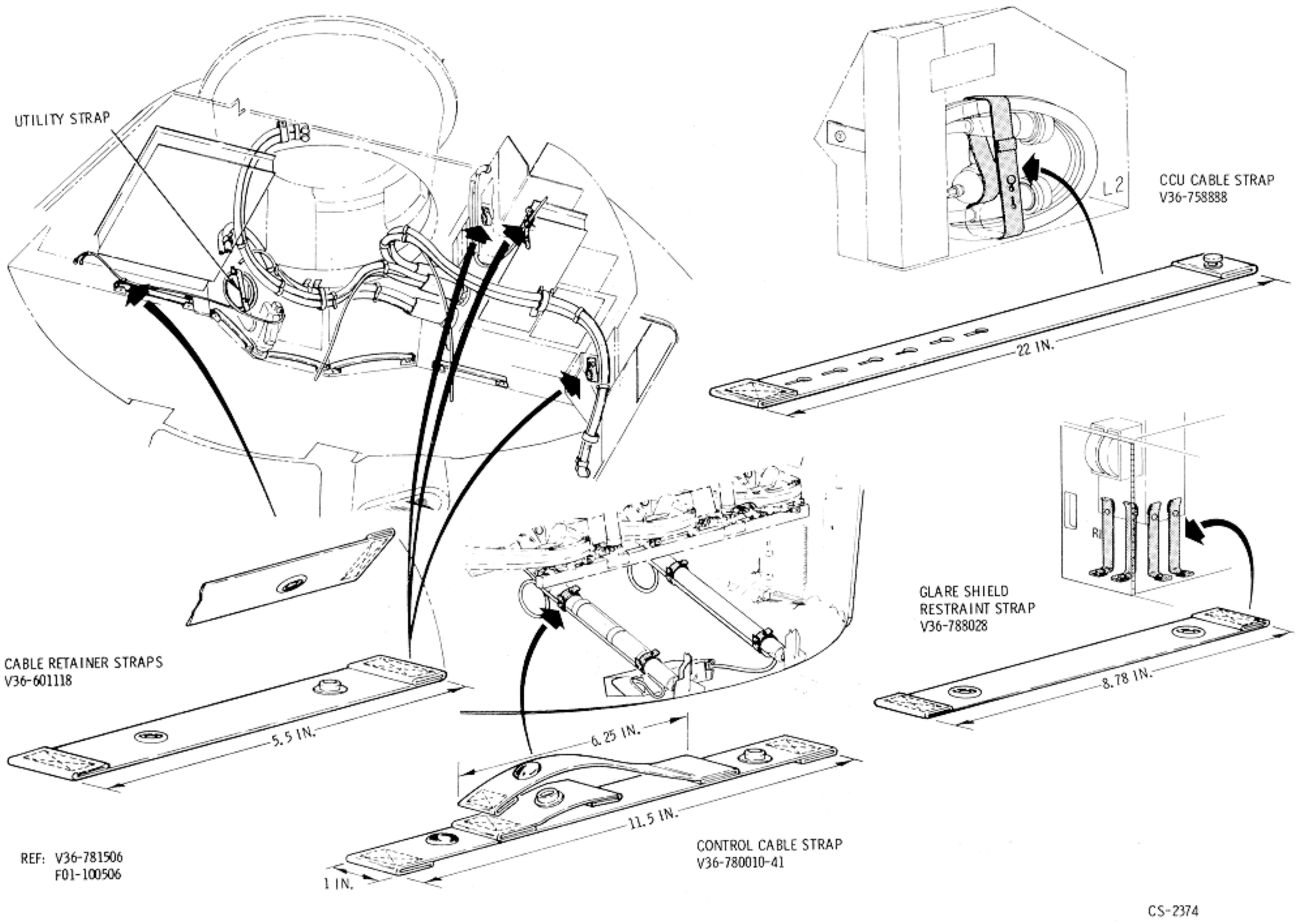

Figure 2.12-12. Special Straps

Center Couch DPS Burn Straps (Figure 2.12-13). The center couch has to be stowed for a LM DPS burn and EVA. For a LM DPS burn, the seat and legpan is lowered to the aft bulkhead while the body support stays hinged at the headbeam. The folded seat-legpan must be restrained to the aft bulkhead by the DPS burn strap. The couch DPS burn strap is 29 inches long, with one snap (stud) at one end and 6 snap sockets at the other end. It attaches to a "D" ring on the A1 stowage locker and around the knee control handle. When not in use, the strap is stowed in a locker.

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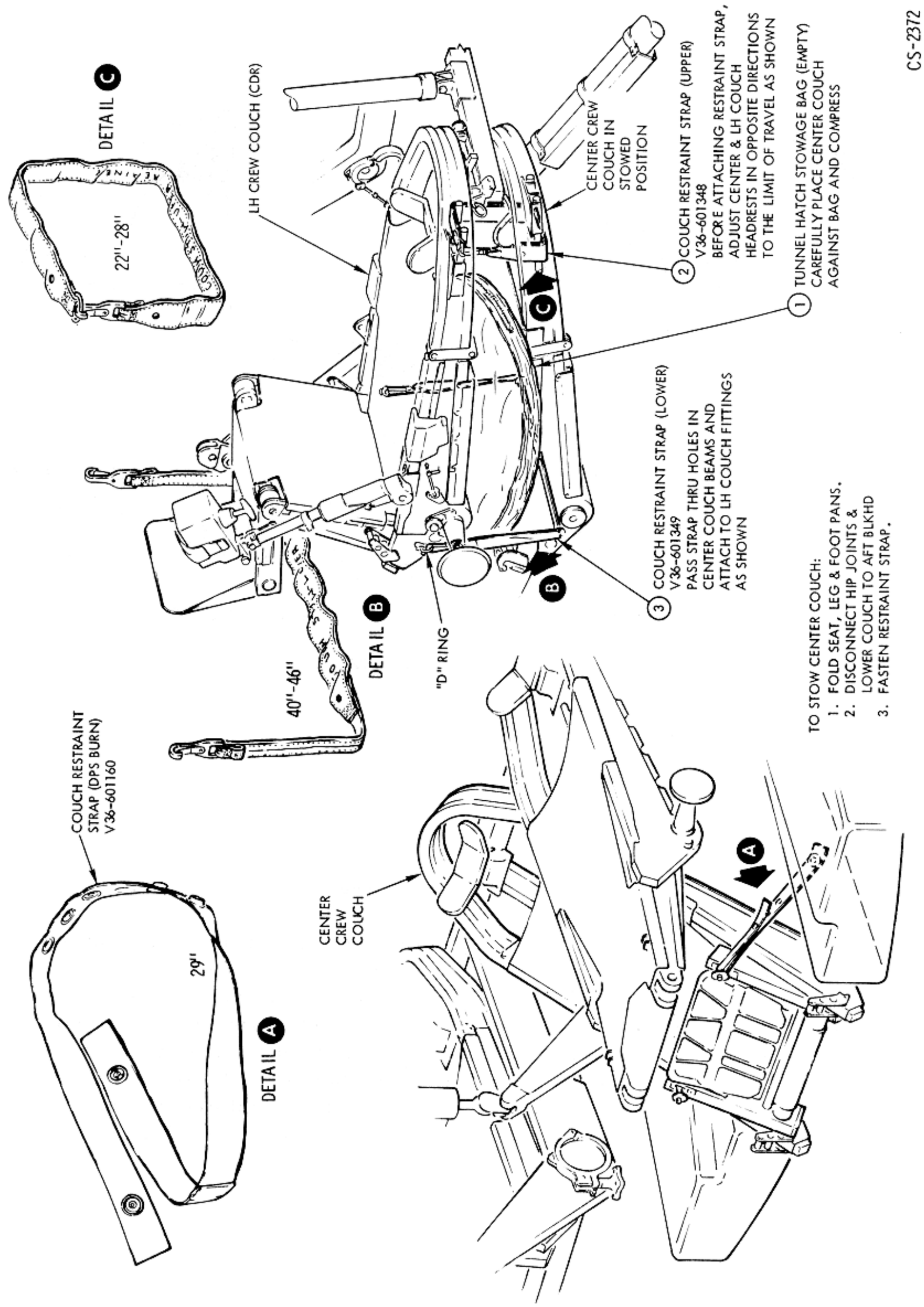

Figure 2.12-13. Center Couch Restraint Straps

Center Couch Stow Straps (Figure 2.12-13). During the preparation for EVA, the center couch is removed from its center position and stowed under the left couch. The center couch is restrained to left couch by the two center couch stow straps.

The "upper" center couch stow strap routes around the headrest support bars and connects to itself. It is 24 inches long, has a "D" ring at one end, a center flat rubber bungee section, and a snap-hook at the other end.

The "lower" center couch stow strap routes through two holes in the center couch body support at the seatpan. It is 43 inches long, has a 12-inch bungee section, and a hook at each end which attaches to "D" rings on the left couch body support near the seatpan. When not in use, the straps are stowed.

Cable Retainer Straps (Figure 2.12-12). The cable retainer strap is 5.5 inches long with a back-to-back socket and stud at one end and a socket at the other end. The socket/stud will attach to studs bonded on the structure and when the socket is attached to the strap stud/socket, it forms a loop. This facilitates routing the TV camera cable and the translation control cable. When not in use, the straps are left attached to a wall stud.

Drogue Stow Straps (Figure 2.12-14). When required, the probe is stowed under the seatpan and the drogue under the backpan of the right couch. The two drogue stow straps are attached to the right body support by one strap each. When not in use, the free end of the straps are attached to the couch also.

The outboard strap is 38 inches long with a 6-inch bungee section also and a snap hook on the free end. When stowing the drogue, the strap is threaded through the remaining two handles and the hook is snapped to a "D" ring attached to the hip beam by another strap.

Probe Stow Straps (Figure 2.12-14). The two probe stow straps are identical. They are 26 inches long with a snap hook at one end, a right angle hook at the other, and a 6-inch bungee section. To stow the probe, position it under the seatpan with the probe pointing outboard. Attach the right angle hook around the lap belt connector on the seatpan by pressing the hook lever. Route the straps around the ends of the probe and snap the hook end to the "D" rings on the right couch. When not in use, the probe straps are stowed.

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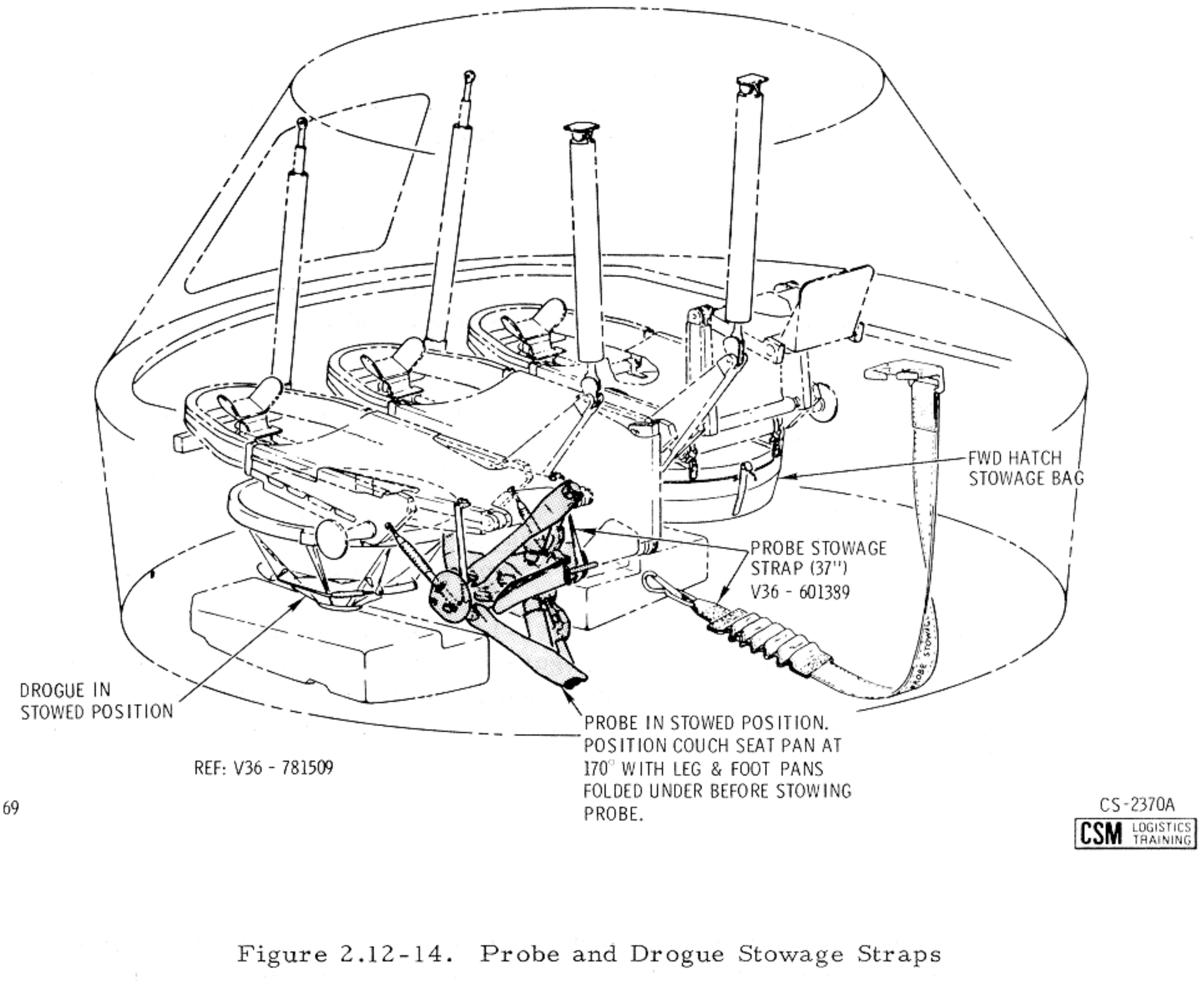

Figure 2.12-14. Probe and Drogue Stowage Straps

Utility Straps (Figure 2.12-15). The utility straps are named for their versatility. They are used for holding looped straps and cables in stowage lockers or compartments and for restraining other equipment to the structure during the mission.

The utility straps are 12.5 inches long with two studs and two sockets positioned so as to form two loops when snapped. One loop will wrap around a piece of equipment and the other loop around structure or will attach to structure by the snap.

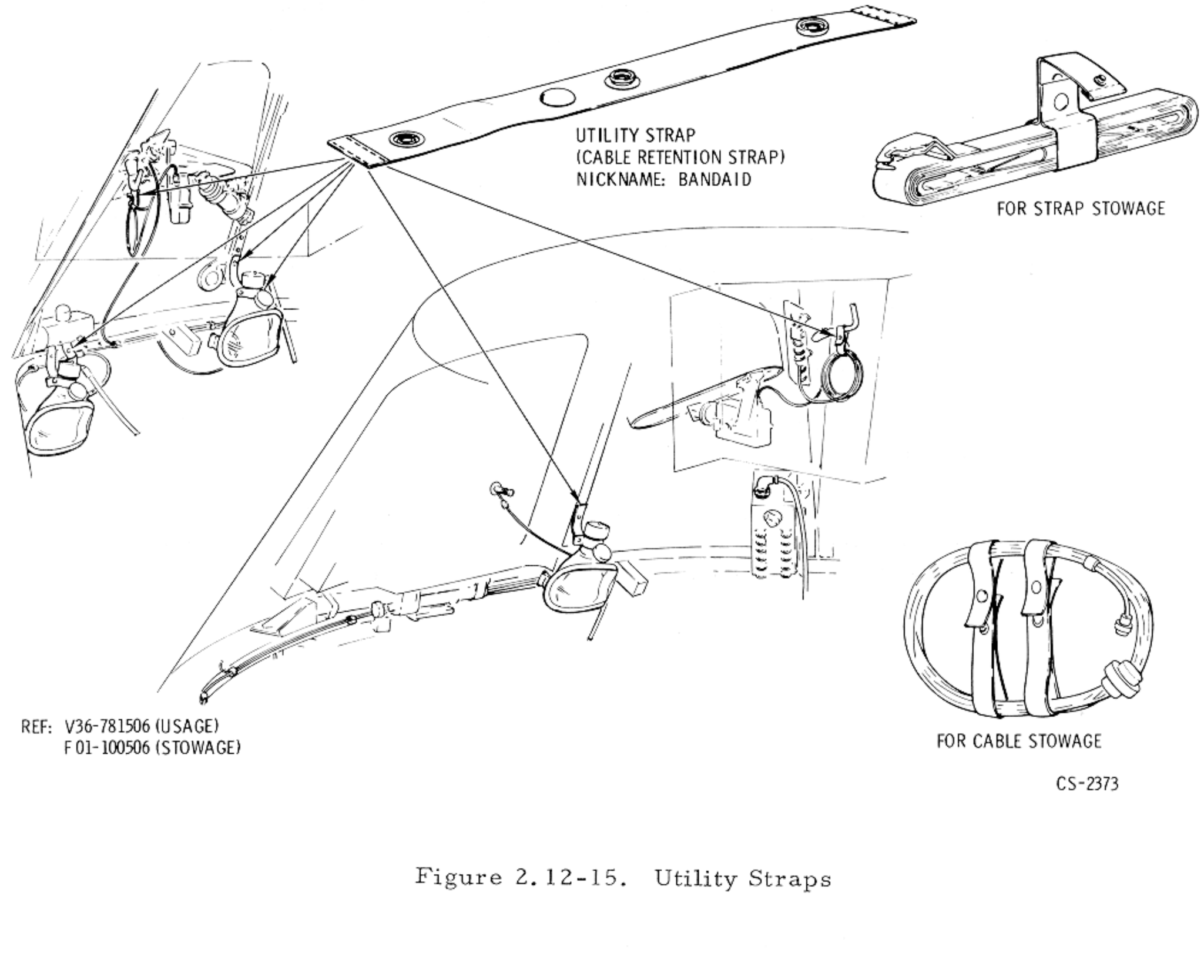

Figure 2.12-15. Utility Straps

2.12.3.2.7 MDC Glareshade Straps (Figure 2.12-12).

The MDC glareshade straps retain the MDC glareshades in their R4 stowage compartment. The straps are 5 inches long with sockets at both ends that snap onto studs bonded to the structure. One end of the strap always stays attached.

2.12.3.2.8 Velcro and Snaps Retainer Locations

There are numerous 1-inch square patches of Velcro located in the crew compartment. They are bonded to the structure and control panels in

accordance with crew and crew support requirements. Each CM has a "Velcro and Snaps Map" designating the location of all retainers. The drawing number is V36-6300XX, the XX being the CM numerical designation plus 4. Example, the "Velcro and Snaps Map" for CM 112 is V36-630016.

2.12.3.2.9 Tunnel Hatch Stow Bag (Figure 2.12-13).

The tunnel hatch must also be stowed when required. However, due to some remotely flammable materials, the hatch must be stowed in a beta cloth bag with a circumferential zipper. The bag is lashed under the left couch by straps and remains there. When the center couch is stowed under the left couch, the stow bag is collapsed between the couches.

2.12.3.2.10 Sleep Restraint Tiedown Ropes

During entry preparation for an unsuited entry, the spacesuits are stowed in a sleep restraint and lashed down in the center aisle by ropes

A rope is a PBI (polybenzimidazole) fiber, 10-feet long, and has plastic ferrules on the ends to prevent fraying. There are five ropes stowed. Miscellaneous restraints are shown in figure 2.12-16.

(To be supplied at a later date.)

Figure 2.12-16. Miscellaneous Restraints

2.12.4 SIGHTING AND ILLUMINATION AIDS.

Sighting and illumination aids are those devices, lights, or visual systems that aid the crew in the accomplishment of their operational mission. This handbook describes the internal sighting aids first and the external second. The crew compartment floodlights and panel lighting is described in the electrical power system section 2.6 of this handbook.

2.12.4.1 Internal Sighting and Illumination Aids (Figure 2.12-17).

Internal sighting and illumination aids include window shades for controlling incoming light, internal viewing mirrors, the crewman optical alignment sight for docking and aiming the data acquisition camera, a LM active docking target for LM to CM docking, window markings for monitoring entry, a monocular for lunar survey, and some miscellaneous items such as floodlight glareshields, MDC glareshades, and an eyepatch.

2.12.4.1.1 Window Shades (Figure 2.12-18).

The CSM has five windows: two triangular-shaped rendezvous windows, two square-shaped side windows, and a hatch window. Periodically, the light coming through these windows has to be restricted. This is accomplished by window shades (figure 2.12-18).

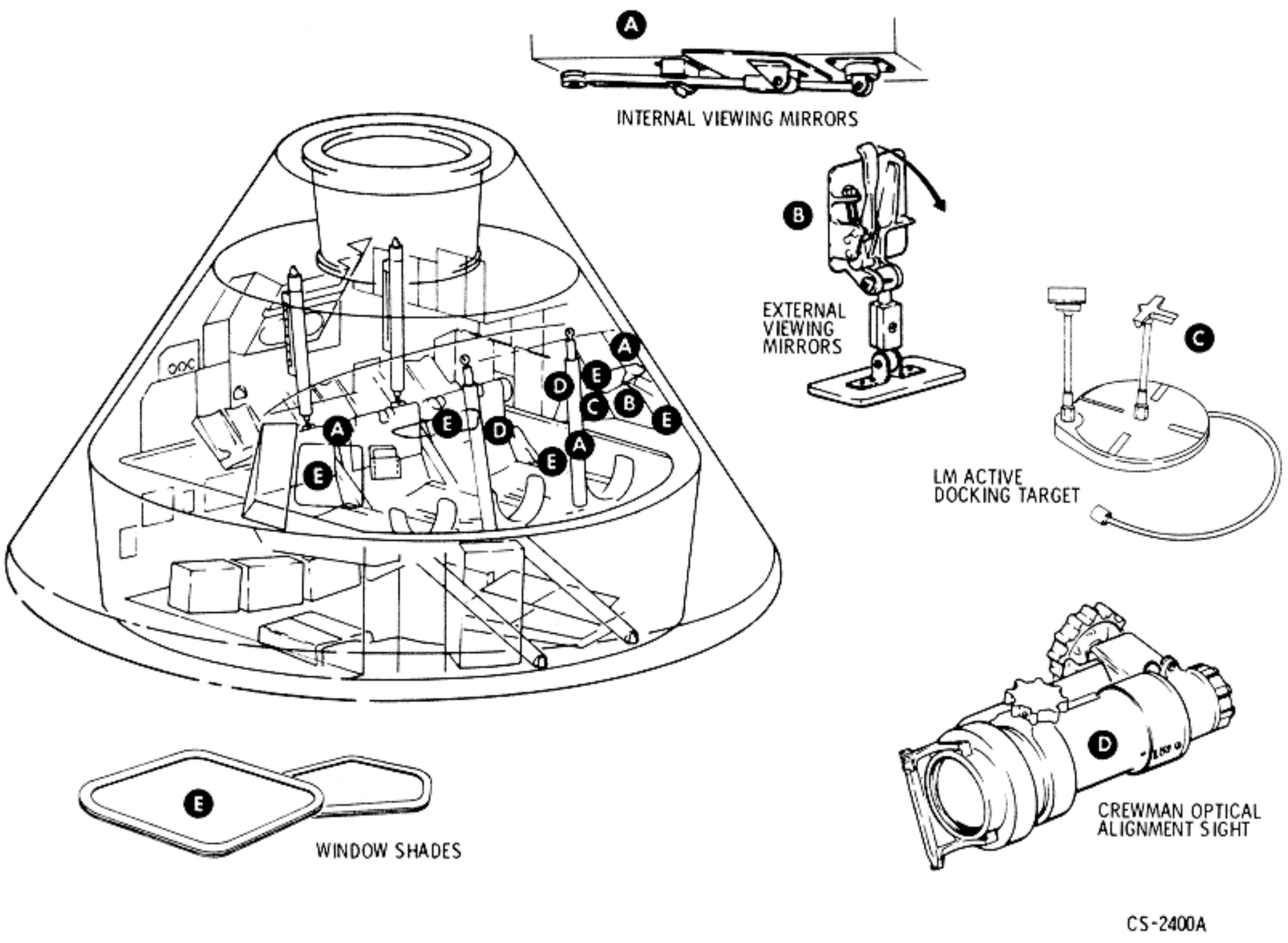

Figure 2.12-17. Internal Sighting and Illumination Aids

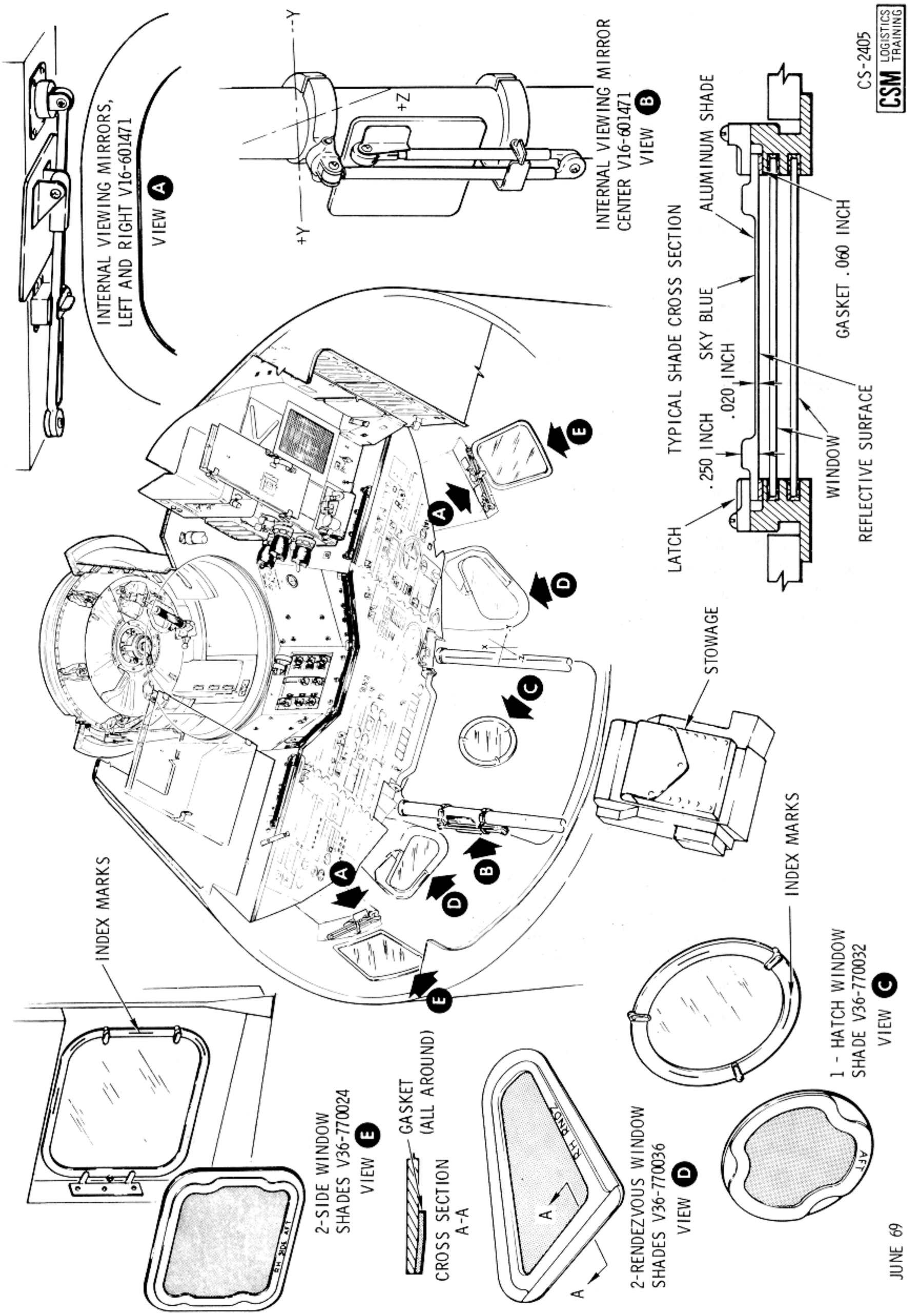

Figure 2.12-18. Window Shades and Mirrors

The window shades are aluminum sheets held on by "wing" latches. The shades are 0.020-inch thick with a frame of 0.250 inch. The shade has a gasket on the "light" side which seats against the window. Each window frame has three wing latches, or two latches and a clip, that restrain the shade on the window. The shades are stowed in a stowage bag in the upper equipment bay.

2.12.4.1.2 Internal Viewing Mirrors (Figure 2.12-19).

When the astronaut is in a pressurized spacesuit on the couch, his field of vision is very limited. He can see only to the lower edge of the main display console (MDC), thus "blanking out" his stomach area where his restraint harness buckling and adjustment takes place. The function of the internal viewing mirrors is to aid the astronaut in buckling and adjustment of the restraint harness, locating couch controls and spacesuit connectors. By positioning all the mirrors to view the MDC from the LEB, the CMP can periodically monitor the instruments while in lunar orbit.

There are three mirrors, one for each couch position. The mirrors for the left and right astronaut are mounted on the side of the lighting and audio control console above the side viewing window and fold. The center astronaut's mirror is mounted on the right X-X head attenuator strut.

(To be supplied at a later date.)

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Figure 2.12-19.

The mirror assembly consists of a mounting base, a two-segmented arm, and a mirror. The mirror is rectangular (4.25 by 3.5 inches), flat, and steel with an aluminized surface. The two-segmented arm allows a reach of approximately 22 inches from the mount. The arms have swivel joints with a friction adjustment to position the mirrors in the desired angles. The friction is adjusted with tool R, a torque set driver. The mirrors are locked in position by a clamp during boost and entry.

2.12.4.1.3 Crewman Optical Alignment Sight (COAS) (Figure 2.12-20).

The primary function of the crewman optical alignment sight (COAS) is to provide range and range rate to the CM or LM pilot during the docking maneuver. The closing maneuver, from 150 feet to contact, is an ocular kinesthetic coordination of the astronaut controlling the CM with economy of fuel and time.

A secondary function of the sight is to provide the crewman a fixed line-of-sight attitude reference image which, when viewed through the rendezvous window, appears to be the same distance away as the target. This image is boresighted (by means of a sight mount) parallel to the centerline (X-axis of the CM) and perpendicular to the Y-Z plane.

COAS Description. The crewman optical alignment sight (COAS) is a collimator device, similar to the aircraft gunsight, weighing approximately 1-1/2 pounds, is 8 inches long and requires a 28-vdc power source. The COAS consists of a lamp with an intensity control, reticle, barrel-shaped housing, mount, combiner assembly, filter, and a power receptacle. The reticle consists of a 10-degree circle (figure 2.12-20), vertical and horizontal cross hairs with 1-degree marks, and an elevation scale (on the side) of -10 to +31.5 degrees. The elevation scale is seen through an opening or window.

The COAS is stowed in a mount by the left side window at launch and entry, and other periods as the mission requires. Two spare lamps are stowed in U3. The COAS can be mounted on the right or left rendezvous window.

COAS Operation. The receptacle is de-energized by placing switch on panel 16 (right) or 15 (left) to the OFF position. If sighting at extremely bright sunlight, the filter is unstowed, and installed between the barrel and combiner by looping tether around the barrel, positioning the filter approximately parallel with the combiner, and pressing onto barrel by engaging clips. Do not slide filter on combiner frame or damage may result to clips. Install COAS on the window mount and energize circuit by placing switch to ON.

For the left window operations, the barrel index is matched with LW by unlocking the barrel lock and rotating the barrel until the detent seats. For

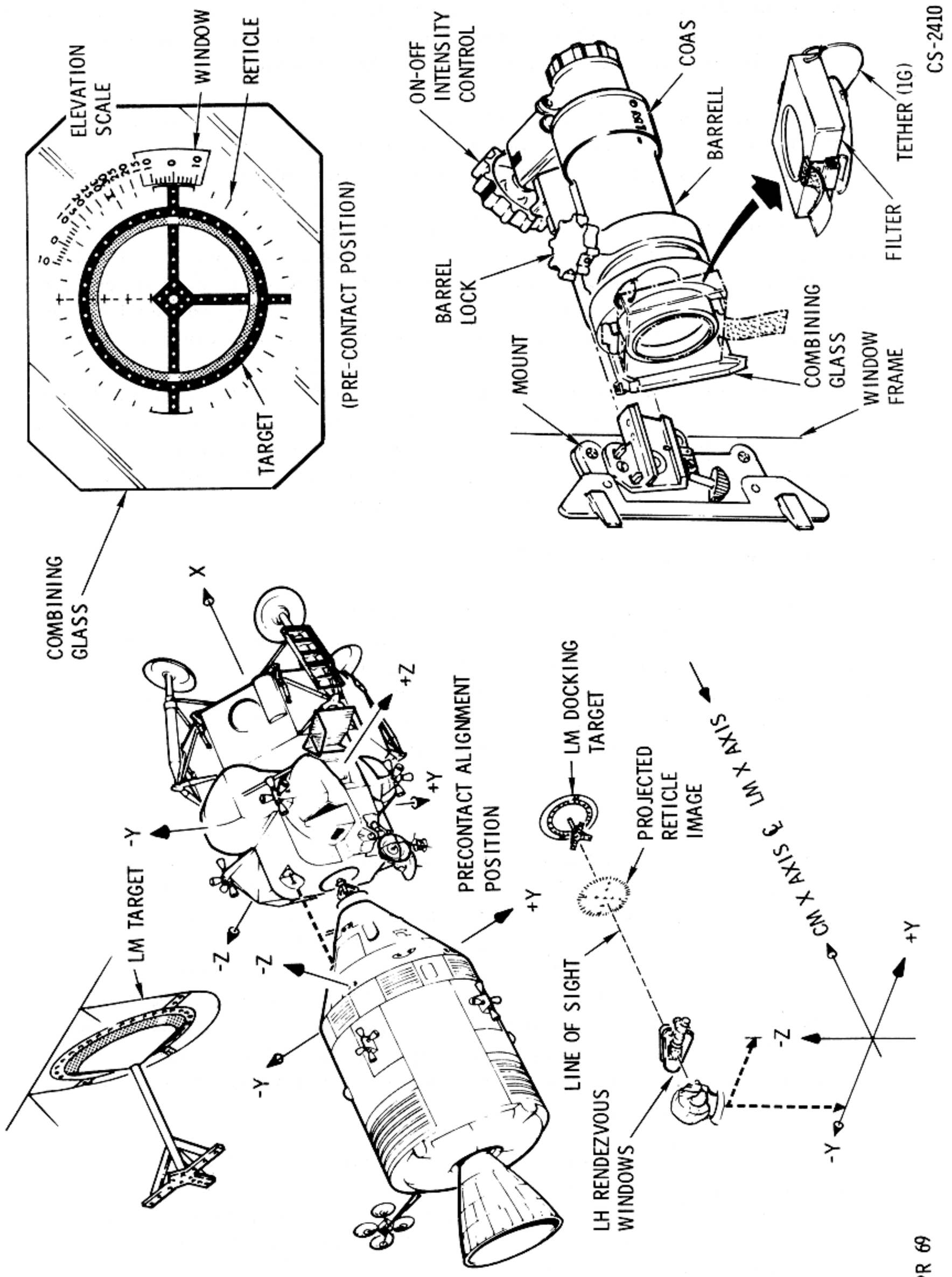

Figure 2.12-20. Crewman Optical Alignment Sight System

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right window operations, use the RW index mark. There may be a little play when the detent seats. To duplicate the boresighted condition, the barrel must be snugged or rotated against the detent. The direction of rotation is on the sidewall near each COAS mount.

