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NAVSEA SG420-BU-MMA-050

REVISION 5

OPERATION, MAINTENANCE, AND REPAIR
INSTRUCTIONS WITH PARTS LIST

ORGANIZATIONAL, INTERMEDIATE, AND DEPOT
MAINTENANCE LEVELS

SSN 688 CLASS
WEAPONS DELIVERY SYSTEM
EQUIPMENT MANUAL

VOLUME V
VERTICAL LAUNCH SYSTEM (U)

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FOREWORD

This manual covers the Operation, Maintenance, and repair instructions with parts list for the SSN 688 Class Weapons Delivery System Equipment, Vertical Launch System. An illustrated parts breakdown is also included in this manual. This manual is intended for use by Organizational Level and Intermediate Maintenance Activity (IMA) Level Personnel.

The manual covers the above areas in the following sequence:

Ships, maintenance activities, training activities, supply points, depots, naval shipyards, and supervisors of shipbuilding are requested to arrange for the maximum practical use and evaluation of NAVSEA technical manuals. All errors, omissions, discrepancies, and suggestions for improvements to NAVSEA technical manuals shall be reported to the Naval Sea Data Support Activity (NSDSA), Naval Surface Warfare Center, Port Hueneme Division (Code 5E30DP), Bldg 1388, 4363 Missile Way, Port Hueneme, CA 93043-4307 on NAVSEA Technical Manual Deficiency/Evaluation Report (TMDER), NAVSEA Form 4160/1. To facilitate such reporting, three copies of NAVSEA Form 4160/1 are included at the end of each newly published technical manual. All feedback comments will be thoroughly investigated and originators will be advised of action resulting therefrom. Extra copies of this form may be obtained from website http://nsdsa.phdnswc.navy.mil or TMDERs can be submitted directly from this website.

A copy of all comments and recommendations for changes to this document should also be submitted for advance information to: Commander, Naval Undersea Warfare Center (NUWC) Division 1176 Howell Street, Newport, RI 02841-1708 (Attn: Code 4124)

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Reference	Publication/Dwg No.	Title
1	S9SSN-W4-SSM-BSO/ (U) 688CLV2P12	SSN688 Class SSM, Volume 2, Part 12 Vertical Launch System
2	0948-095-7030	Ship Valves Technical Manual User Information for SSN688 Class Submarines
3	S9558-AA-MMA-010 thru - 140	Ship Valves Technical Manual, Volumes 1-14
4	S9727-AA-MMA-010 S9727-AA-MMA-020	Technical Manual, Missile Tube Control Panel, Volume I and Volume II
5	S9SSN-W4-SSM-FCO/ (U) 688CLV4P1C3	SSN688 Class SSM, Volume 4, Part 1, Chapter 3, Ship Service Hydraulic System
6	S9SSN-W4-SSM-FE1/ (U) 688CLV4P1C5A	SSN688 Class SSM, Volume 4, Part 1, Chapter 5A, External Hydraulic System
7	S9SSN-W4-SSM-JEO/ (U) 688CLV4P4C5	SSN688 Class SSM, Volume 4, Part 4, Chapter 5, Plumbing and Gravity Drain System
8	S9SSN-W4-SSM-FAO/ (U) 688CLV4P1C1	SSN688 Class SSM, Volume 4, Part 1, Chapter 1, High-Pressure Air System
9	S9SSN-W4-SSM-NEO/ 688CLV6P3B3	SSN688 Class SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A VLS Support Systems Operation
10	S9SSN-W4-SSM-NBO/ 688CLV6P2	SSN688 Class SSM, Volume 6, Part 2, CP62-9, VLS Missile Emergency Procedure
11	S9SSN-W4-SSM-FBO/ (U) 688CLV4P1C2	SSN688 Class SSM, Volume 4, Part 1, Chapter 2, Service Air System
12	S9SSN-W4-SSM-FGO/ (U) 688CLV4P1C7	SSN688 Class SSM, Volume 4, Part 1, Chapter 7, Potable Water System
13	S9SSN-W4-SSM-AAO/ (U) 688CLV1	SSN688 Class SSM, Volume 1, Chapter 7 General Information

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14	SW282-KB-MMM -010 thru 050	Technical Manual, Mk 121, Mod O Missile Interface Console
15	SW282-KC-MMM -010 thru 050	Technical Manual, Mk 122, Mod O Interface Control Console
16	OD 44979	Firing Craft Operating Procedures and Checklists, SSN688 Class (Volume 2, Part 8 or 9 and Volume 14, Part 2 or 3)
17	SE168-A4-MMA-010/(C)	Nuclear Weapons Security Alarm Circuit 5FZ
18	S9SSN-X2-SCB-010/(U)	Submarine Safety Certification Boundary Book
19	S9SSN-W4-SSM-BJO/ (C) 688CLV2P7C1	SSN688 Class SSM, Volume 2, Part 7, Chapter 1, Fire Control System
20	SW394-AG-MMA-010	Technical Manual, AUR Simulator
21	SW820-AD-WHS-010/ UGM-109-2	Intermediate Level Activity Handling, Loading and Stowage and Quality Assurance Test and Inspection Procedures (QATIP)
22	S9SSN-W4-SSM-GDO/ (C) 688CLV4P2C4	SSN688 Class SSM, Volume 4, Part 2, Chapter 4, 60 Hertz Power Distribution System
23	CSLINST 4355.2 CSPINST 4355.2	COMSUBLANT/COMSUBPAC Quality Assurance Manuals
24	NS250-342-1	Handbook of Cleaning Practices
25	MIL-STD-767	Cleaning Requirements for Special Purpose Equipment, Including Piping Systems
26	0901-LP-480-0002	Naval Ships' Technical Manual, Chapter 9480, Piping Systems
27	MIL-STD-1622	Cleaning of Shipboard Compressed Air Systems
28	S9086-KC-STM-000/ Chapter-300	Naval Ships' Technical Manual, Chapter 300, Electric Plant General

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Reference	Publication/Dwg No.	Title
29	0900-LP-007-9010	Electric Shock, Its Causes and Prevention
30	0969-203-9010	Technical Manual, Ultrasonic Cleaner, MD1219-A-1 Type 1
31	0981-052-8090	Electric Cable Comparison Guide
32		Handbook H-28, Part III, Appendix II
33	S9086-CJ-STM-000/ Chapter -075	Naval Ships' Technical Manual, Threaded Fasteners, Chapter 075
34	S9SSN-W4-SSM-NPO/ (U) 688CLV6P3B12	SSN688 Class SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures
35	EB-1257	Bore Gage Technical Manual
36	S9558-AA-MMA-060	Ship Valves Technical Manual, Volume 6
37	0965-LP-123-1010	Technical Manual, Integrated Announcing System, AN/WIC-2B (V)
38	S9SSN-W4-SSM- NKO/ (U) 688CLV6P3B8	SSN688 Class SSM Volume 6, Part 3 Book 8 OI 633-4, Ship Service Hydraulic System Operation
39	S9086-AA-STM-000	Chapter 001, General-NSTM Publications Index and User Guide
40	S9086-CM-STM-000/ Chapter -078	Naval Ships' Technical Manual, Chapter 078, Gaskets, Packing, and Seals
41	S9505-AF-MMA-010	Technical Manual, Submarine Non-Nuclear Piping System
42	SG420-CC-MME-010	VLS Loading Platform Technical Manual Revision B
43	S9726-AC-MMA-010	Missile Tube Ballast Can Technical Manual
44	105-688-TAV	ETD, Page 19, Figure 4

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45	T9074-AS-GIB-010/271	Nondestructive Testing Requirements for Metals
46	S9086-C1-STM-000/ Chapter -091	Naval Ships' Technical Manual, Chapter 091, Submarine Hull Inspection
47	S9SSN-W4-SSM-FE1/ (U) 688CLV4P1C5	SSN688 Class SSM Volume 4, Part 1, Chapter 5 External Hydraulic System
48	S9086-S4-STM-000/ Chapter -556	Naval Ships' Technical Manual Chapter 556, Hydraulic Equipment (Power Transmission and Control)
49	50400-AD-URM-010/TUM	Tag-out User Manual
50	S9510-AB-ATM-010	Technical Manual, Nuclear Powered Submarine Atmosphere Control (U), Appendix B
51	SE331-AA-MMA-010/ (C) BSY-1	Combat Control/Acoustic Set, AN/BSY-1 (V) General Information and Safety Precautions, System Overview, Chapter 1, Part 1
52	SW395-AG-MMM-010	Description, Operation, Maintenance, Repair and Installation for the Tube Control Panel Volume 1
53	SW395-AG-MMM-020 SW395-AG-MMM-030 SW395-AG-MMM-040	Troubleshooting Procedures for the Tube Control Panel, Volume 2 Part 1, Volume 2 Part 2 and Volume 2 Part 3
54	OPNAVINST 5100 Series	Navy Safety Precautions for Forces Afloat
55	TM NAVSHIPS No. 0948-012-5000	Valves Standard Navy Section 7.1
56	Maintenance Standard 0948-012-5000	General Acceptance Criteria
57	NAVSEA Letter Ser. 376 ED1/E-018 DTD. 20 Jan. 1995	Subject, Removal of Parker Seals
58	Submarine Maintenance Standard (MS No.7210-081-013	Restore Vertical Launch System Hull Valves
59	COMNAVSUBFOR-INST 8500.4	COMNAVSUBFOR INST 8500.4 Conventional Weapons Manual (CWM)
60	MIP 7211/901	SSN 688 Class Vertical Launch System Maintenance Index Page (SSN 719-725 and 750)
61	MIP 7211/903	SSN 688 Class Vertical Launch System Maintenance Index Page (SSN 751 and Later)

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Ref.	SSN 721 & LATER	Title	SSN 719 & 720
1.1	516-5794869	Diagram External Hyd. System	704-5580100
2.1	405-5795131	Missile Tube Control and Indication Cabling Diagram	405-5484068
3.1	704-5794817	VLS Flood and Drain System Diagram	508-5580106
4.1	513-5795657	VLS Pressurization/Vent System Diagram	704-5580120
5.1	607-5754852	Sound Dampening, Non-Pressure Hull, Fwd and Aft	607-5580198
6.1	704-5755257	Vertical Launch System Missile Tube Details	704-5483949
7.1	405-5795136	Missile Tube Hydraulic Control & Indication Schematic Wiring Diagram	405-5484076 and 405-5484077
8.1	405-5795133	Missile Tube Control & Indication Schematic Wiring Diagram	405-5484070
9.1	405-5795134	Missile Tube Control and Indication Cabling Diagram	405-5484074
10.1	113-5754875	Foundation Missile Tube MBT 2 & Details	113-5484080
11.1	113-5754876	Foundation Missile Tube MBT 2 & 3 Sections	113-5580552
12.1	704-5795402	Muzzle Hatch Operating Mechanism	704-5483954
13.1	407-5795890 (For SSN 751 and Later)	SSN688 Class Submarine Weapons Launch Console Tube Control Panel Interface	N/A

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13.2	407-7063826 (For SSN 751 and Later)	SHIPALT 3939KP – SSN688 Class Submarine Weapons Launch Console Tube Control Panel Interface Mods for Block Upgrade	N/A
14.1	407-5858307 (For SSN 751 and Later)	SSN688 Class Submarine Tube Control Panel Functional Diagram	N/A
14.2	407-7063827 (For SSN 751 and Later)	Shipalt SSN3939KP – SSN688 Class Submarine Tube Control Panel Functional Diagram Mods for Block Upgrade	N/A
15.1	704-5858418	Missile Tube Muzzle Hatch Hydraulic Rotary Actuator Assembly and Detail	704-5858418
16.1	405-6016267 (For SSN 751 and Later)	SSN688 Class Submarine Missile Tube Hydraulic K CRT K-15EH Cabling Diagram	N/A
17.1	405-6016269 (For SSN 751 and Later)	SSN688 Class Submarine Missile Tube Hydraulic Control and Indication K CRT K-15EH Schematic Diagram	N/A
18.1		SSN688 Class Submarine Removal/ Installation Missile Tube Hatch Actuator Arrangement	521-5901503
19.1	N/A	VLS Missile Tube Control Panels, Equipment Flow Path	845-5483939
20.1	704-5580100	SSN688 Class Vertical Launch Sys Hydraulic System Diagram Tables, Pipe List and Material Schedule	704-5580100
21.1	Sargent Dwg. No. 20722-001	Valve Assembly Special	Sargent Dwg. No. 20722-001
22.1	Sargent Dwg. No. 20938-400	Manifold Assembly	Sargent Dwg. No. 20938-400

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23.1	Sargent Dwg. No. 20350-001	Pilot Valve Assembly	Sargent Dwg. No. 20350-001
24.1	704-5483998	Valve Assembly Missile Tube Flood and Drain	704-5483998
25.1	704-5483999	Hydraulic Actuator Missile Tube Flood and Drain	704-5483999
26.1	815-1853076	Magnetic Switch	815-1853076
27.1	Flo-Tork, Inc. Dwg. No. 32-3146	Hydraulic Rotary Actuator, Model 32C	Flo-Tork, Inc. Dwg. No. 32-31465
28.1	845-5580317*	Valve Assembly, Ball, Hydraulic Operator, Type 1	845-5580317
29.1	845-4458709	Tool Assemblies, Special, Ball Valves	845-4458709
30.1	845-5580582*	Valve Assembly, Ball-Full Port Manual Operator 2" 700 PSI	845-5580582
31.1	845-5580474*	Valve Assembly Ball-Full Port Manual Operator 1 1/2" 700 PSI	845-5580474
32.1	Vacco Dwg. No. S1E10106	Vertical Launch System Pressurization and Vent Valve	Vacco Dwg. No. S1E10106
33.1	Vacco Dwg. No. S1D10025	3-Way Solenoid Valve with Manual Override	Vacco Dwg. No. S1D10025
34.1	113-5765848*	Foundation Flood and Drain System	113-5765848
35.1	704-5580279	Flood and Drain, Vertical Launch Center, Forward Arrangement	704-5580279
36.1	803-4385050	Mechanical Standard Drawing 1 1/2" and 2" Hull/Backup Valve Assembly	803-4385050
37.1	Flo-Tork, Inc. Dwg. No. 70-28490	Hydraulic Rotary Actuator	Flo-Tork, Inc. Dwg. No. 70-28490

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38.1	E.B. Div. Dwg. No. S-6088	SSN688 Class Handling Equipment 1 1/2" Hull and Backup Valve	E.B. Div. Dwg. No. S-6088
39.1	NORCO Dwg. No. RI 2941-1	Platform Interlock Fitting Hull Receiver	NORCO Dwg. No. RI 2941-1
40.1	6510970	Modified P/V Port Plug	6510970
41.1	302-4454431	External Wireways Installation Standard Methods	302-4454431
42.1	CPG 1570B	E.B. Document	CPG 1570B
43.1	5940679	SSN688 Class Submarine Vertical Launch System Installation of Fairings.	5940679
44.1	7614765	VLS Weapon Control Cable Header Tool Operating Procedure	7614765
45.1	5928036	Flanges Special for VLS	4865086
46.1	521-5901503	SSN 688 Class Submarine Removal/Installation Missile Tube Hatch Actuator Arrangement.	
47.1	704-8206350	SSN 688 Class Submarine VLS Hatch Fairing and Linkage Upgrades	704-8206350
48.1	704-6937652	ShipAlt 3936KP Installation Bearings	704-6937652
49.1	6557914	Insulator Assembly, VLS TOMAHAWK, Weapon Control	

* = Only appears on SSN 719 & 720 SDI

LIST OF MANUFACTURERS

CAGE	NAME	ADDRESS
43689	Newport News Shipbuilding and Drydock Company Ship Repair Sales Department	4101 Washington Ave. Newport News, VA. 23607-2734 (757) 688-2768
96169	General Dynamic Corp. & Electric Boat Division	75 Eastern Point Rd. Groton, CT. 06340-4989 (860) 433-4644
1EE60	Louis J. Hansen Ent, Inc.	5105 W. Roosevelt Rd. Cicero, ILL. 60804 (708) 652-4900
28199	Henschel Inc. General Signal Corp Unit	9 Malcolm Hoyt Dr. P.O. Box 30 Newbury Port, MA. 01950-0020 (978) 462-2400
21392	Preece Inc.	P.O. Box 19684 Irvine, CA. 92713-9684 (714) 770-9411
02750	Eaton Aerospace/Engineered Sensors	15 Durant Ave Bethel, CT. 06801 (203) 796-6000
01496	Air-Dry Corporation of America	1740 Commerce Way Paso Robles, CA 93445 (805) 227-0434
99517	VACCO Industries	10350 Vacco Street South El Monte, CA. 91733 (626) 443-7121

LIST OF MANUFACTURERS (Continued)

CAGE	NAME	ADDRESS
78062	Sargent Controls and Aerospace	5675 W. Burlingame Rd Tucson, AZ 85743 (520) 744-1000
50632	Kamatics Corp.	1330 Blue Hills Ave. Bloomfield, CT. 06002 (860) 243-9704
52115	L. L. Rowe Company	66 Holton Street Woburn, MA 01801-5205 (781) 729-7860
0DNZ3	SEACON Phoenix Inc.	52 Airport Rd. Westerly, RI 02891-3402 (401) 506-6658
07270	Flo-Tork, Inc. 1701 North Main Street	P.O. Box 68 Orrville, OH 44667-0068 (330) 682-0010
38056	Dresser Industries, Inc. Ashcroft Commercial Sales Operation	250 East Main Street Stratford, CT 06497 (203) 385-0660
50225	Naval Undersea Warfare Center	Building 990/4 Code 4124, Room 425 1176 Howell Street Newport, RI 02841-1708 (401) 832-1846
7V969	General Dynamics Information Technology	100 Mechanic Street Pawcatuck, CT 06379-2163 (860) 599-5699

LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviations and acronyms are used throughout this manual to identify or describe a part and to maintain overall economy of space. The abbreviations and acronyms listed are in alphabetical sequence and are cross-referenced to the appropriate word or term.

AC	Alternating Current
ACN	Advance Change Notice
A&I	Alteration and Improvement
A/I	Actuator/Indicator
APL	Allowance Parts List
APV	Air Pressure Vent
AR	As Required
ASSY	Assembly
AUR	All Up Round
AURES	All Up Round Electronic Simulator
AURS	AUR Simulator
AURVS	AUR Volumetric Shape
BCP	Ballast Control Panel
BHD	Bulkhead
BUMED	Bureau of Medicine and Surgery
C	Confidential
CAC	Capsule Armed Command
CAGE	Commercial and Gov" Entity (Formally FSCM)
CC	Cubic Centimeters
CC/A	Combat Control/ Acoustics
CCS	Combat Control System
CID	Commercial Item Description
CLS	Capsule Launching System
CONN	Connection
CONT	Control
CRES	Corrosion Resistant Steel
CU	Cubic
CYL	Cylinder
DC	Direct Current
DET	Detail
DIA	Diameter
D/P	Differential Pressure
DPMS	Dew Point Monitoring System
DR	Drive
Drvr/Rcvr	Driver/Receiver
DWG	Drawing
EMS	Environmental Monitoring Sensor
F/D	Flood and Drain
FIG	Figure
FL/DR	Flood/Drain
FLH	Flathead
FSCM	Federal Supply Code Manufacturers (See CAGE)
ft-lbs	Foot Pounds
GA	Gage
GND	Ground
HD	Head
HDR	Header
HEX	Hexagon
HMLP	Hydraulic Missile Launch Port
HMLS	Hydraulic Missile Launch Starboard
HYDR	Hydraulic
HZ	Hertz
IAW	In Accordance With
ICC	Interface Control Console
ID	Inside Diameter
IMA	Intermediate Maintenance Activity
IMO	Initiate/ Monitor/Operate
in	Inch or Inches
INBD	Inboard
INIT	Initialize
in-lbs	Inch Pounds
INT	Internal
IPB	Illustrated Parts Breakdown
ITL	Intent to Launch

ITP	Index of Technical Publications
Kw	Kilowatt
lbs	Pounds
LED	Light Emitting Diode
LH	Left Hand
LKG	Locking
MBT	Main Ballast Tank
Meg Ohm	One Million Ohms
MFD	Missile Flood and Drain
MG	Motor Generator
MIC	Missile Interface Console
MIP	Maintenance Index Page
MK	Mark
MLC	Missile Launch Console
MRA	Module Rack Assembly
MRC	Maintenance Requirement Card
MS	Military Standard
MSL	Missile
MT	Missile Tube
MTCP	Missile Tube Control Panel
MTEL	Missile Tube Extension Loader
MTG	Mounting
MTS	Missile Tubes
N.C.	Normally Closed
NiCu	Nickel Copper
NO	Number
N.O.	Normally Opened
NPT	National Pipe Taper (Thread)
OD	Outside Diameter
Ohms	Resistance Measurement
OUTBD	Outboard
OPR	Operate
PC	Piece
PMS	Planned Maintenance System
PSI	Pounds Per Square Inch
PSIA	Pounds Per Square Inch Absolute
PSID	Pounds Per Square Inch Differential
PSIG	Pounds Per Square Inch Gage
PT	Part
P/V	Pressurization/Vent
QA	Quality Assurance
QTY	Quantity
Rdh	Roundhead
Ref	Reference
RH	Right Hand
rhr	Roughness Height Rating
SCFM	Standard Cubic Feet Per Minute
Sch	Sockethead
SDI	Ship Drawing Index
Skt	Socket
SLB	Self-Lubricated Bearings
sltd	Slotted
SQ	Square
SSCOR	Silent Self-Controlled Orificial Restrictor
STBD	Starboard
STD	Standard
SWL	Safe Working Load
TB	Terminal Board
TCP	Tube Control Panel
TEMPALT	Temporary Alteration
THK	Thick
TMDER	Technical Manual Deficiency/Evaluation Report
TYP	Typical
UNC	Unified Coarse
UNF	Unified Fine
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VLC	Vertical Launch Center
VLS	Vertical Launch System
VLV	Valve
WDSEM	Weapons Delivery System Equipment Manual
WLC	Weapons Launch Console

CHAPTER 1 GENERAL INFORMATION AND SAFETY PRECAUTIONS

5-1-1 INTRODUCTION.

Volume V of the Weapons Delivery System Equipment Manual (WDSEM) contains the technical information and identifies the reference material required to install, operate, maintain, troubleshoot, repair and overhaul the SSN688 Class Vertical Launch System (VLS).

The vertical launch system is a weapon system that provides SSN688 Class submarines (starting with SSN 719), with the capability to carry, check status, preset, and launch up to 12 encapsulated Tomahawk All Up Round (AUR) cruise missiles from vertical tubes located in the forward free flood area of the ship. The VLS does not degrade existing SSN688 Class weapon systems or submarine operational capabilities.

This volume provides information for the VLS onboard SSN 719 and later submarines. Although the configurations for SSN 719 and later are similar, slight differences exist. For example, the locking mechanism and the location of the flood/drain valves on SSN 719 and 720 differ from SSN 721 and later, and the electrical interfaces on SSN 751 and later differ from SSN 719-725 and 750. To avoid any misunderstanding, ship specific text should be read carefully by the user. When the text does not identify a specific configuration, the text is applicable to all configurations.

Volume V contents are arranged in six chapters and five appendices, some of which are further divided into sections covering major subjects. CHAPTER 1 identifies the equipment covered and provides general safety precautions. CHAPTER 2 describes and refers to basic procedures for component alignment, adjustment and test. CHAPTER 3 provides references to preventive maintenance. CHAPTER 4 contains troubleshooting procedures applicable to both electrical and mechanical equipment. CHAPTER 5 provides corrective maintenance procedures including special criteria for parts repair or refurbishment. CHAPTER 6 provides repair parts identification of selected components illustrated by exploded view isometric drawings. Throughout this volume, inspection, lubrication, testing, troubleshooting and maintenance procedures are keyed to supporting illustrations. Also contained in CHAPTER 6 are two additional tables, one for miscellaneous parts identification and one containing the applicable SHIPALTs, TEMPALTs and A&I numbers up to the date of this manual. Appendix A contains pages that allow the reader to make up a VLS Quick Reference Manual. Appendix B is a MTCP Fault Troubleshooting Guide and Appendix C is a TCP Fault Troubleshooting Guide. Appendix D is General Vertical Launch System Illustrations which help the user understand the overall operation of the Vertical Launch System.

5-1-2 PURPOSE AND SCOPE.

The purpose of this volume is to support organizational and intermediate level maintenance requirements for the VLS missile tube sub systems, assemblies, and associated equipment with minimal reference to other maintenance publications. This manual contains the procedures and identifies the reference material required to inspect, clean, adjust, test, lubricate, troubleshoot, repair, and overhaul components of the VLS missile tubes and associated equipment. References are also made to maintenance procedures provided by Maintenance Requirement Cards (MRCs) of the Planned Maintenance System (PMS). A List of References is provided to support cases where operational and functional information is necessary in supporting troubleshooting and maintenance procedures. References 2 (Ship Valves Technical Manual User Information) and 3 (Ship Valves Technical Manual) are identified as the sources of information for troubleshooting, maintenance and repair of all labeled valves used with the VLS missile tubes system. Similarly, References 4 (Missile Tube Control Panel Technical Manual) and 53 (Troubleshooting Procedures for the Tube Control Panel) are used for troubleshooting the missile tube control panel and tube control panel, respectively. Lists of referenced technical publications and reference drawings are provided in the front of this volume.

Throughout this manual, the valve number, noun name or both refer to valves. To aid the user in recognizing the relationship between valve numbers and their noun name Table 5-1-1 is provided. Table 5-1-1 will list the most commonly used valves. This table is not an all-inclusive list of the valves for the VLS. Refer to Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A) for additional valves.

Table 5-1-1 Valve Identification

VALVE NUMBER		VALVE NOMENCLATURE
AIR PRESSURE VENT		
APV-(*)-1		Pressurization/Vent Control Valve
APV-(*)-2		Pressurization/Vent Hull Stop Isolation
APV-(*)-3		Pressurization/Vent Isolation
APV-(*)-4		Pressurization/Vent Drain
APV-(*)-14		Pressurization/Vent Purge/Vacuum Connection
HYDRAULIC MISSILE LAUNCH		
HML-3		Isolation Accumulator All Charge
HMLP(S)-7		VLS Port (Starboard) Supply Line Valve
HMLP(S)-20		Hatch & Flood/Drain Valve Open
HMLP(S)-(*)-22		Hatch & Flood/Drain Valve Control Valve
HMLP(S)-(*)-23		Leakoff & Case Vent Line
HMLP(S)-(*)-24		Flood/Drain Close Valve
HMLP(S)-(*)-25		Hatch Close Valve
HMLP(S)-30		Flood/Drain Isolation Valve Control Valve
HMLP(S)-31		Equalization Valve Control Valve
MISSILE FLOOD AND DRAIN		
(MFD-1)	MFD-7	Equalization Hull Valve
(MFD-2)	MFD-8	Equalization Backup Valve
(MFD-3)	MFD-9	Manual Flood/Drain Isolation Valve
(MFD-4)	MFD-10	Flood and Drain Header Backup Valve
(MFD-5)	MFD-11	Drain Isolation Valve
MFD-(*)-6		Flood/Drain Valve to Missile Tube

Hydraulic valve numbers: The "P" in the valve number stands for Port and the "S" stands for Starboard. Valve numbers without a "P" or "S" are common to both tube banks.
An (*) stands for tube under test.
Parentheses ( ) around an entire valve number indicate a starboard tube.

5-1-3 SAFETY PRECAUTIONS.

The Commanding Officer or other authority willl issue orders necessary for any situations not covered in these general and specifice safety precautions throughout this manual.
Specific safety precautions for the Vertical Launch System are presented in the text and in instructions provided for specific maintenance and repair procedures. Procedures presented in this volume are subject to applicable general safety precautions provided in Reference 54 (Navy Safety Precautions for Forces Afloat). Additional general safety precautions are as follows:

a. Do not repair or adjust equipment alone under any circumstances. The immediate presence of someone capable of rendering aid is required.

b. Interlocks are provided for safety of personnel and equipment and should only be used for the purpose intended. They should not be battle-shorted or otherwise nullified, except by authorized maintenance personnel. Do not depend solely upon interlocks for protection. Whenever possible, disconnect power at power distribution source.

c. If equipment must be repaired/adjusted while in motion, a safety watch shall be posted. The safety watch must have a full view of the repair/adjustment operation and immediate access to controls that can stop the equipment in motion.

d. Proper installation and maintenance of protective guards and shutdown devices around rotating parts of machinery and high voltage sources shall also be observed.

e. An injury, no matter how slight, should never go unattended. Always obtain first aid or medical attention immediately.

f. Personnel working with or near high voltage shall be familiar with approved resuscitation methods. If someone is injured and stops breathing, initiate resuscitation immediately. A delay could cost the victim's life.

5-1-3.1 <u>General Equipment Handling.</u>

The following safety precautions are specifically applicable to the equipment covered in this volume. They are not intended to replace or supersede the contents of either Reference 16 (OD 44979 Vol. 2 Pt. 8 or 9 and Vol. 14 Pt. 2 or 3) or 21 (Intermediate Level Activity Handling, Loading and Manual), which should be used as the guidelines for weapons handling.

a. Never stand or work under suspended equipment being moved between the ship and dockside.

b. Never load handling equipment to its maximum rated capacity; always inspect handling equipment prior to use.

c. Use safety latches or mouse hooks prescribed in handling procedures.

d. Do not allow items being handled to be unrestrained in any direction at any time.

e. Keep personnel not involved in handling clear of the handling area.

f. Ensure personnel and equipment is clear of hydraulically operated components prior to and during operation.

5-1-3.2 <u>Safety Precautions for Working With High Pressure Air and Liquid Systems.</u>

Except as specifically directed in a procedure requiring the assembly or disassembly of hydraulic or high pressure air systems, all procedures in this volume are subject to applicable provisions of

Reference 54 (Navy Safety Precautions for Forces Afloat). Additional safety precautions are as follows:

a. Never intentionally expose the human body to a direct stream of high-pressure air or hydrqulic fluid.

b. Wear goggles or safety glasses when using compressed air to dry or clean equipment. Particles of dust or other foreign matter may be propelled at high velocity and cause eye injury.

c. Ensure that no sparks, open flames, or other sources of ignition are present in the vicinity of a high-pressure air or hydraulic fluid discharge.

d. Avoid application of heat to air system piping. Air expansion could cause a rupture.

e. Avoid rapid opening of a manually-operated valve when applying high-pressure air or hydraulic fluid to previously empty lines or equipment. Crack open valves slowly until line pressures are equalized.

f. Open components or piping must be sealed or capped to prevent entry of contaminants that could induce damage or explosive conditions.

5-1-3.3 Safety Precautions for Working With Electrical Equipment.

Except as specifically directed, procedures involving connecting, disconnecting or otherwise handling electrical equipment are subject to applicable provisions of References 28 (Naval Ships' Technical Manual, Chapter 300), 29 (Electric Shock, Its Causes and Prevention) and 54 (Navy Safety Precautions for Forces Afloat.

5-1-3.4 Tagout Procedures.

Except as directed in a specific maintenance or repair procedure, all procedures are subject to tagout procedures provided in Reference 49 (Tag-out User Manual) and current Shipboard instructions.

5-1-4 MISSILE TUBE ARRANGEMENT AND LOCATIONS.

The missile tube assemblies and supporting systems are arranged in two independent banks of six tubes (Port and Starboard) to prevent the loss of more than six tubes due to a single system failure or malfunction. Figure 5-1-1 shows the arrangement for SSN 719 and 720, and Figure 5-1-2 shows the arrangement for SSN 721 and later.

The missile tube assemblies are located in forward Main Ballast Tanks (MBTs) 2 and 3, for SSN 719 and 720 and in MBT 2 for SSN 721 and later. Tube numbers are painted on the underside of the muzzle hatches and numbered by weld beads on the topside fairing covers.

5-1-5 MISSILE TUBE ASSEMBLY.

The missile tube assembly houses and provides physical ship interfaces for the AUR/AUR Volumetric Shape (AURVS) or Missile Tube Ballast Can.

Each missile tube is approximately 25 feet long and has a nominal 25-inch inside diameter. The missile tubes are constructed to meet the ship's pressure hull envelope requirements. The lower ends of the missile tubes are fitted with skirt-type weldments. In addition, missile tubes for SSN 719 and 720 are pinned to the foundations at the bottom of MBT 2 and 3 using a 7-inch diameter steel pin. Lateral support and vertical alignment of the tubes are provided by weldments to three horizontal structured flats that engage machine lands on the external surface of the tubes.

A circumferential groove at the top of the missile tube, in conjunction with retention segments (see Figure 5-1-3) and a shoulder below the groove, secure the AUR/AURVS or Missile Tube Ballast Can in the missile tube. Three circumferential shock lands interface with shock pads on the Capsule Launching System (CLS)/AUR. A growth ring in the bottom of the missile tube is provided for use with future AUR configurations. A pressure sensing line, equipped with a quick-disconnect fitting, connects the AUR/AURVS to the missile tube assembly and provides AUR/AURVS pressure to the Differential Pressure (D/P) transducer. Alignment pins, located in the upper end of the missile tube, provide alignment between the AUR/AURVS and the missile tube. Lastly, the missile tube provides a sealing surface for two circumferential O-rings located on the upper end of the AURVS or two O-ring loaded poly paks located on the upper end of the AUR to provide Pressurization/Vent (P/V) system interface and to prevent water from entering the P/V system and the lower end of the missile tube.

Each watertight missile tube assembly is a separate, functional unit consisting of a vertically mounted steel cylinder with a muzzle hatch and attached fairing, hatch operating mechanism, and fairing locking mechanism (SSN 721 and later), or hatch T-bar locking mechanism (SSN 719 and 720). Interface connections between the ship support systems and the AUR are Flood/Drain (F/D) system, P/V system, Environmental Monitoring Sensor (EMS), D/P transducer sensing lines, hatch position sensors and an electrical umbilical penetration. All outboard components of the missile tube are located in the free flood area above the upper horizontal support flat for the tube, except for the F/D valves for SSN 721 and later, which are located in MBT 2.

Access to all equipment within the missile tube free flood area is achieved by removing the portable access plates faired into the superstructure or by opening a muzzle hatch. In addition, access to the interior of MBT 2 is provided through manholes between the MBT boundary and the free flood area. Access to the interior of MBT 3 is provided through manholes between the MBT boundary and the free flood area (SSN 719 and 720) or through hull access plates aft of the tubes in MBT 3A and 3B when SHIPALT 4068D is completed (SSN 721 and Later). The latter access openings, in conjunction with flood grate covers allow entry to the interior of the MBT's for maintenance and inspection without dry-docking the ship.

5-1-5.1 <u>Muzzle Hatch and Operating Assembly.</u>

The muzzle hatch provides a closure for the upper end of the missile tube. The muzzle hatch and operating mechanism assembly (Figure 5-1-4), consist of a pressure-proof hatch attached via a hatch arm to the missile tube. The assembly also includes the fairing. A hydraulic rotary actuator via an operating mechanism independently operates each muzzle hatch.

The fairings are sound dampened in accordance with Reference Drawing 5.1 (Sound Dampening, Non-Pressure Hull, Fwd and Aft). The perimeter of the fairing rests on a sound-dampening gasket molded from Buna-N rubber and secured to non-pressure hull opening by machine studs, studs, brackets and self-locking nuts (ShipAlt 4292K not installed) as shown in Figure 5-1-5. ShipAlt 4292K replaces the molded gasket and associated backing bar with 6 adjustable stops to provide a more efficient means to achive proper fairness of the fairing with the superstructure as shown in Figure 5-1-6.

The muzzle hatch fairing (Figure 5-1-7) is designed to fit flush with the superstructure for the top of the missile tube. Fairing movement is integral with hatch operation through an interconnecting linkage with the hatch arms. In the hatch-closed position, the fairing is preloaded to resist hydrodynamic suction (lifting) loads at high speeds and to prevent noise emissions due to rattling.. ShipAlt 4292K modifies the existing interconnecting linkage by incorporating a a reverse threaded connecting link to provide a full range of adjustability. Both types of linkages are shown in Figure 5-1-7.

The hatch assembly consists of a 30.625-inch diameter dish-shaped, pressure-proof steel cover with a NiCu rim for the top of the tube. The hatch is sealed to the muzzle face with a conventional T-lip face-seal Buna-N gasket having a 28.5-inch mean diameter. The gasket is secured by a retaining ring and 36 self-locking countersunk machine screws (Figure 5-1-5). The outside of the dish-shaped hatch has two pairs of welded clevis fittings with 1.25-inch diameter drilled holes for attachment to the hatch arm. The over toggle of the operating mechanism accomplishes hatch locking in both shut and open positions.

The muzzle hatch can be gagged in the open position by using the gagging pin (Figure 5-1-8). The gagging pin is inserted (using the extension handle) through the hinge arm hub and torque shaft to engage a gagging block attached to the hatch operating gear foundation. The anti-rotation bolt prevents the gagging pin from rotating freely while attaching or removing the extension handle. Hatch gagging is done for the safety of personnel to prevent the muzzle hatch from inadvertently shutting.

The muzzle hatch operating mechanism is used to open and shut the hatch. Figure 5-1-9 shows a typical arrangement for SSN 721 and Later. Figure 5-1-10 shows the typical arrangement for SSN 719 & 720. A rack and pinion hydraulic rotary actuator mounted on a foundation beside the tube powers the mechanism. The primary connection from the hydraulic actuator is the spline end of the actuator pinion gear shaft, which drives the adjustable operating linkage. The spline teeth of the hatch arm clevis engage the torque shaft, which engages the hatch arm. The muzzle hatch operating linkage over toggles in both the shut and open position. The over toggling of the linkage prevents the movement of the muzzle hatch in the event of loss of hydraulics. Figure 5-1-8 is a typical picture of the linkage in over toggle for SSN 721 and Later.

When the hatch is commanded open for SSN 721 and later (Figure 5-1-8) hydraulic pressure simultaneously vents from the fairing lock hydraulic cylinder and the muzzle hatch actuator. Due to pressure differential, the fairing lock cylinder will operate prior to the muzzle hatch actuator causing the fairing locking mechanism to disengage from the fairing dogs prior to muzzle hatch movement.

The muzzle hatch locking T-bar device, for SSN 719 and 720 (Figure 5-1-10), is a mechanically operated mechanism. The T-bar is swung into and out of place by a linkage driven from the hatch actuator clevis. The initial rotation of the hatch clevis moves the T-bar linkage, which unlocks the hatch. When the hatch is shutting, for SSN 719 and 720, the last rotation of the hatch actuator causes the T-bar to lock the hatch arm.

5-1-6 HYDRAULIC SYSTEM.

The VLS hydraulic system (3000 psi nominally) is a subsystem of the ship's external and service hydraulic systems that supplies hydraulic fluid for all hydraulically operated VLS components located both inside and outside the pressure hull. The external hydraulic system normally supplies hydraulic power to operate the muzzle hatch, fairing locking mechanism and flood/drain valve which all have actuators external to the pressure hull. The ships service hydraulic system supplies hydraulic power to the components of the VLS located inside the pressure hull. Figure 5-1-11 shows a general valve arrangement of the valves associated with the Vertical Launch System. Figure 5-1-12 and Figure 5-1-13 are simplified operational modes of the VLS hydraulic system. The ship's external hydraulic system has a single header isolation HML-3 upstream of the VLS accumulators. Down stream of isolation HML-3 the VLS hydraulic system is divided into two headers (port and starboard). All VLS hydraulic components for port and starboard banks work in the same manner. The VLS hydraulic system receives 3000 psig fluid through an isolation valve HMLP(S)-7. Down stream of HMLP(S)-7 the header splits into two lines, one line is the common open (C-1) supply. This open supply has only one bank isolation HMLP(S)-20, which supplies the muzzle hatch actuator, fairing lock hydraulic cylinder (SSN 721 and Later) and the flood/drain valve actuator. This design was incorporated to minimize hull penetrations. The other line supplies a directional control valve HMLP(S)-(*)-22 to provide shut (C-2) side fluid pressure. The shut side hydraulic lines have individual tube isolations for the flood/drain valve HMLP(S)-(*)-24 and the muzzle hatch HMLP(S)-(*)-25. The fairing lock hydraulic cylinder (SSN 721 and later) is in the muzzle hatch line and is isolated when the muzzle hatch actuator is isolated. There are 12 case vent leak-off headers, each terminating into a funnel drain through isolation valves HMLP(S)-(*)-23 in the vertical launch center or VLS valve station on the SSN 751 and later.

The VLS hydraulic system design characteristics are as follows:

External Hydraulic System Supply

Hydraulic fluid	2075 T-H Mil-H-17672 D
System normal operation pressure	2495 to 2940 psig
Maximum operation pressure	2940 psig
Design pressure	3300 psig
System normal temperature	Ambient
Maximum temperature	122° F
Minimum temperature	28° F
Accumulator (2) Capacity	1800 cubic inches (each)

For additional information, characteristics, settings and test procedures for the relief valve, refer to References 2 (Ship Valves Technical Manual User Information) and 3 (Ship Valves Technical Manual).

5-1-6.1 Accumulators.

Two piston type, single tailrod, 1800 cubic inch accumulators serve as reservoirs of high pressure hydraulic fluid for use by the VLS hydraulic system in the event of ships external hydraulic system failure (Figure 5-1-14). These accumulators are maintained in a fully charged condition by the ships external hydraulic system and have a check valve in the header to prevent loss of accumulator and system pressure in the event of ships external hydraulic system failure. Hydraulic fluid is stored in the tailrod (top) side of the accumulator. The air (bottom) side of each accumulator is connected to an air flask, which is charged from the high-pressure air system. The airside of the accumulator is provided with an air bleed and drain valve to bleed air or drain any fluid from the accumulator.

The accumulator tailrod is equipped with a small hole, which terminates near the outboard end of the tailrod to indicate internal leakage. Excess leakage indicates that dynamic seals require replacing. When accumulator fluid leakage reaches approximately 1/4 pint (approximately 120 cc) per day, the dynamic seals should be replaced at the first opportunity.

A content indicator is mounted on top of the accumulator. This indicator has corrosion-resistant steel housing approximately 29 inches high, which encloses the accumulator tailrod. Attached to the accumulator tailrod is a mechanical indicator rod, which indicates the fluid level within the accumulator.

The common sections of the MTCP and TCP are provided with lights to indicate the contents of the hydraulic accumulators. When the fluid side of the accumulator is charged between 85 and 95 percent capacity, an electrical limit switch mounted on the contents indicator is activated, and the hydraulic accumulator CHGD (MTCP) or NORM (TCP) indicator will be lit respectively.

When the accumulator level drops below 85 percent, the hydraulic accumulator NOT CHGD (MTCP) or LOW (TCP) indicator, as applicable, will be lit.

When fully charged, each accumulator has a full capacity fluid pressure of 2680 psig. When all fluid is expelled from the accumulator, the pressure drops to 2300 psig.

Two six-cubic foot air flasks (one for each accumulator) are used to provide a large volume of high-pressure air for the accumulators in order to maintain a relatively constant hydraulic fluid pressure. For normal operation, the air flasks are fully charged to 2570 psig from the high-pressure air system.

5-1-6.2 Control Valves and Actuators.

Twenty-four hydraulic rotary actuators of a double seal design are used outboard of the pressure hull on SSN 719 and 720. The SSN 721 and later has the same twenty-four hydraulic rotary actuators and twelve additional piston actuators for the fairing locking mechanism. All external actuators are of the double seal design with a leak-off cavity between all seals. The actuators have unbalanced piston areas, which will allow the entire system to be pressurized in the normal or shut condition. The small piston of the actuator supplied by the open (C-1) port is constantly pressurized from the open (C-1) side header HMLP(S)-20. The actuators are thus controlled by either pressurizing or venting the shut (C-2) lines through the hatch & flood/drain valve control valve HMLP(S)-(*)-22. A single directional control valve controls the hatch actuator, fairing lock hydraulic cylinder and the flood/drain valve actuators.

The muzzle hatch rotary actuator (Figure 5-1-15), body encases four cylinder sleeves (two large and two small, into which two piston racks (each with unequal piston end diameters) mesh with the pinion gear. The cylinder sleeve bores provide bearing and sealing surfaces for the piston racks, which operate inside the sleeves. O-rings and Polymyte backup rings make up the dynamic seals between the piston racks and the cylinder sleeves. The actuator pinion clevis (not shown) meshes with the pinion gear shaft outside the actuator body. The pinion gear cavity is ported to provide the combined venting and leakoff passage required for the actuator gear chamber.

Each piston rack has a lengthwise passage bored, which contains an internal check valve to facilitate venting of air from the system and the check valve seats with OPEN side hydraulic pressure on the C-1 port of the VLS external actuators. This check valve consists of a bearing ball, spring, spring retainer, and retainer pellet.

The port and starboard ship service hydraulic system header supplies the four inboard rotary actuators (Figure 5-1-16), used in the F/D system. The actuators are of balanced design and operate by pressurizing one side and porting the other side to return. For additional information on the inboard and outboard actuators refer to References 2 (Ship Valves Technical Manual User Information), 3 (Ship Valves Technical Manual), 5 (SSM, Volume 4, Part 1, Chapter 3 Ship Service Hydraulic System), 48 (Naval Ships' Technical Manual Chapter 556) and 49 (Submarine Technical Repair Standard for Hydraulically Operated Rotary Actuators).

The hatch & flood/drain valve control valves, HMLP(S)-(*)-22 (Figure 5-1-17), are four-way, three-position, solenoid operated, spring-return-to-center control valves. The control valves have a third solenoid and spring operated pinlock, which latches the control valve spool in the hatch open position. This is referred to as hatch blocked and is so indicated on the MTCP or TCP. The third solenoid is used to move the pinlock away from (i.e., unlock) the spool. For security purposes, each hatch & flood/drain valve control valve can be rendered inoperable by individual valve keylocks. The keylock mechanically locks the control valve in the center position, thus locking the hatch and flood/drain valve shut.

The hatch & flood/drain valve control valve, HMLP(S)-(*)-22 mounts on the manifold assembly HMLP(S)-21. Each manifold assembly holds six control valves and their associated adjustors. There are two adjustors per valve, one is for the muzzle hatch and the other is for the flood/drain valve. The adjustors control the rate at which the hydraulic fluid is ported to the control valve, which in turn controls the rate at which the muzzle hatch or flood/drain valve operates.

There are four additional control valves (Figure 5-1-16) that support the VLS. The flood and drain isolation valve control valves, HMLP(S)-30 and equalization valve control valves, HMLP(S)-31, which are four-way, two positions, solenoid operated spring-return control valves. References 2 (Ship Valves Technical Manual User Information), 3 (Ship Valves Technical Manual), and 5 (SSM, Volume 4, Part 1, Chapter 3) provide additional information othe the control valves.

5-1-7 Flood/Drain System.

The F/D system (Figure 5-1-18), floods the missile tube underhatch volume to sea pressure through independent headers for each bank of six tubes. It also allows the underhatch volume to be drained and maintained at submarine internal ambient pressure. Each header is connected to the tube underhatch volume through a remotely actuated outboard flood/drain valve. The system consists of a Silent Self-Controlled Orificial Restrictor (SSCOR) to meet ship acoustic requirements, an outboard tube flood/drain valve, backup isolation valves, a drain isolation valve and sight glass, and a backup hose connection to the 125 psig-service air system.

The F/D system is designed to support flooding and equalizing any number of missile tubes simultaneously; and, to perform within flow and time constraints consistent with ship acoustic and weapons system reaction time requirements. An inboard hose connection in each flood and drain header provides a backup method of equalizing the underhatch volume with sea pressure using ship 125 psig service air system. Reference 1 (SSM, Volume 2, Part 12, Vertical Launch System) and Reference Drawing 3.1 (VLS Flood and Drain System Diagram) provide additional information on the Missile Flood/Drain system.

Except for those items discussed below, all major components for the F/D system are located on the third platform between frames 24 and 30 (Figure 5-1-11). The controls and status displays for the F/D system are located on the port and starboard MTCPs or TCPs. These panels are components of the missile launch console (SSN 719-725 and 750) or weapon launch console (SSN 751 and Later). The missile launch console is located on the third platform, frame 29, on the centerline. The weapons launch console is located on the third platform, frame 35, on the centerline. The flood/drain valves are located near their respective missile tubes in MBT 2 (A/B), except for SSN 719 and 720, which are topside in the free flood area. The equalization hull and backup valves are located in the torpedo room, third platform, between frames 35 and 36, port and starboard.

A Silent, Self-Controlled Orificial Restrictor SSCOR is located in the inboard piping between the equalizing hull and backup valves. The SSCOR is a pressure compensated multi-orifice plate restrictor that automatically provides a constant water velocity at all launch depths to meet ship acoustic requirements. Refer to Reference 3 (Ship Valves Technical Manual Chapter 15-13-7) for a detailed description of the SSCOR.

5-1-7.1 Flood/Drain System Operation.

The Flood/Drain system has two modes of operation: Flood and Equalize or drain underhatch volume. To flood the underhatch volume, the F/D system is lined up in the ready-to-flood mode. The lit FLOOD READY indicator (MTCP) or READY TO FLOOD indicator (TCP) shows this. This indicator confirms that the drain isolation valve is shut and the equalization hull and backup valves, and the flood/drain header hull and backup valves are open. For additional information on flooding and equalizing, refer to Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

To drain the underhatch volume, the F/D system is lined up in the ready-to-drain mode. The lit DRAIN READY indicator (MTCP) or READY TO DRAIN indicator (TCP) shows this. This indicator confirms that the drain isolation valve, flood/drain header hull and backup valves are open, the equalization hull and backup valves are shut, the hatch shut indicator is lit, and the DRAIN INHIBITED indicator (MTCP) or DRAIN INHB indicator (TCP) is not lit. For additional information on draining, refer to Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-1-8 PRESSURIZATION/VENT SYSTEM.

The P/V system (Figure 5-1-19) monitors the AUR/AURVS and provides replenishment of stowage pressure to the AUR/AURVS when required. The P/V system also pressurizes or vents the AUR/AURVS to maintain its pressure within the specified ranges of differential pressure over the underhatch pressure prior to launch. The P/V system is supplied with 700 psig ship service air, and consists of independent port and starboard piping systems that provide pressurization and venting for the AUR/AURVS in two banks of missile tubes. A backup source of air is provided to each bank from the ship’s 125 psig system through an inboard hose connection. When the underhatch area is flooded the underhatch-to-AUR/AURVS pressure differential is controlled between -1.5 to +7.2 psid. When the hatch is opened, the AUR/AURVS is pressurized to 3.8 to 7.2 psid. The P/V system is designed to maintain the differential pressure over the launch depth band and ship speed band for all ship headings in the maximum allowable Sea State. The P/V system also is designed to limit airflow velocities to meet the ship's acoustic requirements. A keylock locks the P/V hull valves shut for security purposes. For additional information on the P/V system, refer to Reference 1 (SSM, Volume 2, Part 12 Vertical Launch System) and Reference Drawing 4.1 (VLS Pressurization/Vent System Diagram).

The P/V system utilizes a P/V port plug (Figure 5-1-20) to protect the P/V piping from contamination when a missile tube is empty or a ballast can is installed. When an AUR/AURVS is loaded the P/V port plug is replaced with a P/V filter prior to loading an AUR/AURVS. The P/V filter prevents the passing of contaminants between the AUR/AURVS and the P/V system.

All major components for the P/V system are located on the third platform between frames 25 and 29 (Figure 5-1-11) except for a pressure switch and a dual differential pressure transducer. The pressure switch and differential pressure transducers are housed in one assembly located adjacent to each missile tube in the VLS free flood area.

The Pressurization/Vent Control Valve APV-(*)-1 (Figure 5-1-21) controls the flow of 700 psig air to the AUR/AURVS and vents air from the AUR/AURVS. The valve is a solenoid-operated, three-way, two-position, two-poppet valve, which is pilot-operated using the 700 psig service air as a constant supply. For additional information on the control valve refer to Reference 3 (Ship Valves Technical Manual).

5-1-8.1 <u>Pressurization/Vent System Operation.</u>

The P/V system has three modes of operation, stowage, lowband, and highband.

Normally the P/V system is secured in a stowage mode with the underhatch volume at ship's internal ambient pressure. Ships force personnel periodically monitor the pressure between the underhatch volume and the AUR/AURVS at the MTCP or TCP to ensure a positive AUR/AURVS stowage pressure range from 2.0 to 6.0 psid.

In the hatch shut prelaunch mode (Tube Flooded) and in proper valve lineup with the PVC MODE switch (MTCP) or PVC MODE switch (TCP) switch in AUTO, the differential pressure is automatically maintained between -1.5 to +7.2 psid. These limits represent low band. When the differential pressure is within these limits, the pressure IN BAND indicator will be lit.

When the hatch is opened, the AUR/AURVS is pressurized to between 3.8 to 7.2 psid. These limits represent high band. When the differential pressure rises to 6.7 psid, the vent indicator energizes, and the P/V control valve shifts to vent the AUR/AURVS. When the differential pressure drops to 5.0 psid, the P/V control valve shifts to the shut position. If the differential pressure drops to 4.0 psid while in the hatch open prelaunch mode, the PRESS indicator on the MTCP or TCP energizes, and the P/V control valve shifts to pressurize the AUR/AURVS. When the differential pressure rises to 6.0 psid the PRESS indicator deenergizes, and the P/V control valve shifts to the shut position.

5-1-8.2 Differential Pressure Transducer.

The missile tube is provided with pressure sensing lines that interface with the AUR/AURVS and the underhatch cavity (Figure 5-1-22). The line that senses AUR/AURVS pressure has a male "preece" connection, which normally connects to the AUR/AURVS pressure sensing hose. A missile tube quick-disconnect pressure cap is installed when the pressure sensing hose is disconnected. The pressure sensing lines provide the D/P transducer with AUR/AURVS pressure and underhatch pressure inputs.

The pressure sensing hose is threaded into the capsule on one end and has a quick-disconnect fitting on the other that connects to the preece fitting after the missile tube quick-disconnect pressure cap is removed. This connection allows the D/P transducer to monitor AUR/AURVS internal pressure.

The differential pressure transducer assembly is mounted adjacent to each missile tube in the free flood area. Each assembly consists of two functionally independent differential pressure transducers. The individual transducers sense the differential pressure between the underhatch volume and AUR/AURVS. The transducer assembly has three inlet ports; two ports are connected to the underhatch volume and one port is connected to the AUR/AURVS via a pressure sensing hose. Two underhatch volume ports are provided in case one port becomes clogged with debris. Either transducer A or B may be selected. A pressure switch is part of the differential pressure transducer assembly. The pressure switch is factory-set to provide open contacts when AUR/AURVS pressure is greater than 24.4 psia and closed contacts when pressure is less than 21.4 psia. An open switch prevents operation of the tube flood/drain valve, which could cause rupturing of the AUR closure. A closed pressure switch represents a safe draining condition. A switch on the MTCP or TCP allows for selection of either transducer A or B. The selected transducer pressure reading will be displayed on the MTCP or TCP panel. On the MTCP a meter override switch allows the selected transducer reading to be overridden and the alternate transducer reading to be momentarily displayed with P/V control remaining with the selected transducer.

5-1-8.3 Dewpoint Monitoring System.

The Dewpoint Monitoring System (DPMS) (Figure 5-1-23) was used to indicate the dewpoint of the 700 psig air supply to the P/V system. The need for a redundant monitoring system in addition to the dewpoint monitor at the ships air compressors was deemed unnecessary. The circuit cards in the MTCP or TCP, and the dewpoint meter will be blocked off. The actual sensor will remain installed in the system piping.

5-1-9 MISSILE TUBE COOLING SYSTEM.

When a ship is dockside or dry-docked, solar radiation may cause a temperature alarm. This occurs when internal tube temperature reaches 100° F. Cooling should be accomplished by connecting a hose from a dockside water supply to the ship's missile tube cooling system. When the tube cools below 100° F, the cooling system may be secured. For additional information on the missile tube cooling system refer to References 1 (SSM, Volume 2, Part 12 Vertical Launch System) and 9 (SSM, Volume 4, Part 1, Chapter 1, High-Pressure Air System).

5-1-10 ENVIRONMENTAL MONITORING SENSOR ASSEMBLY.

An Environmental Monitoring Sensor (EMS) assembly (Figure 5-1-24) is located adjacent to the umbilical connector of each missile tube. The EMS has a slotted cover (SHIPALT 3941D) that will remain installed except during EMS testing and cleaning. It senses underhatch pressure, temperature, and the presence of fluid. When either underhatch pressure or temperature is outside prescribed limits or when the presence of fluid is detected, a signal is sent which activates an alarm on the MTCP or TCP. In addition an alarm signal is sent to the Ballast Control Panel (BCP) Alarm panel and the Command Launch Console (CLC); the temperature alarm will also sound over the 1MC.

The temperature alarm will activate when either a low temperature of 0° F or a high temperature of 100° F is reached. The pressure alarm will activate when underhatch pressure reaches 55 psia. The TCP is equipped with keyswitches, which can silence EMS alarms on a per-tube basis.

An alarm override keyswitch on the TCP allows for overriding or disabling of audible and visual indications for the individual missile tube summary, moisture, temperature and pressure alarms.

There are currently two types of EMSs in use in the Fleet. Henshel, Inc. and the Consolidated Control Corp. (CCC). Form, fit, and function are the same, but the CCC EMS has a longer length and a gas-filled insert, which should not be removed from the housing except by depot repair facility (Figure 5-1-24).

5-1-11 SECURITY ALARM SYSTEM.

The VLS security alarm system provides features to ensure the security of special weapons. For a detailed description of the security system, refer to Reference 17 (Nuclear Weapons Security Alarm Circuit 5FZ).

5-1-12 MISSILE LAUNCH CONSOLE (SSN 719 thru 725 and 750).

The VLS Missile Launch Console (Figure 5-1-25) consists of three major sections, the Missile Tube Control Panel (MTCP), Missile Interface Console (MIC) and Interface Control Console (ICC). The VLS Missile Launch Console contains the controls, indications, and interlock circuitry required to ready the tubes to support launch and to monitor tube operations. The console also provides all of the interfaces between VLS and the Combat Control System (CCS).

Two MTCPs (one for the port tubes and one for the starboard tubes) are located in the Vertical Launch Center (VLC) as components of the missile launch console. Each MTCP supports a bank of six missile tubes and contains controls and indications to control the operation of the muzzle hatches, flood and drain valves and the P/V system. For additional information on the MTCP refer to Reference 4 (Missile Tube Control Panel Technical Manual).

Two MIC's (one for the port tubes and one for the starboard tubes) are located in VLC as components of the missile launch console. The MIC contains the controls and indicators for the weapon identification and power. For additional information and operating instructions on the MIC, refer to References 4 (Missile Tube Control Panel Technical Manual) and 14 (Mk 121, Mod O Missile Interface Console Technical Manual).

The ICC interfaces the missile with the ship's fire control system. Contained within the ICC is an imbedded simulator for fire control/missile fault isolation. It has the ability to switch power controls of the MTCP to control the opposite MTCP (Port MTCP controls starboard tube bank and vice versa) in the event of a casualty. The upper portion of the ICC contains a secure cabinet for the VLS data links. For additional information and operation instructions, refer to Reference 15 (Mk 122, Mod O Interface Control Console Technical Manual).

5-1-13 INTEGRATED WEAPONS LAUNCH CONSOLE (SSN 751 and Later).

The integrated weapons launch console (Figure 5-1-26) is divided into two major sections. The Tube Control Panel (TCP) is the upper section and the Weapons Launch Console (WLC) the lower section.

The TCP is the primary interface between the launcher missile/torpedo tubes and the WLC. The TCP provides launcher status to the WLC and receives weapon status and launcher related commands from the WLC and provides vital interlocks in the launching/firing circuit.

The primary function of the WLC is to provide support for the vertical and horizontal launched weapons. The WLC has built-in simulator diagnostics and hardware for self-tests. The WLC interfaces with all tube loaded weapons, tube control panel, command launch console, torpedo data converter, service power and security alarm systems.

5-1-14 MAGNETIC AND MICRO SWITCHES.

Magnetic switches (Figure 5-1-27) are utilized on the missile tubes to indicate the position of missile tube hatches and flood/drain valves. The switch assemblies are watertight pressure proof enclosures each containing two, magnetic proximity, dual reed type switches. These magnetic switches sense missile tube muzzle hatch open, Capsule Arm Command (CAC), muzzle hatch shut, F/D valve open, F/D valve shut and fairing locking device locked (SSN721 and Later).

SHIPALT 4111D incorporated a new weapon control cable which completes the Capsule Arm Command (CAC) circuit vice the Intent-To-Launch (ITL) circuit.

These switches signal the MTCP (SSN 719-725 and 750) or TCP (SSN 751 and Later) logic circuits and light indicators and perform interlock functions to permit the MTCP or TCP to safely operate control valve solenoids. Refer to CHAPTER 6 for proper switch configuration.

Hatch position magnetic switches signal the fully open and fully shut condition of the hatch. When the hatch is open, magnets mounted on the muzzle hatch arm actuate the hatch open switches, which complete the circuit to the missile tube control console and hatch open/ITL/CAC circuit. When the hatch is shut, magnets mounted on the front of the missile tube hatch actuate the hatch shut switch. The hatch shut switch assembly is mounted in a bracket, which is attached to the hatch T-bar lock (SSN 719 and 720). The hatch shut switch assembly is mounted in a bracket, which is attached to the missile tube (SSN 721 and Later). Additionally, SSN 721 and later have a switch for the fairing locking mechanism, which also must be closed to get a hatch shut indication.

Standard micro switches (Figure 5-1-27) are used to monitor major inboard flood and drain system valves and hatch blocked. Hatch blocked is an indication that the hatch and flood/drain valve control valve has shifted. These switches signal the MTCP or TCP logic circuits and light indicators. They also perform interlock functions to permit the MTCP or TCP to deenergize control valve solenoids.

5-1-15 ELECTRICAL INTERLOCKS.

When AUR internal pressure is 24.4 PSIA or greater the drain inhibit interlock prevents draining the underhatch volume until the AUR or AURVS is vented below 21.4 psia. This interlock prevents the opening of any flood/drain valve in the applicable tube bank.

The drain isolation valve interlock prevents the drain isolation valve and equalization hull valve from being open at the same time thus preventing the system from being lined-up to flood/drain simultaneously. This interlock prevents the opening of the muzzle hatch with the drain isolation valve open and lining up the flood/drain system to flood directly from sea to the bilge-collecting tank. Refer to Figure 5-1-18.

The equalization hull valve interlock prevents the equalization hull valve from opening unless the following conditions exist:

(SSN 719-725 and 750) One missile tube in that bank, port or starboard, must be in the operate mode and the drain isolation valve must be shut.
(SSN 751 and Later) The missile tube support section, port or starboard, must be in the operate mode and the drain isolation valve must be shut.

The tube in operate interlock functions as follows:

(SSN 719-725 and 750) At least one tube MONITOR/OPERATE switch must be in OPERATE in order to position the flood and drain system valves that are common to that bank. For additional information on interlocks, refer to Reference 4 (Missile Tube Control Panel Technical Manual).

(SSN 751 and Later) The tube in operate interlock ensures that the missile tube support section INIT/MON/OPER toggle switch has been initialized and then placed in OPER for flood/drain system valve operation, and the missile tube section INIT/MONITOR/OPERATE keyswitch has been initialized and then placed in operate prior to those valves being operated from the TCP. When the keyswitch is in MONITOR, solenoid power is disconnected and command logic is inhibited for that tube. For additional information on interlocks, refer to Reference 52 (Description, Operation, Maintenance, Repair and Installation for the Tube Control Panel).

The majority of the magnetic switches are used for position indication. The new ruggedized parallel Intent-To-Launch/Capsule Arm Command (ITL/CAC) magnetic switch functions as a firing circuit interlock, insuring that the missile tube muzzle hatch is completely clear of the missile tube launch cone, prior to missile launch.

5-1-16 SUPPORT SYSTEMS.

5-1-16.1 Electrical Systems.

Electrical Systems provide power to monitor and control the internal environment of the missile tube and the security system to prevent unauthorized operation of the tubes. The electrical system provides constant communication between the ship and all missile tubes at the MTCP or TCP. This constant communication is necessary to maintain the VLS in a constant state of readiness.

All electrical indications, signals, commands and responses are provided to and from, the AUR, AURVS, Missile Tubes, and Fire Control System via Cables, Electrical Connectors, Junction Boxes and Penetrators. Refer to Figure 5-6-24 through Figure 5-6-26 for specific cable, connector, and penetrator identification. SSN 721 and later have a connectorized box in the "bath tub" area instead of a solid branch cable. Figure 5-1-28 is a typical diagram of the missile tube control cabling arrangement for a single tube.

The weapon control cable connects to the missile tube umbilical penetrator through which electrical signals pass between the missile and the fire control system. The umbilical penetrator is located near the top of the missile tube. The main section of the umbilical is a flat molded cable, which is attached to the outside of the capsule and runs vertically along its length Figure 5-1-29 is a typical diagram of the weapon control cabling arrangement for a single tube.
The MTCP receives 115 VAC, 60 Hz, single-phase electrical power from the ship service distribution system. For additional information on the MTCP, refer to Reference 4 (Missile Tube Control Panel Technical Manual). The 60 Hz power distribution system is described in Reference 22 (SSM, Volume 4, Part 2, Chapter 4, 60 Hertz Power Distribution System).

The TCP receives 115 VAC 60 Hz power from the ships service distribution system. For additional information, refer to Reference Drawing 13.1 (Weapons Launch Console Tube Control Panel Interface).

5-1-16.2 Service Air System.

The service air system is supplied by two independent systems. One system supplies 700 psig air, which is normally used by the missile tube P/V system. This system also supplies 700 psig air, if required, through sea chest blow valves MFD-18 (MFD-12) for blowing the equalization hull valve and strainer plate clear of foreign matter. The other system provides 125 psig emergency service air through isolation valves MFD-23 (MFD-17) to provide a backup method of equalizing the underhatch volume. For additional information on the service air system, refer to Reference 11 (SSM, Volume 4, Part 1, Chapter 2, Service Air System).

5-1-16.3 <u>High-Pressure Air System.</u>

The high-pressure air system is used to charge the accumulator air flasks. For additional information on the high pressure air system refer to Reference 8 (SSM, Volume 4, Part 1, Chapter 1, High-Pressure Air System).

5-1-16.4 <u>Ship Service Hydraulic System.</u>

The ship service hydraulic system supplies 3000 psig hydraulic fluid to operate the equalization valve and the flood and drain header backup isolation valve actuators. For additional information on the ship service hydraulic system refer to Reference 5 (SSM, Volume 4, Part 1, Chapter 3, Ship Service Hydraulic System).

5-1-16.5 <u>External Hydraulic System.</u>

The external hydraulic system supplies 3000 psig hydraulic fluid to the VLS hydraulic system to operate the hatch and flood/drain valve actuators and fairing locking mechanism (SSN 721 and Later). For additional information on the external hydraulic system refer to Reference 6 (SSM, Volume 4, Part 1, Chapter 5A, External Hydraulic System).

5-1-16.6 <u>Gravity Drain System.</u>

The gravity drain system receives any leakoff from the hatch and flood/drain valve actuators (SSN 719 and 720) and the fairing lock cylinder (SSN 721 and Later). The gravity drain system also supports both the P/V and F/D systems. For additional information on the gravity drain system refer to Reference 7 (SSM, Volume 4, Part 4, Chapter 5, Plumbing and Gravity Drain System).

5-1-16.7 <u>Potable Water System.</u>

Water for flushing the Silent Self-Controlled Orificial Restrictor (SSCOR) is supplied by the potable water system through a hose connection to valves MFD-20 (MFD-14). For additional information on the potable water system, refer to Reference 12 (SSM, Volume 4, Part 1, Chapter 2, Service Air System).

5-1-17 VLS UNIQUE TEST EQUIPMENT/TOOLS

The SMMS Performance Monitoring Team (PMT) currently uses three pieces of test equipment to monitor/troubleshoot the Vertical Launch System. These three pieces of test equipment are the Data Processing Unit II (a hydraulic monitoring system), the Environmental Monitoring Sensor (EMS)/Delta Pressure Transducer (DPT)/Magnetic Switch Tester, and the Automated Multi Cable Test Set (AMCATS).

The Data Processing Unit II (DPU II) is used to measure hydraulic operating and breakaway pressures of the hatch actuator and associated valves.

The Environmental Monitoring Sensor (EMS)/Differential Pressure Transducer (DPT)/Magnetic Switch Tester (Figure 5-1-30) is used to test specific components or isolate a problem to the Control Panel/Tube Control Cable. The tester can simulate the function of an EMS / DPT / Magnetic Switch or it can function as a Control Panel.

The Automated Multi Cable Test Set (AMCATS) (Figure 5-1-31) is used to perform continuity and insulation resistance checks on both the weapon control and tube control cables. Figure 5-1-32 shows various special tools used throughout the Vertical Launch System. The Pressure Monitoring Test Rig (Figure 5-1-33) is used during routine maintenance. The Emergency DPT pressure gauge (Figure 5-1-33) is used to monitor pressure when the DPT is non-operational. Figure 5-1-34 is a picture of a P/V port plug modified IAW NAVSEA DWG # 6510970 for use during testing of the P/V system.

The SSN688 Class VLS Tube Trainer (Figure 5-1-35) simulates a fully operational missile tube. There are two VLS Tube Trainers; one is located in Groton, Connecticut and the other in Pearl Harbor, Hawaii. The tube trainer missile tube is approximately five feet tall and includes the muzzle hatch and all tactical missile tube interfaces. The trainer hydraulic system is operationally equivalent to the Shipboard system. The trainer hydraulic system operates the muzzle hatch, fairing and flood/drain valve. The trainer is populated with form/fit/function components including Environmental Monitoring Sensor, Differential Pressure Transducer, Weapon Control Umbilical Penetrator and associated Missile Tube Control and Weapon Control Umbilical Cables, Magnetic Switches. A VLS weapon capsule, replicating the uppermost (approximately five feet) section of a tactical weapon, which may be loaded using modified loading equipment.

The trainer has a platform surrounding the missile tube to accommodate a tactical loading crew and a Hydraulic Power Unit for the MTEL. The tube is capable of being pressurized for tube tightness testing and post loadout bubble testing.

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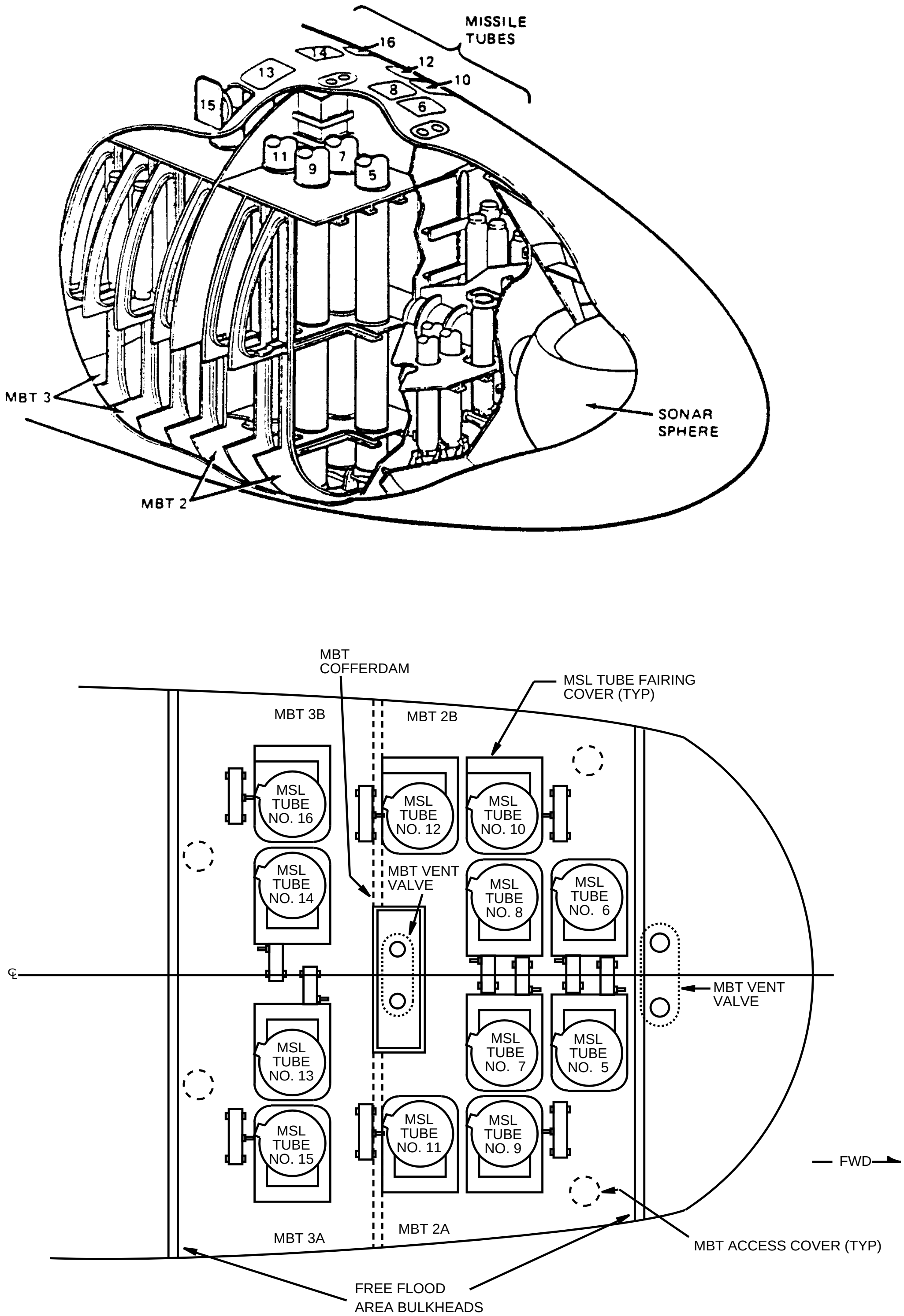
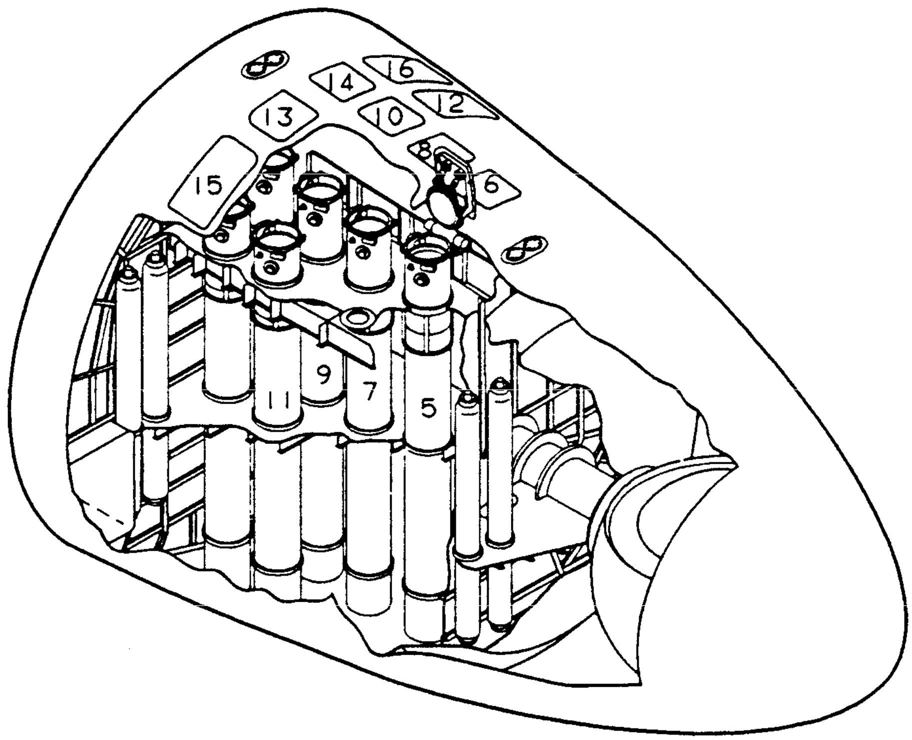


Figure 5-1-1 Missile Tube Arrangement (SSN 719 and 720)



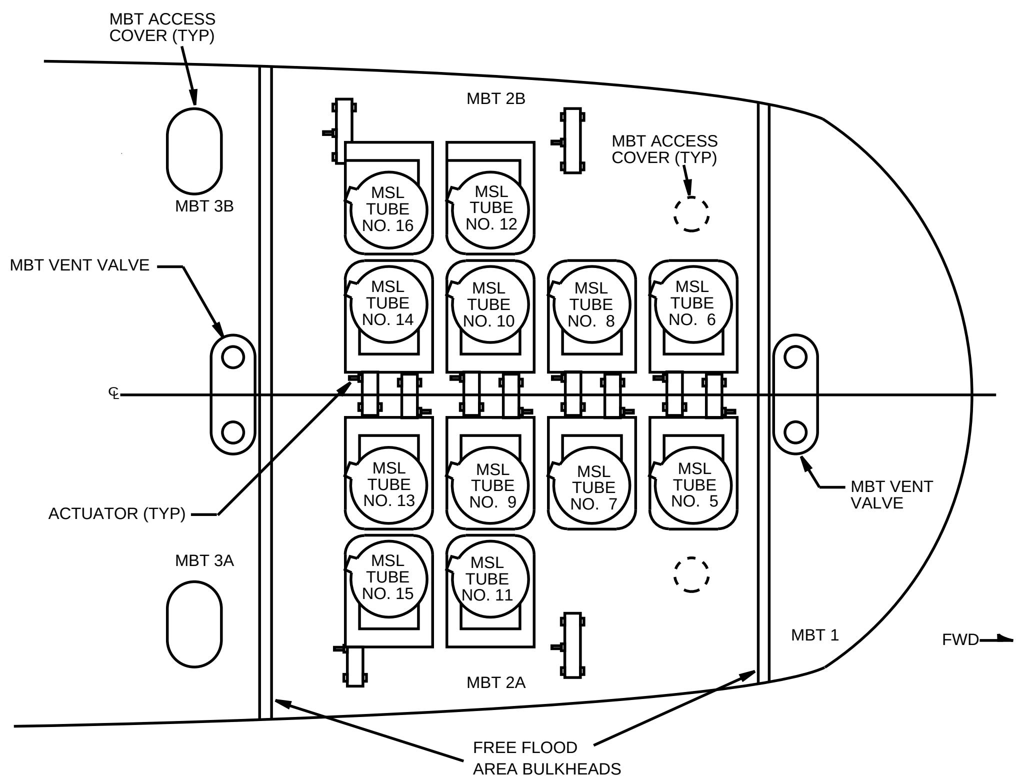


Figure 5-1-2 Missile Tube Arrangement (SSN 721 and Later)

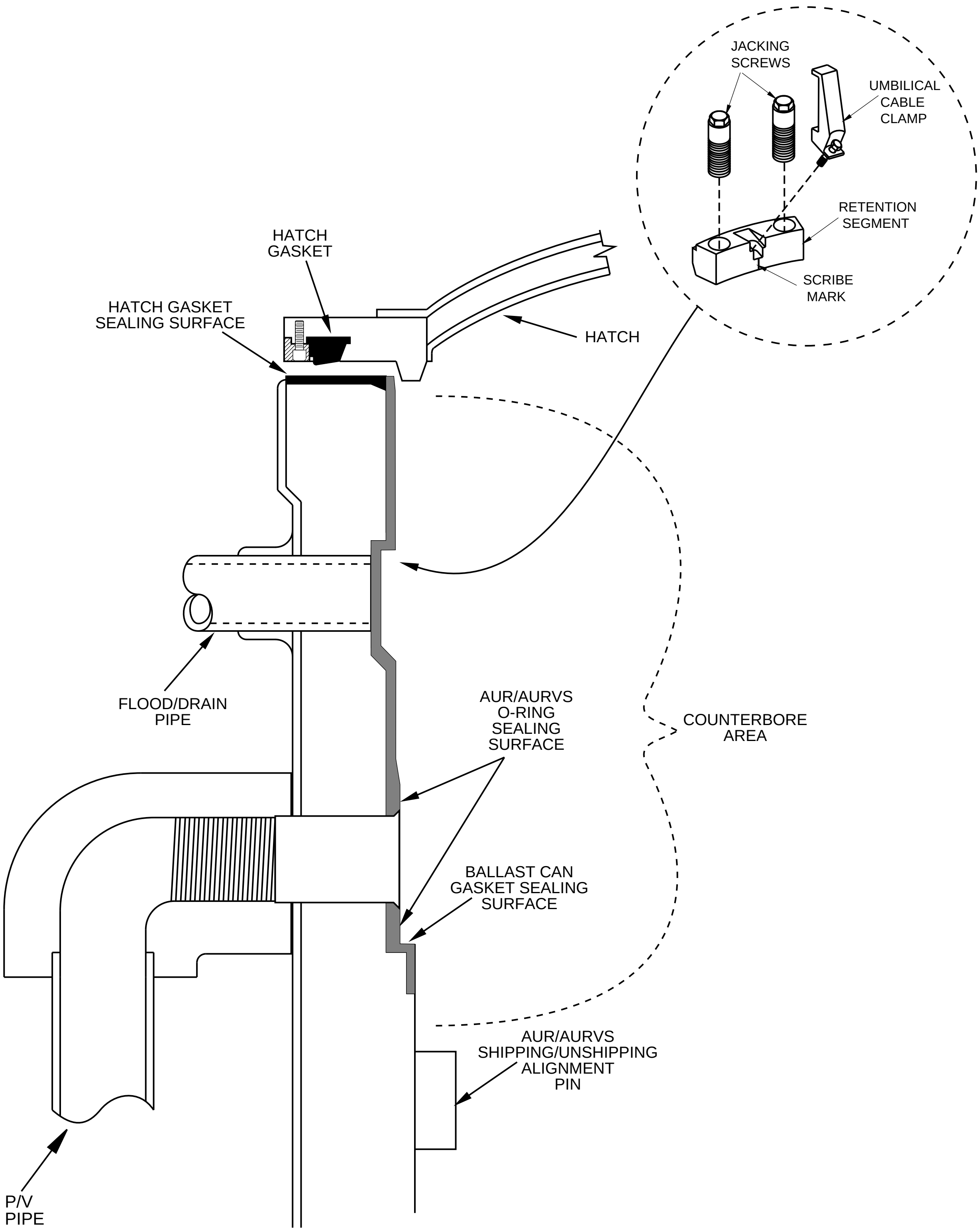


Figure 5-1-3 Missile Tube Assembly (Cut-Away)

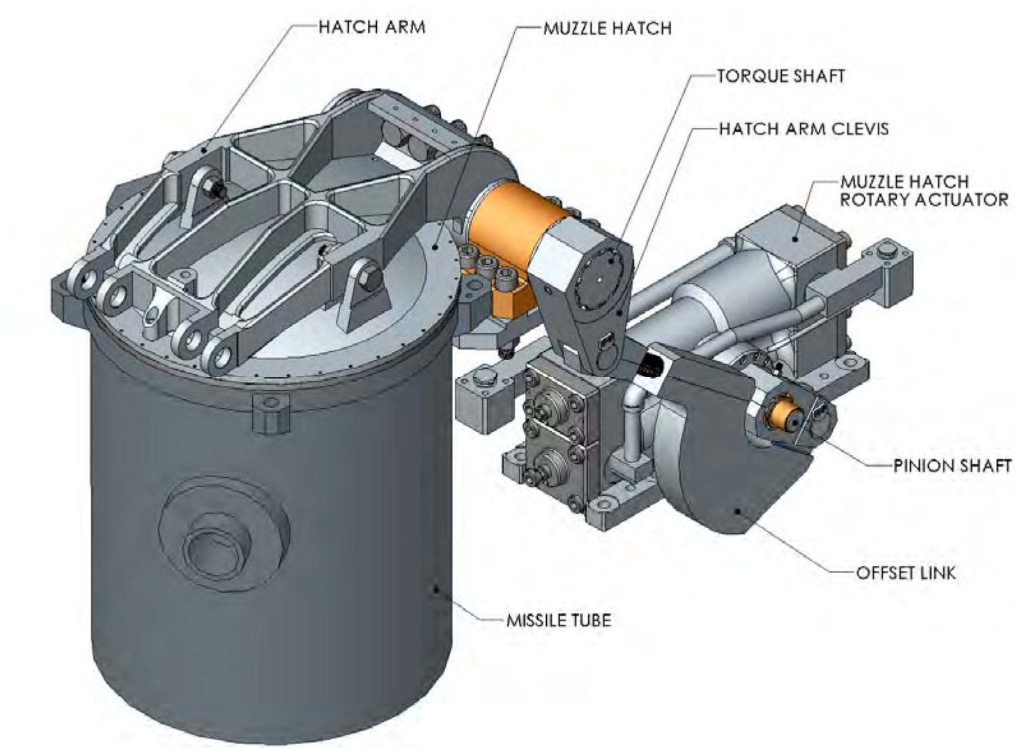
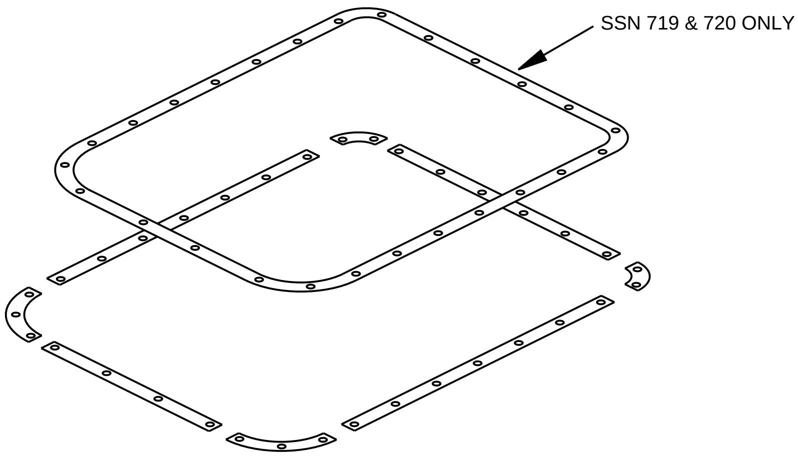
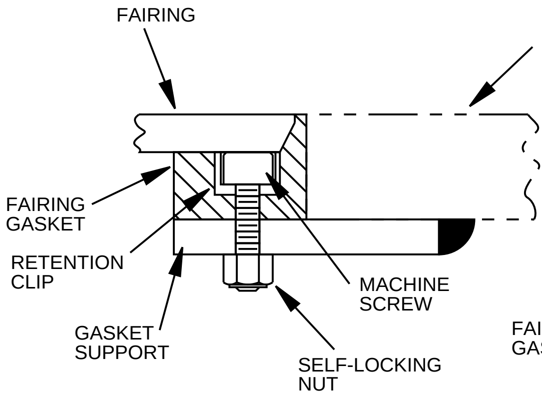


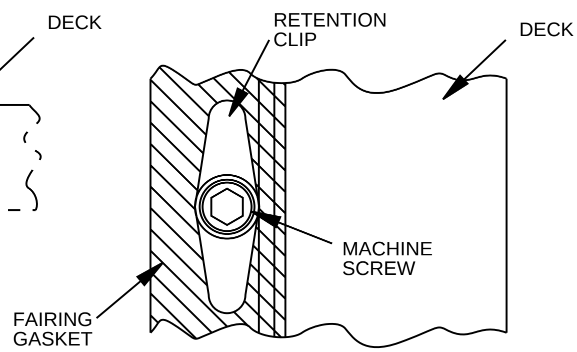
Figure 5-1-4 Muzzle Hatch and Operating Mechanism (Typical)



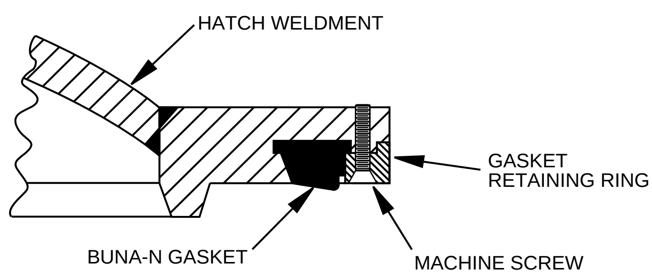
FAIRING GASKET (PERSPECTIVE PLAN VIEW)



FAIRING GASKET (SECTIONAL VIEW)



FAIRING GASKET (TOP VIEW)



MUZZLE HATCH GASKET (SECTIONAL VIEW)

Figure 5-1-5 Fairing Gasket and Muzzle Hatch Gasket

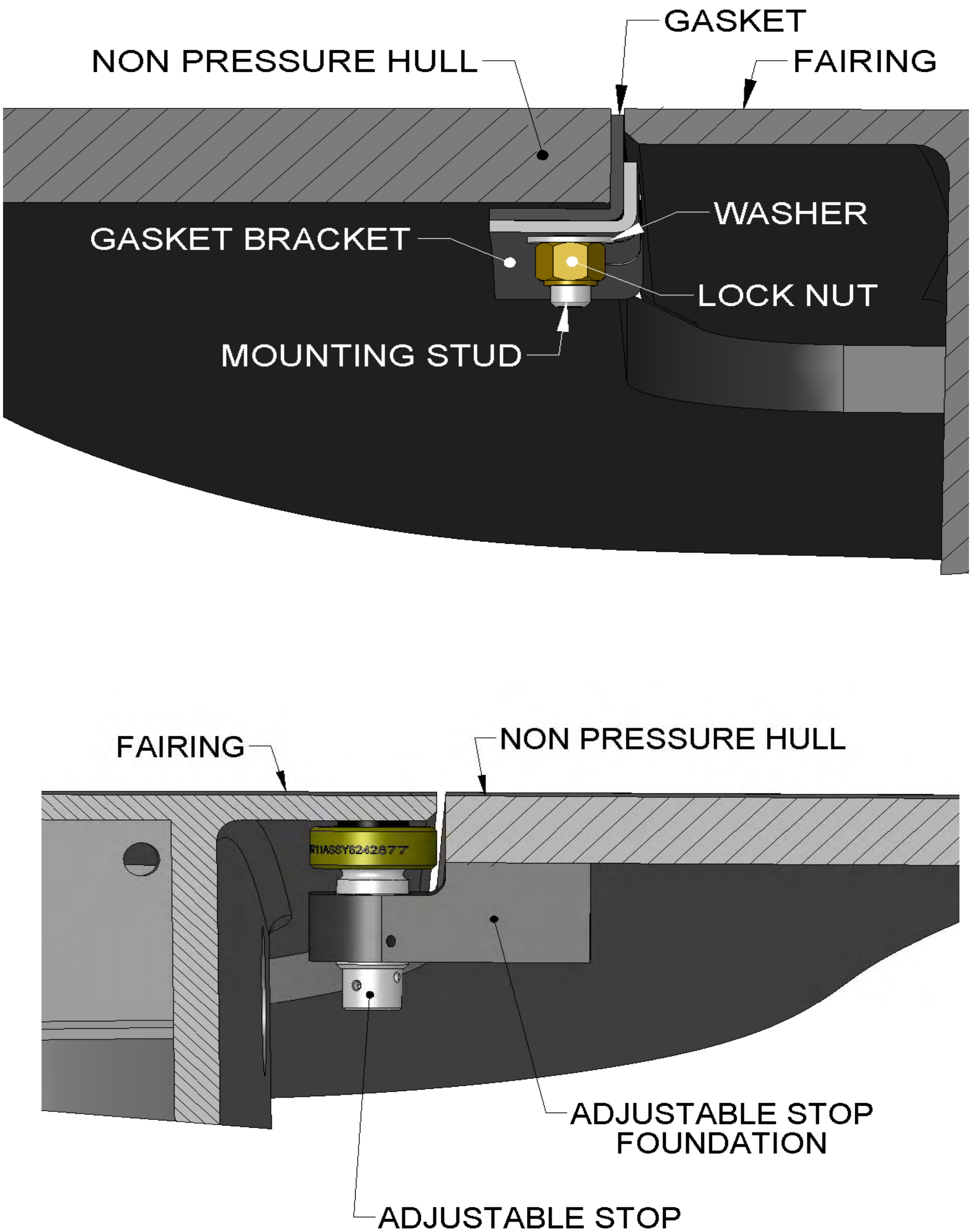


Figure 5-1-6 ShipAlt 4292K Fairing Gasket and Adjustable Stop

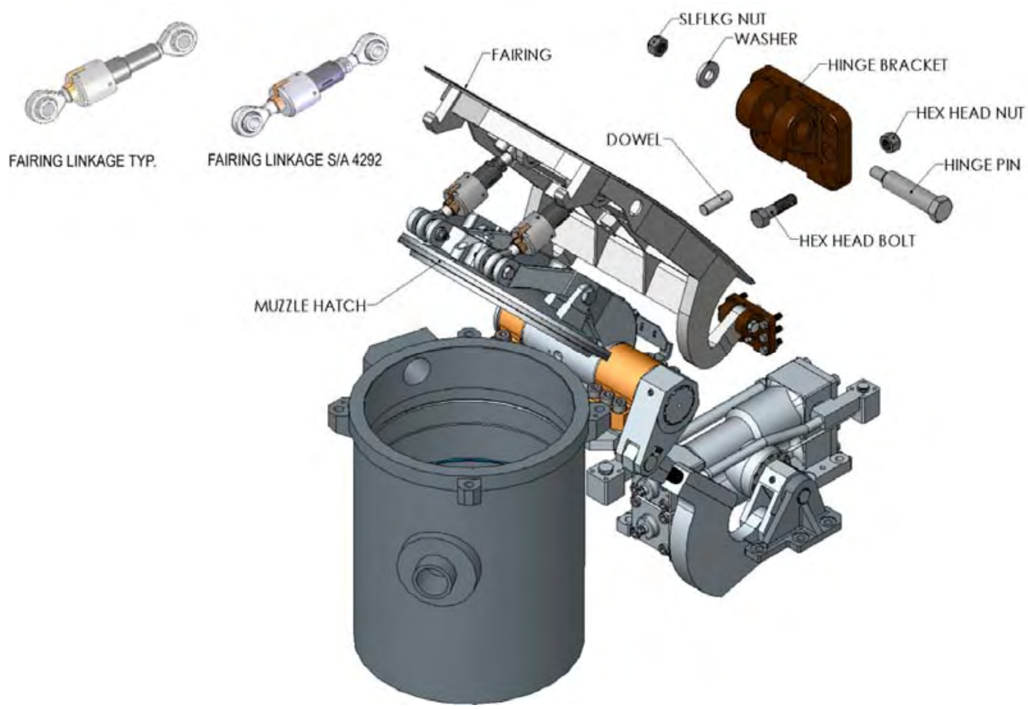


Figure 5-1-7 Muzzle Hatch Fairing and Connecting Linkage

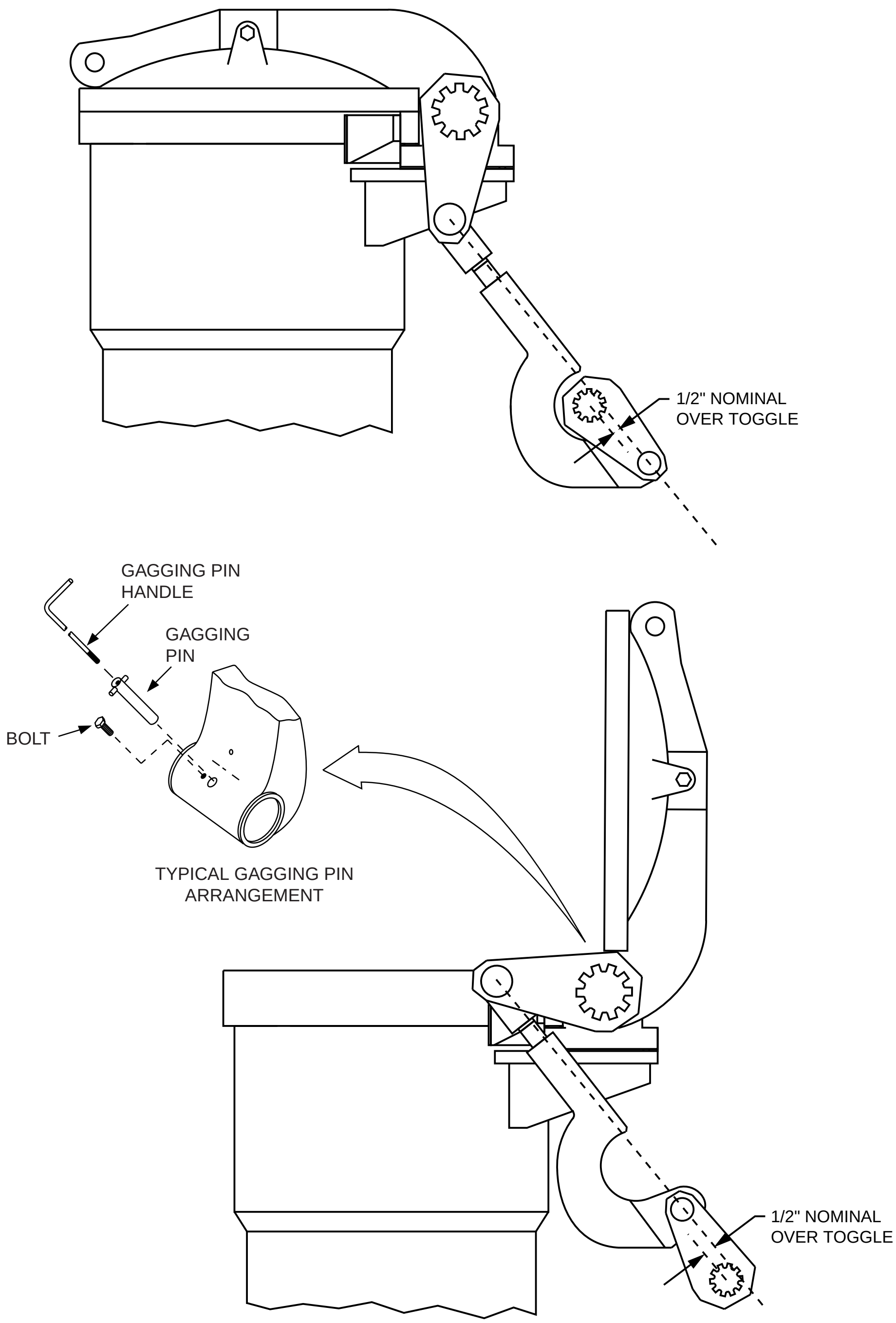


Figure 5-1-8 Muzzle Hatch Linkage Over Toggle (SSN 721 and Later)(Typical)

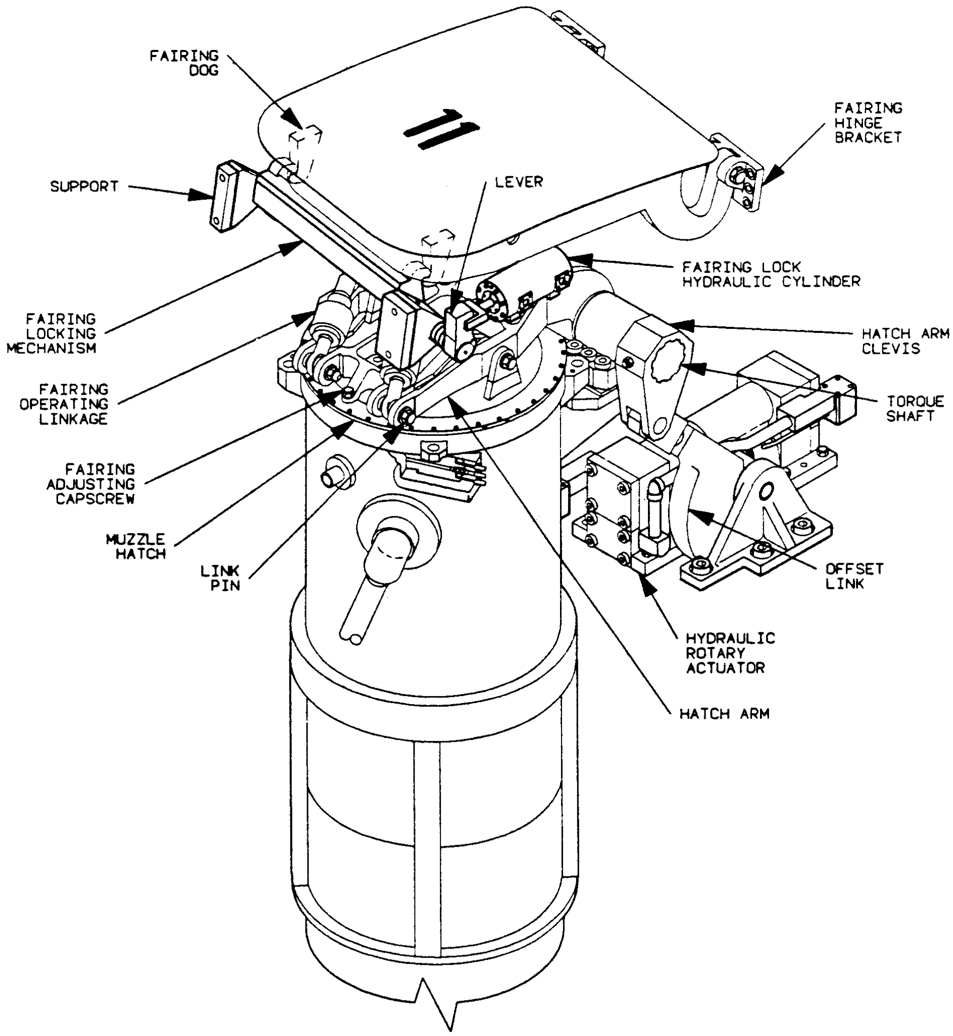


Figure 5-1-9 Missile Tube Muzzle Hatch Operating and Locking Mechanism (SSN 721 and Later)(Typical)

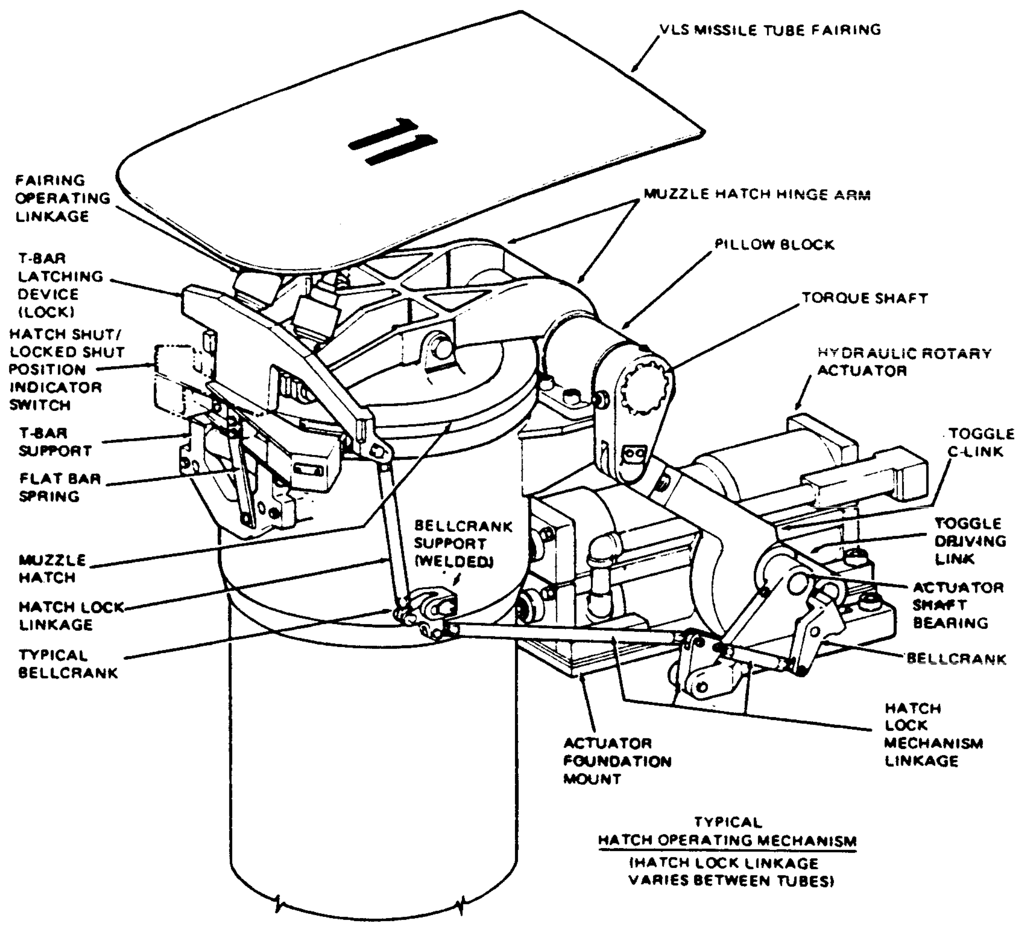


Figure 5-1-10 Missile Tube Muzzle Hatch Operating and Locking Mechanism (SSN 719 and 720)(Typical)

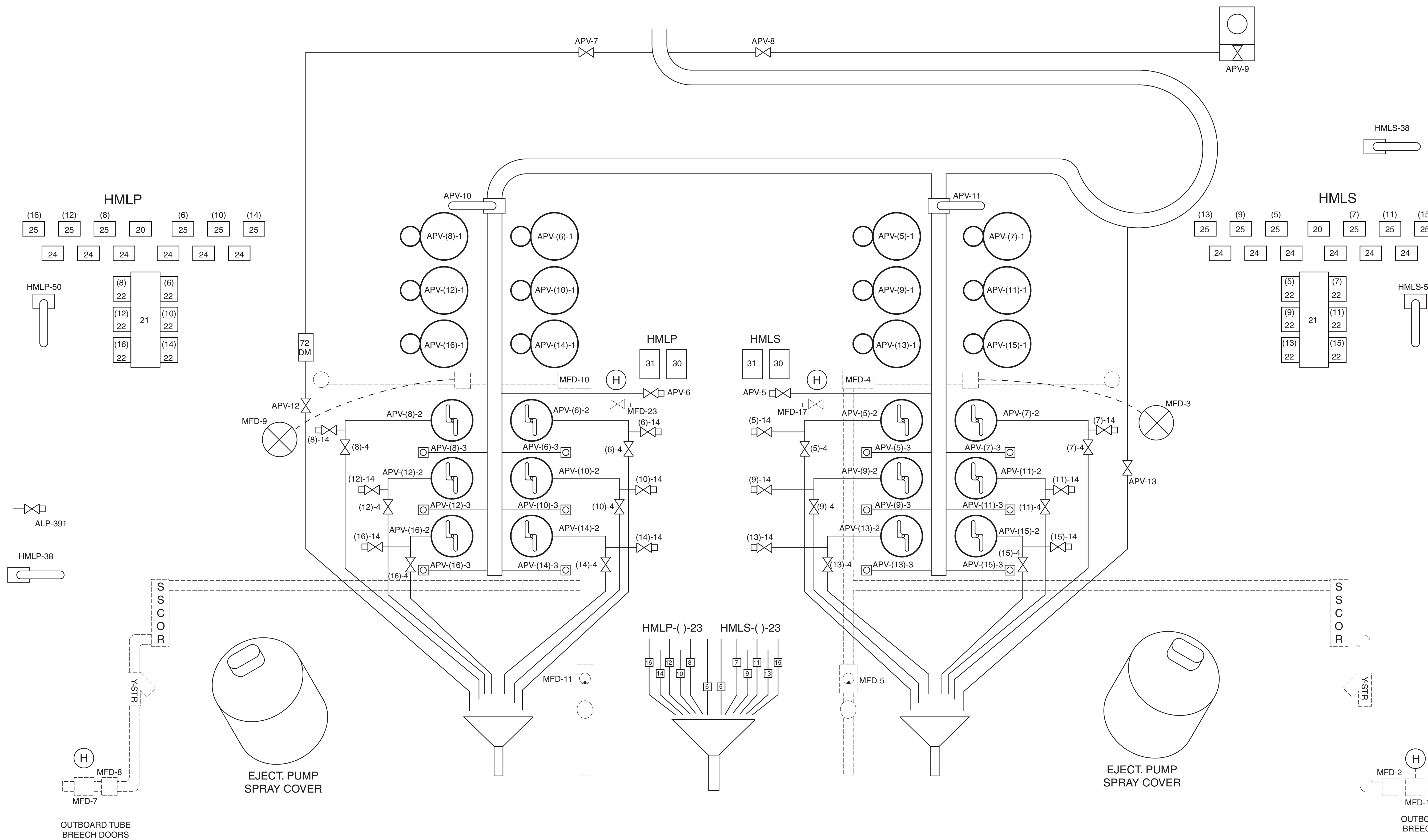
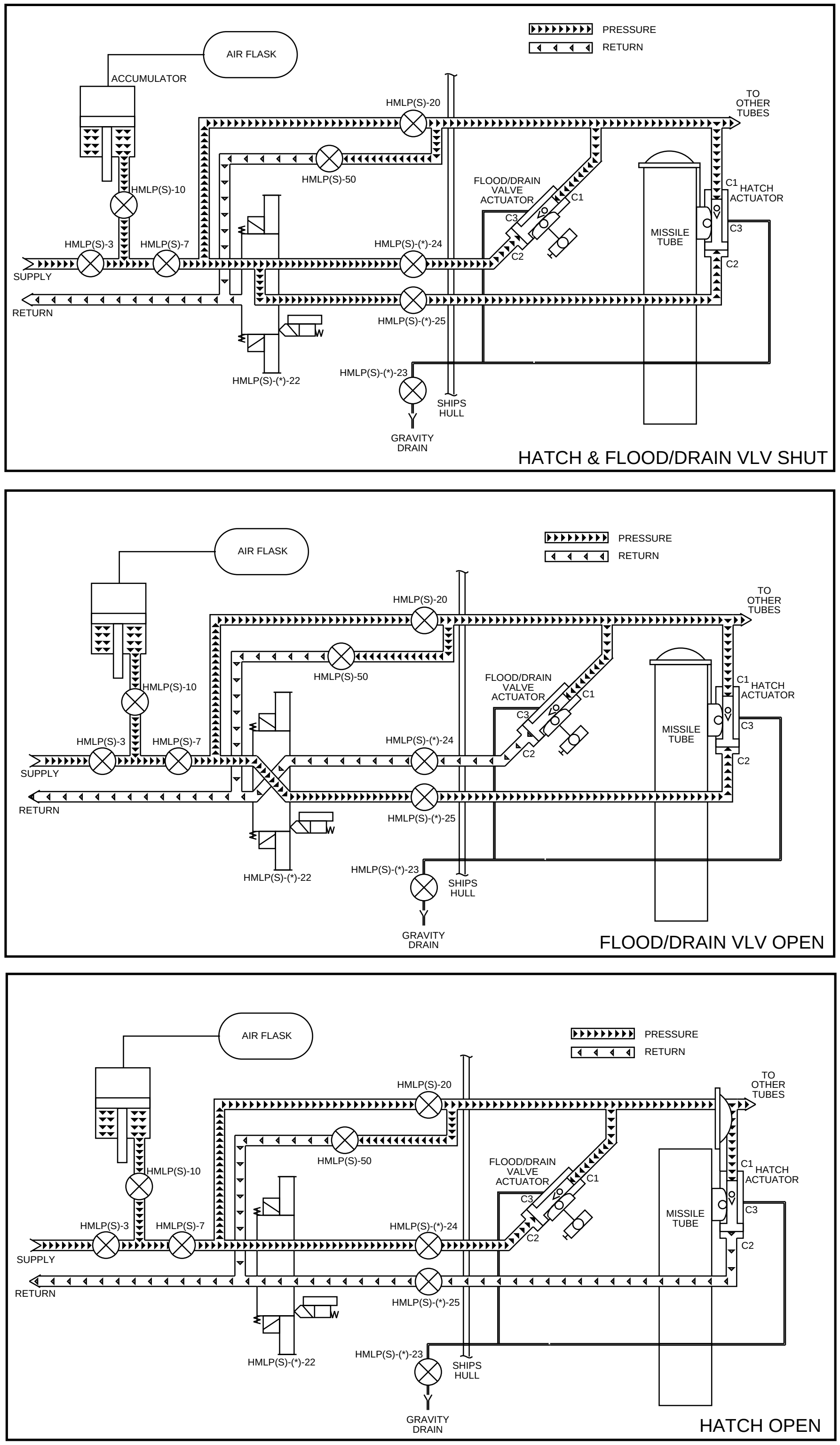
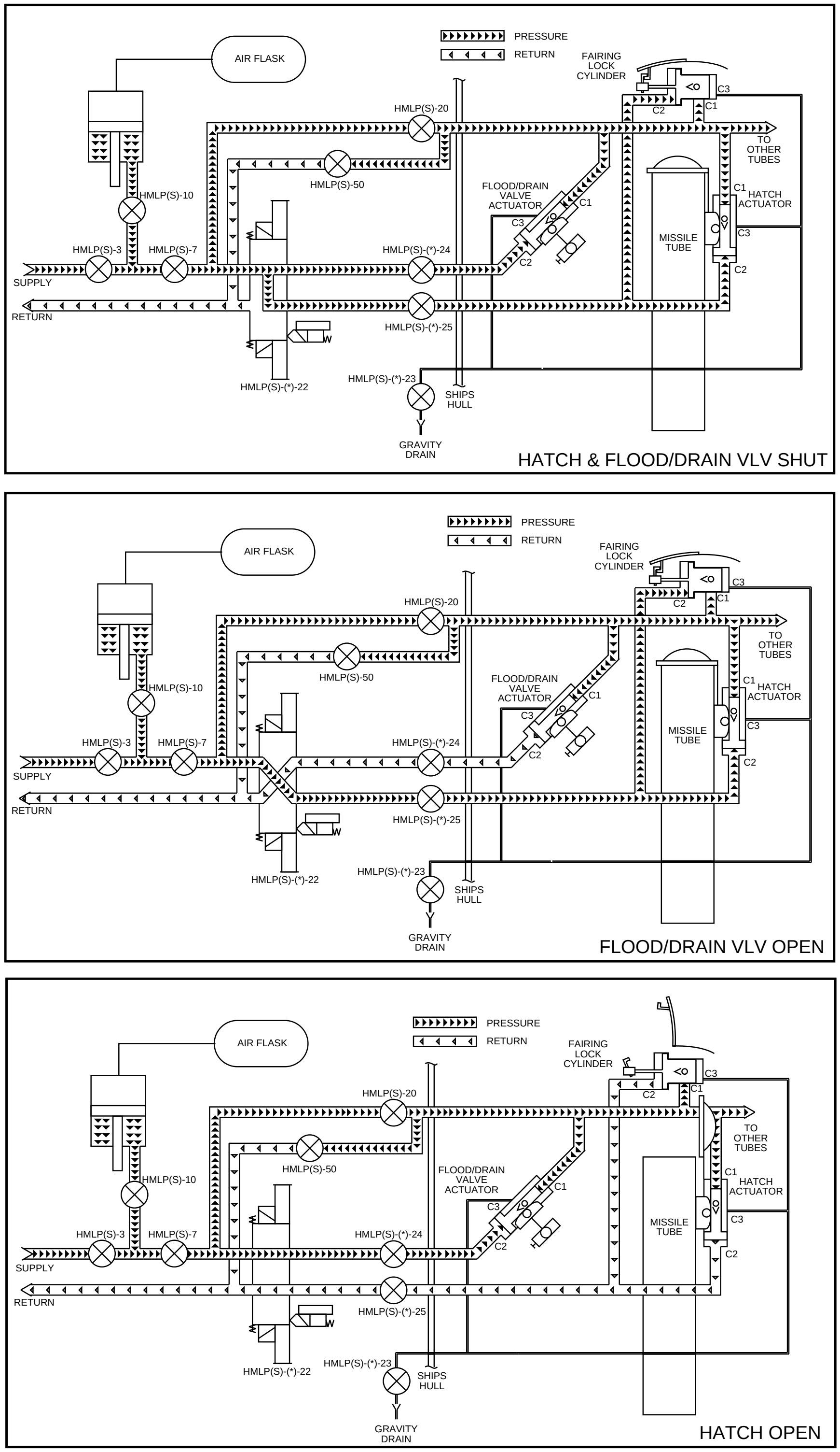


Figure 5-1-11 General Valve Arrangement



NOTES: 1. (S) IN VALVE NUMBERS ARE FOR THE STARBOARD TUBES.
2. * INDICATES TUBE NUMBER.

Figure 5-1-12 Hydraulic System (SSN 719 and 720)(Simplified)



NOTES: 1. (S) IN VALVE NUMBERS ARE FOR THE STARBOARD TUBES.
2. * INDICATES TUBE NUMBER.

Figure 5-1-13 Hydraulic System (SSN 721 and Later)(Simplified)

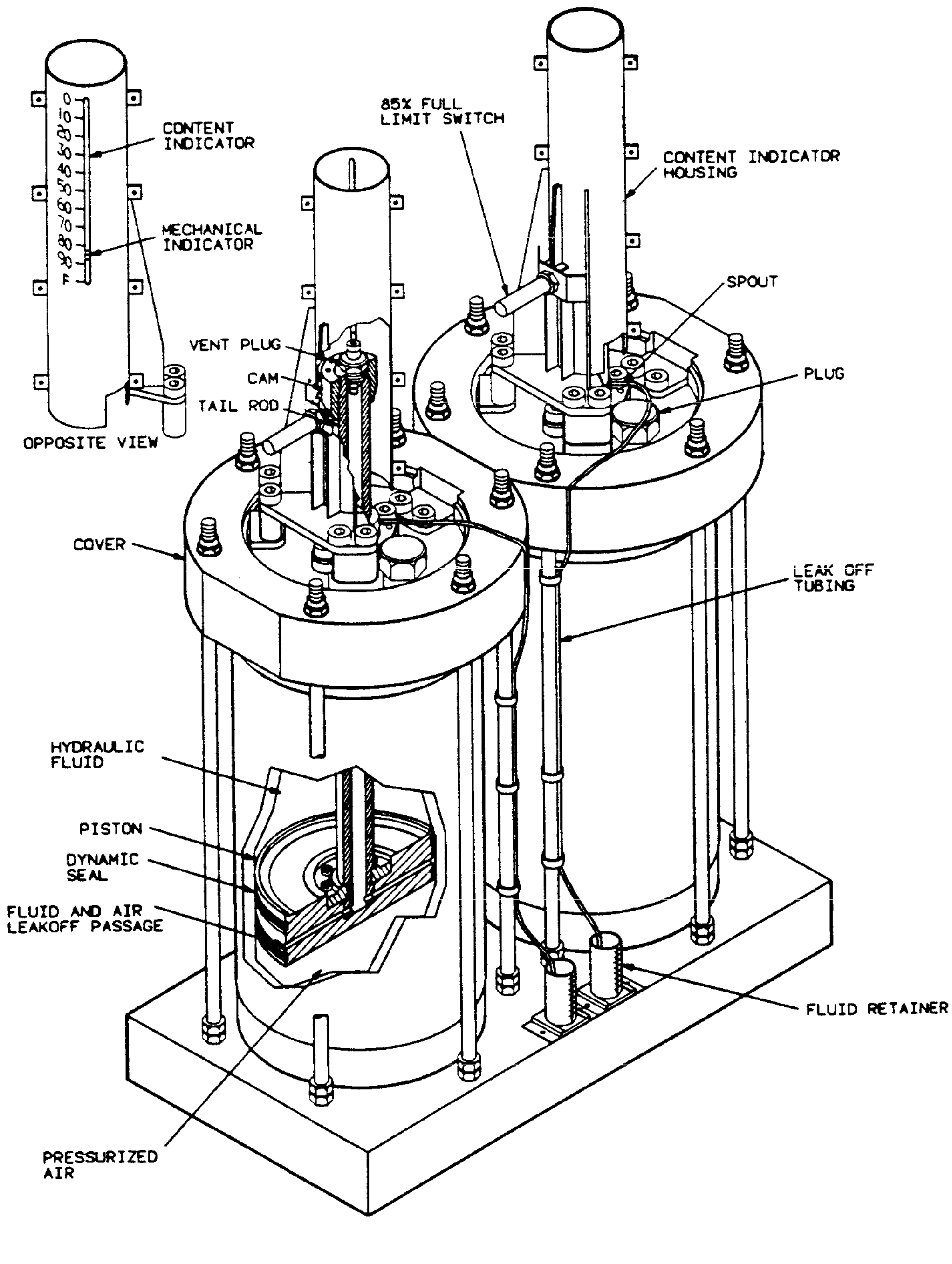


Figure 5-1-14 Hydraulic Accumulator

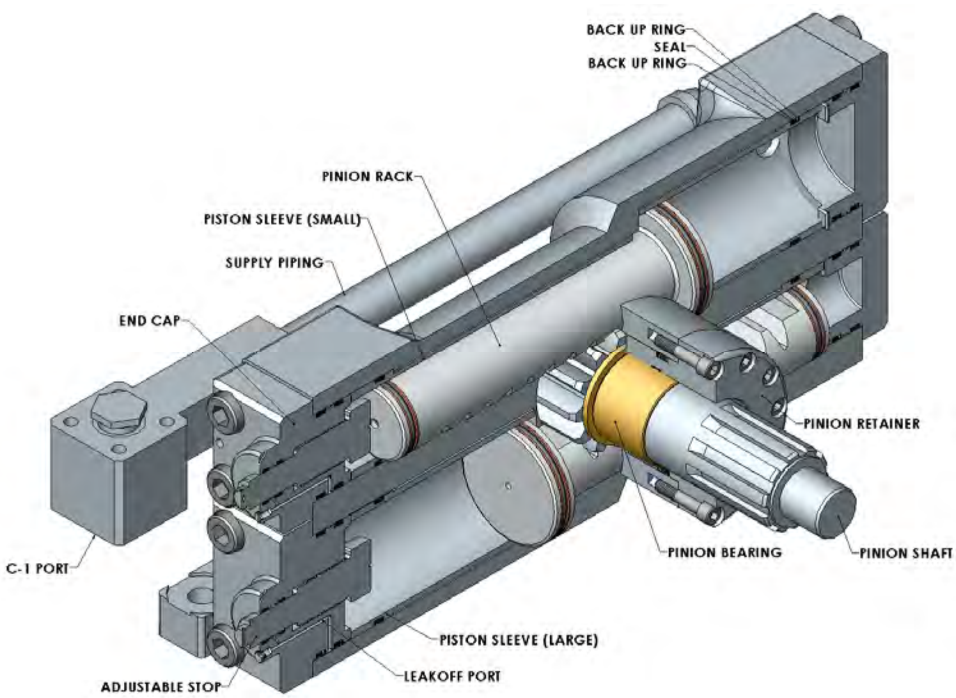


Figure 5-1-15 Muzzle Hatch Rotary Actuator (Open Position Shown) (Cutaway)

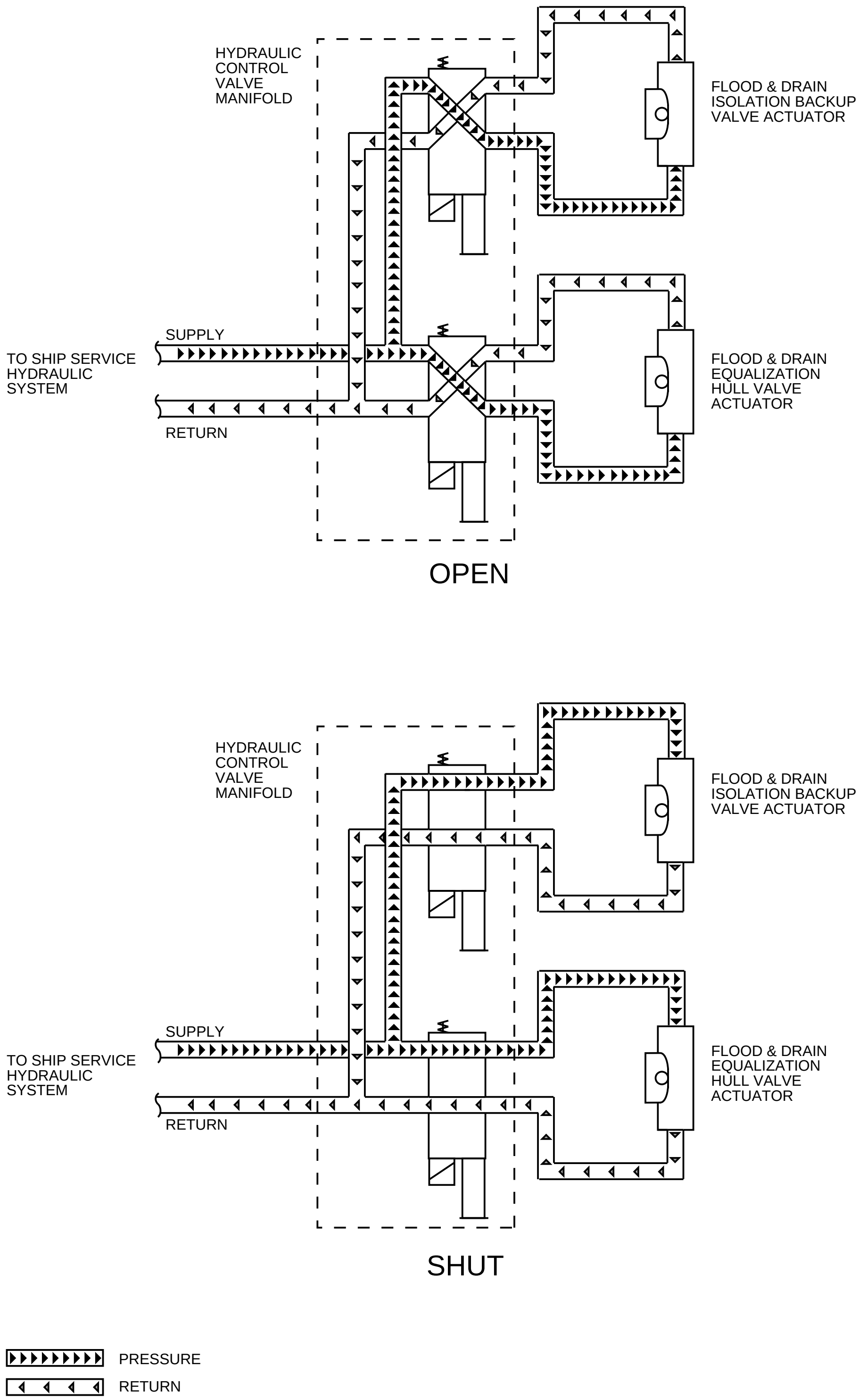


Figure 5-1-16 Inboard Actuator/Control Valves

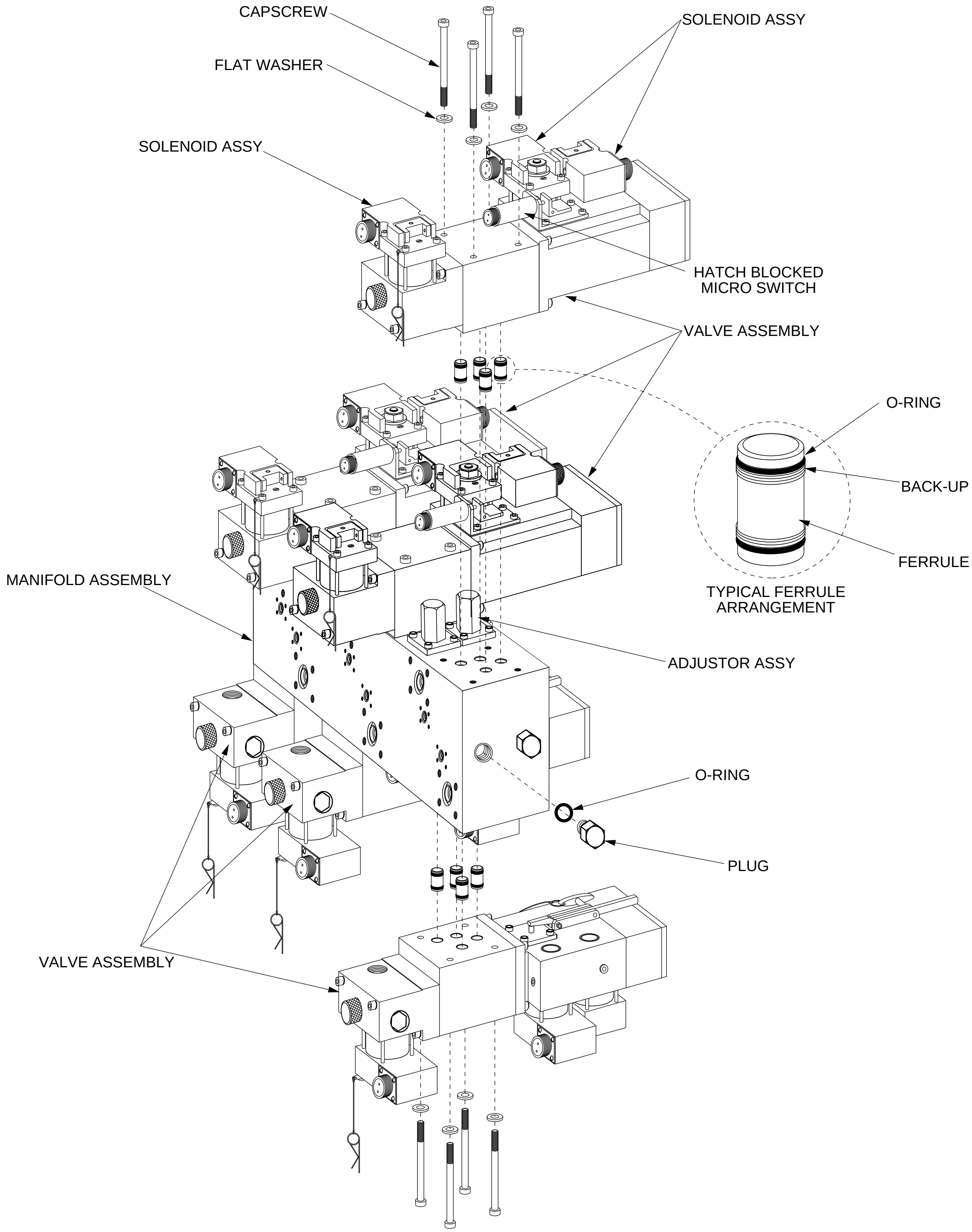


Figure 5-1-17 Hatch & Flood/Drain Valve Control Valve HMLP(S)-(*)-22 Mounted on HMLP(S)-21 Manifold

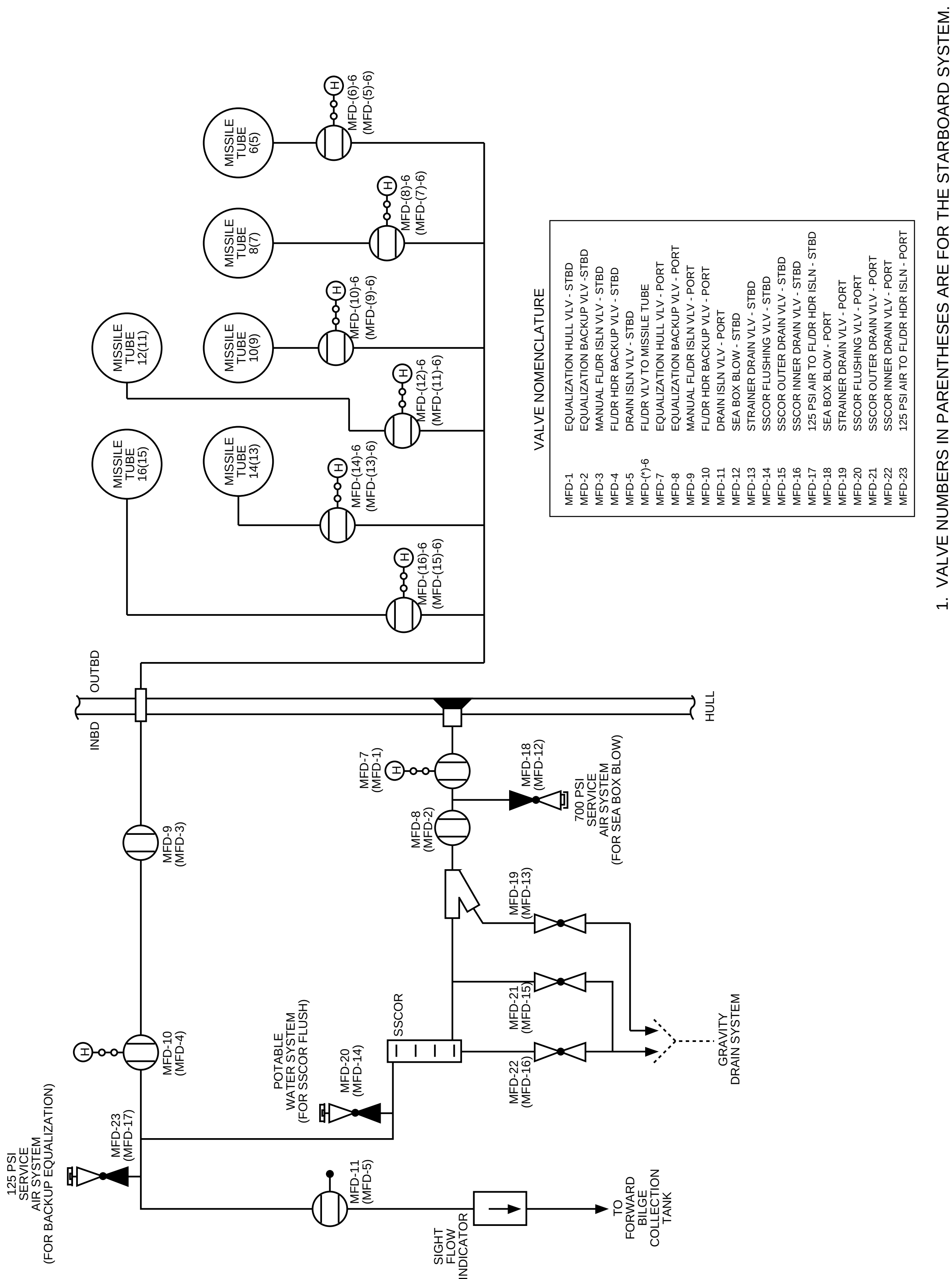


Figure 5-1-18 Flood/Drain System (Typical)

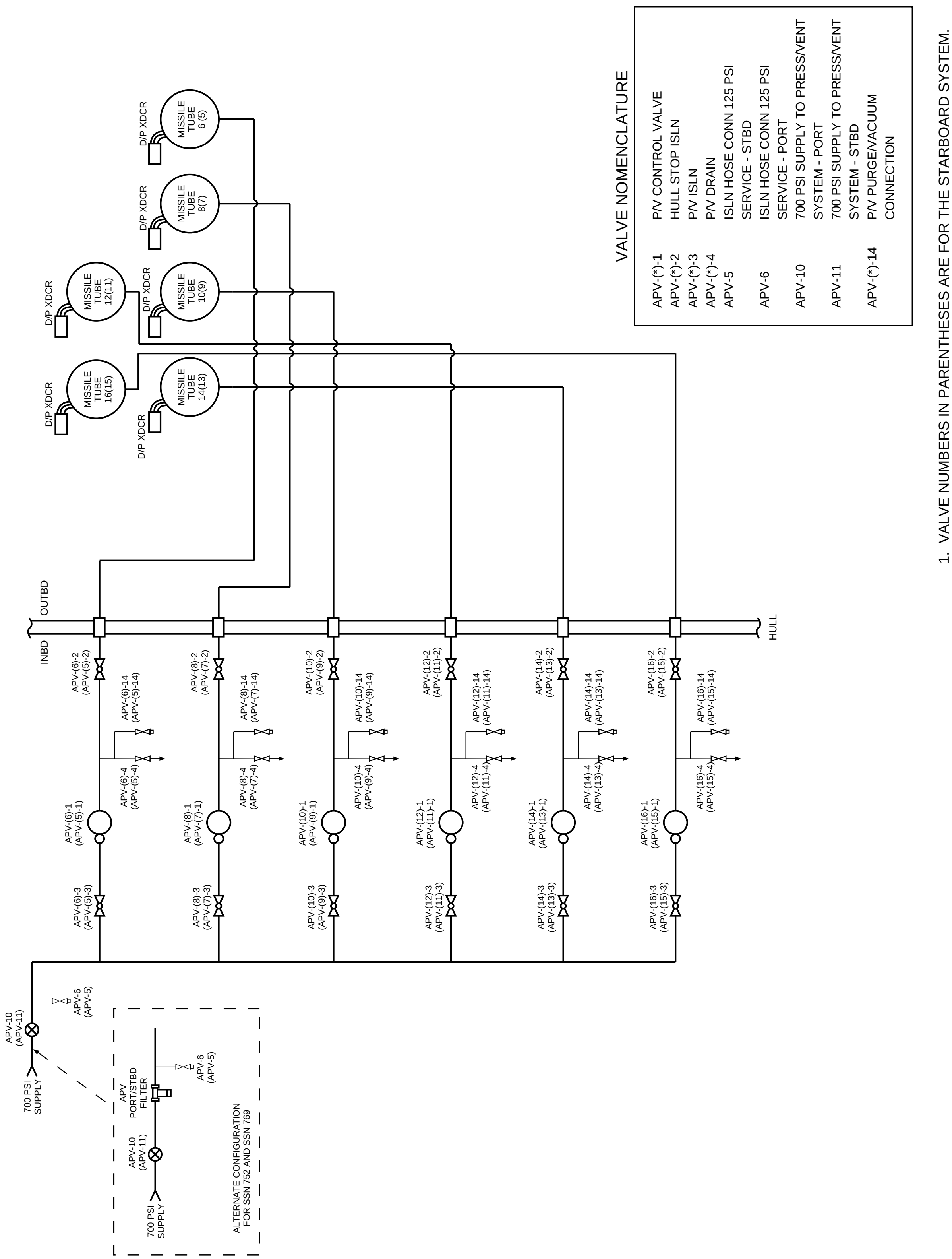


Figure 5-1-19 Pressurization/Vent System (Typical)