To turn lamp on, turn intensity control clockwise until the reticle appears on the combiner glass at the required brightness. The actual usage and visual presentations will be discussed in paragraph 2.13.

Additional Uses. While photographing activities or scenes outside the spacecraft with the 16 mm data acquisition camera, the COAS is used to orient the spacecraft and aim the camera. The camera will be mounted in the right window at a 90-degree angle to the X-axis, and will be shooting out the right rendezvous window, via a right angle mirror assembly.

A constant angle on a star during a differential velocity maneuver (MTVC) can be maintained by use of the elevation scale. The barrel lock is lifted and turned so the barrel can be rotated, and will hold in an intermediate position by friction. The elevation will be read on the elevation scale using the horizontal "line" of the reticle as the index.

2.12.4.1.4 LM Active Docking Target (Figure 2.12-21).

After lunar rendezvous and acquisition, the LM approaches the CM from the forward end. At 50 feet, the LM pitches 90 degrees for the final approach, during which the LM Commander will sight through the overhead window, using the LM COAS for alignment. The LM overhead window will align on the CM right rendezvous window. The LM docking target will be placed in the CM right rendezvous window to function as a guide to the LM Commander.

The LM active docking target is a collapsible target of similar configuration as the LM docking target but approximately half the size. The base is 8 inches in diameter with green electroluminescent (EL) lamps and a black stripe pattern on the front. The airplane, or stand-off cross, is lit by a red incandescent lamp and its support strut folds for stowing. When folding the strut, failure to slide the nut more than 1/2 inch from the pivot point may result in damage to the face of the target. The adapter support strut is removable, fits into the base slotted stud, and is secured by a 1-inch nut that should be hand tightened only. When assembling the adapter support strut to the base, align the white indices on the base and adapter.

The base has a power cord for connection to panel 16 near the right-side viewing window. It operates on ac, and is powered from the LIGHTING RUN/EVA/TGT-AC2 right CB on auxiliary CB panel 226. The light is controlled by the DOCKING TARGET switch on MDC-16 and has three positions: OFF, DIM, and BRIGHT.

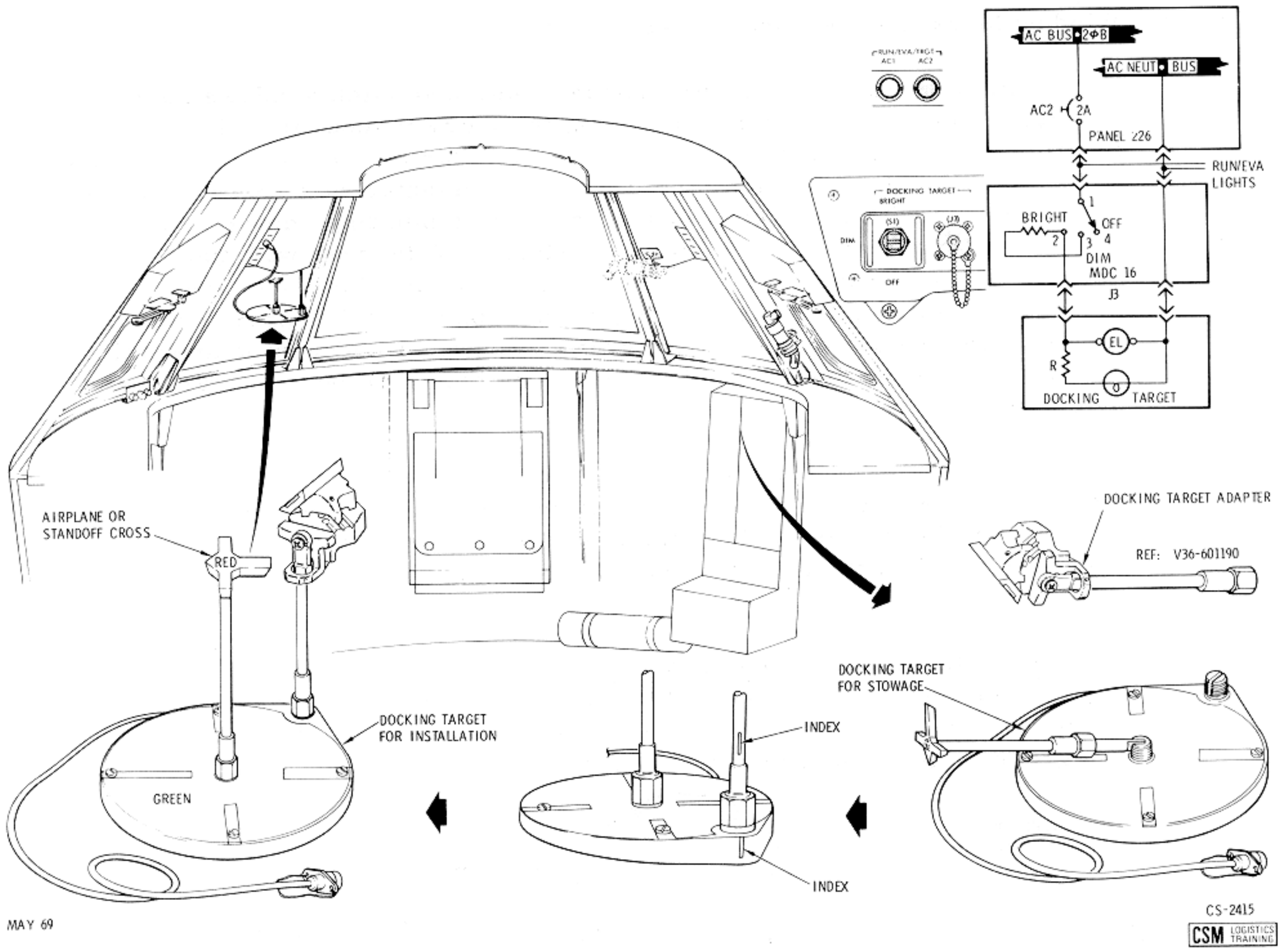

Figure 2.12-21. LM Active Docking Target

For support during usage, the mounting support strut slides into the right COAS mount on the right rendezvous window frame. The target is stowed in U3 Locker on the side wall near the aft bulkhead and side hatch.

Operation. Remove the target from the U3 locker, extend the strut, and lock in place with locknut. Remove the adapter support strut from U3 and attach to the base. Verify right LIGHTING RUN/EVA/ TGT-AC2 CB on panel 226 is closed and the DOCKING TARGET switch on MDC-2 is OFF. Insert target mount strut slide into COAS mount until it seats fully. When fully seated, the power connector will be mated.

To activate target, turn DOCKING TARGET switch to requested brightness, DIM or BRIGHT. To deactivate target, turn switch to OFF. To remove target and stow, reverse the installation procedure.

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2.12.4.1.5 Window Markings (Figure 2.12-22).

The left rendezvous, right rendezvous, and hatch windows have markings to aid the crew in monitoring the entry maneuver and also function as a visual reference for orientation during a manually controlled entry. After SM separation, the CM will be oriented to a "bottom" forward entry attitude with the crew's heads and Z-axis pointing "down." The X-axis will make an angle of approximately 31.7 degrees with the "aft" horizon during most of the entry, so as the commander views the horizon through the left rendezvous window, it will appear 31.7 degrees from the X-axis. During the entry roll program, the actual roll can be approximated by markings on the window periphery that have been precalculated by computers.

Being a method that requires a fixed-eye position to avoid parallax, the 80th-percentile crewman eye position is used - his eyes are 15 inches aft of the 31.7-degree mark on the inner rendezvous windows. If a crewman is other than the 80th percentile, he will have to adjust his head/eye position.

Left Rendezvous Window Markings. The commander, viewing through the left rendezvous window, has window marks that are yellow epoxy ink applied externally on the glass. The index marks are every 5 degrees from -5 degrees to +35 degrees.

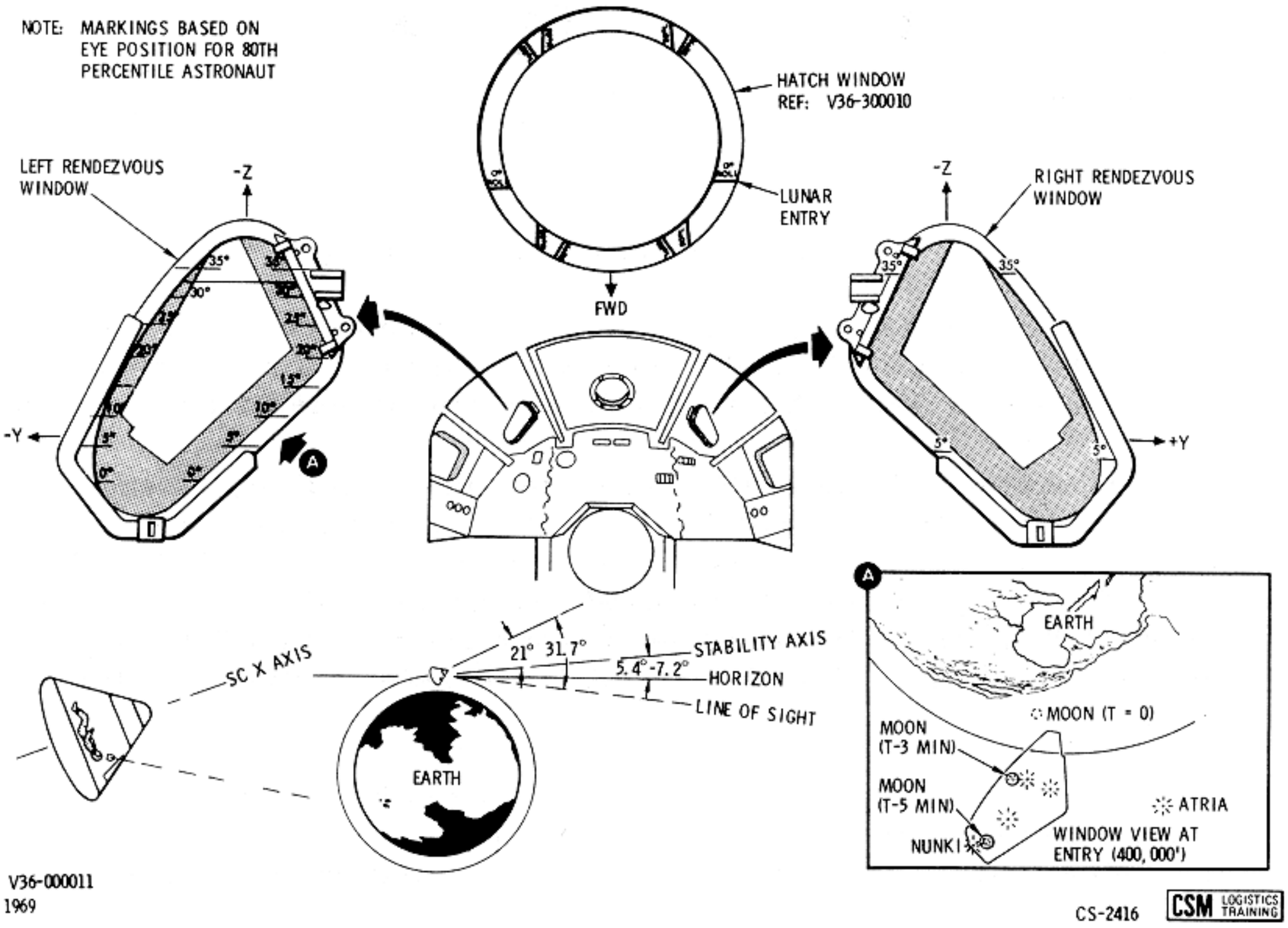

Figure 2.12-22. CM Window Markings

Center (Hatch) Window Frame Markings. Entry begins at 400,000 feet (75 miles). When .05 g is sensed, the G&N system computes the entry path to land at a certain location. The entry involves rolling the command module to control the lift vector. The CMP in the center couch can monitor the entry roll program. At 400,000 feet, the horizon will appear across the 0° ROLL marks. As the CM is rolled, there are 55° R&L, 90° R&L roll marks to compare to the horizon and estimate roll.

The black roll marks are on the hatch window frame.

Right Rendezvous Window Frame Markings. The LMP will also monitor the entry but in a limited degree. The right rendezvous window frame only has the 5° and 35° markings in black.

2.12.4.1.6 Monocular (Figure 2.12-23).

The monocular is used during lunar orbit to identify lunar points of interest. It is one half of a 10 x 40 (8 power) binocular and consists of the right barrel and the focusing mechanism. The monocular is 5.56 inches long and weighs 0.75 pound.

2.12.4.1.7 Couch Floodlight Glareshield (Figure 2.12-23A). ▮

The glareshields are used to diffuse the light from the two couch floodlights when they are required for operations. They fold open for stowage and are held around the floodlights by snaps. The glareshields are bronze screen coated with flourel and have tape hinges.

2.12.4.1.8 MDC Glareshades (Figure 2.12-23A). ▮

In the event the crew does not use the window shades to black out the light, the MDC glareshades are used to shade selected vital displays on the MDC panels 1 and 2.

The glareshades have a molded fiberglass base with sponge flourel rubber panel sides. A Velcro hook is bonded on the base flanges as a method of restraint. The shades are labeled DSKY, MISSION TIMER, and EMS DELTA V.

Shortly after entering earth orbit, the glareshades are removed from stowage and placed over the display keyboard (DSKY - panel 2), mission timer (MISSION TIMER - panel 2), and the entry monitor system display delta V/ranging (EMS DELTA V - panel 1). The displays have Velcro pile for restraint. They are left emplaced the remainder of the mission.

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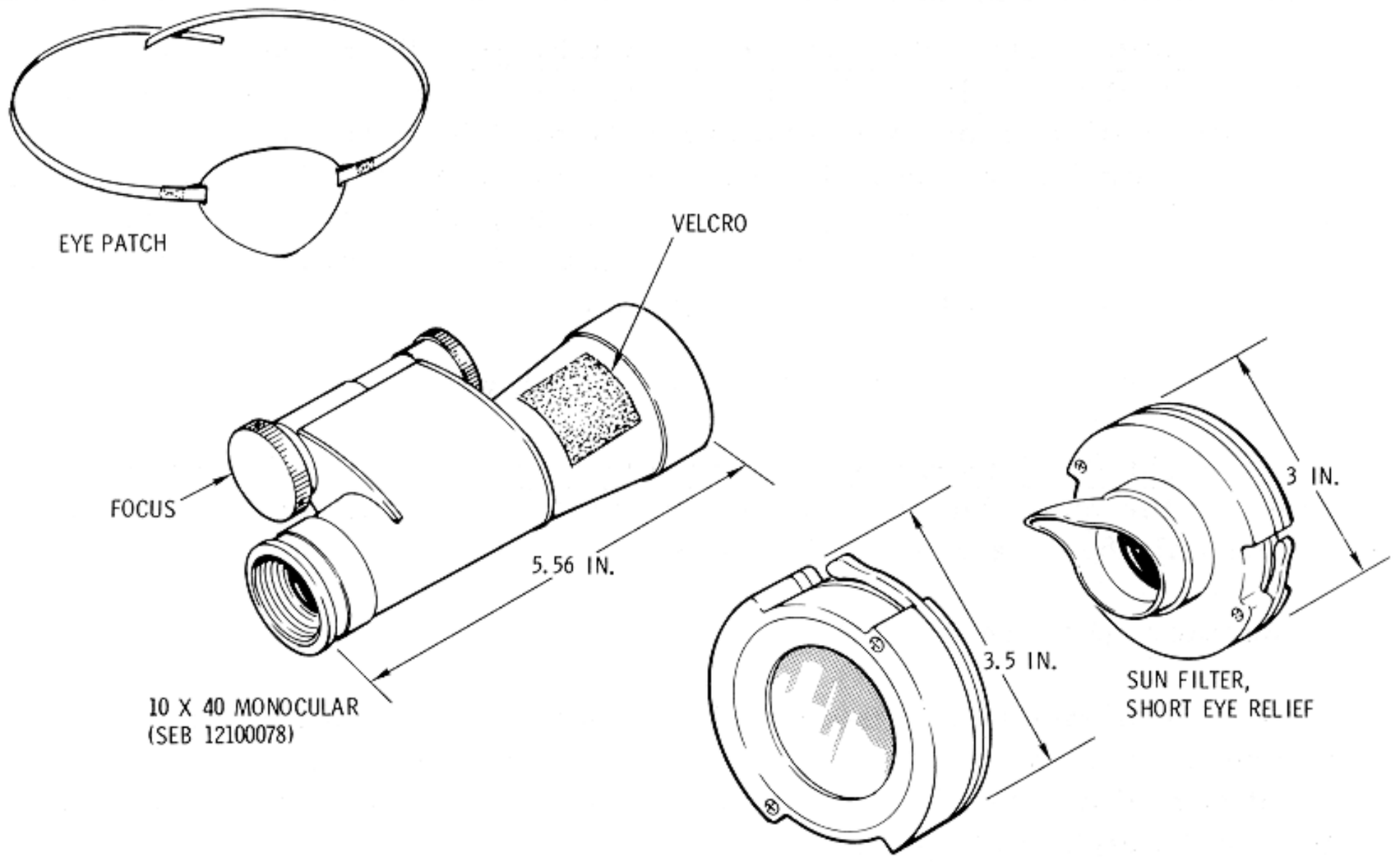

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Figure 2.12-23. Miscellaneous Internal Sighting and Illumination Aids

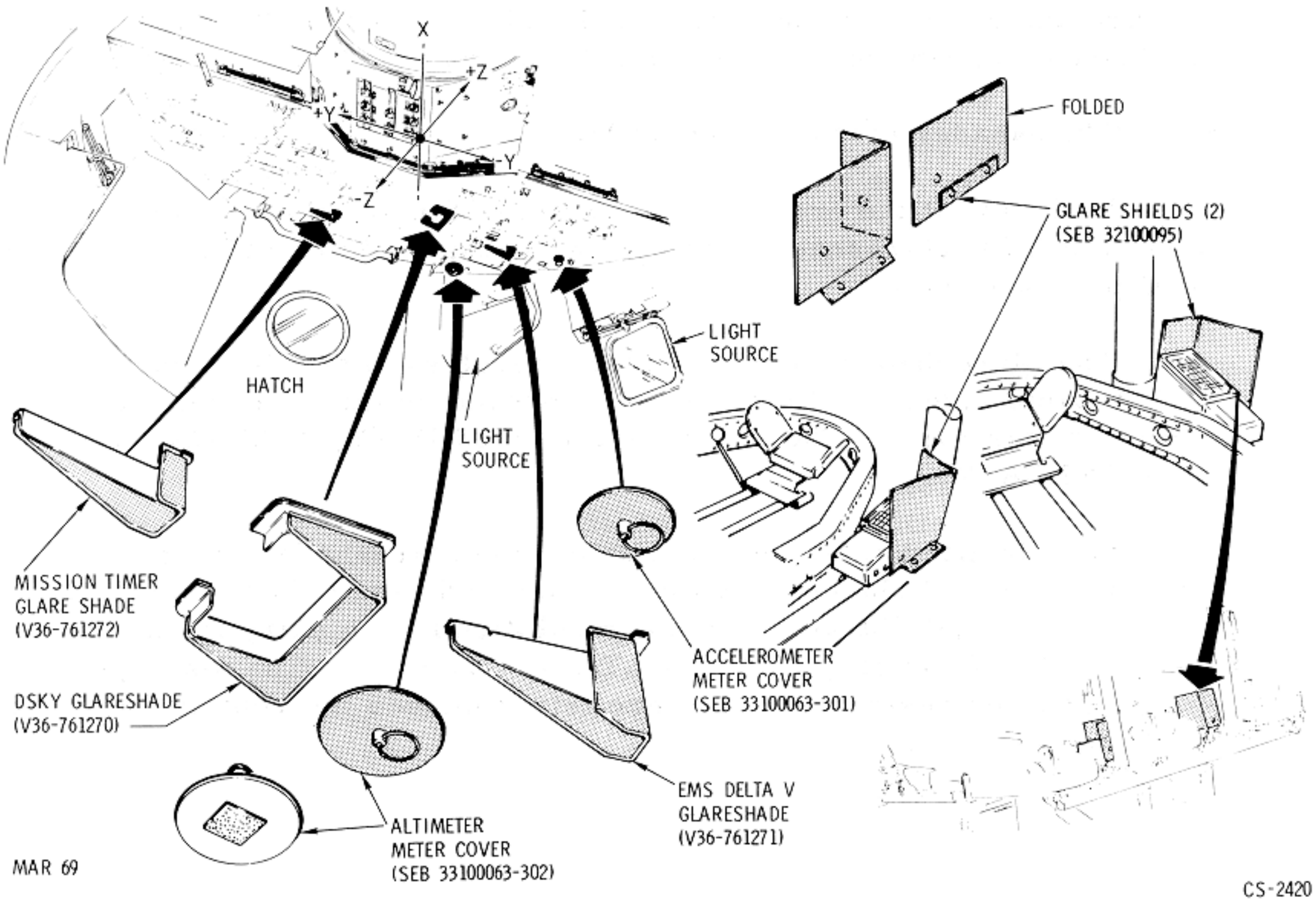

Figure 2.12-23A. Miscellaneous Internal Sighting and Illumination Aids

2.12.4.1.9 Eyepatch (Figure 2.12-23).

During the preparation to use the sextant or telescope, the LMP or other crewman must condition his eye for "night vision" when he anticipates viewing the darkness. He will wear an eyepatch that will shut out ambient light.

2.12.4.1.10 Telescope Sun Filters (Figure 2.12-23).

When sighting the G&N telescope toward the sun, the sun rays are attenuated by the use of the telescope sun filters. There are two sun filter assemblies, one that is used on the long eyepiece for suited operations, and one that is used on the standard (short) eyepiece for unsuited or shirt-sleeve operations.

The standard eyepiece sun filter is 3 inches in diameter, 0.6 inch thick, and has an eyeguard or eyecup. The long eyepiece sun filter is 3.5 inches in diameter and 0.9 inch thick. Both filters have similar mechanisms for attachment. They are rocker-arm levers 180 degrees apart, that seat a shoe in a grove on the eyepiece.

To install the standard eyepiece sun filter, the eyepiece eyeguard must be removed by unscrewing and stowing. Then, align the filter to the eyepiece, press the levers, slide on eyepiece, release levers, and seat the shoes. The long eyepiece filter installs directly on the long eyepiece in the same manner.

2.12.4.1.11 Meter Covers (Altimeter and Accelerometer) (Figure 2.12-23A). ▮

Reflected light from meters is another annoying occurrence to the crew. To limit the reflection from the altimeter and accelerometer (MDC-1) which are inactive most of the mission, the crew places covers over them.

The covers are flat, circular, sheet metal, 3 inches and 4 inches in diameter for the accelerometer and altimeter, respectively. They have a ring on one side for handling and a patch of Velcro hook on the other side for restraint.

2.12.4.2 External Sighting and Illumination Aids (Figure 2.12-24).

External illumination aids are those devices or lights located on the exterior surface of the CSM that furnish the visual environment to perform operational activities. The aids will be described in the order of their operational usage during a normal mission as follows: external spotlight

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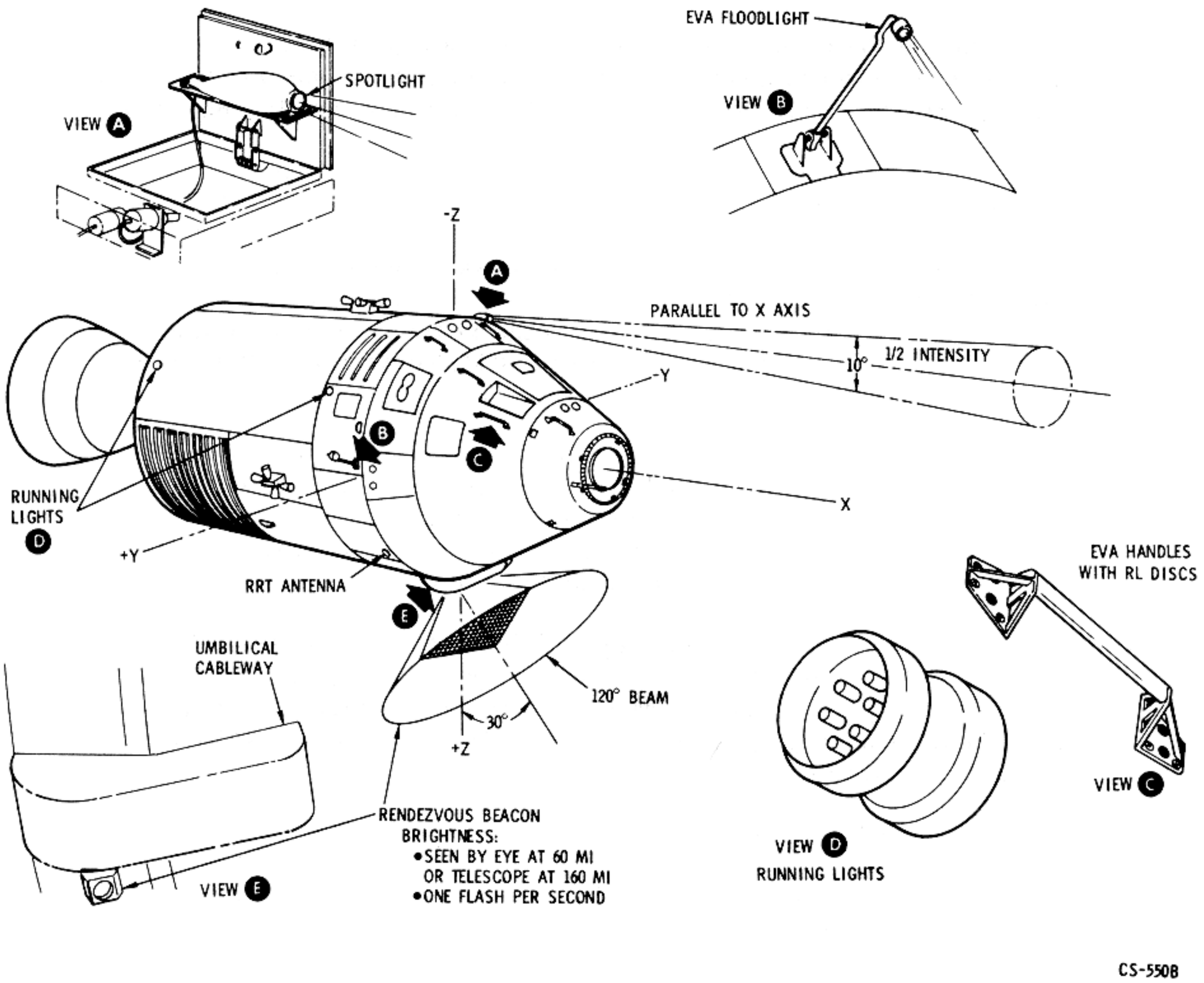

Figure 2.12-24. External Illumination Aids

used during transposition and docking, running lights for CSM gross attitude determination during lunar rendezvous, EVA handles and radioluminescent (RL) disks for lunar rendezvous CSM forward end identification and EVA activities, EVA floodlight used during EVA and retrieval of exterior paint samples, and the rendezvous beacon for backup to the rendezvous radar transponder (RRT).

2.12.4.2.1 Docking Spotlight (Figure 2.12-25).

During the transposition and docking phase of the mission (or simulation), the CSM separates from the spacecraft LM adapter (SLA) and S-IVB, translates forward 100 to 150 feet, pitches 180 degrees, rolls 60 degrees, and translates toward the LM/SLA/S-IVB for docking. During the translation toward the LM/SLA/S-IVB, it is desirable to light the LM so the proper perspective is maintained and excessive maneuvering is decreased, thus minimizing SM RCS propellant usage. The lighting of the LM/SLA is accomplished by use of the docking spotlight.

The spotlight is mounted behind the left rendezvous window on the door of a concealed compartment in the CM/SM fairing. The door is spring-loaded to the deployed position and is held flush by a pin extended

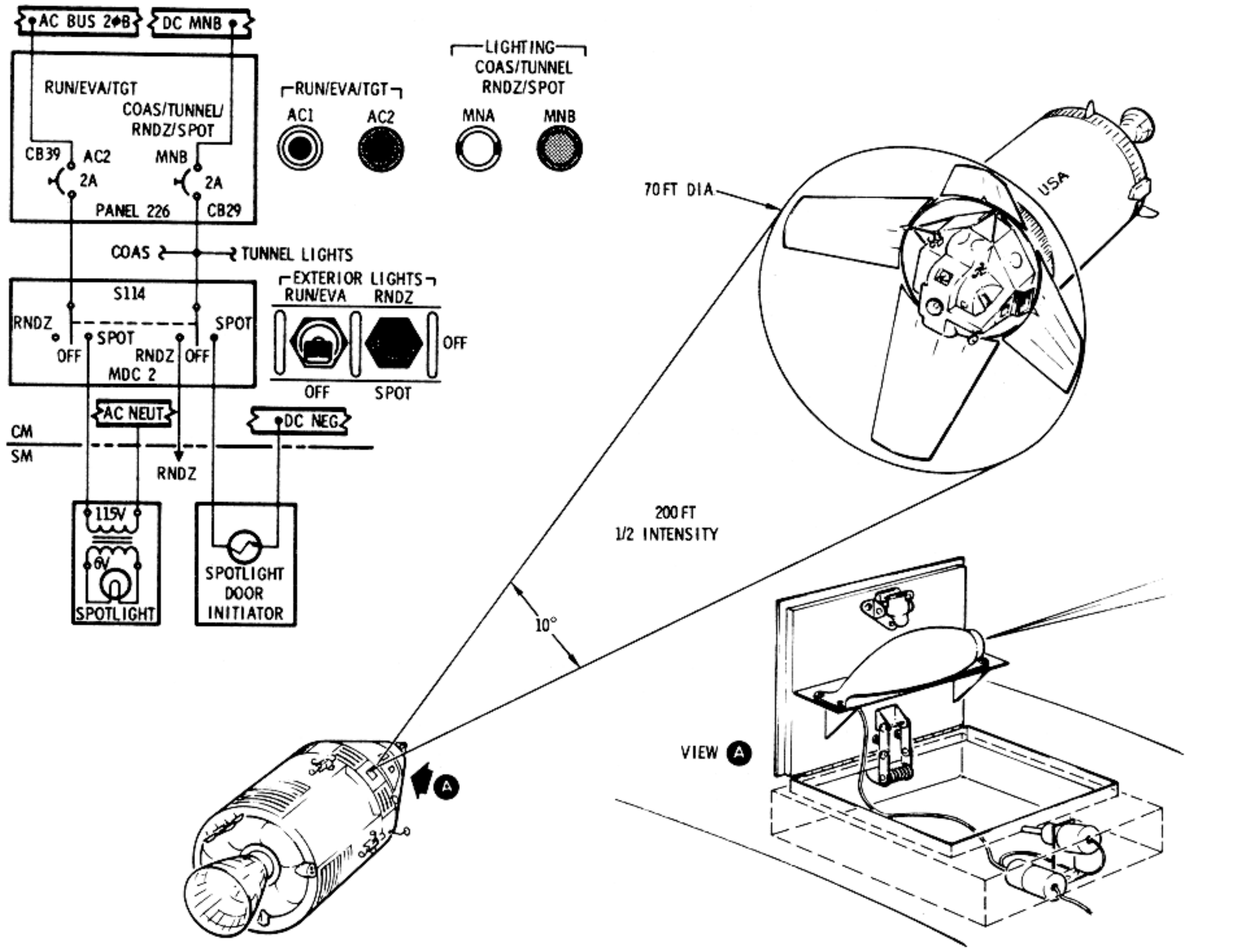

Figure 2.12-25. Docking Spotlight

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from an actuator. To deploy the spotlight/door, on MDC-2 (upper left) place the EXTERIOR LIGHTS-RNDZ SPOT switch in the SPOT position. The spotlight door initiator/actuator receives 28 vdc, its pin-retention wire melts, pulling the spring-loaded pin and releases the door. The sping-loaded door swings to the deployed position and is held there by a hinge-brace. As the switch is placed in the SPOT position, it simultaneously applies 115 vac to the spotlight, turning it on.

When docking has been completed and the spotlight is no longer needed, the switch is placed in the OFF position, removing power from the spotlight. The compartment door remains open, or deployed, for the remainder of the mission. If the spotlight is required again, place the switch in the SPOT position.

The circuit breakers for the spotlight are on panel 226. The a-c circuit breaker is labeled RUN/EVA/TGT-AC2 and the d-c circuit breaker is labeled COAS/TUNNEL/RNDZ/SPOT-MNB.

2.12.4.2.2 Running Lights (Figure 2.12-26).

The lunar rendezvous and docking phase, or simulation, requires a "gross attitude" determination by the LM crew after CSM acquisition at a distance of approximately 2000 feet. This is achieved by viewing the CSM running lights.

The running lights consist of eight lights on the service module exterior: two red, two green, and four amber. Four of the lights are on the fairing, just forward of the SM forward bulkhead, and approximately halfway between the axes. The remaining four are on the aft end of the SM, 6 inches forward of the aft bulkhead and also halfway between the axes. The two lights on the upper right quadrant are green, the two lights on the upper-left quadrant are red, and the four lights on the lower quadrants are amber. The light fixtures contain four or six colored lamps and are wired in series-parallel for redundancy.

When required or requested, the CM pilot can turn on the running lights by placing the EXTERIOR LIGHTS-RUN/EVA switch on MDC-2 (upper left) in the RUN/EVA position. A-C power is applied to the lights via a transformer, stepping the power down to 3.6 volts. The lights are turned off by placing the switch to the OFF position.

The circuit breakers for the running and EVA lights are on panel 226 and labeled LIGHTING-RUN/EVA/TGT-AC 1 and AC 2. The EVA floodlight and docking target are also powered by AC 1 and AC 2.