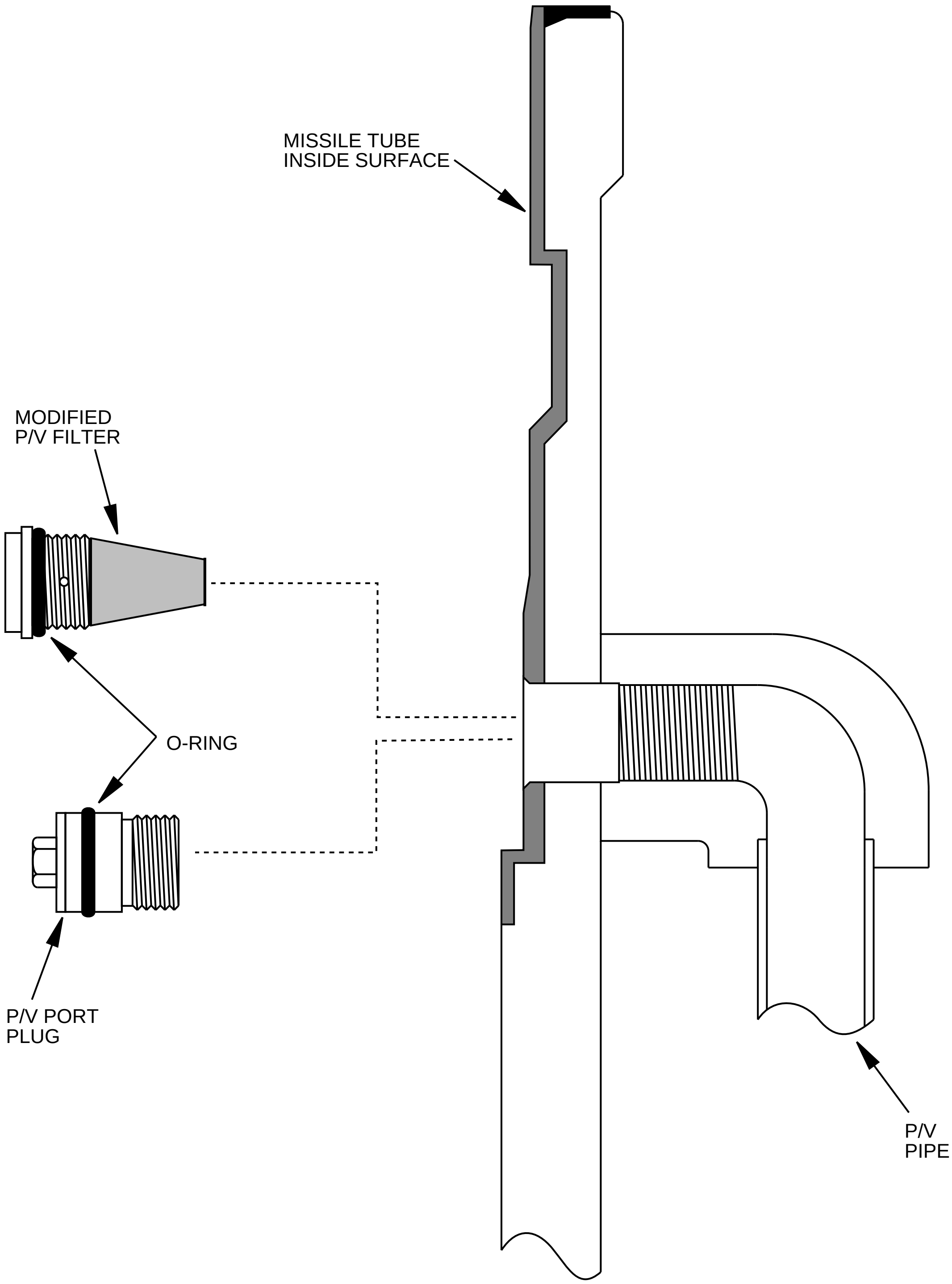


Figure 5-1-20 Pressurization/Vent Missile Tube Connection

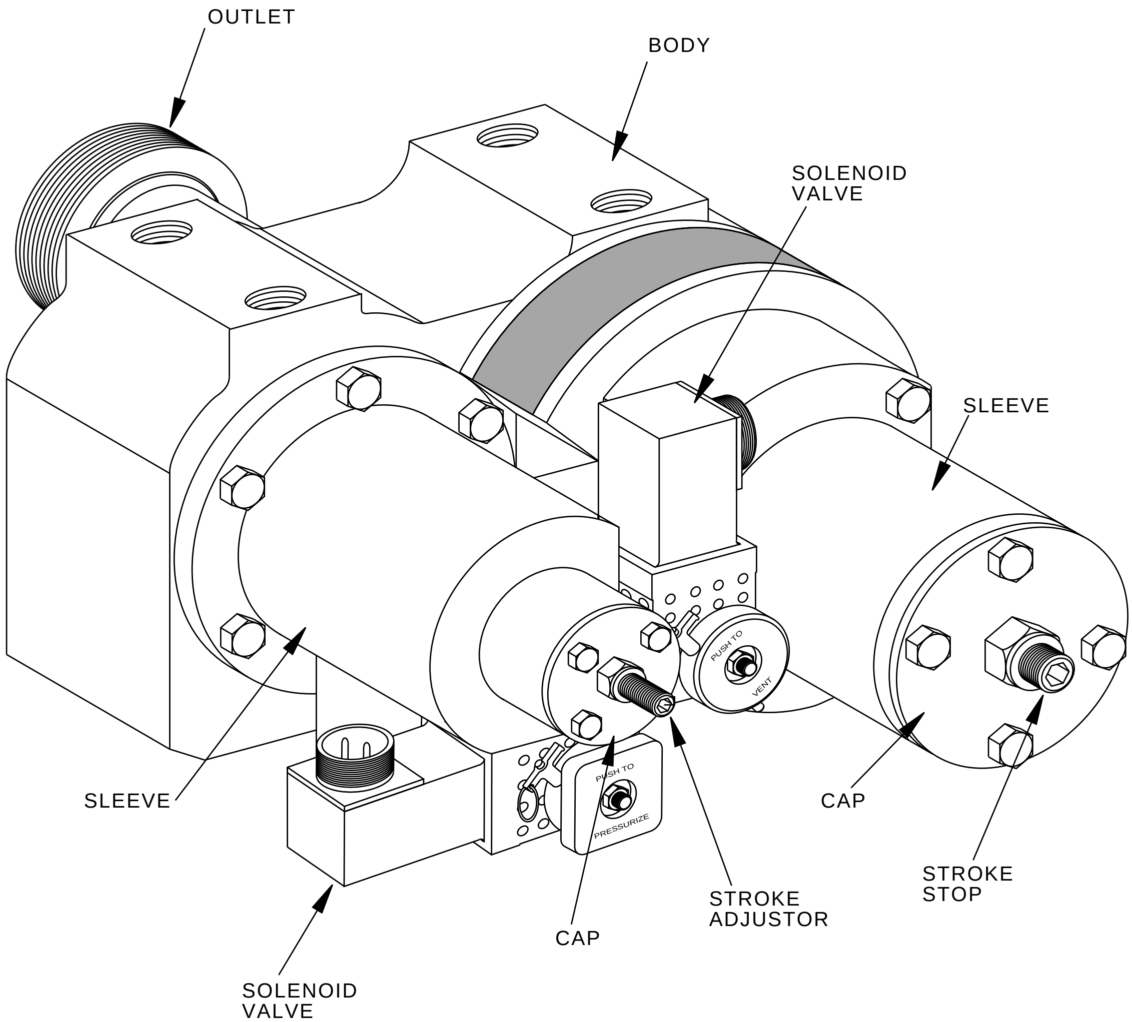


Figure 5-1-21 Pressurization/Vent Control Valve APV-(*)-1

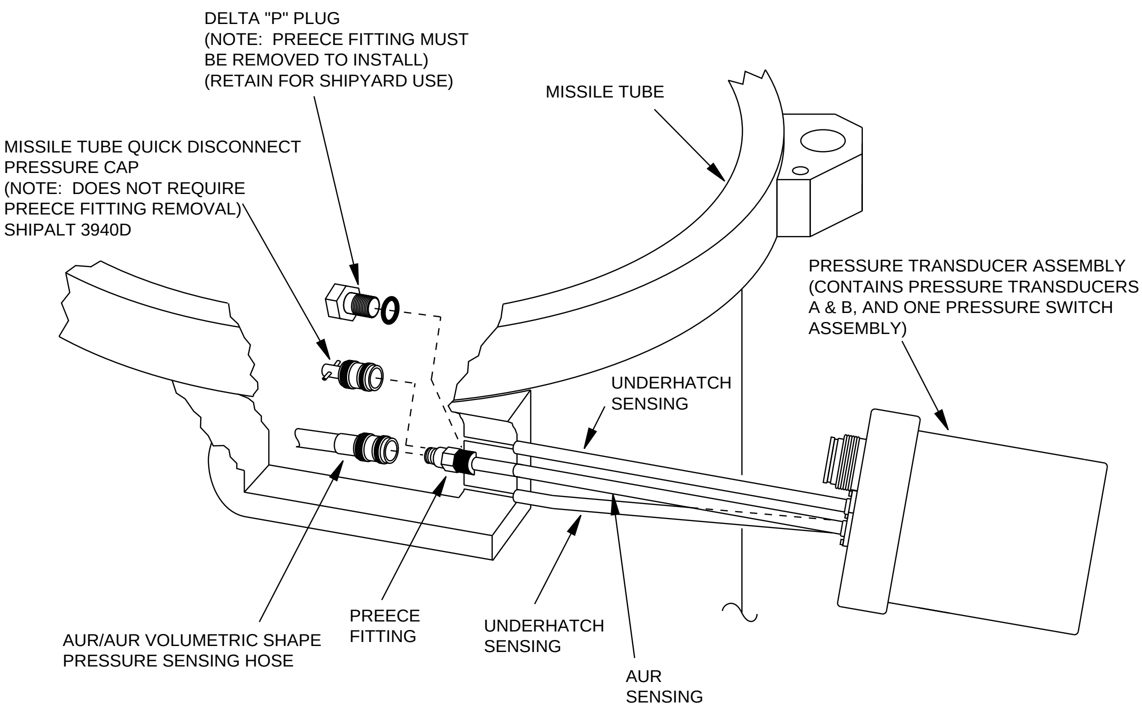


Figure 5-1-22 Differential Pressure Sensing System

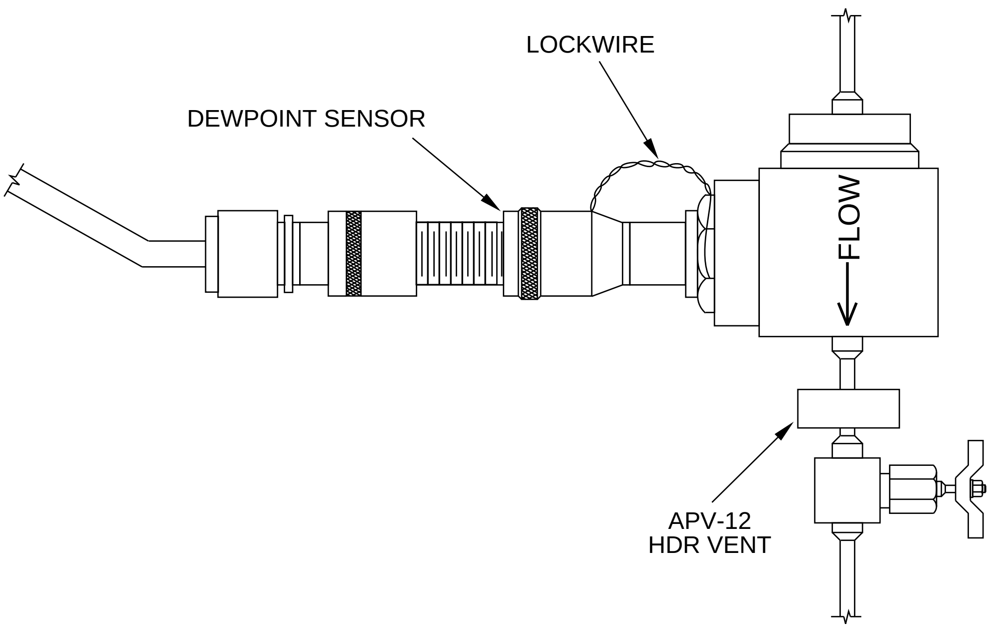


Figure 5-1-23 Dewpoint Sensor

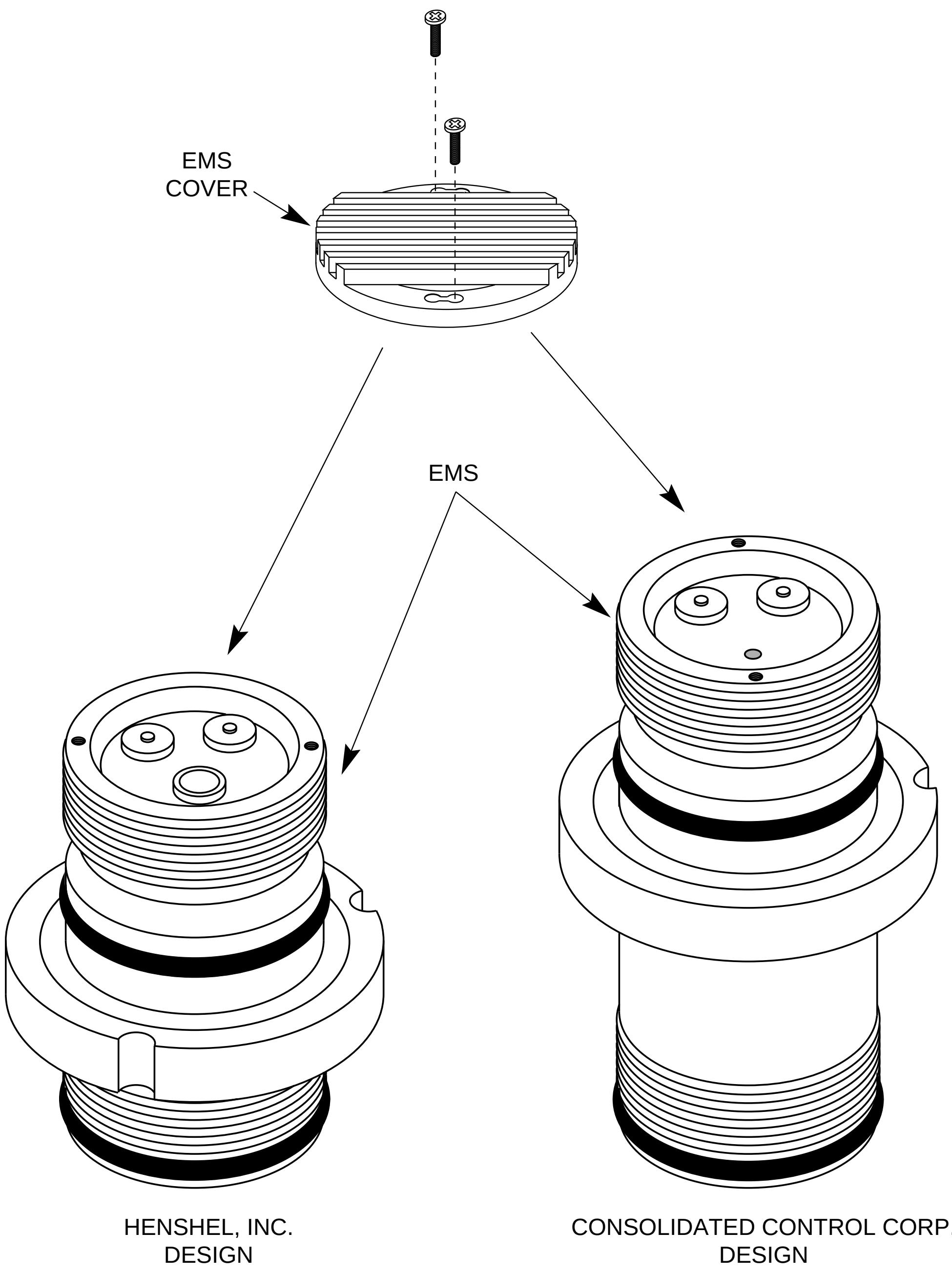


Figure 5-1-24 Environmental Monitoring Sensor Assembly

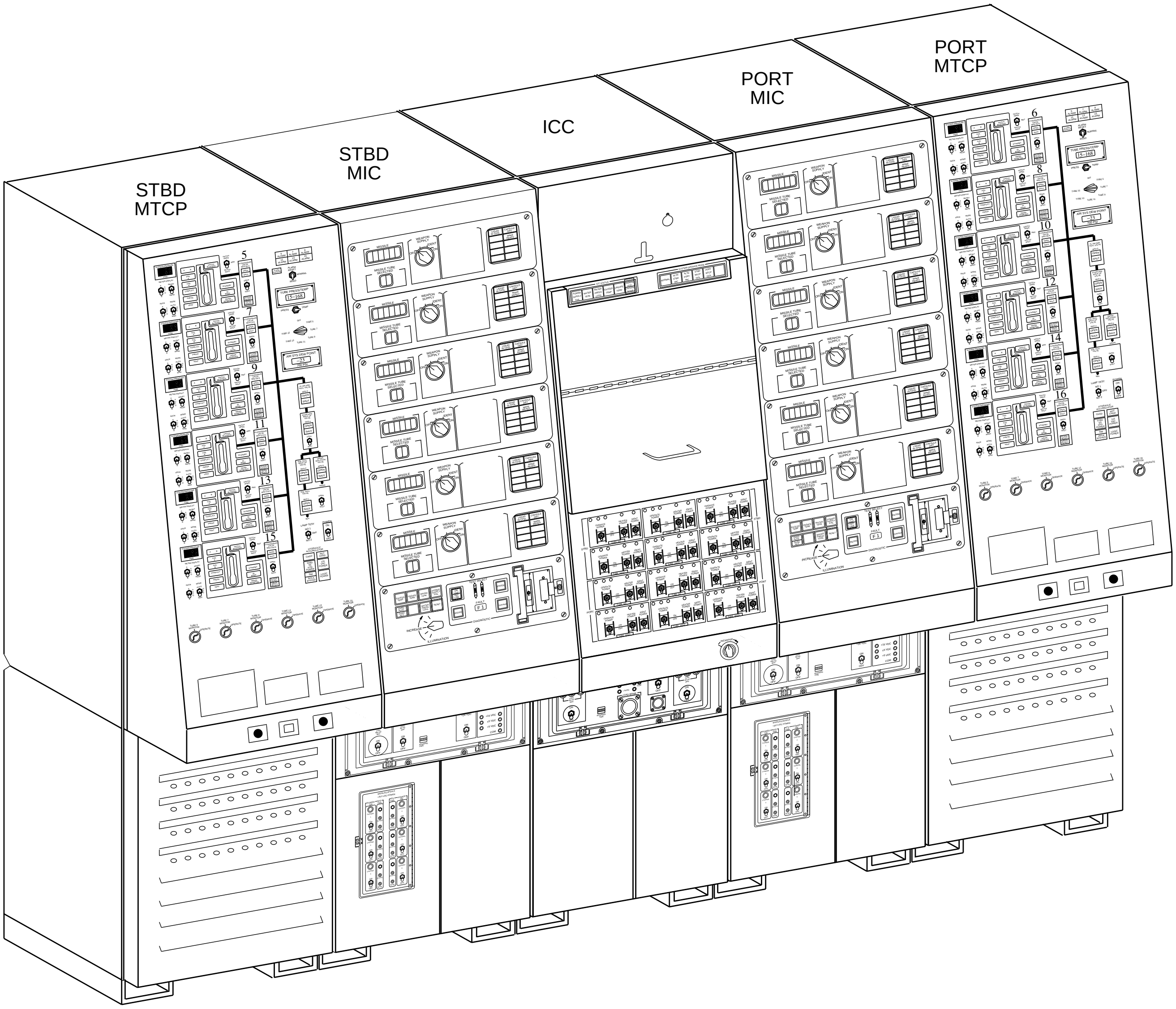


Figure 5-1-25 VLS Missile Launch Console

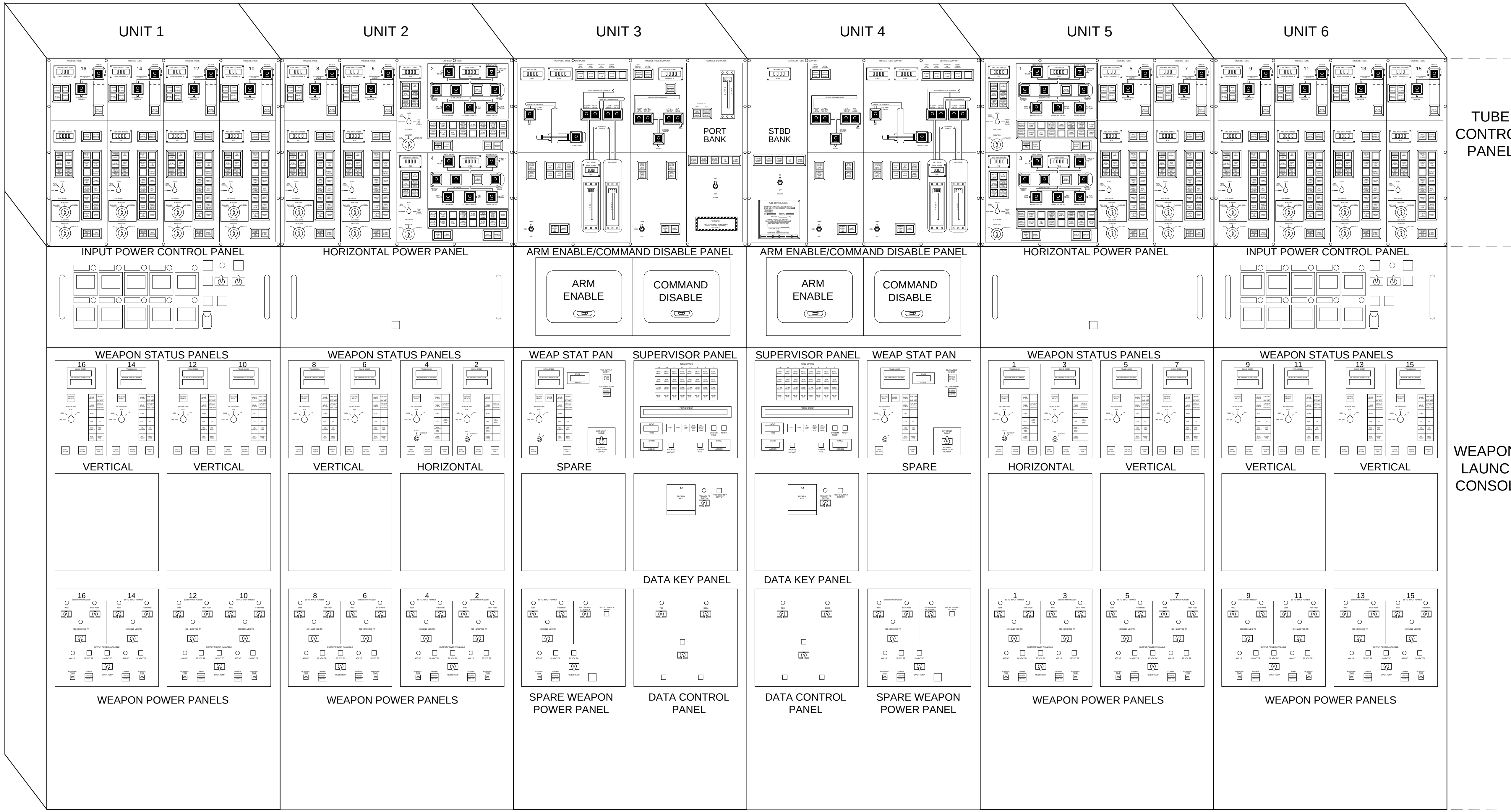
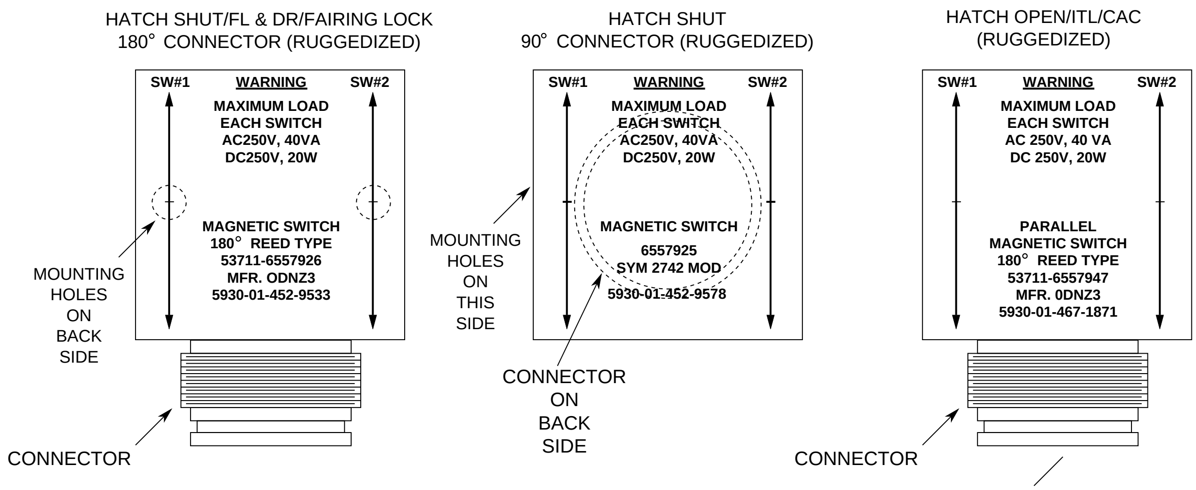
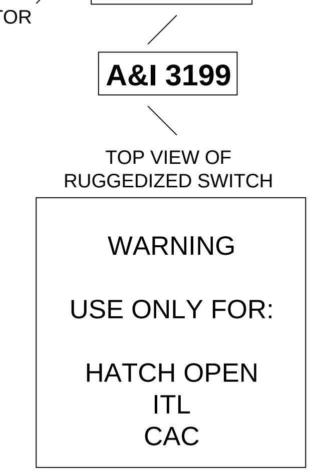


Figure 5-1-26 Integrated Weapons Launch Console

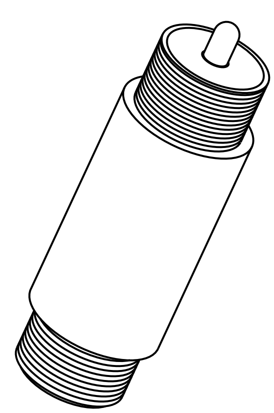




SWITCH ARRANGEMENTS

NOTE:

RUGGEDIZED MAGNETIC SWITCHES CAN BE IDENTIFIED FROM THE ORIGINAL NON-RUGGEDIZED MAGNETIC SWITCHES BY VIEWING THE SWITCH INTERNAL CONSTRUCTION THRU THE TRANSPARENT URETHANE. ON THE RUGGEDIZED SWITCH THE ELECTRICAL CONNECTOR AND MOUNTING STUDS FOUNDATION ARE COMMON. THE MOUNTING STUD HOLES ON THE BACK SIDE OF THE RUGGEDIZED SWITCH HAVE A SQUARE FOUNDATION AND A NON-RUGGEDIZED SWITCH HAS A ROUND FOUNDATION HOLE.



MICROSWITCH

Figure 5-1-27 Magnetic Switches and Micro Switch (Typical)

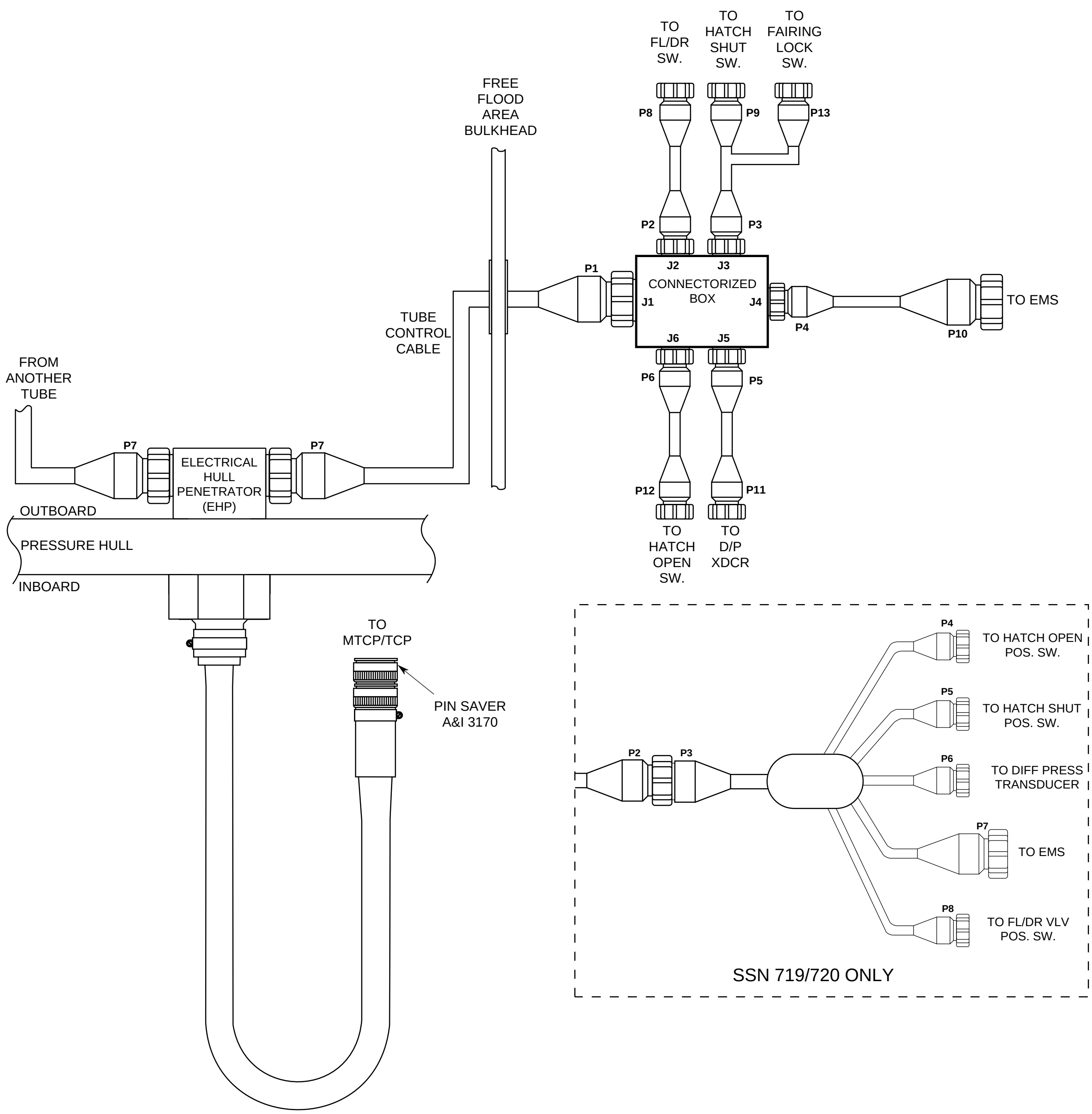


Figure 5-1-28 Missile Tube Control Cabling (Typical)

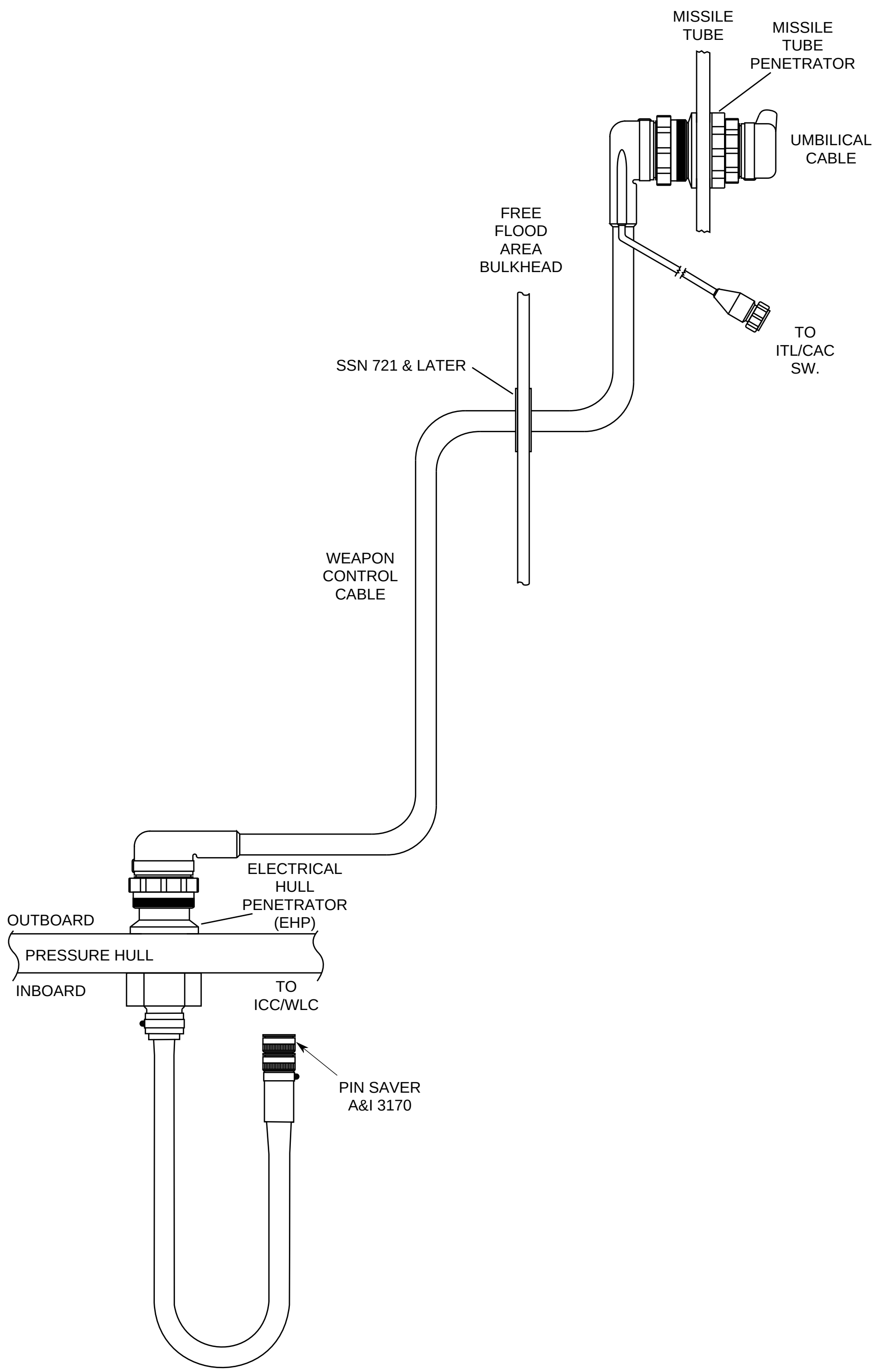


Figure 5-1-29 Weapon Control Cabling (Typical)

Figure 5-1-30 EMS/DPT/Magnetic Switch Tester

Figure 5-1-31 Automated Multi Cable Test Set (AMCATS)

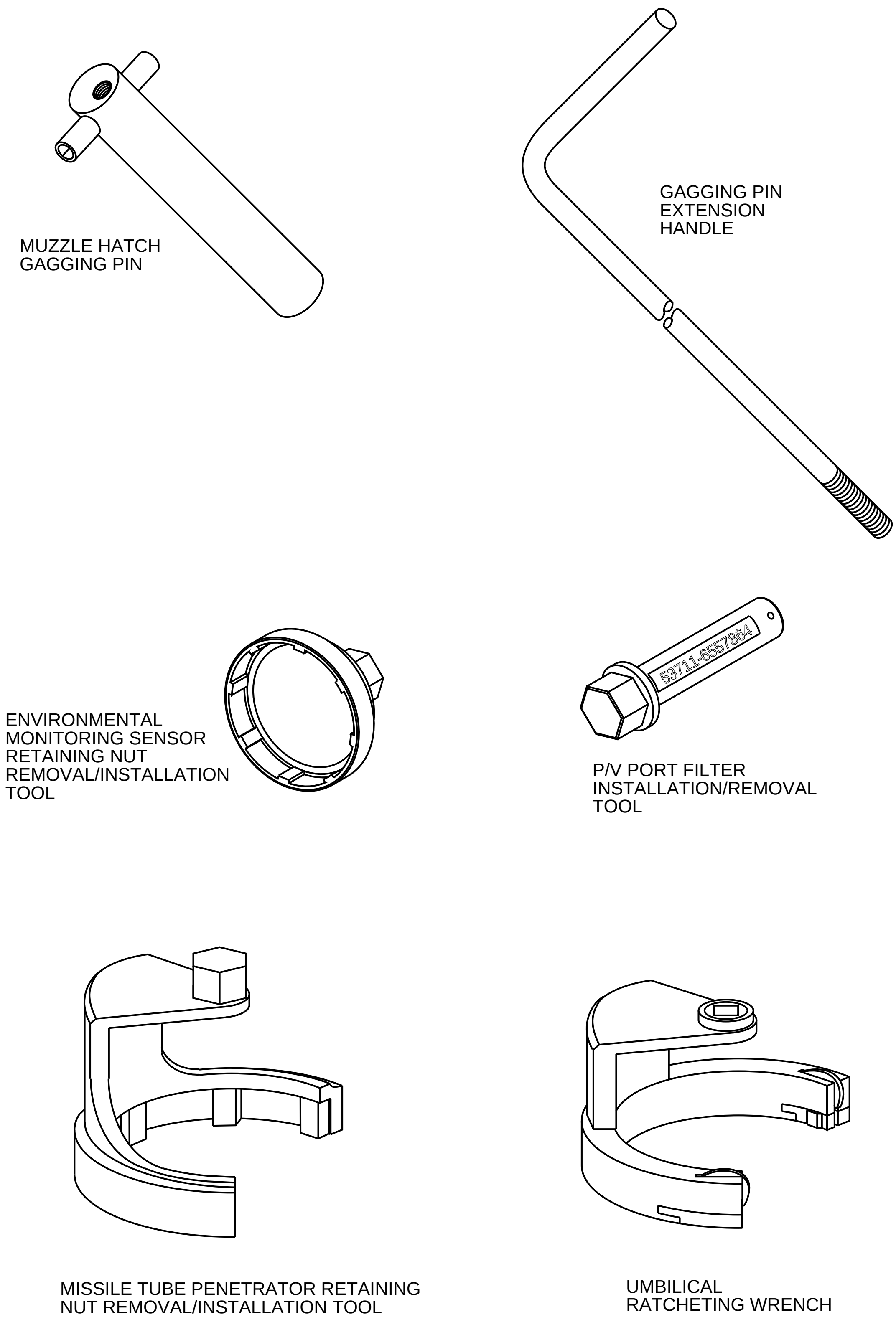
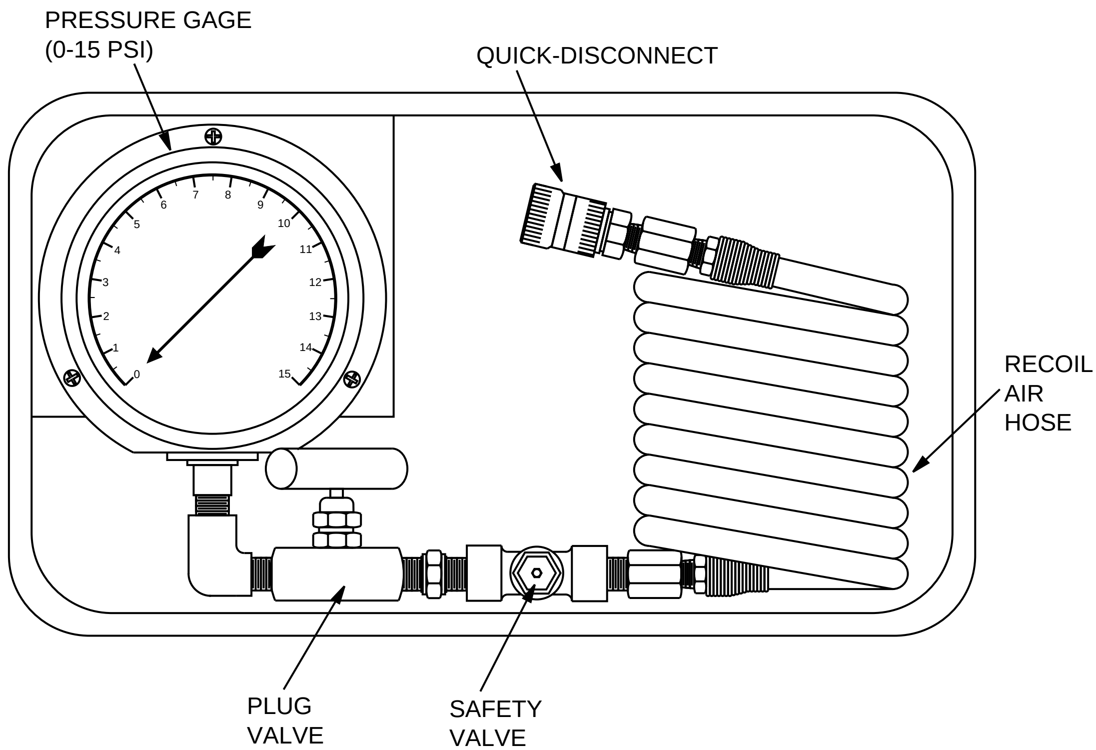
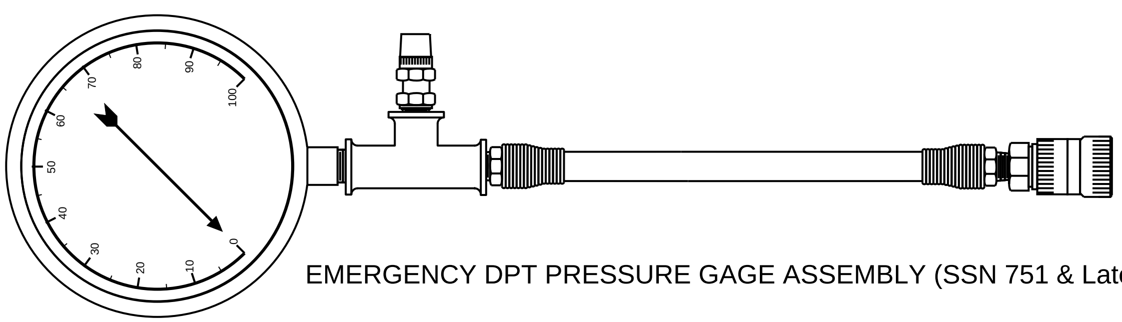


Figure 5-1-32 Special Tools



PRESSURE MONITORING TEST RIG



EMERGENCY DPT PRESSURE GAGE ASSEMBLY (SSN 751 & Later)

Figure 5-1-33 Pressure Monitoring Test Rig and Emergency DPT Pressure Gage Assembly

NOTE: MODIFIED IN ACCORDANCE WITH NAVSEA DWG #6510970

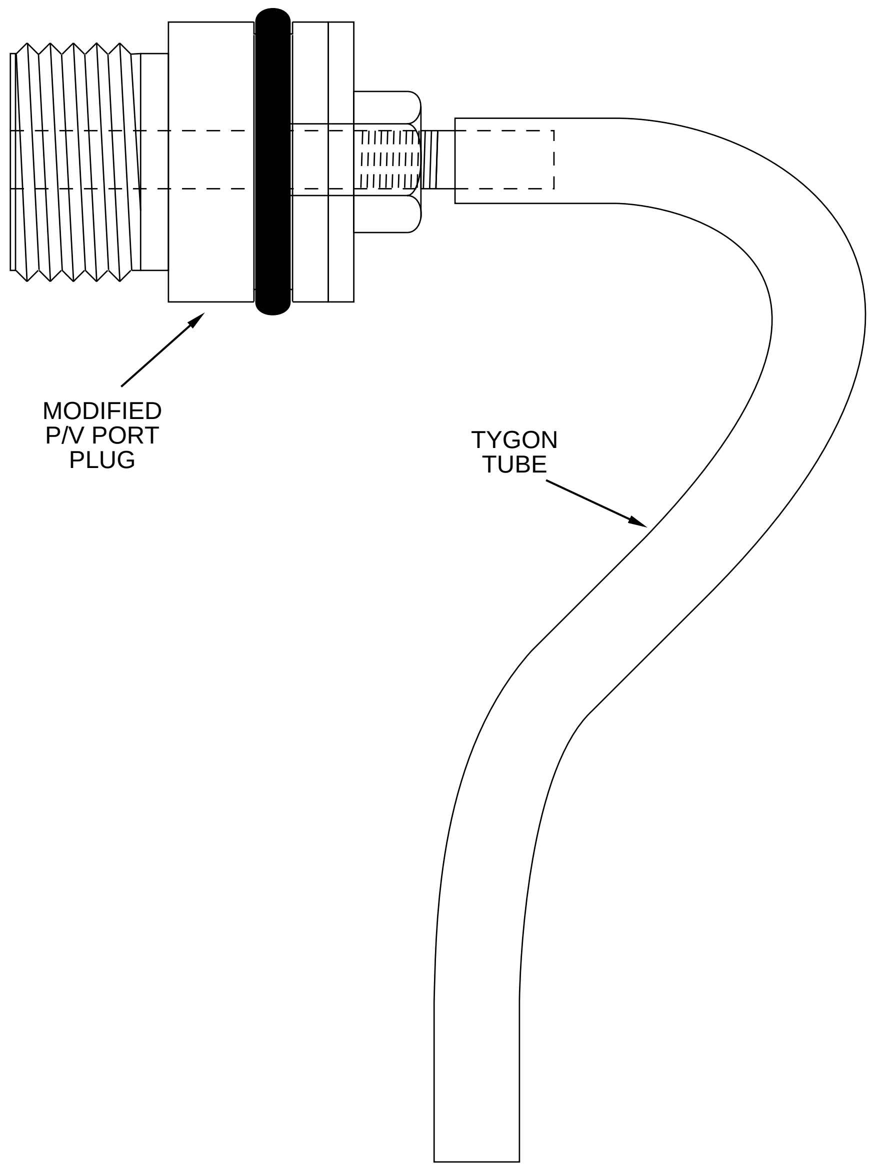


Figure 5-1-34 Pressurization/Vent Port Plug Test Rig

Figure 5-1-35 Vertical Launch System Tube Trainer Device 21H34

CHAPTER 2 ALIGNMENT, ADJUSTMENT AND TEST PROCEDURES

5-2-1 PURPOSE AND SCOPE.

This chapter addresses alignment, adjustment, and test procedures for various missile tube components and support systems, and procedures for the alignment and readjustment of critical Vertical Launch System (VLS) indicator switch assemblies. Procedures for isolation of components, marking and identification of disassembled parts, disconnecting of piping, and general cleaning, inspection and alignment techniques for common equipment are not covered in this Chapter, however, if additional information is required the appropriate reference or reference drawing provide more detailed supporting information.

5-2-2 VERTICAL LAUNCH SYSTEM.

Required Combat Systems SSN688 Class VLS missile tube system tests are listed in Table 5-2-1. Operational Tests are in the applicable Maintenance Requirement Cards (MRC) listed on the appropriate Maintenance Index Pages (MIP). Additional tests and alignments which supports troubleshooting contained in CHAPTER 4 and the repair procedures contained in CHAPTER 5 are provided in this Chapter.

Figure 5-2-1 SUBMEPP Standardized Test Procedures Applicable to SSN 688 Class VLS

TEST NO.	TITLE
715-2-1997	MISSILE TUBE CONTROL AND INDICATION CIRCUIT K-15EH INBOARD INSTALLATION INSPECTION TEST
715-2-1998	VERTICAL LAUNCH SYSTEM EXTERNAL CABLING CONFIDENCE/VERIFICATION (PRE-SEA TRIALS)
715-2-2147	VERTICAL LAUNCH SYSTEM (VLS) MISSILE TUBE HATCHES AND FAIRINGS LINK AGE ADJUSTMENT AND TIMING (SSN719 AND LATER)
715-2-2150	VLS 700 PSIG TOMAHAWK PVC SYSTEM STRENGTH & TIGHTNESS TEST (SSN719 - 773)
715-2-2151	VERTICAL LAUNCH SYSTEM MISSILE TUBE FLOOD AND DRAIN SYSTEM - STRENGTH AND TIGHTNESS TEST
715-2-2153	SSN688 CL VLS MISSILE TUBE BORE GAGING
715-2-2154	VLS MISSILE TUBE UNDERHATCH TIGHTNESS TEST
715-2-2155	VLS MISSILE TUBE COOLING SYSTEM - STRENGTH AND UNOBSTRUCTED FLOW TESTS
715-2-2161	SSN688CL VERTICAL LAUNCH SYSTEM (VLS) MISSILE TUBE INTERNAL DIMENSIONS
715-3-2152	VERTICAL LAUNCH SYSTEM (VLS) MISSILE TUBE HATCHES & FAIRING OPERATION
715-3-2158	SSN688CL - VLS MISSILE TUBE FIT CHECK
715-3-2159	SSN688CL (VLS) MISSILE TUBE HATCHES AND FAIRINGS -CLEARANCE AND OPERATION (SSN719 & SSN720)
715-3-2162	VERTICAL LAUNCH SYSTEM (VLS) PRESSURE/VENT CONTROL VALVE FLOW RATE TEST
715-3-2164	MISSILE TUBE ENVIRONMENTAL MONITORING SENSOR CIRCUIT TEST
715-5-1999	VERTICAL LAUNCH SYSTEM EXTERNAL CABLING CONFIDENCE/VERIFICATION (POST DEEP DIVE)

TEST NO.	TITLE
715-5-1999	VERTICAL LAUNCH SYSTEM EXTERNAL CABLING CONFIDENCE/VERIFICATION (POST DEEP DIVE)
715-5-2135	SSN688 CL VERTICAL LAUNCH SYSTEM (VLS) - OPERABILITY & PERFORMANCE TEST (SSN751 AND LATER)
715-5-2156	SSN688 CLASS VLS MISSILE TUBE ALIGNMENT (WATERBORNE)
715-5-2157	SSN688 CLASS VLS MISSILE TUBE ALIGNMENT (DRYDOCK)
715-5-2160	SSN688 CL VERTICAL LAUNCH SYSTEM (VLS) OPERABILITY AND PERFORMANCE TEST (SSN719-725 AND 750)

5-2-3 FAIRING ASSEMBLY TEST.

a. Refer to drawing nos. 704-5940679, 704-5940680 and 704-5483960 for alignment, adjustment and testing procedures. Associated and detail drawings may be found in Table 5-6-2.

b. Restore system to conditions existing prior to maintenance. Operate muzzle hatch and fairing through several cycles checking for binding, noise and smooth operation.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

c. Ensure fairing fairness conforms to the requirement of reference drawing 43.1 (Installation of Fairings) and/or reference drawing 47.1 (VLS Hatch Fairing and Linkage Upgrades) as follows:

(1) A 1/8” to 1/4” gap should exist between the fairing cover and non-pressure hull to ensure proper fairing to gasket interface.

(2) Verify fairing gasket is installed around perimature of fairing to prevent fairing cover rattles.

(3) (SHIPALT 4292K ONLY) Verify fairing gasket is installed on the forward and aft portions of the fairing to prevent fairing cover rattles.

(4) Inspect fairness using a 1/2” x 1/2” wood batten spanning at least two frame space held in a fore and aft direction. The fairness shall be such that a 5/32 feeler gage is excluded from under the entire length of the batten.

NOTE

Measurements shall be taken by moving the batten one frame space at a time.

(5) Check local discontinuities on the fore and aft portions of the fairing using a 1/2” x 1/2” x 2” wood batten where the fairness shall be such that a 1/32” feeler gage shall be excluded from under the entire length.

NOTE

Epoxy may be used as an emergent repair to meet fairness requirements of reference drawing 43.1 (Installation of Fairings). (Epoxy smoothing material in accordance with NSTM S9086-VD-STM-000 Chapter 631, shall be used to meet smoothness requirements.) The epoxy repair should be replaced using re-fairing techniques, “weld buildup” repair at next availability.

d. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

5-2-4 FAIRING LOCKING MECHANISM TEST (SSN 721 and Later).

5-2-4.1 Operational Test.

NOTE

Refer to drawing nos. 704-5940679, 704-5940680 and 704-5483960 for alignment, adjustment and testing procedures. Associated and detail drawings may be found in Table 5-6-3.

a. Operate muzzle hatch and fairing through several cycles checking for binding, noise and smooth operation in accordance with current shipboard instructions.

b. Ensure fairing fairness conforms to the measurements recorded prior to repair of the fairing locking mechanism.

NOTE

If a measurement was not recorded prior to repair then the fairing fairness must conform to the requirements of Reference Drawing 43.1 (Installation of Fairings) as outlined in paragraph 5-2-3.

c. Check proper operation of fairing locking device using applicable MRC from MIP 7211.

d. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

5-2-4.2 <u>Fairing Locking Mechanism Adjustment.</u>

a. Open muzzle hatch in accordance with current shipboard instructions.

b. Remove bolts, pin retainer, pin and cotter pin. Disconnect fairing lock bar linkage from clevis. Refer to Figure 5-2-1

NOTE

1/2 turn of fairing lock bar linkage equates to 1/16 inch travel of lock bar dogs.

c. Turn the fairing lock bar linkage to achieve desired setting.

NOTE

The required clearance of the locking bar is shown in Figure 5-2-1.

<u>CAUTION</u>

Adjusting the linkage too short or too long so the lock cylinder does not travel full stroke causes high stress in the fairing lock bar linkage.

d. Reconnect the fairing lock bar linkage to clevis.

e. Test adjustment by conducting operational test using paragraph 5-2-4.1.

f. If adjustment was made and the cotter pin hole does not line up, drill a new hole in the fairing lock bar linkage to ensure the cotter pin can be reinstalled.

NOTE

If a new hole is required it needs to be inline with the existing hole and could form an elongated if drilled ajecent with the existing hole as shown in Figure 5-2-2.

5-2-5 FAIRING LOCK HYDRAULIC CYLINDER TESTS (SSN 721 and Later).

Procedures for conducting hydrostatic tests, (strength and porosity, and internal leakage), are provided in the following paragraphs. If the fairing lock hydraulic cylinder (Figure 5-2-1) has been completely disassembled, it should be bench tested for internal leakage. If the hydraulic cylinder has been weld repaired, or new untested pressure boundary hardware has been installed, it should be bench tested for strength and porosity. Ensure that a 7500 PSIG pressure source can be applied to the hydraulic cylinder.

NOTE

Test fittings for the fairing lock hydraulic cylinder can be locally manufactured by modifying flange 8, 9 and 10 of Reference Drawing 45.1 with the appropriate connection to match Hydro test unit.

5-2-5.1 Strength and Porosity Test.

NOTE

The use of 2190 TEP hydraulic fluid is acceptable for testing VLS hydraulic components. However, it should be drained and flushed with 2075 T-H hydraulic fluid prior to reinstallation or applicable hydraulic fluid.

NOTE

Enternal External leakage for the below conditions shall be zero for a duration of 10 minutes of pressure applied. If leakage is found, disassemble and repair hydraulic cylinder as necessary then retest.

a. With C-1 (open-side) and C-2 (shut-side) ports open slowly apply 4500 PSIG to C-3 (Leakoff) port and verify no leakage.

b. Vent off hydraulic pressure on the C-3 (leak-off) port.

c. Apply 4500 PSIG to both C-1 (open-side) and C-2 (shut-side) ports simultaneously with C-3 (leakoff) port open and verify no leakage.

d. Vent off hydraulic pressure on C-1 (open-side) and C-2 (shut-side) ports.

f. With C-2 (shut-side) and C-3 (leakoff) ports open, slowly apply 7500 PSIG to C-1 (open-side) port and verify no leakage.

g. Vent off hydraulic pressure on C-1 (open-side) port.

h. If no leakage is found, strength and porosity test is complete. Replace all seals and perform internal leakage test.

5-2-5.2 <u>Internal Leakage Test.</u>

NOTE

The use of 2190 TEP hydraulic fluid is acceptable for testing VLS hydraulic components. However, it should be drained and flushed with 2075 T-H hydraulic fluid prior to reinstallation or applicable hydraulic fluid.

a. Cycle fairing lock hydraulic cylinder to verify proper operation of seals.

NOTE

The fairing lock hydraulic cylinder should be cycled approximately 25 times to ensure seals or properly installed prior to conducting Internal Leakage Test.

b. With C-2 (shut-side) and C-3 (leakoff) ports open, slowly apply 3000 PSIG to C-1 (open-side) port.

NOTE

To detect small leaks monitor gage for drop in pressure.

c. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure is allowed. Observe C-2 (shut-side) port, C-3 (leakoff) port and external areas of the actuator. No leakage is allowed.

d. If the pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

e. If leakage is found, disassemble and repair hydraulic cylinder as necessary. Repeat test.

f. If no leakage is found, stroke actuator shut by venting the C-1 (open-side) port and slowly applying pressure to the C-2 (shut-side) port until the actuator is in the shut position.

g. Apply 3000 PSIG to C-1 (open-side) and C-2 (shut-side) ports simultaneously with C-3 (leakoff) port open.

h. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure is allowed. Observe C-3 (leakoff) port and external areas of the actuator. No leakage is allowed.

i. If the pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

j. If leakage is found, disassemble and repair hydraulic cylinder as necessary. Repeat test.

k. With C-1 (open-side) and C-2 (shut-side) pressurized to 3000 PSIG, slowly apply 3000 PSIG to C-3 (leakoff) port.

NOTE

During this portion of the Internal Leakage Test with the C-3 (Leakoff) port pressurized the seawater seals are only tested from the inboard direction.

l. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure or leakage is allowed.

m. If the pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

n. If leakage is found, disassemble and repair hydraulic cylinder as necessary. Repeat test.

o. If no leakage and/or drop in pressure is found, test is complete.

p. Vent off hydraulic pressure on the C-3 (leak-off) port then vent off the C-1 (open-side) and C-2 (shut-side) ports.

5-2-5.3 Case Vent Leakoff Tightness Test.

CAUTION

Ensure the hatch actuator, flood/drain valve actuator and fairing lock cylinder (SSN 721 and Later) is installed with C-1, C-2, and C-3 pipes connected for the tube to be tested prior to performing this test.

NOTE

If all external hydraulic components for tube under test have not been overhauled, the possisibilty exist that during this test the seawater seals on components that have not been repaired will shift and cause the seawater seal to leak.

NOTE

Upon completion of the case vent leakoff tightness test, a Deep Dive will be required to verify integrity of seawater seals from the outboard direction prior to close out of Work Package. Since a Deep Dive is required to verify the integrity of the seawater seals from the outboard direction a Case Vent Leakoff Tightness Test is not manditory. However it is highly recommended if all external hydraulic components for tube under test have been overhauled.

NOTE

If required to gain better access to components under test the fairing assembly can be disconnected. IAW Paragraph 5-5-5.

NOTE

(*) Indicates tube under test.

a. Remove plug from HMLP(S)-(*)-23 and install new O-Ring and backups on special test fitting and install HML-23 special test fitting. Refer to Figure 5-2-4.

b. Verify HMLP(S)-(*)-23 valve is shut and connect test rig to special test fitting.

CAUTION

To prevent damaging muzzle hatch actuator sleeves never pressurize C-3 (leakoff) port unless C-1 (open-side) and C-2 (shut-side) ports are pressurized to equal or greater pressure.

c. Pressurize the case vent C-3 (leakoff) line to 450 psig in 50 Lb. increments applying Leak-Tec or soapy water solution at each 50 Lb. increment to all outboard seawater seal locations.

NOTE

These seals are located in the C-1, C-2, and C-3 pipe connections of the muzzle hatch hydraulic actuator, flood/drain valve hydraulic actuator and fairing lock hydraulic cylinder (SSN-721 and Later). The seawater seals are also located in the end caps and pinion retainer of the muzzle hatch hydraulic actuator, the end cap and shaft seal of the fairing lock cylinder, and the bonnet and shaft seal on the flood/drain actuator. Refer to Figure 5-2-4.

d. When 450 psig is reached allow pressure to stabilize for ten minutes. Repressurize if required.

e. Hold 450 psig for 30 minutes. No drop in pressure or leakage is allowed.

f. If no leakage is found, case vent leakoff test is complete.

g. Slowly open HMLP(S)-(*)-23 valve until completely vented. Disconnect test rig and remove HML-23 special test fitting.

h. Install new O-Ring on plug, then install plug into the HMLP(S)-(*)-23 valve.

i Conduct a deep dive prior to close out of work package to verify integrity of seawater seals from the outboard direction.

NOTE

Maximum allowable seawater leak rate is zero. Refer to paragraph 5-4-5 for troubleshooting procedures as required.

5-2-5.4 Operational Test.

NOTE

Refer to drawing nos. 704-5940679 and 704-5940680 for alignment, adjustment and testing procedures. Associated and detail drawings may be found in Table 5-6-4.

a. Cycle VLS hydraulic system fluid using applicable MRC from MIP 7211.

b. Operate muzzle hatch through several cycles checking for binding, noise and smooth operation in accordance with current shipboard instructions.

c. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211

5-2-6 MUZZLE HATCH T-BAR LOCKING MECHANISM TEST (SSN 719 and 720).

After reassembly and reinstallation, align, adjust and conduct operational test of the muzzle hatch T-bar as follows:

5-2-6.1 Muzzle Hatch T-Bar Locking Mechanism Alignment and Adjustment.

a. Open muzzle hatch in accordance with current shipboard instructions.

b. Remove T-bar pin to disconnect T-bar linkage (Figure 5-2-5).

c. Manually cycle T-bar and hatch locking linkage to ensure they operate freely.

CAUTION

The coating (Karon V) used on the pins and bearings in SHIPALT 3936K will be damaged if lubricated with any petroleum based lubricants. Do not use penetrating oil; use only non-petroleum based lubricant (vegetable oil).

d. If the T-bar or hatch locking linkage does not operate freely, lubricate connections with a non-petroleum based lubricant and manually cycle the T-bar linkage.

e. Install T-bar pin to reconnect T-bar linkage. Lubricate T-bar pin connection with oil.

f. Using a straightedge and ruler, check that T-bar lock can not be manually pulled closer than 2 15/32 inches from the missile tube counterbore edge (Figure 5-2-6).

NOTE

If the T-bar can be pulled closer than 2 15/32 inches, cam travel readjustment will be required after remaining measurements are taken.

g. Shut muzzle hatch for remaining steps in accordance with current shipboard instructions.

NOTE

It will be necessary to have access to the locking mechanism area through another open muzzle hatch or through an access opening in the non-pressure hull.

h. Check overlap of T-bar lock with outer ends of hatch hinge arms. The acceptable range is 3/4 inch to 1 inch (Figure 5-2-7).

NOTE

If not in acceptable range then readjustment will be required after remaining measurements are taken.

i. Check that flat bar spring clearance is .010 to .015 inch (Figure 5-2-7).

j. If flat bar spring clearance is not .010 to .015 inch clearance, remove lockwire and adjust then relockwire the adjusting screw.

k. Check vertical clearance between T-bar lock and ends of hatch hinge arm. Clearance should not be less than .050 inch, or more than .075 of an inch (Figure 5-2-8).

NOTE

Paint buildup on ends of the hinge arms may cause a smaller clearance.

l. Remove paint buildup, if required.

NOTE

Steps 5-2-6.1.m thru 5-2-6.1.q are conditional steps and are required only if readjustment for step 5-2-6.1.f or 5-2-6.1.h is required.

m. Ensure that the hatch linkage is 1/2 inch nominal over toggle when shut, before making any adjustments (Figure 5-2-9).

n. Check/readjust T-bar cam drive travel as follows:

(1) Remove T-Bar pin to disconnect T-Bar linkage (Figure 5-2-5).

(2) Position T-bar lock to 1 inch overlap of hatch hinge arms, and adjust T-bar stop screw (Figure 5-2-8) to contact the missile tube to prevent more than 1 inch overlap of T-bar in shut position (Figure 5-2-7).

(3) Adjust unlocking contact screw head to contact the cam ramp of the actuator clevis arm. When in the proper toggled shut position, the head of the unlocking contact screw should be 1/4 inch below the corner of the cam surface (Figure 5-2-10).

NOTE

In some cases it may be necessary to grind down the flat area on the contact screw where it mates with the cam ramp to allow the bellcrank and unlocking contact screw to rotate to the position shown in Figure 5-2-10.

(4) Adjust locking contact screw to .002 to .005 inch clearance with its driving lug on the actuator clevis arm as shown in Figure 5-2-10 (unlocking screw against opening cam).

(5) While maintaining the T-bar held in the 1.000 inch overlap position (Figure 5-2-7**),** adjust linkage as necessary to reinstall T-bar pin **(**Figure 5-2-5**)**

(6) Ensure that T-bar will not rattle in the locked shut position by adjusting the T-bar stop screw to remove any looseness.

o. Open the muzzle hatch in accordance with current shipboard instructions.

p. Using a straightedge and ruler, check that T-bar lock cannot be manually pulled closer than 2 15/32 inches from the missile tube counterbore edge (Figure 5-2-6).

q. If required, adjust the tie rod length to reduce the T-bar overlap and readjust the T-bar stop screw to remove any looseness.

NOTE

If after readjusting the unlocking cam, the T-bar still can be pulled closer than 2 15/32 inches from the missile tube counterbore edge, it is permissible to adjust the tie rod length to reduce the T-bar overlap of the hinge arms in the locked position, but not less than 3/4 inch. If T-bar overlap is reduced, readjust T-bar stop screw to remove any looseness.

5-2-6.2 Operational Test.

a. Operate muzzle hatch and fairing through several cycles checking for binding, noise and smooth operation in accordance with current shipboard instructions.

b. Verify proper operation of T-bar locking mechanism using applicable MRC from MIP 7211.

c. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

5-2-7 MUZZLE HATCH AND MUZZLE HATCH OPERATING MECHANISM TEST.

NOTE

Electrical, hydraulic and Pressurization/Vent (P/V) systems must be in a station keeping line-up and all previous tagouts for repairs must be cleared.

a. Operate muzzle hatch and fairing through several cycles checking for binding, noise, and smooth operation in accordance with current shipboard instructions.

b. Ensure fairing fairness conforms to the measurements recorded prior to repair of the fairing locking mechanism.

NOTE

If a measurement was not recorded prior to repair then the fairing fairness must conform to the requirements of Reference Drawing 43.1 (Installation of Fairings) as outlined in paragraph 5-2-3.

c. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

d. Check proper operation of hatch open and CAC switches using applicable MRC from MIP 7211.

5-2-8 MUZZLE HATCH AND FAIRING GASKET TEST.

5-2-8.1 Muzzle Hatch Gasket.

a. Operate muzzle hatch and fairing through several cycles checking for binding, noise, and smooth operation in accordance with current shipboard instructions.

b. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

5-2-8.2 Fairing Gasket.

NOTE

Refer to drawing no. 704-5940680 for alignment, adjustment and testing procedures. Associated and detail drawings may be found in Table 5-6-8.

a. Operate muzzle hatch and fairing through several cycles checking for binding, noise, and smooth operation in accordance with current shipboard instructions.

b. Ensure fairing fairness conforms to the measurements recorded prior to repair of the fairing locking mechanism.

NOTE

If a measurement was not recorded prior to repair then the fairing fairness must conform to the requirements of Reference Drawing 43.1 (Installation of Fairings) and/or reference drawing 47.1 (VLS Hatch Fairing and Linkage Upgrades) as outlined in paragraph 5-2-3.

c. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211

5-2-9 MUZZLE HATCH ROTARY ACTUATOR TESTS.

Procedures for conducting hydrostatic tests (strength and porosity, and internal leakage) are provided in the following paragraphs. If the rotary actuator (Figure 5-2-11) has been completely disassembled, it should be bench tested for internal leakage. If the rotary actuator has been weld repaired, or new untested pressure boundary hardware has been installed, it should be bench tested for strength and porosity. Ensure a 7500 PSIG pressure source can be applied to the rotary actuator.

NOTE

Test fittings for the muzzle hatch rotary actuator, can be locally manufactured in accordance with NAVSEA Dwg. 6510922, 6510923, and 6510924 for ports C-1, C-2, and C-3 respectfully.

5-2-9.1 <u>Strength and Porosity Test.</u>

NOTE

The use of 2190 TEP hydraulic fluid is acceptable for testing VLS hydraulic components. However, it should be drained and flushed with 2075 T-H hydraulic fluid prior to reinstallation or applicable hydraulic fluid.

NOTE

External leakage for the below conditions shall be zero for a duration of 10 minutes of pressure applied. If leakage is found, disassemble and repair hydraulic actuator as necessary then retest.

a. With C-2 (shut-side) and C-3 (leakoff) ports open, slowly apply 7500 PSIG to C-1 (open-side) port and verify no leakage.

b. If no leakage is found, stroke actuator shut by venting the C-1 (open-side) port, and slowly applying pressure to the C-2 (shut-side) port until the actuator is in the shut position.

c. Apply 4500 PSIG to both C-1 (open-side) and C-2 (shut-side) ports simultaneously with C-3 (leakoff) port open and verify no leakage.

CAUTION

To prevent damaging actuator sleeves never pressurize C-3 (leakoff) port unless C-1 (open-side) and C-2 (shut-side) ports are pressurized to equal or greater pressure. Do not allow actuator to stroke with C-3 (leakoff) port pressurized.

d. With ports C-1 (open-side) and C-2 (shut-side) pressurized to 3000 PSIG, apply 3000 PSIG to C-3 (leakoff) port and verify no leakage.

e. If no leakage is found, strength and porosity test is complete.

f. Vent off hydraulic pressure on the C-3 (leakoff) port then vent off the C-1 (open-side) and C-2 (shut-side) ports. Replace all seals and perform internal leakage test.

5-2-9.2 Internal Leakage Test.

NOTE

The use of 2190 TEP hydraulic fluid is acceptable for testing VLS hydraulic components. However, it should be drained and flushed with 2075 T-H hydraulic fluid prior to reinstallation or applicable hydraulic fluid.

a. Cycle muzzle hatch hydraulic rotary actuator to verify proper operation of seals.

NOTE

The muzzle hatch hydraulic rotary atuator should be cycled approximately 25 times to ensure seals or properly installed prior to conducting Internal Leakage Test.

b. With C-2 (shut-side) and C-3 (leakoff) ports open, slowly apply 3000 PSIG to C-1 (open-side) port.

NOTE

To detect small leaks monitor gage for a drop in pressure.

c. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure is allowed. Observe C-2 (shut-side) port, C-3 (leakoff) port and external areas of the actuator. No leakage is allowed.

d. If pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

e. If leakage is found, disassemble and repair actuator as necessary. Repeat test.

f. If no leakage is found, stroke actuator shut by venting the C-1 (open-side) port, and slowly applying pressure to the C-2 (shut-side) port until the actuator is in the shut position.

g. Apply 3000 PSIG to C-1 (open-side) and C-2 (shut-side) ports simultaneously with C-3 (leakoff) port open.

h. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure is allowed. Observe C-3 (leakoff) port and external areas of the actuator. No leakage is allowed.

i. If pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

j. If leakage is found, disassemble and repair actuator as necessary. Repeat test.

CAUTION

To prevent damaging actuator sleeves never pressurize C-3 (leakoff) port unless C-1 (open-side) and C-2 (shut-side) ports are pressurized to equal or greater pressure. Do not allow actuator to stroke with C-3 (leakoff) port pressurized.

k. With C-1 (open-side) and C-2 (shut-side) pressurized to 3000 PSIG, slowly apply 3000 PSIG to C-3 (leakoff) port.

l. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure or leakage is allowed.

m. If pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

n. If leakage is found, disassemble and repair actuator as necessary. Repeat test.

o. If no leakage and/or pressure drop is found, test is complete.

p. Vent off hydraulic pressure on C-3 (leakoff) port then vent off the C-1 (open-side) and C-2 (shut-side) ports.

NOTE

Actuator must be in the open position for installation.

q. With C-2 (shut-side) and C-3 (leakoff) ports open, slowly pressurize the C-1 (open-side) port until the actuator is in the open position.

5-2-9.3 Case Vent Leakoff Tightness Test.

Refer to paragraph 5-2-5.3 for Case Vent Leakoff Tightness Test.

5-2-9.4 Operational Test.

NOTE

Refer to Reference Drawing 15.1 (Missile Tube Muzzle Hatch Hydraulic Rotary Actuator Assembly and Detail) for alignment, adjustment and testing procedures. Associated and detail drawings may be found in Table 5-6-9.

a. Cycle VLS hydraulic system fluid using applicable MRC from MIP 7211.

b. Operate muzzle hatch and fairing through several cycles checking for binding, noise, and smooth operation in accordance with current shipboard instructions.

c. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

d. Check proper operation of hatch open and ITL/CAC switches using applicable MRC from MIP 7211.

5-2-9.5 Actuator Check Valve Leak Test.

NOTE

If muzzle hatch (SSN 719 and 720) or muzzle hatch and fairing locking mechanism (SSN 721 and Later) move while the muzzle hatch is open and hatch close valve HMLP(S)-(*)-25 is shut, the probable cause is an internal check valve leaking in either the hatch actuator (SSN 719 and 720) or the hatch actuator and fairing lock hydraulic cylinder (SSN 721 and Later).

NOTE

(*) Indicates tube under test.

a. Open muzzle hatch in accordance with current shipboard instructions.

b. Verify hatch close valve HMLP(S)-(*)-25 shut.

c. Verify muzzle hatch gagging pin is installed.

d. Wait 15 minutes then attempt to rotate gagging pin utilizing gagging pin handle.

e. If gagging pin can be rotated, actuator check valve leak test is complete.

f. If gagging pin cannot be rotated, shut muzzle hatch in accordance with current shipboard instructions.

g. Cycle VLS hydraulic system fluid using applicable MRC from MIP 7211.

h. Open muzzle hatch in accordance with current shipboard instructions.

i. Verify hatch close valve HMLP(S)-(*)-25 shut.

j. Verify muzzle hatch gagging pin is installed.

k. Wait 15 minutes then attempt to rotate muzzle hatch gagging pin utilizing gagging pin handle.

l. If movement of the muzzle hatch or fairing locking mechanism occurred, refer to CHAPTER 4, paragraph 5-4-5.2.

m. If movement of the muzzle hatch or fairing locking mechanism did not occur, the actuator check valve leakage test is complete.

n. Shut hatch in accordance with current shipboard instructions.

5-2-10 ENVIRONMENTAL MONITORING SENSOR ASSEMBLY TEST.

a. Test environmental monitoring sensor using applicable MRC of MIP 7211.

NOTE

Conduct a bubble test of the EMS penetrator while performing the appropriate tightness test.

b. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC of MIP 7211.

5-2-11 MISSILE TUBE PENETRATOR ASSEMBLY TEST.

a. Perform VLS Weapon Control Cable Confidence Test using applicable MRC of MIP J-001/900 (SSN 719-725 & 750) or 4630/901 (SSN 751 & Later).

NOTE

Conduct a bubble test of the Missile Tube Penetrator while performing the appropriate tightness test.

b. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC of MIP 7211.

5-2-12 DIFFERENTIAL PRESSURE TRANSDUCER ASSEMBLY TEST.

a. Verify operation of differential pressure transducer using applicable MRC of MIP 7211.

NOTE

Conduct a bubble test of the D/P sensing line connections while performing the appropriate tightness test.

b. Conduct Missile Tube Tightness or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

5-2-13 HATCH & FLOOD/DRAIN VALVE CONTROL VALVE HMLP(S)-(*)-22 TEST.

5-2-13.1 <u>Operational Test.</u>

NOTE

Observe leakage at mechanical joints and connections while performing this test

a. Cycle VLS hydraulic system fluid using applicable MRC from MIP 7211. Refer to Figure 5-2-12.

b. Measure muzzle hatch and flood/drain valve cycle time and verify proper operation using applicable MRC from MIP 7211.

NOTE

If cycle time is unsatisfactory, refer to paragraph 5-2-13.2 for adjustment procedures.

5-2-13.2 Hatch & Flood/Drain Valve Flow Restrictor Adjustments.

NOTE

The stroke of the control valve is not adjustable. Flow through the valve is adjusted by the setting of the flow restrictor of the corresponding adjuster.

a. Remove cover from end cap as applicable. Refer to Figure 5-2-13.

NOTE

The forward flow restrictor (forward cover) is for missile tube muzzle hatch adjustment and the aft flow restrictor (aft cover) is for flood/drain valve adjustment.

NOTE

The component to be adjusted should be opened to relieve hydraulic pressure from the adjustor before adjustment is attempted.

b. Loosen locknut and adjust travel of flow restrictor (slide/sleeve matched set) using a flat-tip screwdriver to turn the threaded shaft of the flow restrictor (slide/sleeve matched set) clockwise to decrease flow rate or counterclockwise to increase flow rate.

c. When adjustment is within specifications, tighten locknut while holding threaded shaft of flow restrictor (slide/sleeve matched set) with a flat-tip screwdriver.

d. Measure muzzle hatch and flood/drain valve timing and verify proper operation using applicable MRC from MIP 7211.

e. Reinstall cover.

5-2-14 FLOOD/DRAIN VALVE MFD-(*)-6 ROTARY ACTUATOR TESTS.

Procedures for conducting hydrostatic tests (strength and porosity, and internal leakage) are provided in the following paragraphs. If the flood/drain valve actuator (Figure 5-2-14), has been completely disassembled, it should be bench tested for internal leakage. If the valve rotary actuator has been weld repaired, or new untested pressure boundary hardware has been installed, it should be bench tested for strength and porosity. Ensure that a 7500 PSIG pressure source can be applied to the hydraulic actuator.

NOTE

Test fittings for the fairing lock hydraulic cylinder can be locally manufactured by modifying flange 1, 3 and 11 of Reference Drawing 45.1 with the appropriate connection to match Hydro test unit.

5-2-14.1 Strength and Porosity Test.

NOTE

The use of 2190 TEP hydraulic fluid is acceptable for testing VLS hydraulic components. However, it should be drained and flushed with 2075 T-H hydraulic fluid prior to reinstallation or applicable hydraulic fluid.

NOTE

External leakage for the below conditions shall be zero for a duration of 10 minutes of pressure applied. If leakage is found, disassemble and repair hydraulic actuator as necessary then retest.

a. With C-2 (shut-side) and C-3 (leakoff) ports open, slowly apply 7500 PSIG to C-1 (open-side) port and verify no leakage.

b. If no leakage is found, stroke actuator shut by venting the C-1 (open-side) port, and slowly applying pressure to the C-2 (shut-side) port until the actuator is in the shut position.

c. Apply 4500 PSIG to both C-1 (open-side) and C-2 (shut-side) ports simultaneously with C-3 (leakoff) port open and verify no leakage.

d. With ports C-1 (open-side) and C-2 (shut-side) pressurized to 3000 PSIG, apply 3000 PSIG to C-3 (leakoff) port and verify no leakage.

e. If no leakage is found, strength and porosity test is complete.

f. Vent off hydraulic pressure on the C-3 (leakoff) port then vent off the C-1 (open-side) and C-2 (shut-side) ports. Replace all seals and perform internal leakage test.

5-2-14.2 <u>Internal Leakage Test.</u>

NOTE

The use of 2190 TEP hydraulic fluid is acceptable for testing VLS hydraulic components. However, it should be drained and flushed with 2075 T-H hydraulic fluid prior to reinstallation or applicable hydraulic fluid.

a. Cycle flood/drain valve hydraulic rotary actuator to verify proper operation of seals.

NOTE

The flood/drain valve hydraulic rotary actuator should be cycled approximately 25 times to ensure seals or properly installed prior to conducting Internal Leakage Test.

b. With C-2 (shut-side) and C-3 (leakoff) ports open, slowly apply 3000 PSIG to C-1 (open-side) port.

NOTE

To detect small leaks monitor gage for a drop in pressure.

c. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure is allowed. Observe C-2 (shut-side) port, C-3 (leakoff) port and external areas of the actuator. No leakage is allowed.

d. If the pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

e. If leakage is found, disassemble and repair actuator as necessary. Repeat test.

f. If no leakage is found, stroke actuator shut by venting the C-1 (open-side) port and slowly applying pressure to the C-2 (shut-side) port until the actuator is in the shut position.

g. Apply 3000 PSIG to C-1 (open-side) and C-2 (shut-side) ports simultaneously with C-3 (leakoff) port open.

h. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure is allowed. Observe C-3 (leakoff) port and external areas of the actuator. No leakage is allowed.

i. If the pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

j. If leakage is found, disassemble and repair actuator as necessary. Repeat test.

k. With C-1 (open-side) and C-2 (shut-side) already pressurized to 3000 PSIG, slowly apply 3000 PSIG to C-3 (leakoff) port.

l. Isolate hydraulic pressure source and monitor gage for 30 minutes. No drop in pressure or leakage is allowed.

m. If the pressure drops with no visible sign of leakage, repressurize until pressure stabilizes or leakage is found.

n. If leakage is found, disassemble and repair actuator as necessary. Repeat test.

o. If no leakage and/or pressure drop is found, test is complete.

p. Vent off hydraulic pressure on the C-3 (leak-off) port then vent off the C-1 (open-side) and C-2 (shut-side) ports.

5-2-14.3 Case Vent Leakoff Tightness Test.

Refer to paragraph 5-2-5.3 for Case Vent Leakoff Tightness Test.

5-2-14.4 Operational Test.

a. Cycle VLS hydraulic system fluid using applicable MRC from MIP 7211.

b. Operate flood/drain valve through several cycles checking for binding, noise, and smooth operation in accordance with current shipboard instructions.

c. Conduct Missile Tube Tightness Test or Underhatch Tightness Test as required using applicable MRC from MIP 7211.

5-2-15 PRESSURIZATION/VENT CONTROL VALVE APV-(*)-1 TEST.

NOTE

The following test is not intended for use during in-service testing.

The P/V control valve test is required after either "in-place" maintenance or removal and reinstallation of entire valve.

CAUTION

If the missile tube contains an AUR/AURVS, monitor the differential pressure meter. If an increase in differential pressure occurs, vent missile tube.

5-2-15.1 Tightness Test.

a. Open the 700 PSI supply to P/V system APV-10 (APV-11).

NOTE

( ) Indicates valves in starboard tube bank.
(*) Indicates tube under test.

b. Verify that hull stop Isln APV-(*)-2 is shut.

c. Open P/V isolation valve APV-(*)-3.

NOTE

If the tube is loaded with an AUR/AURVS, monitor for capsule increase in pressure in the advent of a leaking hull stop APV-(*)-2.

d. Manually override P/V control valve APV-(*)-1 using PRESSURIZE manual override button until airflow equalizes in valve and against hull stop Isln APV-(*)-2.

e. Using a leak test solution, check P/V control valve APV-(*)-1 for any air leaks.

f. If leakage is found, disassemble P/V Control Valve APV-(*)-1 and repair/retest as necessary.

g. If no leaks are noted after a 5 minute hold time, test is complete.

h. Vent pressure between P/V control valve APV-(*)-1 and hull stop Isln APV-(*)-2 by depressing P/V control valve APV-(*)-1 VENT manual override button until air is no longer heard escaping from disc assembly.

5-2-15.2 Operational Test.

a. Verify the MONITOR/OPERATE keyswitch on the MTCP or the INIT/MONITOR/ OPERATE keyswitch on the TCP is in MONITOR.

b. Verify PVC Mode switch is in MAN on the MTCP or MAN VENT on the TCP.

c. Verify that hull stop Isln APV-(*)-2 is SHUT.

d. Place the MONITOR/OPERATE keyswitch on the MTCP or the INIT/MONITOR/ OPERATE keyswitch on the TCP to OPERATE.

e. Momentarily place PVC Mode switch to AUTO. When P/V control valve APV-(*)-1 starts to pressurize, shift the PVC Mode switch to MAN on MTCP to MAN VENT on the TCP. P/V control valve APV-(*)-1 will vent.

f. If P/V control valve APV-(*)-1 responded properly, the operational test is complete.

g. If leakage or unsatisfactory operation is found, troubleshoot and /or disassemble P/V control valve and repair or replace components. Repeat test.

5-2-16 PRESSURIZATION/VENT HULL STOP ISOLATION VALVE APV-(*)-2 TEST.

NOTE

( ) Indicates valves in starboard tube bank.
(*) Indicates tube under test.

NOTE

The missile tube must be empty prior to the performance of this procedure.

5-2-16.1 Tightness Test.

a. Line-up electrical and P/V systems to station keeping line-up per Reference 9 (SSN688 Class SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A VLS Support Systems Operation).

b. Open P/V drain APV-(*)-4.

c. Unlock and open hull stop Isln APV-(*)-2.

d. Open muzzle hatch in accordance with current shipboard instructions.

e. Install/verify installed P/V port plug.

f. Shut P/V drain APV-(*)-4.

g. Slowly open P/V Isln APV-(*)-3.

h. Manually override P/V control valve APV-(*)-1 using PRESSURIZE manual override button until pressure equalizes and pressurization stops.

i. Shut hull stop Isln APV-(*)-2.

j. Manually override P/V control valve APV-(*)-1 using VENT manual override button until venting stops.

k. Slowly open P/V drain APV-(*)-4 and listen for air escaping from the drain.

l. If no air is escaping, attach one end of a piece of Tygon Tubing to P/V drain APV-(*)-4. Place the other end in a container of water.

m. Monitor Tygon Tubing in water for air leaks for 10 minutes. No leakage is allowed.

n. Shut P/V drain APV-(*)-4 and remove Tygon Tubing.

o. Slowly open hull stop Isln APV-(*)-2.

p. Manually override P/V control valve APV-(*)-1 using VENT manual override button until venting stops.

q. Open P/V drain APV-(*)-4.

NOTE

A P/V port plug locally modified using Drawing # 6510970 will be required. See Figure 5-2-15.

r. Remove P/V port plug and install modified P/V port plug (Figure 5-2-15).

s. Shut hull stop Isln APV-(*)-2.

t. Shut P/V drain APV-(*)-4.

u. Manually override P/V control valve APV-(*)-1 using PRESSURIZE manual override button until pressure equalizes and pressurization stops.

v. Monitor the opening in the modified P/V port plug for the sound of air escaping.

w. If no air is escaping, attach one end of a piece of Tygon Tubing to the modified P/V port plug. Place the other end in a container of water.

x. Monitor Tygon Tubing in water for air leaks for 10 minutes. No leakage is allowed.

y. Manually press the VENT manual override button on APV-(*)-1 until venting stops.

(1) Remove Tygon Tubing from water and install Low Pressure Gage onto modified P/V Port Plug.

(2) Attach hose between ALP-391 and APV-(*)-14 then open APV-(*)-2 and ALP-391 then slowly open APV-(*)-14 and pressurize the APV piping to 9 PSI shut APV-(*)-14, APV-(*)-2 and ALP-391 when gage reads 9 PSI.

(3) Monitor gage for 10 minutes zero leakage allowed.

(4) Open APV-(*)-2, APV-(*)-14 and ALP-391, then slowly open APV-(*)-4 to vent APV piping and verify gage reads zero and remove hose and stow.

z. Remove modified P/V port plug.

aa. Install P/V filter or P/V port plug as required.

ab. Lock keylock switch on hull stop Isln APV-(*)-2.

ac. Restore systems to station keeping line-up in accordance with Reference 9.

5-2-16.2 <u>Operational Test.</u>

a. Shut hull stop Isln APV-(*)-2.

b. Lock keylock switch on hull stop Isln APV-(*)-2.

c. Attempt to open hull stop Isln APV-(*)-2. It should not open.

d. Unlock keylock switch on hull stop APV-(*)-2.

e. Open hull stop Isln APV-(*)-2. Operate hull stop Isln APV-(*)-2 through several cycles and check for binding, noise and smooth operation.

f. If no problems are noted, test is complete.

5-2-17 MAGNETIC SWITCH AND MICROSWITCH TESTS.

5-2-17.1 <u>General Description of Switch Types.</u>

Microswitches (Figure 5-2-16) are a barrel-type push-button design. When the microswitch is activated a signal is transmitted to the MTCP or TCP. A microswitch is used on the hatch & flood/drain valve control valve for the hatch blocked indication. Microswitches are also used on the equalization hull and backup valves, manual flood and drain isolation valves flood/drain header backup valves, and drain isolation valves.

Magnetic switches (Figure 5-2-17) are a ruggedized assembly, which consists of a water tight, pressure-proof enclosure, containing two magnetic proximity dual reed-type switches. Magnetic switches are used to indicate the muzzle hatch or Flood/Drain Valve position.

The Hatch Open and CAC switches are each wired in parallel to increase reliability. The hatch open switch provides a visual hatch open indication at the MTCP or TCP. The CAC switch acts as an interlock feature with the Combat and Control System (SSN 719-725 and 750) or Command Control/Acoustics (SSN 751 and Later) to ensure that the hatch is fully opened and clear of the missile tube launch cone (Figure 5-2-18) before the CAC signals are transmitted to the missile. The condition and alignment of these switches must be checked in accordance with applicable MRC of MIP 7211. If these switches require readjustment, refer to paragraph 5-2-17.2.

The hatch shut switch provides a visual hatch shut indication at the MTCP or TCP. For SSN 721 and Later the fairing locking mechanism also is required for the hatch shut indication. The new ruggedized hatch shut switch no longer has the 7K-Ohm resister installed and will replace the existing hatch shut switch by natural attrition.

The flood/drain switch provides a visual indication at the MTCP or TCP. The switch assembly is mounted in an enclosure above the valve stem; the two magnets are housed in a magnet holder mounted on the valve stem (Figure 5-2-14). Rotation of the valve stem, aligns the appropriate magnet with a reed switch within the switch assembly to generate the valve position indication.

5-2-17.2 Adjustment Procedures.

Microswitches are adjusted by loosening two jam nuts on the body of the switch and physically moving the switch body either toward or away from the contact point on the valve (Figure 5-2-16).

NOTE

Flood/drain valve magnetic switch assemblies are located in the bath tub area on SSN 719 and 720. However, on SSN 721 and later, access to MBT #2 (A/B) is required to make switch adjustments.

NOTE

For SSN 721 and later, the hatch shut and fairing locking mechanism switches both must be actuated to achieve hatch shut indication.

a. For muzzle hatch open and CAC switches, verify that the hatch is fully open by ensuring that the hatch fully open scribe mark on the pillow block aligns with the scribe mark on the torque shaft. Refer to Figure 5-2-18.

b. Clean all foreign matter from the exposed faces and groove of the magnets.

c. Inspect magnets for cracks and excessive corrosion. Replace if required.

NOTE

The polarity of the magnet is crucial to the operation of the magnetic switch. The magnet poles must be perpendicular to the lines on the switch surface (Figure 5-2-17). Magnets for flood/drain valves should be installed so that the adjacent poles repel (Figure 5-2-14). This will reduce the possibility of duel indications.

d. Verify proper orientation of magnets on switch housing. Ensure mounting is secure.

e. Attempt to actuate the magnetic switch using spare magnets while monitoring indications at MTCP/TCP. If proper indications can not be obtained, refer to CHAPTER 4 for further troubleshooting.

NOTE

Adjustment of the air gap will vary from component to component. The flood/drain valve switch requires shims to move the switch closer to or further from the magnets. The hatch open and CAC switch bracket bolt holes may be elongated to allow movement of the switches. (If the hatch open/CAC magnets require repositioning the magnet bracket tack welds to the hatch arm will have to be cut to adjust magnet bracket. However the bracket may be tack welded and the magnet arms may be bent causing excessive gap. The locking bar switch adjustment is accomplished by adding or removing shims.

NOTE

If the bracket welds are broken for any reason they must be welded in accordance with NAVSEA Dwg #704-5795318 (SSN 721 & Later).

CAUTION

To prevent damage to the magnetic switch, ensure magnet does not contact switch. Nominal air gap is 1/4 inch.

f. Adjust air gap as required to obtain proper indications.

WARNING

Personnel shall keep hands and tools clear of valve and switch while valve is in operation.

g. Operate hatch or valve through several cycles to verify proper indications.

h. Coat the magnet and fill the groove with a light coat of water wash resistant grease (CID A-A-50433).

5-2-18 MISSILE TUBE CONTROL CABLE TEST.

Refer to applicable Reference drawing for testing procedures.

NOTE

Retest after completion of Deep Dive to verify integrity of the cable and connections.

a. Test environmental monitoring sensor and differential pressure transducer using applicable MRC from MIP 7211.

b. Cycle controls, switches, valves and hydraulic actuators from the MTCP or TCP using applicable MRC from MIP 7211

5-2-19 WEAPON CONTROL CABLE TEST.

Refer to applicable Reference drawing for testing procedures.

NOTE

Retest after completion of Deep Dive to verify integrity of the cable and connections.

a. Conduct cable confidence test using applicable MRC from MIP J001-R-54 (CCS MK1) or 4630 (AN/BSY-1).

5-2-20 MISSILE TUBE PREECE FITTING TEST.

5-2-20.1 Tightness Test

Refer to Figure 5-2-19 for testing arrangement.

a. Open muzzle hatch in accordance with current shipboard instructions.

b. If missile tube is loaded with an AUR/AURS, verify missile is vented and P/V system is secured and in station keeping line-up per Reference 9 (SSN688 Class SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A VLS Support Systems Operation).

CAUTION

Damage to the AUR/AURS may be caused if the P/V System is not secured.

c. After verifying missile is vented, disconnect the pressure sensing line from the missile tube preece fitting.

d. Connect pressure calibration unit hose with pressure sensing adapter to preece fitting in missile tube.

e. Slowly pressurize calibrator unit until calibrator reads 020.00 psig.

f. Apply leak-tech solution to preece fitting and quick disconnect and monitor for leaks. No leakage is allowed.

g. Repeat steps 5-2-20.1e. and 5-2-20.1f. for 40, 60, 80 and 100 psig.

h. Vent calibrator unit and disconnect pressure calibrator unit from missile tube preece fitting and stow unit.

i. Install quick disconnect pressure cap.

5-2-20.2 <u>Operational Test</u>

Check operation of differential pressure transducer using applicable MRC of MIP 7211.

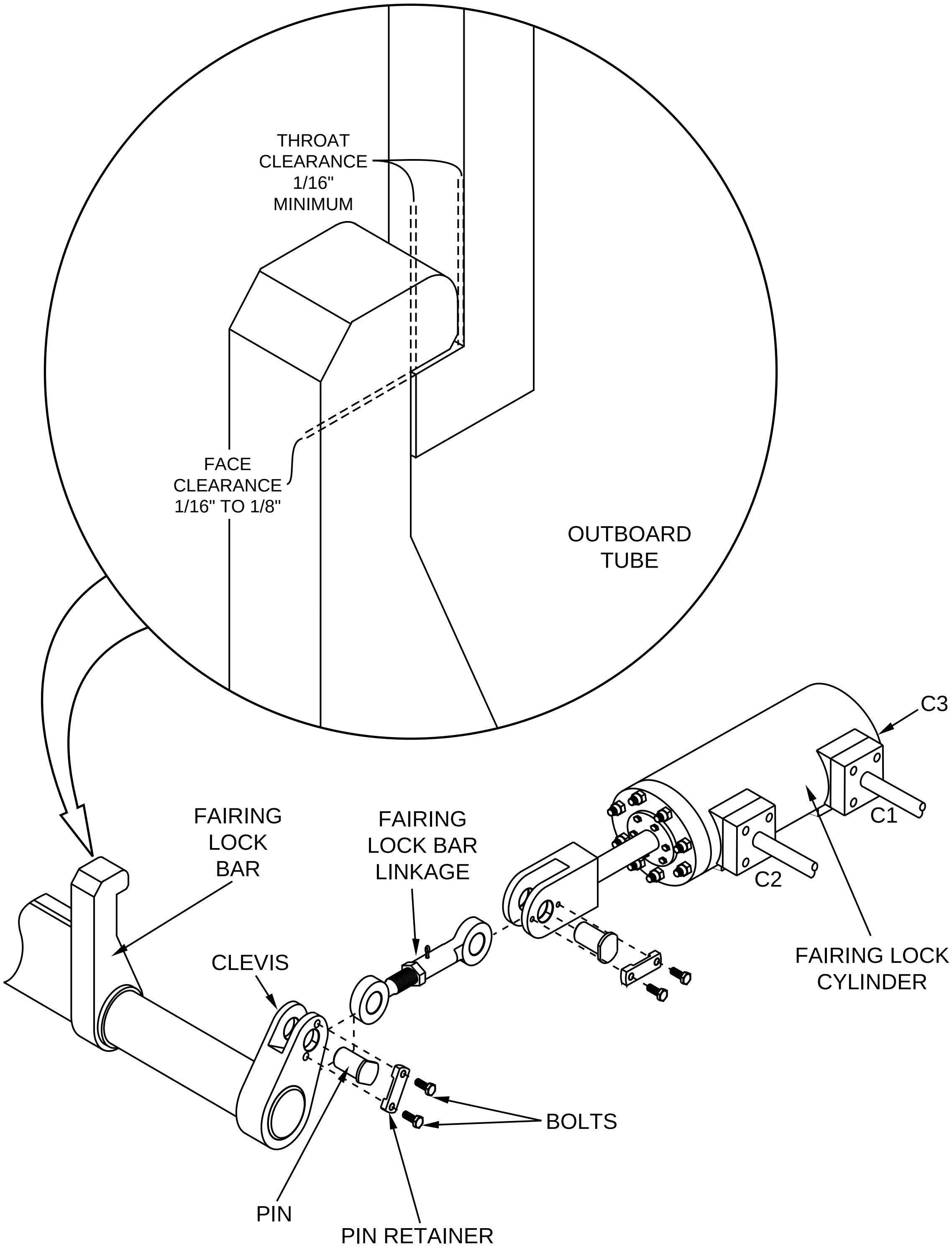


Figure 5-2-1 Fairing Locking Mechanism (Typical)

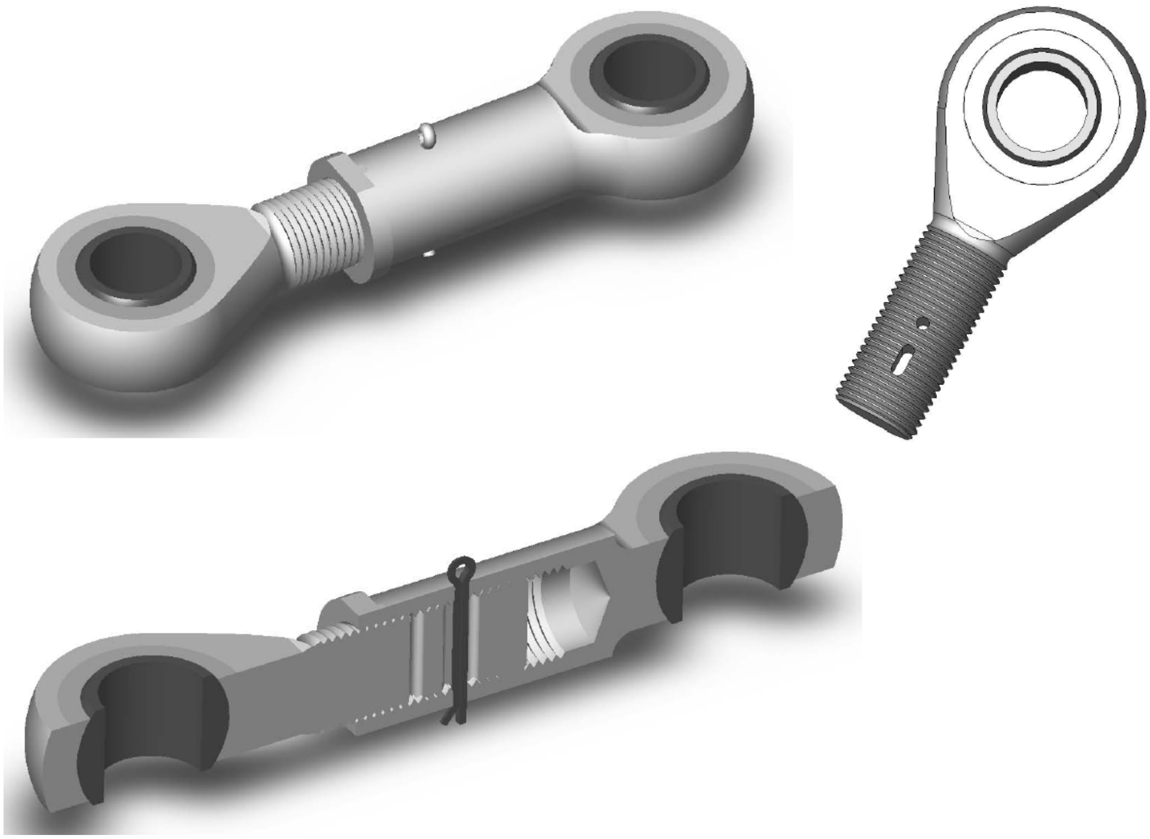


Figure 5-2-2 Fairing Lock Bar Connecting Linkage

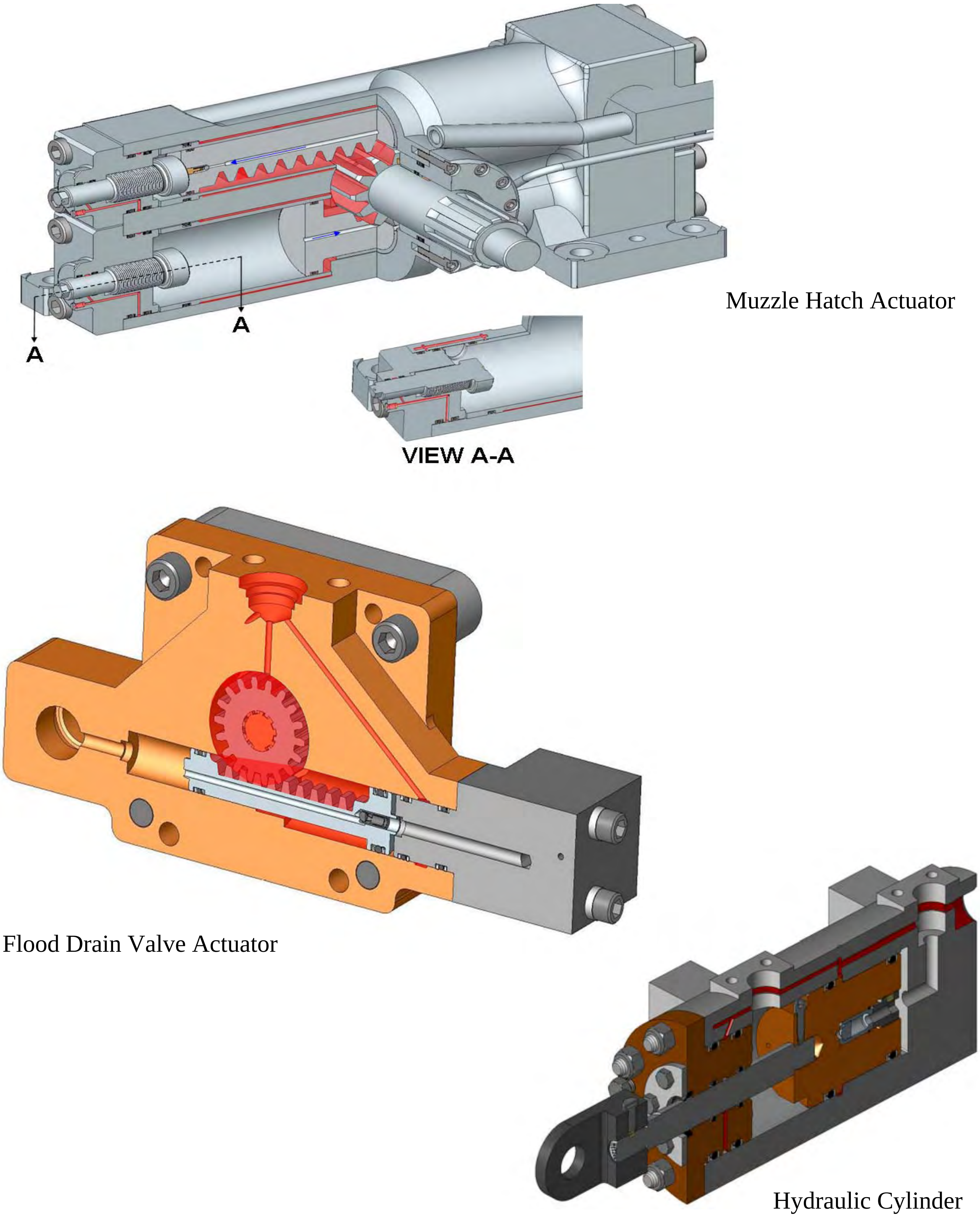


Figure 5-2-3 Outboard Components C-3 Leakoff Paths

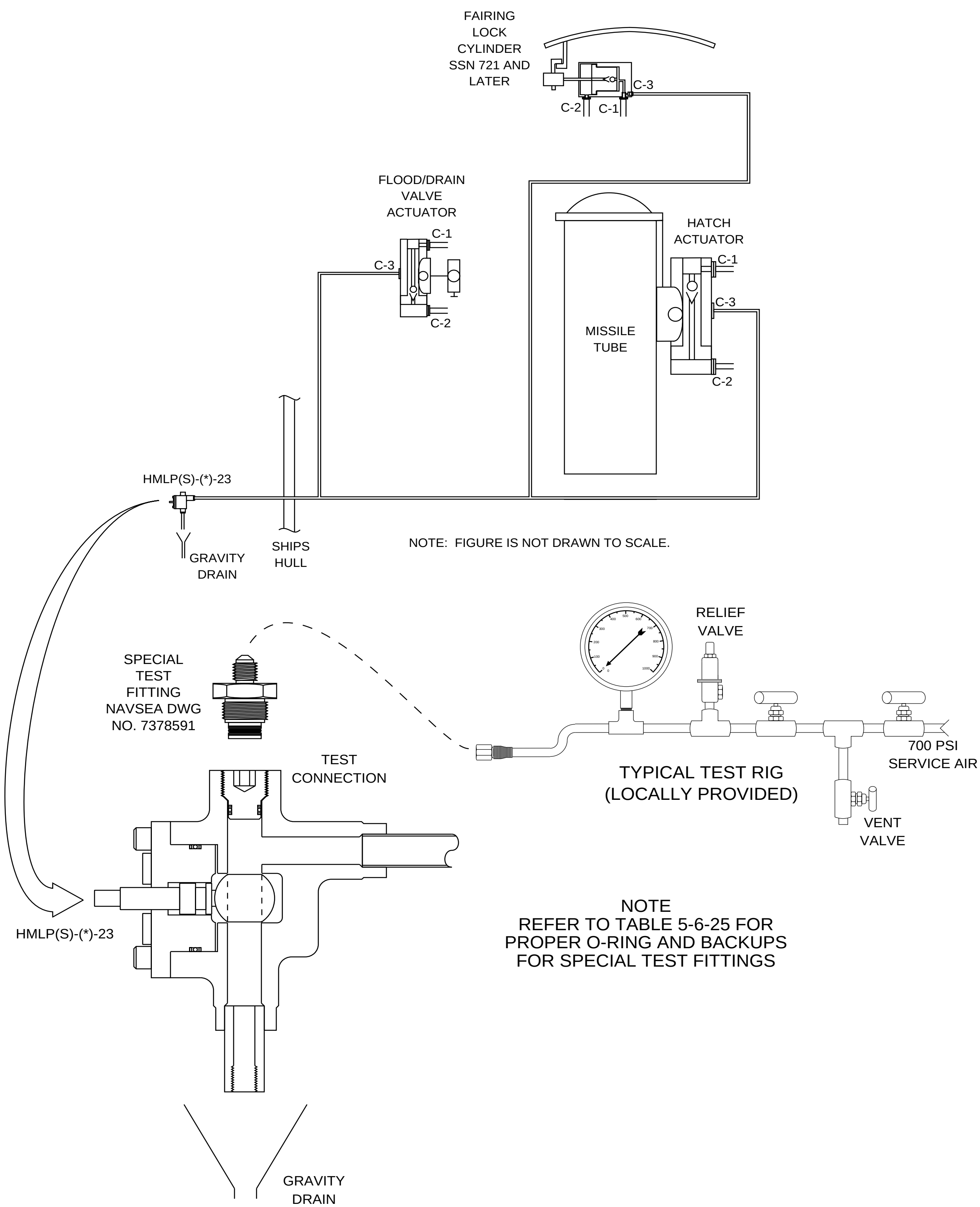


Figure 5-2-4 Case Vent Leakoff Test

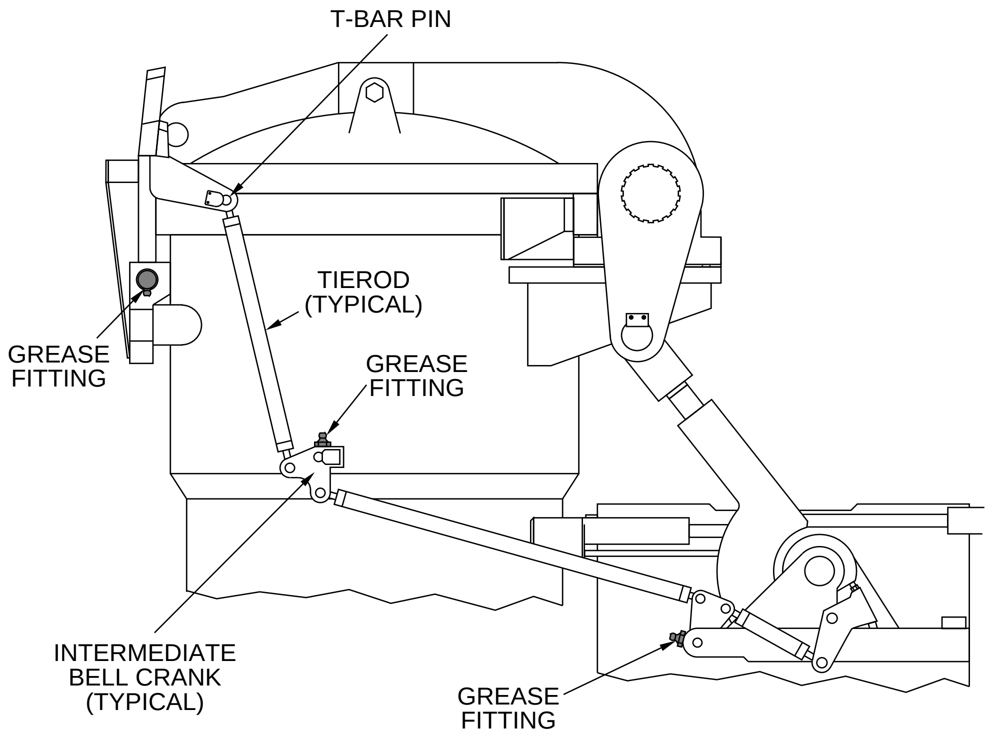


Figure 5-2-5 T-Bar Linkage

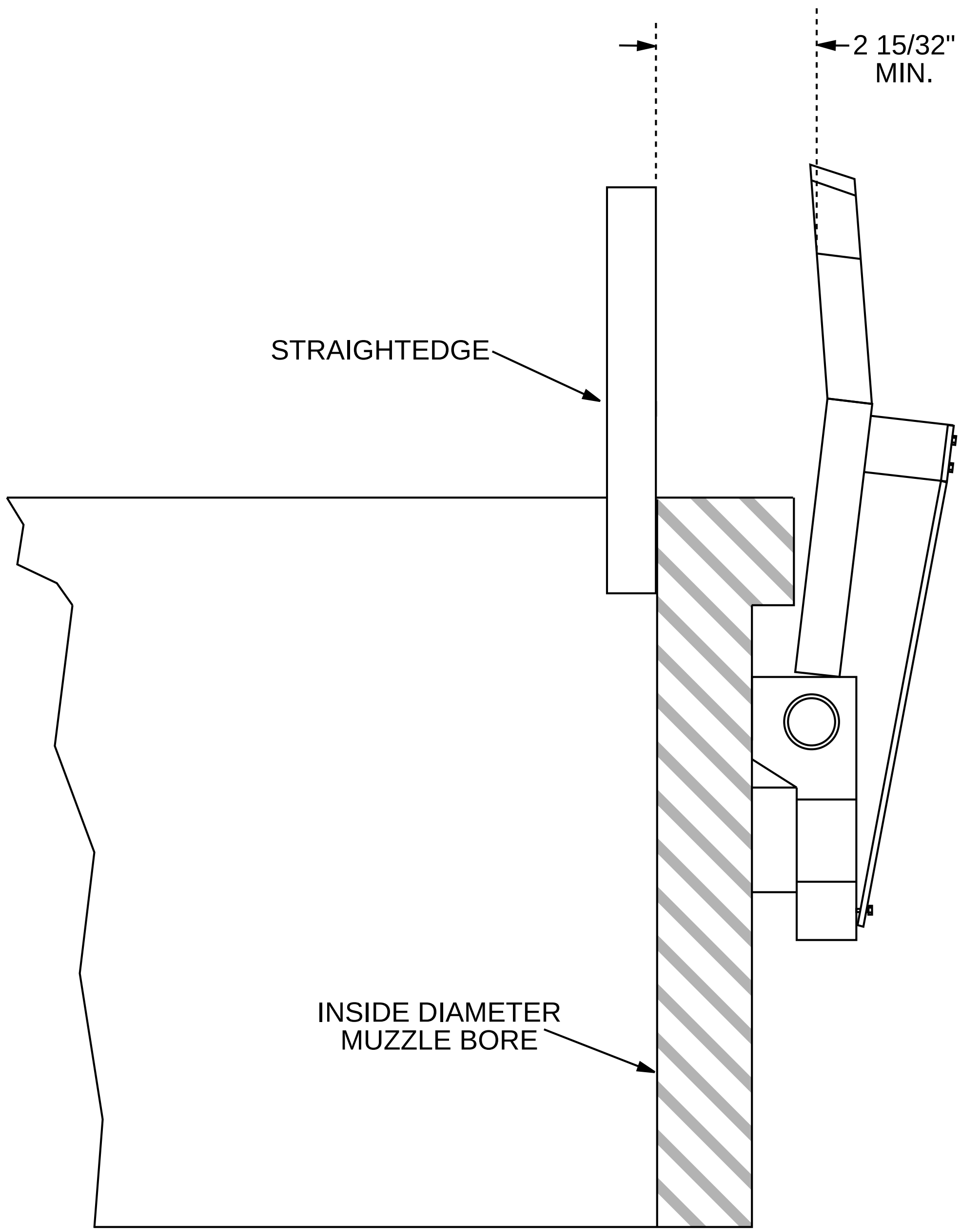


Figure 5-2-6 T-Bar Measurement

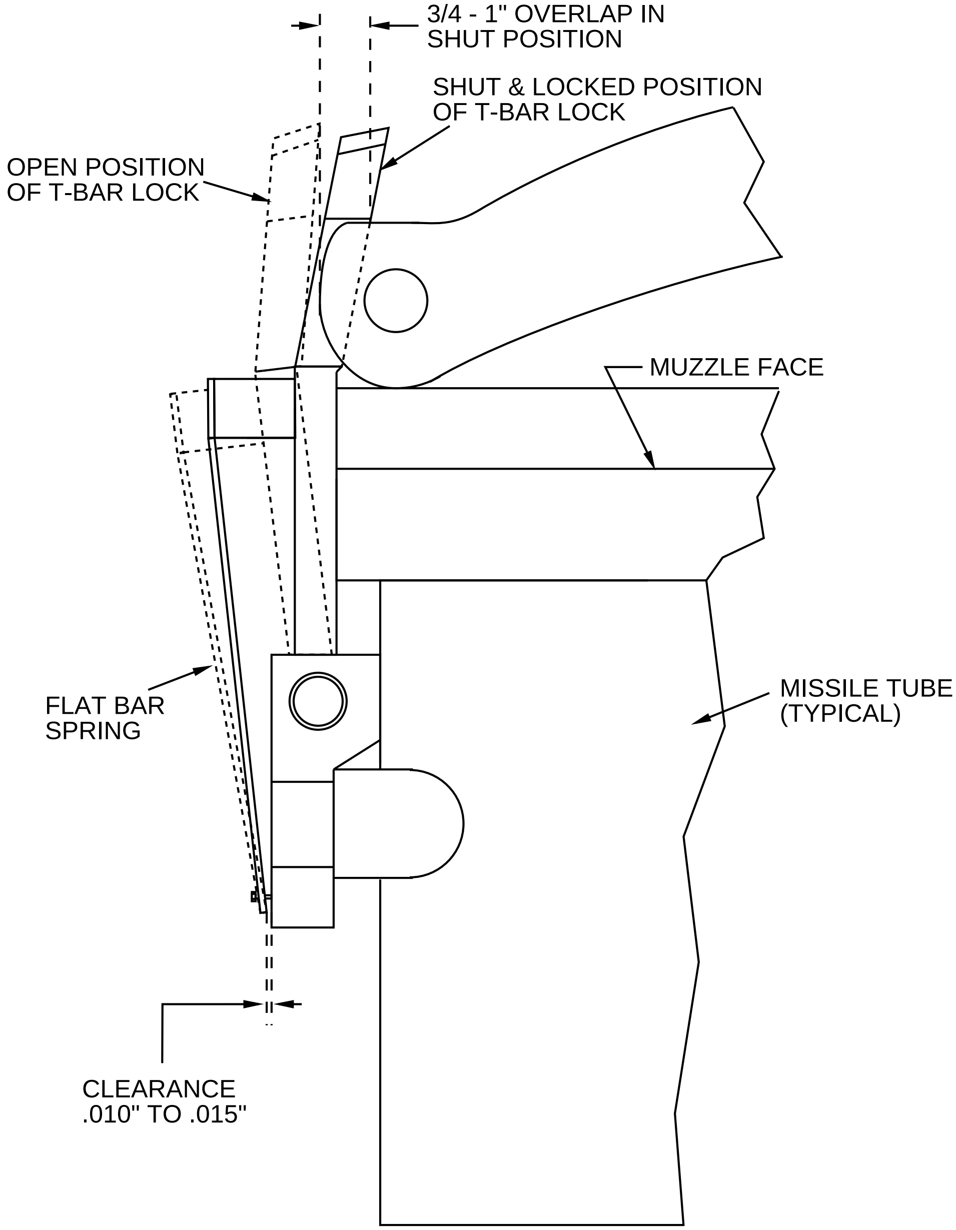


Figure 5-2-7 T-Bar Overlap

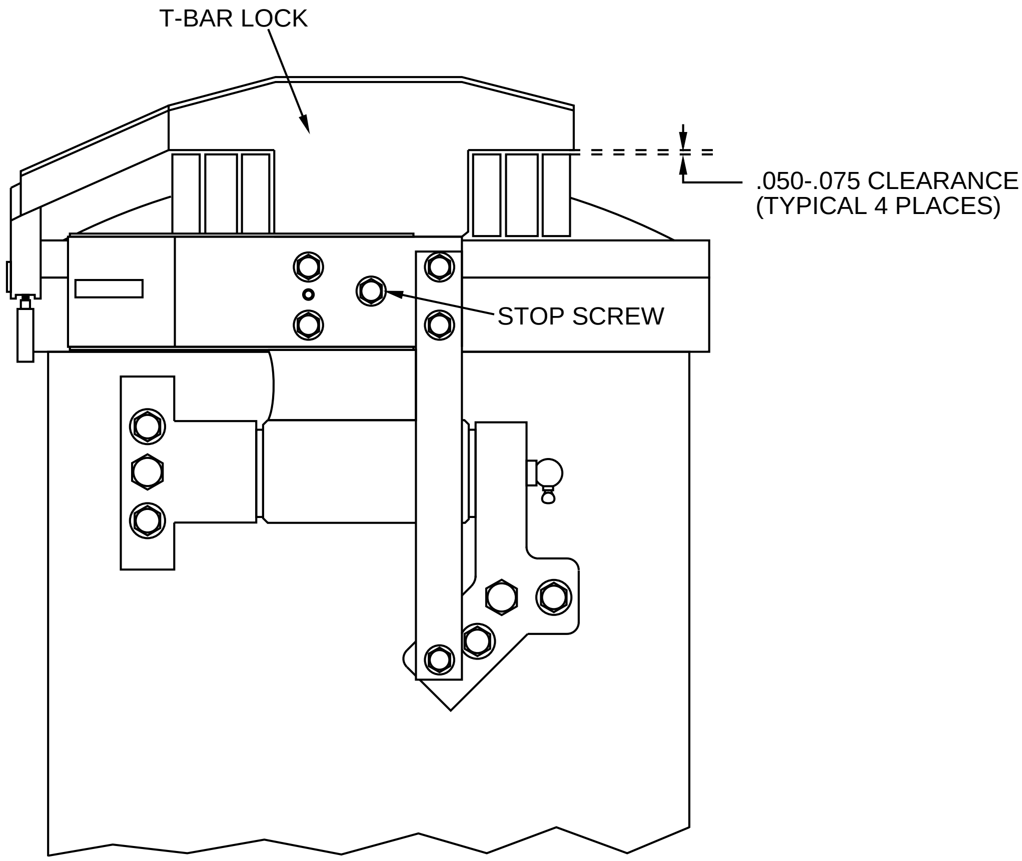


Figure 5-2-8 T-Bar Clearance

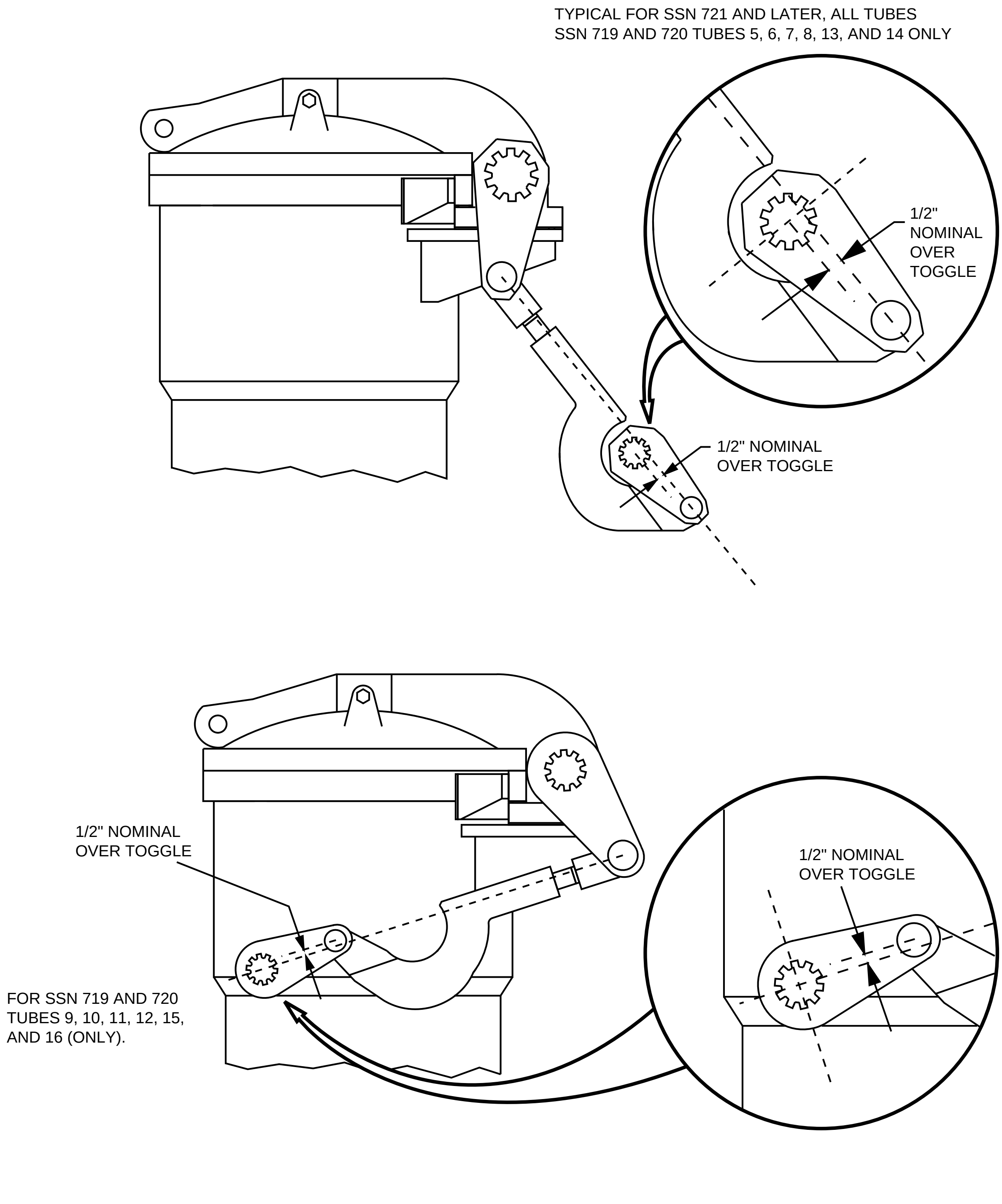


Figure 5-2-9 Muzzle Hatch Linkage

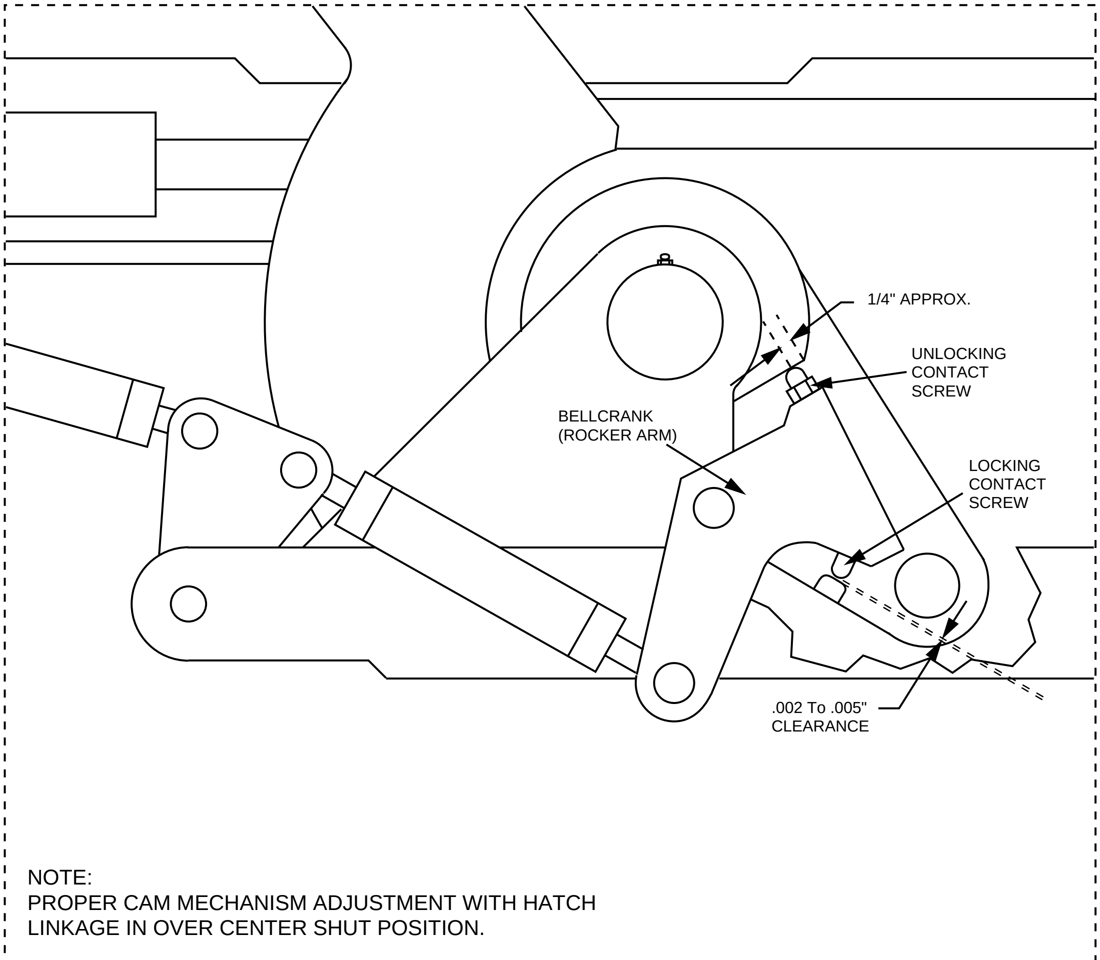


Figure 5-2-10 Linkage Contact Screws

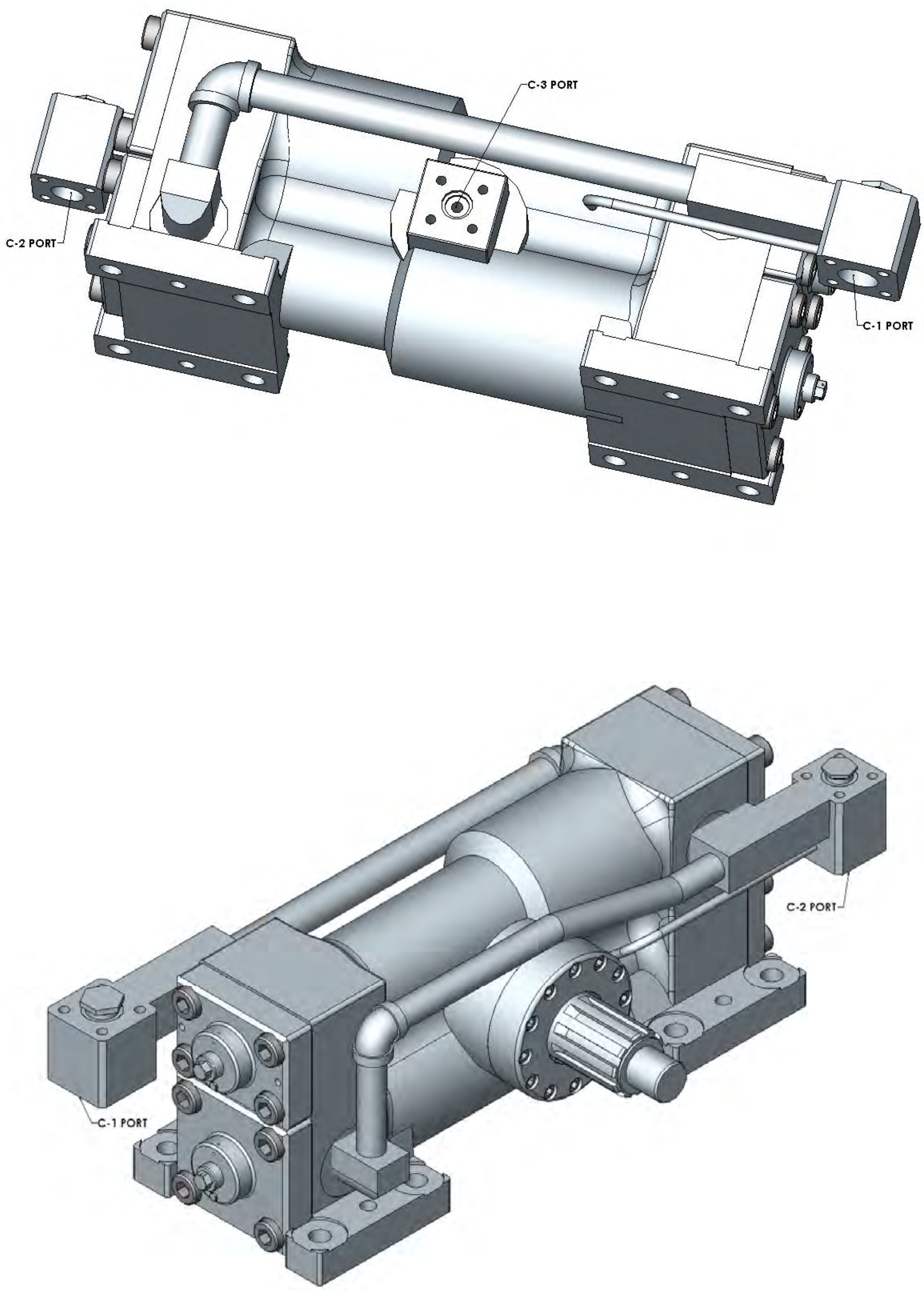


Figure 5-2-11 Muzzle Hatch Hydraulic Rotary Actuator

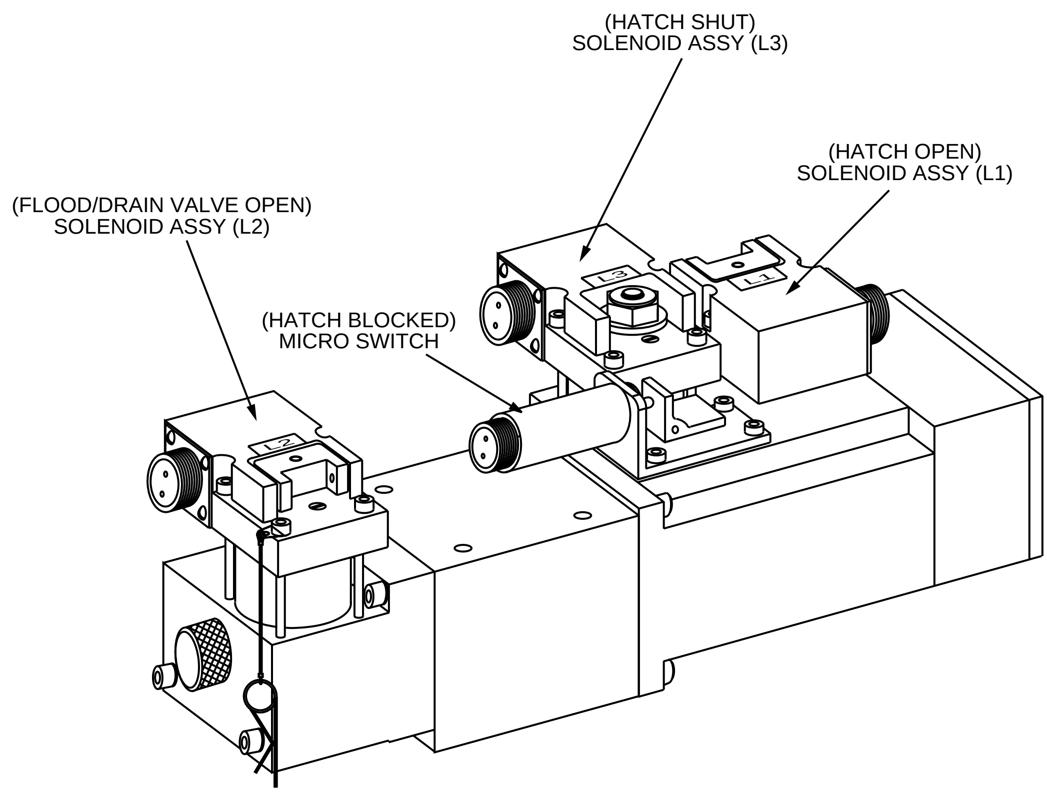


Figure 5-2-12 Hatch & Flood/Drain Valve Control Valve

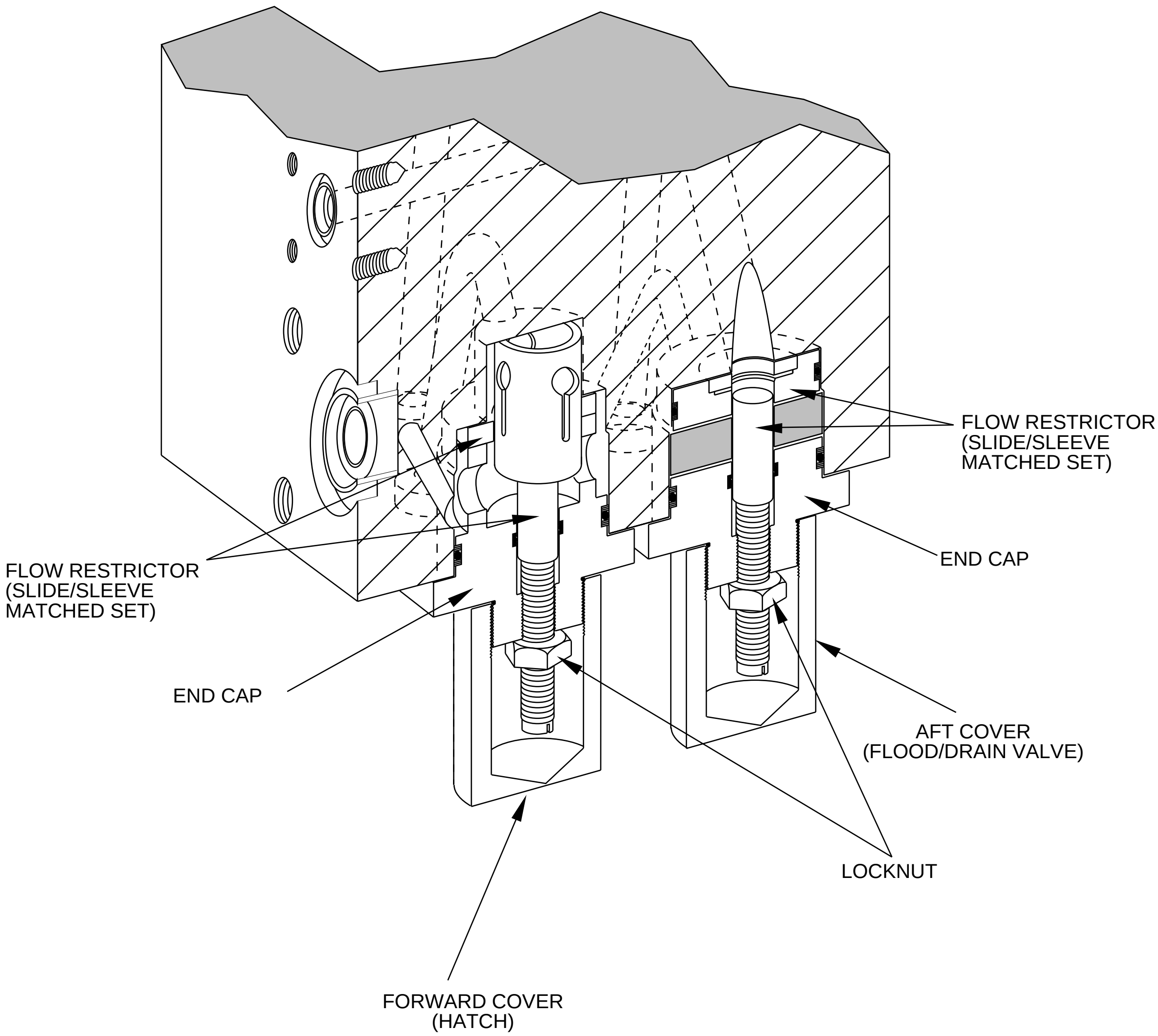


Figure 5-2-13 Hatch & Flood/Drain Valve Adjustor

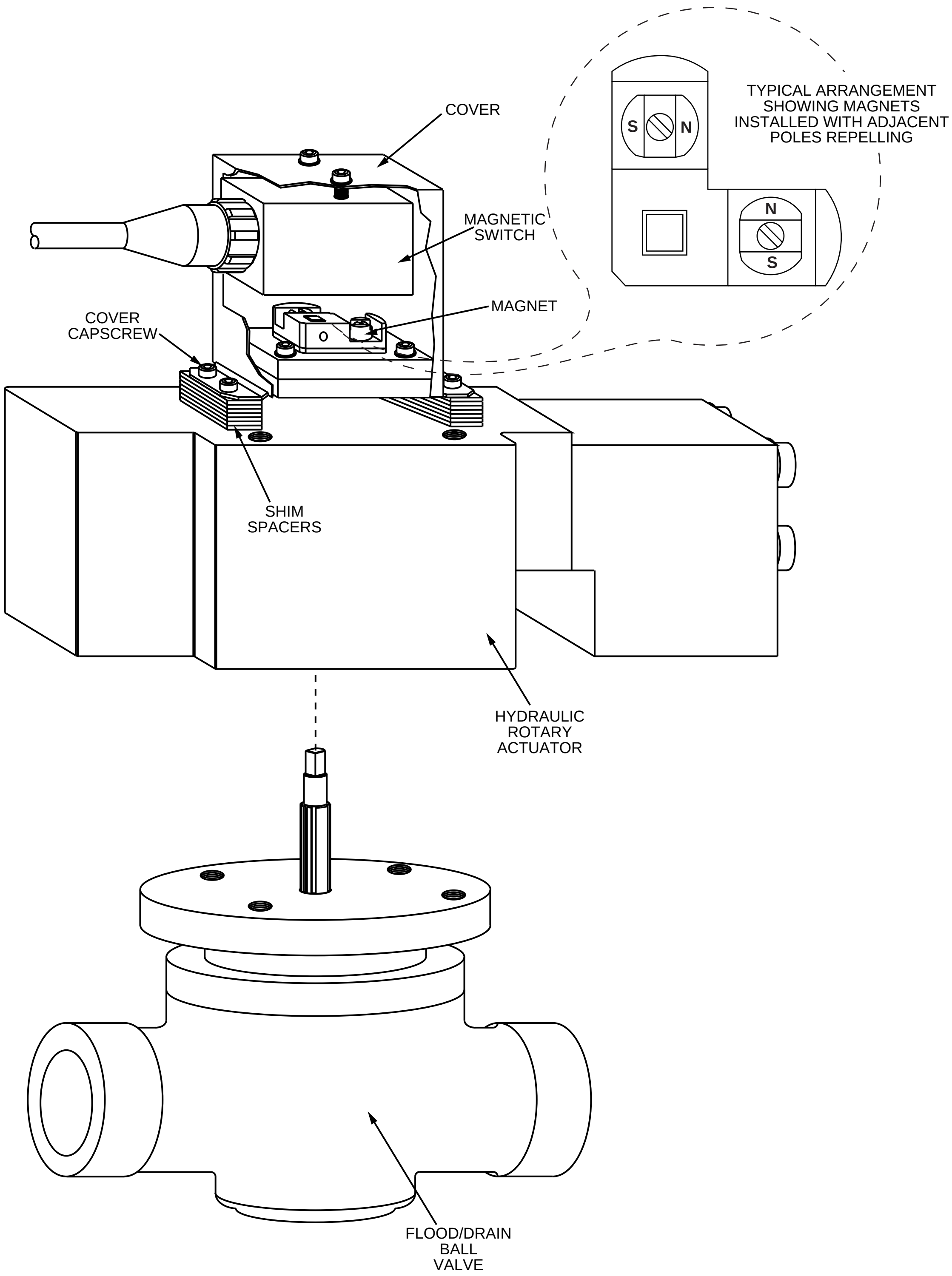


Figure 5-2-14 Flood/Drain Valve

NOTE: MODIFIED IN ACCORDANCE WITH NAVSEA DWG #6510970

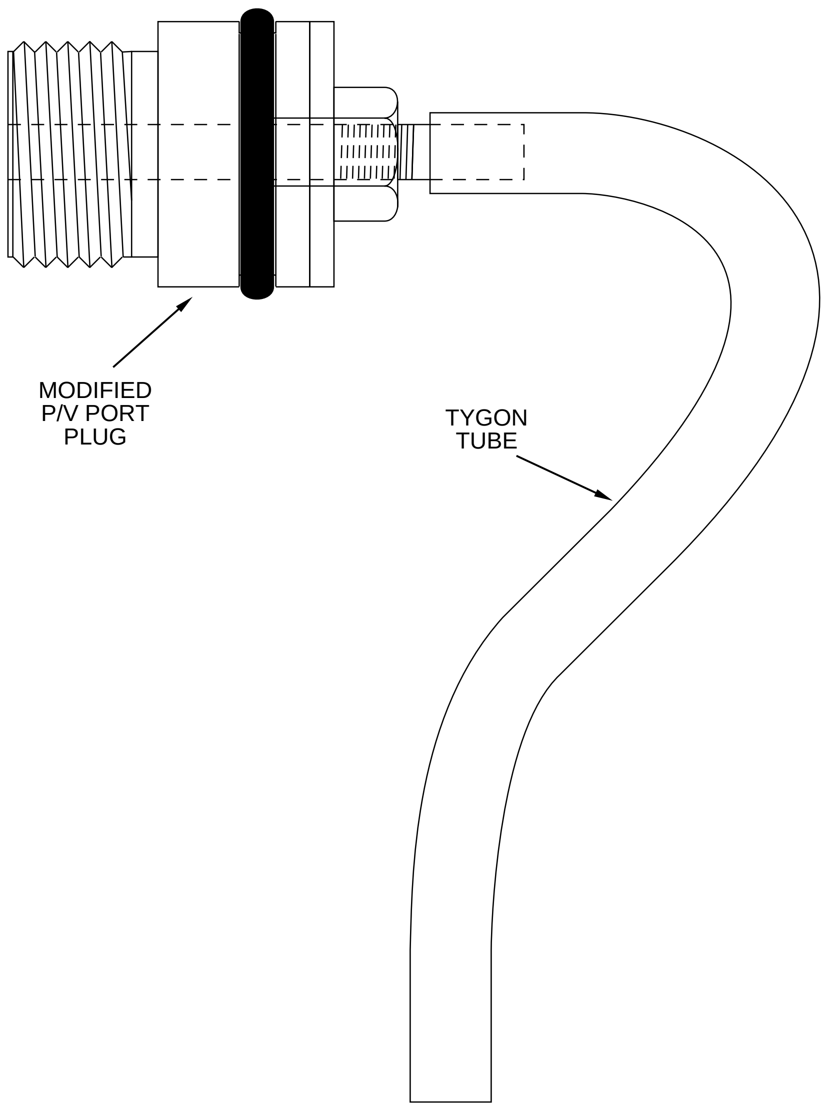


Figure 5-2-15 Pressurization/Vent Port Plug Test Rig

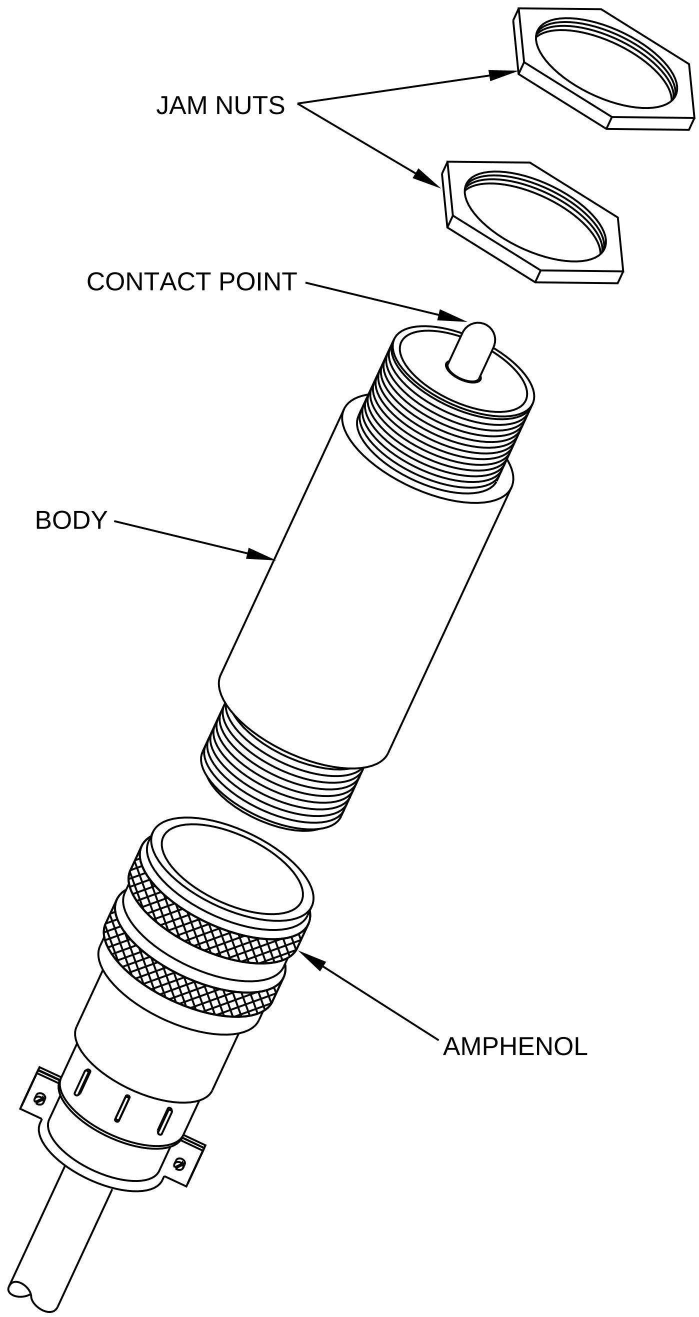


Figure 5-2-16 Microswitch (Typical)