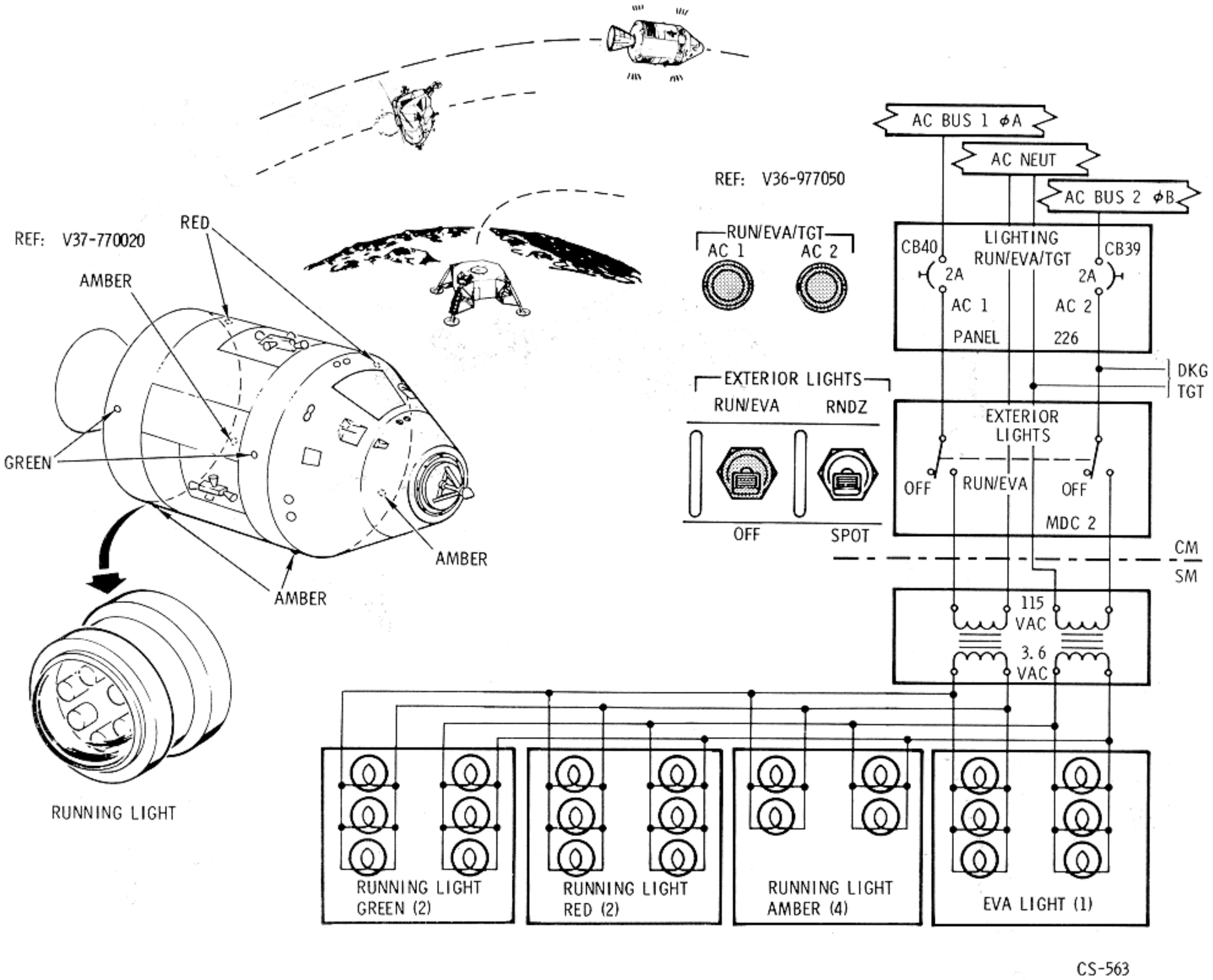

Figure 2.12-26. Running Lights

2.12.4.2.3 EVA Handles With RL Disks (Figure 2.12-27).

During the lunar rendezvous and docking phase, or simulation, after the "gross attitude" has been determined by viewing the running lights, the LM must approach the CSM from the forward end of the CSM which is accomplished by viewing the radioluminescent (RL) disks in the ring handle. RL disks are also located in other EVA handles.

The EVA handles consist of a ring handle, an extendable handle, a hatch handle, and four fixed handles. The ring handle is a circular hollow tube around the docking ring at station $X_c = 108$. There are eight supports,

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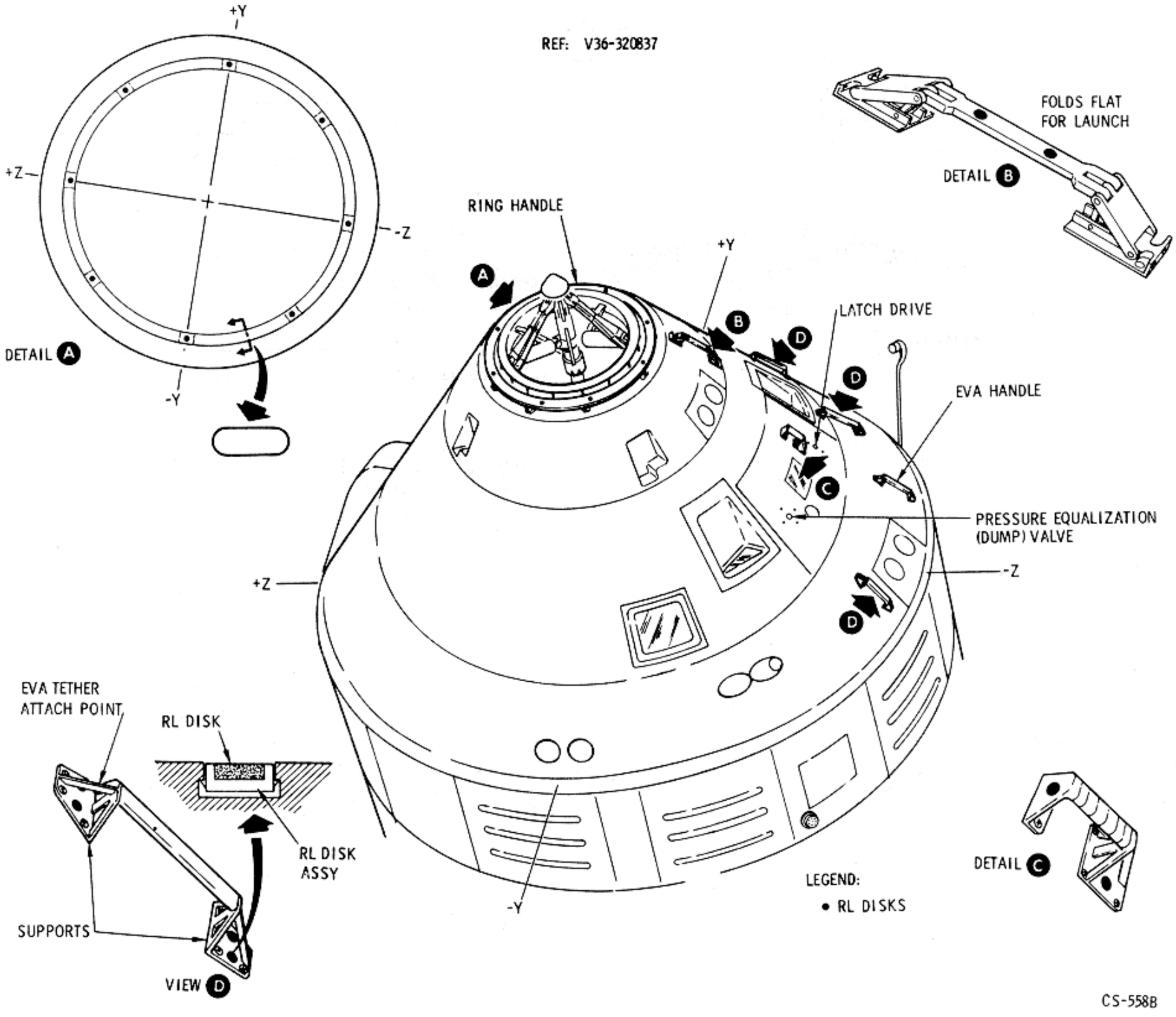

Figure 2.12-27. EVA Handles With RL Disks

located every 45 degrees, starting at any axis. Each support has an RL disk on the forward side. An additional use of the ring handle during EVA, in a docked configuration, is a handhold by the crew.

The remainder of the handles are on the hatch side of the CM exterior. From forward to aft, on the forward heat shield is an extendable (pop-up) handle that is collapsed until the boost protective cover is jettisoned with the launch escape tower. Fixed handles are located along-side the right rendezvous window, hatch, and positive pitch CM RCS engines.

The fixed handles are aluminum, oval-shaped tubes 12 inches long with a support fitting at each end. The handles are used for EVA maneuvering. The hatch has a smaller fixed handle near the latch mechanism that is used for opening the hatch. All the handle supports are bolted into fiber-glass inserts into the ablative material. They may or may not burn off on entry.

The handle supports have a small bar to which the EVA tether can be attached. The handle supports also contain the RL disks for illumination. The disks are approximately 5/8 inch in diameter. They are mounted in 0.730-inch-diameter retainers which are held in the handle supports by spring clips. The RL disks are slightly radioactive and light (glow) in the dark.

There are RL disks mounted in the hatch ablative material: two adjacent to the latch drive and four adjacent to the pressure equalization (dump) valve. These function to locate the latch and valve in the dark.

2.12.4.2.4 EVA Floodlight (Figure 2.12-28).

During EVA, while the hatch area is dark, additional light is available from the EVA floodlight. It is boom-mounted and is located on the SM fairing aft of the CM right-side viewing window. The cork-covered boom is deployed as the boost protective cover jettisons with the launch escape system, pulling a pin that holds the boom in its stowed position. The light fixture is similar to the running lights; the exception is six white lamps wired in series - parallel.

The EVA floodlight is on the running lights circuit and is turned on by the EXTERIOR LIGHTS-RUN/EVA switch on MDC-2 (upper left). The circuit breaker is located on panel 226 and labeled LIGHTING-RUN/EVA/TGT-AC 1 and AC 2.

2.12.4.2.5 Rendezvous Beacon (Figure 2.12-29).

In the event the LM rendezvous radar or the CSM rendezvous radar transponder malfunctions during the lunar rendezvous, visual tracking is required as a backup. For night (lunar darkness) tracking, the LM crew will use the alignment optical telescope (AOT) to view the CM rendezvous beacon.

The beacon is mounted on the CSM fairing approximately 10 inches from the CSM umbilical fairing (+Z) in the -Y direction. The beacon beam is canted forward so the center of the 120-degree beam is at an angle of 60 degrees from the X (longitudinal) axis. The light has the brightness of a third magnitude star, capable of being seen at 160-nautical miles by telescope or 60-nautical miles by the unaided eye. When turned on, the rendezvous beacon will flash at a rate of 1 flash per second.

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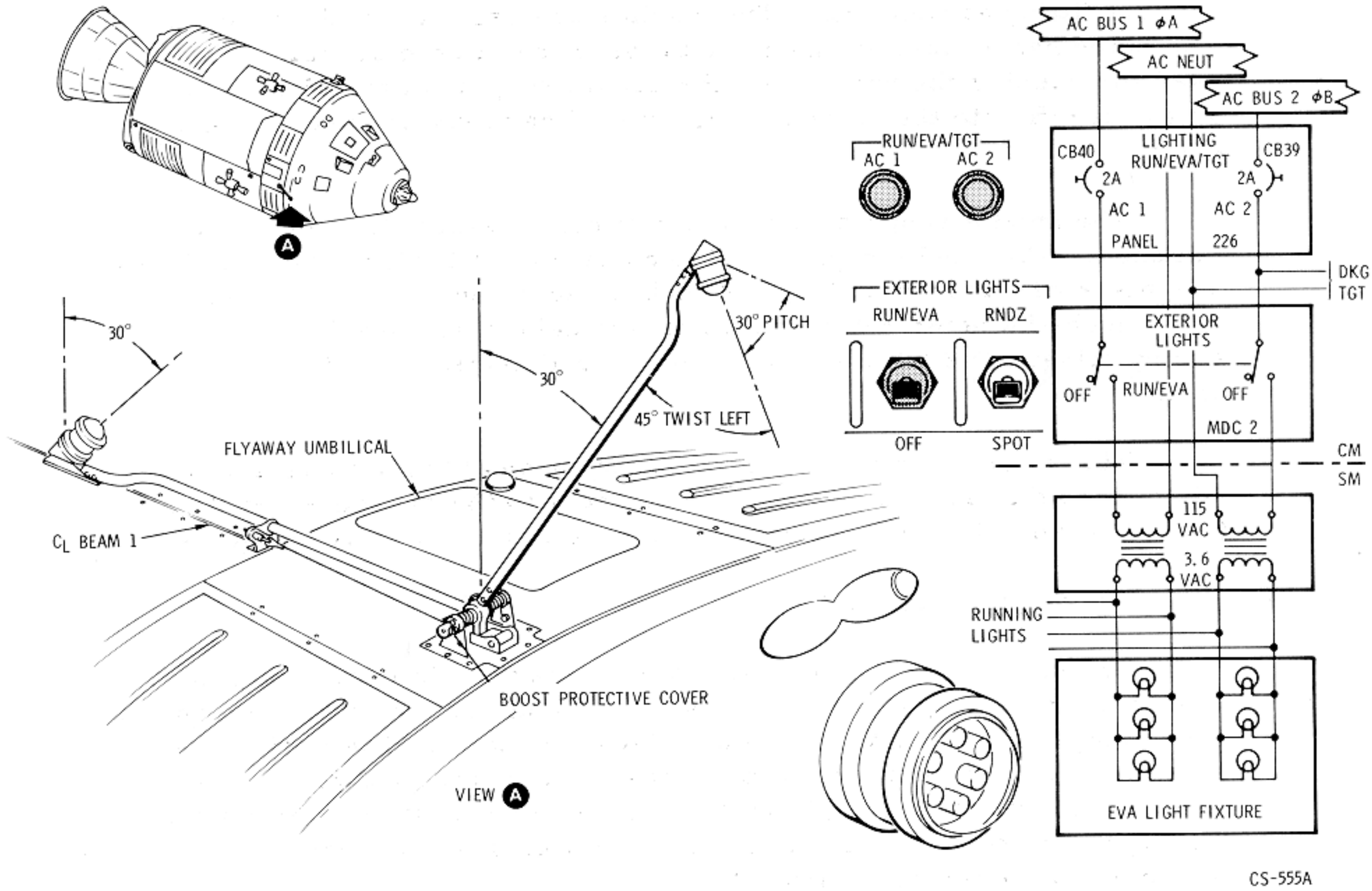

Figure 2.12-28. EVA Floodlight

The light is controlled from the MDC-2 (upper left) EXTERIOR LIGHTS-RNDZ/SPOT switch. The switch is placed in the RNDZ position when the beacon is needed. The circuit breaker is located on panel 226 and is marked LIGHTING-COAS/TUNNEL/RNDZ/SPOT - MNB.

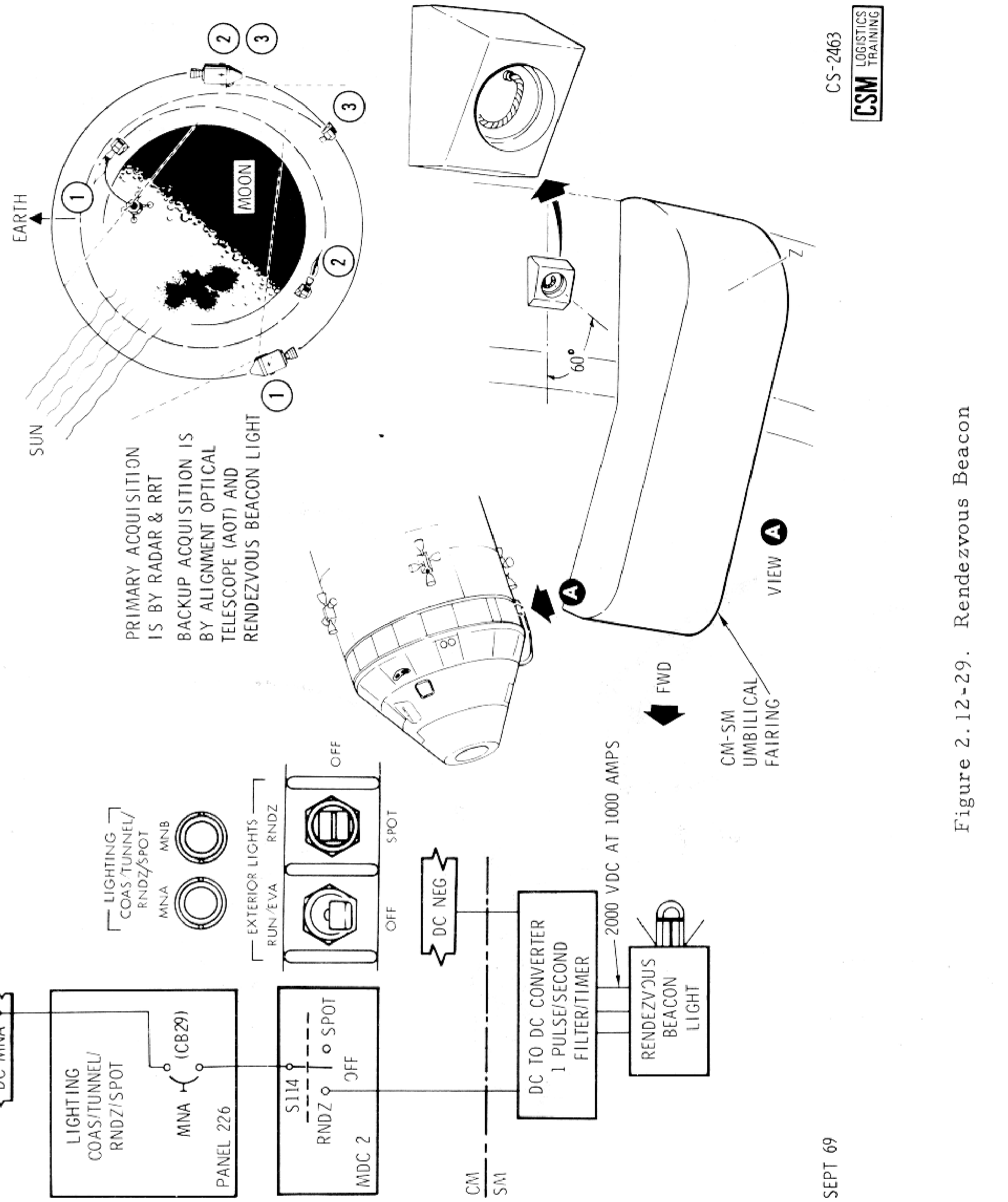

Figure 2.12-29. Rendezvous Beacon

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2.12.5 MISSION OPERATIONAL AIDS (Figure 2.12-30).

Mission operational aids are those stowed devices, apparatus, and paraphernalia the crew utilizes to perform the required mission. Normal, backup, and emergency requirements are accomplished by these items. Miscellaneous items that are not related to other spacecraft systems or subsystems are also included and described in this category.

2.12.5.1 Flight Data File (Figure 2.12-31).

The flight data file is a mission reference data file that is available to the crewmen within the command module. The file contains checklists, manuals, charts, a data card kit, and LMP data file. It weighs approximately 20 pounds.

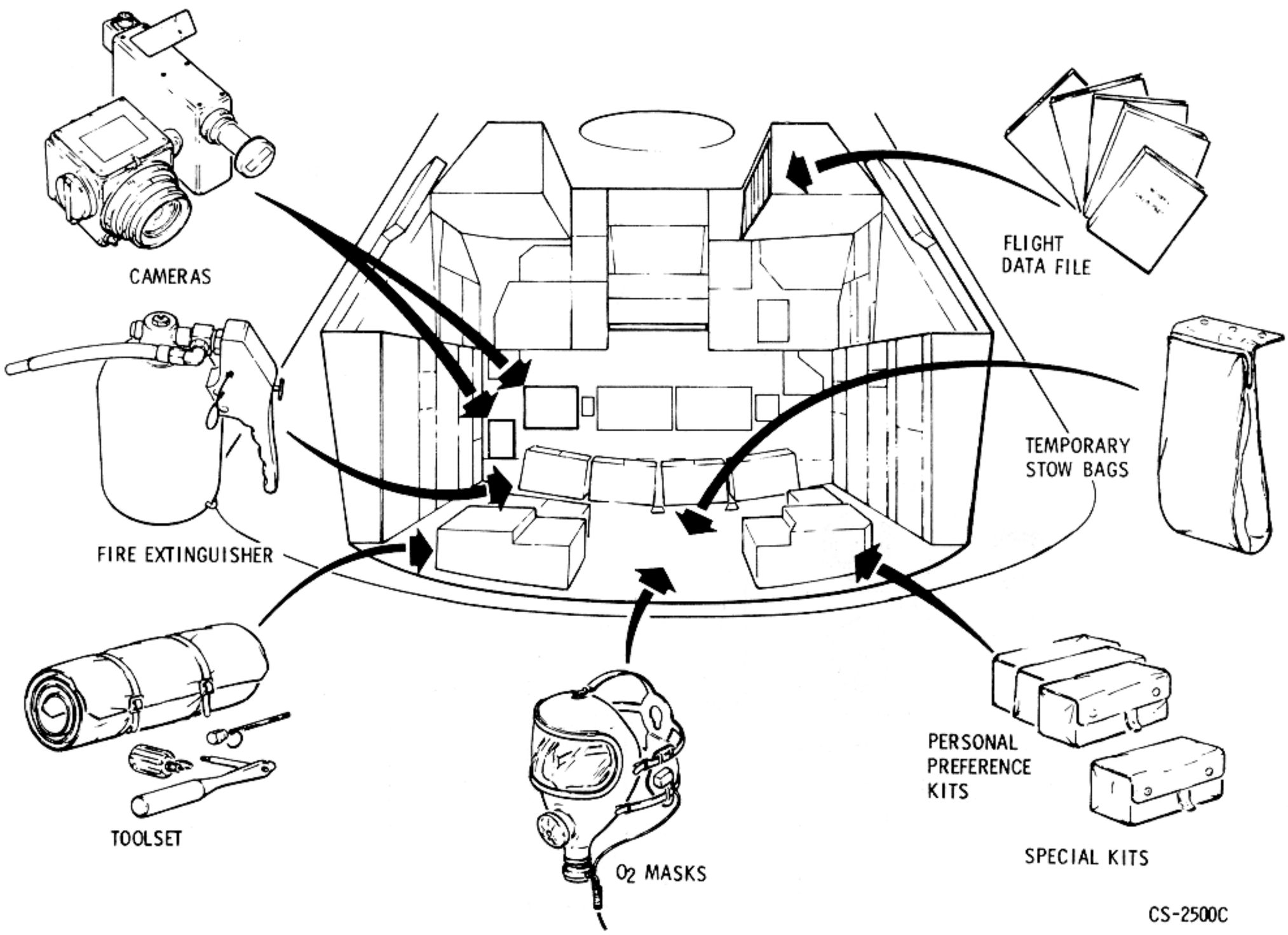

Figure 2.12-30. Mission Operational Aids

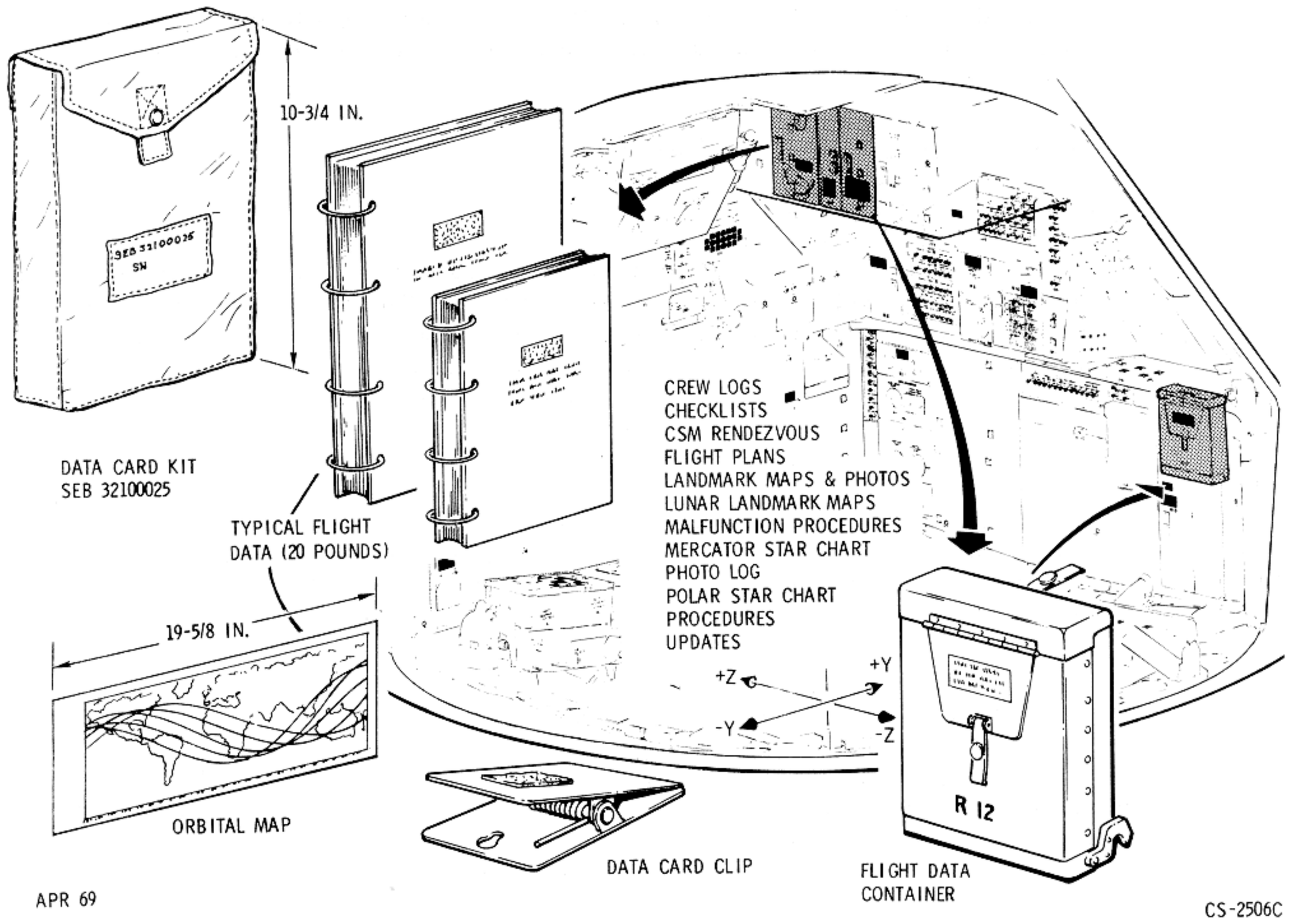

Figure 2.12-31. Flight Data File

2.12.5.1.1 LM Pilot's Flight Data File.

The LM pilot's data file is an aluminum container and is stowed in compartment R3 in the RHFEB at launch and entry. The data file contains a crew log, charts and graphs, systems data, and malfunction procedures. It is attached on the right girth shelf near the LM pilot's right shoulder after orbit for accessibility.

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2.12.5.1.2 Data File Clip.

The data file clip function is to attach the handbooks to the structure for accessibility. It is a metal clamp (clipboard type) with a patch of Velcro on one side.

2.12.5.2 Crewman Toolset (Figure 2.12-32).

2.12.5.2.1 General.

The crewman toolset provides multipurpose tools and/or attachments for mechanical actuations and valve adjustments. The toolset contains the following items: a pouch, an emergency wrench, an adapter handle, an adjustable end wrench, a U-joint driver, a torque set driver, a CPC driver, 3 jack screws, and a 20-inch tether. Each tool has a tether ring and is designated with a letter of the alphabet. All tools are capable of being used with a PGA gloved hand.

The adapter handle (tool E) is most often used. Therefore, if the tool required is other than tool E, a placard will indicate the correct tool and the direction of rotation. For specific tool usage, refer to tool usage chart. During February 1969, a group of tools associated with the probe were added.

2.12.5.2.2 Toolset Description and Use.

Tools B, E, and V have small 5/32-inch and large 7/16-inch hex drives similar to allen-head wrenches. The small drive is primarily used for mechanical fastener and ECS valve operation. The large drive is used for large torque requirements and connecting to drivers. Drivers, such as tools L, R, and V, have 7/16-inch hex sockets that receive the large drives.

Toolset Pouch. The toolset pouch is a tool retention device made of beta cloth. The pouch has pockets with retention flaps and Velcro tabs. For zero-g stowage, it has Velcro hook patches so it can be attached to the CM structure. For launch and entry stowage, it rolls and fits into a stowage locker on the aft bulkhead. The pouch will stow all of the tools. However, some crewman may elect to stow the adapter handle E in the spacesuit, or in a more accessible compartment.

Tool B - Emergency Wrench. The emergency wrench is 6.25-inches long with a 4.25-inch drive shaft. The drive shaft has a large drive only. The wrench is capable of applying a torque of 1475-inch pounds, and has a ball-lock device to lock it in a socket. It is essentially a modified allen-head L-wrench. An additional tool B is aboard the LM.

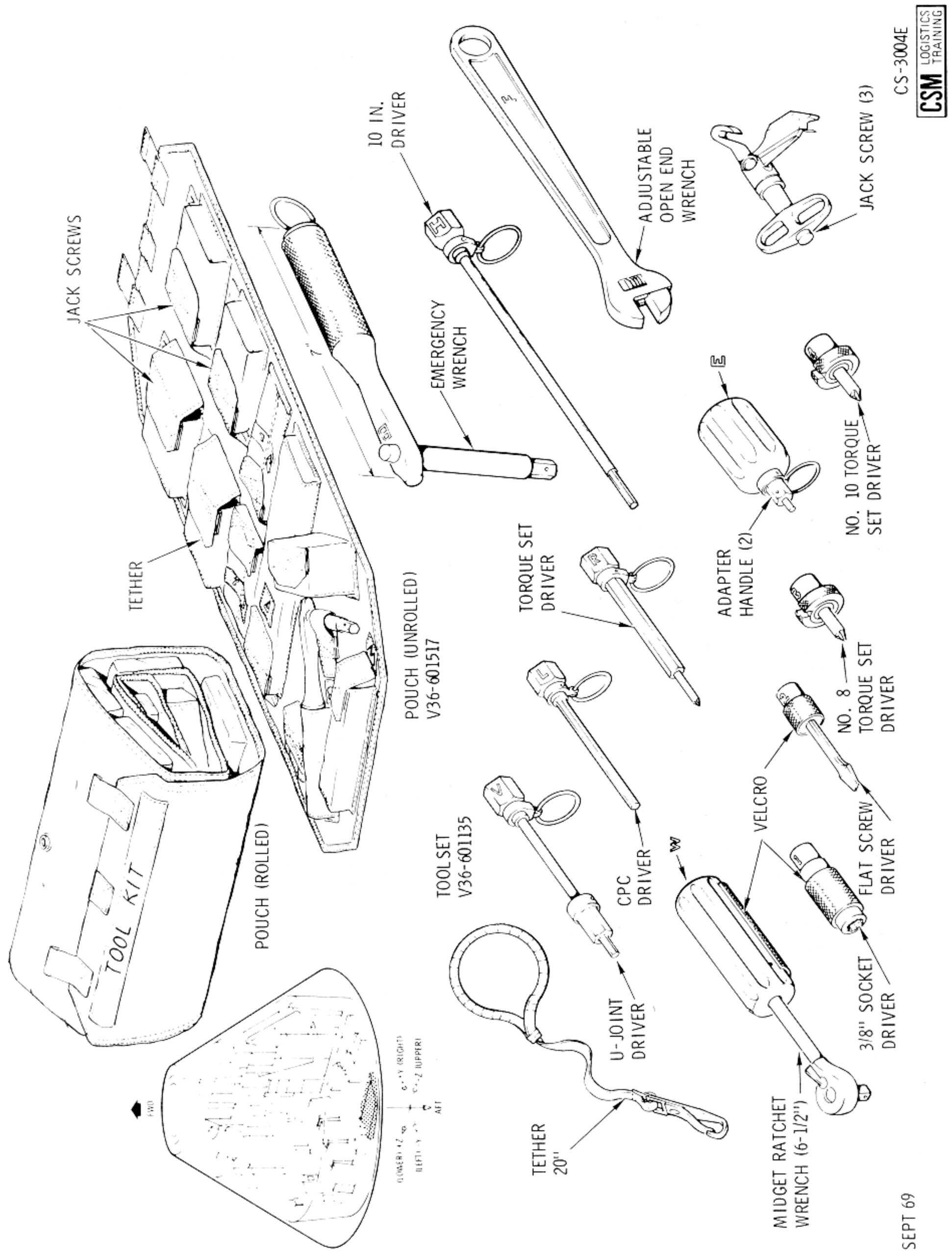

Figure 2.12-32. Crewman Toolset

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Crewman Toolset Usage Chart

E = Emergency, or Backup, Tool Usage
P = Primary Tool Usage

Function	Small Drive Tip	Large Drive	Emer Wrench	Adap Handle (2)	Adj End Wrench	Torque Set Driver	U-Joint Driver	Midget Ratchet	3/8" Socket	1/4" Screw Driver	NR 8 Torque Set	NR 10 Torque Set
Tool Designator			B	E	F	R	V	W	1	2	3	4
A. Environmental Control System	X			P								
1. Open/close ECS valves on oxygen, water, coolant control, girth shelf ECS, and LHEB ECS panels.												
2. Operate secondary cabin temperature valve (LHFEB).	X			P								
3. Operate CM/tunnel LM PRESSURE EQUALIZATION valve (from LM side).		X	P									
4. Unlatch/latch fasteners of access panels to filter and coolant controls (LHEB).	X			P								
5. Unlatch/latch fasteners of access panel to cabin atmosphere recirc system (LHFEB).	X			P								
6. Position PRIM ACCUM FILL valve OPEN/CLOSE.	X			P								
7. Open hatch dump valve (from outside EVA).		X	P									
8. Unlatch/latch fasteners of access panel to waste water line filter.				P								
B. Guidance and Control System												
1. R/R G&N handles (2) on G&N panel (LEB).	X			P								
2. Adjust scanning telescope shaft and trunnion axis (emergency mode) (LEB Panel 121).	X			E			E					
3. Open/close EMS pot GTA cover and adjust EMS pot on MDC-1 during prelaunch checklist by backup crew.	X			P								
C. Mechanical Systems - Inside CM												
1. Install/remove survival beacon connector (5/8) hex.	X				P							
2. Any drive screw or fastener with a 5/32" internal hex.	X			P								
3. Adjust mirror U-joints.				P		P						
4. R/R sea water access tube plug (LHEB).	X		P									

Crewman Toolset Usage Chart

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Tool Designator			B	E	F	R	V	W	1	2	3	4
5. Tighten/loosen sea water teflon guide plug (3/4" hex).					P							
6. R/R stowage lockers.	X			P								
7. Manually remove forward tunnel hatch latch pivot pin.					E			E		E		
8. Tighten lightweight headset mic boom.								E		E		
9. Adjust window shade latches.								E		E		
10. Backup for "R" tool.								E			E	E
11. Manually release docking ring latches.										E		
D. Mechanical Systems - Unified Hatch												
1. R/R bell crank.		X	E									
2. Operate unified hatch latch drive (from inside).		X	E									
3. Isolate latch linkage.		X	E									
4. Actuate latches (backup adjustment 11/16 flats).					E							
5. Disconnect/remove hinges.		X	E									
E. Probe and Tunnel Equipment												
1. Remove nuts and bolts from ends of shock struts (emergency probe collapse and removal).					E			E	E			
2. Remove fairings from docking ring latches (prior to manual release of docking ring latches).								E			E	E

Tool E - Adapter Handle. The adapter handles are approximately 3.5-inches long and 1.5-inches in diameter. Each has a large and small drive and fits all drivers. A ball detent will assist in maintaining contact with the drivers. It is used similar to a screwdriver.

Tool F - End Wrench. There is one adjustable end wrench per tool-set, a 10-inch crescent wrench. The end wrench is used to install and remove the survival beacon connector and emergency activation of the hatch latches.

Tool L - Cold Plate Clamp Driver. The CLP driver is 5 inches long with a 7/32-inch hex at one end and the 7/16-inch socket at the other. It is used to remove the waste water servicing plug on the water panel (352) in preparation for partial dump of waste water tank.

Tool R - Torque Set Driver. The torque set driver is 4 inches long with a 7/16-inch socket at one end, a shaft in the center, and a No. 10 torque set screwdriver at the other end. It is used primarily to adjust the mirror universal joints that may come out of adjustment during vibration loads.

Tool V - U-Joint Driver. The U-joint driver has a 7/16-inch driver socket at one end and a universal joint with a small and a large hex drive at the other end. The U-joint driver will rotate up to an angle of 30°. It is used to gain access to the "hard to get at" fasteners.

NOTE

The following five tools (W, 1, 2, 3, 4) are referred to as "docking probe tools" but their capability is greater than emergency probe disassembly. The tools are all modified SNAP ON tools and have Velcro patches for restraint. The attachment tools have 1/4-inch drive sockets.

Tool W - Midget Ratchet Wrench. The midget ratchet wrench is 6.62 inches in length, has a 1/4-inch drive with an R/L ratchet controlled by a pawl on one end, and a 1-inch cylindrical handle on the other. The handle has a 2-1/2-inch length of Velcro hook for restraint. Its function is to drive attachment tools 1, 2, 3, and 4.

Tool 1 - 3/8-Inch Socket. Tool 1 is 2 inches long, has a 1/4-inch drive socket on one end, and a 3/8-inch 12-point socket on the other. It is used to remove the nuts from the bolts that retain the shock strut to the probe supports.

Tool 2 - Screw Driver. A 1/4-inch flat screw driver 2.8 inches long is tool number 2. It is used to torque any slotted screws or bolts and those listed in the tool usage chart.

Tools 3 and 4 - Number 8 and 10 Torque Set Drivers. The torque set drivers are 1.6 inches long. The numbers 8 and 10 indicate the number 8 and 10 torque set tips. They are used to remove number 8 and 10 torque set screws (some of which are listed in the tool usage chart) and as a backup for tool R, the 5-inch torque set driver.

Tether. The tether is a strap 14 inches long with a snap hook at one end and a loop at the other. The hooks can be snapped into the tool tether ring to secure it to the crewman when moving about the CM.

Jackscrew. The jackscrew is approximately 4 inches long with a wing nut on one end. The opposite end has a trunnion, about which a lever rotates, and through which a hook shaft slides. When the wing nut is turned clockwise, it draws the hook shaft into the barrel.

In the event the side hatch is deformed and the hatch latch mechanism will not engage the hatch frame, the jackscrew is used to draw the hatch to the position the latch mechanism will engage. If the latch will not engage, the screwjacks will hold the hatch closed so that it will withstand the thermal load of entry. However, it may not be pressure-tight.

To use, engage the lever into the three catches on the hatch frame (two on right, one on left). Next, engage the hook into the three catches on the hatch and screw the wing nut clockwise, taking care to tighten evenly in increments. That is, a couple of turns on one jackscrew, then a couple of turns on the next jackscrew (next clockwise position), etc., until the hatch is snug.

Tool H - 10-inch Driver. The 10-inch driver has a 7/16-inch driver socket at one end and a 9-inch shaft with a 5/32-inch hex drive (small tip). It is used to disconnect and connect the fasteners holding the food freezer in its stowage position.

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2.12.5.3 Cameras.

Two basic types of operational cameras and associated accessories are furnished to facilitate in-flight photography: a 16 mm cine/pulse camera and a 70 mm still camera. Photography assignments vary from mission to mission and hardware requirements vary accordingly. Spacecraft crew equipment stowage lists reflect camera equipment configuration. Typical mission photography task assignments include the following: synoptic terrain and weather studies, LM docking, crew operations, crew EVA, and targets of opportunity. Later manned flights will provide for specific scientific experiments and will require specialized equipment. A brief description of the two basic operational cameras and their accessories follows.

2.12.5.3.1 16 mm Data Acquisition Camera (Figure 2.12-33).

The data acquisition camera is a modified movie camera and is an improved version of the earlier Gemini-type 16 mm sequence camera equipped with new-type external film magazines which greatly enhance the photographic capabilities. Primary use of the camera will be to obtain sequential photographic data during manned flights. It will be used for documentary photography of crew activity within the CM and for recording scenes exterior to the spacecraft. Bracketry installations at each rendezvous window facilitate use of the camera for CSM-LM docking photography to recording engineering data. An additional hatch-mounted bracket facilitates use of the camera for EVA photography. Camera modes of operation (frame rates) are variable as follows: Time, 1 frame per second (fps), 6 fps, 12 fps, and 24 fps. Shutter speeds are independent of frame rate and include 1/60 second, 1/125 second, 1/250 second, 1/500 second and 1/1000 second. Camera power is obtained from spacecraft electrical system via panel-mounted 28-vdc utility receptacles. Camera operation is manually controlled by an ON-OFF switch located on the front of the camera. Camera weight, less film magazine, is 1.8 pounds. When bracket-mounted at either spacecraft rendezvous window, the camera line of sight is parallel (±2 degrees) to vehicle X-axis. Camera accessories include a power cable, film magazines, lenses, right angle mirror, and a ring sight, which are described in the following paragraphs.

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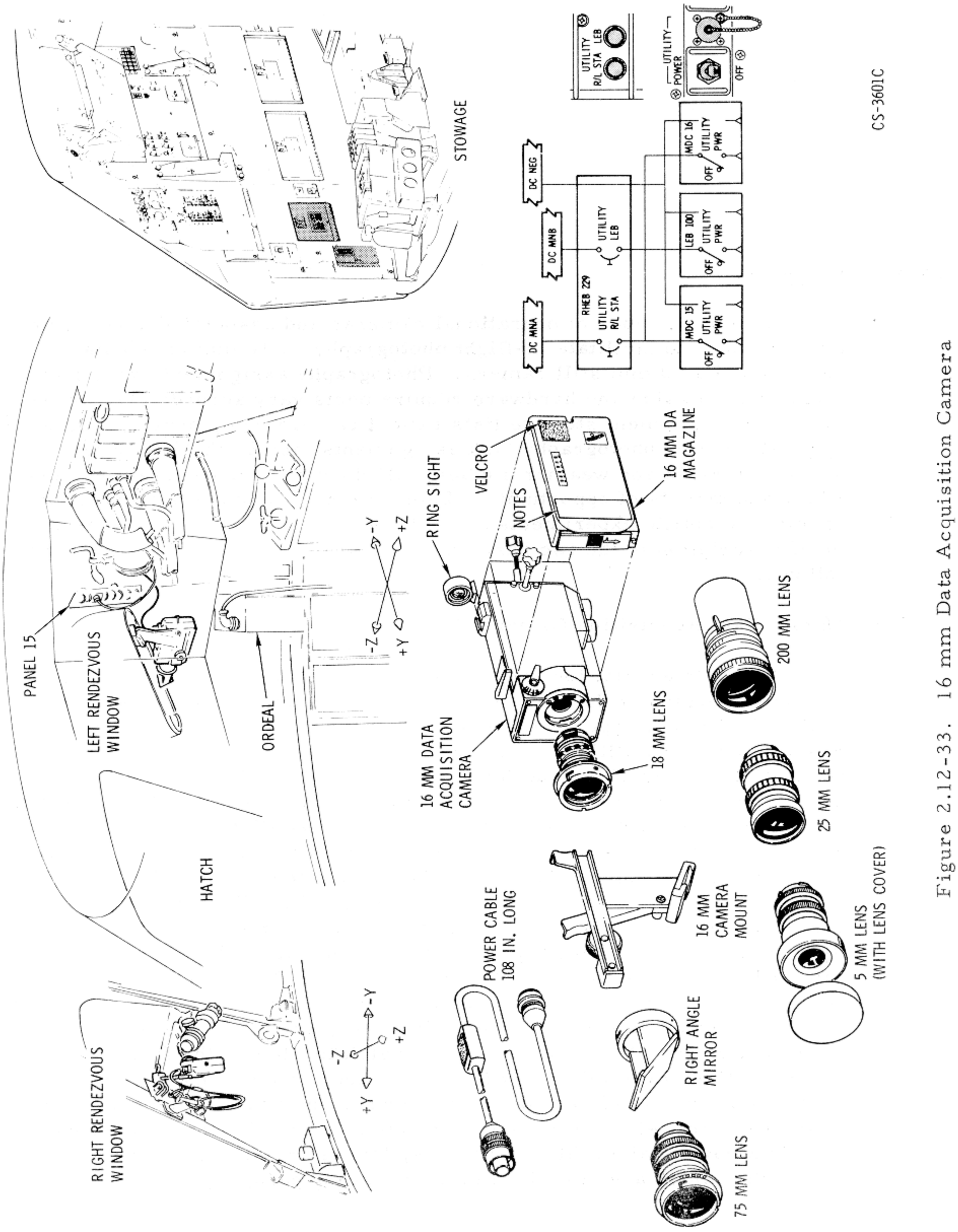

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Figure 2.12-33. 16 mm Data Acquisition Camera

Power Cable. The power cable provides the necessary connection between the spacecraft electrical power system and the 16 mm camera. The cable is approximately 108 inches long and weighs approximately 0.23 pound. Built-in electrical lamps are energized automatically during camera operation and serve as visual indication that the mechanism is working. Utility receptacles, 28 vdc, are located on spacecraft panels 15, 16, and 100.

16 mm Film Magazine. Film for each mission is supplied in pre-loaded film magazines that may be easily installed and/or removed from the camera by a gloved crew member. Film capacity is 130 feet of thin base film. Total weight of magazine with film is approximately one pound. Magazine run time versus frame rate is from 87 minutes at one frame per second to 3.6 minutes at 24 frames per second. Each magazine has a "film remaining" indicator plus an "end of film" red indicator light. Future plans include film magazines of 400-foot capacity. Quantity and type of film supplied is determined by mission requirements.

Lenses. Four lenses of different focal length, which are provided for use on the 16 mm camera, are described herewith.

5 mm f/2 — an extreme wide-angle lens designed for wide-angle photography. Primary use will be for close interior photography of crew activity within the spacecraft and for EVA photography. Viewing angle of 80 degrees (vertical) by 117 degrees (horizontal) on a 16 mm format. Weight of lens with protective cover is approximately 0.69 pound.

10 mm — (SEB 33100010) a medium wide-angle lens, the field of view being 41.1 degrees x 54.9 degrees. It will be used for internal crew activities and equipment when details are required. Focus is from 6 inches to infinity with aperture openings from f1.8 to 22. It is similar in size to the 5 mm lens and has two spike-like handles for setting f stop and distance with the gloved hands.

18 mm T/2 — (SEB 33100023) a lens of slightly wide-angle design and high optical quality. Primary use is for vehicle-to-vehicle photography while bracket-mounted at left or right rendezvous window. It is also the widest angle lens that may be used with the right-angle mirror. This lens is usually stowed on the camera. Viewing angle of 24 degrees x 32 degrees and weight is approximately 0.57 pound.

18 mm Kern — (SEB 33100018) the newest 18 mm lens model for general photography of intravehicular and extravehicular activities. It is slightly larger and longer than the former lens and is distinguished by its two spike-like handles for setting the f stop and distance with the gloved hand. This improved lens has larger numbers for reading while in the EV spacesuit.

75 mm f/2.5 — (SEB 33100078) a medium telephoto lens design with excellent optical properties. Primary use is for photography of distant objects and ground terrain. Usually used on the bracket-mounted camera. Viewing angle of 6 degrees x 8 degrees, weight is approximately 0.53 pound.

75 mm Kern — (SEB 33100019) the newest 75 mm lens model for DAC telephotos. This lens is similar in appearance to the new 18 mm lens, having two handles for f stop and distance gloved hand settings and larger printed numbers. It also has a sun shade.

Right Angle Mirror. This accessory, when attached to the bracket-mounted 16 mm camera and lens, facilitates photography through the spacecraft rendezvous windows along a line of sight parallel to vehicle X-axis with a minimum of interference to the crewmen. It adapts to the 18 mm, 75 mm, and 200 mm lenses by means of bayonet fittings.

Ring Sight. An accessory used on the 16 mm camera as an aiming aid when the camera is hand-held. The concentric light and dark circular rings, as seen superimposed on the view, aid the user in determining the angular field of view of the sight. It is attached to the camera by its shoe sliding into a C rail. It is also used on the 70 mm camera.

Data Acquisition Camera Bracket. This device facilitates in-flight mounting of the 16 mm camera at spacecraft left or right rendezvous windows. The bracket is a quick-disconnect hand-grip that may be attached to a dovetail adapter at either rendezvous window. The camera attaches to the bracket by means of a sliding rail. Two marked locating stops are provided for correct positioning of the camera at a window, one for the 18 mm lens and one for the 75 mm lens only. Bracketry alignment is such that installed camera/lens line of sight is parallel to spacecraft X-axis, ±1 degree.

16 mm Camera Operation. Remove camera bracket (grip) from stowage and attach it to dovetail at appropriate rendezvous window. Unstow 16 mm camera and accessories as required. Attach selected lens. Install right-angle mirror on lens (optional). Install ring sight on camera for hand-hold use (optional). Install film magazine on camera. Determine correct exposure. Set lens aperture and focus. Set camera mode (frame

rate) and shutter speed. Install power cable on camera. Install camera in mounting bracket (optional) at window. On spacecraft MDC panels 15 and 16, verify UTILITY POWER receptacle switch is in OFF position. Mate camera power cable to appropriate receptacle. Place switch to POWER position and verify green operate light on camera is illuminated steadily for approximately 3 seconds to indicate electrical circuit operation. Filming operation can be started by pressing the operate button (switch) on front of camera. To stop, press operate button again.

2.12.5.3.2 70 mm Hasselblad Electric Camera and Accessories (Figure 2.12-34).

The 70 mm camera is primarily used for high resolution still photography, and is hand-held or bracket mounted and manually operated. Camera features include interchangeable lenses and film magazines. The standard lens is an 80 mm f/2.8, a 250 mm f/4 and 500 mm f/8 telephoto lens is provided for photography of distant objects. Two types of 70 mm film magazines are provided, one for standard-base films, the other for thin-base films. Camera accessories include filters and a ring sight. Some specific uses of the camera are as follows:

- Verify landmark tracking
- Lunar landmark and mapping
- Record Saturn IVB separation
- Photograph disturbed weather regions (hurricanes, typhoons, etc.), debris collection on the spacecraft windows, SLA separation, LM during rendezvous and docking, terrain of geological and oceanographic interests, and other space equipment in orbit
- Act as a backup to the 16 mm sequence camera
- Record in-cockpit operation, e.g., normal positions of suited crewmen.

The 70 mm Hasselblad camera is electrically operated. The increased ease of operation and improved photographic quality distinguish this camera from the earlier model still camera. A built-in 6.25-vdc battery-powered, electric-motor-driven mechanism advances the film and cocks the shutter whenever the actuation button is pressed. An accessory connector permits remote camera operation and shutter operation indication for time correlation. All accessories for the earlier model camera, except film magazines, may be used on the electric camera. Weight of the camera, with 80 mm lens and 2 batteries, without film magazine, is 4.04 pounds. The camera accessories are herewith described.

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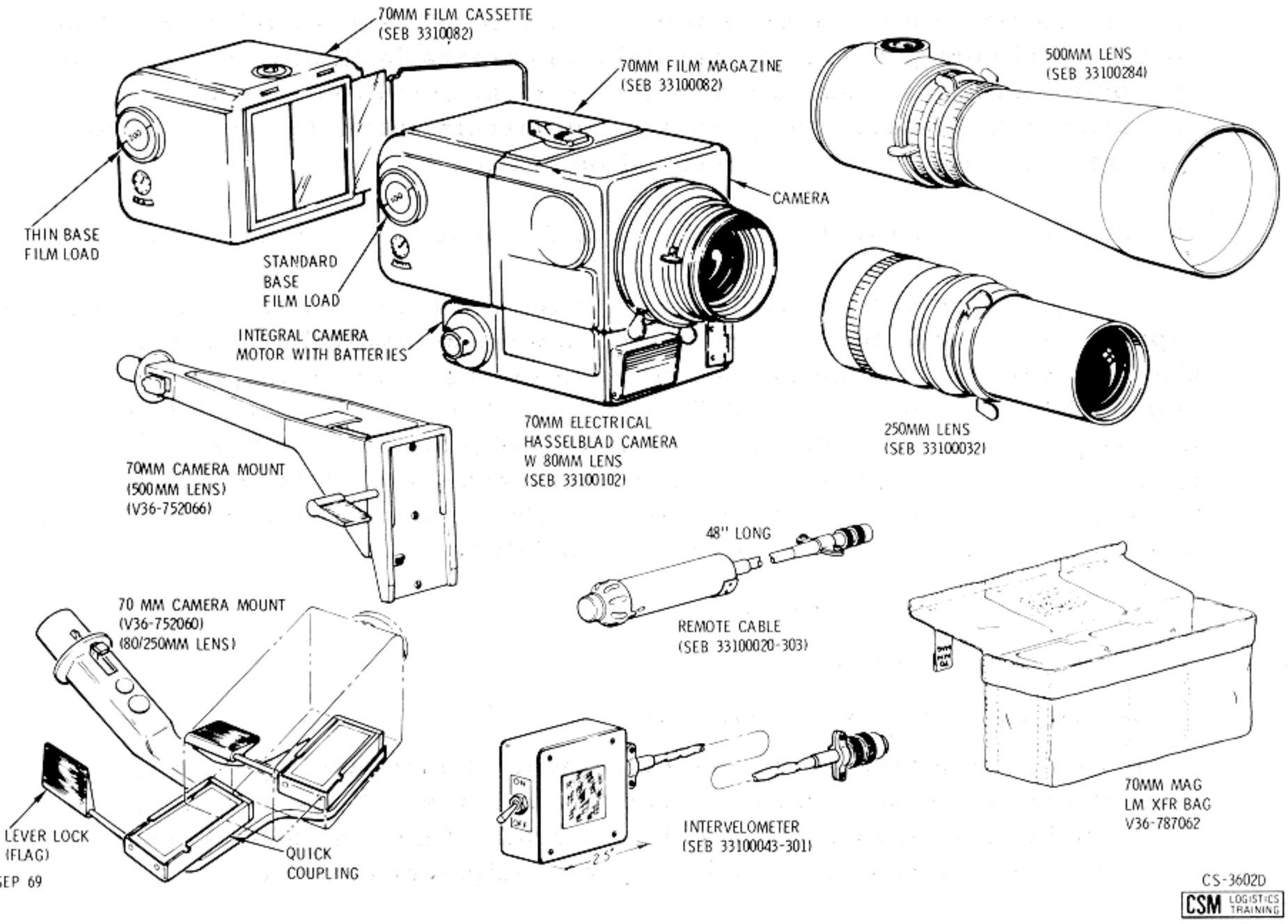

Figure 2.12-34. 70 mm Hasselblad Electric Camera and Accessories

80 mm f/2.8 Lens. Standard or normal lens for the 70 mm camera with 2-1/4 x 2-1/4-inch film format. Used for general still photography when a wide angle or telephoto view is not required. Focuses from 3 feet to infinity. Has built-in shutter with speeds from 1 second to 1/500 second. Field of view, each side, is approximately 38 degrees x 38 degrees.

250 mm f/5.6 Lens. A telephoto lens that is primarily used for photography of terrain and distant objects. It produces a 3X magnification over the standard 80 mm lens. The relatively narrow view of this lens necessitates careful aiming of the camera to insure the desired scene is

photographed. A mount is available for mounting the camera and lens at the right rendezvous window to view parallel to vehicle X-axis. The lens focuses from 8.5 feet to infinity, and has built-in shutter with speeds from 1 second to 1/500 second. Field of view, each side, is approximately 13 degrees x 13 degrees. Weight of lens is 2.06 pounds.

500 mm f/8 Lens. (Figure 2.12-34) The 500 mm lens is used for telephotography such as lunar landscape, lunar mapping, and targets of opportunity. It produces a 6X magnification over the standard 80 mm lens and its field of view is 7 x 7 degrees. The 500 mm lens focuses from 28 feet to infinity but because of mounting limitations in the crew compartment and lens travel toward the window during focusing, its mounted focusing capability is approximately 100 feet to infinity. The lens has a built in shutter with speeds from 1 second to 1/500th of a second.

Photar 2A Filter. (SEB 33100050-206) The Photar filter replaces the haze filter for Hasselblad Electric Camera and is used with color film to produce good color rendition and improved contrast in photographs of the earth. It can be used with the 80 mm and 250 mm lens.

Remote Control Cable. (Figure 2.12-34) The function of the remote control cable is to actuate the shutter from the left couch while sighting targets through the COAS in the left rendezvous window. The cable is 48 inches long with a handle and button at one end and a connector at the other.

70 mm Film Magazines. Two types of film magazines are used, one for standard-base film, the other for thin-base film. Either film magazine attaches to rear of camera and is locked in place by a lever-actuated clamp. The type 100 film magazine is for standard-base film and capacity is 100 2-1/4 x 2-1/4 inch frames. The type 200 film magazine is for thin-base film and capacity is 200 2-1/4 x 2-1/4 inch frames. Each film magazine contains gross-film indicators for frame count.

Lunar Surface 70 mm Film Magazine. The lunar surface 70 mm film magazines are standard 70 mm magazines that have a thermal protective coating. They are stowed in the 70 mm magazine LM transfer bag.

70 mm Magazine LM Transfer Bag. The 70 mm magazine LM transfer bag is beta cloth, has a capacity of 3 magazines, and a flap cover to restrain them. The magazine bag with exposed 70 mm magazines is transferred from the LM to the CM for entry and retrieval.

70 mm Camera Mount for 80 and 250 mm Lens. For the purpose of photographing parallel to the X-axis, the camera mount is used. It is T-shaped, the stem being 7 inches long and the bar 6 inches. The stem inserts into a socket mount along the right or left side of the hatch frame, marked EHC MOUNT ATTACH (80 MM/250MM LENS, approximately

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7 inches from the TV socket mount. The T bar portion has two quick couplings (lower and upper) that attaches to the camera. The lower quick coupling is for use of the camera with the 250 mm lens and will align the camera parallel with the X-axis. The upper quick coupling is for use of the camera with the 80 mm lens and is pitched upward 12±2° from the X-axis during prelaunch alignment to give the camera an unobstructed view.

To use the mount, the 70 mm camera is assembled, adjusted, and set. The camera can be attached to the appropriate mount quick coupling by sliding it to the stop and locking by rotating the (flag) lever 90 degrees. Failure to position the camera all the way to the stop before locking may result in the window aperture obstructing the camera view. The stem is inserted into the socket mount near the hatch frame until the latches snap in. (Caution should be exercised because of the close proximity of the lens to the window.) The intervalometer cable is then attached. The camera is sighted by using the COAS and orienting the CSM X-axis toward the target. To use the 80 mm lens, the COAS elevation scale is set to +12 degrees. The camera can be momentarily displaced (swung out of the way) by pressing the latch levers and rotating until the latches reseat.

70 mm Camera Mount for 500 mm Lens. (Figure 2.12-34) The camera mount is L-shaped with a quick coupling on one end and a round stem with a latch at the other. The mount stem will insert in the socket marked EHC MOUNT ATTACH (500 MM LENS) adjacent to the right side of the hatch frame on the girth ring. When installed with the camera, the 500 mm lens centerline will be aligned 10 ±1 degrees off the X-axis toward the -Z direction.

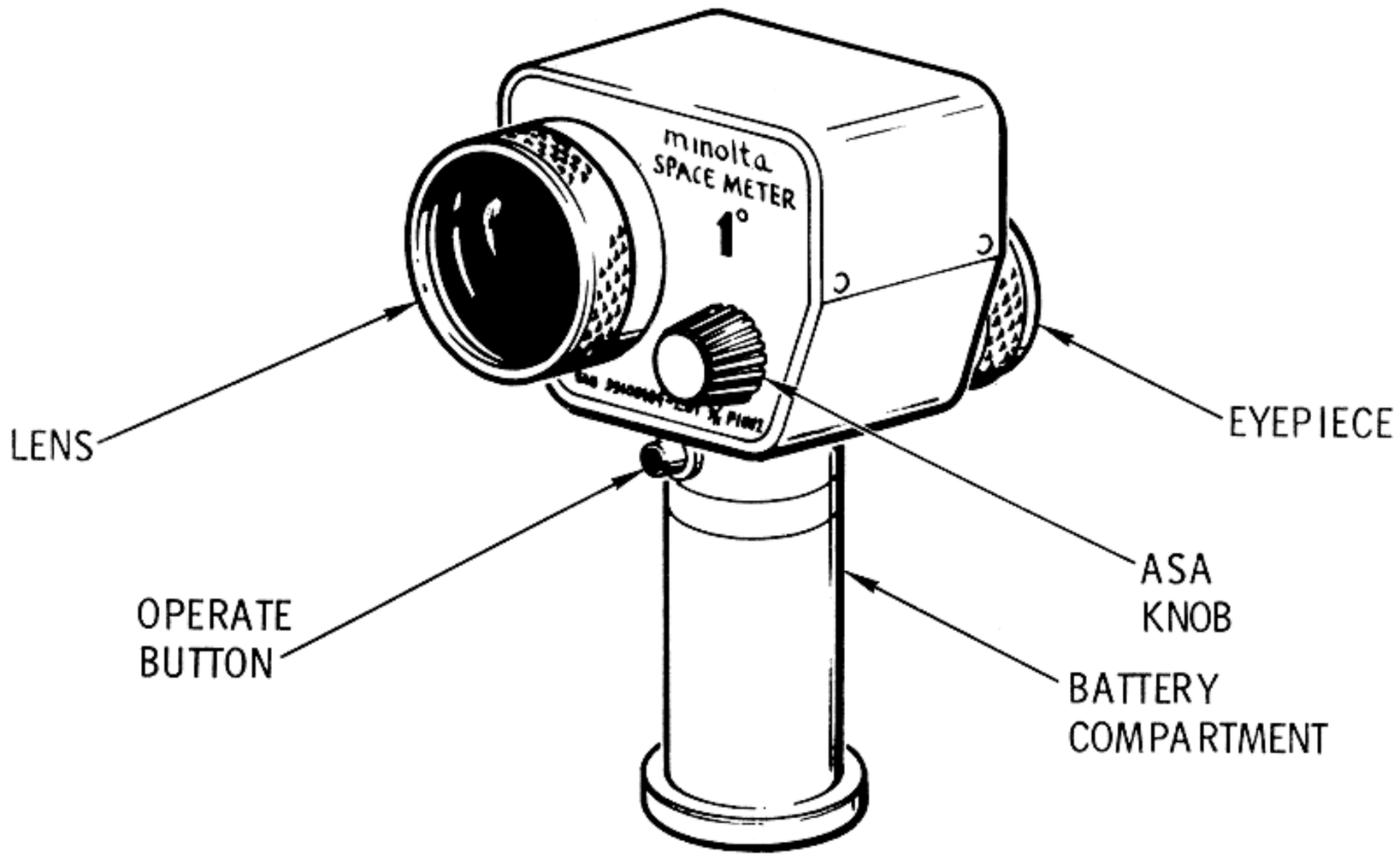
For 70 mm camera operations using the 500 mm lens, the lens is attached to the camera and the settings are adjusted. The camera is attached to the mount. The quick coupling is similar to the 80/250 mm lens mount type. In addition, it has a positive latch with a button that must be depressed to remove the camera from the mount. The right couch headrest is adjusted to the footward position when the mount is attached to the girth ring socket.

To sight the camera using the COAS, the COAS barrel is rotated to +10 degrees on the elevation scale. The COAS centerline is then aligned parallel with the camera and lens centerline.

Intervalometer. The intervalometer is a remote control device for taking sequential pictures. It is extremely useful for making a strip map (vertical stereo strip from rendezvous window, oblique stereo strip from side windows, etc.). Its control box is 2.5 x 2.5 x 1 inches and has an ON/OFF switch. A 120-inch cable connects it to the camera accessory connector. The intervalometer is preset at 20-second intervals and is powered from the Hasselblad Electric Camera battery pack.

2.12.5.3.3 Automatic Spotmeter (Figure 2.12-35).

This meter replaces the earlier model spotmeter and greatly enhances the crewman's ability to obtain accurate exposure information with a minimum of expended time and effort. The unit is a completely automatic CdS reflectance light meter with a very narrow angle of acceptance (one degree). The meter scales are automatically rotated to indicate the correct camera shutter speed/lens aperture values for the selected



AUTOMATIC
SPOTMETER
(SEB 33100104)

SEPT '69

CS-3603B
CSM LOGISTICS TRAINING

Figure 2.12-35. Spotmeters

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photographic subject. Brightness range is from 0.32 to 5000 foot-lamberts, with an extended range to 20,000 foot-lamberts by use of accessory neutral density filter. ASA range is from 3 to 25,000 and the weight of meter is 1.9 pounds.

2.12.5.4 Accessories and Miscellaneous Equipment

2.12.5.4.1 Temporary Stowage Bags (Figure 2.12-36, Sheet 1)

The temporary stowage bags are used for temporary stowage of small items and permanent stowage of dry refuse or "trash."

The waste bag, nicknamed the "VW" bag, is a two-pocket unit. The outer pocket is deep, about 3 feet by 1 foot by 3 inches and is held shut by a bar spring. The inner pocket is flat, about 1 by 1 foot and is held shut by a rubber bungee. The bags are attached to the girth shelf and LEB by snaps.

The outer bag is for dry uncontaminated waste matter and the inner bag serves as temporary stowage for small items.

There are three waste bags, one for each crewman. The Commander's bag attaches to the left girth shelf, the LM pilot's to the right girth shelf, and the CM pilot's, the LEB. They are stowed in a stowage locker at launch and entry.

2.12.5.4.2 Pilot's Preference Kits (Figure 2.12-36, Sheet 3)

The pilot's preference kits are small beta cloth containers 7 x 4 x 2 inches, and weigh 0.5 of a pound. Each crewman will pack it with personal equipment or equipment of his choice.

2.12.5.4.3 Fire Extinguisher (Figure 2.12-36, Sheet 1)

A fire in the cabin, or behind the closeout or protection panels, is extinguished by a small fire extinguisher. One fire extinguisher, on locker A3 near the LEB, is provided.

The extinguisher weighs 8 pounds and is about 10 inches high with a 7-inch nozzle and handle. The tank body is a cylinder with a dome, and is made of stainless steel. The extinguishing agent is an aqueous gel (hydroxymethyl cellulose) which expells 2 cubic feet of foam for approximately 30 seconds under 250 psi at 140°F. The expulsion agent is Freon and is separated from the gel by a polyethylene bellows. The nozzle, handle, and actuator button are insulated against sparking. As a safety measure against overheating, a disk will rupture between 350 and 400 psi, allowing the gel to expel.

To operate, pull the safety pin in the handle, point at the fire or insert in a FIRE PORT, and press the button.