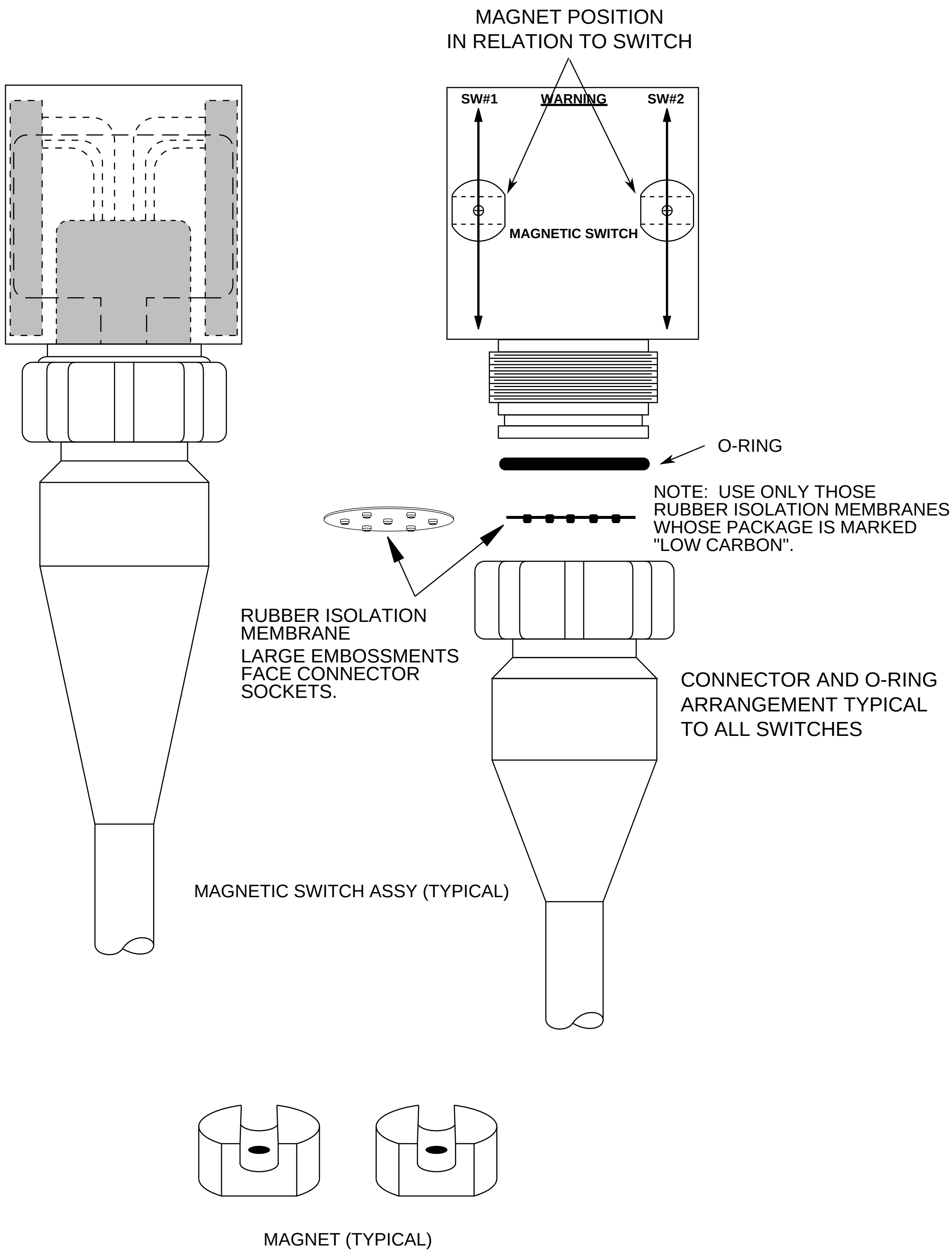


Figure 5-2-17 Magnetic Switch Assembly (Typical)

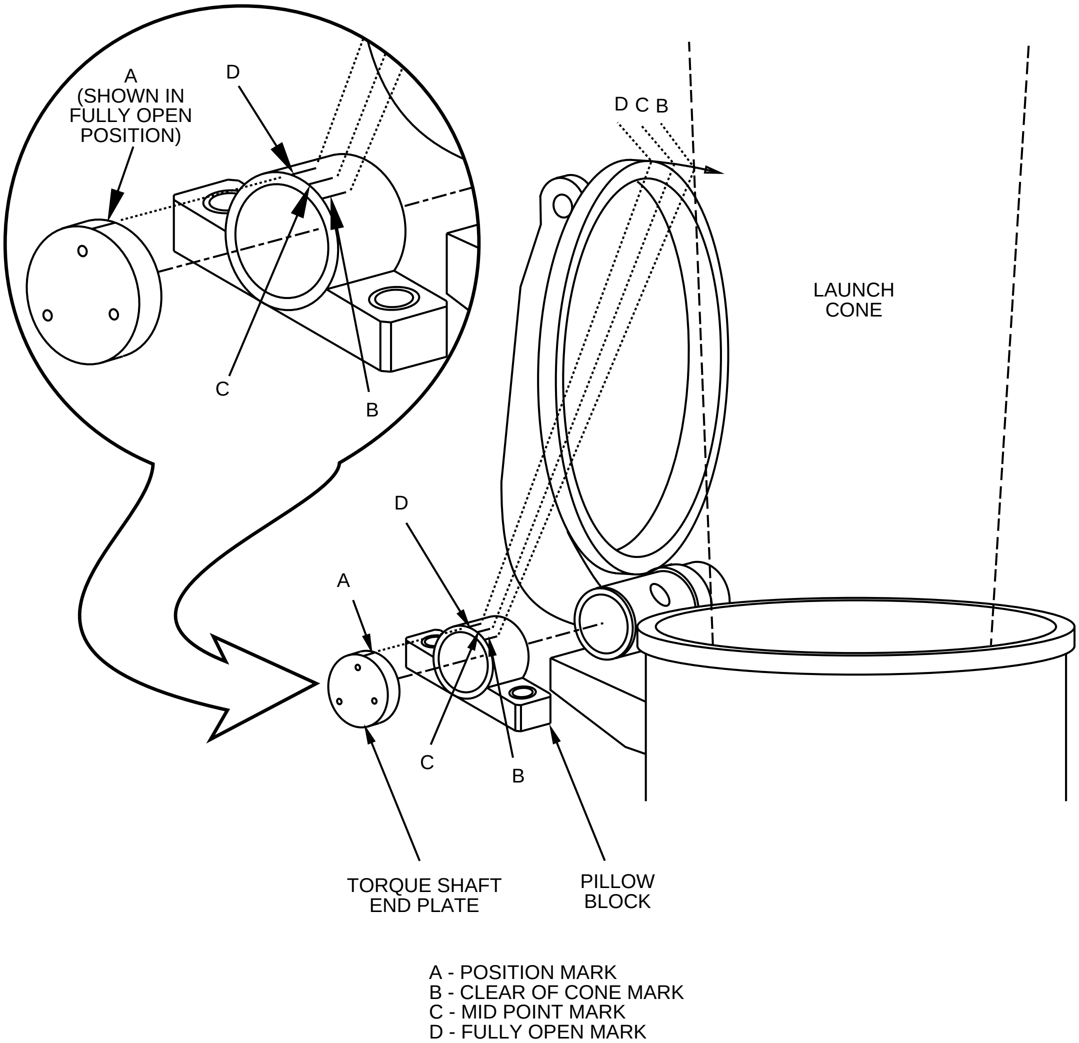


Figure 5-2-18 Hatch Open/CAC Scribe Marks

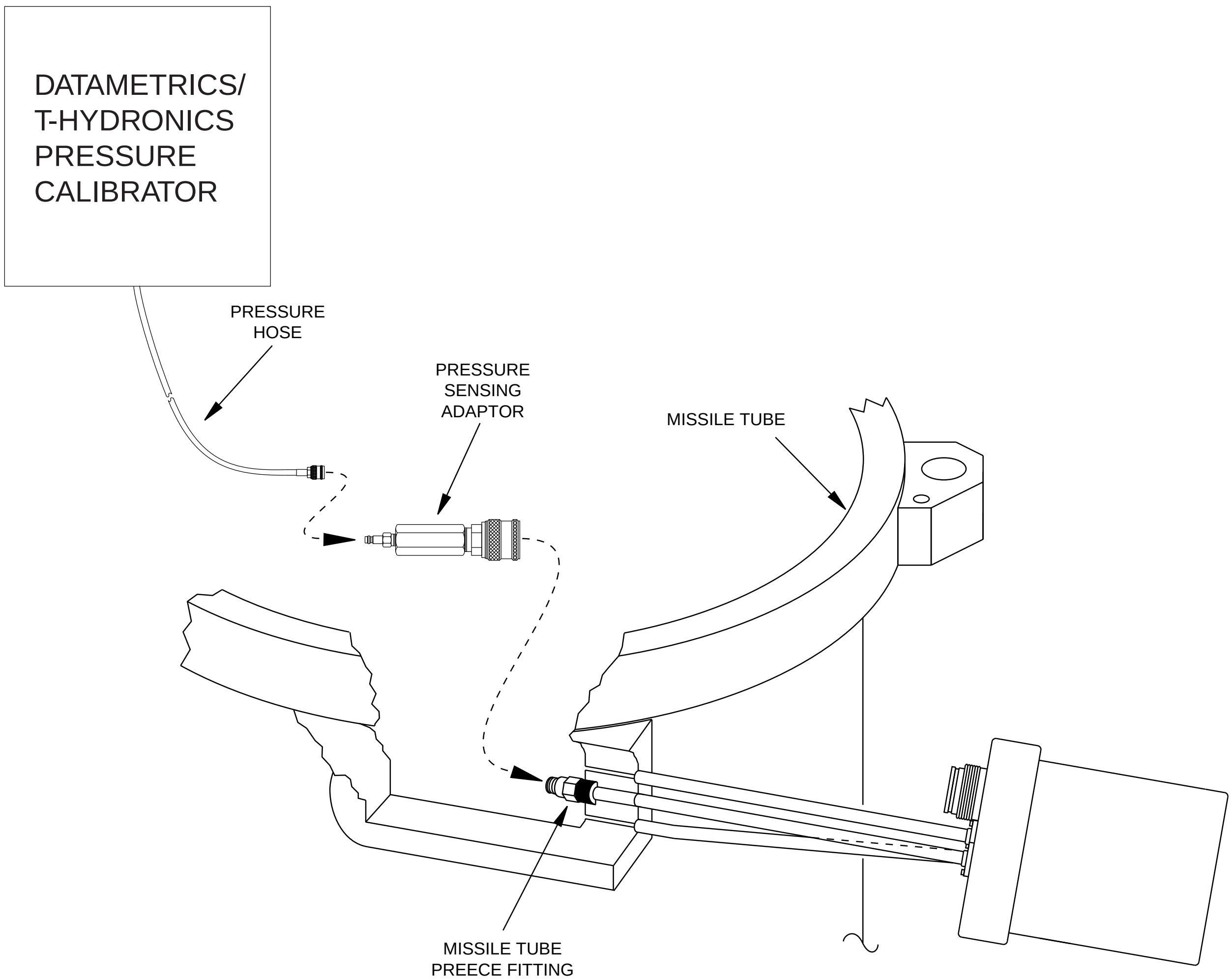


Figure 5-2-19 Missile Tube Preece Fitting Test Arrangement

CHAPTER 3 SCHEDULED MAINTENANCE

5-3-1 INTRODUCTION.

Scheduled maintenance coverage for the Vertical Launch System (VLS) missile tube system equipment is contained in the Planned Maintenance System (PMS) documentation. Scheduled maintenance consists of periodic performance of those actions required to maintain missile launching system equipment in an optimum state of readiness.

5-3-2 PREVENTIVE MAINTENANCE.

Preventive maintenance requirements are further subdivided to include inspection procedures for determining equipment condition, cleaning techniques to reduce wear or failure due to presence of foreign materials and contaminants, and lubrication requirements and procedures to reduce wear on rotating or sliding parts.

Preventive maintenance procedures for the VLS missile tubes and associated equipment were developed in accordance with OPNAVINST 4790.4 (Series). Refer to the current SSN688 Class Vertical Launch System Maintenance Index Page (MIP) 7211/901 (SSN 719-725 and 750) or 7211/903 (SSN 751 and Later) for updated procedures.

5-3-3 PERFORMANCE TESTS.

Performance tests for AUR missile launching equipment consists of those actions required to proof-test a component or mechanism following corrective maintenance and parts replacement. Recertify safety of ship components or mechanisms where integrity has been breached during repair and overhaul procedures, and after major repair and parts replacement. Performance tests are called out in the applicable section of CHAPTER 2 or are listed in.

CHAPTER 4 TROUBLESHOOTING

5-4-1 INTRODUCTION.

Troubleshooting procedures for the VLS missile tube and associated equipment are divided into general troubleshooting procedures and detailed troubleshooting procedures. General troubleshooting procedures discuss primary fault isolation techniques that should be performed to eliminate simple and easily identified faults. These techniques are divided into procedures for mechanical faults and procedures for electrical faults. Specific troubleshooting procedures provide step-by-step equipment and component tests. The specific troubleshooting procedures are divided into sections for major items of equipment, which are further subdivided into subsections for equipment components as required. In addition to the troubleshooting procedures contained in this chapter, Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide and Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide provides additional detail troubleshooting procedures.

5-4-1.1. Troubleshooting Sequence.

Troubleshooting begins with recognizing the failure of a system or equipment to perform its function properly, and is followed by the use of troubleshooting procedures in a logical sequence. Troubleshooting procedures herein should be used as follows: First, determine which systems have failed and note all available initial indications. Second, refer to paragraph 5-4-2 and perform all applicable general-troubleshooting procedures to eliminate simple faults, oversights and improper system lineups. Third, locate the affected specific troubleshooting procedure that covers the component. Use the specific troubleshooting procedures to isolate the faulty component.

5-4-1.2. VLS Electrical Fault Troubleshooting Guides.

The troubleshooting guides contained in Appendices B and C were developed in recognition of fleet needs to have troubleshooting information, which can be applied to the MTCP or TCP and outboard tube control circuit problems in an expedient way. These guides were developed for use by technicians to assist them in recognizing and determining problem source(s) in the control panel and outboard tube control circuits.

The information contained in these guides is based on the VLS ISEA’s experience and interface with fleet personnel. It has been accumulated from several years of on-site technical support, phone conference technical support, fleet CASREP system, and individual technical knowledge.

5-4-2 GENERAL TROUBLESHOOTING PROCEDURES.

The purpose of general troubleshooting procedures are to facilitate fault isolation and repair by eliminating simple or obvious faults before using troubleshooting tables or fault logic diagrams.

When a mechanical fault is suspected, perform applicable procedures in paragraph 5-4-2.1.

When an electrical fault is suspected, perform applicable procedures in paragraph 5-4-2.2.

CAUTION

Where troubleshooting procedures call for checking sensitive switches and their actuators manually operate a switch only if the associated circuits are deenergized and tagged out of service. Manual closure of switch contacts may unintentionally initiate a function that could cause equipment damage.

5-4-2.1. Mechanical Faults.

Mechanical faults involving VLS missile launching equipment will generally be indicated by the failure of a muzzle hatch to move when ordered. This should be interpreted as incorrect valve position or function, a failure in a hydraulic or mechanical system, or a possible obstruction or binding problem. To troubleshoot these types of mechanical faults, perform the steps that follow.

NOTE

The Hydraulic Monitoring (Data Processing Unit) maintained by the local Performance Monitoring Team (PMT) can be used to assist in troubleshooting.

a. Verify electrical, hydraulic and flood/drain systems are in station keeping line-up.

b. Check for obstructions. Inspect the area in the path of and adjacent to the muzzle hatch, for obstructions. If an obstruction is found, remove the obstruction then inspect the missile tube, muzzle hatch and hatch operating linkage in the area of the obstruction to determine if damage was done when the moving force was applied. If damage is found, repair the damage and, if necessary, test the equipment involved prior to continuing with muzzle hatch operation.

c. Inspect for binding. Binding can be caused by components, which are misaligned due to excessive wear, improper installation or physical damage. Close inspection of the equipment in use will usually detect improperly installed components. Correct the problem by properly installing the component. Indication of a worn component will normally become evident during operation as excessive play or slippage and will cause misalignment. In such cases, refer to the inspection techniques and acceptance criteria procedures in CHAPTER 5 to determine if a component is worn and should be repaired or replaced.

d. If a hydraulic actuator or power cylinder fails to turn or move upon application of hydraulic power, the mechanism should be inspected for material that could bind the operating mechanism. Failure to open or shut fully may be the result of improper toggle linkage adjustment or open position stop adjustment. Similar procedures should be used if an interlock fails to perform its designed function following initiation of an operating cycle.

e. Check muzzle hatch. If the muzzle hatch is not fully shut, leakage will occur. If the muzzle hatch indicates fully shut, examine muzzle hatch operating mechanism for debris. Clear debris that may be causing poor seating. If this action does not stop leakage, replace muzzle hatch gaskets in accordance with paragraph 5-5-11.

f. If a solenoid-operated valve fails to operate when the appropriate switch is actuated, manually override the solenoid. If the valve operates when the solenoid is manually overridden, troubleshoot the failure as an electrical fault, or troubleshoot the failure as a mechanical fault if the valve fails to operate when it is overridden, troubleshoot in accordance with Reference 3 (Ship Valves Technical Manual, Volumes 1-14).

5-4-2.2. Electrical Faults.

Electrical faults will generally be indicated by the failure of a mechanical component to move when an electrical switch on the MTCP or TCP is activated. Evidence of electrical faults will generally be a lack of proper indication on the MTCP or TCP. To troubleshoot these types of electrical faults, perform the following steps:

a. Verify electrical, hydraulic, Flood/Drain, and Pressure/Vent systems in station keeping line-up.

b. Perform a front panel lamp test on the MTCP or TCP to verify all lamps are lit.

c. Ensure MTCP or TCP front panel controls are in the proper configuration for the required operating condition in accordance with Reference 9 (SSN688 Class SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A VLS Support Systems Operation).

d. Inspect for blown fuses/tripped breakers on the MTCP or TCP and replace fuses if necessary. Refer to Reference 4 (Missile Tube Control Panel Technical Manual, Volume I and Volume II) or 53 (Troubleshooting Procedures for the Tube Control Panel, Volume 2 Part 1, Volume 2 Part 2 and Volume 2 Part 3).

e. Verify that no environmental alarm conditions exist.

f. Ensure valve and hatch lamp indications are correct for the required operating condition. Refer to Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A) for additional information.

g. Verify Hydraulic Accumulator CHGD and SS HYD POWER indicators on MTCP or HYDR ACCUM NORM and HYDRA PRESS 3000 PSIG NORM indicators on TCP are lit.

h. Verify 115 VAC PWR and LOGIC PWR indicators on MTCP or 115 VAC POWER AVAIL, 5 VDC POWER AVAIL and 28 VDC POWER AVAIL indicators on TCP are lit.

i. If the above actions fail to isolate or correct the malfunction, carefully inspect the cabling, connectors and actuators of all control valve interlock switches for damaged cables, loose connectors or loose switch hardware.

5-4-2.3. MTCP or TCP Switch and Indication Faults.

The indication scheme for all electro-hydraulically controlled valves and hatches is identical and is designed to provide the trained operator with the information necessary to determine the location of a malfunction. Steps 5-4-2.3a through 5-4-2.3d below describes the operator, logic, indication, control valve and actuator actions during valve and hatch opening which normally occur within approximately 5 seconds. Steps 5-4-2.3e through 5-4-2.3f is a list of incorrect indication schemes and their meaning to the operator.

a. Operator places the MTCP or TCP command switch to the open position and releases it.

b. The valve (hatch) OPEN indicator begins to flash indicating the MTCP or TCP interlock logic was satisfied and the solenoid signal was sent to the control valve.

c. The valve (hatch) SHUT indicator extinguishes indicating that the solenoid signal was received, the control valve has shifted, and the valve (hatch) has moved from the shut position.

d. The valve (hatch) OPEN indicator remains lit indicating that the valve (hatch) has reached the fully open position.

e. Valve (hatch) OPEN indicator fails to flash after the command switch is placed to OPEN.

(1) Interpretation – The solenoid command was not sent from the MTCP or TCP.

(2) Probable Cause – Interlocks are not satisfied.

f. Valve (hatch) SHUT indicator remains lit and the OPEN indicator continues to flash.

(1) Interpretation – The valve (hatch) failed to move after the solenoid command was sent.

(2) Probable Causes are as follows:

(a) Solenoid command was not received by valve.

(b) Control valve failed to transfer.

(c) Blown fuse on the MTCP or circuit breaker tripped on TCP.

g. Valve (hatch) OPEN indicator flashes then remains lit, but the SHUT indicator remains lit.

(1) Interpretation - Power was not removed from the SHUT indication after the valve (hatch) was fully open.

(2) Probable Cause - Shut magnetic switch failed to deactivate.

h. Both the valves (hatch) OPEN and SHUT indicators extinguished.

(1) Interpretation - Indication malfunction.

(2) Probable Cause - Burned out light bulbs.

5-4-3 SPECIFIC MISSILE TUBE, MUZZLE HATCH AND FAIRING TROUBLESHOOTING PROCEDURES.

Troubleshooting the missile tube is limited to visual inspections for sealing surface corrosion, nicks, gouges, structural cracks and visible faults.

Muzzle hatch, fairing, hydraulic actuator and operating linkage troubleshooting involves determination of worn or corroded sealing surfaces, frozen or galled pins, bushings, links, fasteners or physical damage to the equipment. These conditions are evident by hydraulic leaks, unusual noise, binding or failure in performance.

5-4-3.1. Inoperative Muzzle Hatch or Faulty Indication.

This procedure is to assist in the isolation of an incorrect muzzle hatch indication or an inoperative muzzle hatch. Every possible fault will not be covered during this procedure, however, the most probable faults will be discussed.

NOTE

This procedure focuses on problems encountered when opening the muzzle hatch to assist in troubleshooting the Hydraulic Monitoring (Data Processing Unit), that is maintained by the local Performance Monitoring Team (PMT) site can be used.

NOTE

If the muzzle hatch linkage is noisy or binding while operating, or the muzzle hatch fails to fully open, the possible causes are corrosion/galling of the sliding/rotating surfaces, or linkage is out of adjustment.

Prior to conducting this procedure ensure that appropriate general troubleshooting procedures are complete.

a. Attempt to operate the muzzle hatch in accordance with current shipboard instructions.

(1) If the muzzle hatch operated, the tube control circuitry is functioning. Troubleshoot the position switches and cables using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

(2) If the muzzle hatch doesn't operate, continue troubleshooting with this procedure.

b. Verify the appropriate indicator flashes.

(1) If the required indicator is not flashing, the solenoid command was not sent from the control panel. Verify all required interlocks are made and troubleshoot tube control circuitry using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

(2) If the required indicator is flashing, the probable causes are; the control valve did not receive the solenoid command; the control valve failed to operate; or blown fuse (MTCP) or circuit breaker tripped (TCP).

c. Attempt to manually override the control valve in accordance with current shipboard instructions.

(1) If the muzzle hatch operated, continue to troubleshoot the problem electrically using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting.

(2) If the muzzle hatch did not operate, the probable causes are: lock bar (SSN 721 and Later), or T-bar (SSN 719 and 720) failed to operate, the case vent leakoff valve HMLP(S)-(*)-23 is shut causing a hydraulic lock. Debris preventing movement, corrosion and/or galling has seized sliding/rotating surfaces or improperly adjusted or damaged/broken muzzle hatch linkage.

d. Monitor topside for evidence (sound) of lock bar (SSN 721 and Later), or T-bar (SSN 719 and 720), movement.

(1) If movement is not noticed, then the possible cause is either broken/galled or improperly adjusted lock bar or T-bar linkage. Adjust linkage IAW paragraph 5-2-4.2 or 5-2-6.1.

(2) If movement did occur, the possible cause is either broken/galled or improperly adjusted hatch linkage, or rotary actuator is binding.

NOTE

If muzzle hatch linkage is suspect, contact the VLS ISEA for guidance.

e. Gain access to muzzle hatch linkage and verify the lock bar (SSN 721 and Later), or T-bar (SSN 719 and 720) are clear and that the muzzle hatch operating linkage is over toggled by approximately 1/2”. Refer to Figure 5-4-1.

(1) If problem is found repair as directed by the VLS ISEA.

(2) If problem is not found, continue to troubleshoot as necessary and if desired the muzzle hatch can be jacked open.

NOTE

If the Lock bar (SSN 721 and Later), or T-bar (SSN 719 and 720) is clear the muzzle hatch can be jacked open.

f. If a missile tube muzzle hatch does not open when hydraulically commanded and the hatch and flood/drain valve control valve shifts, the hatch can be jacked open using a porta-power to assist the hatch out of the shut over toggle position as follows:

(1) Verify muzzle hatch is hydraulically commanded shut by observing hatch blocked indicator on control panel.

NOTE

If hatch blocked indicator is lit, then the HATCH & FL/DR VLV CONT VLV is positioned to open the muzzle hatch.

(2) Open adjacent tube to gain access to the actuator and linkage.

(3) Verify lock bar stroked clear of fairing (T-bar clear of hatch arm on SSN 719 and 720).

(4) Using appropriate available blocking or shoring, position a porta-power (10 ton max) with at least a three inch stroke on the lower actuator clevis and link arm positioned to push clevis and link arm out of shut over toggle when pressure is applied to the porta-power (see Figure 5-4-1).

(5) Apply moderate pressure on the porta-power.

WARNING

Remain clear of all muzzle hatches and linkages when hatch is commanded open.

(6) Ensure all personnel are clear of muzzle hatch, fairing, actuator and linkage.

g. Command the muzzle hatch to open in accordance with current shipboard instructions and apply pressure to the porta-power as required until hatch opens.

5-4-4 SPECIFIC FLOOD/DRAIN SYSTEM TROUBLESHOOTING PROCEDURES.

Problems associated with the flood/drain system can range from debris in the system piping causing the missile tube underhatch area to flood slowly to faulty valves in the system preventing operation of the flood/drain system. The procedures in this section will concentrate on the valves that may prevent the system from operating. Debris in either the Y-strainer or the hull strainer plate can be cleared by performing the appropriate MRCs from MIP 7211 for cleaning the Y-strainer or blowing the strainer hull plate.

5-4-4.1. Inoperative Flood/Drain Valve or Faulty Indication.

This procedure is to assist in the isolation of an incorrect flood/drain valve indication during operation, or an inoperative flood/drain valve. Every possible fault will not be covered during this procedure, however, the most probable faults will be discussed.

NOTE

It may be necessary to gain access to MBT 2 A/B for troubleshooting. MBT access procedures are contained in Reference 34 (SSN688 Class SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

Prior to conducting this procedure ensure that appropriate general troubleshooting procedures are complete.

a. Attempt to operate the flood/drain valve in accordance with current shipboard instructions.

(1) If the flood/drain valve operated, the tube control circuitry is functioning. Troubleshoot the position switches and cables using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

(2) If the flood/drain valve did not operate, continue troubleshooting using this procedure.

b. Verify that appropriate indicator flashes.

(1) If the required indicator is not flashing, the solenoid command was not sent from the control panel. Verify all required interlocks are made and troubleshoot tube control circuitry using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

(2) If the required indicator is flashing, the probable causes are; the control valve did not receive the solenoid command; the control valve failed to operate; there is a blown fuse (MTCP) or tripped circuit breaker (TCP).

c. Attempt to manually override the control valve in accordance with current shipboard instructions.

(1) If the flood/drain valve operated, continue to troubleshoot the problem electrically using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

(2) If the flood/drain valve did not operate, the probable causes are: a faulty actuator, the case vent leakoff valve HMLP(S)-(*)-23 is shut causing a hydraulic lock, debris preventing movement, corrosion and/or galling has seized sliding/rotating surfaces.

d. Gain access to the flood/drain valve actuator for further investigation of the problem.

(1) If problem is found repair as necessary.

(2) If problem is not found, continue to troubleshoot as necessary and contact the VLS ISEA for further direction.

5-4-4.2. Equalization Hull Valve and Flood/Drain Header Backup Valve.

This procedure is to assist in the isolation of an improper Equalization Hull Valve or flood/drain header backup valve faulty indication during operation. Every possible fault will not be covered during this procedure; however, the most probable faults will be discussed.

Prior to conducting this procedure ensure that appropriate general troubleshooting procedures are complete.

a. Attempt to operate valve in accordance with current shipboard instructions.

(1) If the valve operated, tube control circuitry is functioning. Proceed to step 5-4-4.2.b.

(2) If the valve did not operate, proceed to step 5-4-4.2.c.

b. Verify that appropriate indicator flashes.

(1) If the required indicator is not flashing, the solenoid command was not sent from the control panel. Verify all required interlocks are made and troubleshoot the control panel circuitry using References 4 (Missile Tube Control Panel Technical Manual, Volume I and Volume II) or 53 (Troubleshooting Procedures for the Tube Control Panel, Volume 2 Part 1, Volume 2 Part 2 and Volume 2 Part 3).

(2) If the required indicator is flashing, the probable causes are: the valve did not receive the solenoid command, the control valve failed to operate properly, or there is a blown fuse (MTCP) or tripped circuit breaker (TCP).

c. Attempt to manually override the control valve in accordance with current shipboard instructions.

(1) If the valve operated, continue to troubleshoot electrically using Reference 4 (Missile Tube Control Panel Technical Manual, Volume I and Volume II) or 53 (Troubleshooting Procedures for the Tube Control Panel, Volume 2 Part 1, Volume 2 Part 2 and Volume 2 Part 3).

(2) If the valve did not operate, then continue to troubleshoot. Possible problems might be something physically preventing the valve from operating or the hydraulic control valve is faulty.

5-4-4.3. Drain Isolation, Equalization Hull Backup, or Flood/Drain HDR Hull Valve.

This procedure is to assist in the isolation of a faulty: Drain Isolation Valve, Equalization Hull Backup Valve, or Flood/Drain Hdr Hull Valve faulty indication during operation of valve. Prior to conducting this procedure ensure the appropriate general troubleshooting procedures are complete.

a. In accordance with current shipboard instructions, manually operate the valve while monitoring the position switch and valve operating mechanism.

   (1) If the valve mechanism operated the position switch, troubleshoot the position switch and associate cable using Reference 4 (Missile Tube Control Panel Technical Manual, Volume I and Volume II) or 53 (Troubleshooting Procedures for the Tube Control Panel, Volume 2 Part 1, Volume 2 Part 2 and Volume 2 Part 3).

   (2) If the valve mechanism did not operate the position switch make the required adjustments and retest.

5-4-5 SPECIFIC VLS HYDRAULIC SYSTEM TROUBLESHOOTING PROCEDURES

5-4-5.1. <u>Water/Oil Leaking From Leakoff And Case Vent Valve.</u>

Reference 9 (SSM Vol 6, Pt. 3 Book 3, OI 631-18, OI 631-18A VLS Support Systems Operation) directs the Ship to shut the Leakoff & Case Vent Line valve (HMLP(S)-(*)-23) with a leak greater then ten drops per minute. However it is preferable to leave the valve open as long as leak rate is manageable, i.e. water or oil entering the forward bilge collection tank at a reasonable rate and/or loss of Hydraulic oil at a reasonable, sustainable rate based on Ship's discretion. This will minimize the risk of contaminating the external hydraulic system with seawater. It will also minimize the risk of hydraulic fluid leaking past the seawater seals when the Leakoff & Case Vent Line becomes pressurized with hydraulic fluid.

(WATER) The maximum allowable water leak rate is 0. If the leakoff & case vent valve HMLP(S)-(*)-23 is leaking water, one of the sea water side seals is leaking on one or more of the actuators. If the leak develops while at sea, the only valve line up change is to shut HMLP(S)-(*)-23 for the effected tube if leak rate is unmanageable. Troubleshooting is not possible while at sea. Troubleshoot the sea water leak when in port by conducting a case vent leakoff tightness test per paragraph 5-2-5.3.

NOTE

If the hydraulic system valve line up is altered from station keeping with the case vent and leakoff line pressurized due to seawater leakage, the possibility of sea water intrusion into the external hydraulic system is significantly increased.

(OIL) The maximum allowable oil leak rate with the hatch open is 60 DPM. The maximum allowable oil leak rate with the hatch shut is 10 DPM. If oil is draining from the leakoff & case vent valve HMLP(S)-(*)-23 above the maximum allowable leak rate, investigate and repair at the earliest opportunity. If the leak develops while at sea, troubleshooting is not possible and the only valve line up change is to shut the HMLP(S)-(*)-23 for the effected tube if leak rate is unmanageable to stop the loss of hydraulic fluid. With the HMLP(S)-(*)-23 shut the internal (C-3 line), pressure will build up and the fairing lock cylinder will move to the unlocked position, however, muzzle hatch will not move. At the earliest opportunity after the ship is in port the following troubleshooting procedure should be conducted to determine which component is leaking. See Figure 5-4-2.

NOTE

If fairing lock moves to the unlock position, the hatch shut indication will be lost, however the hatch will not come open. When the hatch shut indication is lost, the EMS will fail to function.

WARNING

Prior to operating any VLS external hydraulic component ensure that HMLP(S)-(*)-23 is open.

a. In accordance with current shipboard instructions, open the missile tube muzzle hatch on the effected tube and monitor the leakage.

   (1) (SSN 719 and 720) If the leakage stops the leak is on the C-2 side of the muzzle hatch rotary actuator. Repair muzzle hatch adaptor in accordance with CHAPTER 5.

   (2) (SSN 721 and Later) If the leakage stops the most probable leak source is the C-2 side of the muzzle hatch rotary actuator or fairing lock hydraulic cylinder. Continue to troubleshoot with step 5-4-5.1.b.

   (3) If the leak remains proceed to step 5-4-5.1.j.

CAUTION

Upon completion of troubleshooting new software must be installed at C-3 connections prior to testing in accordance with paragraph 5-2-5.

NOTE

In order to visually inspect for leaks, it may be necessary to disconnect the fairing from the muzzle hatch in accordance with paragraph 5-5-5.

b. With the muzzle hatch in the open position, disconnect the C-3 pipe from the fairing lock cylinder. Seal the pipe end and fairing lock cylinder with plastic bags to prevent hydraulic fluid from leaking into the bath tub area.

c. Shut the muzzle hatch in accordance with current shipboard instructions.

NOTE

If the HMLP(S)-(*)-23 leak rate is less than a solid stream, it may be necessary to leave the hatch shut a minimum of 30 minutes to help detect leak.

d. Open muzzle hatch in accordance with current shipboard instructions.

e. Inspect the C-3 port on the fairing lock cylinder.

(1) If oil flowed from the port while the hatch was shut, the leak source is the fairing lock cylinder. Repair fairing lock cylinder in accordance with CHAPTER 5.

(2) If oil did not flow from the cylinder, the most probable leak source is the C-2 side of the muzzle hatch rotary actuator. Continue to troubleshoot with step 5-4-5.1.f.

f. Disconnect the C-3 pipe from the muzzle hatch actuator and seal the pipe end and actuator port in plastic bags to prevent hydraulic fluid from leaking into the bathtub area.

g. Shut the muzzle hatch in accordance with current shipboard instructions.

h. Open the muzzle hatch in accordance with current shipboard instructions.

i. Inspect the C-3 port on the muzzle hatch actuator.

(1) If oil flowed from the port while the hatch was shut, the source is the muzzle hatch actuator. Repair muzzle hatch actuator in accordance with CHAPTER 5.

(2) If oil did not flow from actuator C-3 port then the probable leak source is the flood/drain valve actuator. Repair flood/drain valve actuator in accordance with CHAPTER 5.

j. If leakage continued when the hatch was opened in step 5-4-5.1.a. The most probable leak source is the C-1 side of the muzzle hatch actuator or fairing lock cylinder (SSN 721 and Later) or either side of the flood/drain valve actuator. To continue troubleshooting, shut the muzzle hatch.

k. In accordance with current shipboard instructions, open the flood/drain valve MFD-(*)-6 and monitor leakoff & case vent valve HMLP(S)-(*)-23 for leaks.

(1) If the leak stops the most probable leak source is the C-2 side of the flood/drain valve actuator. Repair flood/drain valve actuator in accordance with CHAPTER 5.

(2) If the leak remains shut the flood/drain valve and continue with step 5-4-5.1.l.

NOTE

Due to internal check valves which flow from the shut side to the open side (C-2 to C-1) in all of the external actuators and having a common open hydraulic header, it is not possible to isolate open side hydraulics on any one tube. All shut side hydraulics must be isolated, in order to isolate the open side hydraulics for the port or starboard side.

l. In accordance with current shipboard instructions, isolate and depressurize hydraulics on the appropriate bank, port or starboard.

(1) (SSN 721 and Later) Proceed to step 5-4-5.1.m.

(2) (SSN 719 and 720) Proceed to step 5-4-5.1.o.

CAUTION

Upon completion of troubleshooting new software must be installed at C-3 connections prior to testing in accordance with paragraph 5-2-5.

m. (SSN 721 and Later) Disconnect the C-3 pipe from the fairing lock cylinder. Seal the leakoff & case vent pipe and the cylinder housing in plastic bags to prevent hydraulic fluid from leaking into the bathtub area.

CAUTION

Monitor connections topside while repressurizing hydraulic system to prevent excessive spillage.

n. (SSN 721 and Later) In accordance with current shipboard instructions, repressurize hydraulics on the effected bank. Monitor the fairing lock cylinder and the leakoff & case vent pipe for oil flow.

(1) If oil flows from the fairing lock cylinder C-3 connection, the leak source is the C-1 side of the fairing lock cylinder. Repair fairing lock cylinder in accordance with CHAPTER 5.

(2) If oil does not flow from the fairing lock cylinder C-3 connection isolate and depressurize hydraulics on the appropriate bank and reconnect the C-3 pipe. Continue to troubleshoot with step 5-4-5.1.o.

CAUTION

Upon completion of troubleshooting new software must be installed at C-3 connections prior to testing in accordance with paragraph 5-2-5.

o. Disconnect the C-3 pipe from the muzzle hatch actuator. Seal the leakoff & case vent pipe and the leakoff connection area on the muzzle hatch actuator with plastic bags to prevent hydraulic fluid from leaking into the bathtub area.

CAUTION

Monitor connections topside while repressurizing hydraulic system to prevent excessive spillage.

p. In accordance with current shipboard instructions, repressurize hydraulics on the effected bank. Monitor muzzle hatch actuator and leakoff & case vent pipe for oil flow.

(1) If oil flows from the muzzle hatch actuator C-3 connection, the leak source is the C-1 side of the muzzle hatch actuator. Repair muzzle hatch actuator in accordance with CHAPTER 5.

(2) If oil does not flow from the muzzle hatch actuator C-3 connection, the leak source is the C-1 side of the flood/drain valve actuator. Depressurize hydraulics on the appropriate bank and reconnect the C-3 pipe. Repair the flood/drain actuator in accordance with CHAPTER 5.

5-4-5.2. Muzzle Hatch and Fairing Locking Mechanism Movement with Muzzle Hatch Open.

WARNING

Pressure in the VLS Hydraulic System can be as high as 3000 psig. To prevent injury to personnel and damage to equipment, refer to disassembly procedures in CHAPTER 5 before attempting to adjust or disassemble hydraulic equipment.

NOTE

If muzzle hatch and fairing locking mechanism move while the muzzle hatch is open and gagging pin installed, the probable cause is a leak in the internal check valve in either the hatch actuator or fairing lock cylinder, or both.

a. Conduct hydraulic fluid cycle in accordance with appropriate MRC of MIP 7211.

b. Verify the following:

(1) Hydraulic system is in station keeping line-up.

(2) Muzzle hatch open.

(3) Hatch close valve HMLP(S)-(*)-25 shut and tagged.

(4) Leakoff & case vent valve HMLP(S)-(*)-23 open, not leaking.

WARNING

Gagging pin spring pin must be fully seated against hatch arm during this entire procedure.

c. Verify gagging pin is fully seated.

d. Establish sound-powered phone communication between topside and the vertical launch center.

WARNING

Ensure topside muzzle hatch is clear of personnel and material.

e. Clear tagout and open hatch close valve HMLP(S)-(*)-25.

f. Observe muzzle hatch and fairing locking mechanism. No movement should occur.

g. Verify no leakage from leakoff & case vent valve HMLP(S)-(*)-23

h. Shut hatch close valve HMLP(S)-(*)-25 and wait 30 minutes.

i. Observe muzzle hatch and fairing locking mechanism for any movement.

NOTE

If movement occurs from either the muzzle hatch fairing or fairing locking mechanism the internal check valve of either the hatch actuator or fairing lock cylinder or both may be leaking.

j. Open hatch close valve HMLP(S)-(*)-25 and observe fairing locking mechanism and muzzle hatch/fairing return to full open position.

(1). If no movement occurred troubleshooting complete.

(2) If movement occurred continue with step 5-4-5.2.k

k. If movement occurred, shut hatch close valve HMLP(S)-(*)-25.

l. Shut isolation supply valve HMLP(S)-7.

m. Crack open vent valve HMLP(S)-50, bleed down until gage HMLP(S)-726-GA 001 reads 200 psi.

n. Shut vent valve HMLP(S)-50.

o. Shut hatch and flood/drain valve open valve HMLP(S)-20.

NOTE

A container should be placed under piping to collect any leaking hydraulic fluid.

NOTE

The C-2 port of the fairing lock hydraulic cylinder is the port nearest the piston rod. (Refer to Figure 5-4-2).

p. Slowly loosen and remove C-2 port piping on the fairing lock hydraulic cylinder.

q. Observe the C-2 port on the fairing lock hydraulic cylinder and the disconnected pipe.

(1) If oil leaks from the disconnected pipe, the check valve in the hatch actuator is leaking. Repair hatch actuator in accordance with CHAPTER 5.

(2) If oil leaks from the C-2 port on the fairing lock hydraulic cylinder, the check valve in the fairing lock hydraulic cylinder is leaking. Repair fairing lock hydraulic cylinder in accordance with CHAPTER 5.

r. When the source of the leak has been determined, shut hatch and flood/drain valve open valve HMLP(S)-20.

5-4-6 PRESSURIZATION/VENT SYSTEM TROUBLESHOOTING PROCEDURES

Pressurization/Vent (P/V) System problems are usually identified when the system is in a pressurized, station keeping line up. The major problems are with the P/V control valve APV-(*)-1, or hull stop Isln valve APV-(*)-2.

The P/V control valve APV-(*)-1, has two electrically operated solenoids that control the operation of the valve. If either solenoid fails when electrically commanded (operated from the MTCP/TCP) it must be manually overridden at the valve.
Slow pressurizing or venting could be due to a faulty P/V control valve or a dirty/clogged P/V filter (in the missile tube). This could directly effect the ability of the P/V system to keep “pressure in band” when the ship is maneuvering.

The problems found with the hull stop Isln valve APV-(*)-2, is that a leaky hull stop Isln valve could be missed for a long period of time unless it is combined with a leaky pressurization/vent control valve APV-(*)-1, P/V drain APV-(*)-4, or P/V purge vacuum valve APV-(*)-14. This leaky hull stop Isln valve combined with another leaky valve will require the tube loaded AUR/AURVS to be replenished on an increasing frequency.

5-4-6.1. Pressure/Vent Control Valve.

CAUTION

If the P/V control valve pressurizes for more than 10 seconds without any indication of an increase in pressure, position the P/V control switch to MAN VENT.

a. In accordance with shipboard instructions, attempt to operate the P/V control valve from the control panel.

(1) If the P/V control valve operated, proceed to step 5-4-6.1.b.

(2) If the P/V control valve did not operate, proceed to step 5-4-6.1.c.

b. Verify the appropriate indicator is lit.

(1) If the appropriate indicator is lit i.e., PRESS or VENT and the missile differential pressure does not change, the probable causes are: P/V filter is clogged, P/V port plug is installed, faulty differential pressure transducer, or faulty missile differential meter. Continue to troubleshoot using the applicable MRCs of MIP 7211 to clean the P/V filter and verify operation of the differential pressure transducer.

(2) If the appropriate indicator is not lit, continue to troubleshoot using Appendix A, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

c. In accordance with shipboard instructions, attempt to manually override the P/V control valve by pressing the appropriate override button.

(1) If the P/V control valve operated, continue to troubleshoot the controlling circuits using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

(2) If the P/V control valve did not operate, the probable causes are: either a faulty solenoid control value or a faulty P/V control valve. Repair P/V control valve in accordance with CHAPTER 5.

5-4-6.2. Troubleshooting A Continual Decrease of The Missile Differential Pressure.

A continual decrease in the missile differential pressure can be a result of various problems. A bad O-ring on the AURVS (lip seals on AUR), preece fitting, O-ring, or an improperly connected pressure sensing line can cause the missile differential pressure to decrease. A faulty hull stop Isln valve APV-(*)-2 along with another faulty valve upstream of APV-(*)-2 will also affect the missile differential pressure.

NOTE

Monitoring the tube pressure will aid in isolating the problem of a continual decrease in the missile differential pressure.

NOTE

The following step is to be performed after an AUR/AURVS differential pressure has decreased while the missile still has stowage pressure.

a. While monitoring the tube pressure, vent the underhatch area using current shipboard instructions.

NOTE

If the tube pressure decreased and the missile differential pressure increased the probable causes are: an improperly connected pressure sensing line, a bad O-ring on the AURVS (lip seal on AUR), a leaky capsule closure assembly, a bad O-ring on preece fitting/bad O-ring on sensing line of quick disconnect coupling or a faulty hull stop Isln valve (APV-(*)-2).

b. Perform bubble test IAW Reference 16 (OD 44979 Vol. 14, Pt 2 or 3 and Vol. 2, Pt 8 or 9).

(1) If leak was found repair as necessary.

(2) If leak was not found, test the hull stop Isln valve (APV-(*)-2) for leaks IAW paragraph 5-2-16.

5-4-7 UNDERHATCH SENSING EQUIPMENT.

Underhatch sensing equipment includes the Environmental Monitoring Sensor (EMS) and the Differential Pressure Transducer (DPT). However, the information given here is applicable to magnetic switches as well.

Initial troubleshooting should be conducted using the VLS component tester, which is located at the Performance Monitoring Team (PMT) sites. This tester will help narrow the problem to either the individual component or the appropriate cabling.

5-4-8 VLS ELECTRICAL SYSTEMS TROUBLESHOOTING PROCEDURES.

NOTE

Ensure Requirements of Reference 59 (COMNAVSUBFOR INST 8500.4 Conventional Weapons Manual (CWM) are adhered to while conducting troubleshooting procedures.

5-4-8.1. Missile Tube Control Cable Faults

The missile tube control cable provides the indication signal path for the flood/drain valve; the hatch open, hatch shut, and fairing locking mechanism (SSN 721 and Later), the environmental monitoring sensor and differential pressure transducer.

Possible indications that could indicate a faulty missile tube control cable could be a tripped 28 vdc breaker and/or dual indication or lack of proper indication of the components. This procedure is to assist in the isolation of such indication.

If the problem is not found after completing the following procedure then further troubleshooting of the Missile Tube Control Panel (SSN 719 thru 725), or Tube Control Panel (SSN 751 and Later) will be required using Appendix B, Missile Tube Control Panel (MTCP) Fault Troubleshooting Guide or Appendix C, Tube Control Panel (TCP) Fault Troubleshooting Guide.

Steps 5-4-8.1.a. through 5-4-8.1.f. are the only steps that can be completed while the ship is underway to assist in the isolation of a problem. This entire procedure will have to be accomplished, when the ship returns to port because the problem might disappear when the ship surfaces.

CAUTION

While conducting missile tube control cable testing the environmental monitoring system will be deactivated, therefore missile monitoring will not be available during testing.

CAUTION

Missile tube control cable testing will involve cabling associated with 2 missile tubes. Ensure 28 vdc circuit breakers for both missile tubes are secured. Refer to Figure 5-4-3 through Figure 5-4-5 as applicable.

a. Position the TCP Alarm Override switches for both tubes to ALM DSBL position.

b. Isolate 28 vdc prior to disconnecting any missile tube control cables and tagout in accordance with current Shipboard instructions.

c. Identify the Electrical Hull Penetrator (EHP), and inboard cable number for missile tube in question and determine which position on the EHP the missile tube in question is connected to (i.e. Missile Tubes 5 & 7 share the same EHP with Missile Tube 5 connected to position 1 and Missile Tube 7 connected to position 2). Refer to Figure 5-4-3 through Figure 5-4-5, then locate appropriate EHP using Figure 5-4-6.

d. Label both the inboard cable and EHP and disconnect inboard cable, ensuring that the casualty pin saver (if installed) is removed.

NOTE

Problems detected in step e. will only isolate the problem to a specific branch of the missile tube control cable (i.e. Hatch open switch). This is the only troubleshooting that can be completed at sea where access to specific components is limited.

NOTE

Continuity between pin-to-ground (hull ground), indicates a short and is the probable cause of a tripped 28 vdc circuit breaker.

NOTE

Figure 5-4-7 through Figure 5-4-9 indicate which pins should have continuity under the appropriate condition. (i.e. Hatch open and Flood/Drain Valve shut.) Acceptance criteria for pin-to-pin continuity is less than 10 OHMS.

NOTE

Refer to Figure 5-4-10 and Figure 5-4-11 for connector pin arrangements.

e. Perform pin-to-pin and pin-to-ground (hull ground), continuity check and record results for later use during follow on troubleshooting.

NOTE

In order to conduct further troubleshooting the ship will have to be import where personnel will have access to the components.

f. If underway perform the following:

(1) Reconnect the inboard cable to the EHP in accordance with current shipboard instruction.

(2) Position the TCP Alarm Override switches for both tubes to ALM ENBL position.

(3) Clear tagout in accordance with current shipboard instruction.

(4) Further troubleshooting of outboard components will be required upon return to port.

g. (SSN 719 and 720 Only) Disconnect the missile tube control cable Outboard Interconnection Harness Assembly. Refer to Figure 5-4-3. (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

h. (SSN 721 and Later) Disconnect the missile tube control cable (P1), connector from the connectorized box. Refer to Figure 5-4-4 and Figure 5-4-5. (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

CAUTION

Steps 5-4-8.1.i and 5-4-8.1.j are to be completed topside with the inboard cable disconnected to prevent damaging additional equipment.

i. On the P2 (SSN 719 and 720), or P1 (SSN 721 and Later), connector of the missile tube control cable perform a pin-to-pin continuity check on the EHP and missile tube control cable. Acceptance criteria in less than 10 OHMS.

CAUTION

When conducting insulation resistance test on missile tube outboard cabling never test the Environmental Monitor Sensor (EMS) or Differential Pressure Transducer (DPT). Only use 50 volts when testing magnetic switches.

j. On the P2 (SSN 719 and 720), or P1 (SSN 721 and Later), connector of the missile tube control cable perform an insulation resistance test (using 500 volts), pin-to-pin and pin to ground on the EHP and missile tube control cable. Acceptance criteria is 5 MegOhms minimum.

NOTE

When a cable connector is disconnected for an insulation resistance test, ensure that the connector is attached to ships hull ground to eliminate any false readings.

(1) If the EHP and missile tube control cable has a fault complete troubleshooting in accordance with CHAPTER 5 missile tube control cable replacement procedure.

(2) If the EHP and missile tube control cable did not have a fault continue with procedure.

k. (SSN 719 and 720) Disconnect the suspect component and perform an insulation resistance test (using 500 volts), pin-to-pin and pin to ground from the component connector back to the P3 connector. Acceptance criteria is 5 MegOhms minimum. Refer to Figure 5-4-3.

(1) If the Interconnection Harness Assembly has a fault, replace Interconnection Harness Assembly in accordance with CHAPTER 5.

(2) If the Interconnection Harness Assembly did not have a fault continue with procedure.

l. (SSN 721 and Later) Disconnect the suspect component cable from the connectorized box and perform an insulation resistance test (using 500 volts), pin-to-pin and pin to ground on the connectorized box. Acceptance criteria is 5 MegOhms minimum. Refer to Figure 5-4-4 or Figure 5-4-5. (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

(1) If the connectorized box has a fault, replace connectorized box and retest.

(2) If the connectorized box did not have a fault, continue with procedure.

m. (SSN 721 and Later) Disconnect the suspect component and perform an insulation resistance test (using 500 volts), pin-to-pin and pin to ground from the component connector back to the connectorized box end of the outboard cable assembly. Acceptance criteria is 5 MegOhms minimum. Refer to Figure 5-4-4 or Figure 5-4-5. (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

(1) If the outboard cable assembly has a fault, replace outboard cable assembly and retest.

(2) If the outboard cable assembly did not have a fault, continue with procedure.

CAUTION

Only use 50 volts when conducting resistance test on magnetic switches.

n. Conduct electrical checks on magnetic switches. Perform continuity test while attempting to actuate the switch. Perform an insulation resistance test (using 50 volts), pin-to-pin and pin to ground. Acceptance criteria is 5 MegOhms minimum.

(1) If the magnetic switch tested satisfactory then adjust magnetic switch in accordance with CHAPTER 2.

(2) If the magnetic switch tested unsatisfactory then replace magnetic switch and retest.

NOTE

The EMS/DPT/MAGNETIC-SWITCH Tester held by the local Performance Monitor Team (PMT) site may be used to complete a final check on an EMS or D/P transducer.

o. If the suspect bad component is a environmental monitoring sensor or differential pressure transducer replace in accordance with CHAPTER 5.

p. Reconnect all electrical connections topside in accordance with CHAPTER 5 outboard cable connector assembly mating procedure.

q. When testing and repairs are complete perform the following:

(1) Clear applicable tagout in accordance with current shipboard instruction.

(2) Position the TCP Alarm Override switches for both tubes to ALM ENBL position.

(3) Position the VLS SUMMARY ALARM Switch to NORM at the BCP Common Alarm Panel.

5-4-8.2. Weapon Control Cable Faults.

The weapon control cable provides the signal path for all weapon commands and their responses. It also provides the Capsule Arm Command (CAC) signal with SHIPALT 4111D installed.

Possible failures that would indicate a faulty Weapon Control Cable are: Missile tube failed to shoot during routine maintenance, failed AMCATS testing or failed to shoot an AUR during an actual launch. This procedure will assist in the isolation of the fault.

NOTE

If the failure occurred during an AUR attempted launch, prior to conducting this procedure, the weapon control circuits should be tested using an AURES MK 101 in accordance with Reference 60 (SSN 688 Class Vertical Launch System Maintenance Index Pages MIP 7211/901 SSN 719-725 and 750) or Reference 61 (SSN 688 Class Vertical Launch System Maintenance Index Pages MIP 7211/903 SSN 751 and Later).

NOTE

Figure 5-4-12 thru Figure 5-4-17 will aid in cable identification and connector pin arrangements. Figure 5-4-6 will assist in identifying and locating the Electrical Hull Penetrators.

If the problem is not found after completing the following procedure then further troubleshooting of the fire control system, alternating between the Weapons Interface Module (WIM) and Spare Weapons Interface Module (SWIM) (SSN 751 and Later) or the fire control system components Interface Control Console (ICC) or Missile Interface Console (MIC) (SSN 719 thru 725 and 750) will be required.

Due to the physical arrangement of the Weapon Control Cable, the Electrical Hull Penetrator (EHP), the Missile Tube Penetrator (MTP) and the inside of the missile tube where the AUR/AURVS umbilical mates with the missile tube penetrator, this entire procedure will have to be accomplished when the ship is in port with missile tube muzzle hatch open and AUR/AURVS umbilical disconnected and tagged out in accordance with current shipboard instructions.

NOTE

Ensure requirements of Reference 59 (COMNAVSUBFOR INST. 8500.4) are adhered to while conducting troubleshooting procedures

a. Open missile tube muzzle hatch in accordance with current shipboard instructions.

b. Isolate power to the missile tube prior to disconnecting any cables and tagout in accordance with current shipboard instructions.

c. If an AUR/AURVS is tube loaded disconnect the umbilical in accordance with Reference 16 (OD44979, Firing Craft Procedures).

d. If a Ballast Can is tube loaded, or the tube is empty, remove the missile tube umbilical security cap in accordance with current shipboard instructions.

e. Disconnect connector P-3 from the CAC switch (Refer to paragraph 5-5-27 for Outboard Cable Unmating.

NOTE

If the suspect fault is the CAC signal, then prior to conducting the procedure the CAC switch should be troubleshot in accordance with step 5-4-8.1.n.

f. Visually inspect connector P-3 and ensure face is dry.

g. Install a jumper in connector P-3 on pins 3 and 4.

h. Identify the inboard cable and Electrical Hull Penetrator (EHP) number for the missile tube under test. Refer to Figure 5-4-12, Figure 5-4-13 or Figure 5-4-14.

CAUTION

Use care when disconnecting the inboard cable from the EHP pigtail, not to bend the pins in the EHP.

i. Label both the inboard cable and EHP pigtail and disconnect the inboard cable from the EHP.

NOTE

If pin saver A&I 3170 is installed, ensure pin saver is removed for troubleshooting.

NOTE

When a cable connector is disconnected for an insulation resistance test, ensure that the connector is attached to ships hull ground to eliminate any false readings.

NOTE

Weapon Control Cable shields are pins 10, 17, 44 and 78.

j. Conduct electrical check at the EHP pigtail to test the EHP, WCC and MTP, perform continuity test first, this will verify correct EHP. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

(1) If EHP, WCC, MTP electrical checks are satisfactory, record results and continue to troubleshoot inboard cable and MTCP in accordance with Reference 4 (Missile tube Control Panel Technical Manual, Volume I and Volume II) or TCP in accordance with Reference 53 (Troubleshooting Procedures for the Tube Control Panel, Volume 2 Part 1, Volume 2 Part 2 and Volume 2 Part 3).

(2) If EHP, WCC, MTP fail electrical checks, record results and continue with step 5-4-8.2k.

k. Disconnect connector P-2 from MTP.

l. Inspect connector face and MTP for evidence of moisture. If required clean using alcohol and cotton swabs or acid brushes.

m. Conduct electrical check at the EHP pigtail to test the EHP and WCC, perform continuity test first. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts) pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

n. Conduct electrical checks on MTP performing continuity test first. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test. Acceptance criteria is less then 5 MegOhms.

(1) If MTP and WCC/EHP tested sat, mate up connector in accordance with CHAPTER 5.

(2) If MTP tested unsat, replace MTP in accordance with CHAPTER 5.

(3) (SHIPALT 4111D not installed) If WCC/EHP tested unsat, mate up connector in accordance with CHAPTER 5. Further troubleshooting will be required in accordance with CHAPTER 5.

(4) (SHIPALT 4111D installed) If WCC/EHP test unsat, remove WCC insulator assembly from the P2 connector in accordance with Reference Drawing 44.1 (VLS Weapon Control Cable Header Tool Operating Procedure) and continue with step 5-4-8.2.o.

o. Visually inspect Weapon Control Cable connector for:

• Bent pins	Straighten
• Corrosion	Replace EHP connector
• Deteriorated plating material on pins	Replace EHP connector
• Burnt spots	Replace EHP connector
• Broken pins	Replace EHP connector
• Water intrusion	Clean/Dry
• Keyways	Clean/Repair
• Threads	Clean/Repair
• O-Ring sealing surface	Clean/Repair

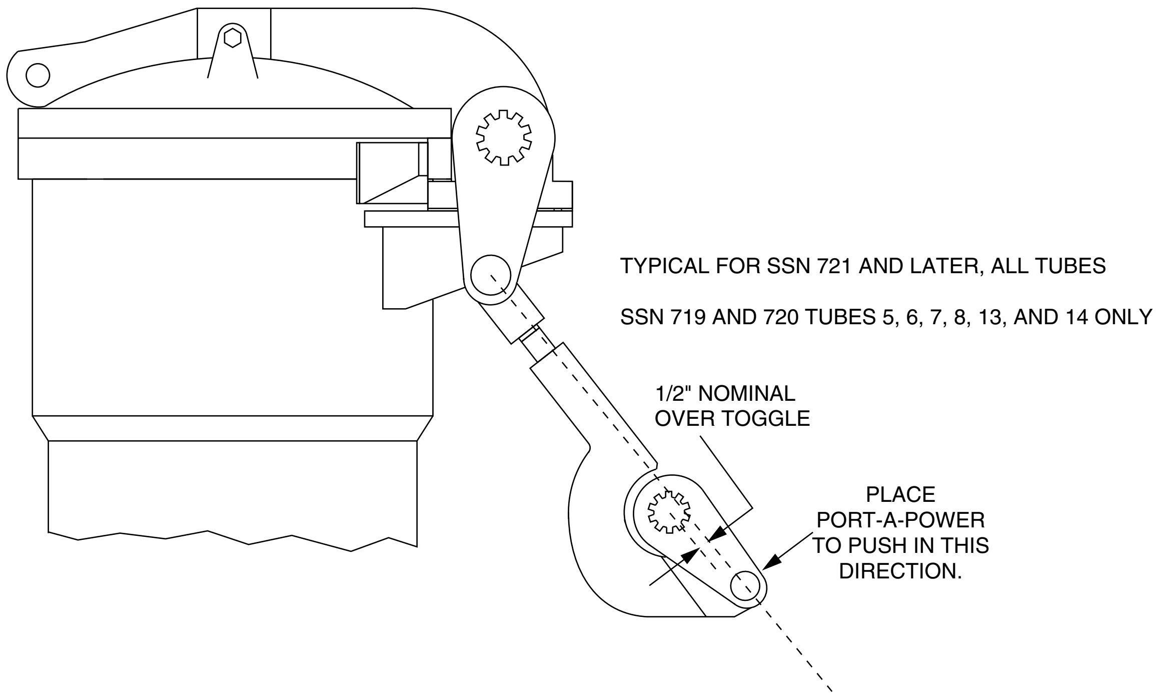
p. Conduct electrical checks on WCC/EHP with insulator assembly removed. Perform continuity test first. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test, (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

NOTE

Ensure that the test jumper is installed between pins 3 and 4 of connector P-3.

(1) If WCC/EHP tested unsat, reinstall WCC insulator assembly in accordance with Reference Drawing 44.1 (VLS Weapon Control Cable Header Tool Operating Procedure) then mate up connectors in accordance with CHAPTER 5. Further troubleshooting will be required in accordance with CHAPTER 5.

(2) If WCC/EHP tested satisfactory, install new insulator assembly in accordance with installation procedures contained in Reference Drawing 44.1 (VLS Weapon Control Cable Header Tool Operating Procedure) and retest cable in accordance with step 5-4-8.2.m. Remate cable to MTP in accordance with CHAPTER 5.



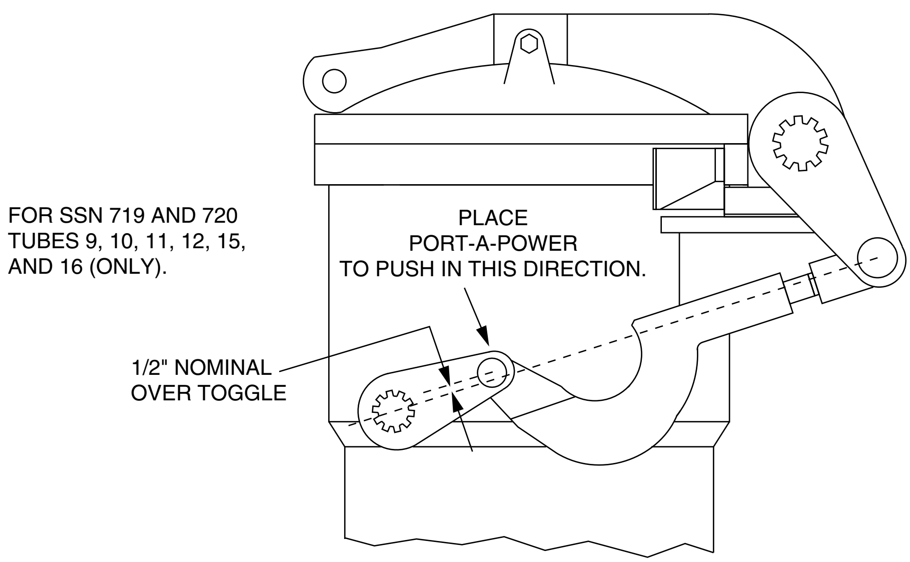


Figure 5-4-1 Hatch Linkage Over Toggle Jacking Positions

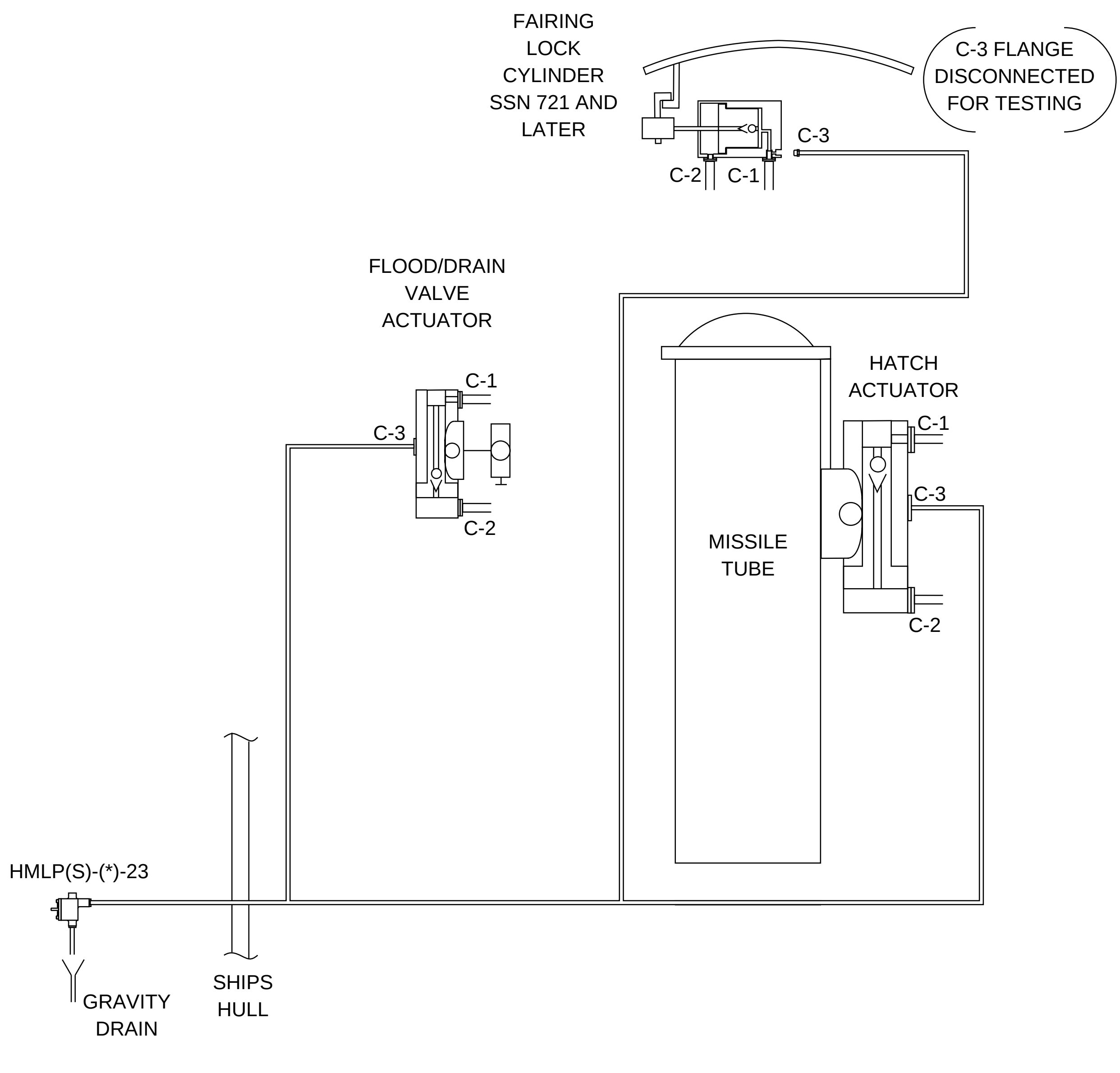


Figure 5-4-2. Case Vent Leakoff Test

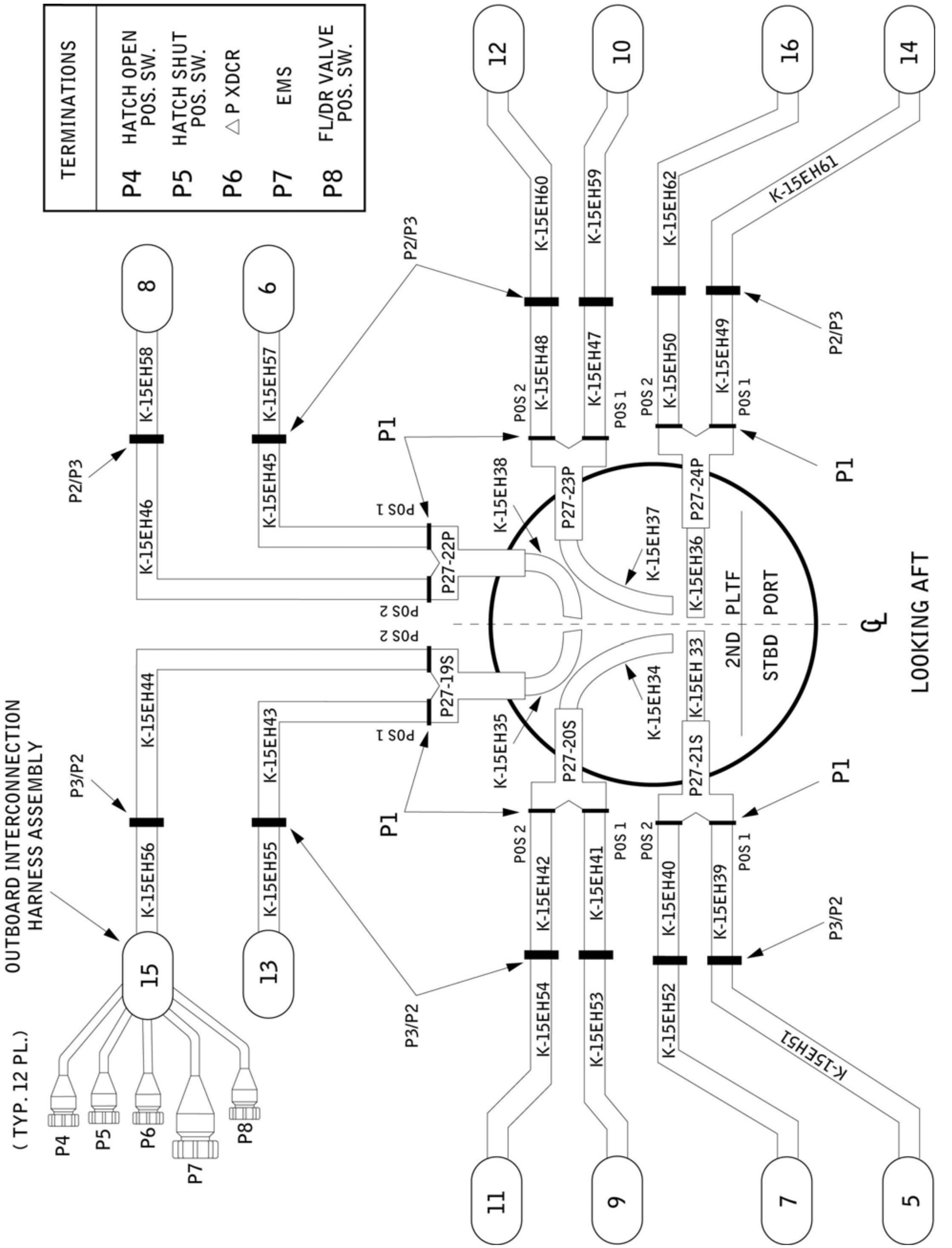


Figure 5-4-3. SSN 719 and 720 K-15EH Circuit

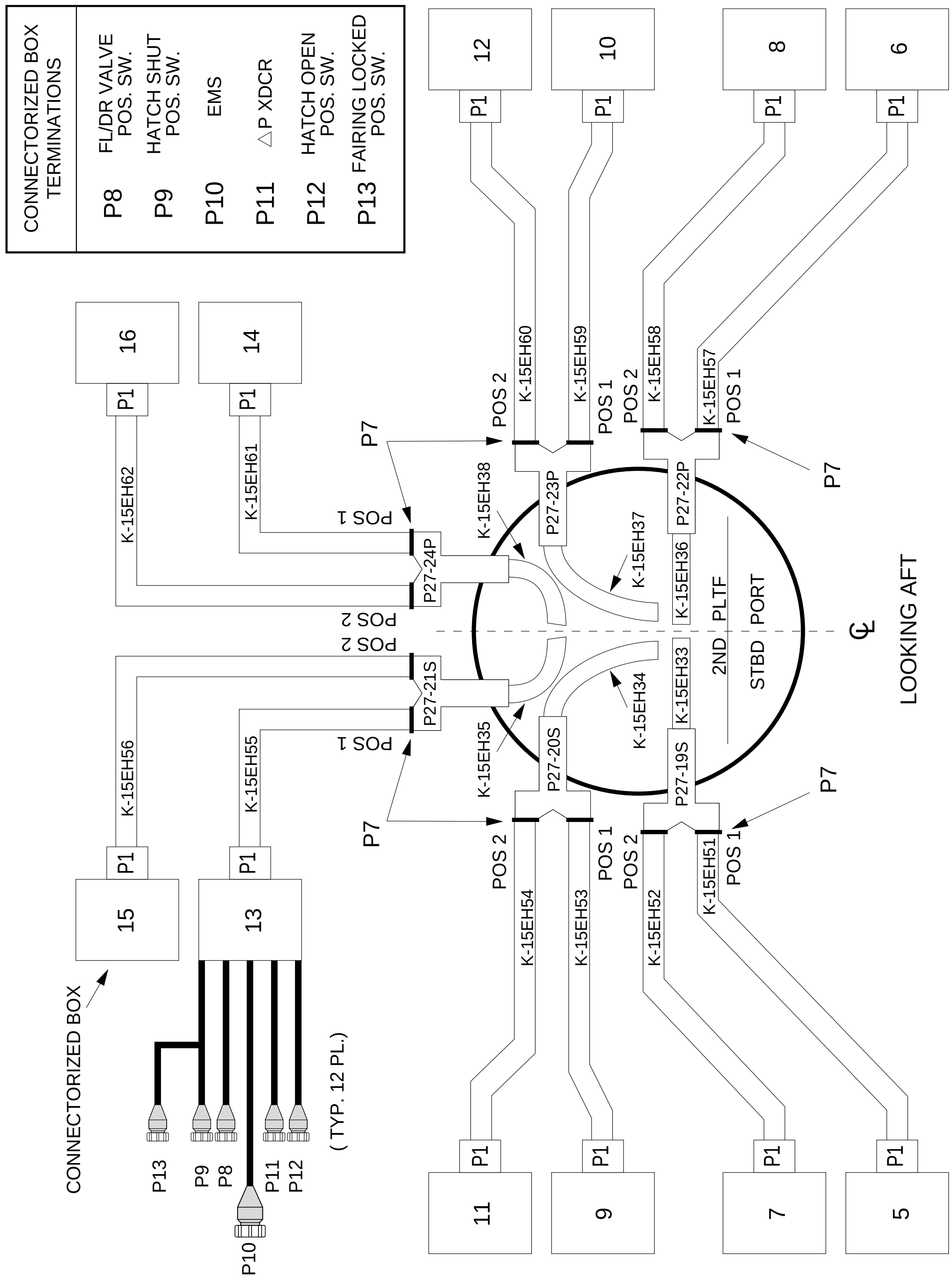


Figure 5-4-4. SSN 721 thru 725 and 750 K-15EH Circuit

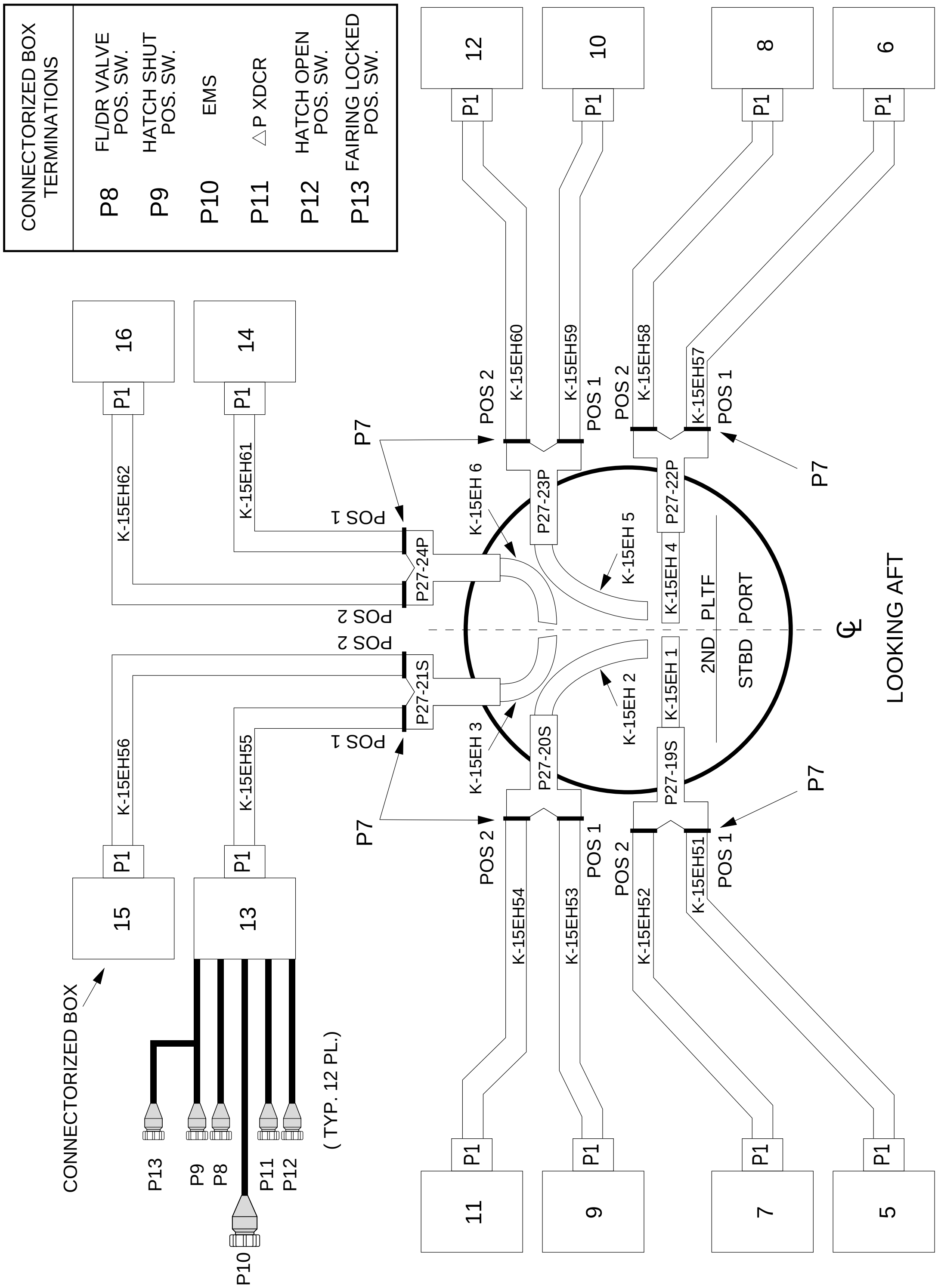


Figure 5-4-5. SSN 751 and Later K-15EH Circuit

WEAPON CONTROL CABLE (SSN 719 and 720)

Missile Tube Number	Electrical Hull Penetrator Number	Inboard Cable Number
5	P26-19S	G-1GW8
6	P26-23P	G-1GW14
7	P26-18S	G-1GW9
8	P26-22P	G-1GW15
9	P26-17S	G-1GW10
10	P26-21P	G-1GW16
11	P26-16S	G-1GW11
12	P26-20P	G-1GW17
13	P26-12S	G-1GW12
14	P26-15P	G-1GW18
15	P26-13S	G-1GW13
16	P26-14P	G-1GW19

MISSILE TUBE CONTROL CABLE (SSN 719 AND 720)

Missile Tube Number	Electrical Hull Penetrator Number	Inboard Cable Number
5	P27-21S	K-15EH33
6	P27-22P	K-15EH36
7	P27-21S	K-15EH33
8	P27-22P	K-15EH36
9	P27-20S	K-15EH34
10	P27-23P	K-15EH37
11	P27-20S	K-15EH34
12	P27-23P	K-15EH37
13	P27-19S	K-15EH35
14	P27-24P	K-15EH38
15	P27-19S	K-15EH35
16	P27-24P	K-15EH38

WEAPON CONTROL CABLE (SSN 721 thru 725 & 750)

Missile Tube Number	Electrical Hull Penetrator Number	Inboard Cable Number
5	P26-12S	G-1GW8
6	P26-14P	G-1GW14
7	P26-13S	G-1GW9
8	P26-15P	G-1GW15
9	P26-16S	G-1GW10
10	P26-20P	G-1GW16
11	P26-17S	G-1GW11
12	P26-21P	G-1GW17
13	P26-18S	G-1GW12
14	P26-22P	G-1GW18
15	P26-19S	G-1GW13
16	P26-23P	G-1GW19

MISSILE TUBE CONTROL CABLE (SSN 721 thru 725 & 750)

Missile Tube Number	Electrical Hull Penetrator Number	Inboard Cable Number
5	P27-19S	K-15EH33
6	P27-22P	K-15EH36
7	P27-19S	K-15EH33
8	P27-22P	K-15EH36
9	P27-20S	K-15EH34
10	P27-23P	K-15EH37
11	P27-20S	K-15EH34
12	P27-23P	K-15EH37
13	P27-21S	K-15EH35
14	P27-24P	K-15EH38
15	P27-21 S	K-15EH35
16	P27-24P	K-15EH38

WEAPON CONTROL CABLE (SSN 751 & Later)

Missile Tube Number	Electrical Hull Penetrator Number	Inboard Cable Number
5	P26-12S	R-CS543
6	P26-14P	R-CS541
7	P26-13S	R-CS544
8	P26-15P	R-CS542
9	P26-16S	R-CS537
10	P26-20P	R-CS533
11	P26-17S	R-CS538
12	P26-21P	R-CS534
13	P26-18S	R-CS539
14	P26-22P	R-CS535
15	P26-19S	R-CS540
16	P26-23P	R-CS536

MISSILE TUBE CONTROL CABLE (SSN 751 & Later)

Missile Tube Number	Electrical Hull Penetrator Number	Inboard Cable Number
5	P27-19S	K-15EH1
6	P27-22P	K-15EH4
7	P27-19S	K-15EH1
8	P27-22P	K-15EH4
9	P27-20S	K-15EH2
10	P27-23P	K-15EH5
11	P27-20S	K-15EH2
12	P27-23P	K-15EH5
13	P27-21S	K-15EH3
14	P27-24P	K-15EH6
15	P27-21S	K-15EH3
16	P27-24P	K-15EH6

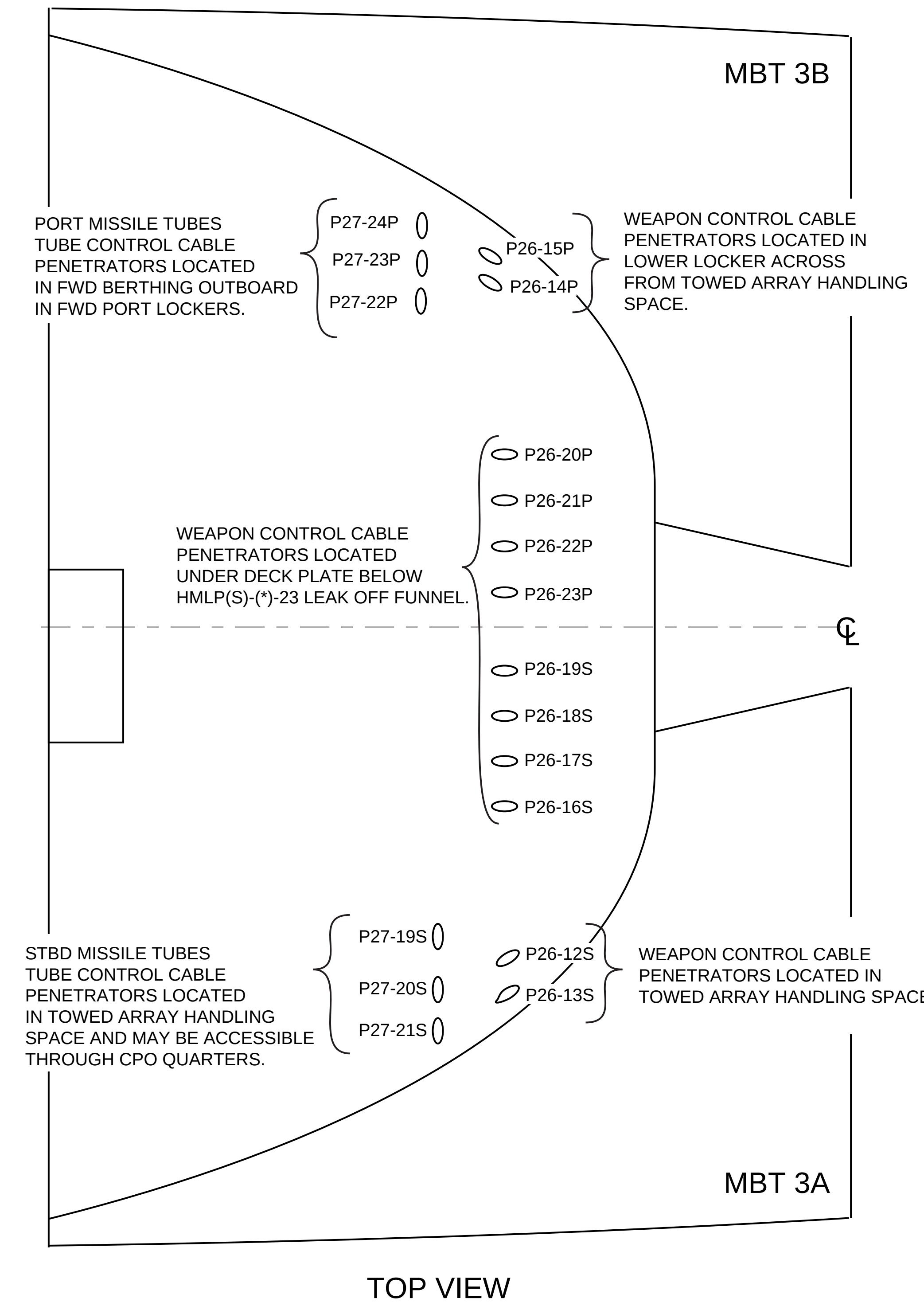
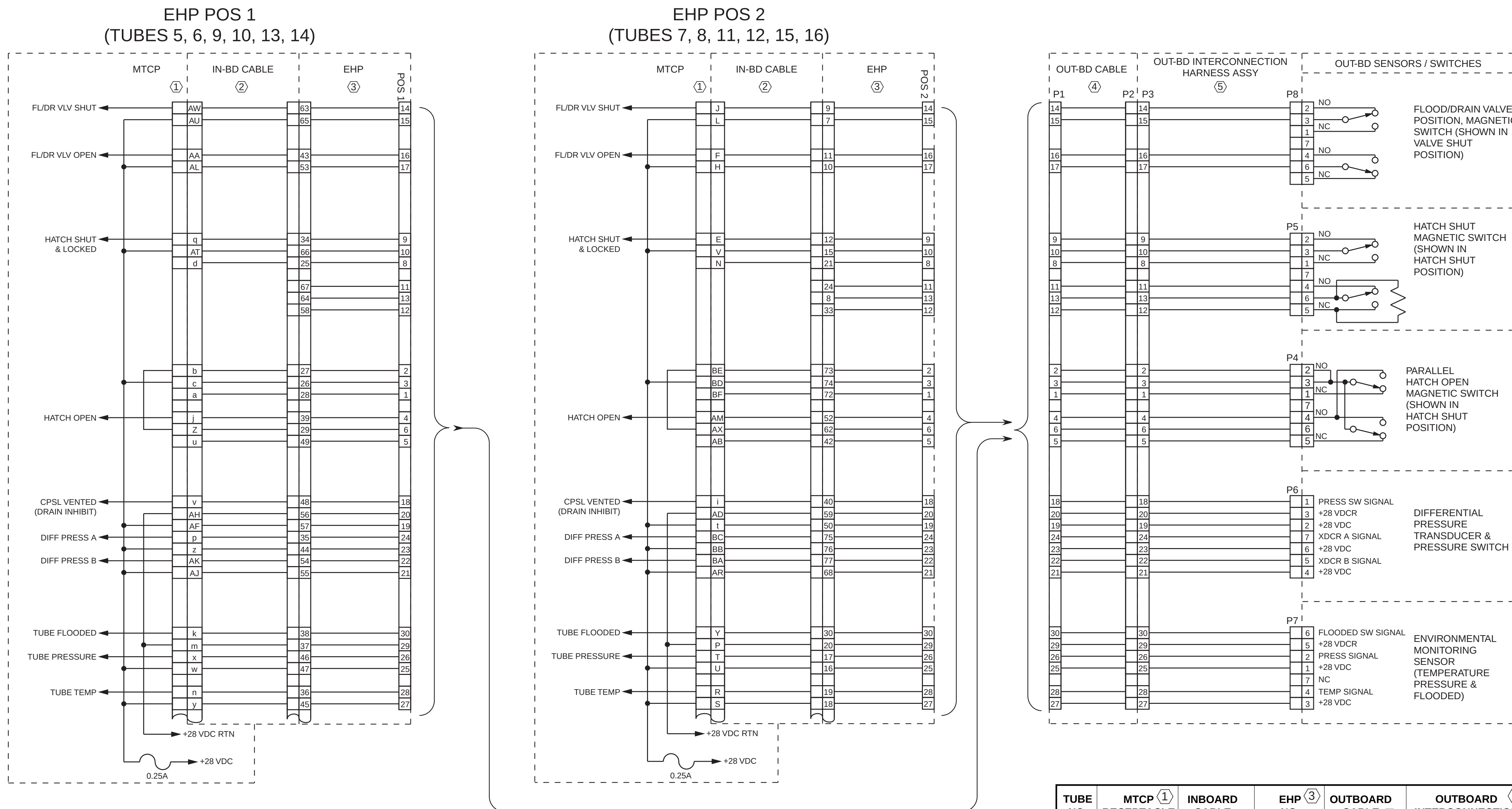
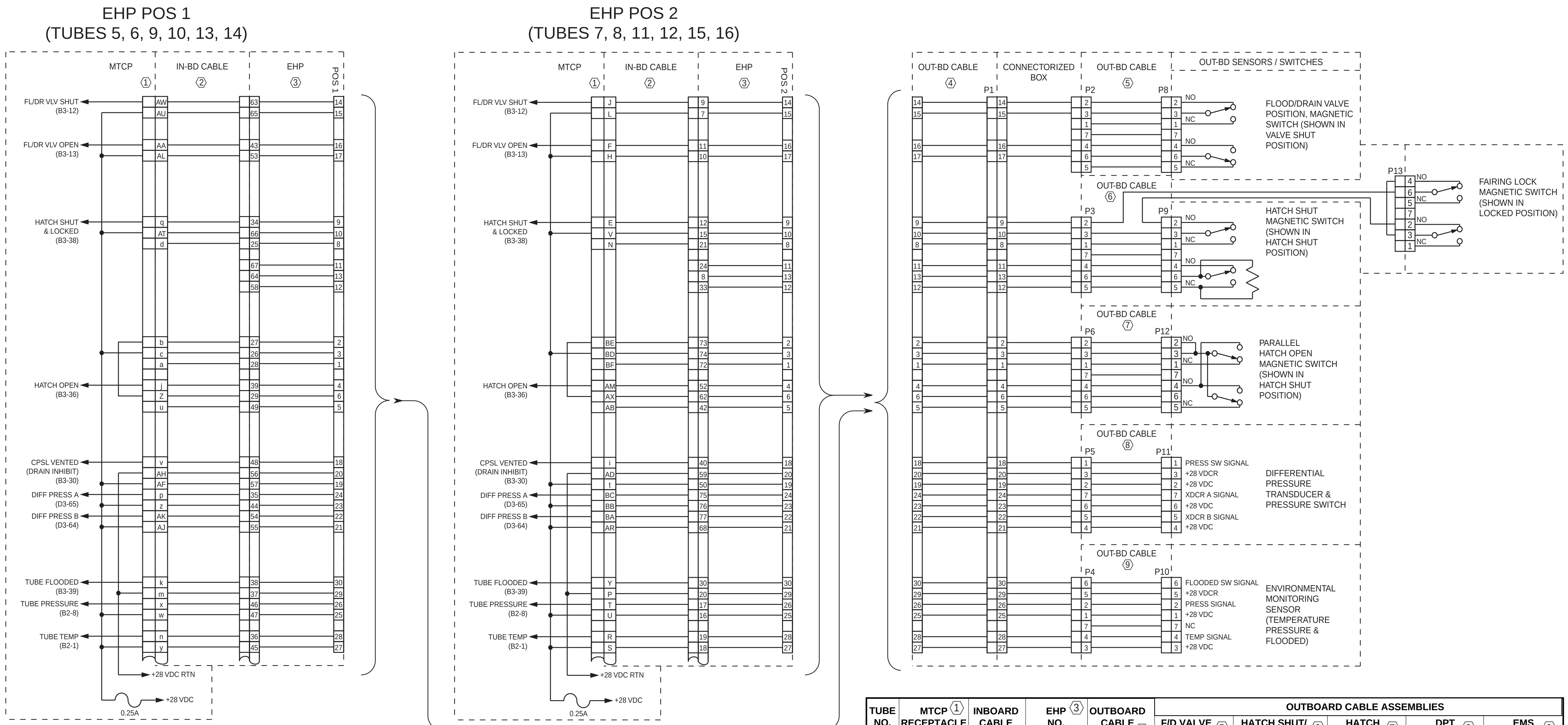


Figure 5-4-6. Electrical Hull Penetrator Internal Locations



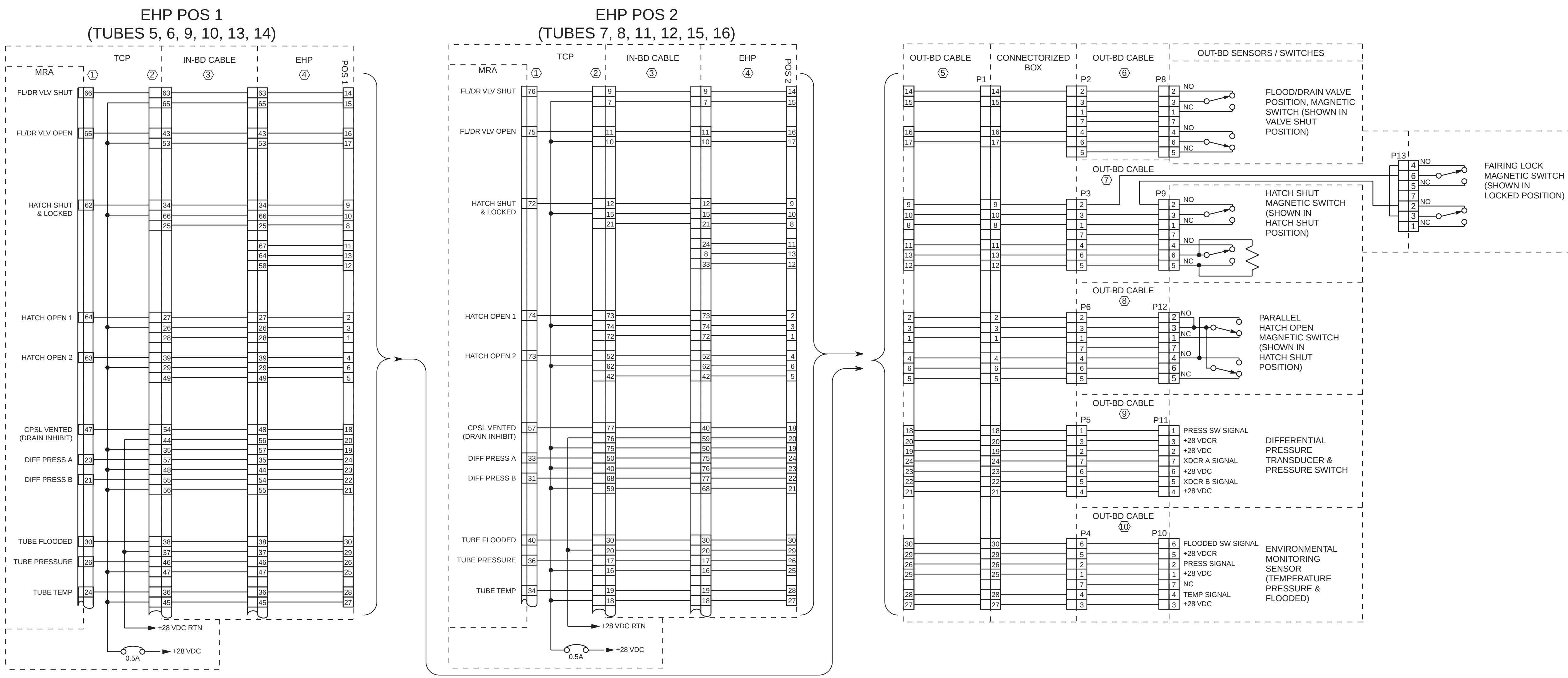
TUBE NO.	MTCP (1) RECEPTACLE NO.	INBOARD CABLE NO. (2)	EHP (3) NO.	OUTBOARD CABLE NO. (4)	OUTBOARD (5) INTERCONNECTION HARNESS ASSY No.
5	J4 STBD	K-15EH33	P27-21S	K-15EH39	K-15EH51
6	J4 PORT	K-15EH36	P27-22P	K-15EH45	K-15EH57
7	J4 STBD	K-15EH33	P27-21S	K-15EH40	K-15EH52
8	J4 PORT	K-15EH36	P27-22P	K-15EH46	K-15EH58
9	J5 STBD	K-15EH34	P27-20S	K-15EH41	K-15EH53
10	J5 PORT	K-15EH37	P27-23P	K-15EH47	K-15EH59
11	J5 STBD	K-15EH34	P27-20S	K-15EH42	K-15EH54
12	J5 PORT	K-15EH37	P27-23P	K-15EH48	K-15EH60
13	J10 STBD	K-15EH35	P27-19S	K-15EH43	K-15EH55
14	J10 PORT	K-15EH38	P27-24P	K-15EH49	K-15EH61
15	J10 STBD	K-15EH35	P27-19S	K-15EH44	K-15EH56
16	J10 PORT	K-15EH38	P27-24P	K-15EH50	K-15EH62

Figure 5-4-7. Missile Tube Cabling and Wiring Diagram, K-15EH Circuit (SSN 719 and 720)



TUBE NO.	MTCP ① RECEPTACLE NO.	INBOARD CABLE NO. ②	EHP ③ NO.	OUTBOARD CABLE NO. ④	OUTBOARD CABLE ASSEMBLIES F/D VALVE ⑤	HATCH SHUT/ FAIRING LOCK ⑥	HATCH OPEN ⑦	DPT ⑧	EMS ⑨
5	J4 STBD	K-15EH33	P27-19S	K-15EH51	K-15EH51A	K-15EH51B	K-15EH51E	K-15EH51D	K-15EH51C
6	J4 PORT	K-15EH36	P27-22P	K-15EH57	K-15EH57A	K-15EH57B	K-15EH57E	K-15EH57D	K-15EH57C
7	J4 STBD	K-15EH33	P27-19S	K-15EH52	K-15EH52A	K-15EH52B	K-15EH52E	K-15EH52D	K-15EH52C
8	J4 PORT	K-15EH36	P27-22P	K-15EH58	K-15EH58A	K-15EH58B	K-15EH58E	K-15EH58D	K-15EH58C
9	J5 STBD	K-15EH34	P27-20S	K-15EH53	K-15EH53A	K-15EH53B	K-15EH53E	K-15EH53D	K-15EH53C
10	J5 PORT	K-15EH37	P27-23P	K-15EH59	K-15EH59A	K-15EH59B	K-15EH59E	K-15EH59D	K-15EH59C
11	J5 STBD	K-15EH34	P27-20S	K-15EH54	K-15EH54A	K-15EH54B	K-15EH54E	K-15EH54D	K-15EH54C
12	J5 PORT	K-15EH37	P27-23P	K-15EH60	K-15EH60A	K-15EH60B	K-15EH60E	K-15EH60D	K-15EH60C
13	J10 STBD	K-15EH35	P27-21S	K-15EH55	K-15EH55A	K-15EH55B	K-15EH55E	K-15EH55D	K-15EH55C
14	J10 PORT	K-15EH38	P27-24P	K-15EH61	K-15EH61A	K-15EH61B	K-15EH61E	K-15EH61D	K-15EH61C
15	J10 STBD	K-15EH35	P27-21S	K-15EH56	K-15EH56A	K-15EH56B	K-15EH56E	K-15EH56D	K-15EH56C
16	J10 PORT	K-15EH38	P27-24P	K-15EH62	K-15EH62A	K-15EH62B	K-15EH62E	K-15EH62D	K-15EH62C

Figure 5-4-8. Missile Tube Control Cabling and Wiring Diagram, K-15EH Circuit, (SSN 721 thru 725 and 750)



TUBE NO.	HARNESS ① & MRA CONNECTOR	TCP ② RECEPTACLE NO.	INBOARD ③ CABLE NO.	EHP ④ NO.	OUTBOARD ⑤ CABLE NO.	OUTBOARD CABLE ASSEMBLIES: F/D VALVE ⑥	HATCH SHUT/ FAIRING LOCK ⑦	HATCH OPEN ⑧	DPT ⑨	EMS ⑩
5	5H-5c P10	UNIT 5 J14	K-15EH1	P27-19S	K-15EH51	K-15EH51A	K-15EH51B	K-15EH51E	K-15EH51D	K-15EH51C
6	2H-5c P10	UNIT 2 J14	K-15EH4	P27-22P	K-15EH57	K-15EH57A	K-15EH57B	K-15EH57E	K-15EH57D	K-15EH57C
7	5H-5c P10	UNIT 5 J14	K-15EH1	P27-19S	K-15EH52	K-15EH52A	K-15EH52B	K-15EH52E	K-15EH52D	K-15EH52C
8	2H-5c P10	UNIT 2 J14	K-15EH4	P27-22P	K-15EH58	K-15EH58A	K-15EH58B	K-15EH58E	K-15EH58D	K-15EH58C
9	6H-5a P7	UNIT 6 J5	K-15EH2	P27-20S	K-15EH53	K-15EH53A	K-15EH53B	K-15EH53E	K-15EH53D	K-15EH53C
10	1H-5a P7	UNIT 1 J5	K-15EH5	P27-23P	K-15EH59	K-15EH59A	K-15EH59B	K-15EH59E	K-15EH59D	K-15EH59C
11	6H-5a P7	UNIT 6 J5	K-15EH2	P27-20S	K-15EH54	K-15EH54A	K-15EH54B	K-15EH54E	K-15EH54D	K-15EH54C
12	1H-5a P7	UNIT 1 J5	K-15EH5	P27-23P	K-15EH60	K-15EH60A	K-15EH60B	K-15EH60E	K-15EH60D	K-15EH60C
13	6H-5b P10	UNIT 6 J10	K-15EH3	P27-21S	K-15EH55	K-15EH55A	K-15EH55B	K-15EH55E	K-15EH55D	K-15EH55C
14	1H-5b P10	UNIT 1 J10	K-15EH6	P27-24P	K-15EH61	K-15EH61A	K-15EH61B	K-15EH61E	K-15EH61D	K-15EH61C
15	6H-5b P10	UNIT 6 J10	K-15EH3	P27-21S	K-15EH56	K-15EH56A	K-15EH56B	K-15EH56E	K-15EH56D	K-15EH56C
16	1H-5b P10	UNIT 1 J10	K-15EH6	P27-24P	K-15EH62	K-15EH62A	K-15EH62B	K-15EH62E	K-15EH62D	K-15EH62C

Figure 5-4-9. Missile Tube Control Cabling and Wiring Diagram, K-15EH Circuit, (SSN 751 and Later)

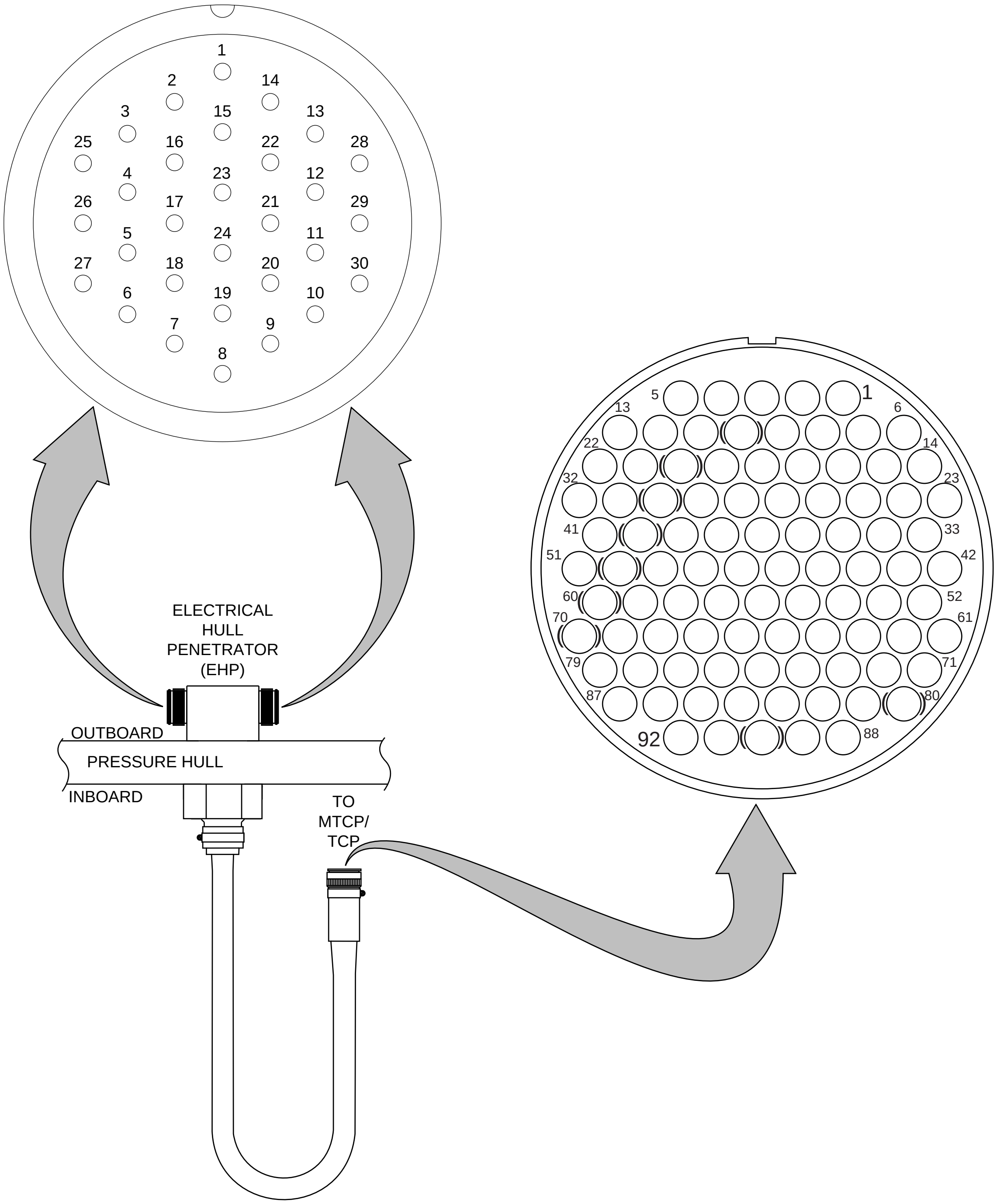
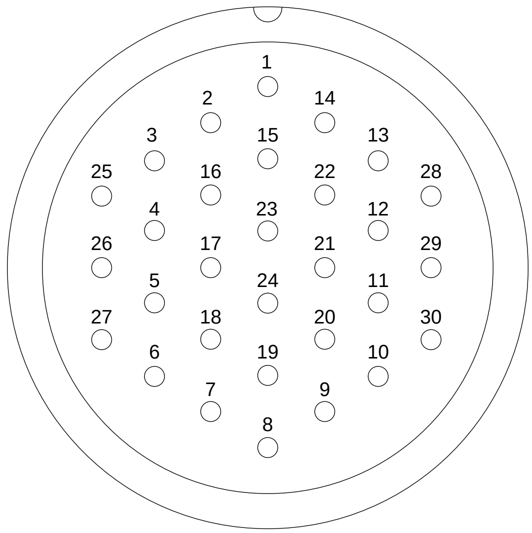
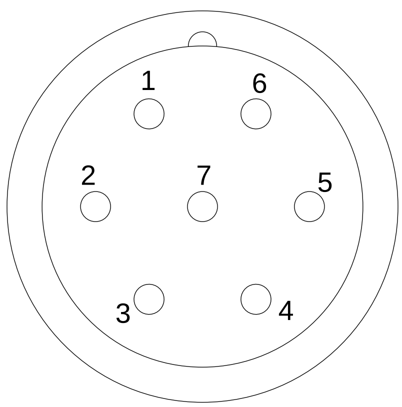


Figure 5-4-10. Missile Tube Control EHP Pin Arrangement

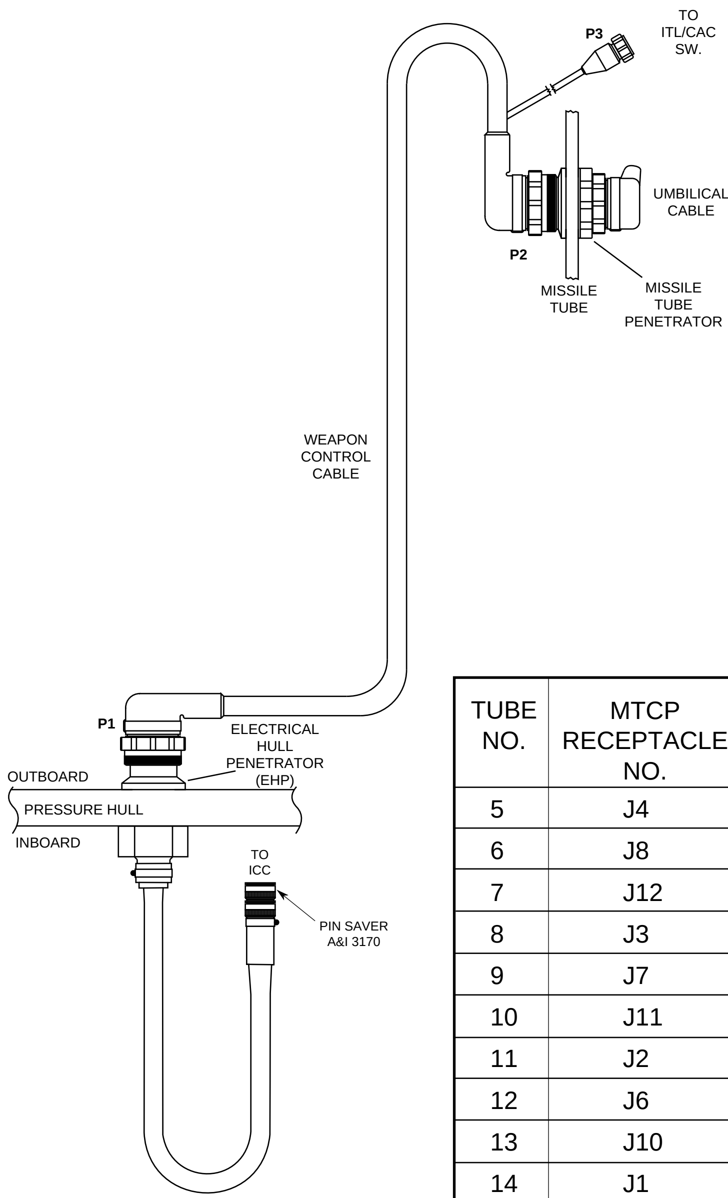


30 Pin Electrical Connector
(Pin Arrangement)



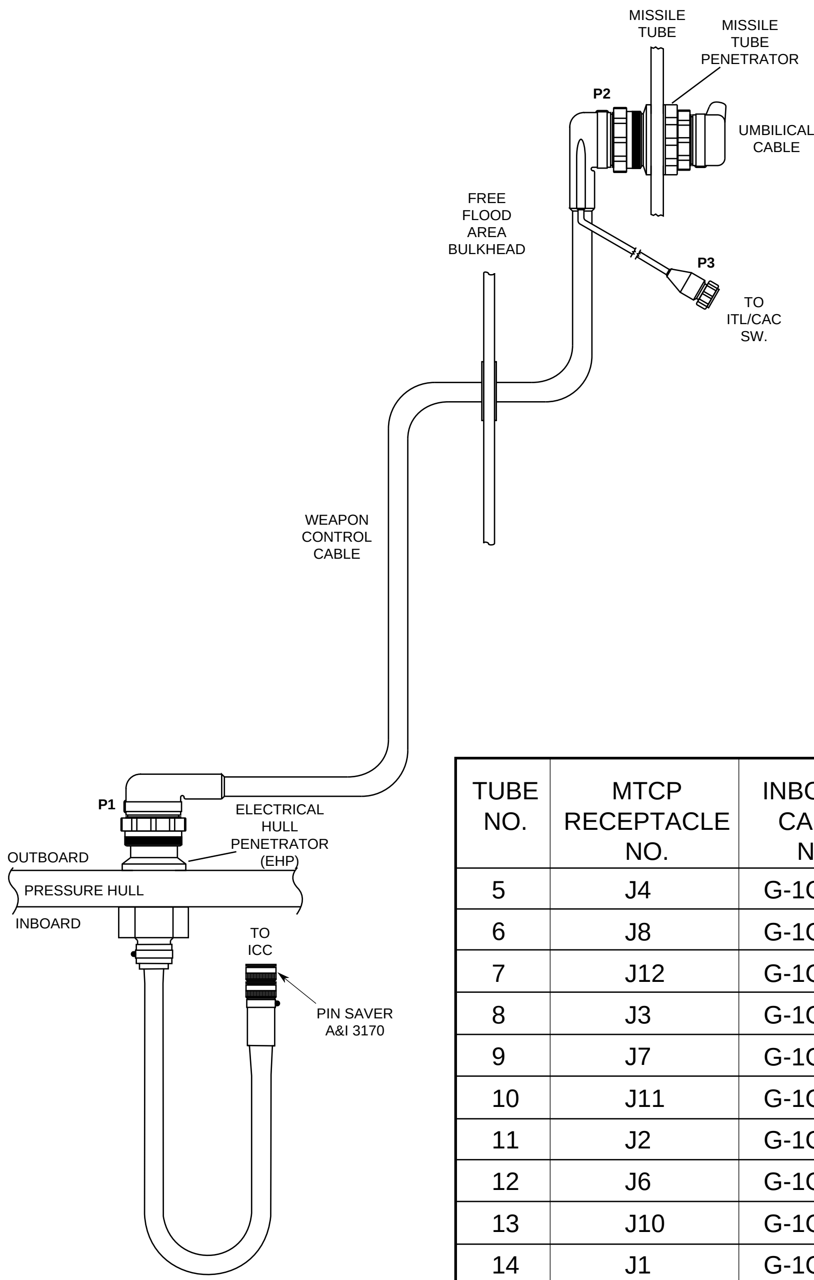
7 Pin Electrical Connector
(Pin Arrangement)

Figure 5-4-11. Connectorized Box Connectors



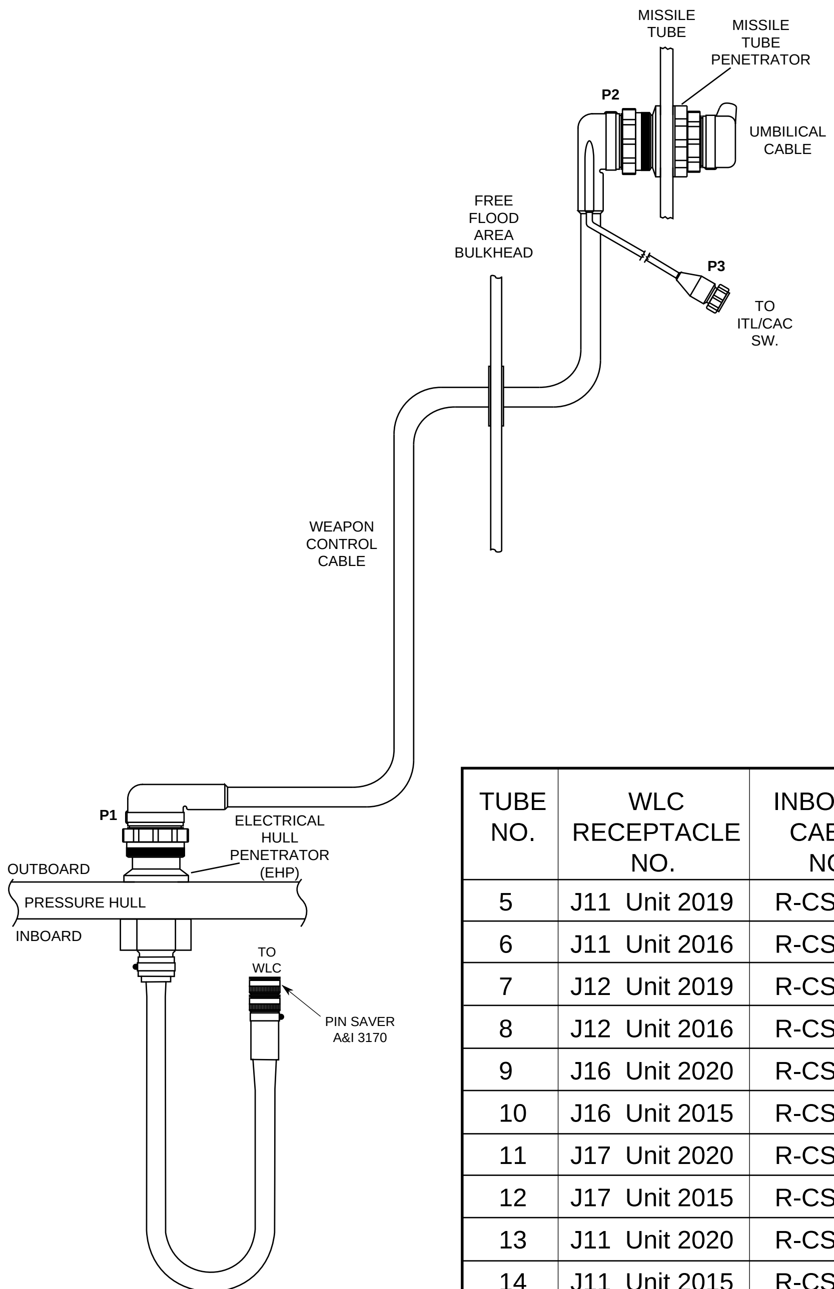
TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.
5	J4	G-1GW8	P26-19S	G-1GW8A
6	J8	G-1GW14	P26-23P	G-1GW14A
7	J12	G-1GW9	P26-18S	G-1GW9A
8	J3	G-1GW15	P26-22P	G-1GW15A
9	J7	G-1GW10	P26-17S	G-1GW10A
10	J11	G-1GW16	P26-21P	G-1GW16A
11	J2	G-1GW11	P26-16S	G-1GW11A
12	J6	G-1GW17	P26-20P	G-1GW17A
13	J10	G-1GW12	P26-12S	G-1GW12A
14	J1	G-1GW18	P26-15P	G-1GW18A
15	J5	G-1GW13	P26-13S	G-1GW13A
16	J9	G-1GW19	P26-14P	G-1GW19A

Figure 5-4-12. Weapon Control Cabling (SSN 719 and 720)



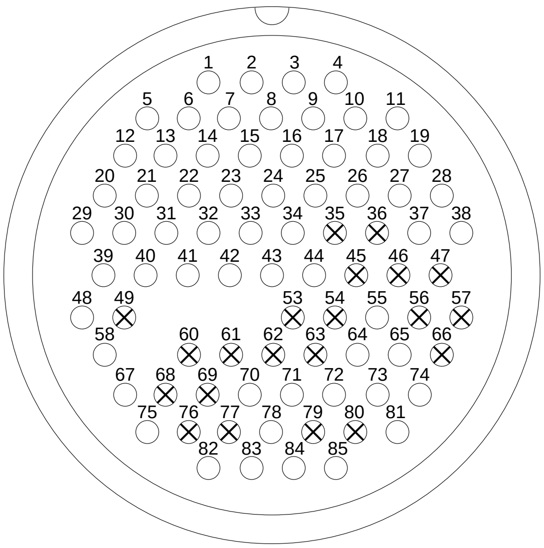
TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.
5	J4	G-1GW8	P26-12S	G-1GW8A
6	J8	G-1GW14	P26-14P	G-1GW14A
7	J12	G-1GW9	P26-13S	G-1GW9A
8	J3	G-1GW15	P26-15P	G-1GW15A
9	J7	G-1GW10	P26-16S	G-1GW10A
10	J11	G-1GW16	P26-20P	G-1GW16A
11	J2	G-1GW11	P26-17S	G-1GW11A
12	J6	G-1GW17	P26-21P	G-1GW17A
13	J10	G-1GW12	P26-18S	G-1GW12A
14	J1	G-1GW18	P26-22P	G-1GW18A
15	J5	G-1GW13	P26-19S	G-1GW13A
16	J9	G-1GW19	P26-23P	G-1GW19A

Figure 5-4-13. Weapon Control Cabling (SSN 721 thru 725 and 750)

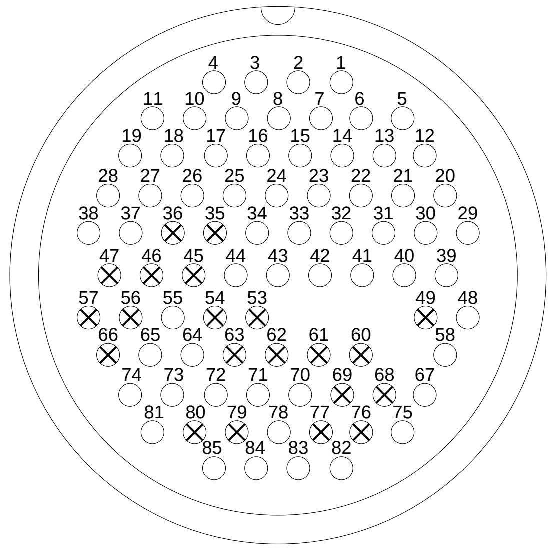


TUBE NO.	WLC RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.
5	J11 Unit 2019	R-CS543	P26-12S	R-CS1092
6	J11 Unit 2016	R-CS541	P26-14P	R-CS1086
7	J12 Unit 2019	R-CS544	P26-13S	R-CS1093
8	J12 Unit 2016	R-CS542	P26-15P	R-CS1087
9	J16 Unit 2020	R-CS537	P26-16S	R-CS1094
10	J16 Unit 2015	R-CS533	P26-20P	R-CS1088
11	J17 Unit 2020	R-CS538	P26-17S	R-CS1095
12	J17 Unit 2015	R-CS534	P26-21P	R-CS1089
13	J11 Unit 2020	R-CS539	P26-18S	R-CS1096
14	J11 Unit 2015	R-CS535	P26-22P	R-CS1090
15	J12 Unit 2020	R-CS540	P26-19S	R-CS1097
16	J12 Unit 2015	R-CS536	P26-23P	R-CS1091

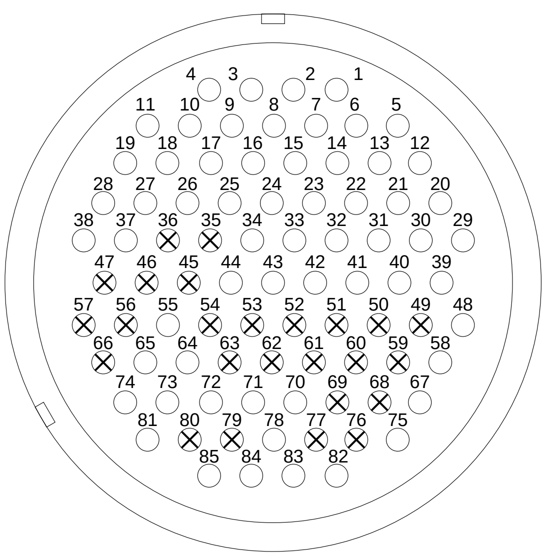
Figure 5-4-14. Weapon Control Cabling (SSN 751 and Later)



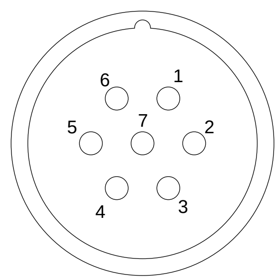
MISSILE TUBE PENETRATOR
WATER SIDE



MISSILE TUBE PENETRATOR
MISSILE SIDE



WEAPON CONTROL CABLE
P1 & P2 CONNECTOR



WEAPON CONTROL CABLE
P3 CONNECTOR

NOTE: PINS WITH AN "X" ARE NOT USED WITH THE NEW 56 CONDUCTOR WEAPON CONTROL CABLE WHICH HAVE "CAC" MARKED ON THE MOLDED CONNECTOR AT BOTH ENDS OF THE CABLE ASSEMBLY.

Figure 5-4-15. Weapon Control Pin Arrangement

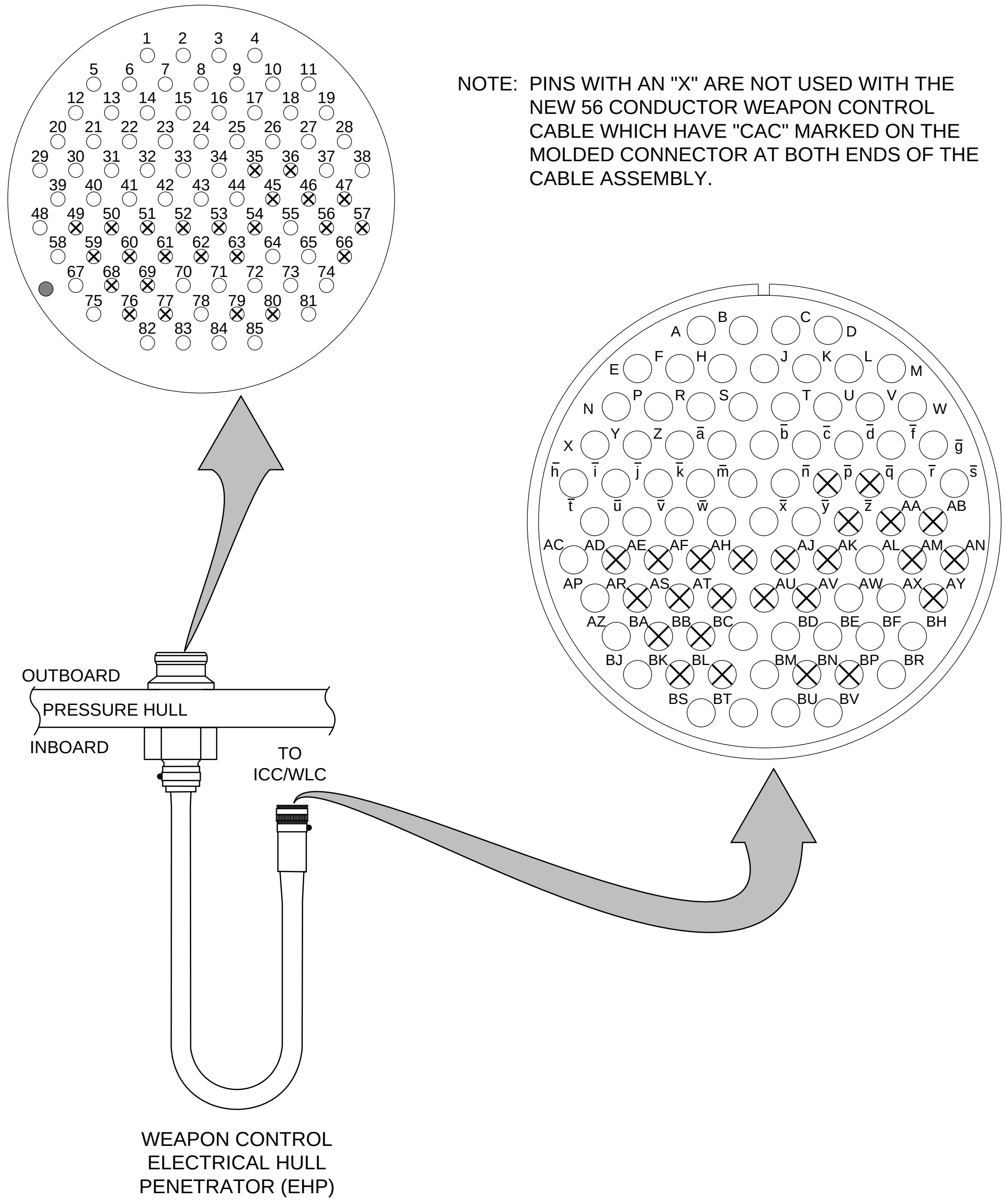


Figure 5-4-16. Electrical Hull Penetrator Pin Arrangement

NOTES: PINS WITH AN "*" ARE NOT USED WITH THE NEW 56 CONDUCTOR WEAPON CONTROL CABLE WHICH HAVE "CAC" MARKED ON THE MOLDED CONNECTOR AT BOTH ENDS OF THE CABLE ASSEMBLY.

SYMBOL ⌐ INDICATES LOWER CASE LETTERS.

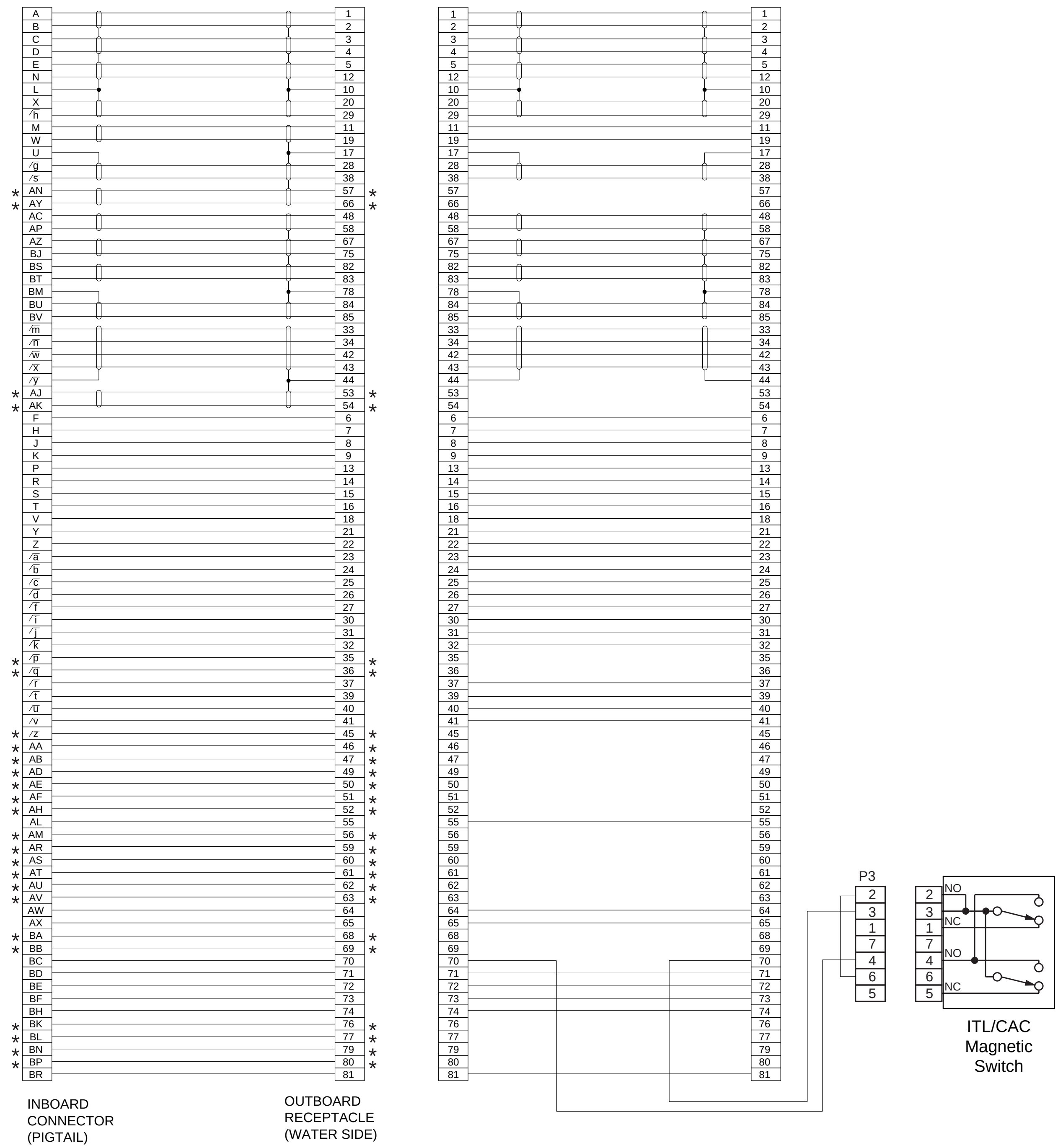


Figure 5-4-17. Weapon Control Circuit Wiring Diagram

CHAPTER 5 MAINTENANCE, REPAIR AND OVERHAUL

5-5-1 INTRODUCTION.

Maintenance, repair and overhaul procedures for the Vertical Launch System (VLS) equipment are provided in this chapter. This chapter contains the removal, disassembly, reassembly and installation procedures which were developed as a guide for the user in the repair/overhaul of VLS components.

Maintenance procedures for all labeled valves are contained in Reference 3 (Ship Valves Technical Manual). The Ship Valves Technical Manual Users Information, Reference 2, refers the user to applicable chapters of Reference 3 (Ship Valves Technical Manual). The manual user needs only to know the valve label to locate maintenance information for the specific valve.

The maintenance procedures in this manual are applicable to the three levels of maintenance: Organizational, Intermediate and Depot. Those corrective maintenance and repair procedures which require special skills and equipment, and are generally beyond the capability of organizational level maintenance, are designated as requiring Intermediate Maintenance Activity (IMA)/Depot Level assistance.

Certain valves in the Pressure/Vent system and Flood/Drain system are within the subsafe boundary. Maintenance on those valves will require the proper SUBSAFE/QA certification documentation prior to commencement of the maintenance. Consult the Quality Assurance Manual and the Submarine Material Identification and Control for Piping Systems Boundary Book to determine which valves are within the SUBSAFE boundary.

The illustrations referred to herein are located at the end of this chapter and in CHAPTER 6.

5-5-2 SCOPE AND ARRANGEMENT

Corrective maintenance procedures consist of removal and replacement procedures for parts subject to wear or damage and reference adjustment procedures needed to realign the equipment. Each procedure has a minimum references and lists initial conditions, precautions and limitations where applicable.

5-5-3 GENERAL NOTES.

a. Remove bearings/bushings from equipment/components only if required by the inspection criteria or when the inspection cannot be accomplished in place.

b. If it is necessary to remove the bearing/bushing, a hardwood dowel or similar object should be used to prevent damaging the bearing/bushing surfaces.

c. Exercise care when removing/installing O-rings, dynamic seals or backup rings. If an O-ring removal/installation tool is not available, use a wooden or soft object.

d. When performing missile tube corrective maintenance, open or shut the hatch in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

e. The loading platform should be used at all times during missile tube maintenance or repair.

f. A tube tightness test shall be conducted after removal of the hatch, missile tube umbilical penetrator, EMS penetrator and differential pressure transducer or upon completion of any major missile tube repair or any linkage adjustment. If missile cannot be removed for repair an Underhatch Tightness Test using the applicable MRC of MIP 7211 must be accomplished.

h. Software must be changed on all piping connection when conducting procedures within this Chapter.

5-5-4 <u>SAFETY PRECAUTIONS.</u>

Procedures provided herein are subject to shipboard safety precautions, safety precautions presented in CHAPTER 1 as applicable, and the following specific requirements:

a. If sound-powered phone communications are lost at any time during hatch operations, stop all operations until communications are restored.

b. Failure to vent a pressurized CLS/AUR prior to opening the missile tube hatch could cause the closure to rupture.

c. Muzzle hatch area must be clear of personnel and material before opening/shutting a muzzle hatch.

d. Gagging pin spring pin must be fully seated against hatch arm to ensure safety of personnel working in, on, or around an open missile tube.

e. Ensure all tagout procedures are in accordance with current shipboard/shore instructions.

f. Operate missile tube muzzle hatch in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

g. Topside personnel must wear a safety harness when working in or around an empty or uncovered missile tube.

h. Do not use any cleaning solvents or petroleum products (greases, penetrating oils, etc.) on surfaces that are covered with or come in contact with KARON V. Refer to CHAPTER 6 for bearing modification applicability.

i. To ensure safety of the worker in the tube, person topside will maintain visual and audible contact with the worker in tube.

j. An open, unattended missile tube shall be covered with a closure protective cover (CPC), capsule loading cover (CLC), counterbore cover or spent capsule cover (depending on situation) to prevent injury to personnel and damage to equipment.

k. All activities shall comply with Reference 54 (Navy Safety Precautions for Forces Afloat).

l. Suffocation hazard exists. Before entering missile tube, the tube must be ventilated and certified free of toxic gas in accordance with current BUMED and ship's instructions.

m. Ensure system pressures and ship’s external vent and supply tank (if applicable) are vented prior to removal of any component from a system.

n. Ensure that applicable hydraulic, seawater and air valves are positioned correctly and tagged out in accordance with current shipboard/shore instructions.

o. Ensure the applicable electrical circuits are tagged out in accordance with current shipboard/shore instructions.

p. Avoid striking and possibly damaging other equipment or piping.

q. Protect threads and machined surfaces during equipment/component removal, disassembly or replacement.

r. Protect all openings, piping, electrical connectors and components from entry of foreign materials when equipment is opened or disassembled.

s. Collect oil in a container for subsequent disposal.

5-5-5 FAIRING CONNECTING LINKAGE.

Removal procedures contained herein provide the information necessary for the removal and reinstallation of the fairing connecting linkage (Figure 5-6-1). Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-1 for parts identification.

5-5-5.1. Initial Conditions

a. Inspect fairing fairness in accordance with paragraph 5-2-3 step c and record results.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

b. Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-5.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-5.3. Fairing Connecting Linkage Removal.