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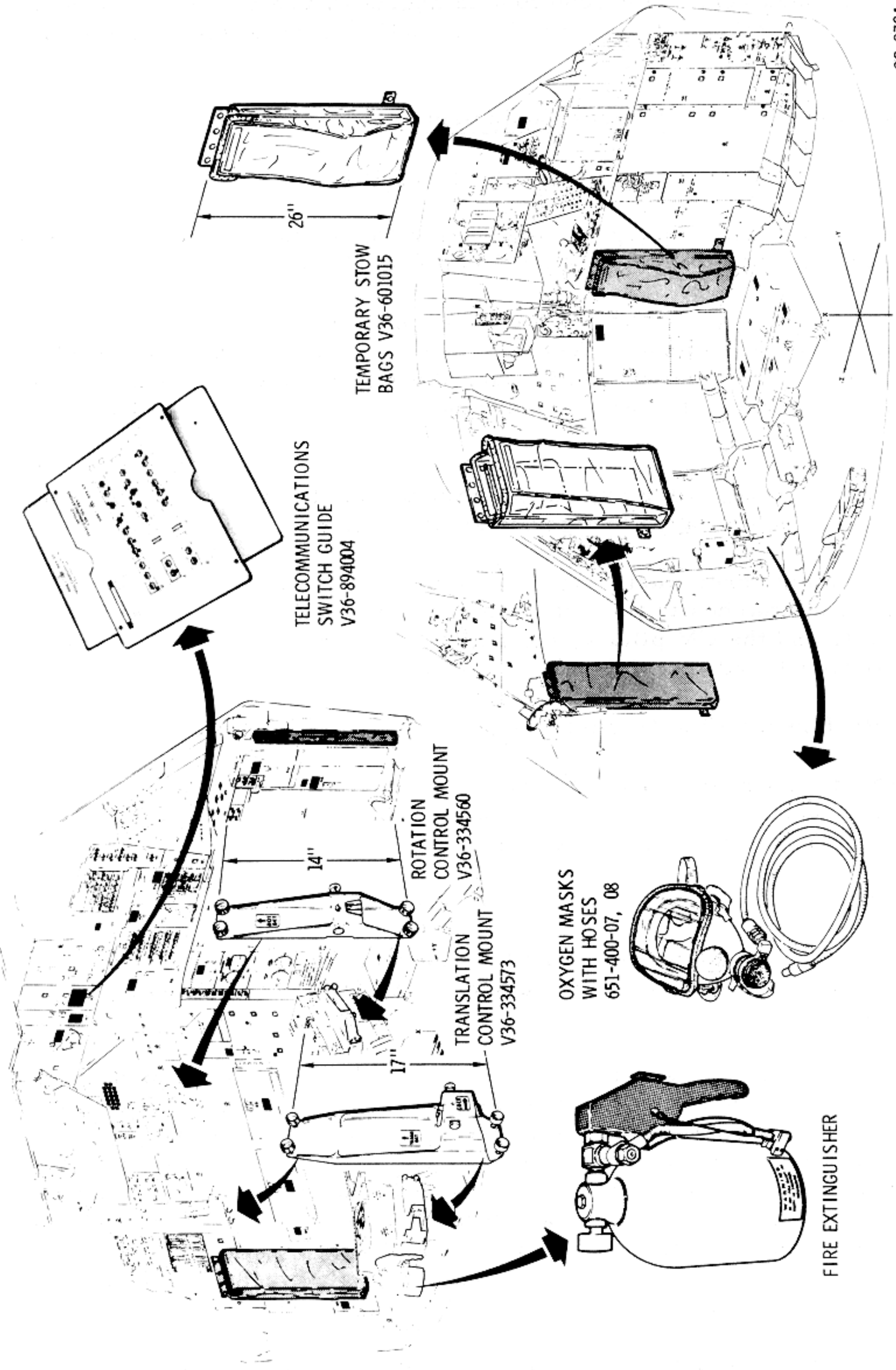

Figure 2.12-36. Accessories and Miscellaneous Equipment (Sheet 1 of 4)

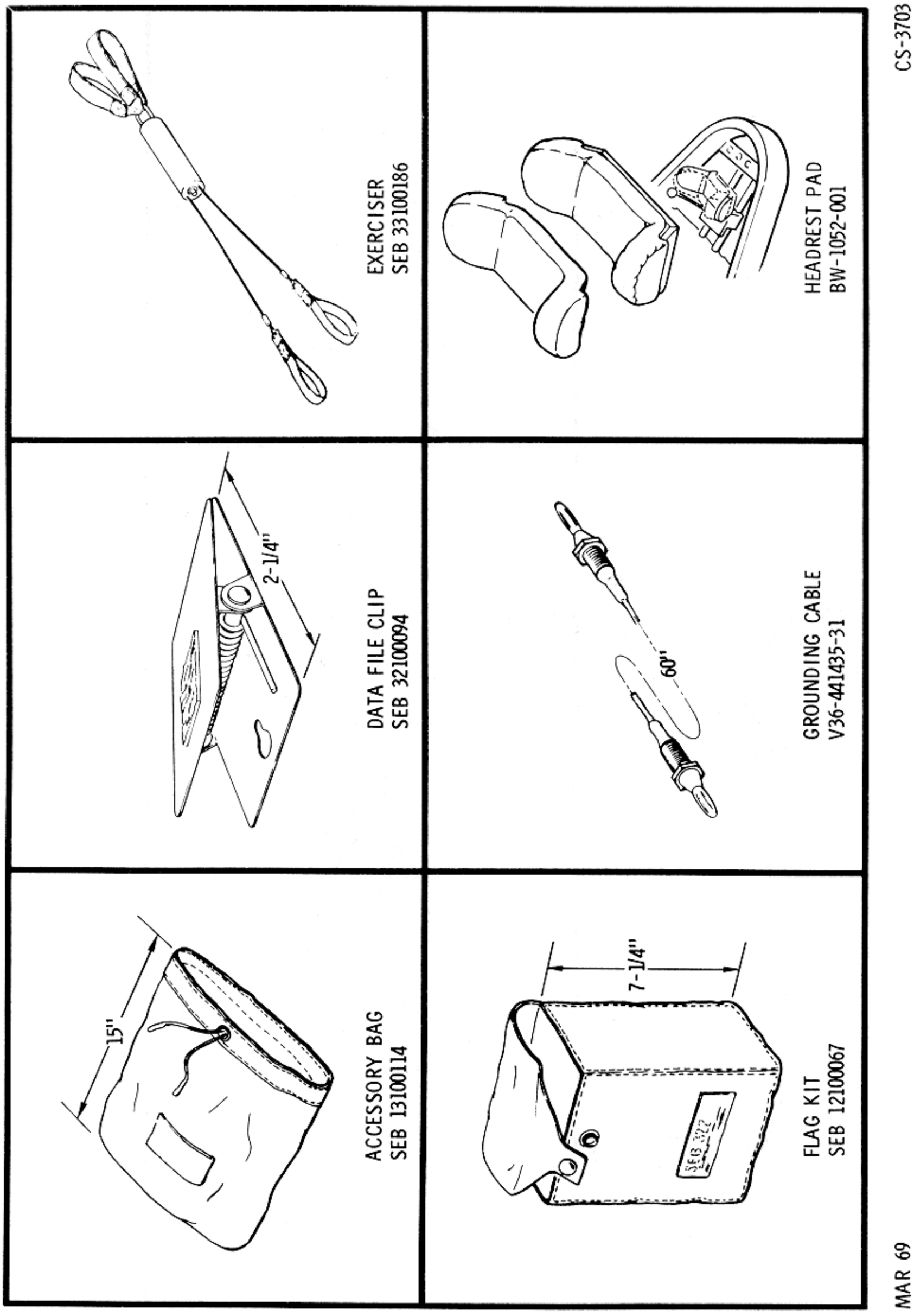

Figure 2.12-36. Accessories and Miscellaneous Equipment (Sheet 2 of 4)

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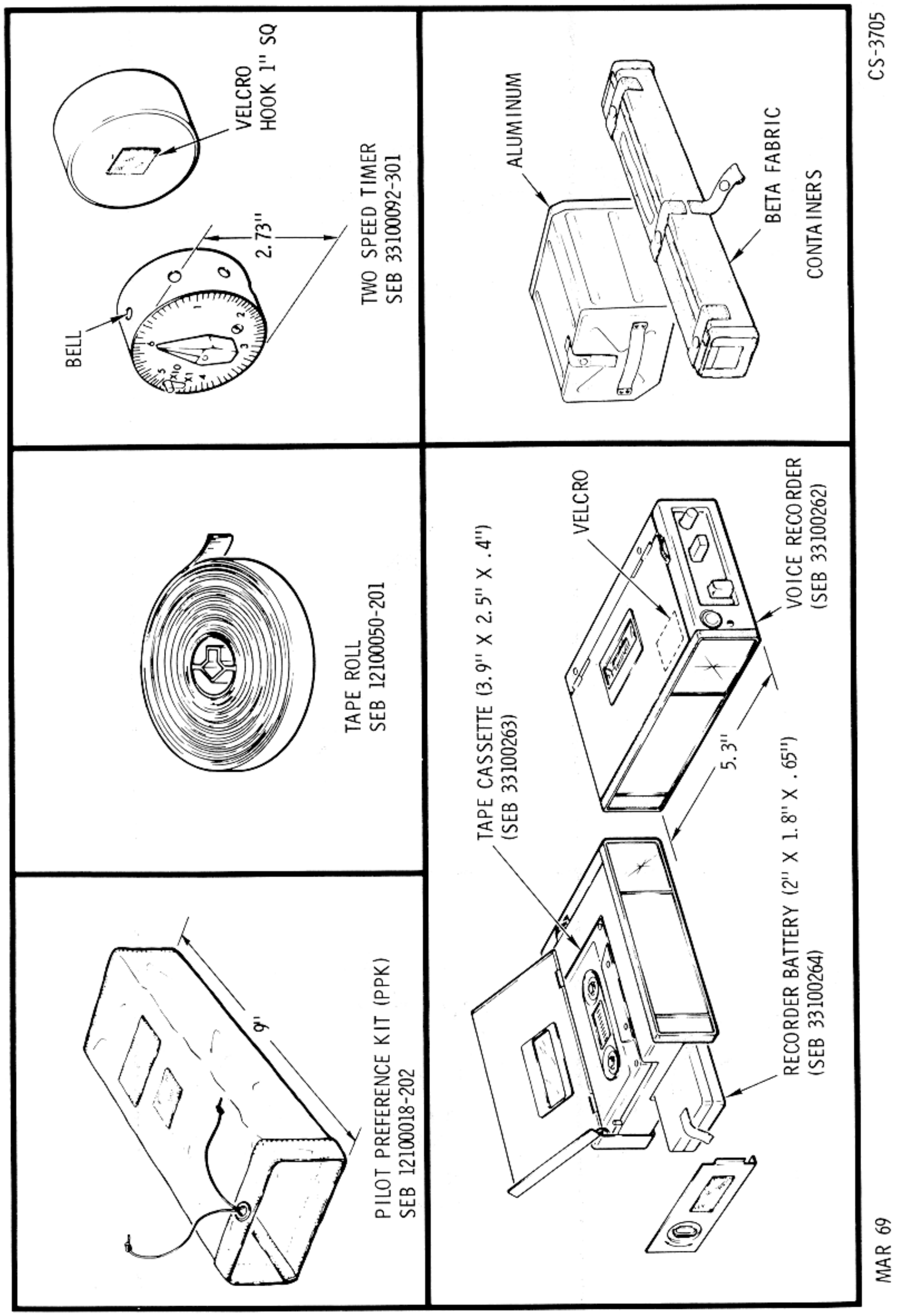

Figure 2.12-36. Accessories and Miscellaneous Equipment (Sheet 3 of 4)

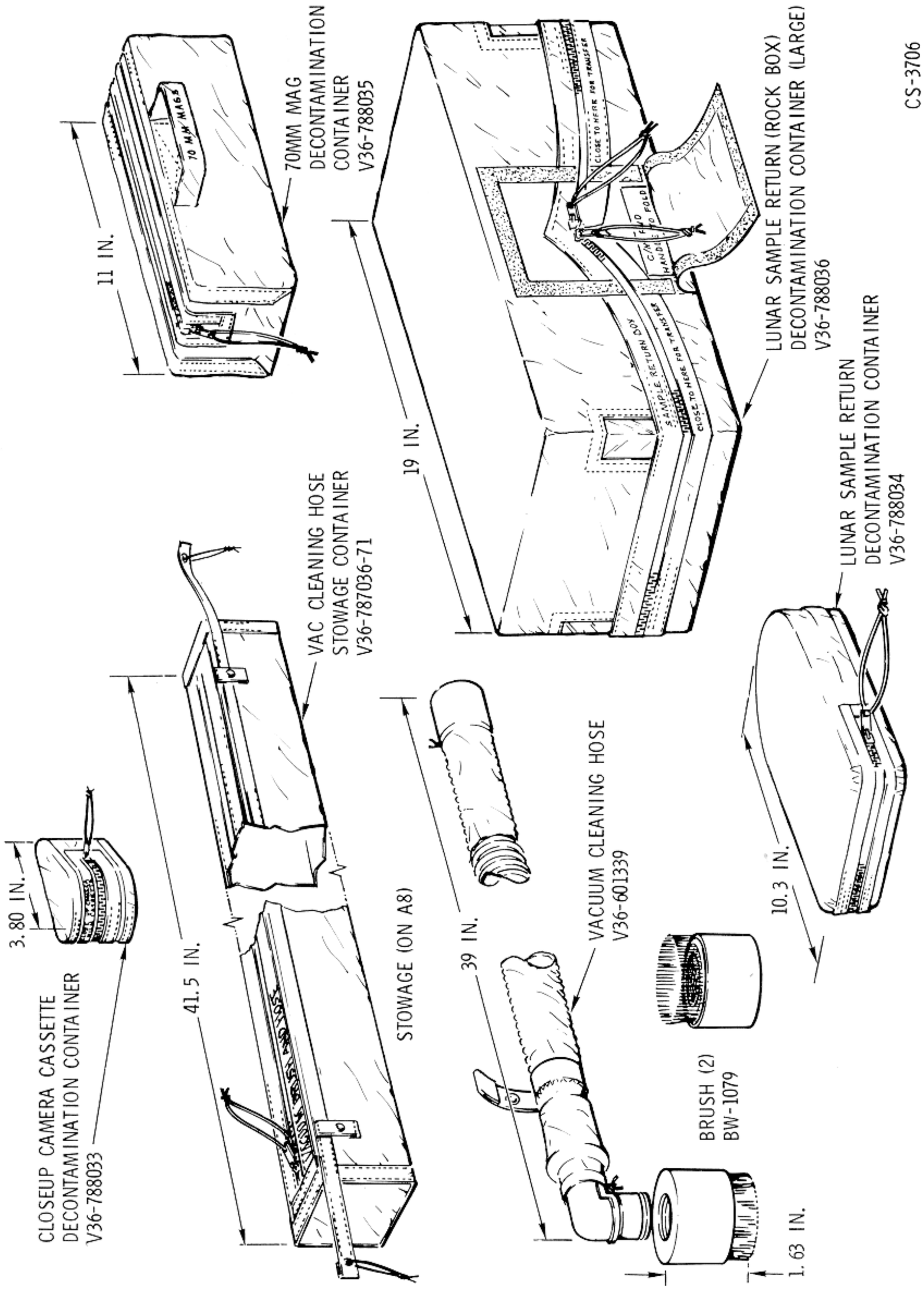

Figure 2.12-36. Accessories and Miscellaneous Equipment (Sheet 4 of 4)

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2.12.5.4.4 Oxygen Masks (Figure 2.12-36, Sheet 1)

In the event of smoke, toxic gas, or hostile atmosphere in the cabin during the shirtsleeve environment, three oxygen masks are provided for emergency breathing.

The mask is a modified commercial type (GFP) with headstraps to hold it on. A utility strap is attached to the mask muzzle for inflight stowage. The oxygen is supplied at 100 psi through a flexible hose from the emergency oxygen/repressurization unit on the upper equipment bay by actuating the emergency oxygen valve handle on panel 600. The mask has a demand regulator that supplies oxygen when the crewman inhales.

The three masks are stowed in a beta cloth bag on the aft bulkhead below and aft of the emergency oxygen/repressurization unit. The masks are removed by pulling the center tape loop handle to disengage the snap fasteners restraining the cover. For inflight accessibility, the oxygen masks are stowed along the girth ring near the side hatch by attaching its utility strap snap socket to a stud.

2.12.5.4.5 Inflight Exerciser (Figure 2.12-36, Sheet 2)

An inflight exerciser, similar to the "Exergenie," is provided for daily exercise. It will be stowed in a small beta cloth container inside a stowage locker on the aft bulkhead.

2.12.5.4.6 Tape Roll (Figure 2.12-36, Sheet 3)

A 6-inch diameter roll of 1-inch wide tape is provided for utility purposes.

2.12.5.4.7 Two-Speed Timer (Figure 2.12-36, Sheet 3)

The two-speed timer is a two-mode kitchen timer. It is used by the crew to time short period events such as fuel cell purge. The face markings are 0 to 6. The two modes are 6 minutes and 60 minutes and are set by positioning a lever on the face to X1 or X10. To operate, set the mode, turn the pointer to the desired time setting, and an alarm bell will ring when the time elapses.

2.12.5.4.8 Accessory Bag (Figure 2.12-36, Sheet 2)

There are three accessory bags stowed in the PGA helmet bags at launch. They will be used for utility purposes. The bags are beta cloth, flat (15 x 10 inches) and the open end has a drawstring closure.

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2.12.5.4.9 Headrest Pad (Figure 2.12-36, Sheet 2)

During an unsuited entry, the crew will need pads on the couch headrest to ease landing impact to the head and to raise the head to the helmeted eye position. Therefore, there are three headrest pads stowed at launch that are attached to the couch headrests at entry.

The headrest pads are 5 x 13 x 2 inches and are a black fluorel sponge. They have pockets on the ends to slip over the headrests and restrain them.

2.12.5.4.10 Grounding Cable (Figure 2.12-36, Sheet 2)

Static electricity is generated by crew activity in the crew compartment. The CO_2 canisters must be grounded when removing them from the stowage locker or compartment to the ECS filter. The canisters have a jack in the center to receive a plug when removing and replacing the canisters.

The grounding cable is sixty inches long with a plug at each end. It is stowed at launch. When using, ground it by inserting one plug in a jack on locker A3. The opposite end inserts into the CO_2 canister jack.

2.12.5.4.11 Voice Recorder, Cassettes, and Battery Packs (Figure 2.12-36, Sheet 3)

The voice recorder is a small (5 x 4 inches) battery-powered unit used to record data pertinent to the crew log. The recording element is a tape cassette. It is stowed with a battery and a cassette installed, ready for operation. For the number of batteries and cassettes aboard the spacecraft, refer to the stowage list or drawing.

2.12.5.4.12 Decontamination Bags (Figure 2.12-36, Sheet 4)

When returning items and equipment from the moon, precautions are taken to minimize lunar contamination to the CM and earth. The items are vacuumed, placed in decontamination bags (containers) aboard the LM, and the outer surface of the bags vacuumed. The items with decontamination bags are then transferred.

The items requiring decontamination bags are the two lunar sample return containers (LSRC), the contingency lunar sample return container (CLSRC), 70 mm magazine container, and the lunar close-up camera cassette. The PGA bag will be used for the CDR and LMP space suit return container as it can be readily attached and detached from the CM aft bulkhead.

The decontamination bags are Beta cloth with zipper closures and fit snuggly over the item and its container.

The decontamination bags are stowed in a CM aft bulkhead locker and transferred into the LM after lunar rendezvous.

2.12.5.4.12A Vacuum Cleaning Hose and Brushes (Figure 2.12-36, Sheet 4)

The vacuum cleaning hose and two brushes are stowed in an aft bulkhead locker of the CM at launch. The hose and one brush are transferred to the LM after lunar rendezvous to vacuum the return items. The brush functions as a vacuum head and the hose is connected to the LM ECS return hose during vacuuming. The vacuumed lunar dust and particles are trapped in the LM ECS LiOH canister. The brush and hose are left in the LM at separation.

The vacuum cleaning hose is similar to the oxygen hoses, 41.5 inches in length, and covered with a Beta cloth sleeve. It has a 90-degree elbow at the brush end. The brushes fit on the elbow and have a screen filter on the inside. One brush is left aboard the CM for utility vacuuming as needed.

2.12.5.4.13 Flag Kit (Figure 2.12-36, Sheet 2)

The flag kit is a Beta cloth bag containing the American flag, which is returned from the LM.

2.12.5.4.14 Containers (Figure 2.12-36, Sheet 3)

Containers are located inside stowage lockers and compartments. The aluminum type are usually boxes with a door entry for containment of stowable items. The cloth or soft type, are Beta cloth, and have flap closures held by snaps or Velcro.

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2.12.5.5 Utility Outlets (Figure 2.12-37).

The crew compartment has three electrical utility outlets of 28 volts dc. The outlets are disbursed for accessibility and are located near the left side window (MDC 15), the right side window (MDC 16), and on the lower equipment bay panel 100. Each outlet or receptacle has an adjacent UTILITY switch with a POWER and OFF position. The circuit breakers for the utility outlets are on panel 229 and marked UTILITY R/L STA for MDC 15 and 16, and UTILITY LEB for panel 100.

2.12.5.6 Scientific Instrumentation Outlets (Figure 2.12-37).

For supplying 28 vdc to scientific experiments, there are receptacles on panels 162 and 163 of the LEB and panel 227 on the right girth shelf. Each outlet has an adjacent switch with a POWER and OFF position. The circuit breaker for the receptacles are on panel 5 and marked INSTRUMENTS/SCI EQUIP/NONESS/SEB-2 for panels 162 and 163. The CB for panel 227 is on MDC 5 and marked NONESS/HATCH. The nonessential bus 2 must be powered by the switch on MDC 5 marked NONESS BUS MNA - OFF - MNB.

Panels 162 and 163 are behind the LEB closeout panels and compartment B5, respectively. If the mission does not indicate usage, the switch will be safety wired to the OFF position.

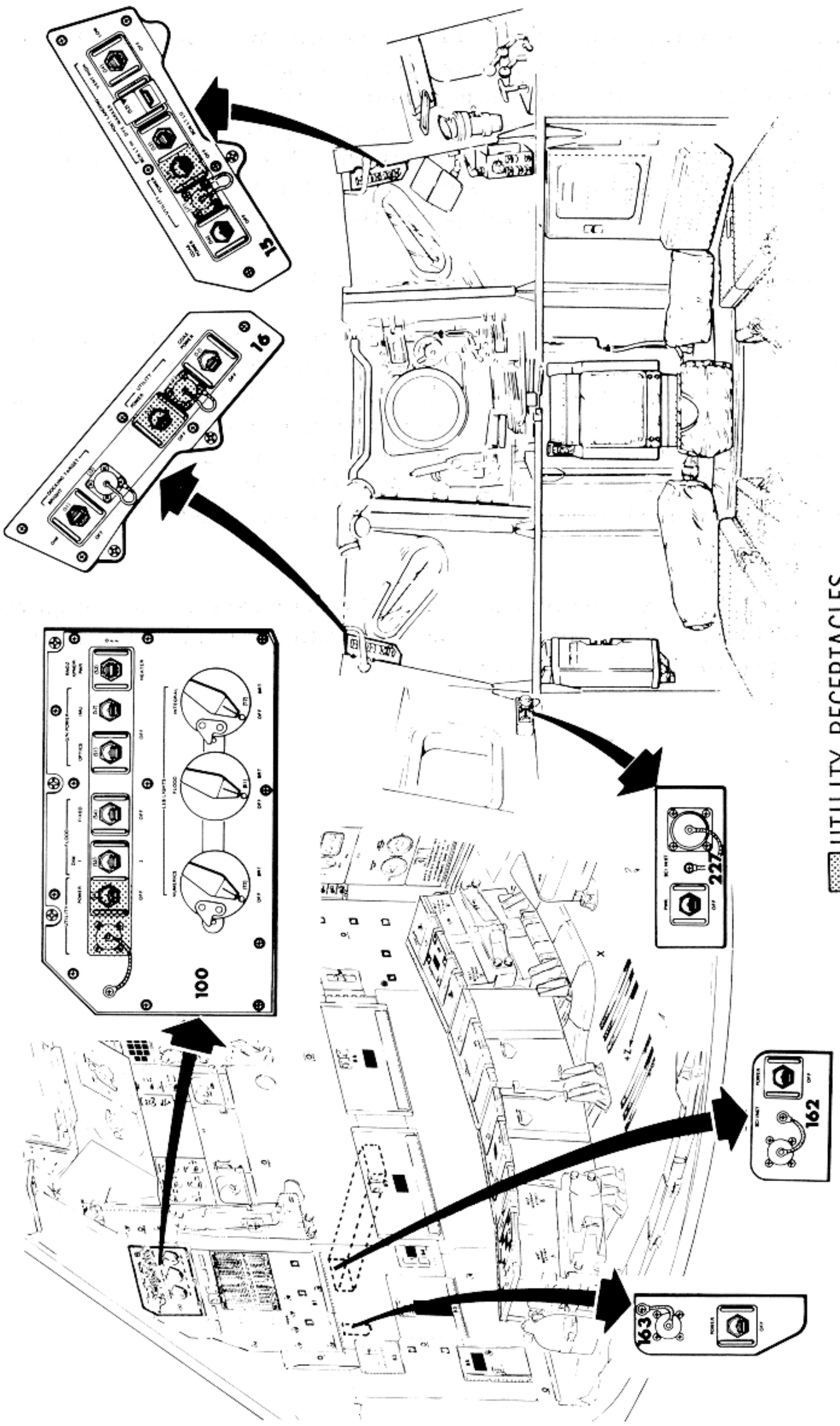

Figure 2.12-37. Utility and Scientific Instrumentation Outlets

2.12.6 CREW LIFE SUPPORT

2.12.6.1 Crew Water.

2.12.6.1.1 Drinking Water Subsystem (Figure 2.12-38).

The source of cold water for drinking and food preparation is the water chiller. The line is routed to the cold water valve of the FOOD PREPARATION WATER tank; and has a maximum pressure of 48 psi, a minimum pressure of 18 psig, and a nominal working pressure of 22 to 27 psig. The crewman drinking water line is teed off, and routed through a shutoff valve to the water dispenser located beneath the main display panel structure.

The water dispenser assembly consists of an aluminum mounting bracket, a coiled viton rubber hose with a QD, and a water dispenser in the form of a lever-actuated pistol. The water pistol delivers approximately 8 milliliters of water per second (ml/s) when actuated. It has a QD at the bottom of the handle for connecting to the coiled hose. The

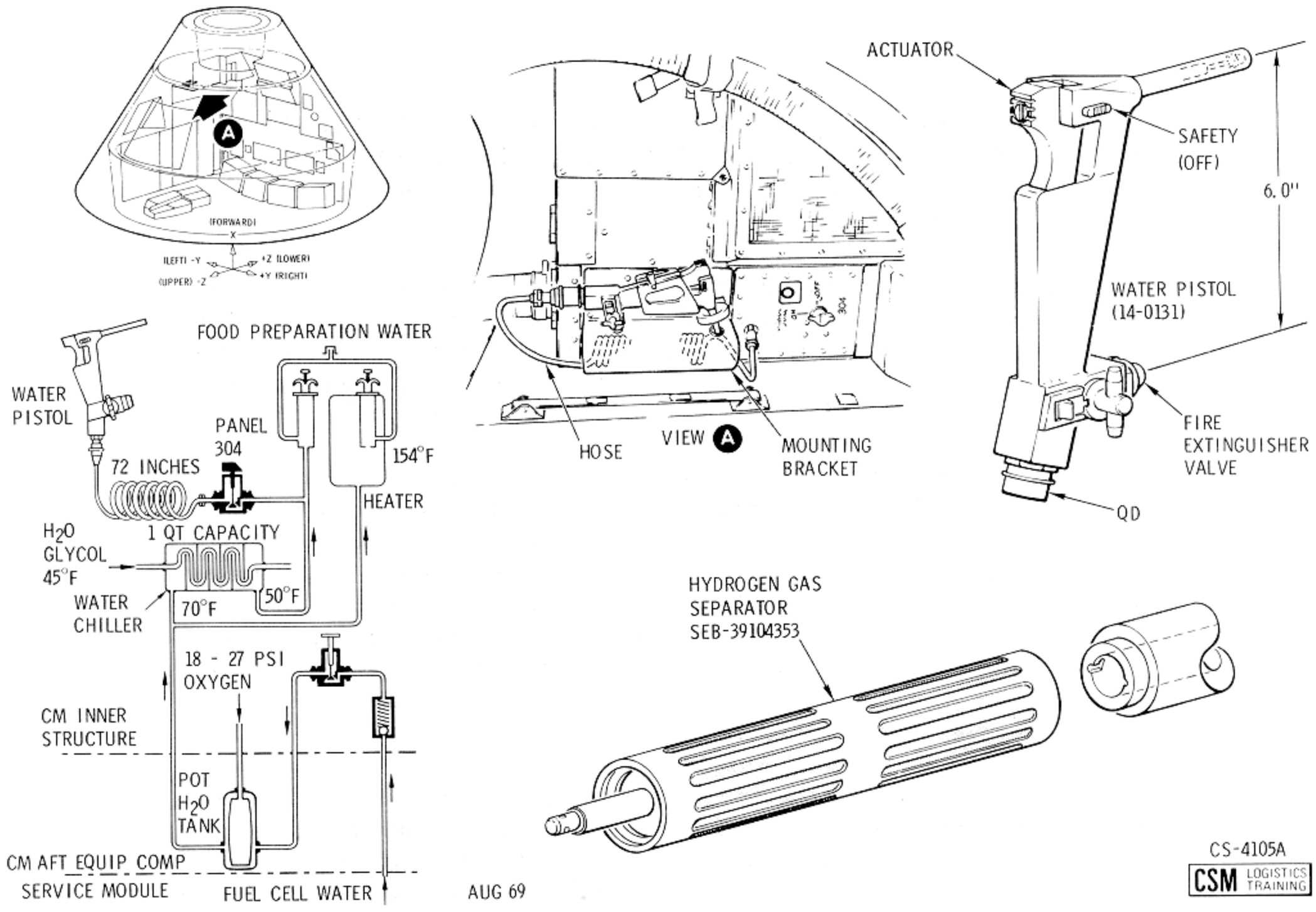

Figure 2.12-38. Drinking Water Subsystem

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handle contains a fire extinguishing valve that delivers water at the rate of 38 ml/s in a 60 degree cone when actuated. The pistol is identical to the LM water pistol.

The uncoiled hose will reach 72 inches, and when the pistol is returned to the mount, the hose will re-coil into the housing. The pistol is stowed in the mounting bracket and is held in place by a retainer lever or attached to the crew compartment structure.

Operational Use. The shutoff valve on panel 304 is opened during the countdown to activate the system. This is accomplished with the valve handle. The shutoff valve will be open for the entire mission unless the pistol or dispenser assembly develops a leak or malfunctions.

The pistol with the gas separator is placed in the mouth and the actuator lever pressed.

After landing, the potable water supply will be used for drinking until depleted. Then, the sea water can be converted to potable water by a device in the survival kit.

2.12.6.1.2 Food Preparation Water (Figure 2.12-39).

The food preparation water is metered from the FOOD PREPARATION WATER supply on the LHFEB (panel 305), and is used to reconstitute the food. It meters cold water at 50°F and hot water at 154°F to 1-ounce aliquots.

There are two syringe-type valves, and a water nozzle with a protective cover and lanyard. The hot water tank capacity is 38 ounces (slightly more than a quart) and is heated by 25- and 20-watt calrod heaters controlled by three thermostats. The thermostats are powered through the POT H_2O HTR, MNA and MNB circuit breakers on MDC-5.

To operate, remove nozzle protective cover by pulling and attach gas separator slowly, engaging the bayonet fittings. Secure food bag and cut protective cover from the food bag valve. Push food bag valve on the separator nozzle, verifying the food bag valve is open. Pull the syringe handles and release (1 cycle) as many times for as many ounces of water needed. Do not overfill as backpressure may cause the gas separator to leak. When finished, pull the food bag valve off nozzle and replace cover.

2.12.6.1.3 Gas/Water Separation (Figure 2.12-39A)

The swallowing of water with excessive gas is uncomfortable. During the production of water by the fuel cells, hydrogen is in solution and under a pressure of 64 psi which is partially removed by the hydrogen gas separator prior to entering the potable water tank. As the pressure is reduced to 25 psi in the potable water tank, the hydrogen and oxygen

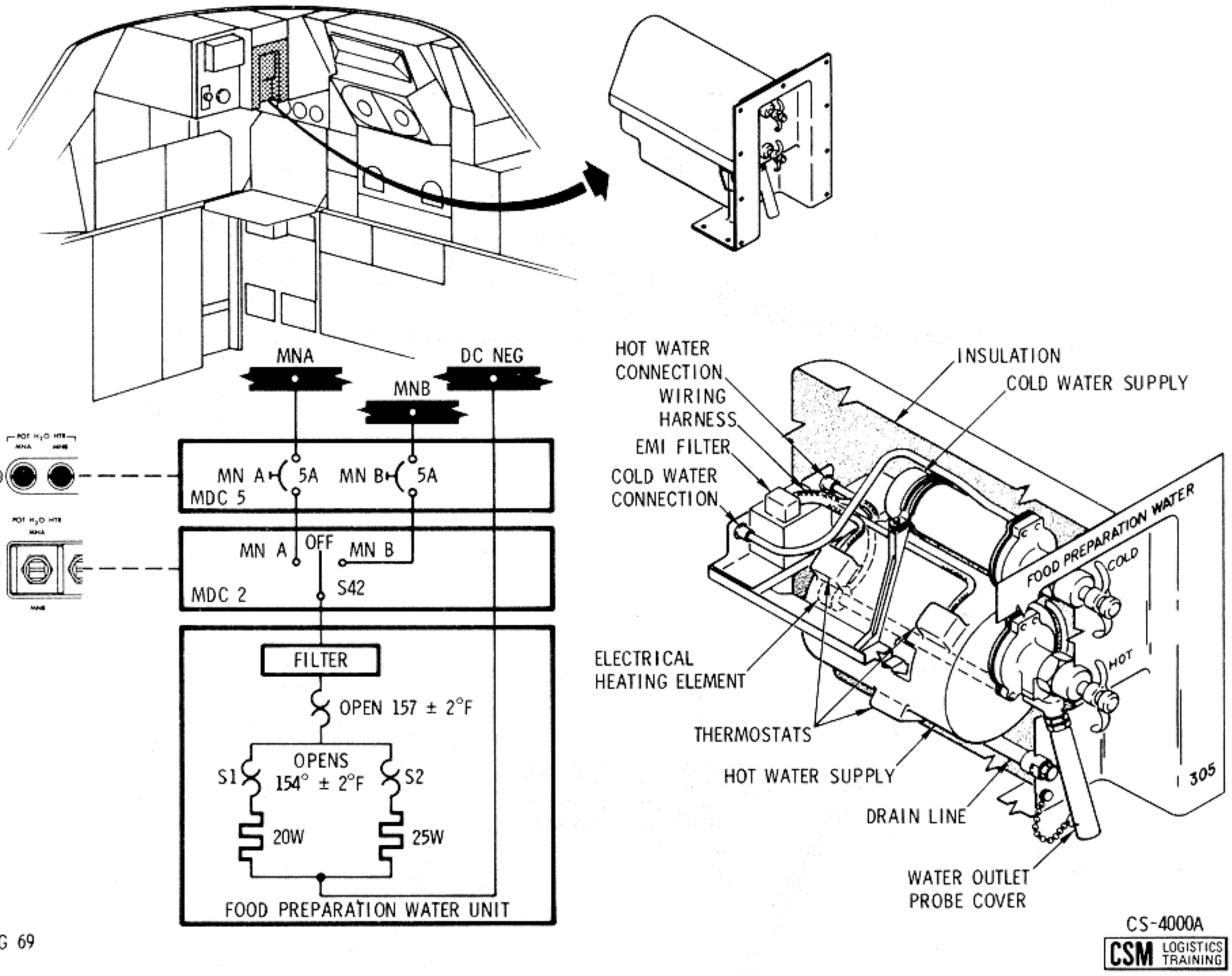

Figure 2.12-39. Food Preparation Water System

gases increase in volume and migrates through the bladder. Further reduction of pressure at the water pistol outlet to 5 psi frees more of the hydrogen and oxygen from solution. The function of the gas/water separator is to separate the hydrogen and oxygen from the drinking water and food preparation water and vent it into the crew compartment. Two gas/water separators, a drying adapter, a nozzle cap, and a stowage bag are provided.

The gas separator is a cylinder 6 inches long with a female (inlet) fitting at one end and a nozzle (outlet) at the other end. The inlet fitting has a bayonet key and will fit and lock up the food preparation water nozzle on panel 305 or fit on the water pistol barrel. The separator outlet nozzle will interface with a food bag or can be inserted in the mouth for drinking.

Water from the pistol or food preparation water unit enters the inner chamber and is routed through holes in the upper end into the outer chamber. The water flows along a teflon hypophobic membrane that allows gas to permeate the membrane and pass through slots in the cylinder wall.

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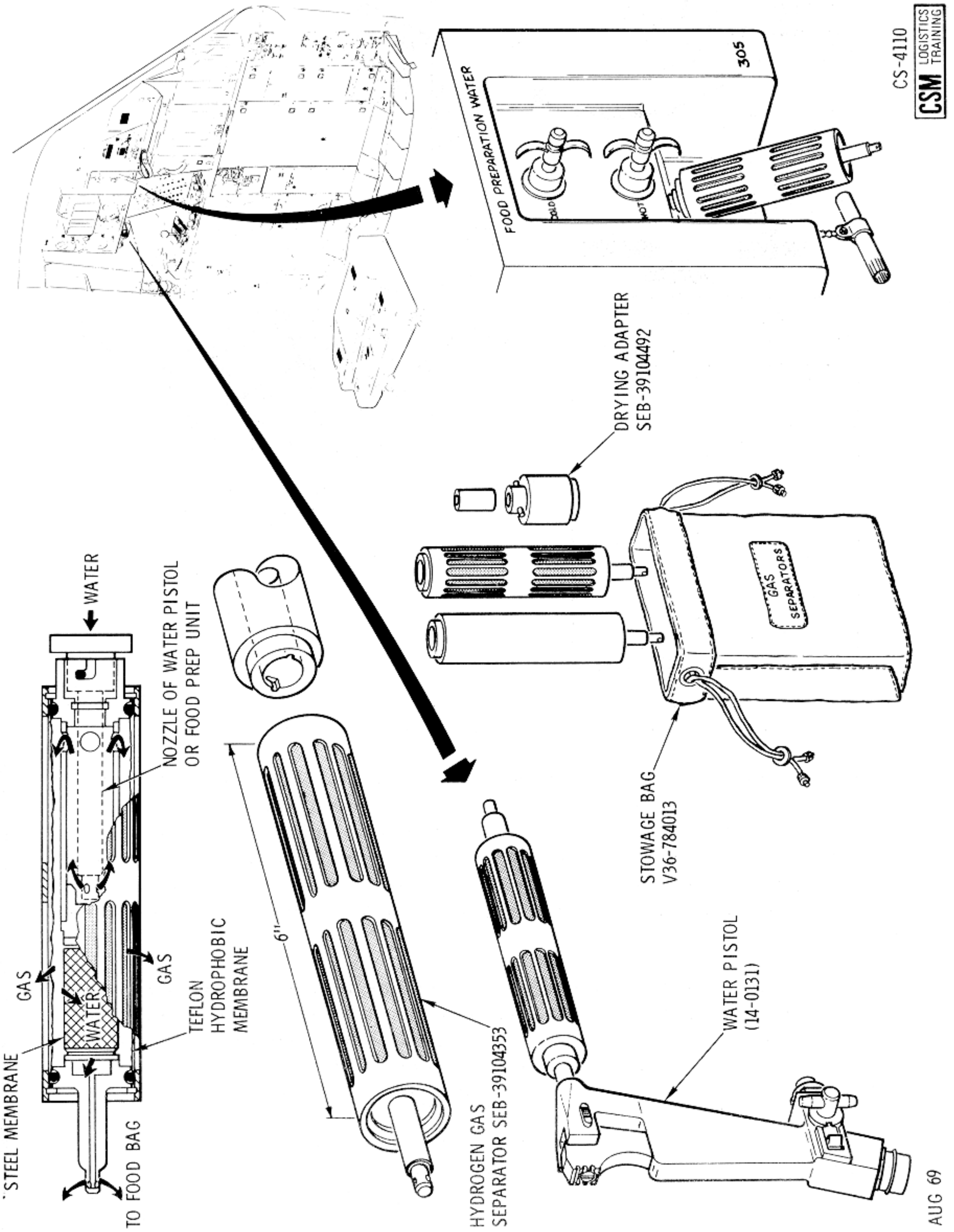

Figure 2.12-39A. Gas Water Separator

At the outlet end the water passes through a hypophilic stainless steel fine mesh screen chemically treated to transmit water readily. The water then flows through the outlet nozzle.

Operation. The separator membrane has to be pre-wet before using. Attach a separator to the water pistol barrel by rotating and pushing slowly until seated. Caution should be exercised when handling the separator as getting the outside surface of the membrane wet will cause it to leak and lose its effectiveness as a gas separator. When seated, the water pistol actuator is triggered in short bursts until water is observed at the outlet nozzle. Ten minutes for membrane wetting is allowed. The gas separator is carefully removed from the water pistol by twisting and pulling. The food preparation water nozzle cover is removed and the pre-wet separator is slid onto the nozzle. The bayonet key is engaged to the nozzle studs and turned, to lock on the separator. The food preparation water unit is then ready for use. Care must be taken when filling a food bag, to ensure the bag is not folded or the sides stuck together and from excessive filling as a slight backpressure will result in water breakthrough of the membrane and destroy its effectiveness as a gas separator. After each use, water on the exterior of the separator should be dried with a tissue (handy wipe).

For the water pistol, the pre-wetting procedure is repeated before use. After each use of the water pistol separator, it is removed from the pistol, the nozzle is blown through (backflushed). The water pistol is removed and stowed before each SPS firing.

Before entry, the separators are placed in the stowage bag and stowed.

Gas Separator Drying. In the event of water break breakthrough, a gas separator must be dried. A gas separator adapter and a nozzle cap are provided and stowed in the gas separators stowage bag.

The gas separator is removed from the food preparation water nozzle or water pistol and dried carefully with a utility towel (caution should be exercised as the membrane can be damaged with pencils or tools). The nozzle cap is placed on the separator nozzle to seal it. Access is gained to the QD panel behind WMS panel 252. The male QD cap is removed and the gas separator adapter is attached to the panel QD. The separator inlet (female) port is mated to the adapter male port. Cabin gas flows through the membrane, through the separator inlet, and into the waste water dump line to space. A ten-minute flow for drying is allowed. The separator, adapter, and nozzle cap are removed, the panel QD cap is replaced and the panel is closed. The separator adapter, nozzle cap, gas separator are stowed or the gas separator is pre-wet and used.

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2.12.6.2 The Galley System (Figure 2.12-40).

The galley system provides for cold or ambient stowage, heating, and serving food. It consists of food, a frozen food container (freezer), a food warmer (hotplate), a hot food holder (hot pad), stowage compartments and lockers.

2.12.6.2.1 Food.

The food furnishes a balanced diet of approximately 2500 calories per day to each crew member and is contained in food sets or separate packages. The food sets are stowed in two prepacked food boxes for compartments B1 and L3. Oral hygiene assemblies for brushing the teeth and spoons for eating are also included. Miscellaneous food packages are stowed in aft bulkhead lockers and the freezer.

There are several forms of food such as freeze-dried food in bags, wet packs, frozen food packs, dried fruit packs, beverages in bags, bread packs, and canned food.

Wet packs are frankfurters or a meat and gravy combination such as ham, turkey, and beef. They are packaged in aluminum dishes with a peel-away cover and are eaten with a spoon.

The frozen food packs are of the TV dinner type with a limited selection of breakfast, lunch, and dinner. They are also packaged in aluminum dishes with a peel-away cover and eaten with a spoon.

Standard dried fruits are vacuum-packed in plastic bags for cutting open and eating.

Freeze-dried beverages and fruit juices are packaged in the same type of plastic bags as the freeze-dried food. They can be used for supplementary liquid meals in emergencies.

Bread is vacuum-packed in plastic bags and are spread with ham, chicken, or tuna salad from cans which have plastic, snap off lids.

The freeze-dried food is usually a meat combination dish, soup, or combination salad and is vacuum-packed in plastic bags. The food bag has a one-way poppet valve through which the food preparation water supply or gas separator nozzle is inserted. The bag has a second valve through which the food passes into the mouth. Approximately one-half of the food is packaged in Kel F plastic bags to make one meal for each astronaut. There are meal bags for breakfast, lunch, and dinner. Cleansing cloths are also included for each meal. The meal bags have red, white, and blue patches to identify them for the individual crewman.

The freeze-dry food is reconstituted by adding hot or cold water through the one way valve on the food bag neck. It is then kneaded by hand for approximately 3 to 5 minutes. When reconstituted, the neck is cut off with scissors and placed in the mouth. A squeeze on the bag forces food into the mouth. When finished, a germicide tablet, attached to the bag, is slipped through the mouthpiece to prevent fermentation and gas. The bag is then rolled as small as possible, taped, and returned to the food stowage compartment.

2.12.6.2.2 Frozen Food Container.

The function of the frozen food container (freezer) is to maintain frozen food packs at a temperature of -100°F to +15°F for 12 days, opening a maximum of once a day for 2 minutes.

The freezer is essentially a large vacuum bottle. The capacity is one cubic foot and will hold 24 food packs weighing a total of 18 pounds. It is an oval shaped cylinder 18.6 inches wide and 18 inches long and weighs approximately 55 pounds without food. It has a 6-inch opening at one end and 4 attachment fittings (Calfax) on the underside. The freezer is stowed on the aft bulkhead for launch and entry, adjacent to lockers A4 and A5 on the +Z centerline. The freezer is removed and replaced with the use of tools E and H.

During the mission, the freezer is stowed in the upper equipment bay (right) adjacent to locker U3 with two straps, the access door forward. Once a day, the crew withdraws the desired frozen food packages and heats them by placing them in the food warmer.

2.12.6.2.3 Food Warmer (Figure 2.12-40)

Another unit of the galley system is the food warmer, or hotplate. Its function is to warm foods from a frozen state to 130±10°F in 20 minutes or less. It is stowed in locker A5 for launch and entry.

The food warmer consists of an enclosed electrical power unit, three dishes, and a power cable. The oven unit is 9.3 x 6.8 x 5.8 inches, weighs 6 pounds, has a control panel, cover, and requires 300 watts to operate. The warmer cover is spring-loaded open and when closed, presses on the food and warming dish to maintain contacts in the dish well. An interlock switch deactivates the heating circuit when the cover is open. A moat around the edge of the dish well will collect moisture from cooking food packs. The warmer control panel has two lights, two switches, and a receptacle. The receptacle receives the power cable connector. The HEATING CYCLE switch has a LONG position to be used when warming

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frozen food packs (20 minutes) and a SHORT position for wet and dry food packs (10 minutes). The RESET switch is momentary and starts the timer and the warming cycle. The indicator lights are marked COMPLETED and HEATING. A thermal switch provides automatic shutoff to prevent the dish from overheating in addition to a timer shutoff. A strap with snaps is attached to restrain the warmer in its using position on the right side of panel 10 in the tunnel area.

The warmer dishes are insulated steel bowls about 6 x 5 x 1 inches with internal heating elements and external contacts and hold frozen, wet, or dry food packs. One dish is stowed in the warmer and two are stowed in a container on locker A3. After heating, they may be used to contain the opened food pack during eating. The frozen food pack is designed so its cover may be peeled back as the meal is eaten to contain the uneaten portion.

Food Warmer Operation. The warmer, dish, power cable, and holder are removed from stowage. The warmer is mounted to the right of panel 10 by its strap and snaps. The FOOD WARMER switch on panel 201 should be OFF, and the power cable connectors attached to the receptacles on the warmer and panel 201. The CABIN FAN 2 switch on panel 2 should be OFF as simultaneous operation may trip the CABIN FAN 2 - AC 2 circuit breakers (2 amps) on panel 5.

The food pack to be heated is procured and placed in the warmer dish; the cover is closed, and latched. The FOOD WARMER switch on panel 201 is set to ON; the warmer HEATING CYCLE mode switch is set to the applicable LONG or SHORT position; the warmer RESET switch is momentarily set to RESET. The HEATING light should be on to indicate the cycle has begun. The HEATING light will turn on and off 48 times as the power is applied to the dish (power is applied intermittently to prevent scorching the food). The dish and food will be warmed when the COMPLETED light turns on. The warmer dish and food pack are removed using the holder. The moisture is wiped from the warmer dish well and moat.

In the event the warmer dish gets soiled, a tissue is dampened and the dish is wiped clean and dried with a utility towel.

During preparation for entry, the food warmer, dish, holder, and power cable are disassembled and stowed.

The power cable is 34 inches long with a connector at each end. The 90-degree elbow end connects to the warmer receptacle and the straight end to the panel 17 receptacle for electrical power.

2.12.6.2.4 Hot Food Holder (Figure 2.12-40)

To handle frozen and hot food packs, a hot food holder (hot pad) is provided. It is 9 inches long, fabricated of Beta cloth, insulated with Beta felt, and fits either hand. It is stowed with the food warmer when not in use.

2.12.6.2.5 Stowage (Figure 2.12-40).

Food is stowed in two areas: the food stowage compartment (2125 cubic inches) in the lower equipment bay (LEB), and the food stowage compartment (2947 cubic inches) in the left-hand equipment bay (LHEB). Combined, they offer approximately 5072 cubic inches of food storage volume, which is sufficient for a 10.6-day mission.

The LEB compartment door is held closed with a "dog ear" latch (squeeze latch). The door is held by a slide and bell-crank detent, and acts as a food shelf. When opened, the door inner surface has patches of Velcro hook. The food box, located inside, is fiberglass with an open end, covered with Beta cloth held on by snaps. The cloth is detached to gain access to the food packages.

The LHEB food compartment (L3) has two doors. Each door has a squeeze latch and is hinged at the top. The food box is similar to the LEB food box.

2.12.6.2.6 Contingency Feeding System.

In the event the cabin is depressurized, the crew will be in their spacesuits and pressurized. Feeding will therefore have to be through the helmet feed port with use of the contingency feeding adapter. However, the backpressure from the spacesuit into the food bag may rupture the bag so it must have a protective cover—the food restraint pouch. Only fluids, primarily fruit drinks and punches will be drunk under these conditions as the solid food is too large to pass through the adapter. This condition could last five or less days.

The contingency feeding adapter and food restraint pouch are in a Kel F package and stowed in the LEB food compartment B1.

Food Restraint Pouch. The food restraint pouch is a strong nylon bag that fits over the food bag and prevents its rupture. While it contains the food bag, it can be compressed, forcing drinks from the bag, through the adapter into the mouth of the crewman.

Contingency Feeding Adapter. Nicknamed the "pon" tube, the contingency feeding adapter is a tube like device that inserts into, and opens, the food bag valve. It also inserts through the PGA helmet feed-through port and into the crewman's mouth.

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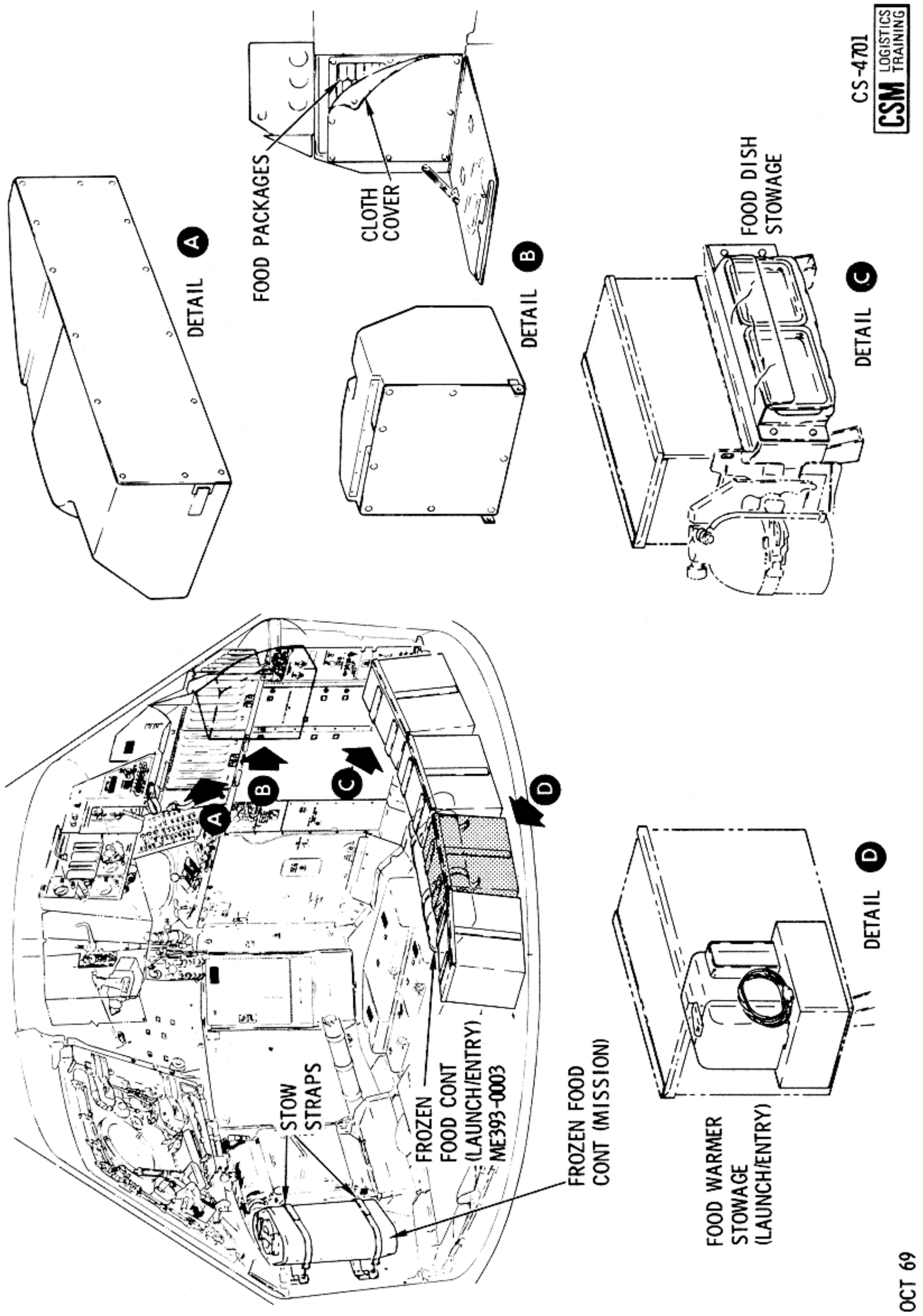

Figure 2.12-40. The Apollo Galley System (Sheet 1 of 2)

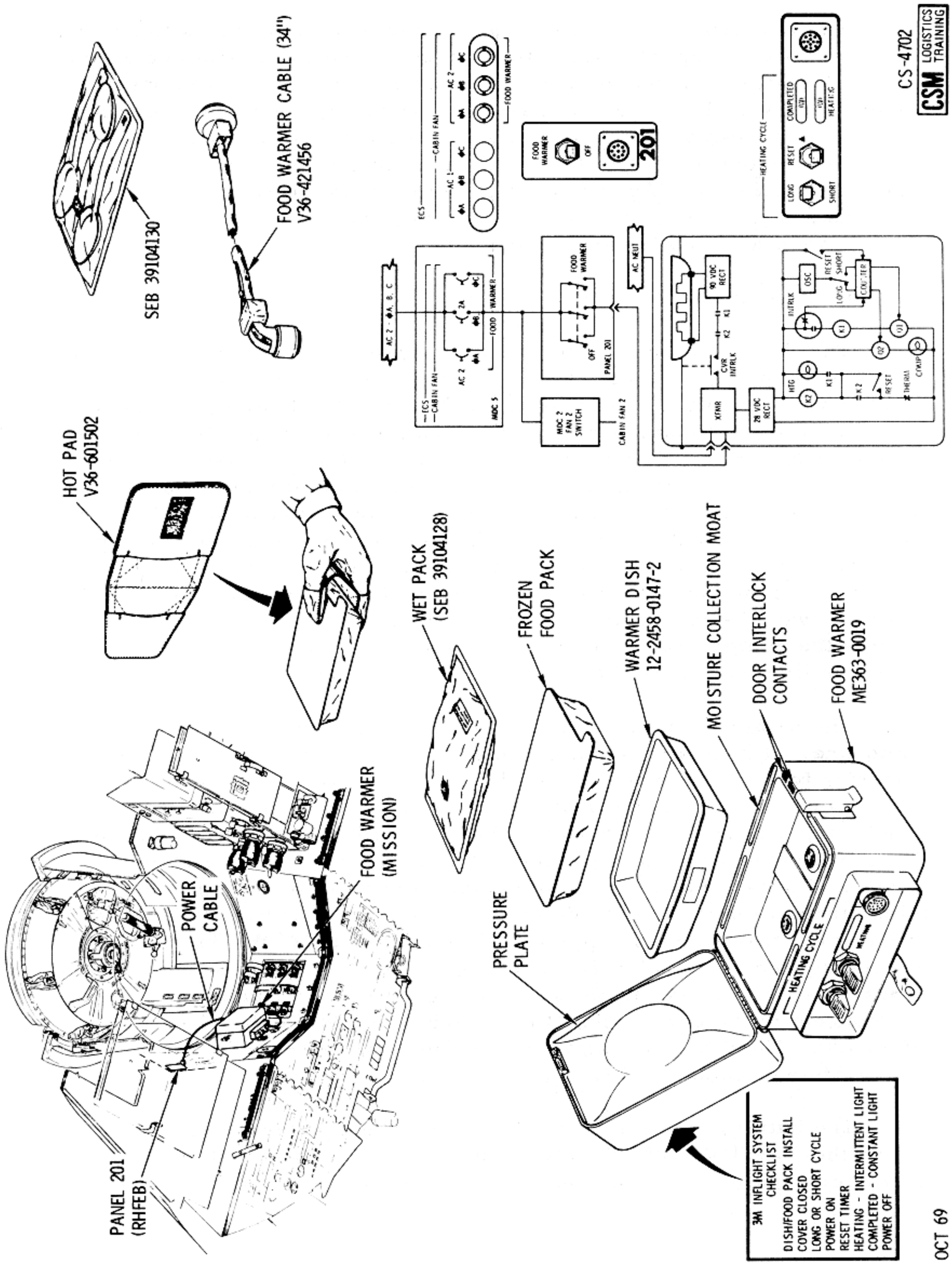

Figure 2.12-40. The Apollo Galley System (Sheet 2 of 2)

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2.12.6.3 Waste Management System and Supplies.

The function of the Waste Management System (WMS) is to control and/or dispose of crew waste solids, liquids, and waste stowage gases. The major portion of the system is located in the RHEB. The basic requirements of the system are ease of operation, accessible supplies, collection and stowage of feces, urine collection and overboard dump, removal of urine from the PGA, urination while in the couches, venting of waste stowage gases, and vacuuming waste liquids overboard. The WMS contains a urine, fecal, waste stowage vent, and vacuum subsystem with their associated supplies and equipment.

2.12.6.3.1 General Description (Figure 2.12-41).

The WMS contains a urine transfer system (UTS), or urine receptacle, urine hose, a vacuum fitting, a fecal collection device, fecal stowage compartment, a WMS panel with two QD's, a control valve, a urine dump line with a special dump nozzle and an auxiliary dump nozzle. Opening the control valve on the WMS panel subjects the system to a 5-psi differential pressure, crew compartment to space. The dump nozzle contains an exit orifice of 0.055 inch that restricts gas flow to a maximum of 0.4 cfm and liquid flow to 1 pound per minute. The gas flow is limited to prevent excessive loss of cabin oxygen during system usage. To prevent the formation of ice at the dump nozzle, which could block flow, the dump nozzle contains two 5.7-watt heaters controlled from panel 101 (LEB). A switch selects the dump nozzle heater to be enabled. Two 2-watt heaters are on the urine line just inboard of the nozzle and are operating continuously.

The battery vent/waste water dump subsystem parallels the urine dump line. It routes outgassing and emergency relief of fluids from the batteries to the WMS panel (252), through the battery vent valve to the ECS water panel 352 where the waste water vent line T's into it. From panel 352, it is routed through a 215-micron filter on the aft bulkhead, through a penetration fitting in the sidewall, to the waste water dump nozzle. The temperatures of both dump nozzles (0 to 100 degrees F) are telemetered to earth to provide an indication of impending nozzle freezing. In the event that either dump nozzle freezes or clogs, the dump lines can be interconnected. To interconnect, open the door below panel 252, exposing a flex line connected to a stowage QD. Disconnect the flex line and connect to the QD 2 inches to the right marked TO WASTE WATER NOZZLE. The interconnecting allows fluids to flow out the "open" (unrestricted) dump nozzle.

The battery vent line contains a pressure transducer that has a readout on the SYSTEMS TEST meter (position 4A) on panel 101 (LEB). A periodic check of the battery vent line pressure will indicate freezing or

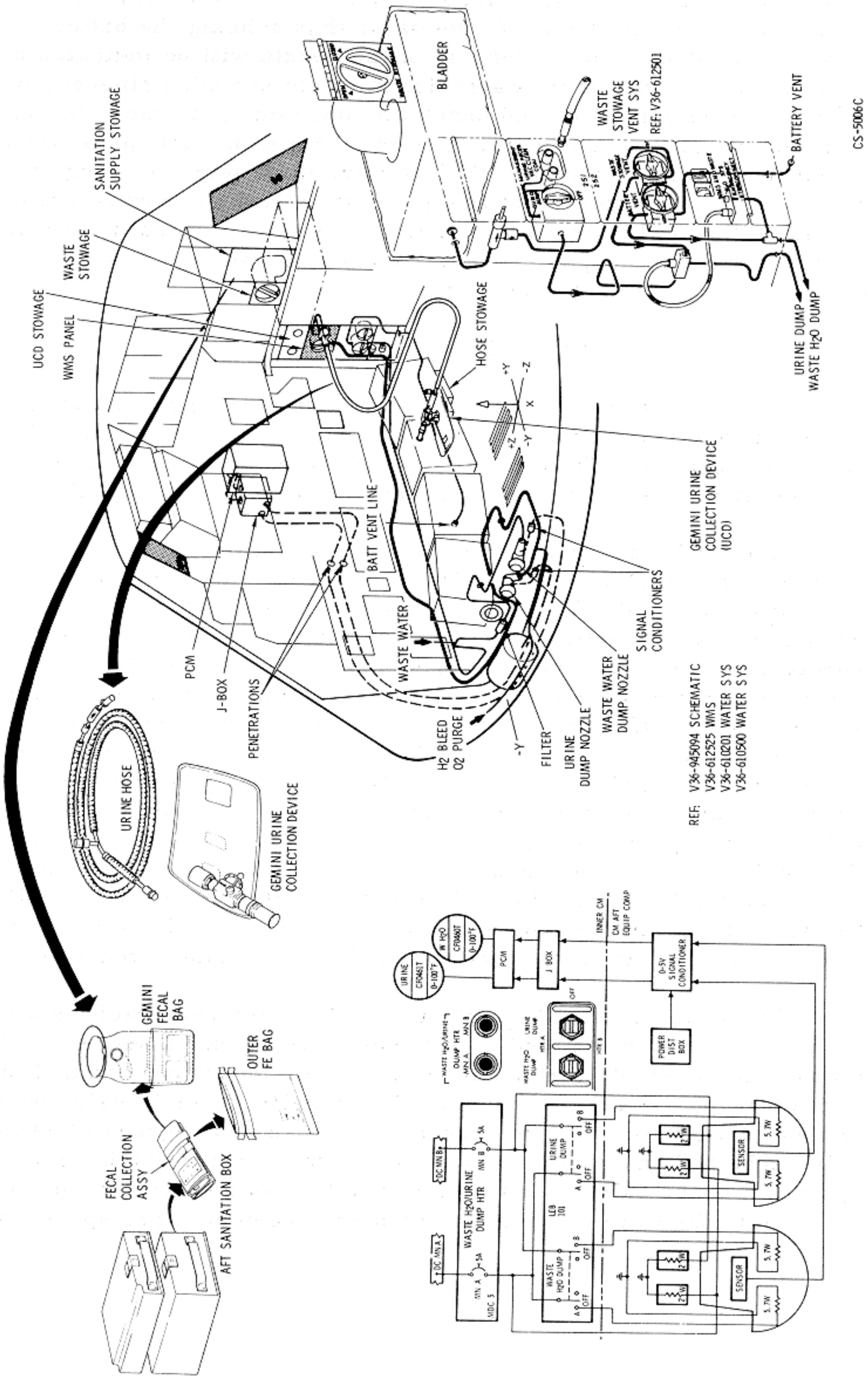

Figure 2.12-41. Waste Management System

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clogging of the waste water dump nozzle. (This is not likely to occur if the waste water tank is drained periodically.) Place the BATTERY VENT valve (panel 252) in the VENT position, thus sensing the battery vent and waste water dump line. Plugging of the nozzle will be indicated by a rise in pressure. If the waste water dump nozzle becomes plugged, interconnect the urine dump line and check the urine dump nozzle. Insert the cabin nitrogen purge (vacuum) fitting into the WMS panel QD, pressurize the lines (5 psi) by opening the OVBD DRAIN valve (to DUMP), closing the valve, and monitor the battery vent line pressure. If the pressure drops to zero, the urine line and nozzle are clear. If the system remains pressurized, both nozzles are plugged. The auxiliary dump system should then be used and is described in subsequent paragraphs.

2.12.6.3.2 Urine Subsystem (Figure 2.12-42).

The urine subsystem has two contending urine collection devices for collecting and transferring urine, the Urine Transfer System (UTS) and the Urine Receptacle. The remainder of the urine subsystem is a 120-inch flexible urine hose (capable of reaching a crewman in a couch), and a filter.

Gemini Urine Transfer System (UTS). The components of the urine transfer system (UTS) are a rollon, receiver, valve with a manifold, collection bag, and a 3/8-inch quick-disconnect (QD). The rollon is a rubber tube that functions as an external catheter between the penis and the receiver/valve. The rollon is used approximately one day (5 to 6 urinations) and then replaced. Ten additional rollons per crewman are in a stowed rollon cuff assembly coded red, white, and blue. The rollon attaches to the urine receiver. The receiver is a short tube that contains a low-pressure differential check valve (0.038 psi), a low pressure differential bypass valve, and screws onto the valve manifold. The collection valve has two positions, OPEN and CLOSED, and allows urine to flow into the manifold. The other end of the valve manifold has a 3/8-inch QD and the collection bag throat is teed into the manifold. The urine collection bag is rectangular in shape with a capacity of approximately 1200 ccs. Each crewman will have his personal UTS for sanitary reasons.

Urine Receptacle With Plenum. The urine receptacle is a relief tube with a valve on the exit end. Both ends have threaded sections. The diaphragm assembly will screw on the receiving (front) end and the plenum will screw on the exit (rear) end. The urine receptacle valve opens when turned 90 degrees counterclockwise and closes 90 degrees clockwise. The relief tube body has slanted holes downstream of the diaphragm and upstream of the valve that allows gas to bypass the diaphragm when attached to the penis. There is one urine receptacle per spacecraft.

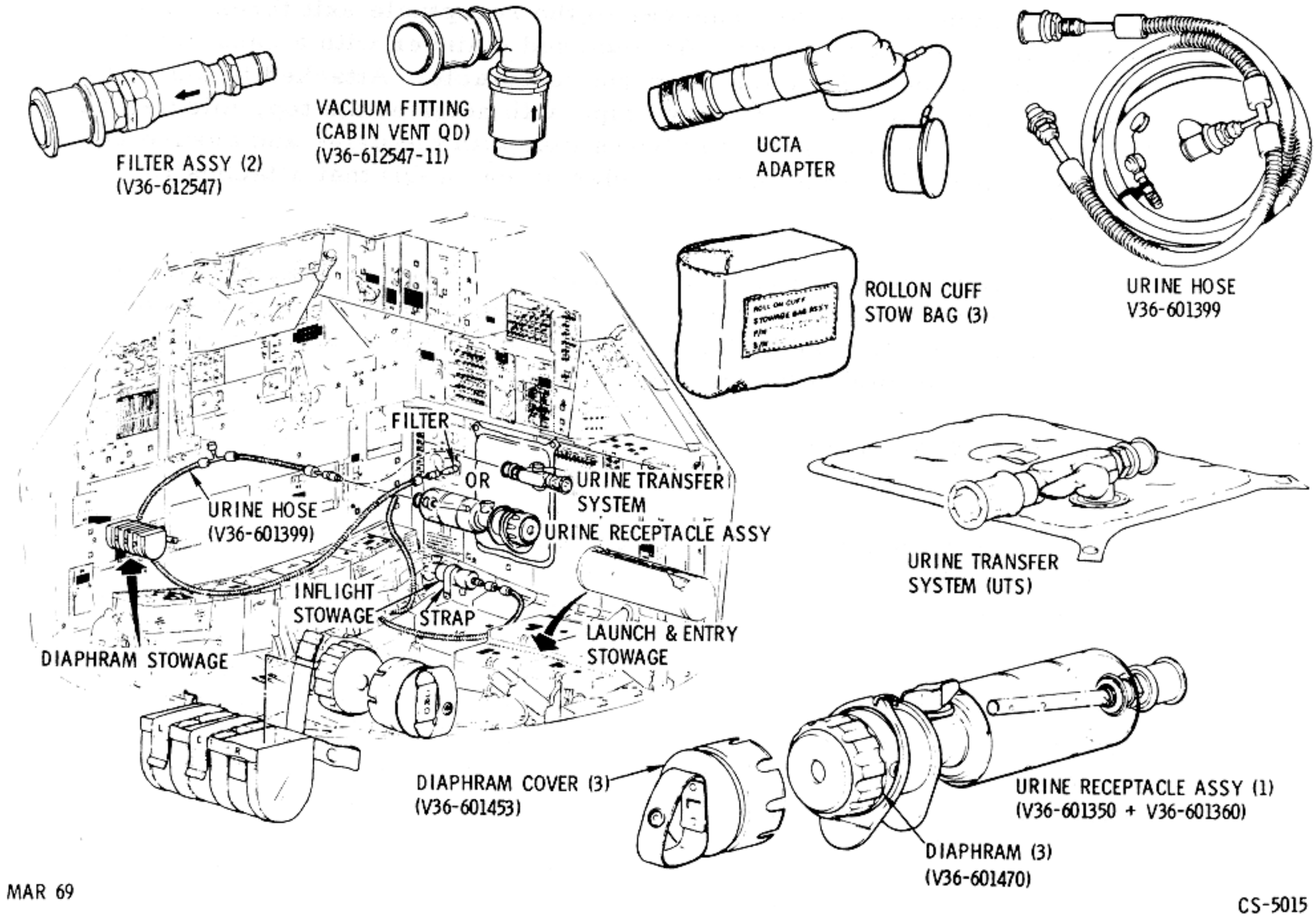

Figure 2.12-42. Urine Subsystem Components

The diaphragm assembly is a short cylinder with a stretched diaphragm over the upstream or receiving end. The diaphragm has a hole in the center through which the penis is placed. The diaphragm is attached to a collar that moves along the outside of the cylinder and stretches the diaphragm. The collar is moved by a wishbone fitting. The diaphragm attaches to the receptacle by screwing. Each crewman will have his personal diaphragm marked L, C, or R. Each diaphragm will have a plastic cap cover with a strap handle and a snap. The diaphragms are stowed in a beta cloth container with compartments marked L, C, and R.

The plenum chamber attaches to the receptacle exit threaded section and is sealed with an O-ring. An enclosed cylinder with a capacity of 780 cc, it receives the urine from the receptacle. Attached to the bottom of the plenum is an open end stand pipe with holes at the top, middle, and lower end. This allows gas to always mix with the urine and assure an adequate flow. The exit end of the plenum has a QD that attaches to the urine hose.

The diaphragm-receptacle-plenum, or urine receptacle assembly will receive and transfer urine at a maximum rate of 40 cc per second. The urine subsystem has a capacity of 1200 cc at the rate of 40 cc per second. The assembly will be stowed in an aft bulkhead locker for launch and entry. During the mission, it will be stowed on the aft bulkhead cable-way, by the WMS panel 252 with the aid of a strap. It should always be stowed with a diaphragm and cover attached to restrict debris.