CAUTION

Secure fairing to prevent movement while removing fairing connecting linkage.

CAUTION

Support fairing connecting linkage during removal from hatch arm clevis.

a. Matchmark rod end bearing of linkage assembly (4) to hatch arm, prior to removal.

b. Remove self-locking nut (1), washer (2) and link pin (3) from fairing padeye weldments.

c. Remove self-locking nut (1), washer (2) and link pin (3) from hatch arm clevis and disconnect fairing linkage.

d. Secure the ends of the linkage in such a manner to prevent them from getting out of adjustment.

5-5-5.4. Fairing Connecting Linkage Cleaning Procedures.

Clean connecting linkage in an area free of dirt and debris using an appropriate degreaser/cleaner .

5-5-5.5. Fairing Connecting Linkage Inspection and Repair.

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-1 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect rod end bearings as follows:

(1) Examine rod end bearings for cracks or deformations. Cracked or deformed rod end bearings are unacceptable. Replace defective rod end bearings at reassembly.

(2) Examine rod end bearings for corrosion, pitting and defective surface finish. Maximum allowable pitting depth is limited to 15 percent of rod end bearing thickness covering 25 percent of the surface area. The inner bearing surface finish must be 63 rhr or smoother.

(3) Ensure diametrical clearance between inside diameter of rod end bearings and outside diameter of sleeves (6) area does not exceed 0.007 inch.

(4) Examine rod end ball for excessive looseness or freedom to rotate and ensure it is properly secured in its socket. Replace rod end bearing if ball is excessively loose.

c. Inspect the link pins (3) as follows:

(1) Examine link pins for bends or cracks. A bent or cracked link pin is unacceptable and must be repaired or replaced at reassembly.

(2) Examine link pins for corrosion, scoring, pitting and galling. Link pins that are pitted or scored to a depth greater than 0.010 inch are unacceptable. Clean up galled area if required. The outer surface finish of the link pin must be 63 rhr or smoother.

5-5-5.6. Fairing Connecting Linkage Reinstallation.

After cleaning, inspecting and repairing of fairing linkage, reassemble in accordance with the following procedures. Apply grease (CID A-A-50433) to threaded fasteners and pins.

NOTE

Evenly apply water-wash grease to items (3) and (4) prior to assembly.

WARNING

Personnel shall keep hands clear of connecting linkage while attempting to align linkage with mating component.

a. Reinstall the fairing connecting linkage by reversing the order of procedures in paragraph 5-5-5.3.

b. Clear applicable tagout in accordance with current shipboard instructions.

5-5-5.7. Test Requirements.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

Refer to CHAPTER 2 for test requirements for fairing and fairing assembly fairness.

5-5-6 FAIRING ASSEMBLY.

Repair and overhaul procedures herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly and reinstallation of the fairing assembly. Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-2 for parts identification.

NOTE

This procedure requires IMA/DEPOT assistance.

5-5-6.1. Initial Conditions.

a. Inspect fairing fairness in accordance with paragraph 5-2-3 step c and record results.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

b. Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

c. Support fairing and remove fairing connecting linkage in accordance with paragraph 5-5-5.3.

5-5-6.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-6.3. Fairing Removal and Disassembly.

NOTE

Support fairing using a crane or a similar device.

a. Remove self-locking hex nuts (3) and washers (2) from hinge pins (6).

b. Remove hinge pins (6) from hinge brackets (1).

c. Remove fairing from hinge brackets (1) and move to a clean working area.

d. If required, remove fairing hinge brackets for inspection as follows:

(1) Remove self-locking hex nuts (7) and bolts (5).

(2) If required, remove dowels (4).

NOTE

Refer to general notes, paragraph 5-5-3, steps a. and b., for bearing/bushing removal.

e. If required, remove bushings (10) from fairing arms.

f. If installed, remove locking pellets from bolts (5) as required.

5-5-6.4. Fairing and Hinge Bracket Cleaning Procedures.

Clean components in an area free of dirt and debris using an appropriate degreaser/cleaner .

5-5-6.5. Fairing and Hinge Bracket Inspection and Repair.

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-2 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect hinge pin (6) as follows:

(1) Examine hinge pin for bends and cracks. Repair or replace defective hinge pin.

(2) Examine hinge pin for corrosion, scoring, pitting and galling. If hinge pin is pitted or scored to a depth greater than 0.010 inch, it must be replaced. Clean up galled area if required. The outer surface finish of the hinge pin must be 63 rhr or smoother.

c. Inspect bushing (10) as follows:

(1) Examine hinge bushing for cracks or deformation. Replace defective bushing.

(2) Examine hinge bushing for corrosion, pitting and defective surface finish. Maximum allowable pitting depth is limited to 15 percent of wall thickness covering a maximum of 25 percent of the surface area. The inner surface finish must be of 63 rhr or smoother.

(3) Ensure diametral clearance between the inside diameter of the hinge bushing and the outside diameter of the hinge pin bearing area does not exceed 0.008 inch.

d. Inspect hinge bracket (1) as follows:

(1) Examine hinge bracket for corrosion, pitting and defective surface finish. Maximum allowable pitting is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

(2) Examine hinge bracket for cracks. Repair or replace defective hinge bracket.

(3) Ensure diametral clearance between the inside diameter of the hinge bracket bearing area and the outside diameter of the bushing does not exceed 0.003 inch.

5-5-6.6. Fairing and Hinge Bracket Reassembly and Reinstallation.

After cleaning, inspection and repair of the fairing and hinge bracket, reassemble and reinstall in accordance with the following procedures. Apply grease (CID A-A-50433) to threaded fasteners and pins.

a. Reassemble and reinstall the fairing assembly by reversing the order of procedures in paragraph 5-5-6.3.

b. Reinstall the fairing connecting linkage in accordance with paragraph 5-5-5.6

c. Clear applicable tagout in accordance with current shipboard instructions.

5-5-6.7. Test Requirements.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

Refer to CHAPTER 2 for test requirements for fairing assembly and fairing assembly fairness.

5-5-7 FAIRING LOCKING MECHANISM (SSN 721 and Later).

Repair and overhaul procedures contained herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly and installation of the fairing locking mechanism. Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-3 for parts identification.

5-5-7.1. Initial Conditions.

Muzzle hatch open in accordance with Reference 9 (SSM Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-7.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-7.3. Fairing Locking Mechanism Removal and Disassembly.

a. Matchmark bearing cap (4) to bearing base (3) and bearing (2) and spacers (8) to foundation.

b. Remove bolts (6) and pin retainer (7) from clevis of lock (1).

c. Remove pin (5) from clevis of lock (1) and rod end (21). Allow rod end to hang out of the way.

d. Remove mounting bolts (9) and nuts (10) from bearing (2) and bearing cap (4).

NOTE

Mounting bolts may be different sizes. Therefore, it should be noted what sizes come from what positions.

e. Remove locking mechanism from foundation to a convenient work area.

NOTE

Prevent bearing cap, dowel pins or spacers from falling out and getting lost.

f. Remove spacers (8) and dowels (12) from foundation.

g. Remove bearing caps (4), bushings (27) and dowels (12) from bearing base (3).

h. Remove bearings (2) and bearing bases (3) from lockbar assembly (1).

i. Remove spacers (13) and bushings (26) if required from locks (1).

j. Remove screws (16) and nuts (20) (if applicable) and remove brackets (15) from lockbar assembly (1).

k. If required, remove capscrews (24), nuts (25), magnets (19) and spacers (17) and (18) from bracket (15).

5-5-7.4. Fairing Locking Mechanism Cleaning Procedures.

Clean locking mechanism parts in an area free of dirt and debris using an appropriate degreaser/cleaner .

5-5-7.5. Fairing Locking Mechanism Inspection and Repair.

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-3 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect bearing (2), bearing base (3), and bearing cap (4) bushings (26) and (27) as follows:

(1) Examine bearing, bearing base and bearing cap for cracks. Areas suspected of cracks shall be checked using the dye penetrant method. Repair or replace defective parts prior to reassembly.

(2) Examine bearing, bearing base, bushings and bearing cap for corrosion and pitting. Corrosion and pitting are acceptable provided they are limited to 15 percent of wall thickness covering a maximum of 25 percent of the total surface area.

(3) Examine bushings for cracked or chipped Kamatics material. If cracked or chipped the bushings (26) or (27) must be replaced.

c. Inspect lockbar assembly (1) as follows:

(1) Examine lock assembly for cracks. Areas suspected of cracks shall be checked by the dye penetrant method. Repair or replace defective lock assembly at reassembly.

(2) Examine the lock for corrosion or pitting. Corrosion and pitting is acceptable provided they are limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area. The shaft bearing area shall have a surface finish 63 rhr or smoother.

(3) Examine the fairing dog mating surfaces for evidence of excessive wear. If excessive wear is evident, repair or replace latch assembly at reassembly.

5-5-7.6. Fairing Locking Mechanism Reassembly and Reinstallation.

After cleaning, inspecting and repairing the fairing locking mechanism, reassemble in accordance with the following procedures. Apply grease (CID A-A-50433) to threaded fasteners and pins. Do not apply grease to pins or bushings coated with kamatic material.

NOTE

Torque inboard mounting bolts (9) to 200-225 ft. lbs. and outboard mounting bolts (9) to 350-375 ft. lbs.

a. Reassemble and reinstall fairing locking mechanism by reversing the order of procedures in paragraph 5-5-7.3.

b. Replace all cut lockwire.

c. Clear applicable tagout in accordance with current shipboard instructions.

5-5-7.7. Test Requirements.

Refer to CHAPTER 2 for test requirements for fairing locking mechanism.

5-5-8 FAIRING LOCK HYDRAULIC CYLINDER (SSN 721 and Later).

Repair and overhaul procedures herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly and reinstallation of the fairing lock hydraulic cylinder. Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-4 for parts identification.

NOTE

(SHIPALT 4292K) Teflon backup rings have been replaced with Parbak backup rings and Quad Seals have been replaced with O-Rings in accordance with Reference Drawing 49.1 (ShipAlt 4292K Fairing System Upgrade).

5-5-8.1. Initial Conditions.

Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-8.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-8.3. Fairing Lock Hydraulic Cylinder Removal and Disassembly.

WARNING

Ensure VLS Hydraulic System is tagged out in accordance with current shipboard instruction.

a. Vent VLS hydraulic system and tagout in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

CAUTION

Applicable HMLP(S)-(*)-23 should be shut prior to disconnecting C-1/C-2/C-3 hydraulic lines.

b. Disconnect hydraulic cylinder hydraulic lines and collect oil for disposal. Install appropriate FME to protect pipe ends and cylinder fittings from contamination.

c. If required, remove fairing locking mechanism in accordance with paragraph 5-5-7.

NOTE

If fairing locking mechanism was not removed, rod end (22) must be disconnected (Figure 5-6-3).

d. If required, remove bolts (6) and pin retainer (7) from fairing lock cylinder clevis and remove pin (5) from fairing lock cylinder clevis and rod end (22) (Figure 5-6-3).

CAUTION

Hydraulic cylinder weighs approximately 40 lbs and should be supported while removing mounting bolts.

e. Remove either mounting bolts or nuts (not shown).

f. Remove hydraulic cylinder and move to a clean work area.

g. If required, remove dowel (not shown) from cylinder housing.

h. Remove locking screw (24) and locking pellet (142) of Reference Drawing 49.1 (SHIPALT 4292K VLS Hatch Fairing and Linkage Upgrades).

i. Remove hex head bolts (4) from retainer ring (5), remove retainer ring from end cap (7).

j. Remove nuts (2) from studs (22).

CAUTION

When removing end cap (7) from cylinder housing (23), care must be taken to avoid damaging the cylinder walls or piston rod (12).

k. Tighten jacking bolts (3) to remove end cap (7) and, if required, remove studs (22) from cylinder housing (23).

l. Remove wiper ring (6) from end cap (7).

m. Remove quad ring seal (8), and o-ring (10), backup rings (9) and (11) and jacking bolts (3) from end cap (7).

NOTE

It may be necessary to install rod clevis (1) onto piston rod (12) to facilitate removal of piston rod (12) and piston (13) as an assembly.

n. Carefully remove piston rod (12) and piston (13) from cylinder housing (23).

o. Loosen locking screw (14) and remove piston rod (12) from piston (13).

p. Remove quad ring seals (15) and (16) and backup rings (11) and (17) from piston (13).

q. Remove retainer (21), check valve (18) and O-ring (19) from piston (13). If required, remove locking pellet (20) from retainer.

5-5-8.4. Fairing Lock Hydraulic Cylinder Cleaning Procedures.

Clean cylinder parts in an area free of dirt and debris using an appropriate degreaser/cleaner

5-5-8.5. <u>Fairing Lock Hydraulic Cylinder Inspection and Repair.</u>

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-4 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect seal surfaces for any defects that would prevent O-rings from sealing properly.

c. Inspect piston rod (12) and piston (13) as follows:

(1) Examine external surfaces of the piston rod and piston for corrosion and pitting, especially in areas of thin wall sections. Examine areas suspected of cracks by dye penetrant method. Surface defects are acceptable if the diameter does not exceed 0.010 inch, if their depth does not exceed 0.005 inch and if the average spacing between defects is not less than 1/32 inch. The surface finish of the piston rod must be 16 rhr or smoother.

(2) Examine piston rod and piston for wear. Excessively worn piston rod must be repaired or replaced before reassembly.

(3) Measure the diametral clearance between the smaller end of the piston outside diameter and the inside diameter of the cylinder housing. Diametral clearance must not exceed 0.006 inch. If diametral clearance exceeds its allowable limits, repair or replace piston.

(4) Measure the diametral clearance between the larger end of the piston outside diameter and the inside diameter of the cylinder housing. Diametral clearance must not exceed 0.009 inch. If diametral clearance exceeds its allowable limits, repair or replace piston.

(5) Measure the diametral clearance between the outside diameter of the piston rod and the inside diameter of the end cap. Diametral clearance must not exceed 0.007 inch. If diametral clearance exceeds its allowable limits, repair or replace piston rod.

d. Inspect cylinder housing (23) as follows:

(1) Examine the internal and external surfaces of the cylinder housing for corrosion and pitting, especially in areas of thin wall sections. Examine areas suspected of cracks by the dye penetrant method. Maximum allowable pitting is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area. The surface finish of the cylinder housing must be 16 rhr or smoother.

(2) Surface defect of the cylinder housing is acceptable if the diameter does not exceed 0.010 inch, if the depth does not exceed 0.005 inch and if the average spacing between defects is not less than 1/32 inch.

(3) Examine cylinder housing for wear. Excessively worn cylinder housing must be repaired or replaced.

(4) Examine ports C-1 and C-2 and leakoff passage C-3 for foreign material. Remove as necessary.

e. Inspect end cap (7) as follows:

(1) Examine the end cap for corrosion and pitting.

(2) Examine areas suspected of cracks by dye penetrant method. Maximum allowable pitting is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

(3) Measure the diametral clearance between the inside diameter of the end cap and the outside diameter of the piston rod stem. Diametral clearance must not exceed 0.065 inch. If diametral clearance exceeds its allowable limit, repair or replace end cap.

f. Examine retaining ring (5) for cracks, nicks, burrs and corrosion. Minor nicks and burrs may be removed using crocus cloth. Replace retaining ring if cracked.

g. Examine insert pellet (20) of check valve retainer (21) and replace if required.

h. Inspect rod clevis (1) as follows:

(1) Examine clevis for cracks that may cause failure. Cracks are unacceptable. Repair or replace clevis if cracked.

(2) Examine clevis for corrosion and pitting. Corrosion and pitting are acceptable provided they are limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

5-5-8.6. Fairing Lock Hydraulic Cylinder Reassembly.

After cleaning, inspecting and repairing of the hydraulic cylinder, reassemble in accordance with the following procedure. Lightly lubricate O-rings with system hydraulic oil (2075).

CAUTION

When reassembling cylinder, care must be taken to prevent damaging O-rings when inserting piston into cylinder housing.

a. Install O-ring (19) on check valve (18).

b. Install check valve (18), retainer (21) with locking pellet (20) in piston (13).

c. Install quad ring seals (15) and (16) and backup rings (11) and (17) on piston (13).

d. If piston rod (12) was removed from piston (13) install piston rod (12) into piston (13) and secure with locking screw (14).

e. Carefully insert piston (13) and piston rod (12) into housing (23).

f. If studs (22) were removed, install studs (22) into housing (23).

g. Install quad ring seal (8), and o-ring (10), and backup rings (11) and (9) on end cap (7).

h. Ensure jacking bolts (3) are retracted and carefully install end cap (7) onto housing (23).

i. Secure end cap (7) to housing (23) using self-locking hex nuts (2), and torque to 20 + 5 - 0 ft-lbs.

j. Install wiper ring (6) and retainer ring (5) on end cap (7) and secure with bolts (4).

k. Attach rod clevis (1) to piston rod (12) securing it with locking screw (24) and locking pellet (142) of reference drawing 704-8206350 (SHIPALT 4292K VLS Hatch Fairing and Linkage upgrades) not shown on Figure 5-6-4.

l. Torque locking screw (24) to 75 + 0 - 5 in-lbs.

m. Perform applicable bench test in accordance with paragraph 5-2-5.

5-5-8.7. Fairing Lock Hydraulic Cylinder Reinstallation.

a. Align and install hydraulic cylinder using mounting bolts or nuts.

b. Reconnect hydraulic lines to fairing lock cylinder.

c. Reinstall fairing locking mechanism by reversing the order of procedures contained in paragraph 5-5-7.

d. Replace all cut lockwire.

e. Open applicable HMLP(S)-(*)-23.

f. Clear tagout and restore VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-8.8. Test Requirements.

Refer to CHAPTER 2 for test requirements for fairing lock hydraulic cylinder.

5-5-9 MUZZLE HATCH T-BAR LOCKING MECHANISM (SSN 719 and 720).

Repair and overhaul procedures contained herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly and reinstallation of the muzzle hatch T-bar locking mechanism. Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-5 for parts identification.

5-5-9.1. Initial Conditions.

a. Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

b. Power to applicable missile tube muzzle hatch indicating circuit secured.

5-5-9.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-9.3. Muzzle Hatch T-Bar Locking Mechanism Removal and Disassembly.

a. Remove self-locking capscrew (10) and washer (11) from flatbar spring (8).

b. Remove self-locking capscrews (9), flatbar spring (8) and spring mount (7) from hatch closed switch bracket (1).

c. Ensure hatch closed switch (not shown) is removed from hatch closed switch bracket (1).

d. Remove self-locking capscrews (4), washers (3), self-locking capscrew (6), insert (5), dowel pin (2), and hatch closed switch bracket (1) from locking T-bar (16).

e. Remove self-locking capscrews (30) and pin retainer (31) from locking T-bar (16). Then remove pin (32) and disconnect tie rod (33) from locking T-bar (16).

f. Remove self-locking capscrews (13) and hinge brackets (17) or (18) and (20) as applicable with locking T-bar (16), from mounting pads on missile tube.

g. Move applicable hinge bracket (17) or (18) and (20) and locking T-bar (16) to a convenient work area and disassemble as follows:

NOTE

The T-bar locking mechanism varies in design. Perform steps (1) through (5), as applicable.

(1) If required, remove lubricating fitting (not shown) from shaft pivot (12).

(2) Remove self-locking setscrew (15) and shaft pivot (12) and disconnect T-bar (16) from applicable hinge bracket (17) or (18) and (20).

(3) Remove self-locking capscrew (27), pin retainer (28) and pin (29) from locking T-bar (16).

(4) Remove pivot shaft (26) from hinge bracket (17).

(5) Remove self-locking nut (21), washer (22), clevis (23) and key (25) from pivot shaft (26).

NOTE

Refer to general notes, paragraph 5-5-3, steps a. and b., for bearing/bushing removal.

h. If required, remove journal bearings (14) or (19) from hinge bracket (17) or (18) and (20), as applicable.

i. Remove self-locking capscrew (41) and closed hatch magnet bracket (42). If required, disassemble magnet retainer as follows:

(1) Remove self-locking nuts (40).

(2) Remove capscrews (35), special spacers (36), U-shape magnets (37), magnet housings (38) and spacers (39).

j. Remove self-locking nuts (43) and special bolts (46) from bellcrank (45). Disconnect tie rods (34) and (53) from bellcrank (45).

NOTE

Do not change the length of the tie rods until exact measurements are taken to ensure proper alignment upon reinstallation.

k. Remove self-locking capscrews (50) and pin retainer (49) from missile tube. Remove pin (48) and disconnect bellcrank (45) from missile tube. Remove lubricating fittings (not shown) from bellcrank (45) if necessary.

l. Remove self-locking nuts (57) and special bolts (55) or self-locking capscrews (59), pin retainer (58) and pin (60) from bellcrank (56) as applicable. Disconnect tie rod (53) from bellcrank (56).

m. Remove self-locking nut (69) and capscrews (68) holding shaft bearing (65) to foundation.

n. Remove shaft bearing (65) from hydraulic rotary actuator pinion gear and move shaft bearing (65) to a convenient work area.

o. Remove self-locking nuts (61) and special bolts (74) or self-locking capscrews (59), pin retainer (58) and pin (60) from bellcrank (62) as applicable. Disconnect tie rod (76) from bellcranks (56) and (62).

p. Remove self-locking capscrews (67) and pin retainer (66) from shaft bearing (65). Remove pin (70) or self-locking nut (52) and special bolt (51) and remove bellcrank (56).

q. Remove self-locking capscrews (71) and pin retainer (72) from bellcrank (62).

r. Remove pin (73) and bellcrank (62) from shaft bearing (65).

s. If required, remove bellcrank unlocking contact screw (64) and locking contact screw (63) from bellcrank (62).

t. If required, remove lubricating fittings (not shown) from bellcranks (45), (56), (62) and shaft bearing (65).

u. If tie rods (34), (53) and (76) require disassembly, perform the following steps:

    (1) Measure tie rods (34), (53), (76) lengths and record results.

    (2) If required, remove tie rods ends (33), (44), (47), (54), (75) and (77).

5-5-9.4. Muzzle Hatch T-Bar Locking Mechanism Cleaning Procedures.

Clean T-bar mechanism in an area free of dirt and debris using an appropriate degreaser/cleaner.

5-5-9.5. Muzzle Hatch T-Bar Locking Mechanism Inspection and Repair.

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-5 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect bellcranks (45), (56), and (62) as follows:

(1) Examine bellcranks for cracks. Areas suspected of cracks shall be checked using the dye penetrant method. Repair or replace defective bellcrank at reassembly.

(2) Examine external surfaces of bellcranks for corrosion and pitting, especially in areas of thin wall sections. Maximum allowable external corrosion pitting depth is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

(3) Examine the diametral clearance between bellcrank pin or bolt holes and outside surface of pins or bolt. Diametral clearance must not exceed 0.012 inch. If diametral clearance has been exceeded, replace bellcrank or install oversize pin or bolt at reassembly.

c. Inspect tie rods (34), (53), and (76) as follows:

(1) Examine tie rod for cracks and bends. Cracks and bends are unacceptable. Repair or replace at reassembly.

(2) Examine tie rod ends for corrosion, pitting and defective surface finish. Remove corrosion. Maximum allowable pitting depth is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

d. Inspect hinge bracket (17) or (18) and (20) and locking T-bar (16) as follows:

(1) Examine hinge bracket and locking T-bar for cracks. Repair or replace defective part prior to reassembly.

(2) Examine hinge bracket and locking T-bar hinge bores for scoring, corrosion and galling. Repair or replace as necessary.

e. Inspect journal bearing (14) or (19) as follows:

(1) Examine journal bearing for cracks, corrosion or deterioration. Replace bearing as necessary.

(2) Ensure diametral clearance between inside diameter of journal bearing and outside diameter of pivot shaft bearing area does not exceed 0.015 inch.

f. Inspect rod bearings (33), (47), (75), and (77) as follows:

(1) Examine rod bearings for cracks or deformations. Cracked or deformed rod bearings are unacceptable. Replace defective rod bearings at reassembly.

(2) Examine rod bearings for corrosion, pitting and defective surface finish. Maximum allowable pitting depth is limited to 15 percent of rod bearing thickness covering 25 percent of the surface area. The inner bearing finish must be 63 rhr or smoother.

(3) Ensure diametral clearance between inside diameter of rod bearings and outside diameter of pin or bolt areas does not exceed 0.010 inch.

(4) Examine rod ball for looseness and ensure it is properly secured in its socket. Replace rod bearing if ball is excessively loose.

g. Inspect pins (48), (70), (73), and shaft pivot (12) or (26) as follows:

(1) Examine pins and shaft pivot for bends and cracks which may cause failure. Bent or cracked pins and shaft pivot must be repaired or replaced prior to reassembly.

(2) Examine pins and shaft pivot for corrosion, scoring, pitting and galling. Pins and shaft pivot corroded or scored to a depth greater than 0.010 inch are unacceptable. Repair or replace part prior to reassembly.

5-5-9.6. Muzzle Hatch T-Bar Locking Mechanism Reassembly and Reinstallation.

After cleaning, inspecting and repairing muzzle hatch T-bar locking mechanism, reassemble and reinstall in accordance with the following procedures:

a. Lubricate parts as follows:

(1) Check the applicable drawing to determine if the lubricant has been specified. If a lubricant has not been specified, perform step (2).

(2) All nuts shall have threads and washer face coated with FEL-PRO-C5-A (MIL-A-907).

b. Replace plastic insert as required.

NOTE

If magnet assembly was disassembled, refer to drawing 704-5765850 for coating procedures.

c. Reassemble and reinstall muzzle hatch T-bar locking mechanism by reversing the order of procedures in paragraph 5-5-9.3.

d. Replace all cut lockwire.

e. Clear applicable tagout in accordance with current shipboard instructions.

5-5-9.7. Test Requirements.

Refer to CHAPTER 2 for test requirements for muzzle hatch T-bar locking mechanism.

5-5-10 MUZZLE HATCH AND MUZZLE HATCH OPERATING MECHANISM.

Repair and overhaul procedures contained herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly and reinstallation of the muzzle hatch and muzzle hatch operating mechanism. Use applicable drawings for specific installation/ adjustment procedures not covered in this volume. Refer to Figure 5-6-6 for parts identification. Figure 5-5-1 identifies the new bushings and pins part numbers.

5-5-10.1. Initial Conditions.

Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-10.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-10.3. Muzzle Hatch and Muzzle Hatch Operating Mechanism Removal and Disassembly.

NOTE

This procedure requires IMA/DEPOT assistance and is normally conducted on an empty missile tube. However, if conditions dictate and local directives allow, this procedure can be conducted by installing a capsule protective cover or capsule loading cover.

a. Remove missile tube fairing in accordance with paragraph 5-5-6.

b. Remove muzzle hatch T-bar locking mechanism in accordance with paragraph 5-5-9 if required (SSN 719 and 720).

c. A torque load exists on toggle linkage, remove the load as follows:

NOTE

Hydraulic pressure is required to perform the following steps.

(1) Ensure hatch close valve HMLP(S)-(*)-(25) is shut.

WARNING

Ensure personnel are clear of the muzzle hatch and linkage while operating the hatch.

(2) Command the muzzle hatch to the shut position by operating the appropriate switch.

(3) Unpin and slowly open the hatch close valve until the torque load is off the toggle linkage and the muzzle hatch gagging pin can still rotate freely. Shut the hatch close valve HMLP(S)-(*)-25.

(4) Command the muzzle hatch to the open position by operating the appropriate switch.

WARNING

Hydraulics will not be tagged out until the completion of steps 5-5-10.3d through 5-5-10.3j. Personnel must use caution while working around operating linkage.

d. Record measurement of distance between upper flat of offset link (9) and lower flat of turnbuckle (12).

e. Matchmark turnbuckle (12) to offset link (9) and disconnect hatch link if required.

f. Apply restraining device on offset link (9).

CAUTION

Properly secure offset link (9) while performing steps 5-5-10.3g. through 5-5-10.3j.

g. Remove self-locking capscrews (18) and retainer (19) from hatch clevis (21).

WARNING

Muzzle Hatch and/or Muzzle Hatch Operating Linkage may need to be repositioned to gain access for the removal of Link Pins (7) and (20). Ensure that the Muzzle Hatch and/or Muzzle Hatch Operating Linkage is properly secured to prevent personnel injury.

h. Remove link pin (20) from hatch clevis.

i. Remove self-locking capscrews (5) and pin retainer (6) from actuator clevis (15).

j. Remove link pin (7) from actuator clevis (15).

WARNING

Ensure VLS Hydraulic System is tagged out in accordance with current shipboard instruction.

k. Secure VLS hydraulics as follows:

(1) Vent and tagout VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

(2) Tagout the muzzle hatch in accordance with current shipboard instructions.

CAUTION

The hatch link and turnbuckle assembly weighs approximately 200 lbs. Use proper lifting device when removing.

l. Remove offset link (9) and turnbuckle (12) from clevis (21) and (15).

m. Using crane or similar lifting device remove offset link (9) and turnbuckle (12) and move to a convenient work area.

n. Visually inspect pin bearings (8), (10), (13) and (14) of turnbuckle (12) and offset link (9). Use emery cloth to remove scale as necessary. Replace in accordance with paragraph 5-5-3 step b. if damaged.

WARNING

Ensure hatch indicating circuits are de-energized to prevent injury to personnel or damage to equipment.

o. If required remove Hatch Open and CAC magnetic switches (not shown) to gain access and prevent damage while working in that area.

CAUTION

The muzzle hatch and hatch arm assembly weighs approximately 500 lbs. Use proper lifting device when removing.

NOTE

Some of the bolts (24) restraining pillow block (25) are body bound and do not have self locking nuts.

p. Remove self-locking nuts (37) and tapped or fitted bolts (24) from pillow block (25). If applicable, remove dowel pins (36).

q. Remove self-locking nuts (58) and fitted bolts (56) from pillow block (57).

r. Remove gagging pin (62), freeing the hatch and hatch arm assembly.

s. Attach a crane or similar lifting device to the hatch and hatch arm assembly.

NOTE

There are shims located beneath pillow blocks (25) and (57). Matchmark for proper installation if not welded in place.

t. Remove missile tube muzzle hatch (39) with hatch arm (41) and hatch operating mechanism through fairing opening and move to a convenient work area.

u. Remove self-locking nuts (40) and shoulder bolts (43) and disconnect muzzle hatch (39) from hatch arm (41).

NOTE

Refer to general notes, paragraph 5-5-3, steps a. and b., for bearing/bushing removal.

v. If required, remove bearing (42) and (44) from hatch arm (41).

w. Matchmark hatch clevis (21) to torque shaft (29).

x. Remove self-locking nut (22) and self-locking capscrew (17) from hatch clevis (21).

NOTE

Spacers (23), (55), (27) and (60) can be of different thickness. Ensure they are affixed to component they ride against for proper reinstallation.

y. Remove hatch clevis (21) and spacer (23) from torque shaft (29). Affix spacer (23) to clevis (21) as it was removed from torque shaft.

z. Matchmark shaft retainer (54) to pillow block (57).

aa. Remove capscrews (53), shaft retainer (54), and spacer (55) from torque shaft (29). Affix spacer (55) to shaft retainer (54) as it was removed from torque shaft (29).

ab. Remove pillow block (25) from torque shaft (29).

ac. Remove torque shaft bearing halves (26) from torque shaft (29)

ad. Remove spacer (27) from torque shaft (29). Affix spacer (27) to side of pillow block (25) as it was removed from torque shaft (29).

ae. Remove pillow block (57) and spacer (60) from torque shaft (29). Affix spacer (60) to pillow block (57) as removed from torque shaft (29). If required, remove shaft bearing (59) from pillow block (57).

af. If required, matchmark torque shaft (29) to hatch arm (41).

ag. If required, remove torque shaft (29), torque shaft bearing (61) and torque shaft bearing halves (28) from hatch arm (41).

5-5-10.4. Muzzle Hatch Operating Mechanism Cleaning Procedures.

Clean operating mechanism components in an area free of dirt and debris using an appropriate degreaser/cleaner.

5-5-10.5. Muzzle Hatch Operating Mechanism Inspection and Repair.

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-6 for parts identification.

a. Inspect threaded fasterners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect bearings (26), (28), (59) and (61) as follows:

(1) Examine bearings for significant cracks. A cracked bearing is unacceptable and must be replaced prior to reassembly. The inner surface finish of bearings must be 63 rhr or smoother.

(2) Inspect bearing for proper thickness. Thickness must be at least 0.260 inch.

c. Inspect bearings (42) and (44) as follows:

(1) Without removing bearing from the hinge arm, examine bearings for cracks and wear. A cracked bearing must be replaced at reassembly.

(2) The bearings must be tight in the hinge arm. Replace loose bearings with oversized replacement parts to obtain 0.000 to 0.004 inch diametral clearance.

(3) Ensure diametral clearance between the inside diameter of the bearing and the outside of the shoulder bolt bearing surface does not exceed 0.010 inch. The inner surface finish of the bearing must be 63 rhr or smoother.

d. Inspect pin bushings (8), (10), (13) and (14) as follows:

(1) Without removing bushings, examine pin bushings for cracks, corrosion and wear. A cracked or significantly corroded pin bushing must be replaced prior to reassembly.

(2) The bushing should fit snugly in the hatch link or turnbuckle. Replace with oversized bearings if loose.

(3) Ensure diametral clearance between the inside diameter of the pin bearing and the outside diameter of link pin bearing areas does not exceed 0.010 inch. The inner surface finish of the pin bearing must be 63 rhr or smoother.

e. Inspect clevises (15) and (21) as follows:

(1) Examine clevises for cracks or corrosion.

(2) Examine external surfaces of clevises for corrosion and pitting, especially in areas of thin wall sections. Examine areas suspected of cracks by the dye penetrant method. Maximum allowable external corrosion pitting depth is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

(3) Examine clevises splines for burrs and high spots. There should be no binding between hatch clevis splines and mating splines at reassembly.

f. Inspect hatch arm (41) as follows:

(1) Examine hatch arm for cracks and significant corrosion. Areas suspected of cracks should be examined by the dye penetrant method.

(2) Torque shaft (29) should normally be tight in hatch arm. Disassemble only if loose fit exists.

g. Inspect torque shaft (29) as follows:

(1) The torque shaft will normally be tight in the hatch arm and need not be removed. Examine exposed portion for bends and cracks that could cause failure. Areas suspected of cracks should be examined by the dye penetrant method.

(2) Examine exposed portions of torque shaft for chipped or broken splines.

(3) Examine torque shaft splines for burrs and high spots. There should be no binding at reassembly between torque shaft splines and mating splines at reassembly.

h. Inspect hatch link (9) as follows:

(1) Examine hatch link for cracks. A cracked hatch link must be repaired or replaced prior to reassembly. Inspect pin end for distortion.

(2) Examine hatch link for general corrosion and pitting. Maximum allowable external corrosion pitting depth is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

i. Inspect turnbuckle (12) as follows:

(1) Examine turnbuckle for general corrosion and pitting. Maximum allowable pitting depth is limited to 15 percent of the wall thickness covering a maximum of 25 percent of the surface area.

(2) Examine turnbuckle (link end) for cracks and wear. A cracked hatch turnbuckle must be repaired or replaced prior to reassembly. Inspect pin end for distortion.

j. Inspect pillow blocks (25) and (57) as follows:

(1) Examine pillow blocks for cracks, corrosion and pitting. Cracks are unacceptable. Areas suspected of cracks shall be checked by the dye penetrant method. Corrosion and pitting are acceptable provided they are limited to 15 percent of wall thickness covering a maximum of 25 percent of the surface area. Repair or replace damaged pillow block.

(2) The bearings must be tight in the pillow blocks. Replace loose bearings with oversized replacement parts to obtain 0.000 to 0.004 inch diametral clearance.

k. Inspect link pins (7) and (20) for chips and cracks on the KARON material. Chip or cracked pins must be replaced at reassembly.

5-5-10.6. <u>Muzzle Hatch Operating Mechanism Reassembly and Reinstallation.</u>

After cleaning, inspecting and repairing of the muzzle hatch operating mechanism, reassemble in accordance with the following procedures. Apply grease (CID A-A-50433) to threaded fasteners and pins. Do not apply grease to pins, bushings and bearings coated with KARON V.

a. Check applicable documents for specified lubricant.

CAUTION

Do not use any cleaning solvents or penetrating oil on surfaces that are coated with or come in contact with KARON V.

b. Lubricate mating surfaces of all moving parts (except KARON pins, bushings and bearings) with a liberal coating of grease (CID A-A-50433).

c. Ensure Hatch Open and ITL/CAC magnetic switches are properly installed.

d. Reassemble and reinstall muzzle hatch and muzzle hatch operating mechanism by reversing the order of procedures in paragraph 5-5-10.3.

e. Replace all cut lockwire.

f. Clear all tagouts and restore VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-10.7. Test Requirements.

Refer to CHAPTER 2 for test requirements for muzzle hatch and muzzle hatch operating mechanism.

5-5-11 MUZZLE HATCH AND FAIRING GASKETS.

Repair and overhaul procedures contained herein provide the information necessary for the removal and replacement of the muzzle hatch and fairing gaskets. Use applicable drawings for specific installation/adjustment procedures not covered in this chapter. Refer to for parts identification.

5-5-11.1. Initial Conditions.

Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-11.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-11.3. Muzzle Hatch Gasket Removal and Replacement.

a. Matchmark position of gasket retaining ring (2) in relation to missile tube muzzle hatch, leaving no raised metal when matchmarking. Original matchmark may already be visible.

b. Remove self-locking capscrews (1) from retaining ring (2).

c. Remove retaining ring (2) from hatch, being careful not to damage retaining ring (2).

d. Remove and discard gasket (3).

NOTE

Gasket recess must be cleaned and free of foreign material before installing new gasket.

e. Inspect new gasket (3) for nicks, flat spots, abrasion and mold flash. Inspect and clean gasket recess.

f. Install new gasket (3). For ease of installation, start from top and work downward in both directions.

g. Install retaining ring (2) with matchmarks aligned.

h. Install capscrews (1) after coating capscrews with grease (CID A-A-50433). Start all screws by hand before tightening.

i. Torque capscrews (1) to 75 ± 5 in. lbs.

NOTE

Heads of capscrews must not protrude above face of muzzle hatch.

j. Clean muzzle hatch gasket and seating surfaces. Be sure all debris has been removed.

k. Clear applicable tagout in accordance with current shipboard instructions.

5-5-11.4. Muzzle Hatch Gasket Test Requirements.

Refer to CHAPTER 2 for test requirements for muzzle hatch gasket.

5-5-11.5. Fairing Gasket Removal and Replacement.

NOTE

If SHIPALT 4292K VLS Hatch Fairing and Linkage Upgrades is complete, then the following procedure is not applicable. Adjustable stops are to be repaired/replaced using Reference Drawing 49.1 (SHIPALT 4292K Fairing System upgrade).

NOTE

On SSN 719 and 720, some missile tube fairing gaskets are retained by nuts and capscrews while others are retained by capscrews only. Identify their location during removal to facilitate reinstallation.

a. Inspect fairing fairness in accordance with paragraph 5-2-3 step c and record results.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

b. Remove self-locking nut (4) where applicable, machine screw (5) and retaining clip (7).

c. Remove fairing gasket (6) from gasket retainer.

NOTE

Gasket recess must be clean and free of foreign material before installing new gasket.

d. Inspect new gasket (6) for nicks, flat spots, abrasion and mold flash. Inspect and clean gasket recess.

e. Install new gasket as follows:

(1) Coat new gasket (6) and retainer sealing surfaces with contact cement.

(2) Reinstall retaining clips (7), machine screws (5) and self-locking nut (4) as applicable that were removed in Step 5-5-11.5b.

(3) Fill side gaps with polysulfide caulking compound. Remove excess compound.

(4) After all adjustments have been made to the fairing and hatch, trim excess gasket that protrudes above the non-pressure hull and fairing, flush with the deck, with the muzzle hatch and fairing shut.

f. Clear applicable tagout in accordance with current shipboard instructions.

5-5-11.6. Fairing Gasket Test Requirements.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

Refer to CHAPTER 2 for test requirements for fairing gaskets and fairing assembly fairness.

5-5-12 MUZZLE HATCH AND FAIRING ROTARY ACTUATOR.

Repair and overhaul procedures contained herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly, reinstallation and testing of the rotary actuator. Use applicable drawings for specific installation/adjustment procedures not covered in this chapter. Refer to Figure 5-6-8 for parts identification.
Figure 5-5-1 identifies the new bushing, bearing, and pin part numbers.

5-5-12.1. Initial Conditions.

a. Inspect fairing fairness in accordance with paragraph 5-2-3 step c and record results.

NOTE

Fairing fairness is part of a noise critical system and must conform to the Noise Review Program requirements. Deviations require Noise Review Program approval.

b. Muzzle hatch of tube being worked open and required adjacent muzzle hatches open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

c. Power to applicable missile tube muzzle hatch indicating circuit secured.

5-5-12.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-12.3. Muzzle Hatch Rotary Actuator Removal.

WARNING

Due to the rigging required to handle the actuator safely to prevent dropping rotary actuator and causing injury to personnel or damage to equipment IMA/DEPOT assistance is required.

NOTE

Due to the various operating linkage configurations and structural/piping interference, the actual removal and installation procedure for the muzzle hatch actuator will vary. This procedure simply provides guidance for the removal and installation of the muzzle hatch actuator.

NOTE

Reference Drawing 46.1 (SSN 688 Class Submarine Removal/Installation Missile Tube Hatch Actuator Arrangement) will provide guidance for SSN 721 and Later, however, these drawings will suggest cutting the superstructure which may not be necessary. Conduct ship check to verify accessibility.

NOTE

SSN 719 and 720 will need to consult the installation drawings used by the appropriate shipyard, or contact the VLS ISEA for direction.

NOTE

When removing the muzzle hatch linkage, ensure that the muzzle hatch is not fully open or fully shut, due to over toggle pressures (hydraulic and mechanical).

NOTE

Table 5-5-1 is a recommended list of equipment to be used during removal and installation of the muzzle hatch actuator.

Table 5-5-1. Muzzle Hatch Rotary Actuator Removal and Installation Equipment

ITEM	DESCRIPTION	QUANTITY
1	Hoist, Lvr 0.750 Ton 12 Ft. Lift	6
2	Shackle, AHP 0.750 Size (SWL 4475 LB)	5
3	Sling, Web Eye to Eye 1 inch wide x 33 inches long	4
4	Sling, Web Eye to Eye 1 inch wide x 60 inches long	2
5	Sling, Web Eye to Eye 1 inch wide x 125 inches long	1
6	Wooden Blocks various sizes	As required.
7	Torque Multiplier	1
8	HY-TORC hydraulic torque wrench w/small head	1
9	Pry-bar	2

a. Disconnect fairing from muzzle hatch in accordance with paragraph 5-5-5.

b. Disconnect applicable portions of the muzzle hatch operating linkage and T-bar locking mechanism (SSN 719 and 720), in accordance with paragraph 5-5-9 and 5-5-10.

c. Ensure that all padeyes have been visually inspected prior to use. Inspection shall include examination for corrosion or excessive wear of the eye and examination of the attachment welds for possible cracks. Ensure that padeyes have been "Load Certified" and labeled in accordance with current NAVSEA instructions.

WARNING

Ensure VLS Hydraulic System is tagged out in accordance with current shipboard instruction.

d. Vent and tagout VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

e. Remove steady bearing (2) from the actuator pinion by removing bolts (3) and nuts (1) then slide it off. Refer to Figure 5-6-6.

f. Remove bolts (16) and nuts (11), then remove actuator clevis (15) from actuator. See Figure 5-6-6.

NOTE

There are several different types of fasteners used to secure the hatch actuator to the foundation. Some bolts have nuts, while some are body bound. Refer to the appropriate drawing for proper fasteners.

g. Remove bolts (45) and nuts (44) holding hatch actuator to foundation.

CAUTION

Applicable HMLP(S)-(*)-23 must be shut prior to disconnecting C-1/C-2/C-3 pipes.

h. Remove bolts and nuts holding C-1, C-2, and C-3 hydraulic piping to actuator.

CAUTION

Extreme care should be taken when lifting or seating a hatch actuator on the C-1 and C-2 spigots to prevent bending, binding, gouging, or cutting O-rings and back-up rings.

i. Using jacking bolts (5 inch long ¾” UNC locally manufactured), lift actuator clear of C-1 and C-2 hydraulic piping.

j. Remove and transfer muzzle hatch actuator to clean work area.

5-5-12.4. Muzzle Hatch Rotary Actuator Disassembly.

NOTE

Actuator bodies are made in right and left hand versions as indicated in CHAPTER 6, Table 5-6-9. Parts are removed exactly the same way for both versions. The right hand version is used here for clarity.

Table 5-5-2. Muzzle Hatch Rotary Actuator Disassembly/Reassembly Equipment

ITEM	DESCRIPTION	QUANTITY
1	Ratchet, 3/4" drive	1
2	Ratchet, 1/2" drive	1
3	Socket, 1 1/2" x 3/4" drive	1
4	Socket, 1 9/16" x 3/4" drive	1
5	Socket, 1 5/8" x 3/4" drive	1
6	Socket, 11/16" x 1/2" drive	1
7	Socket, 3/4" x 1/2" drive	1
8	Socket Hd. Allen 1" x 3/4" drive	1
9	Socket Hd. Allen 3/4" x ½" drive	1
10	Socket Hd. Allen 3/8" x ½" drive	1
11	Wrench, Combination 1 1/2"	1
12	Wrench, Combination 1 9/16"	1
13	Wrench, Combination 1 5/8"	1
14	Screwdriver, Flattip 8"	1
15	Hammer, Ballpeen	1
16	Hammer, Plastic tip	1
17	Hardwood/Teflon Dowel 15"	1
18	Gear Puller Assembly	1
19	Cold Chisel 1"	1
20	Center Punch	1

a. Matchmark pinion retainer (68) and end caps (2), (24), (36) and (78) to actuator body (29) prior to disassembly.

CAUTION

When removing pinion retainer from actuator body, use care not to damage the actuator body O-ring sealing surfaces.

NOTE

Pinion may come out of actuator when attempting to remove the pinion retainer, in which case the pinion retainer may need to be pressed off the pinion.

b. Remove self-locking capscrews (69) and pinion retainer (68) from actuator body (29).

NOTE

Refer to general notes, paragraph 5-5-3, steps a. and b., for bearing/bushing removal.

c. If required, remove pinion bearing (63) from pinion retainer (68).

d. Carefully remove pinion gear (61) from actuator body (29) and slide spacer (62) from pinion gear (61).

e. Remove O-rings (64) and (66) and backup rings (65) and (67) from pinion retainer (68).

f. Remove self-locking capscrews (79) from end cap (78) and remove end cap from actuator body (29).

g. Measure and record preset distance from face of adjustable stop (59) to internal face of end cap (78).

h. Remove adjustable stop (59) from end cap (78).

i. Remove self-locking capscrews (25) from end cap (24), and remove end cap from actuator body (29).

j. Measure and record present distance from face of adjustable stop (33) to internal face of end cap.

k. Remove adjustable stop (33) from end cap (24).

l. Remove self-locking capscrews (35) from end cap (36) and remove end cap from actuator body (29)

m. Remove self-locking capscrews (1) from end cap (2) and remove end cap from actuator body (29)

n. Remove O-rings (70), (72), (74) and (76) and backup rings (71), (73), (75) and (77) from end cap (78).

o. Remove O-rings (16), (18), (20) and (22) and backup rings (17), (19), (21) and (23) from end cap (24).

p. Remove O-rings (37) and (39) and backup rings (38) and (40) from end cap (36).

q. Remove O-rings (5) and (3) and backup rings (6) and (4) from end cap (2).

CAUTION

Care must be taken when removing piston rack to avoid damaging internal surfaces of the actuator body.

NOTE

If required, use a hardwood dowel or a similar object to assist in the removal of the piston rack.

NOTE

Piston racks (55) and (9) could mistakenly be interchanged. Ensure piston racks are matchmarked and tagged for proper reassembly.

r. Matchmark piston racks (55) and (9) and cylinder sleeves (46) and (28) to actuator body (29).

s. Remove piston racks (55) and (9) from actuator body (29).

t. Remove O-rings (49) and (56) and backup rings (50) and (57) from piston rack (55).

u. Remove O-rings (14) and (7) and backup rings (15) and (8) from piston rack (9).

v. Remove spring retainers (51), (12) springs (53), (11) and bearing balls (54), (10) from piston racks (55) and (9). If required, remove retainer pellets (52), (13) from spring retainer. Discard spring and bearing ball.

w. Matchmark cylinder sleeves (30), (46), (28) and (43) to actuator body (29).

NOTE

If required, use a hardwood dowel or similar object to assist in the removal of the cylinder sleeve.

x. Remove cylinder sleeve (30), (46), (28) and (43) from actuator body (29).

y. Remove O-ring (31) and backup rings (32) from cylinder sleeve (30).

z. Remove O-ring (47) and backup rings (48) from cylinder sleeve (46).

aa. Remove O-ring (26) and backup rings (27) from cylinder sleeve (28).

ab. Remove O-ring (41) and backup rings (42) from cylinder sleeve (43).

ac. Remove bearing (60) from actuator body (29).

5-5-12.5. Muzzle Hatch Rotary Actuator Cleaning Procedures.

Clean actuator parts in an area free of dirt and debris using an appropriate degreaser/cleaner .

5-5-12.6. Muzzle Hatch Rotary Actuator Inspection and Repair.

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired or replaced as applicable. Refer to Figure 5-6-8 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect seal surfaces for any defects that would prevent O-rings from sealing properly.

NOTE

Extreme is defined as any rapidly deteriorating area, from a small area to an area covering a majority of exterior or interior surfaces. Concentrate inspection on internal passages of body unless external corrosion is present.

When extreme corrosion on exterior or interior surfaces of actuator bodies is evident, repair must be delayed until a thorough inspection has been made in accordance with Section 9 of Reference 49 (Submarine Technical Repair Standard for Hydraulically Operated Rotary Actuators). When water content in system hydraulic fluid is in excess of allowable limits specified in Reference 47 (SSN688 Class SSM Volume 4, Part 1, Chapter 5 External Hydraulic System), repair must be delayed until a thorough inspection has been made in accordance with Section 9 of Reference 49 (Submarine Technical Repair Standard for Hydraulically Operated Rotary Actuators).

c. Inspect actuator body (29) and end caps (2), (24), (36) and (78) as follows:

(1) Examine end caps and actuator body for evidence of cracking. Cracks are not acceptable. Areas suspected of cracking may be further checked by dye penetrant method or fluorescent penetrant method in accordance with Reference 45 (Nondestructive Testing Requirements for Metals). Maximum allowable external corrosion pitting depth is limited to 15 percent of wall thickness covering a maximum of 25 percent of the surface area. Repair or replace defective parts at reassembly.

(2) Remove minor interior and exterior corrosion by lightly sanding with a fine grit emery cloth.

(3) Examine cylinder walls for scoring, corrosion, pitting, and defective surface finish. A cylinder that has been scored lengthwise to a depth greater than 0.004 inch is unacceptable.

(4) Examine transfer passages and leakoff ports of actuator body and remove any accumulated corrosion.

d. Inspect pinion gear (61) and piston racks (9) and (55) as follows:

(1) Examine piston racks and pinion gear for backlash using a feeler gage. Backlash must not exceed 0.025 inch. Check mesh near ends of travel and at the intermediate positions.

(2) Examine pinion gear and piston racks for chipped, cracked, broken and unevenly worn (because of faulty heat treatment) gear teeth. Unevenly worn, cracked, chipped, or broken gear teeth are unacceptable and must be repaired or replaced.

(3) Examine the bearing surface areas of the pinion gear for metal transfer from the bearings to the pinion gear. Remove metal debris.

(4) Examine pinion gear splines for burrs and high spots. There should be no visible backlash or binding at reassembly between pinion and mating splines.

(5) Examine piston racks for sharp edges produced by wear which may damage cylinder. Remove all sharp edges before reassembly.

(6) Examine diametral clearance between piston racks at O-ring grooves and internal surfaces of cylinder. Diametral clearance must not exceed 0.010 inch for working length of sealing area. If diametral clearance has been exceeded, either piston racks or preferably the sleeves, as applicable, must be replaced prior to reassembly.

(7) Clean and inspect ports of piston racks and pinion gear of any foreign material.

(8) Examine piston racks and pinion gear to determine out-of-roundness. Piston racks and pinion gear that are out-of-round are not acceptable and must be repaired or replaced.

e. Inspect cylinder sleeves (28), (30), (43) and (46) as follows:

(1) Examine cylinder sleeve bores for scoring. A cylinder sleeve that has been scored lengthwise to a depth greater than 0.004 inch is unacceptable. Ensure that no sharp edges or roughness remains on score marks or along axis of score marks.

(2) Examine cylinder sleeve bores for corrosion, pitting and defective surface finish. Pitting up to 0.008 inch diameter and 0.004 inch in depth are permitted on walls of cylinder sleeves. Machining walls to remove defects is permissible provided the diametral clearance with piston rack does not exceed 0.010 inch. Surface finish in bores must be 32 rhr or smoother except for allowable pitting.

(3) Examine cylinder sleeve bores to determine diametral clearance with piston rack. Examine both horizontal and vertical axis. If piston rack shows out-of-roundness wear and diametral clearance exceeds 0.010 inch on one axis, cylinder liner is worn and must be replaced.

(4) If necessary, hone or polish cylinder sleeve bore to a finish of 32 rhr or smoother, except for allowable pitting. Machine cylinder to 32 rhr or smoother when examination reveals unacceptable scoring or pitting on cylinder walls and it has been determined that diametral clearance will not be exceeded by machining.

(5) Ensure that ends of sleeves have smooth edges, inside and outside, to allow O-rings to pass without cutting.

f. Inspect bearings (60) and (63) as follows:

(1) Examine bearings for cracks and wear. A cracked or worn bearing is not acceptable and must be repaired or replaced.

(2) Ensure that diametral clearance between inside diameter of bearing and outside diameter of pinion gear bearing area does not exceed 0.010 inch. The inner surface finish of the bearing shall be 63 rhr or smoother.

g. Inspect pinion retainer (68) as follows:

(1) Examine pinion retainer for cracks and wear. A cracked or worn pinion retainer is not acceptable and must be repaired or replaced.

(2) Ensure that diametral clearance between inside diameter of pinion retainer and outside diameter of pinion gear (61) does not exceed 0.010 inch at any point.

5-5-12.7. Muzzle Hatch Rotary Actuator Reassembly.

After cleaning, inspecting and repairing of the rotary actuator, reassemble in accordance with the following procedures. Apply grease (CID A-A-50433) to threaded fasteners. Lightly lubricate all O-rings with system hydraulic oil (2075).

CAUTION

When reassembling rotary actuator, care must be taken to prevent damage to O-rings when inserting piston racks into cylinder sleeves and cylinder sleeves into actuator body.

a. Install new O-rings and backup rings.

b. Lubricate mating surfaces of all moving parts and threaded fasteners with grease (CID A-A-50433) at reassembly.

c. Install sleeve bearing (60) into actuator body (29).

NOTE

If cylinder sleeves have not been removed from housing, proceed to step 5-5-12.7j.

d. Install O-ring (41) and backup rings (42) on cylinder sleeve (43).

e. Install O-ring (31) and backup rings (32) on cylinder sleeve (30).

f. Install O-ring (47) and backup rings (48) on cylinder sleeve (46).

g. Install O-ring (26) and backup rings (27) on cylinder sleeve (28).

CAUTION

Care must be used when installing new cylinder sleeves in housing to avoid damaging internal sleeve diameter surface.

NOTE

If required, use a hardwood dowel or similar object to assist in the installation of the new cylinder sleeves.

h. Install sleeves (30) and (43) in actuator body (29) by carefully aligning matchmarks.

i. Install sleeves (28) and (46) in actuator body (29) by carefully aligning matchmarks.

j. If previously removed install retainer pellets (13) and (52) into spring retainers (12) and (51).

k. Install new bearing balls (10) and (54) new springs (11) and (53) and spring retainers (12) and (51) into piston rack (9) and (55).

l. Install O-rings (14) and (7) and backup rings (15) and (8) on piston rack (9).

CAUTION

Care must be taken when installing piston rack to avoid damaging internal surfaces of sleeve.

NOTE

If required, use a hardwood dowel or a similar object to assist in the installation of the piston rack.

m. Install piston rack (9) in actuator body (29) by carefully aligning matchmarks on cylinder sleeve (28), actuator body and piston rack. To aid in guiding O-ring (14) and backup rings (15), located on the smaller end of piston rack (9), through the cut-out section and into the full bore section of sleeve (30), insert a small bronze or other soft metal spade through the pinion port of actuator body (29) and gently compress the O-ring and backup rings, while carefully inserting the rack into the full bore sleeve section. When installing piston rack, maintain rack teeth in a horizontal position and avoid rotation of rack in sleeve. Insert piston rack until manufacturer match marks line up as shown in Figure 5-5-1.

n. Install O-rings (49) and (56) and backup rings (50) and (57) on piston rack (55).

CAUTION

Care must be taken when installing piston rack to avoid damaging internal surfaces of sleeve.

NOTE

If required, use a hardwood dowel or a similar object to assist in the installation of the piston rack.

o. Install piston rack (55) in actuator body (29) by carefully aligning matchmarks on cylinder sleeve (46), actuator body and piston rack. To aid in guiding O-ring (49) and backup rings (50), located on the smaller end of piston rack (55), through the cut-out section and into the full bore section of sleeve (43), insert a small bronze or other soft metal spade through the pinion port of actuator body (29) and gently compress the O-ring and backup rings, while carefully inserting the rack into the full bore sleeve section. When installing piston rack, maintain rack teeth in a horizontal position and avoid rotation of rack in sleeve. Insert piston rack until manufacturer match marks line up as shown in Figure 5-5.1.

CAUTION

The coating (Karon V) used on the pins and bearings in SHIPALT 3936K will be damaged if lubricated with any petroleum based lubricants. Do not use penetrating oil; use only non-petroleum based lubricant (vegetable oil).

p. Install pinion bearing (63) in pinion retainer (68).

q. Install O-rings (64) and (66) and backup rings (65) and (67) on pinion retainer (68).

NOTE

If required use a hardwood dowel or similar object to assist in locating the piston racks in the actuator body for proper alignment with the pinion gear.

r. Carefully insert pinion gear (61) with manufacturer’s orientation mark (on top) in actuator body (29), being certain matchmarks on gear teeth align with corresponding matchmarks on engaging rack teeth of each piston rack (55) and (9). Refer to Figure 5-5-2 for proper orientation.

s. Install spacer (62) on pinion gear (61).

t. Install pinion retainer (68) over pinion gear (61) onto actuator body (29), by aligning matchmark on pinion retainer with adjacent mark on actuator body. Install self-locking capscrews (69) in actuator body and torque to 55 ± 5 ft-lbs.

u. Install O-rings (16), (18), (20) and (22) and backup rings (17), (19), (21) and (23) on end cap (24).

v. Install adjusting stop in end cap (24). Set to pre-measured distance as recorded in step 5-5-12.4k.

w. Install O-rings (70), (72), (74) and (76) and backup rings (71), (73), (75) and (77) on end cap (78).

x. Install plastic rod in adjusting stop (59) if previously removed. Lubricate stop threads with petrolatum (Federal Specifications VV-P-236). Install adjusting stop in end cap (78). Set to pre-measured distance as recorded in paragraph 5-5-12.4g.

y. Install O-rings (37) and (39) and backup rings (38) and (40) on end cap (36).

z. Install O-rings (5) and (3) and backup rings (6) and (4) on end cap (2).

aa. Install end cap (24) on actuator body (29) and secure with self-locking capscrews (25). Torque capscrews to 360 ± 10 ft-lbs.

ab. Install end cap (78) on actuator body (29) and secure with self-locking capscrews (79). Torque capscrews to 360 ± 10 ft-lbs.

ac. Install end cap (36) on actuator body (29) and secure with self-locking capscrews (35). Torque capscrews to 360 ± 10 ft-lbs.

ad Install end cap (2) on actuator body (29) and secure with self-locking capscrews (1). Torque capscrews to 360 ± 10 ft-lbs.

ae. Lockwire adjusting stops (59) and (33).

af. Perform bench tests in accordance with paragraph 5-2-9.

5-5-12.8. Muzzle Hatch Rotary Actuator Reinstallation.

a. Ensure that all handling equipment required has been visually inspected and tested.

b. Ensure parts are covered to prevent fluid from leaking while rigging into position.

c. Ensure that all padeyes have been visually inspected prior to use. Inspection shall include examination for corrosion or excessive wear of the eye and examination of the attachment welds for possible cracks. Ensure that padeyes have been "Load Certified" and labeled in accordance with current NAVSEA instructions.

WARNING

Ensure that proper rigging equipment is used for safe handling of the actuator to prevent dropping actuator and causing injury to personnel or damage to equipment IMA/DEPOT.

d. Using the appropriate rigging equipment, rig the actuator into position by reversing the procedure used to remove the actuator.

NOTE

Install jacking bolts into actuator base prior to lowering the hatch actuator onto the C-1 and C-2 port spigots.

e. With petrolatum on port sealing areas, carefully lower actuator the last two inches to engage hydraulic line fittings using jacking bolts. Lower squarely to avoid cocking and potentially damaging the sealing surface. If spacers were removed, replace and properly align actuator to foundation. Apply anaerobic sealing compound, Grade H (MIL-S-22473), to full thread engagement length of capscrews. Secure actuator to foundation and attach C-1, C-2 and C-3 piping connections.

f. Remove jacking bolts from actuator base and stow for re-use.

g. Reinstall actuator clevis (15), bolt (16), and nut (11). Refer to Figure 5-6-6.

h. Install actuator steady bearing bracket (2) to its foundation and secure in place using bolts (3) and nuts (1). Refer to Figure 5-6-6.

i. Reconnect applicable portions of the muzzle hatch operating mechanism and T-bar locking mechanism (SSN 719 and 720), in accordance with paragraph 5-5-9 and 5-5-10.

j. Reconnect fairing to muzzle hatch in accordance with paragraph 5-5-5.

k. Reconnect the muzzle hatch operating linkage and fairing in accordance with paragraph 5-5-10.

l. Open applicable HMLP(S)-(*)-23.

m. Clear tagout and restore VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

n. Using applicable Maintenance Requirement Card from MIP 7211, line up hydraulic system to vent air from hatch actuator and piping.

o. Perform the case vent leakoff tightness test per paragraph 5-2-9.

p. Slowly cycle hatch to ensure proper linkage alignment and smooth operation.

q. Perform operational test and check valve leak test in accordance with paragraph 5-2-9.

r. Reinstall all flow path interference items previously removed.

s. Replace all cut lockwire.

t. Clear all tagouts in accordance with current shipboard instructions.

5-5-12.9. Test Requirements.

Refer to CHAPTER 2 for test requirements for muzzle hatch and fairing rotary actuator.

5-5-13 ENVIRONMENTAL MONITORING SENSOR ASSEMBLY.

Procedures contained herein provide the information necessary for the removal, cleaning, inspection, and reinstallation of a replacement environmental monitoring sensor assembly. Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-9 for parts identification.

5-5-13.1. Initial Conditions.

a. Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

b. Power to applicable missile tube monitoring circuits secured and tagged out in accordance with current shipboard instructions.

5-5-13.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-13.3. Environmental Monitoring Sensor Assembly Removal.

a. Disconnect sensor unit from ship's cabling and install protective cap on cable connector Refer to paragraph 5-5-27 for Outboard Cable Unmating).

CAUTION

The sensor face is of a fragile nature and the protective cover must be installed. The environmental monitoring sensor assembly must be handled with care.

b. Using environmental monitoring sensor retaining nut removal/installation tool, remove nut (3) and washer (4) from penetrator body (7).

c. Remove penetrator body (7) from the outboard side of the missile tube.

e. Remove EMS cover (2) and screws (1) for use on replacement EMS.

5-5-13.4. <u>Environmental Monitoring Sensor Assembly Cleaning Procedures.</u>

Clean missile tube receptacle using an appropriate degreaser/cleaner

5-5-13.5. <u>Replacement Environmental Monitoring Sensor Assembly Inspection.</u>

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired or replaced as applicable. Refer to Figure 5-6-9 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect seal surfaces for any defects that would prevent O-rings from sealing properly.

c. Inspect penetrator (7) body for cracks or indication of leakage. Cracks are not acceptable and penetrator body must be repaired or replaced at reassembly.

NOTE

There are two different configurations for Environmental Monitoring Sensors. See Figure 5-1-24

d. Prepare missile tube mating surface for EMS replacement.

5-5-13.6. <u>Environmental Monitoring Sensor Assembly Reinstallation.</u>

After inspection of Environmental Monitoring Sensor, lubricate O-rings with silicone compound (MIL-S-8660) prior to installation.

CAUTION

The sensor face is of a fragile nature and the protective cover must be installed. The environmental monitoring sensor assembly must be handled with care.

a. Install EMS cover (2) with screws (1) on replacement EMS.

b. Lightly lubricate O-rings (5) and (6) with silicone compound (MIL-S-8660).

c. Install O-rings (5) and (6) on penetrator body (7).

NOTE

Utilize all guide pins for proper reinstallation.

d. Insert penetrator body (7) into missile tube.

e. Install washer (4) and nut (3) and torque nut (3) to 45 ± 5 ft. lbs. using the EMS retaining nut removal/installation tool.

f. Install electrical connector in accordance with paragraph 5-5-26.

g. Clear applicable tagouts in accordance with current shipboard instructions.

5-5-13.7. Test Requirements.

Refer to CHAPTER 2 for test requirements for underhatch environmental monitoring assembly.

5-5-14 MISSILE TUBE PENETRATOR ASSEMBLY.

Procedures contained herein provide the information necessary for the removal, cleaning, inspection and reinstallation of a replacement missile tube penetrator assembly. Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-10 for parts identification.

5-5-14.1. Initial Conditions.

a. Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

b. Weapon power to applicable missile tube secured and tagged out in accordance with current shipboard instructions.

c. Missile tube weapon control cable disconnected from outside missile tube with protective cap installed on cable connector.

d. AUR/AUR Volumetric Shape umbilical cable disconnected with protective cap install on cable connector or security cap removed.

5-5-14.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-14.3. Missile Tube Penetrator Assembly Removal.

a. Using the missile tube penetrator nut removal/installation tool, remove nut (1) and washer (2) from penetrator assembly (6).

b. Remove and discard O-ring (3) from missile tube penetrator assembly and remove penetrator assembly (6) from missile tube.

5-5-14.4. Replacement Missile Tube Penetrator Assembly Cleaning Procedures.

Clean missile tube penetrator and mating surfaces using an appropriate cleaner ensuring sealing surfaces are not damaged.

5-5-14.5. Replacement Missile Tube Penetrator Assembly Inspection.

Parts inspected in the following paragraphs that do not meet acceptance criteria, must be repaired if applicable or replaced. Refer to Figure 5-6-10 for parts identification.

a. Inspect nut (1) for damanged threads, cracks and corrosion.

b. Inspect penetrator (6) and penetrator mating surfaces for cracks, or pitting.

c. Prepare missile tube mating surfaces for penetrator replacement.

d. Perform continuity and insulation resistance test prior ot installation.

NOTE

Acceptance criteria is 10 Ohms for the continuity test and 25 Megohms minimum for the insulation resistance test.

5-5-14.6. Missile Tube Penetrator Assembly Reinstallation.

After inspection of Missile Tube Penetrator Assembly lightly coat O-rings with silicone compound, (MIL-S-8660) prior to installation.

a. Install O-rings (7), (4), and (5) onto penetrator (6).

b. Install penetrator (6) into missile tube, aligning dowel pins with key slots.

c. Install O-ring (3) and washer (2) onto penetrator (6).

d. Install nut (1) onto penetrator (6).

e. Ensure penetrator flange and nut (1) are flush with missile tube.

f. Torque nut (1) to 100 ± 10 ft - lbs.

g. Reconnect Weapon Control Cable in accordance with paragraph 5-5-26.

h. Clear applicable tagout in accordance with current shipboard instructions.

5-5-14.7. Test Requirements.

Refer to CHAPTER 2 for test requirements for umbilical penetrator assembly.

5-5-15 DIFFERENTIAL PRESSURE TRANSDUCER ASSEMBLY.

Procedures contained herein provide the information necessary for the removal, cleaning, inspection and reinstallation of a replacement differential pressure transducer. Use applicable drawings for specific installation/adjustment procedures not covered in this volume. Refer to Figure 5-6-12 for parts identification.

5-5-15.1. Initial Conditions.

a. Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

b. Power to applicable missile tube monitoring circuits secured and tagged out in accordance with current shipboard instructions.

5-5-15.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-15.3. Differential Pressure Transducer Assembly Removal.

a. Disconnect electrical cable connector from differential pressure transducer. Install protective cap on electrical cable connector. (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

b. Tie-wrap the three missile tube sensing line pipes (3) together to prevent springing.

c. Remove lockwire from missile tube sensing line fasteners (2).

d. Remove fasteners (2) securing missile tube sensing lines (3) to differential pressure transducer (1).

e. Loosen differential pressure transducer mounting bolts (7) and nuts if used.

NOTE

The differential pressure transducer weighs approximately 50 pounds.

f. While supporting differential pressure transducer (1), remove mounting bolts (7), nuts and retaining bracket if installed.

g. Disconnect differential pressure transducer (1) from missile tube sensing lines (3).

h. Move differential pressure transducer (1) to a convenient area.

i. Remove O-Ring (6) from electrical connector and rubber isolation membrane (8) from connector face.

j. Remove O-rings (4) and (5) from three missile tube sensing line fittings (3).

k. Remove pressure cap or missile pressure sensing hose from preece fitting. Refer to Figure 5-6-20.

l. Remove missile tube preece fitting and remove O-ring. Refer to Figure 5-6-20.

5-5-15.4. Differential Pressure Transducer Assembly Cleaning Procedures.

Clean transducer assembly in an area free of dirt and debris using an appropriate degreaser/cleaner.

5-5-15.5. Differential Pressure Transducer Assembly Inspection and Repair.

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-12 for parts identification.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect seal surfaces for any defects that would prevent O-rings from sealing properly.

c. Inspect and clean sensing lines (3) as follows:

(1) Clean out all three sensing lines using twisted lock wire to loosen any debris or build up in line.

(2) Use low pressure air to blow the lines out. Ensure there is air flow into sensing cavity of missile tube.

d. Inspect enclosure housing (1) exterior surface for water damage or any sign of damage.

5-5-15.6. Differential Pressure Transducer Assembly Reinstallation.

During reinstallation process lightly lubricate O-rings and rubber isolation membrane with silicone compound (MIL-S-8660).

a. Verify sensing lines cleaned in accordance with paragraph 5-5-15.5a. prior to installing transducer.

b. Remove protective cap (MIL 24231/13-011) from replacement differential pressure transducer electrical connector. Install protective cap on old differential pressure transducer.

c. Lubricate and install new O-rings (4) and (5) on missile tube sensing lines (3).

d. Lubricate and install new O-ring (2) on missile tube Preece fitting (1), and install preece fitting in tube. See Figure 5-6-20.

e. Apply grease (CID A-A-50433) to all threaded fasteners.