Urine Hose and Filter. The urine hose is silicon rubber with a Beta cloth cover which will withstand a 6-psi differential pressure and is flexible to facilitate easy routing and handling at zero g. The spacesuit urine QD is located approximately 20 inches from the urine QD and is teed into the hose. The panel QD end of the hose connects to a 215-micron (0.009 inch) filter with a QD which mates with the waste management system (WMS) panel QD. The urine is filtered to prevent clogging the 0.055-inch orifice in the urine dump nozzle. In the event the OVBD (overboard) DRAIN valve leaks, the panel QD can be disconnected to prevent loss of oxygen.

Operation. Urine is dumped in one of the following ways: urination and dumping simultaneously, urination and dumping separately, or draining (dumping) the spacesuit urine collection and transfer assembly (UCTA). There is also an auxiliary dump method which will be described later.

One of the two urine dump nozzle heaters should be on at all times during the mission. The URINE DUMP HTR switch, on panel 101 of the LEB, has three positions: HTR A, HTR B, and OFF. Select HTR A or HTR B. The circuit breakers for this switch are the ECS STEAM/URINE DUCT HTR MNA/MNB circuit breakers on MDC-5 (lower center).

Urine Transfer System, Urinating and Dumping Simultaneously. Connect the panel end of the urine hose (with filter) to the WMS panel QD. Connect the hose urine QD to the urine transfer system (UTS) QD. Next, turn the OVBD DRAIN valve to DUMP. Attach the UTS to the penis by the rollon. Turn the UTS valve handle to OPEN (it will cover the word "OPEN") and urinate. The receiver low pressure differential check valve (0.038 psi) is opened. During this operation, 200 to 300 cc of urine will flow into the urine hose and gradually fill the lines. When the flow

decreases, the UTS bag will begin to fill. The 5-psi pressure differential between cabin and space will cause gas and urine to dump overboard. (With the penis connected, the bypass valve in the receiver prevents a pressure differential on the penis). When urination is complete, roll the rollon back onto the receiver and remove the penis. Place the finger over the bypass valve, thus sucking urine on the outside of the receiver into the receiver flapper valve and preventing it from leaking into the cabin. Close the UTS valve and allow the bag to completely vacuate. Then open the UTS valve and allow a minute purge to clear the urine hose, and then close the valve. Disconnect the UTS QD and stow. Turn the OVBD DRAIN valve to OFF, remove the hose, and stow.

Urine Transfer System, Urinating and Dumping Separately. To urinate and dump separately, unstow the UTS and attach to the penis by the rollon. Turn the UTS valve to OPEN and urinate. The urine will pass through the receiver low-pressure differential flapper valve, through the valve, and into the bag. When urination is complete, remove the UTS by rolling the rollon back to the receiver. A little urine may be clinging to the receiver. Attach a filter to the collection bag QD and then attach the UTS and filter to the WMS panel QD. (This can be accomplished when convenient.) Open the OVBD DRAIN valve and the UTS valve. When the bag is empty (flat), allow 30 seconds for purging before closing the UTS valve and OVBD DRAIN valve. Disconnect UTS QD from the filter QD and stow.

Urinating Using the Urine Receptacle Assembly. The use of the urine receptacle necessitates urinating and dumping simultaneously. To use, obtain the urine receptacle assembly from the mission stowage position and attach personal diaphragm. Remove diaphragm cover and stow. Connect the assembly to the urine hose, rotate WMS OVBD DRAIN valve to DUMP, and rotate the urine receptacle valve 90 degrees counterclockwise until it stops. The system is vented to space and has a 5-psi differential. Open the diaphragm hole, insert penis, urinate, and remove penis. When the plenum empties, allow 60 seconds for the hose and lines to clear, then close urine receptacle valve and OVBD DUMP valve, respectively. Place cover on diaphragm, and stow.

Draining the UCTA While in the Spacesuit. To drain the spacesuit urine collection and transfer assembly (UCTA) through the spacesuit urine transfer QD, proceed as follows. Connect the UTS or urine receptacle to the hose, and the hose to the panel QD. Then connect the hose spacesuit urine QD to the spacesuit urine transfer QD. Position the OVBD DRAIN valve to DUMP. The hose internal pressure is then zero and the spacesuit pressure of 5 psi compresses the UCTA bladder, forcing the urine into the urine hose and overboard dump line. When the bladder has been emptied, open the UTS or urine receptacle valve for approximately a minute to purge the urine hose and line. After closing the UTS or urine receptacle valve, disconnect the urine hose from the spacesuit and UTS or urine receptacle and stow.

CPE

Draining the UCTA After Removal From Spacesuit. It is difficult to drain the UCTA while it is attached to a stowed spacesuit. Therefore, remove the UCTA from the suit by verifying the rollon is clamped and disconnecting the UCTA QD. The urine hose to UCTA adapter is a small tube with a urine hose QD on one end and a UCTA QD on the other. (The UCTA adapter is attached to the urine hose for mission stowage by a strap.) Connect the adapter to the UCTA and the hose spacesuit urine QD. Attach the UTS or urine receptacle assembly to the urine hose, and open the OVBD DRAIN valve and the UTS or receptacle valve. Gas will now flow through the urine hose. Gently compress the UCTA to force urine into the urine hose. When the UCTA is empty, allow 60 seconds purge before closing the UTS or receptacle valve and OVBD DRAIN valve. Disconnect the UCTA from the adapter and attach to the spacesuit.

In the event the cabin is depressurized, and emptying the UCTA is mandatory the UCTA is connected to the urine hose by the UCTA adapter. After opening the OVBD DRAIN valve, the UCTA is firmly compressed, forcing the urine into the hose, lines, and overboard through the dump nozzle.

Auxiliary Dump System (Figure 2.12-43). An alternate method of dumping urine is through the auxiliary dump nozzle in the side hatch. Before launch, the nitrogen purge fitting in the hatch is replaced with an auxiliary urine dump nozzle. The nozzle body passes through the hatch, protrudes slightly inside the hatch and has a pressure plug, electrical connector, and a stowage cover. To prepare for use, remove the auxiliary dump nozzle stowage cover with tool E (small tip). Carefully pull the wires with the connector from inside the stowage cover. Remove the wires from the slot enough to allow clearance for installation of the auxiliary dump nozzle QD. With tool E (small tip) remove the pressure plug (about 20 inch-pounds) and retain. Crew compartment oxygen begins flowing through the dump nozzle. Immediately install the auxiliary dump nozzle QD and hand tighten. Stow the pressure plug and connect the auxiliary dump nozzle power cable to the nozzle connector and to a utility connector on panels 15 or 16. Turn the UTILITY switch to POWER, applying 28 vdc to the two 5.7-watt heaters in the auxiliary dump nozzle. Allow 5 to 10 minutes for the nozzle to warm. The UTS can be dumped by connecting a urine filter to the UTS QD and then attaching it directly to the auxiliary dump nozzle QD. The 5-psi differential pressure will force urine from the UTS bag and overboard through the heated nozzle. When the UTS bag is empty, open the UTS valve for 10 to 20 seconds to purge.

Urination and simultaneous dumping through the auxiliary dump nozzle can be accomplished by connecting the urine hose with filter to the UTS or urine receptacle assembly and the auxiliary urine dump nozzle QD. Apply the rollon or diaphragm to the penis, open the UTS or receptacle valve, and urinate. When completed, remove the penis and allow a 10- to 20-second purge before closing the UTS or receptacle valve.

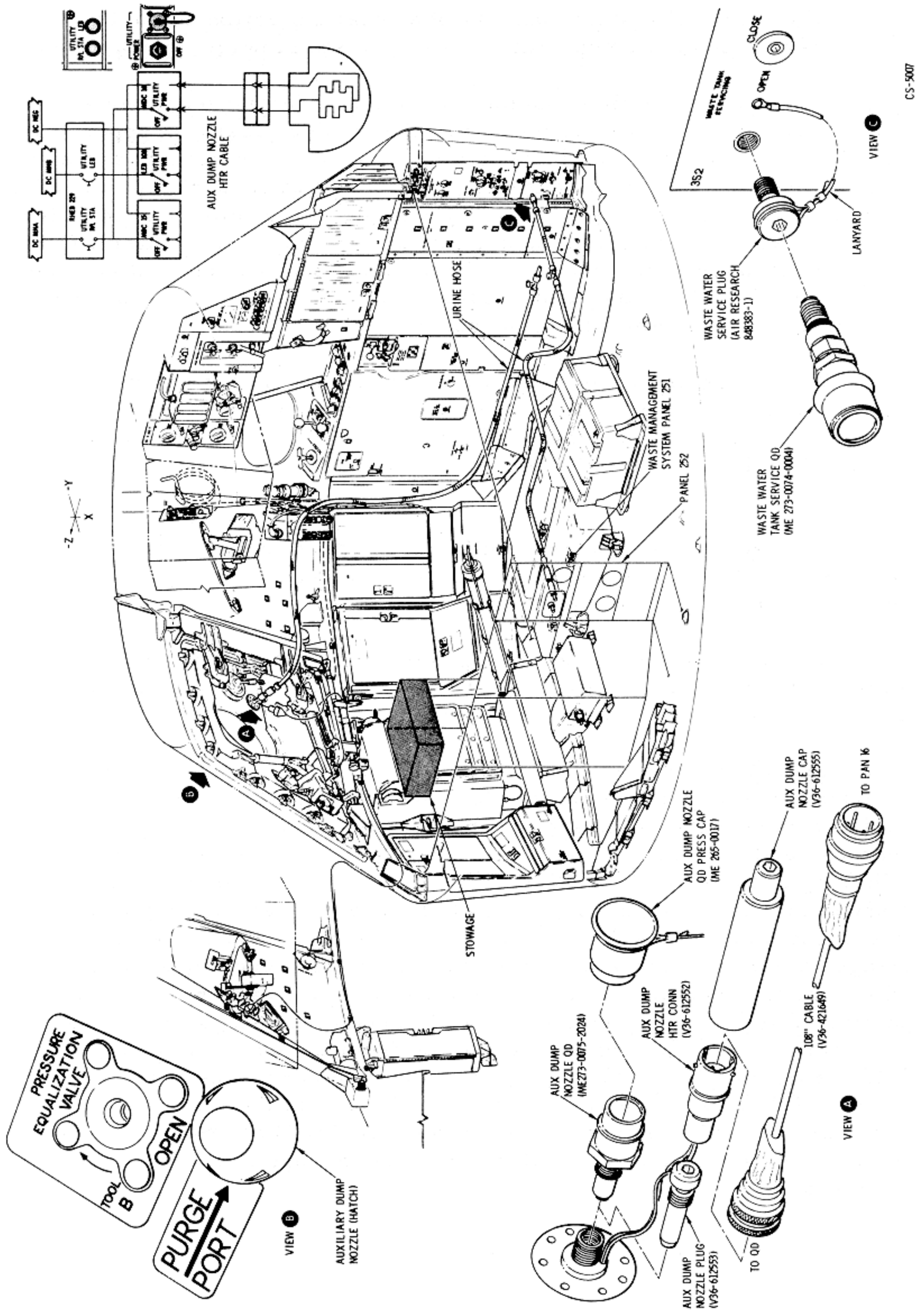

Figure 2.12-43. Auxiliary Dump Nozzle Operations

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2.12.6.3.3 Fecal Subsystem (Figure 2.12-41).

The fecal subsystem consists of a fecal collection assembly, tissue dispensers, stowage compartment, and a waste stowage compartment.

The fecal collection assembly contains a Gemini fecal bag and an outer fecal emisis (FE) bag bound together with a plastic wrapper. The Gemini fecal bag is a plastic sack with a flange at the opening and a finger tube in the center. The flange has a surface of stomaseal tape for adhering to the skin. There is a pocket on the outside of the lower end in which is stowed a wet cleansing cloth and a germicide pouch. The outer FE bag is used for stowage of the used fecal bags and is transparent. It has internal and external seals at its mouth which makes it capable of containing a differential 5-psi internal gas pressure.

The tissue dispensers contain tissue (Kleenex) for wiping, are approximately 8 x 4 x 3 inches, and weigh approximately a half pound a piece. They are stowed in an aft bulkhead locker, and one dispenser is attached to the back of the center couch footpan so it will be available for use.

The fecal collection assemblies are stowed in the RHIEB R 10 compartment in the aft stowage box. The stowage box is fiberglass and has an end door for greater accessibility.

The entry to the waste stowage compartment is through the door R 9 in the RHIEB. This compartment has a capacity of 1600 cubic inches and is part of the Waste Stowage Vent System.

Operation. Retrieve a fecal collection assembly from stowage, remove the wrapper, obtain the Gemini fecal bag, and remove protector strips covering the stomaseal on the flanges. Press the flange to the buttocks and defecate. The finger tube may be used to dislodge any feces adhering to the buttocks. When finished, remove the fecal bag, wipe with tissue, clean with a wet cleansing cloth, remove germicide pouch outer cover and place in the fecal bag. Gently force gas out of the bag, seal the flange opening, locate and rupture the germicide pouch by squeezing. Place the used Gemini fecal bag into the outer FE bag, remove the protective strip from the inner stomaseal surface, press gas from the FE bag and seal. Remove the protective strips from the outer stomaseal surfaces, fold, seal, and knead thoroughly until the blue germicide permeates the feces. Roll into the smallest volume and place in the waste stowage compartment. A split membrane inside the WASTE DISPOSAL door will prevent the fecal bags from "floating" back through the door opening when released.

2.12.6.3.4 Waste Stowage Vent System (Figure 2.12-44).

In the event that several fecal bags rupture during the mission, the waste stowage compartment could emit fecal odors. A bladder has been placed in the compartment with an overboard vent system consisting of a 215 micron filter, check-relief valve, and a vent valve to the urine overboard dump line.

During boost the waste stowage vent valve is open to purge nitrogen from the crew compartment. However, the crew compartment pressure decreases faster than the waste stowage compartment and at a differential pressure of 2 psi, the check valve vents into the crew compartment. During the mission, after the vent valve has been closed, if ruptured fecal bags create an overpressure of 2 psi, the check valve vents, the crew will smell fecal odor and can momentarily turn the waste stowage vent valve to VENT, venting the odor overboard at periodic intervals. Each entry of a

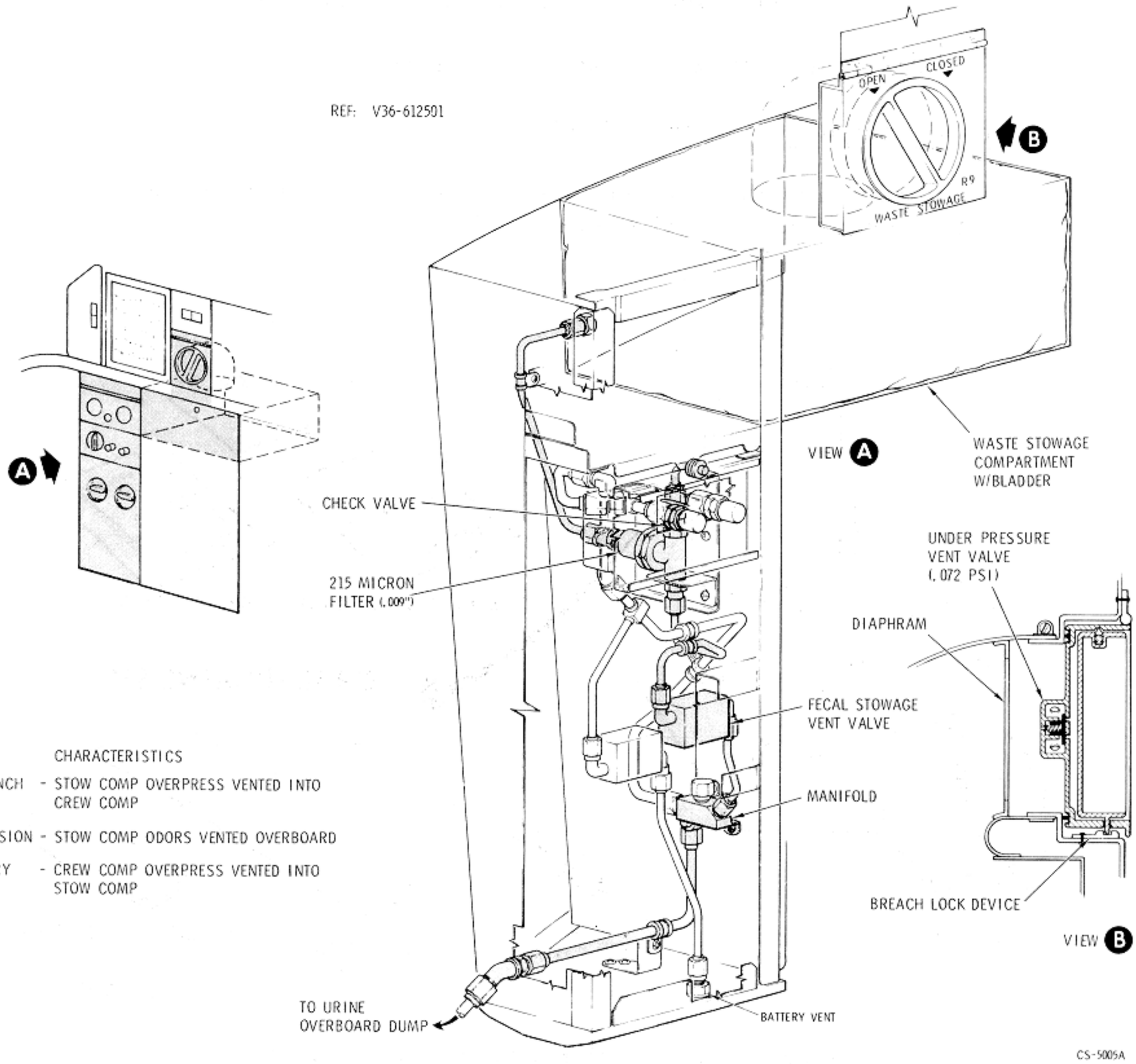

Figure 2.12-44. Waste Stowage Vent System

CPE

fresh fecal bag into the waste stowage compartment would be preceded by an overboard vent action. The waste stowage door forms a pressure seal when "closed." During entry, the crew compartment pressure increases faster than the stowage compartment. A small poppet valve that opens from 0.072 to 0.1 psi is in the waste stowage door and allows the pressure to bleed into the waste stowage compartment.

2.12.6.3.5 Vacuum QD (Cabin Vent QD).

In the event waste liquids escape and pool on the aft bulkhead, they can be "vacuumed" and dumped overboard by use of the vacuum QD and the waste management system. The vacuum QD (V36-612547-11), also called "cabin purge QD," is a 215-micron (0.0086 inch) filter with a QD and 90-degree elbow. The QD will mate to the urine hose.

To vacuum liquid, attach vacuum QD to the urine hose, open WMS OVBD DRAIN valve (panel 251) and use as vacuum cleaner.

The vacuum QD will be stowed when not in use.

2.12.6.4 Personal Hygiene (Figure 2.12-45).

Personal hygiene items consist of an oral hygiene assembly, utility towels, and wet and dry cleansing cloths.

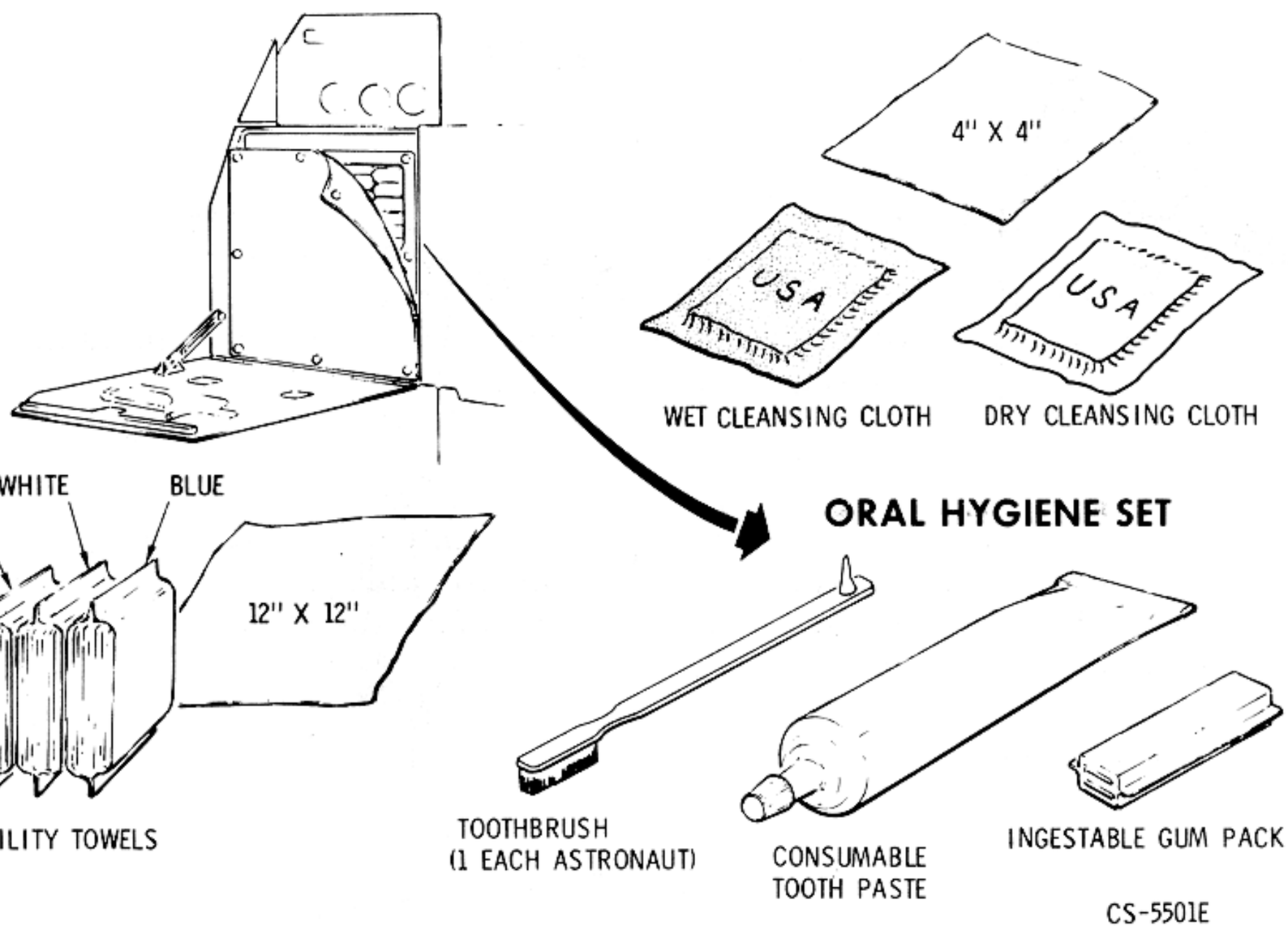

Figure 2.12-45. Personal Hygiene Items

2.12.6.4.1 Oral Hygiene Set - Cleansing of Teeth.

The maintenance of oral health in space flight requires aids which will cleanse the mouth of food debris and bacterial plagues. These aids will be provided each crewmember on an individual basis according to his needs. The oral hygiene set consists of a toothbrush and consumable toothpaste or ingestible gum. The required set will be stored in the first day's food stowage compartment B1, to be used for the entire mission.

2.12.6.4.2 Wet Cleansing Cloth.

Wet cleansing cloths will be used for postmeal and postdefecation hygiene. The cloths are 4 by 4 inches, folded into a 2-inch square and sealed in plastic. They are saturated with a germicide and water.

The cloths for postmeal cleansing are stored, along with the dry cleansing cloth, in the food containers for easy accessibility. The postdefecation cloths are part of the fecal collection assembly.

2.12.6.4.3 Dry Cleansing Cloth.

The dry cleansing cloths will be alternated with the wet cleansing cloths for postmeal cleanup. They are the same size and texture; however, they do not contain water and a germicide. They are also packaged with the food.

The wet and dry cleansing cloths will be placed in the food packages and be part of the "Food Set."

2.12.6.4.4 Utility Towels.

The towels are used for utility cleanup and use. They are 12 x 12 inches and similar to a washcloth, sterile, and packaged in plastic containers. The containers have Velcro patches and stow in an aft bulkhead locker.

2.12.6.4.5 The tissue dispensers contain tissues (Kleenex) for utility-wipe and clean-up purposes. The dispenser consists of a container and tissues. The container is Beta cloth, approximately 9 x 4 x 2 inches, weighs 1.4 pounds with tissues, and has Velcro patches for restraint during the mission. Approximately seven dispensers are stowed in aft bulkhead lockers at launch.

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2.12.7 MEDICAL SUPPLIES AND EQUIPMENT.

The medical equipment is used to monitor current physiological condition of the crewmen, and to furnish medical supplies for treatment of crewmen in-flight medical emergencies.

The medical equipment is subdivided into two functional types: monitoring equipment and emergency medical equipment. The monitoring equipment consists of personal biomedical sensors assembly and a biomedical signal conditioner instrument assembly. The emergency medical equipment is in the medical accessories kit. This kit also contains spares for the bioinstrumentation equipment and harnesses.

2.12.7.1 Bioinstrumentation Harness Assembly (Figure 2.12-46).

The current physical condition is of great importance to the mission monitoring flight surgeon. The heartbeat, by electrocardiograph (ECG) and the respiration, via impedance pneumograph (ZP), are monitored continually throughout the mission. The ECG and ZP are telemetered continuously for all three crewmen simultaneously.

The bioinstrumentation harness is the crewman's personal harness consisting of a sensors assembly and signal conditioner assemblies.

2.12.7.1.1 Personal Biomedical Sensors Instrument Assembly.

The personal biomedical sensors instrument assembly consists of four or more electrodes (silver chloride), signal wire, and accessories, such as paste and application tape.

The sensors (electrodes) are attached to the body of the astronaut, using paste and tape, at areas of sparse muscles (to reduce artifact level), and remain throughout the mission. The sensor assembly consists of two harnesses, a sternal harness attached to the breastbone and an axillary harness attached to ribs near the armpits. The harnesses terminate in connectors that attach to the signal conditioners.

2.12.7.1.2 Biomedical Signal Conditioner Assembly.

Because of their weak signal level, the sensor signals have to be amplified before being telemetered. Thus function is performed by the signal conditioners.

The signal conditioners are 2.3 x 0.46 x 1.5 inches and weigh about 55 grams. They operate through a signal range of plus to minus 5 volts and are powered by a dc-to-dc converter which requires 16.8 vdc. This

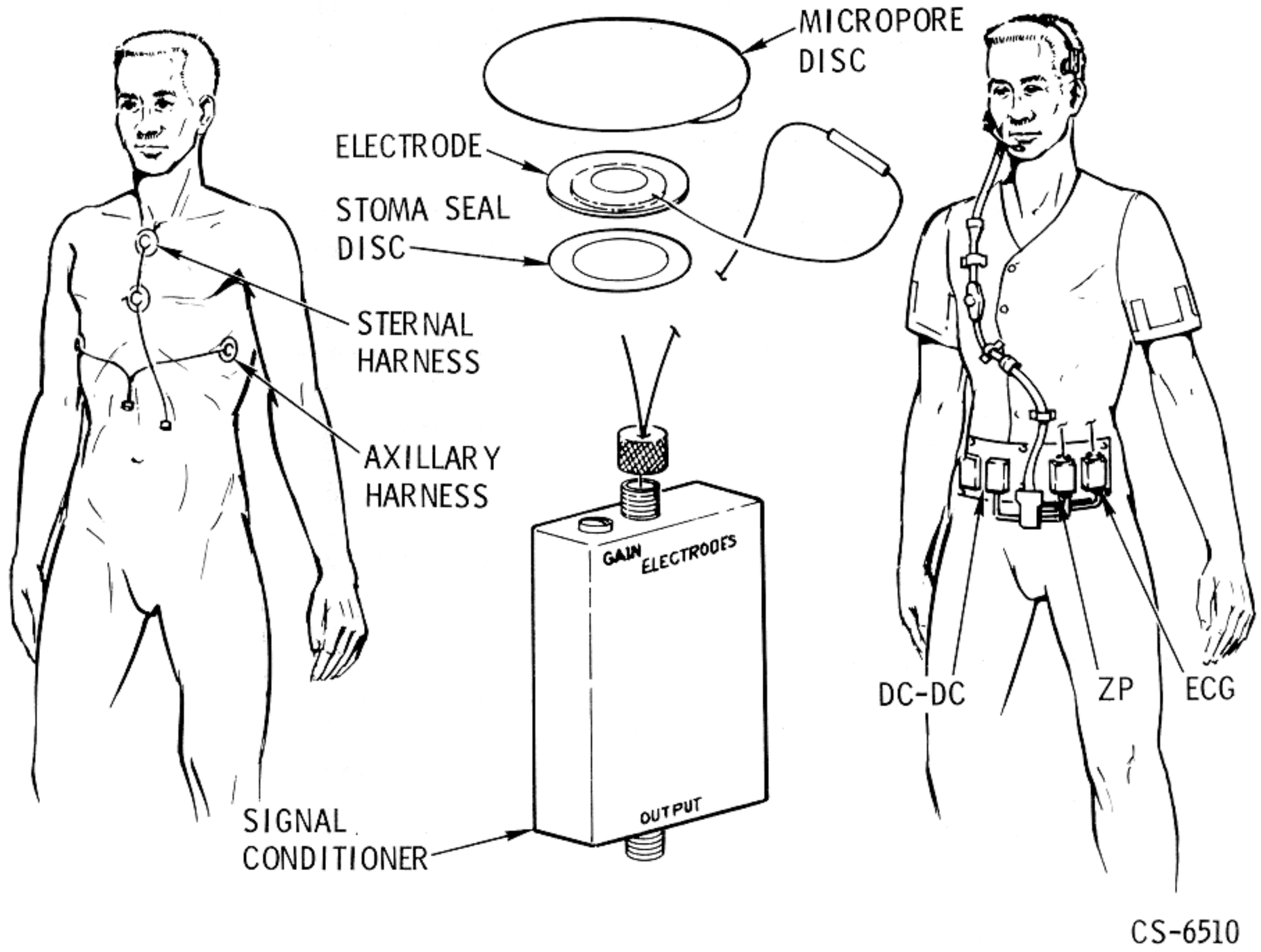

Figure 2.12-46. Bioinstrumentation Harness

input power is supplied through the SUIT POWER switch on each of the audio control panels (MDC 6, 9, 10). There are two signal conditioners (ECG and ZP) and the dc to dc converter.

The signal conditioners fit into pockets in the bioinstrumentation belt which snaps on the CWG at the stomach. Wire leads connect to the sensors, which act as an electrode for the ECG and ZP conditioners. The difference of resistance between two electrodes is measured. Muscle activity (breathing) changes the skin resistance and this change is amplified and transmitted to the telemetry system. Each signal conditioner has an output connector that attaches to the harness leading to the CWG adapter or spacesuit harness.

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2.12.7.1.3 Bioinstrumentation Accessories or Spares.

Spares will be located in the medical accessories kit. The kit has spare electrodes, micropore discs, electrolyte paste, stomaseal disks, and a sternal and axillary harness.

2.12.7.2 Medical Accessories Kit (Figure 2.12-47).

The medical supplies are oral drugs, injectable drugs, dressings, topical agents, and eyedrops. The contents of the medical kit are as follows:

- Oral Drugs and Pills
  - Pain capsules
  - Stimulant
  - Antibiotic
  - Motion sickness
  - Diarrhea
  - Decongestant
  - Aspirin
- Injectable Drugs
  - Pain injectors
  - Motion sickness injectors
- Dressings
  - Compress bandage
  - Band-Aids
- Topical Agents
  - Skin cream
  - Antibiotic ointment
- Eye Drops
- Nasal Emollient
- Sternal harness
- Axillary harness
- Electrode Assemblies
- Thermometer
- Ph paper
- UCTA rollons

The kit is contained in a beta cloth bag with a cloth closure. Inside are leaves with pockets and pouches in which the contents are stowed. The medical accessories kit is stowed in the RHIEB in compartment R8.

In the event the astronauts have to evacuate the command module during the recovery phase, the medical kit will be removed from stowage and carried overboard into the liferafts.

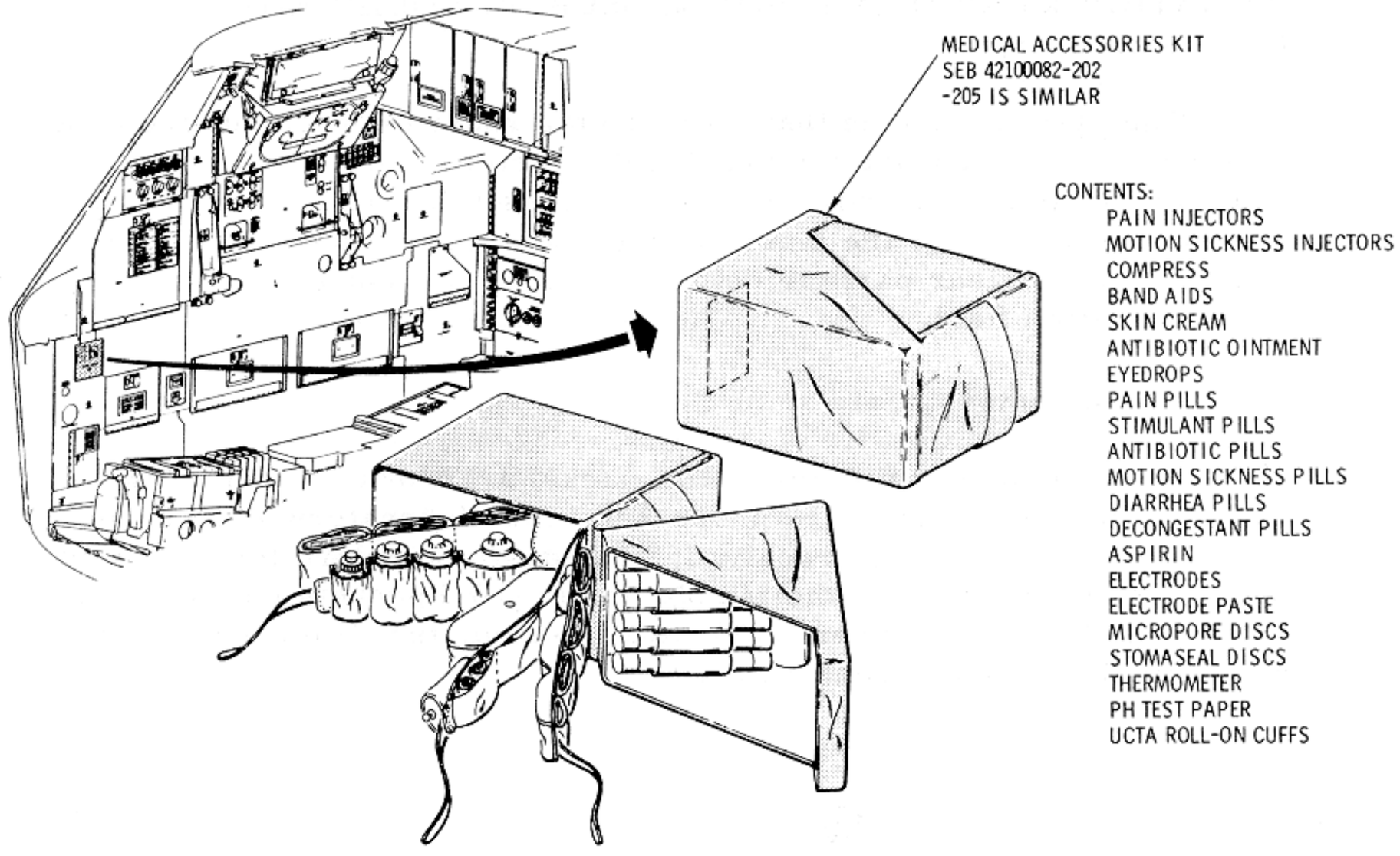

Figure 2.12-47. Medical Accessories Kit

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2.12.8 RADIATION MONITORING AND MEASURING EQUIPMENT (Figure 2.12-48).

The system devices that measure the radiation accumulated dose received by the crew are the passive dosimeters and the personal radiation dosimeters, while the Van Allen Belt dosimeter and the radiation survey meter monitor the ambient strength of the radiation field. In addition, the nuclear particle detection system measures the particle flux of the radiation field.

2.12.8.1 Passive Dosimeters.

Four passive dosimeters (film packs) are worn by each crewman in form film packs which are processed in the laboratory after recovery to determine total dosage received. The dosimeters are located inside the communication hat by the temple and in CWG pockets on the chest, the thigh, and the ankle. When CWGs are changed, the film packs must be respectively switched (figure 2.12-48).

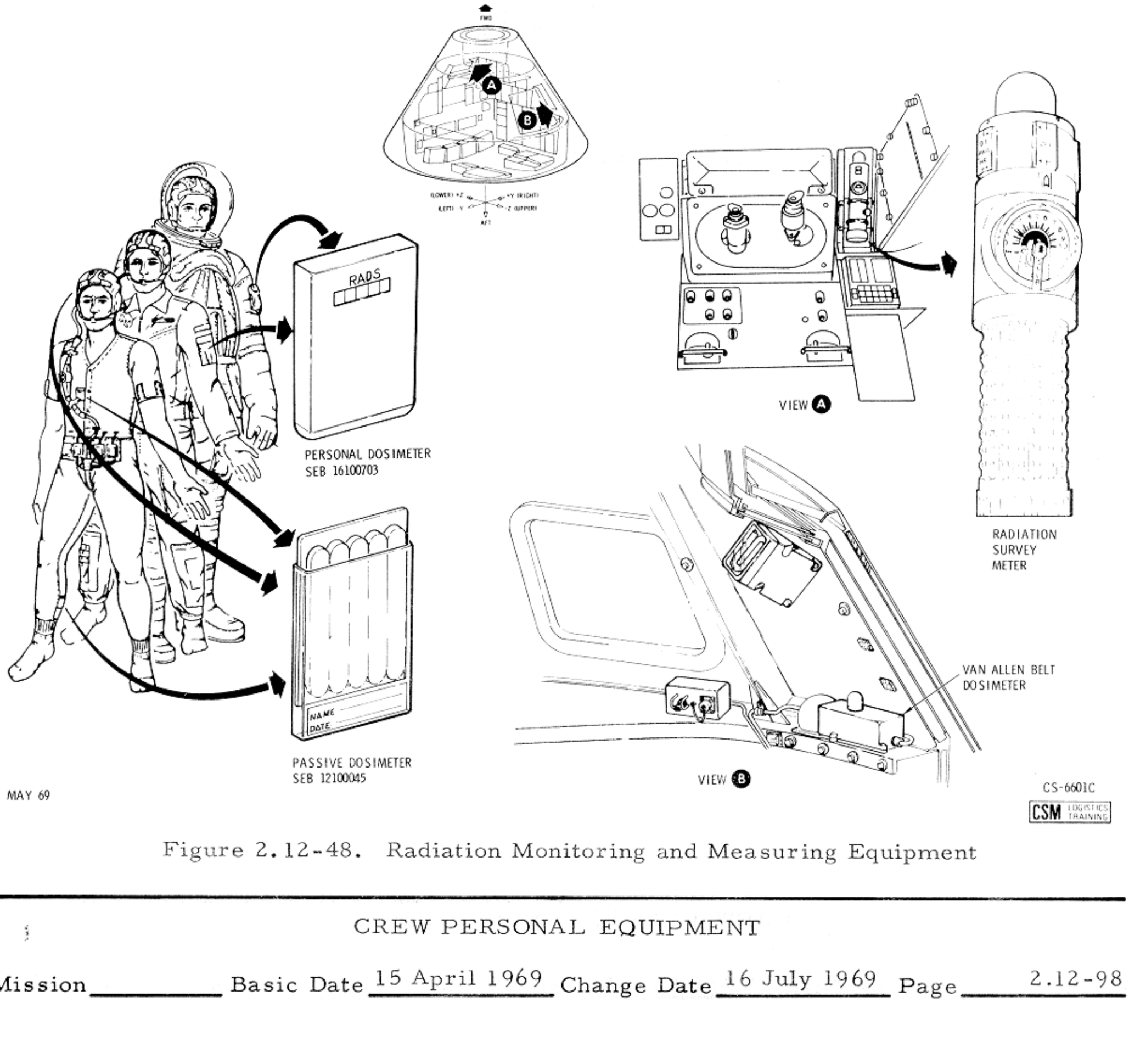

Figure 2.12-48. Radiation Monitoring and Measuring Equipment

2.12.8.2 Personal Radiation Dosimeter (PRD).

Each crewman will wear one personal radiation dosimeter which is battery-powered and the size of a package of cigarettes. The PRDs register readout indicates the accumulated dosage received by the crewman during the mission. The PRD is worn on the PGA or flight coveralls at all times.

2.12.8.3 Radiation Survey Meter (RSM).

The radiation survey meter is used to determine the magnitude of the immediate radiation field. It is a flashlight-like, self-contained unit about 10 inches long and 2 inches in diameter. The RSM has an ON-OFF switch, direct readout dial calibrated in rads/hr, and is battery powered and manually operated.

The RSM is clamped in a bracket mounted on the G&N signal conditioning panel.

2.12.8.4 Van Allen Belt Dosimeter (VABD).

The Van Allen Belt dosimeter is designed to measure dose rates to the skin and to blood-forming organs (depth dose measurement) in the command module. The VABD consists of two individual dosimeters (skin and depth), which have ionization chambers as sensors. The d-c voltage outputs of the VABD are telemetered to ground real time, and these voltage outputs are calibrated to dose rates (rads/hr).

The VABD and its filter module is mounted in the command module on the girth ring between longeron No. 4 (right side) and the hatch.

2.12.8.5 Nuclear Particle Detection System (NPDS).

The NPDS measures proton and alpha particle rates in seven differential energy bands and one integral energy band (8 channels: 4 proton, 3 alpha, and 1 integral proton). The instrument consists of a detector assembly (DA), in the form of a telescope arrangement, and a signal analyzer assembly (SA). The pulse rate from the DA at which particles enter the various energy intervals are converted to d-c voltage levels by ratemeters in the SA; the outputs of the ratemeters are then telemetered to ground.

The NPDS is located in the adapter section between the command module and the service module.

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2.12.9 POSTLANDING RECOVERY AIDS.

The postlanding recovery of the crew and CM may last 48 hours. The recovery aids will assist the crew in signaling the recovery forces and survival.

2.12.9.1 Postlanding Ventilation (PLV) Ducts (Figure 2.12-49).

Shortly after landing, the POST LDG VENT VALVE UNLOCK handle in the upper center of MDC-2 is pulled, unlocking the PLV valves on the forward bulkhead. Then the POSTLANDING - VENT HIGH switch on MDC-15 is positioned to VENT HIGH, forcing air into the CM cabin. The PLV ducts are unstowed and distributed. The crew installs the PLV ducts on the PLV manifold. Each crewmember places a head strap around the back of his head, and lies in his couch. The PLV ducts direct the flow of incoming air to the crewmen. The right- and center-couch crewmen use the short ducts and the left-couch crewman uses the long duct.

The ducts are 3.25 inches in diameter, 15 inches or 35 inches long, and are made of cloth with stiffeners every 5 inches. One end has a head strap and the other end an internal circumferential strip of Velcro for attaching to the PLV manifold. The ducts compress, accordian style, into small volumes that are stowed easily.

Figure 2.12-49. Postlanding Ventilation Ducts

2.12.9.2 Swimmer Umbilical and Dye Marker (Figure 2.12-50).

For daylight visual acquisition during the recovery phase, dye marker is deployed. The CM equipment consists of a dye marker and swimmer umbilical deployment mechanism located on the forward bulkhead and a power control.

The swimmer umbilical and dye marker is spring-loaded and held by a hot wire actuator pin. When the crew determines that the dye marker is required, the DYE MARKER switch is activated to the DYE MARKER position. The POSTLANDING switches are located on MDC-15. The DYE MARKER switch is the center switch of the three POSTLANDING switches. The circuit breaker is on MDC-8 and marked FLOAT BAG - 3 - FLT/PL. The current melts the actuator hot wire, retracting the pin and releasing the dye marker umbilical. It falls in the sea on the end of the 12-foot swimmer umbilical; the dye colors 1000 square feet of sea for 12 hours. When the pararescue personnel arrive, they uncap the swimmer umbilical and plug in a jack, connecting their headset-microphone to the audio center intercomm system, allowing them to communicate with the crew.

2.12.9.3 Recovery Beacon (Figure 2.12-51).

In the event that crew and CM recovery are not effected during daylight, there is a visual acquisition method for night operations. The CM equipment consists of a flashing light (or beacon) located near the tunnel that is turned on by the crew when needed.

Deployment of the beacon begins when the main parachute deploys. A lanyard, attached to the main chute risers, actuates two reefing line cutters that sever a cord holding the recovery beacon arm in the stowed position. A spring rotates the arm in an upright (deployed) position and a latch locks it in place.

The CM has a dual mode recovery beacon and the d-c power source is the SC flight and postlanding bus. The POSTLANDING switches are located on MDC-15. Its circuit breaker is labeled FLOAT BAG 3 FLT/PL and located on MDC-8.

For CM visual acquisition, the BCN LT switch is placed in the LO position. The beacon will flash with a high intensity once every 4 seconds or 15 flashes per minute (FPM). In the low (LO) mode, the operating time is two 12-hour periods.

When the pararescue team is ready for deployment the request for the high rate will be made. The BCN LT switch is then placed in the HI position. The beacon will flash with a low intensity twice every second or 120 FPM. In the high (HI) mode, the operating time is 4 hours.

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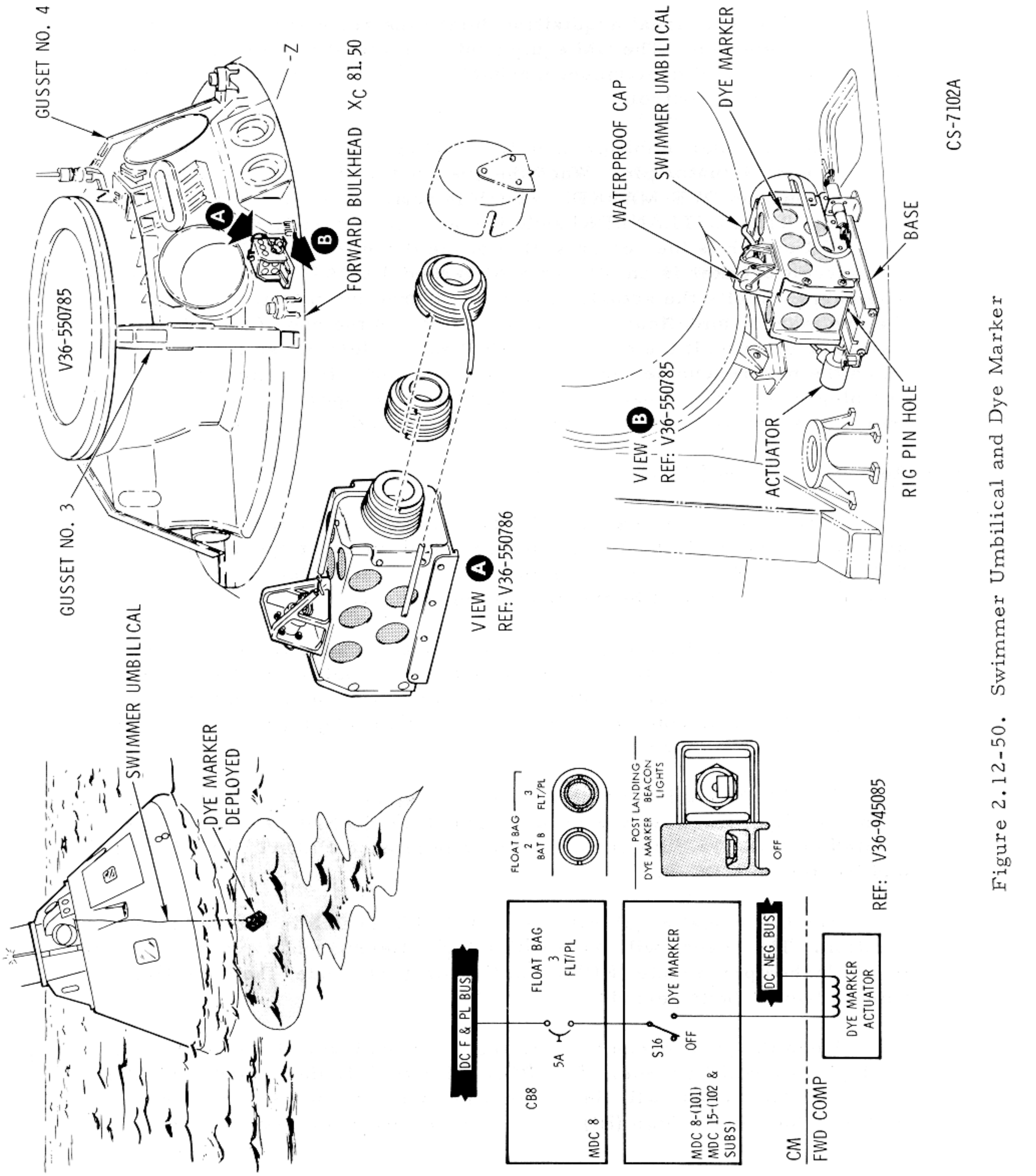

Figure 2.12-50. Swimmer Umbilical and Dye Marker

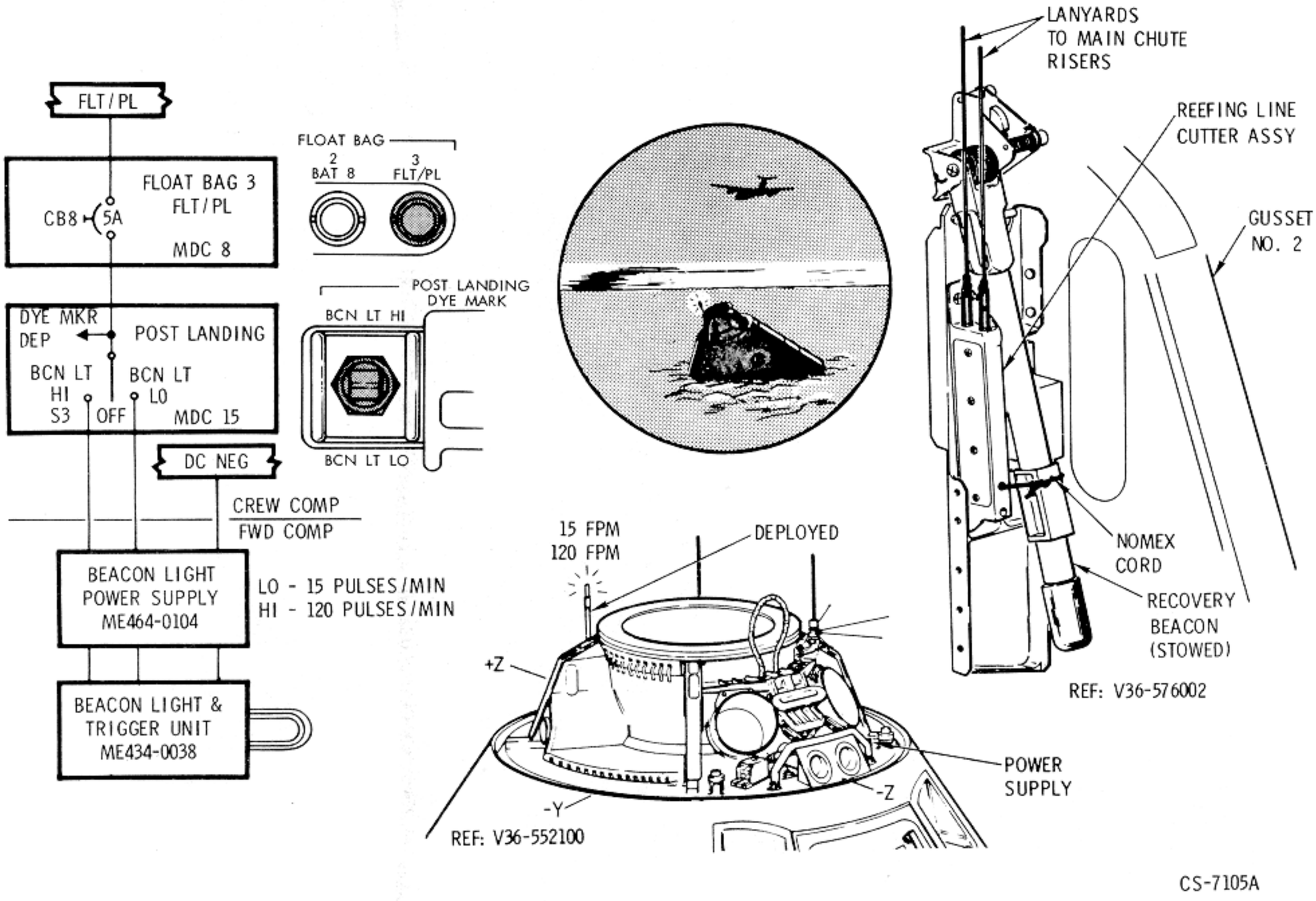

Figure 2.12-51. Recovery Beacon

2.12.9.4 Snagging Line (Figure 2.12-52).

In the event the CM lands beyond the recovery force helicopter range, a recovery aircraft will drop a sea anchor device, consisting of two sea anchors at the ends of a 600-foot floating line. The crew will deploy a snagging line hook through the side hatch pressure equalization valve port after removing the valve. The snagging line is restrained by a plate bolted to the port. As the CM drifts over the sea anchor line, the snagging line hook snags the line, and the CM drift speed is then retarded.

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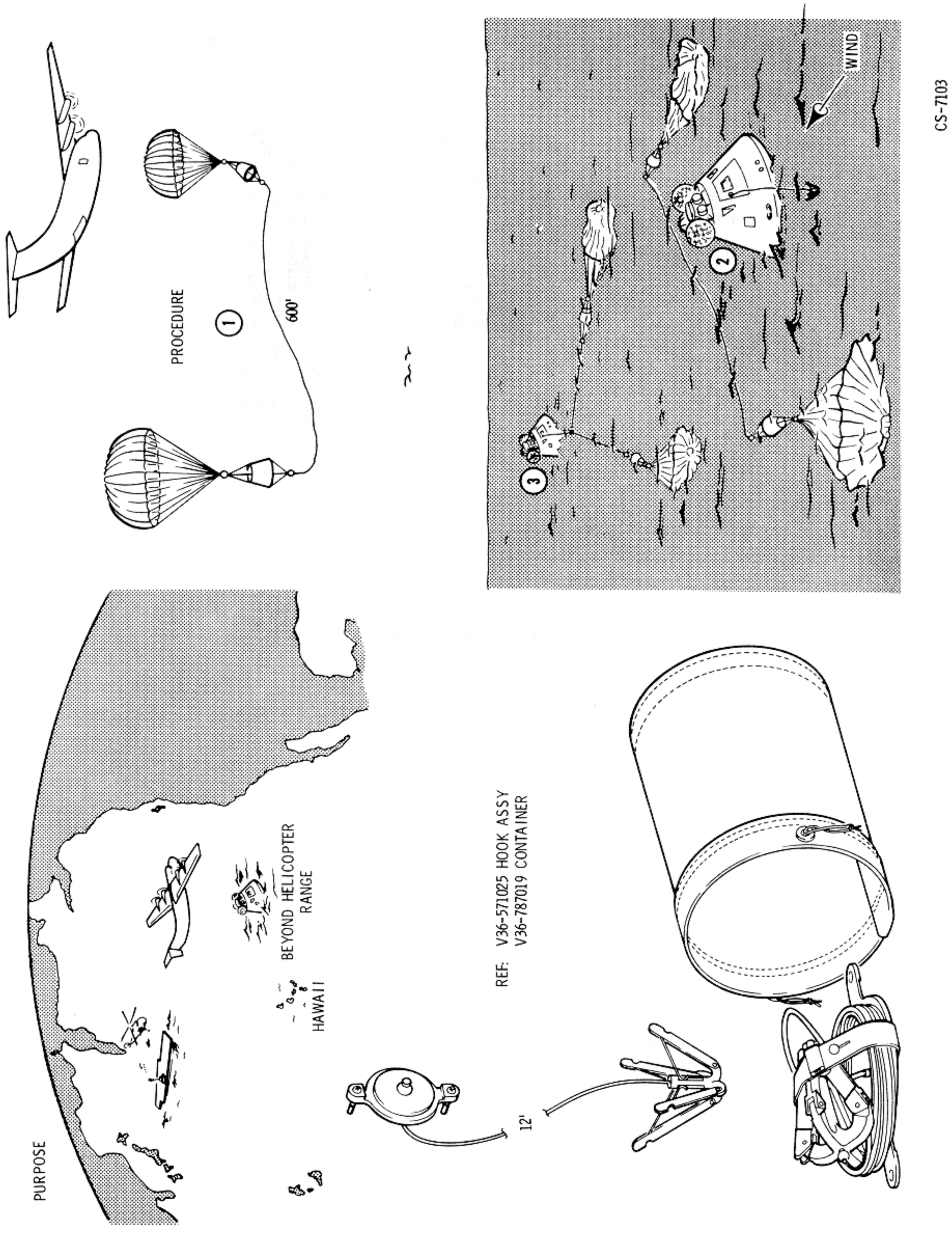

Figure 2.12-52. Snagging Line

2.12.9.5 Sea Water Pump (Figure 2.12-53).

The sea water pump is used for pumping salt water into the CM for desalting and drinking in the event the CM drinking water system is inoperable after landing and the survival hot water has been depleted. The sea water pump is stowed in a beta cloth container in a locker on the aft bulkhead.

The sea water pump consists of an intake hose, a guide fitting, a bellows pump with one way valves, and a discharge hose.

To operate, retrieve the steam vent line sea water pump from stowage. Access to the sea water access plug is through a panel in the LHEB. Tool E will remove the panel. With tool B, insert into hex plug, torque CCW breaking the safety wire and remove plug. Insert sea water pump hose immediately (as sea water may be in the steam vent line) and screw the guide fitting into the boss as tight as possible with the fingers. To feed the intake hose through the fitting, unscrew the teflon guide plug. When the hose is in the sea water outside the CM, tighten the teflon guide plug. Obtain a desalting kit from the survival kit, operate the bellows pump by hand and fill the kit bag.

2.12.9.6 Survival Kit (Figure 2.12-54).

The survival kits function is to provide the equipment necessary for 48-hour crew survival in the water after landing. There are some items that can be used inside the CM such as the water and desalter kits.

The survival kit is stowed in the RHFEB structure in two rucksacks. To remove, open the SURVIVAL KITS door and pull the rucksacks inboard. The rucksacks will have an interconnecting mooring lanyard, and a man-line lanyard.

2.12.9.6.1 Rucksack I.

The rucksacks are cloth bags with a zipper for opening, and a strap for handling. Rucksack I contains the following equipment.

Beacon Transceiver. The UHF beacon/transceiver is a hand-held, battery-powered radio, fixed-tuned to a VHF frequency of 243 mc and manufactured by Sperry Phoenix Company. The radio consists of a receiver-transmitter assembly, a battery pack assembly, and quarterwave antenna. The receiver-transmitter and battery pack assemblies mate to form a water-tight unit measuring 8 by 4-1/2 by 3 inches. The antenna is an 11-1/2-inch-long tapered flexible steel tape, terminating in a coaxial RF connector, and is normally stored in a retaining spool and clipped on top of the radio unit.

CPE

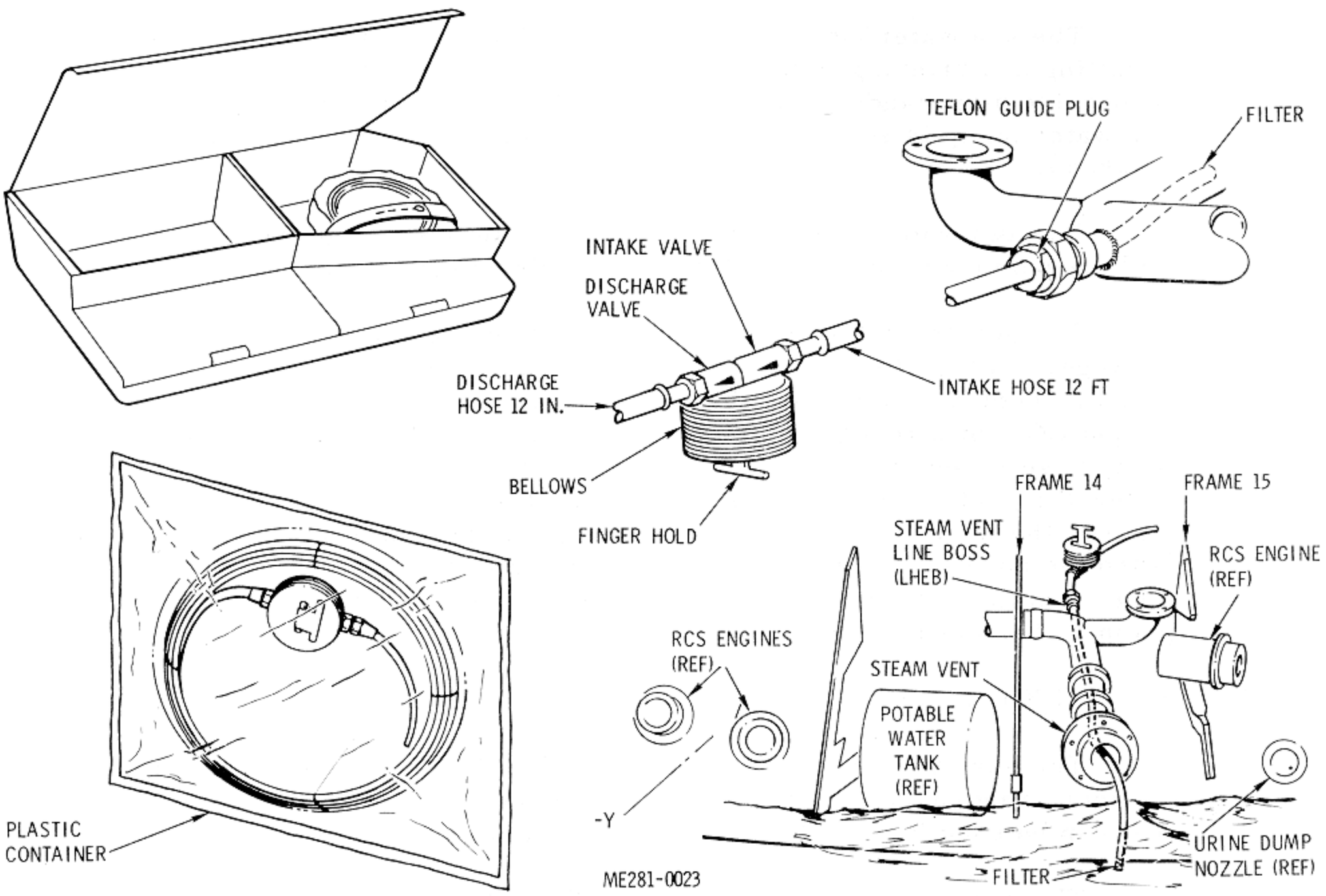

Figure 2.12-53. Sea Water Pump

The radio is capable of line-of-sight operation in either of two modes (beacon or voice) through use of either its own antenna or a suitably connected remote antenna. The transmitter output is protected against damage, while operating, due to accidental shorting of the antenna or submergence of the unit in salt water. In the beacon mode, the transmitter operates unattended for periods up to 24 hours, to transmit an interrupted 1000 cps tone, amplitude-modulated 25 percent on the 243-mc RF carrier. In the voice mode, the radio provides two-way AM voice communication through use of an integral speaker-microphone and PUSH-TO-TALK switch.

A spare battery and spacecraft connector cable is also included.

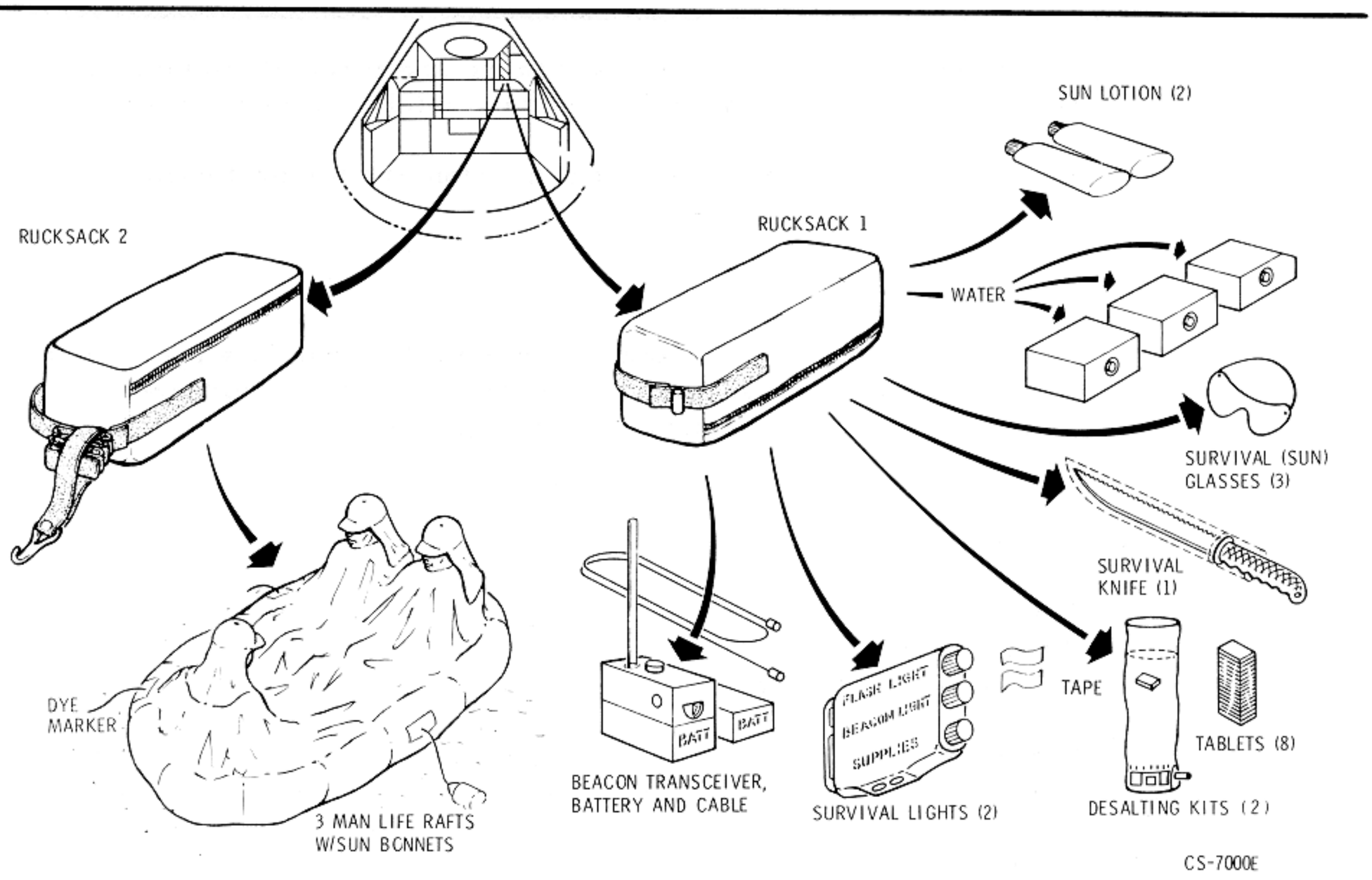

Figure 2.12-54. Survival Kit

Survival Light Assemblies. The survival light is a three-units-in-one device as it contains three compartments. The whole device is waterproof. The controls for the lights are on the bottom.

This first unit is a flashlight. The second unit is a strobe light for night signaling. The third unit is a waterproof compartment containing a fish hook and line, a sparky kit (striker and pith balls), needle and thread, and whistle. The top of the unit is a compass. On one side is a folding signal mirror.

Desalter Kits. The desalter kits contain a desalter process bag, desalter tablets, and bag repair tape. The desalter bags are plastic with a filter at the bottom. Approximately one pint of water is put into a bag and one tablet added. After one hour, drinking water may be taken through a valve on the bottom of the bag.

Machetes. The two machetes are protected with a cloth sheath. The knives are very thin with razor edges. The back edge is a saw.

Sunglasses. For protection of the eyes against the sun and glare, three sunglasses are included. They are a polarized plastic sheet with Sierra Coat III, a gold coating that reflects heat and radio waves.

CPE

Water Cans. For drinking water there are three aluminum cans, with drinking valve, each containing approximately 5 pounds of water.

Sun Lotion. Two containers of sun lotion are for protection of the skin.

2.12.9.6.2 Rucksack 2.

Rucksack 2 contains the flotation gear in the form of a three-man life raft with an inflation assembly and CO_2 cylinder. In addition, it contains a sea anchor, dye marker, lanyards, and a sunbonnet for each crewman.

2.12.10 EQUIPMENT STOWAGE.

The numerous activities of the crew make housekeeping very necessary. All equipment must be stowed at launch and entry, and provisions must be made to restrain loose equipment during the mission.

Patches of Velcro hook are conveniently located on the CM interior structure for stowage of loose equipment, which will also have patches of Velcro pile. Mechanical fasteners (snaps, straps, etc.) will also be used for mission restraint.

Movable or loose equipment is stowed in compartments and lockers located in the equipment bays, on the crew couch, on the aft bulkhead, or sidewalls. The compartments have load bearing doors, internal foam blocks, or boxes to hold and position equipment. On the aft bulkhead, rigid aluminum boxes or reinforced bags are provided for stowage.

Each spacecraft is stowed in accordance with its field installation stowage drawing. Stowage differs from spacecraft to spacecraft because of mission requirements and crew desires.