NOTE

Free movement of differential pressure transducer will be required to hook up missile tube sensing lines.

f. Mount differential pressure transducer (1) using mounting bolts (7), nuts and retaining bracket if previously removed. Do not tighten.

g. Install the three missile tube sensing lines (3) and secure with fasteners (2).

h. Tighten differential pressure transducer mounting bolts (7) and nuts.

i. Lockwire missile tube sensing line fasteners (2).

NOTE

Use only those rubber isolation membranes whose package is marked “Low Carbon”.

j. Mate electrical connector in accordance with paragraph 5-5-26.

k. Remove tie-wraps from missile tube sensing lines (3).

l. Clear applicable tagout in accordance with current shipboard instructions.

5-5-15.7. Test Requirements.

Refer to CHAPTER 2 for test requirements for differential pressure transducer assembly.

5-5-16 MISSILE TUBE SHOCK LANDS AND ALIGNMENT PINS.

Procedures contained herein provide the information necessary for the removal, inspection and reinstallation of the missile tube shock lands and alignment pins. Use applicable drawings for specific installation and adjustment procedures not covered in this volume. Refer to Figure 5-6-13 for parts identification.

5-5-16.1. Initial Conditions.

Muzzle hatch open in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-16.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-16.3. Missile Tube Shock Land Removal.

WARNING

Suffocation hazard exists. Before entering a missile tube, missile tube must be ventilated and certified gas free in accordance with current BUMED and ship's instruction.

WARNING

To ensure safety of the worker in the tube, a person shall be stationed topside and shall maintain visual and audible contact with the worker inside the tube while monitoring the man-lowering device.

WARNING

Use an approved and tested man lowering device and safety harness equipment when working inside missile tube.

NOTE

Each land is optically aligned and cut for a specific position. Mark each missile tube shock land to the missile tube prior to removal for proper reinstallation.

a. Matchmark each shock land (4) and missile tube position to ensure proper AUR alignment after reinstallation of shock lands.

b. Remove PVC epoxy and tape or epoxy as applicable. Remove O-rings (2) from bolt holes.

c. Support shock land and remove bolts (3).

d. Attach handling line and transfer shock land topside. Place shock land in a clean area.

e. If required, remove remaining shock lands by repeating step 5-5-16.3a through d.

5-5-16.4. <u>Missile Tube Shock Land Inspection and Repair.</u>

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-13 for parts identification.

a. Inspect threaded fasterners including self-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect shock lands (4) for cracks, scoring and abrasions. A cracked land is unacceptable. Scoring or abrasion which can be honed into the surface contour of the missile tube is acceptable. When scoring or abrasion cannot be repaired, the shock land must be replaced.

5-5-16.5. <u>Missile Tube Shock Land Reinstallation.</u>

a. Position each shock land (4) to corresponding matchmark for proper missile tube position.

b. Add Loctite sealant #56747 or equal to bolts (3) and install tape over bolts (3).

c. 719/720 only, apply Polyken Tape 231 or equivalent over bolts (3).

d. Install new O-rings (2) over bolt heads.

e. Fill wrench holes with epoxy (PM 6003 resin with PMH 403 Hardner or equivalent) flush with shock land surface. After epoxy hardens, sand flush with shock land contour.

5-5-16.6. <u>Alignment Pin Removal.</u>

a. Remove alignment pin (1) from missile tube.

b. Place alignment pin (1) in a clean secure area.

5-5-16.7. <u>Alignment Pin Inspection and Repair.</u>

Examine alignment pin (1) for corrosion, pitting, gouges or flat spots. Corrosion is unacceptable. Pitting, gouging or flat spots which can be honed out are acceptable. Cracked, deformed or bent alignment pin is unacceptable and must be replaced.

5-5-16.8. <u>Alignment Pin Reinstallation.</u>

a. Reinstall alignment pin and torque to 150 ft. lbs.

b. Clear applicable tagout in accordance with current shipboard instructions.

5-5-16.9. <u>Test Requirements.</u>

Refer to applicable drawing no. listed in Table 5-6-14 for testing procedure.

5-5-17 <u>HATCH & FLOOD/DRAIN VALVE CONTROL VALVE HMLP(S)-(*)-22.</u>

Repair and overhaul procedures contained herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly and reinstallation of the hatch & flood/drain valve control valve. Use applicable drawings for specific installation/ adjustment procedures. Refer to Figure 5-6-14 for parts identification concerning the hatch & flood/drain valve control valve.

5-5-17.1. <u>Initial Conditions.</u>

a. Power to the applicable control/indication circuits secured in accordance with current shipboard instructions.

WARNING

Ensure VLS Hydraulic System is tagged out in accordance with current shipboard instruction.

b. Vent and tagout VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-17.2. **Safety Precautions.**

Observe safety precautions described in paragraph 5-5-4.

Table 5-5-3. Hatch & Flood/Drain Valve Control Valve Required Equipment

ITEM	DESCRIPTION	QUANTITY
1	Assorted O-ring insertion/removal tools	Several
2	Cap, protective, dust	as required
3	Dowel, nylon, 1-3/8" x 6" or equivalent	1
4	Dowel, nylon, 3/8" x 6" or equivalent	1
5	Extension, 4" x 1/4" drive	1
6	Hydraulic Oil (2075)	Cup
7	Key Set, socket head screw, 0.050" - 0.375"	1
8	Lockwire	Roll
9	Magnifying glass	1
10	Mallet, rawhide or equivalent	1
11	Petroleum Jelly	Jar
12	Pliers, diagonal cutting	1
14	Pliers, needle nose	1
15	Pliers, slip joint (Amphenol)	1
16	Ratchet, 1/2" drive	1
17	Ratchet, 1/4" drive	2
18	Screw, 8-32 x 2" (approximate length)	1
19	Screwdriver, flat tip, 3" x 5/32"	1
20	Security System Keys (as applicable)	1
21	Socket Set, 1/2" drive	1
22	Socket Set, 1/4" drive hex key	1
23	Swabs, cotton tip	6
24	Wrench, combination, 1/2"	1
25	Wrench, combination, 1-3/8"	1
26	Wrench, open-end (thin) 1-1/16"	1
27	Wrench, torque, 0-50 ft-lbs, 1/2" drive	1
28	Wrench, torque, 0-50 in-lbs, 1/4" drive	1
29	Wrench, torque, 30-200 in-lbs, 1/4" drive	1

5-5-17.3. Hatch & Flood/Drain Valve Control Valve Removal.

a. Remove lockwire from the hatch & flood/drain valve control valve.

b. Unlock the security system key lock for the hatch & flood/drain valve control valve.

c. Disconnect and label the electrical connectors from solenoid assemblies L1 (78), L2 (11), L3 (47), hatch blocked micro switch (52) and security alarm connector.

d. Install protective covers on solenoids and electrical connectors.

e. Remove security key lock as follows:

(1) Remove capscrews (101) and washers (100) or twist head capscrews (99) from end plate (97).

(2) Remove end plate (97) with security key lock installed, gasket (96) and four sleeves (98). Stow in appropriate security container and retain onboard.

NOTE

Some residual hydraulic pressure may be present. Slowly loosen manifold plugs.

NOTE

Refer to Figure 5-6-15 for numbered items in steps f through k.

f. Remove any remaining pressure in the valve by loosening plugs (1), on bottom of manifold, then remove plugs from manifold to drain any remaining fluid.

g. Remove O-ring (2) from each plug (1).

h. Remove the four capscrews (3) and washers (4) while supporting the valve assembly.

i. Remove the valve assembly from the manifold.

j. Remove the four ferrules (5).

k. Remove and discard O-rings (6) and back-ups (7) from ferrules (5) set aside.

5-5-17.4. Hatch & Flood/Drain Valve Control Valve Disassembly.

Inspect all components for contamination, wear and any abnormal condition during disassembly. Replace parts as necessary. All parts requiring ultrasonic cleaning should be set aside until completion of disassembly of the entire valve. Refer to Figure 5-6-14 for parts identification.

Disassemble the flood/drain end of the hatch & flood/drain valve control valve as follows:

a. Note position (count exposed threads) of hatch blocked microswitch (52) and then remove microswitch from switch plate (55).

b. Remove solenoid assembly L2 (11) as follows:

   (1) Remove capscrews (12), washers (13), pin lock assembly (14) and indicator plate (15) from solenoid assembly L2.

CAUTION

Solenoid assembly and plunger are a matched set. Plunger will drop out when solenoid assembly is removed. Ensure that plunger is not misplaced during disassembly.

   (2) Remove solenoid assembly L2 from the end cap housing (3).

   (3) Remove and discard O-ring (16) from solenoid assembly L2.

c. Remove filter retainer (8), O-ring (9) and filter (10) from end cap housing (3).

d. Remove and discard O-ring (9) from filter retainer (8).

e. Remove plug (19) from end cap housing (3).

f. Remove and discard O-ring (9) from plug (19).

NOTE

End cap housing is under spring pressure.

g. Remove capscrews (4) and (1) and washers (2) from end cap housing (3).

h. Remove end cap housing (3) and spring (29) from body housing (39).

   (1) Remove and discard O-ring (23) from end cap housing (3).

(2) Remove and discard O-ring (26) and backups (28) from inside end cap housing (3).

i. Remove piston (31) and spring retainer (30) from body housing (39).

j. Using a nylon dowel, tap the bottom of the cartridge assembly (17) until it can be removed from the end cap housing (3).

k. Remove and discard O-rings (18) from cartridge assembly (17).

l. Remove cover (5) from end cap housing (3).

m. Remove and discard O-ring (6) from cover (5).

NOTE

Stud (24) is adjusted at factory assembly. If there is no evidence of oil leakage around stud (24), removal may not be necessary.

n. Remove self-locking hex nut (7) from stud (24).

o. Remove stud (24) from end cap housing (3).

p. Remove and discard O-ring (25) and backups (27) from stud (24).

q. Thread an 8-32 x 2" screw into plug (20) and pull plug from end cap housing (3). Remove the 8-32 x 2" screw from plug.

r. Remove and discard O-ring (21) and backups (22) from plug (20).

NOTE

Lee jet is located inside ferrule.

s. Using a firm grip pull ferrule (37), with lee jet (38) installed, from body housing (39) or end cap housing (3).

t. Remove and discard O-rings (21) and backups (22) from ferrule (37).

Disassemble the intermediate cap housing of the hatch & flood/drain valve control valve as follows:

a. Remove cam (95) from lock arm (81) by loosening set screw (94).

b. Remove switch mounting plate (87) and support clamp (93) by removing capscrews (92) and washers (91).

c. Remove intermediate cap housing (85) from end cap housing (61) by removing capscrews (86) and washers (2).

d. Remove lock arm shaft (81), thrust washer (82) and O-rings (84) and (83) from intermediate cap housing (85).

e. Remove piston lock arm (80) from end cap housing (61).

Disassemble the hatch end and body housing of the hatch & flood/drain valve control valve as follows:

a. Remove solenoid assemblies L1 and L3 as follows:

(1) Remove capscrews (48), washers (13) pin lock assembly (14) and indicator plate (79) from solenoid assembly L1.

CAUTION

Solenoid assembly and plunger are a matched set. Plunger will drop out when solenoid assembly is removed. Ensure that plunger is not misplaced during disassembly.

(2) Remove solenoid assembly L1 from end cap housing (61).

(3) Remove and discard O-ring (16) from solenoid assembly L1.

(4) Remove capscrews (48), washers (13) and indicator plate (49) from solenoid assembly L3.

CAUTION

Solenoid assembly and plunger are a matched set. Plunger will drop out when solenoid assembly is removed. Ensure that plunger is not misplaced during disassembly.

(5) Remove solenoid assembly L3 from the end cap housing (61).

(6) Remove and discard O-ring (16) from solenoid assembly L3.

b. Remove filter retainer (8), O-ring (9) and filter (10) from end cap housing (61).

c. Remove and discard O-ring (9) from filter retainer (8).

d. Using a nylon dowel, tap the bottom of L1 and L3 cartridge assemblies (17) until they can be removed from end cap housing (61).

e. Remove and discard O-rings (18) from cartridge assembly (17).

NOTE

End cap housing is under spring pressure.

f. Remove capscrews (51) and washers (2) from end cap housing (61).

g. Remove slide of slide/sleeve matched set (32) from body housing (39) and inspect for contamination using a magnifying glass. Set the slide aside for ultrasonic cleaning.

h. Remove end cap housing (61) from body housing (39).

i. Remove sleeve retainer (33) from body housing (39).

j. Remove and discard O-ring (34) from sleeve retainer (33).

k. Using a nylon dowel, remove sleeve of the slide/sleeve matched set (32) from body housing (39).

l. Remove and discard O-rings (35) and backups (36) from sleeve.

m. Thread an 8-32 x 2" screw in plug (40) and pull plug from body housing (39). Remove the 8-32 x 2" screw from plug.

n. Remove and discard O-ring (41) from plug (40).

o. Remove and discard O-ring (23) from end cap housing (61).

CAUTION

Piston is under spring pressure. Two personnel may be required to perform the following step.

p. While holding tension on piston (44), use override lever (76) to apply pressure to piston lock (70). Release tension on piston (44) and remove piston and spring (29).

q. Remove and discard O-ring (26) and backups (28) from piston (44).

r. Remove override lever (76) by removing cotter pin (75), castellated nut (74), bolt (71), washers (72) and (73) and pin lock assembly (77).

s. Remove capscrews (63) and retainer (64) from end cap housing (61).

t. Remove and discard O-rings (57) and (66) and backups (67) and (65) from retainer (64).

u. Remove piston lock (70) from end cap housing (61).

v. Remove and discard O-ring (68) and backups (69) from piston lock (70).

NOTE

Switch plate is under spring pressure.

w. Remove capscrews (53), switch plate (55), spring retainer (58), spring (59) and spring guide (60) from end cap housing (61).

x. Remove and discard O-rings (57) and (56) from spring retainer (58).

y. Remove and discard O-ring (45) and backups (46) from inside of end cap housing (61).

z. Remove ferrule (62) from end cap housing (61).

aa. Remove and discard O-rings (21) and backups (22) from ferrule (62).

ab. Remove two plugs (50) from end cap housing (61).

ac. Remove and discard O-rings (34) from two plugs (50).

ad. Inspect body housing (39) and end cap housings (61) and (3) for any contamination, wear or abnormal conditions.

5-5-17.5. <u>Hatch & Flood/Drain Valve Control Valve Cleaning Procedures.</u>

Perform general cleaning in an area free of dirt and debris using an appropriate degreaser/cleaner.

The following components must be cleaned in an ultrasonic sink prior to reinstallation:

a. Filters (10) from end cap housings (61) and (3).

b. Ferrule (37) with lee jet (38).

c. End cap housings (61) and (3) and body housing (39).

d. Slide/sleeve matched set (32).

5-5-17.6. <u>Hatch & Flood/Drain Valve Control Valve Reassembly.</u>

Inspect new O-rings and backup rings prior to installation.

Lubricate O-rings and internal components with system hydraulic oil (2075). Refer to Figure 5-6-14 for parts identification.

NOTE

Grease containing silicone shall not be used to assemble hydraulic system components.

Reassemble the hatch end and body housing of the hatch & flood/drain valve control valve as follows:

a. Install O-rings (21) and backups (22) onto ferrule (62) and reinstall into end cap housing (61).

b. Install O-rings (18) on cartridge assembly (17) of solenoid assembly L1.

c. Install cartridge assembly (17) into end cap housing (61), by tapping lightly with a nylon dowel. Verify cartridge assembly is fully seated.

d. Install O-rings (18) on cartridge assembly (17) of solenoid assembly L3.

e. Install cartridge assembly (17) into end cap housing (61), by tapping lightly with a nylon dowel. Verify cartridge assembly is fully seated.

f. Install O-ring (23) on end cap housing (61).

g. Install O-ring (9) on filter retainer (8) and install filter (10) and filter retainer (8) into end cap housing (61).

h. Install O-rings (34) on two plugs (50).

i. Install two plugs (50) on end cap housing (61).

j. Install O-ring (45) and backups (46) to the inside of the end cap housing (61).

k. Install O-rings (57) and (56) on spring retainer (58).

l. Install spring guide (60), spring (59), spring retainer (58) switch plate (55) and capscrews (53) into end cap housing (61). Torque capscrews (53), in an "X" sequence, to 90 ± 10 in-lbs. in 30 in-lb. increments.

m. Install O-ring (68) and backups (69) onto piston lock (70). Reinstall piston lock (70) into end cap housing (61).

n. Install O-ring (26) and backups (28) onto piston (44).

o. Install O-rings (57) and (66) and backups (67) and (65) onto retainer (64).

p. Reinstall retainer (64) onto end cap housing (61) and secure with capscrews (63). Torque capscrews (63), in an "X" sequence, to 90 ± 10 in-lbs. in 30 in-lb. increments.

q. Reinstall override lever (76) to end cap housing (61) and secure in place using bolt (71), washers (72) and (73), castellated nut (74), and cotter pin (75).

CAUTION

Piston is under spring pressure. Two personnel may be required to perform the following step.

r. Using the override lever (76), apply pressure to the piston lock (70), and insert spring (29) and piston (44) until bottomed. While holding tension on piston (44), release piston lock (70). Release tension on piston (44).

NOTE

A small amount of material may have to be cut from the end of the backups to prevent overlapping when installed.

s. Install O-rings (35) and backups (36) onto sleeve of slide/sleeve matched set (32). Ensure that backups do not overlap.

NOTE

A centering hole in sleeve must line up with sleeve retainer hole in body housing (39) to ensure proper installation of sleeve retainer (33).

t. Install sleeve of slide/sleeve matched set (32) into body housing (39). Ensure that the "X" marked on sleeve and the "X" marked on body housing (39) are on the same end.

u. Install O-ring (34) on sleeve retainer (33).

v. Ensure that center hole in sleeve of slide/sleeve matched set (32) is aligned with sleeve retainer hole in body housing (39).

w. Install sleeve retainer (33) in body housing (39).

NOTE

Slide must be inserted with eyebrows facing hatch end of valve.

x. Lubricate slide with hydraulic oil and install slide into sleeve of slide/sleeve matched set (32).

y. Install O-ring (41) on plug (40).

z. Install plug (40) into body housing (39).

NOTE

One of the capscrews (51) cannot be torqued due to limited accessibility.

aa. Line-up and mate end cap housing (61) with body housing (39) and secure in place with washers (2) and capscrews (51). Ensure that the pin lock assembly (77) is attached by one of the capscrews (51). Torque capscrews (51) in an "X" sequence to 135 ± 15 in-lbs in 45 in-lb increments.

ab. Install O-ring (16) on solenoid assembly L1.

CAUTION

Solenoid assembly must be mounted evenly with capscrews tightened uniformly to prevent cocking of solenoid assembly.

ac. Using solenoid assembly mounting arrangement as shown in Figure 5-5-3, attach solenoid assembly L1 to end cap housing (61) ensuring solenoid plunger is installed. Ensure indicator plate (79) and pinlock assembly (14) are secured in place using capscrews (48) and washer (13). Torque capscrews (48) in an "X" sequence to 25 ± 3 in-lbs in 5 in-lb increments.

ad. Install O-ring (16) on solenoid assembly L3.

CAUTION

Solenoid assembly must be mounted evenly with capscrews tightened uniformly to prevent cocking of solenoid assembly.

ae. Using solenoid assembly mounting arrangement as shown in Figure 5-5-3, attach solenoid assembly L3 to end cap housing (61), ensuring solenoid plunger is installed. Ensure indicator plate (49) is secured in place using capscrews (48) and washers (13). Torque capscrews (48), in an "X" sequence, to 25 ± 3 in-lbs in 5 in-lb increments.

af. Replace all cut lockwire.

Reassemble the flood/drain end of the hatch & flood/drain valve control valve as follows:

a. Install O-rings (18) on cartridge assembly (17) of solenoid assembly L2.

b. Install cartridge assembly (17) into end cap housing (3), by tapping lightly with a nylon dowel. Verify cartridge assembly is fully seated.

c. Install O-ring (9) onto filter retainer (8) and install filter (10) and filter retainer (8) into end cap housing (3).

d. Install O-ring (25) and backups (27) on stud (24).

e. If previously removed, screw stud (24) into end cap housing (3) ensuring that it is bottomed out in the housing.

NOTE

It will be necessary to restrain stud while installing hex nut.

f. Install hex nut (7) onto stud (24). Ensure that hex nut is fully seated.

g. Install O-ring (26) and backups (28) into end cap housing (3).

h. Install O-ring (21) and backups (22) on plug (20).

i. Install plug (20) into end cap housing (3).

j. Install O-ring (6) onto cover (5).

k. Install cover (5) onto end cap housing (3).

l. Install O-ring (9) onto plug (19).

m. Install plug (19) into end cap housing (3).

n. Install O-ring (23) onto end cap housing (3).

o. Install O-rings (21) and backups (22) onto ferrule (37).

p. Install ferrule (37) with lee jet (38) into body housing (39) with lee jet screen facing toward end cap housing (3).

q. Install spring retainer (30) and piston (31) into body housing (39). Install spring (29) into end cap housing (3) and install onto body housing (39).

r. Secure end cap housing (3) to body housing (39) with capscrews (4) and (1) and washers (2). Torque capscrews (4) and (1) in an "X" sequence to 90 ± 10 in-lbs in 30 in-lb increments.

s. Install O-ring (16) on solenoid assembly L2.

CAUTION

Solenoid must be mounted evenly with capscrews tightened uniformly to prevent cocking of solenoid.

t. Using solenoid assembly mounting arrangement as shown in Figure 5-5-3, attach solenoid assembly L2 to end cap housing (3) ensuring solenoid plunger is installed. Ensure indicator plate (15) and pinlock assembly (14) are secured in place using capscrews (12) and washers (13). Torque capscrews (12) in an "X" sequence to 25 ± 3 in-lbs. in 5 in-lb. increments.

u. Install hatch blocked microswitch (52) into switch plate (55) in original position as recorded earlier.

v. Replace all cut lockwire.

Reassemble the intermediate cap housing of the hatch & flood/drain valve control valve as follows:

a. Install O-rings (84) and (83) onto intermediate cap housing (85).

b. Install thrust washer (82) and lock arm shaft (81) into intermediate cap housing (85).

c. Install and ensure piston lock arm (80) is properly orientated (clockwise to lock and counterclockwise to unlock).

d. Install intermediate cap housing (85) on end cap housing (61) ensuring that lock arm shaft (81) aligns with piston lock arm (80).

e. Secure intermediate cap housing (85) using capscrews (86) and washers (2).

f. Install switch mounting plate (87) and support clamp (93) using capscrews (92) and washers (91).

g. Install cam (95) on lock arm (81) and secure with set screw (94).

h. Replace all cut lockwires.

5-5-17.7. Hatch & Flood/Drain Valve Control Valve Reinstallation.

Lubricate O-rings with system hydraulic oil (2075).

NOTE

Refer to Figure 5-6-15 for numbered items in steps a through f.

a. Install O-rings (2) on manifold plugs (1).

b. Install manifold plugs (1) on valve manifold.

c. Install O-rings (6) and backups (7) on ferrules (5).

d. Install four ferrules (5) in manifold.

e. Install assembled valve to manifold with four capscrews (3) and washers (4). Torque capscrews in an "X" sequence to 21 ± 2 ft-lbs in 7 ft-lb increments.

f. Lockwire capscrews after valve is installed on manifold.

g. Install security key lock as follows:

   (1) Ensure key lock is installed on end plate (97).

   (2) Position key lock to unlocked position for proper alignment.

   (3) Install four sleeves (98) and align gasket (96) and end plate (97) with intermediate cap housing (85). Secure with twist head capscrews (99) or capscrews (101) with washers (100). Do not twist capscrews off.

h. Remove protective covers from solenoid assemblies L1, L2 and L3 and electrical connectors.

i. Connect the electrical connectors to the solenoid assemblies L1, L2 and L3, hatch blocked microswitch and security alarm connector.

j. Clear tagouts and restore VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

k. Restore hydraulic system to station keeping lineup.

5-5-17.8. Test Requirements.

Refer to CHAPTER 2 for test requirements for the hatch and flood/drain valve control valve.

5-5-18 HYDRAULIC CONTROL VALVE MANIFOLD (ADJUSTORS) HMLP(S)-(*)-21.

Repair and overhaul procedures contained herein provide the information necessary for the removal, disassembly, cleaning, inspection, reassembly and reinstallation of the hydraulic control valve manifold adjustors. Use applicable drawings for specific installation/adjustment procedures. Refer to Figure 5-6-15 for parts identification concerning the hydraulic control valve manifold.

5-5-18.1. Initial Conditions.

a. Power to the applicable control/indication circuits secured in accordance with current shipboard instructions.

WARNING

Ensure VLS Hydraulic System is tagged out in accordance with current shipboard instruction.

b. Vent and tagout VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-18.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-18.3. Hydraulic Control Valve Manifold Adjustor(s) Removal.

Table 5-5-4. Manifold Adjustor Removal and Installation Equipment

ITEM	DESCRIPTION	QUANTITY
1	Assorted O-ring insertion/removal tools	as required
2	Extension, 4" x 1/4" drive	1
3	Lockwire	Roll
4	Pliers, lockwire	1
5	Ratchet, 1/4" drive	1
6	Socket Set, 1/4" hex key	1
7	Swabs, cotton tip	Package
8	Wrench, torque, 30-200 in-lbs, 1/4" drive	1

NOTE

Some residual pressure may be present. Slowly loosen manifold plugs.

Ensure hydraulic pressure is vented as follows:

a. Remove any remaining pressure in the valve by loosening plugs (1), on bottom of manifold, then remove plugs from manifold to drain any remaining fluid.

b. Remove O-ring (2) from each plug (1).

Remove flood/drain valve adjustor as follows:

a. Remove aft cover (13) (flood/drain) from end cap (11).

b. Remove lockwire from the flood/drain valve adjustor.

c. Remove capscrews (15) and remove flood/drain valve adjustor assembly from manifold body.

Remove hatch adjustor as follows:

a. Remove forward cover (13) (hatch) from end cap (14).

b. Remove lockwire from the hatch adjustor.

c. Remove capscrews (15) and remove hatch adjustor assembly from manifold body.

5-5-18.4. Hydraulic Control Valve Manifold Adjustor(s) Disassembly.

NOTE

Refer to Figure 5-6-15 for parts identification.

Disassemble the flood/drain valve adjustor as follows:

NOTE

Close attention must be given to the orientation of the quiet element when removed so that it can be reinstalled in the same manner.

a. Separate washer (12), sleeve of slide/sleeve matched set (9) and quiet element (10) from end cap (11).

NOTE

Count and record the number of threads showing before removing locknut.

b. Remove locknut (16) from slide/sleeve matched set (9).

c. Remove slide from end cap (11).

d. Remove and discard O-rings (18), (19), (21) and (22) and backups (24), (25) and (27) from sleeve (9) and end cap (11).

Disassemble the hatch adjustor as follows:

NOTE

Count and record the number of threads showing before removing locknut.

a. Remove locknut (16) from slide/sleeve matched set (8).

b. Remove slide/sleeve matched set (8) from end cap (14).

c. Remove and discard O-rings (17), (20) and (22) and backups (23) and (26) from end cap (14).

5-5-18.5. Hydraulic Control Valve Manifold Adjustor(s) Cleaning Procedures.

Perform general cleaning in an area free of dirt and debris using an appropriate degreaser/cleaner.

The following components must be cleaned in an ultrasonic sink prior to reinstallation:

a. Quiet element (10).

b. Slide/sleeve matched set (9) or (8)

c. End cap (11) or (14)

d. Washer (12)

5-5-18.6. Hydraulic Control Valve Manifold Adjustor(s) Reassembly.

Lubricate O-rings with system hydraulic oil (2075)

Reassemble flood/drain valve adjustor as follows:

a. Install O-rings (18), (19), (21) and (22) and backups (24), (25) and (27) on sleeve (9) and end cap (11).

b. Initially install slide of slide/sleeve matched set (9) to be flush with outside face of end cap (11).

NOTE

The larger ports of the quiet element will face towards the end cap when the quiet element is properly installed.

c. Install quiet element (10) sleeve of slide/sleeve matched set (9) onto slide of slide/sleeve matched set (9).

d. Turn adjustor counterclockwise to allow washer (12) to be installed flush with sleeve of slide/sleeve matched set (9).

e. Install locknut (16) on slide/sleeve matched set (9).

f. Replace all cut lockwire.

Reassemble hatch adjustor as follows:

a. Install new O-rings (17), (20) and (22) and backups (23) and (26) on end cap (14).

b. Install slide of slide/sleeve matched set (8) to original position in end cap (14).

c. Install sleeve of slide/sleeve matched set (8) to slide of slide/sleeve matched set (8).

d. Install locknut (16) on slide/sleeve matched set (8).

5-5-18.7. <u>Hydraulic Control Valve Manifold Adjustor(s) Reinstallation.</u>

Reinstall hatch adjustor as follows:

a. Install hatch adjustor assembly onto manifold body and hand tighten capscrews (15).

b. Loosen locknut (16) and unscrew slide/sleeve matched set (8) five turns.

c. Torque capscrews (15) in an "X" sequence to 90 ± 10 in-lbs. in 30 in-lb. increments.

NOTE

It will be necessary to adjust slide/sleeve matched set to ensure the appropriate number of threads are showing as recorded earlier.

d. Adjust slide/sleeve matched set (8) and locknut (16) to their original position as recorded earlier.

e. Lockwire capscrews (15).

f. Install forward cover (13) (hatch) hand-tight to end cap (14).

Reinstall flood/drain valve adjustor as follows:

a. Install Flood/Drain adjustor assembly onto manifold body and hand-tighten capscrews (15).

b. Loosen locknut (16) and unscrew slide/sleeve matched set (9) five turns.

c. Torque capscrews (15) in an "X" sequence to 90 ± 10 in-lbs. in 30 in-lbs. increments.

NOTE

It will be necessary to adjust slide/sleeve matched set to ensure the appropriate number of threads are showing as recorded earlier.

d. Adjust slide/sleeve matched set (9) and locknut (16) to their original position as recorded earlier.

e. Lockwire capscrews (15).

f. Install AFT cover (13) (flood/drain) hand-tight to end cap (11).

g. Lubricate and install new O-rings (2) on plugs (1).

h. Install plugs (1) into manifold.

i. Clear tagouts and restore VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

5-5-18.8. Test Requirements.

NOTE

To verify proper operation/adjustment of the hatch and flood/drain valve adjustors operational test of the hatch & flood/drain valve control valve is required.

Refer to CHAPTER 2 for test requirements for the hatch and flood/drain valve control valve.

5-5-19 FLOOD/DRAIN VALVE ROTARY ACTUATOR.

Repair and overhaul procedures contained herein provided the information necessary for the removal disassembly, cleaning, inspecting, reassembly and reinstallation of the flood/drain valve rotary actuator and magnetic switch. Use applicable drawings for specific installation/adjustment procedures not covered in this chapter. Refer to Figure 5-6-16 for parts identification.

5-5-19.1. Initial Conditions.

a. Power to the applicable control/indication circuits secured in accordance with current shipboard instructions.

WARNING

Ensure VLS Hydraulic System is tagged out in accordance with current shipboard instruction.

b. Vent VLS hydraulic system and tagout in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

NOTE

This procedure may be conducted on an empty or a loaded missile tube. The missile tube hatch should be shut so that the flood/drain valve can be positioned as required for valve removal or magnetic switch adjustment. This is necessary due to the construction and design of the hatch & flood/drain valve control valve HMLP(S)-(*)-22.

NOTE

This procedure requires IMA/DEPOT assistance.

(SSN 721 and Later) Gain access into MBT 2 in accordance with Reference 34 (SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

5-5-19.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-19.3. Flood/Drain Valve Rotary Actuator Removal.

CAUTION

Magnetic switch connectors may be damaged by over torquing. Use only a spanner wrench for removal. Do not use a mallet.

NOTE

If switch is being removed to support actuator repair, disconnecting of electrical connector is not required. However, if the connector is disconnected ensure the appropriate protective caps are installed (refer to Table 5-6-28).

a. Disconnect electrical cable connector from flood/drain valve. Install protective cap on electrical cable connector. (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

b. Matchmark cover (28), spacers (24) to actuator body (1).

NOTE

Do not drop spacers (24) when removing capscrews (25) and cover (28).

c. Remove capscrews (25) and washers (26).

d. Remove cover (28) and spacer (24) taking care not to drop spacers (24).

e. Matchmark magnets (33) to magnet holder (34) if magnets are to be removed.

f. Loosen set screw (29) and remove magnet holder (34).

g. Remove capscrews (27) and washers (30) from cover (28).

h. Remove magnetic switch from cover (28).

Table 5-5-5. Flood/Drain Valve Rotary Actuator Removal and Installation Equipment.

ITEM	DESCRIPTION	QUANTITY
1	Thickness gage	1
2	Key set, socket head screw, 0.028" - 0.375"	1
3	Lock wire pliers and lockwire	1
4	Drop light	1
5	Wrench Spanner, Hook, Adjustable (1 1/4 -3”)	1
6	Wrench, torque, 0-50 in-lbs, 1/4" Drive	1

CAUTION

Verify hydraulic system supply/return pressure has been vented.

CAUTION

Applicable HMLP(S)-(*)-23 must be shut prior to disconnecting C-1/C-2/C-3 pipes.

i. Disconnect related piping to missile tube flood/drain valve rotary actuator.

NOTE

The weight of the missile tube flood/drain valve actuator is 50 pounds. Two personnel may be required to handle actuator.

j. Place blocking under flood/drain valve actuator to support its weight.

k. Remove actuator hold down self-locking cap screws (6) and (7).

l. Remove rotary actuator from flood/drain valve.

m. Move actuator to clean work area.

5-5-19.4. Flood/Drain Valve Rotary Actuator Disassembly.

a. Matchmark bearing cap (2) to actuator body (1). Remove self-locking capscrews (8) and bearing cap (2) from actuator body (1). Remove scraper ring (9) from bearing cap. Remove O-rings (14) and (15) and backup rings (17) and (18) from bearing.

b. Matchmark pinion (4) gear teeth to piston rack (3) gear teeth. Remove pinion (4) from actuator body (1) taking care not to damage the pinion splines and gear teeth and the gear teeth of piston rack. Remove O-ring (12) and backup rings (13) from pinion.

c. Matchmark end cap (19) to actuator body (1). Remove lockwire, capscrews (20), washers (23) and end cap (19) from actuator body (1). Remove O-rings (21) and backup rings (22) from end cap.

NOTE

Use a wooden or nylon dowel to remove piston rack out of actuator body.

d. Remove piston rack (3) from actuator body (1) by sliding the piston rack out through the actuator body port hole. Remove O-rings (10) and (12) and backup rings (11) and (13) from piston rack (3).

e. Remove check valve (16) from piston rack (3) using a 6-32 screw. Insert screw into check valve (16). Place piston rack (3) in vice and use the forked end of a crow bar to remove check valve.

5-5-19.5. <u>Flood/Drain Valve Rotary Actuator Cleaning Procedures.</u>

Clean actuator part in an area free of dirt and devris using an appropriate degreaser/cleaner.

5-5-19.6. <u>Flood/Drain Valve Rotary Actuator Inspection and Repair.</u>

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired if applicable or replaced. Refer to Figure 5-6-16.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

(1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

(2) Missing, crossed, or flattened threads are not acceptable.

(3) Clearance fit threads must dengage by hand.

(4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect seal surfaces for any defects that would prevent O-rings from sealing properly.

c. Inspect actuator body (1), and end cap (19) as follows:

(1) Examine actuator body (1), and end cap (19) for cracks which may cause leakage. Cracks are not acceptable. Replace defective parts at reassembly.

(2) Examine interior surfaces of actuator body (1), underside of bearing cap (5) and end cap (19) for evidence of stress corrosion cracking. [Stress corrosion cracking occurs in an area of pitting or corrosion internal to the part, with the cracks perpendicular to the plane of predominant grain flow, unless the crack has extended completely through to the exterior.] [Interior examination may be made using a high intensity light source and a dental or inspection mirror.] Suspected cracking areas may be further checked by the dye penetrant or fluorescent penetrant method in accordance with Reference 45 (Nondestructive Testing Requirements for Metals). The maximum allowable internal corrosion pitting depth is limited to 0.10 inch covering a maximum of 25 percent of the surface area.

(3) Examine the external surfaces of actuator body (1), and bearing cap (5) and end cap (19) for corrosion and pitting. Examine suspected cracking areas by the dye penetrant method. Maximum allowable external corrosion pitting depth is limited to 15 percent of the design wall thickness covering a maximum of 25 percent of the surface area.

(4) Remove minor interior and exterior corrosion by light sanding with a fine grit emery cloth.

(5) Examine the piston rack cylinder walls in actuator body (1) for corrosion scoring and defective surface finish. A cylinder which has been scored lengthwise to a depth greater than about 0.001 inch is unacceptable. (If fingernail or equivalent probe will actually catch in score mark, it is unacceptable.)

(6) Examine the cylinder bores in actuator body (1) for pitting. Pits up to 0.008 inch in diameter and 0.004 inch in depth are permitted on the walls. Machining to remove defects on the cylinder walls is permissible provided the diametral clearance with the piston does not exceed 0.010 inch.

(7) Examine the piston rack cylinder in actuator body (1) with piston rack (3). Examine both the horizontal and vertical axes. If the diametral clearance with the piston diameter exceeds 0.010 inch on either axis, the cylinder is worn and the body must be replaced unless an oversized piston diameter (chrome-plated) is utilized.

(8) Polish the piston rack cylinder walls in actuator body (1) to a finish of 16 rhr except in way of acceptable pits. Machine the cylinder to 16 rhr or smoother when examination reveals unacceptable scoring or pitting on cylinder walls.

(9) Ensure that the diametral clearances between bearing (2) and pinion (4) and actuator body (1) do not exceed 0.010 inch.

d. Inspect pinion (4) and piston rack (3) as follows:

(1) Examine pinion (4) and piston rack (3) for chipped, cracked, broken or unevenly worn (due to faulty heat treatment) gear teeth. Unevenly worn, chipped or broken gear teeth are unacceptable. A piston rack or pinion containing cracks in any location or direction is unacceptable. Remove minor defects. Final surface finish shall be 32 rhr or smoother for pinion bearing surfaces and piston rack sealing surfaces.

(2) Examine pinion (4) splines for burrs and high spots. There should be no visible backlash or binding at reassembly between pinion and mating splines.

(3) At reassembly, examine piston rack (3) and pinion (4) gears for backlash. Backlash should not exceed 0.015 inch between teeth or one degree measured by rotation. To identify the component that requires replacement, compare the worn tooth area with one not in normal contact. The unacceptable component must be replaced at reassembly.

(4) Examine piston rack (3) for sharp edges produced by wear which may damage the cylinder bore. Remove all sharp edges before reassembly.

(5) Examine bearing surface area of pinion (4) for metal transfer from bearing (2) to the pinion. Remove the transferred metal.

e. Inspect bearing (2) as follows:

(1) Examine bearing (2) for cracks and wear. A cracked bearing is not acceptable and must be replaced at reassembly.

(2) Ensure that the diametral clearance between the inside diameter of bearing (2) and the outside diameter of pinion (4) bearing area does not exceed 0.007 inch.

5-5-19.7. Flood/Drain Valve Rotary Actuator Reassembly.

Inspect new O-rings and backup rings prior to installation, lubricate O-rings with system hydraulic oil (2075) and internal components with grease (CID A-A-50433). Refer to Figure 5-6-16 for parts identification.

a. Ensure that piston rack cylinder bore in actuator body (1) is free of particles or other accumulation that may interfere with piston rack (3) installation.

b. Install new check valve (16) into piston rack (3) using a 6-32 screw. Remove screw when check valve (16) is fully seated.

c. Install O-rings (10) and (12) and back-up rings (11) and (13) on piston rack (3).

CAUTION

Do not damage the piston rack O-rings and back-up rings (retainers) when inserting the piston rack into cylinder bore, or when the piston rack passes the center pinion recess in the cylinder bore.

d. Install piston rack (3) in cylinder bore of actuator body (1).

e. Install O-ring (12) and back-up rings (13) on pinion (4). Install pinion (4) in actuator body (1) aligning the pinion gear teeth with piston rack (3) gear teeth matchmarks.

f. Install O-rings (21) and back-up rings (22) on end cap (19).

g. Install end cap (19) on actuator body (1) aligning the end cap and the actuator body matchmarks. Secure end cap (19) with capscrews (20) washers (23) and torque to 25 ± 5 in-lbs. Secure the capscrews with lockwire.

h. Install O-rings (14) and (15) and back-up rings (17) and (18) on bearing (2).

i. Install bearing (2) in actuator body (1), aligning the bearing and the actuator body matchmarks. Secure with self-locking capscrews (8).

j. Install scraper ring (9) on pinion (4).

k. Conduct bench test in accordance with paragraph 5-2-14.

5-5-19.8. Flood/Drain Valve Rotary Actuator Reinstallation.

a. Align actuator pinion spline with valve stem spline and mate.

b. Install actuator hold down self-locking capscrews (6) and (7).

c. Install related piping to flood/drain valve rotary actuator.

d. Replace all removed lockwire.

e. Install magnet holder (34) on pinion (4) and lock with setscrew (29).

f. If removed, install magnets (33) on magnet holder (34) with screws (31) and spacers (32).

CAUTION

Over tightening of capscrews may cause screw inserts to loosen. Do not over tighten capscrews.

g. Install magnetic switch in cover (28) with washers (30) and capscrews (27).

h. Install spacers (24) and cover (28) onto actuator body (1) with washers (26) and capscrews (25).

i. Install electrical connector in accordance with paragraph 5-5-26 if previously removed.

j. Adjust magnetic switch, refer to paragraph 5-2-17.

k. Replace all cut lockwire.

l. Open applicable HMLP(S)-(*)-23.

m. Clear tagout and restore VLS hydraulic system in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

n. For SSN 721 and later, secure main ballast tank in accordance with Reference 34 (SSN688 Class SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures.

5-5-19.9. Test Requirements.

Refer to CHAPTER 2 for test requirements for the flood/drain valve hydraulic rotary actuator and magnetic switch.

5-5-20 PRESSURIZATION/VENT CONTROL VALVE APV-(*)-1.

Two methods of maintenance access for APV-(*)-1 are provided herein. The first method provides procedures for in-place maintenance. "In-place" is defined to mean that the P/V valve body remains installed. Valve components only are removed for maintenance. The second method provides procedures for the removal of the individual P/V valves, as intact assemblies, from the VLC for maintenance elsewhere. Refer to Figure 5-6-17 for parts identification.

NOTE

If the valve is overhauled in-place or removed and overhauled at a more convenient location the actual disassembly and reassembly procedures for the valve is the same.

NOTE

Removal of the P/V control valve components from the "in-place" position can be accomplished with tools identified in Table 5-5-6.

5-5-20.1. Initial Conditions.

This procedure can be conducted on an empty or loaded missile tube, but if the missile tube contains an AUR/AURVS, the missile stowage pressure must be vented to atmospheric pressure prior to the start of this procedure in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

CAUTION

Do not attempt this procedure on a missile tube containing a flooded spent capsule or a pressurized AUR/AURVS.

NOTE

( ) Indicates valves in starboard bank.
(*) Indicates tube under test.

The "in-place" maintenance access for APV-(*)-1 is defined to mean that the P/V valve body remains installed in the VLS system piping. Only P/V valve components are removed for maintenance. Portions of this procedure were derived from Reference 3 (Ship Valves Technical Manual). Refer to Figure 5-6-17 for parts identification.

Secure electrical power to the P/V control valve solenoids by securing power to the MTCP or TCP.

Shut the 700 psi supply to pressurization/vent system APV-10 (APV-11) and open hull stop isolation APV-(*)-2.

Vent the P/V control valve APV-(*)-1 and adjacent piping by pushing both pressurization and vent solenoid manual override buttons several times to remove all control air. Any residual air pressure between APV-(*)-1 and APV-(*)-3 will be vented during disassembly.

Shut the P/V isolation valve APV-(*)-3 and hull stop isolation APV-(*)-2.

Cut lockwire tag and remove electrical connectors from solenoids and install protective caps over the connectors and solenoids.

Remove any interference that would preclude valve or P/V component removal.

Disconnect quiet vent muffler piping connections.

Ensure tagouts are completed in accordance with shipboard instructions.

Openings in the piping system and P/V valve should be covered to prevent contamination.

5-5-20.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-20.3. Pressurization/Vent Control Valve Assembly Removal.

NOTE

Proceed to paragraph 5-5-20.4 if conducting "in-place" maintenance.

Valve location should be considered if maintenance in-place is to be attempted. The upper valves are approximately 5-1/2 feet above the deck plates. Alignment and assembly of these valve components may be more difficult than those at the lower levels. Misalignment may result in O-ring seal damage and additional maintenance actions. The assemblies are very susceptible to dirt, and thus cleanliness is of the utmost importance.

Removal of a P/V valve assembly as a complete unit can be accomplished through the use of a slugging wrench, a bonnet wrench and standard shipboard tools.

a. Remove any interference items.

b. Loosen the four valve body mounting bolts to relief pipe fitting stresses on the union nut connections.

c. Unscrew the 700 psi air inlet and air outlet union nuts behind valve.

d. Pass one end of a nylon line over the adjacent valve body foundation, or equivalent structure, and secure to the valve body. This line will serve as a safety line while the 150 pound valve is being pulled out horizontally and as it is lowered to a deck level dolly.

e. Remove the outboard mounting bolts.

f. Remove the inboard mounting bolts.

g. While one person applies tension to the safety line, two others pull the valve horizontally out of its mounted position. The valve is then lowered to a deck level dolly, or equivalent device, for transportation to a service area.

h. Install dust covers on the pipe and valve union fittings to avoid contamination.

Table 5-5-6. Pressurization/Vent Control Valve Disassembly and Reassembly Equipment

ITEM	DESCRIPTION	QUANTITY
1	Ratchet, 1/4" Drive	1
2	Ratchet, 1/2" Drive with 6" Extension	1
3	Wrench Torque, 0-50 ft-lbs x 1/2" Drive	1
4	Wrench Torque, 0-100 in-lbs x 1/4" Drive	1
5	Pliers, lockwire	1
6	Pliers, Sidecutter	1
7	Screwdriver 1/4" Tip (2)	1
8	15/16" Wrench, Open end	1
9	9/16" Wrench, Open end	1
10	Lockwire	as required
11	1 1/2" Wrench, Open end	1
12	1/2" Socket x 1/2" Drive	1
13	9/16" Socket x 1/2" Drive	1
14	15/16" Socket x 1/2" Drive	1
15	3/32" Hex Key socket x 1/4" Drive	1
16	5/32" Hex Key socket x 1/4" Drive	1
17	3/16" Hex Key socket x 1/4" Drive	1
18	1/4" Hex Key socket x 1/4" Drive	1
19	Key Set, socket head screw 0.028"-0.375"	1
20	Scribe, Machinist's	1
21	Flashlight	1

5-5-20.4. <u>Vent Side Removal.</u>

CAUTION

Cap (13) contains a spring under compression, remove with care.

a. Remove four self-locking bolts (27) and remove cap (13) from sleeve (16).

b. Remove spring (14) from inside of sleeve (16).

CAUTION

When removing sleeve (16), care should be taken not to damage solenoid valve (25), poppet (15), transfer tube (8) or disc assembly (17).

CAUTION

Support sleeve (16) and disc assembly (17) while removing four self-locking bolts (26). Assembly weighs approximately 40 pounds. A second person should be available to assist in removal.

CAUTION

When sleeve (16) and disc assembly (17) are removed from body (1) they could separate.

c. Remove four self-locking bolts (26) from sleeve (16) and disc assembly (17) and separate from body (1).

d. Remove transfer tube (8) from body (1).

5-5-20.5. Pressurization Side Removal.

CAUTION

When removing solenoid valve (24) from sleeve (6), ensure transfer tubes are not dropped or damaged.

a. Remove capscrews (47) from solenoid valve (24).

b. Remove solenoid valve (24) and transfer tubes (46) from sleeve (6) and set aside.

c. Remove and discard O-rings (48) from transfer tubes (46).

CAUTION

When removing sleeve (6) from body (1), care should be taken not to damage poppet (4), spring (5), transfer tube (3) or disc assembly (18).

CAUTION

Support sleeve (6) while removing self-locking bolts (27).

d. Remove six self-locking bolts (27) from sleeve (6) and separate sleeve (6) from body (1).

e. Remove disc assembly (18) from body (1).

f. Remove transfer tube (3) from body (1).

5-5-20.6. Pressurization Side Disassembly.

a. Remove four capscrews (30) from seat retainer (2) and separate seat retainer (2) from disc assembly (18).

b. Remove seat (21) from seat retainer (2).

c. Remove and discard O-rings (35), (33), (34) and (31) from seat retainer (2), disc assembly (18) and transfer tube (3).

d. Pull spring (5) and poppet (4) out of sleeve (6).

e. Remove self-locking bolts (28) from cap (10) and separate cap (10) from sleeve (6).

NOTE

Count the number of threads showing before removing self-locking hex nut (9) from stroke adjustor (7).

f. Remove self-locking hex nut (9) from stroke adjustor (7) while holding stroke adjustor (7) with allen wrench.

g. While counting the number of turns required, remove stroke adjustor (7) from cap (10).

h. If replacing cushion (22), remove self-locking capscrew (29) from stroke adjustor (7) and separate cushion (22) from stroke adjustor (7).

i. Remove and discard O-ring (42) from stroke adjustor (7).

j. Remove and discard O-rings (40), (36) and (42) from sleeve (6), and poppet (4).

5-5-20.7. Vent Side Disassembly.

a. Remove capscrews (47) from solenoid valve (25).

b. Remove solenoid valve (25) and transfer tubes (46) from sleeve (16).

c. Remove and discard O-rings (48) from transfer tubes (46).

d. Loosen setscrew (44) in sleeve (16) using 3/32" hex key to vent any internal pressure. Push poppet (15) forward from disc end to sleeve end to remove residual pressure. Tighten setscrew into sleeve. Torque setscrew to 12-15 in-lbs.

e. Separate disc assembly (17) from sleeve (16).

f. Remove poppet (15) from sleeve (16).

NOTE

Count the number of threads showing before removing self-locking hex nut (12) from stroke stop (11).

g. Remove self-locking hex nut (12) from stroke stop (11).

h. While counting the number of turns required, remove stroke stop (11) from cap (13).

i. Remove cushion (23) from poppet (15) using 5/32" hex key to remove self-locking capscrew (30).

j. Remove seat retainer (19) from body (1). Remove seat (20) from seat retainer.

k. Remove and discard O-rings (31) from transfer tube (8), (37) from seat retainer (19), (38) and (43) from poppet (15), (39) and (41) from disc assembly (17), and (43) and (32) from cap (13).

5-5-20.8. Solenoid Pilot Valve Disassembly.

NOTE

The below steps are applicable for both the pressurization and vent solenoids.

CAUTION

Gland (55) is under spring pressure.

a. Remove four capscrews (59).

b. Remove gland (55) spring (57) and washer (58).

c. Remove sleeve (54) poppet (53) from body (50).

d. Remove seat retainer (52) from body (50).

NOTE

Stem (56) may fall out of body (50). Insure stem (56) remains installed.

e. Remove seat (51) from poppet (53).

f. Remove O-rings (60) and backup rings (62) from poppet (53).

g. Remove O-rings (61) and backup rings (63) from sleeve (54) and seat retainer (52).

5-5-20.9. Pressurization/Vent Control Valve Inspection and Repair.

a. Inspect pressurization side and valve body as follows:

(1) Clean all parts with a soft clean cloth and visually inspect APV-(*)-1 valve internals and pieces for any water marks, residue, damage or abnormal wear.

(2) Visually inspect the supply disk for contamination and ultrasonically clean as needed. Blow dry using compressed air.

(3) Note any defective components for later replacement.

b. Inspect vent side as follows:

(1) Clean all parts with a soft clean cloth and visually inspect APV-(*)-1 valve internals and pieces for any water marks, residue, damage or abnormal wear.

(2) Visually inspect the supply disk for contamination and ultrasonically clean as needed. Blow dry using compressed air.

(3) Note any defective components for later replacement.

5-5-20.10. Pressurization Side Reassembly.

During reassembly lightly lubricate O-rings and bores with silicone compound MIL-S-8660.

NOTE

Prior to reassembly, replace any worn or damaged components.

NOTE

During manufacturing, some seats (21) were marked with a black dot on the face of the seat. Correct installation of seat in seat retainer (2) is with the black dot facing in (not visible). For seats manufactured without the dot, install either side into seat retainer.

a. Insert seat (21) in seat retainer (2).

b. Lubricate O-ring (35) and outside neck diameter of seat retainer (2). Install O-ring on seat retainer.

c. Lubricate O-rings (33) and (34) and inside diameter of disc assembly (18). Install O-rings on disc assembly.

d. Assemble seat retainer (2) to disc assembly (18) using self-locking capscrews (30). Torque self-locking capscrews to 45-50 in-lbs.

e. Lubricate O-rings (31) and install on transfer tube (3).

f. Insert transfer tube (3) and disc assembly (18) into body (1).

g. If previously removed install cushion (22) onto stroke adjustor (7) and secure with self-locking capscrew (29). Torque self-locking capscrew to 12-15 in-lbs.

h. Lubricate O-ring (42) and install on stroke adjustor (7).

i. Using same number of turns counted at disassembly (step 5-5-20.6g.), thread stroke adjustor (7) into cap (10).

NOTE

Only hand tighten self-locking hex nut (9).

j. Secure stroke adjustor (7) with self-locking hex nut (9).

k. Lubricate and install O-ring (40) onto sleeve (6).

l. Lubricate O-rings (36) and (42) and internal bore of sleeve (6).

m. Install O-rings (36) and (42) onto poppet (4).

n. Insert poppet (4) into disc assembly (18) then insert spring (5) onto poppet and slide sleeve (6) into body (1).

CAUTION

When installing sleeve (6) to body (1), care should be taken not to damage poppet (4), spring (5), transfer tube (3) and disc assembly (18).

o. Assemble sleeve (6) to body (1) using self-locking bolts (27). Torque self-locking bolts (27) to 25-28 ft-lbs.

p. Assemble cap (10) to sleeve (6) and secure with self-locking bolts (28). Torque self-locking bolts to 14-16 ft-lbs.

q. Torque self-locking hex nut (9) on stroke adjuster (7) to 10-12 ft-lbs.

r. Lubricate and install O-rings (48) on transfer tubes (46).

CAUTION

Ensure transfer tubes (46) stay in proper position while installing solenoid valve (24).

s. Install transfer tubes (46) into solenoid valve (24).

t. Assemble solenoid valve (24) to sleeve (6) using self-locking capscrews (47). Torque self-locking capscrews to 10-12 ft-lbs.

u. Replace all cut lockwire.

5-5-20.11. Solenoid Pilot Valve Reassembly.

During reassembly lightly lubricate O-rings and bores with silicone compound MIL-S-8660.

a. Install new seat (51) on poppet (53).

b. Lubricate and install backup rings and O-rings (62) and (60) on poppet (53).

c. Lubricate and install backup rings (63) and O-rings (61) on sleeve (54) and seat retainer (52).

NOTE

Insure stem (56) is still installed prior to installing seat retainer (52).

d. Install seat retainer (52) into body (50).

e. Install poppet (53) into sleeve (54).

f. Install poppet and sleeve assembly into valve body (50).

g. Install washer (58), spring (57) and gland (55) on valve body (50) using cap screws (59).

h. Torque capscrews (59) to 8-10 ft. lb.

5-5-20.12. Vent Side Reassembly.

During reassembly lightly lubricate O-rings and bores with silicone compound MIL-S-8660.

NOTE

Prior to reassembly, replace any worn or damaged components.

NOTE

During manufacturing, some seats (20) were marked with a black dot on the face of the seat. Correct installation of seat in seat retainer (19) is with the black dot facing in (not visible). For seats manufactured without the dot, install either side into seat retainer.

a. Lubricate and install O-rings (48) on transfer tubes (46).

b. Install transfer tubes (46) into solenoid valve (25).

c. Assemble solenoid valve (25) to sleeve (16) using self-locking capscrews (47). Torque self-locking capscrews to 10-12 ft-lbs.

d. Insert seat (20) in seat retainer (19). Lubricate O-ring (37) and outside neck diameter of seat retainer. Install O-ring (37) on seat retainer. Install seat retainer in body (1).

e. Lubricate O-ring (41) and inside diameter of seat area of disc assembly (17). Install O-ring (41) in disc assembly.

f. Lubricate O-rings (31) and install on transfer tube (8). Install transfer tube into body (1).

g. Lubricate O-ring (39) and outside diameter of seat area of disc assembly (17). Install O-ring (39) on disc assembly. Install disc assembly into body (1) using transfer tube (8) as a guide to align bolt holes.

h. Install cushion (23) on poppet (15) and install self-locking capscrew (30). Using 5/32" hex key and torque wrench, torque self-locking capscrew to 15-20 in-lbs.

i. Lubricate O-rings (38) (43) and install on poppet (15).

j. Install poppet (15) into disc assembly (17).

k. Assemble sleeve (16) into body (1) and disc assembly (17).

l. Install self-locking bolts (26) into base of sleeve (16). Torque self-locking bolts to 25-28 ft-lbs.

m. Install spring (14) into poppet (15).

n. Lubricate O-rings (32) and (43) and install on cap (13).

o. Using same number of turns counted at disassembly (step 5-5-20.7h), thread stroke stop (11) into cap (13).

NOTE

Only hand tighten self-locking hex nut (12).

p. Secure stroke stop (11) with self-locking hex nut (12).

NOTE

When installing self-locking bolts (27) through cap (13) into sleeve (16), pressure must be applied to cap to overcome spring pressure.

q. Install cap (13) on sleeve (16) using self-locking bolts (27). Torque self-locking bolts to 25-28 ft-lbs.

r. Torque self-locking hex nut (12) to 20-30 ft-lbs.

s. Re-connect electrical cabling to appropriate solenoids.

NOTE

O-rings (49) for quiet vent muffler piping is not shown in Figure 5-6-17. Part number information may be obtained from Table 5-6-17.

t. Lubricate O-rings (49) and install in quiet vent muffler piping connections. Tighten quiet vent muffler piping connections.

u. Replace all cut lockwire.

v. Install any interference items removed.

w. Clear applicable tagout in accordance with current shipboard instructions.

5-5-20.13. Pressurization/Vent Control Valve Assembly Reinstallation.

Reinstallation of the P/V control valve is accomplished in the following manner. Ensure that all required maintenance has been performed and that the required O-rings are in place in the union joints prior to sliding the P/V valve into place. Ensure cleanliness of all joints and tools before reinstallation is attempted.

a. Rig the safety line as specified in paragraph 5-5-20.3d.

b. Two men now lift the valve vertically, while a third man keeps tension on the safety line.

c. Guide the valve horizontally into position and line up the pipe union fittings. Care must be taken at this point to avoid damage to the sealing surfaces on the union fittings.

d. Make up the union connections to a hand-tight condition.

e. Position and install the inboard mounting bolts.

f. Position and install the outboard mounting bolts.

g. Complete the make-up of the unions for both the 700-psi air entrance and air exit lines.

h. Reconnect electrical connections.

i. Replace all cut lockwire.

j. Install any interference items removed.

k. Clear applicable tagout in accordance with current shipboard instructions.

5-5-20.14. Test Requirements.

Refer to CHAPTER 2 for test requirements for pressurization/vent control valve.

5-5-21 PRESSURIZATION/VENT HULL STOP ISOLATION VALVE APV-(*)-2.

WARNING

APV-2 is within the subsafe certification boundary.

NOTE

Maintenance on this valve requires proper subsafe/QA certification documentation prior to commencement of any work. Consult the Quality Assurance Manual, the Submarine Material Identification and Control for Piping Systems Boundary Book and the Submarine Safety Certification Boundary.

Procedures contained herein provide the information necessary for the removal, repair and reinstallation of the pressurization/vent hull stop isolation valve APV-(*)-2. Use applicable drawings for specific installation and adjustment procedures not covered in this volume. Figure 5-5-4 is a cutaway of APV-(*)-2. Refer to Figure 5-6-18 for parts identification.

5-5-21.1. Initial Conditions.

Prior to the start of corrective maintenance for the P/V hull stop isolation valve, the following preparatory steps are to be observed. These steps are to interrupt flow of 700 psi air to the involved P/V control valve APV-(*)-1 and place both the missile tube underhatch area and the AUR at atmospheric pressure.

NOTE

Access to the pressure/vent port inside the missile tube is required to complete post repair testing.

a. Offload AUR/AURVS or Ballast Can.

b. Shut the pressurization supply isolation valve APV-(*)-3 and vent the P/V control valve APV-(*)-1 by pushing the manual override on the vent solenoid.

c. Ensure tagout is in accordance with current shipboard instructions.

5-5-21.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-21.3. Pressurization/Vent Hull Stop Isolation Valve Removal.

In addition to standard tools, maintenance of the hull stop isolation valve may also require the availability of the ball removal tool of Reference Drawing 29.1 (Tool Assemblies, Special, Ball Valves) if removal of the valve ball is necessary. Refer to Reference 3 (Ships Valve Technical Manual) for additional information on valve repair.

a. Disconnect the electrical connector plug from the valve.

b. Unlock valve and remove hex nut (1), washer (2), and handle (3) from stem (12).

NOTE

Use caution when removing breakaway bolts to avoid shearing bolt heads. If bolt heads are sheared, an easy out will be required to remove bolt.

c. Remove four breakaway bolts (4) from cover (5).

d. Remove cover (5) using caution not to break wires. Disconnect wiring from switch and tag wires for reassembly and remove cover (5).

e. Remove upper spacer (7) from stem (12)

f. Remove capscrews (14) and machine screws (16) from bonnet (20). Remove bracket (15) from bonnet (20).

g. Remove cam stop (8) and square key (13) and cam stop (8) from stem (12).

h. Remove lower spacer (9) from stem (12).

i. Using valve handle (3) rotate valve to the open position.

j. Remove valve bonnet (20) by removing nuts (19) from studs (26).

NOTE

The use of jacking screws (28) may be required to remove bonnet (20) from valve body (27).

k. Using the tapped holes in the ball and tools identified in Reference Drawing 29.1 (Tool Assemblies, Special, Ball Valves) as required, remove ball (24), seats (23) and seat retainers (22) from valve body cavity.

l. Remove retaining nut (10) from valve bonnet (20) using an adjustable pin type spanner or equivalent.

m. Remove stem (12) from valve bonnet (20).

n. Remove and discard O-rings from stem (12) and valve bonnet (20).

5-5-21.4. <u>Pressurization/Vent Hull Stop Isolation Valve Cleaning Procedures.</u>

Clean valve parts in an areas free of dirt and debris using an appropriate cleaner.

5-5-21.5. <u>Pressurization/Vent Hull Stop Isolation Valve Inspection and Repair Procedures.</u>

Parts inspected in the following paragraphs that do not meet acceptance criteria must be repaired or replaced as applicable. Refer to Reference Drawing 30.1(Valve Assembly, Ball-Full Port Manual Operator 2” 700 PSI for additional information.

a. Inspect threaded fasteners including sefl-locking fasteners. Inspection is limited to visual examination for defects and signs of damage.

    (1) Visual defects (nicks, cuts, ect.) on thread surfaces and on inserts of self-locking fasteners are not acceptable.

    (2) Missing, crossed, or flattened threads are not acceptable.

    (3) Clearance fit threads must dengage by hand.

    (4) Self-locking fasteners must have a positive reinstallation torque (i.e. other than hand pressure in required through the lock portion).

b. Inspect seal surfaces for any defects that would prevent O-rings from sealing properly.

c. Examine the locking device parts as listed below for corrosion and cracks.

    (1) Cover (5)

    (2) lock bolt (6)

    (3) cam stop (8)

    (4) upper and lower spacer (7 and 9)

    (5) square key (13)

NOTE

Ensure ball & seat stack height meets the requirements identified in Reference 58 (Restore Vertical Launch System Hull Valves).

d. Inspect bonnet (20) and valve body IN ACCORDANCE WITH Reference 58 (Restore Vertical Launch System Hull Valves).

5-5-21.6. Pressurization/Vent Hull Stop Isolation Valve Reinstallation.

During reassembly lightly lubricate O-rings and bores with silicone compound MIL-S-8660.

NOTE

Prior to reinstallation, verify valve body and all components are clean.

NOTE

It is important that the ball be assembled so that when finally seated it is in the open position.

a. Install O-rings (17) and (21) on stem (12) and valve bonnet (20).

b. Install thrust washer (11) and valve stem (12) into bonnet and secure with retaining nut (10) then orientate stem (12) to open position.

c. Ensure jacking screws (20) do not protrude from bottom of bonnet.

d. Install ball (24), seats (23) and retaining rings (22) into valve body (27).

e. Install bonnet (20) onto valve body (27) and tighten retaining nuts (19).

f. Tighten jacking screws until snug against valve body.

g. Using valve handle cycle valve to verify full 90 degree rotation and smooth operation. Leave in shut position.

h. Lubricate slot in cam stop (8) with a thin coating of grease A-A-50433.

i. Ensure pin stop (18) is installed in bonnet (20). Assemble lower spacer (9) cam stop (8), square key (13) and upper spacer (7) to stem (12).

j. Install bracket (15) with switch on bonnet with machine screw (16). Align bracket (15) to ensure cam stop (8) can actuate switch. When the correct bracket position is determined, install capscrew (14) in bracket (15).

k. Lubricate lock bolt and sliding surfaces in cover with a thin coating of grease A-A-50433. Install lock bolt (6) in cover (5) and lock valve. Cycle valve locking device several times to ensure smooth function.

l. Install cover (5) onto valve. Using tags to ensure correct placement, connect wiring to switch. Complete installation of cover.

CAUTION

Do not exceed 75 in-lbs. torque on breakaway bolts.
Do not twist off heads of breakaway bolts.

m. Install breakaway bolts (4) in cover (5).

n. Install valve handle (3), washer (2), and hex nut (1) onto stem (12).

o. Connect valve electrical connector.

p. Clear applicable tagout in accordance with current shipboard instructions.

5-5-21.7. Test Requirements.

Refer to CHAPTER 2 for test requirements for pressurization/vent hull stop isolation valve APV-(*)-2.

5-5-22 MISSILE TUBE PREECE FITTING.

5-5-22.1. Initial Conditions.

a. Muzzle hatch open in accordance with Reference 9 (SSM Volume 6, Part 3, Book 3, OI631-18, OI631-18A.

b. Missile tube preece fitting removed.

5-5-22.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-22.3. <u>Missile Tube Preece Fitting Disassembly (Figure 5-6-20).</u>

<u>CAUTION</u>

Exercise extreme care when disassembling quick disconnect fitting to prevent any scratches, nicks, dents or distortion.

a. Remove O-Ring (2) from body (1) and discard O-Ring (2).

b. Place preece fitting in a vice or suitable retaining device. Hold only on the flats of the body (1).

c. Remove nipple (7) using a strap wrench, Amphenol pliers, or wrap rubber around nipple and turn with vice grips.

<u>CAUTION</u>

The nipple (7) and poppet (6) are under a small amount of spring pressure. Do not lose any parts.

d. Separate nipple (7), poppet (6), spring (5), spring base (4) from body (1).

e. Remove O-Ring (3) from body (1). Discard O-Ring (3).

f. Remove poppet (6) from nipple (7) if not already separated.

g. Remove O-Ring (8) from nipple (7).

h. Clean all parts with a soft cloth. Remove any dirt, grease or grime.

NOTE

Any broken, cracked or damaged components of the preece fitting will require replacement of the entire assembly.

i. Inspect all components for any broken, cracked or damaged parts. Discard entire assembly if any damage is found.

5-5-22.4. <u>Missile Tube Preece Fitting Reassembly.</u>

During reassembly lightly lubricate O-rings and bores with silicone compound MIL-S-8660.

a. Lubricate and install O-Ring (8) inside of nipple (7).

b. Install poppet (6) into nipple (7).

c. Lubricate and install O-Ring (3) on body (1).

d. Insert spring base (4) spring (5) into body (1).

NOTE

Ensure spring (5) is between spring base (4) and poppet (6) for proper operation.

e. Align spring (5) between spring base (4) and poppet shaft (6). Assemble body (1), spring base (4), spring (5) into nipple (7).

f. Place preece fitting in a vice or suitable retaining device. Hold only on the flats of the body (1).

g. Tighten nipple (7) using a strap wrench, Amphenol pliers, or wrap rubber around nipple and tighten with vice grips.

h. Lubricate and install O-Ring (2) on body (1) of the preece fitting.

i. Install new or rebuilt missile tube preece fitting in missile tube.

5-5-22.5. Test Requirements.

Refer to CHAPTER 2 for test requirements for missile tube preece fitting.

5-5-23 PLATFORM INTERLOCK FITTING HULL RECEIVER.

5-5-23.1. Initial Conditions.

Loading Platform section not installed where platform interlock fitting hull receiver work to be performed.

5-5-23.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4.

5-5-23.3. Hull Receiver Removal.

Insert tool into Hull Receiver and remove by rotating counter clockwise to disengage threads from hull. Refer to Figure 5-5-5.

NOTE

Removal of the Platform Interlock Fitting Hull Receiver will require the Hull Receiver tool NAVSEA Dwg 6510969.

NOTE

Tapping the top of the tool with a hammer may be required to free the receiver.

5-5-23.4. Hull Receiver Reinstallation.

a. Inspect hull and receiver threads, chase threads as necessary.

b. Lightly lubricate hull receiver threads with grease (CID-A-A-50433).

c. Insert hull receiver into hull, rotate clockwise until top of hull receiver is flush with hull.

5-5-23.5. Test Requirements.

Test platform interlock fitting hull receiver using the appropriate MRC of MIP 7211.

5-5-24 MISSILE TUBE CONTROL CABLE OR WEAPON CONTROL CABLE (SSN 719 AND 720).

Procedures contained herein provide the information necessary for the removal and reinstallation of the Missile Tube Control Cable (MTCC) or Weapon Control Cable (WCC). Cable replacement is accomplished either while the ship is in drydock or waterborne. This procedure was developed for accomplishment while waterborne, however, this procedure can be easily adapted for a ship in drydock. Use applicable drawings for specific installation, not covered in this volume.

NOTE

Figure 5-5-7 shows a typical tube control cable arrangement for a single missile tube. Figure 5-5-8 shows a typical weapon control cable arrangement for a single missile tube.

NOTE

Refer to Reference Drawing 41.1 (External Wireways Installation Standard Methods) for cable installation.

5-5-24.1. Initial Conditions.

Access to MBT established in accordance with Reference 34 (SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

Missile tube muzzle hatches open as applicable for access to cable trays in accordance with Reference 9 (SSM, Volume 6, Part 3, Book 3, OI 631-18, OI 631-18A).

Electrical isolation complete and tagged out in accordance with current shipboard instructions.

5-5-24.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4 and Reference 34 (SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

5-5-24.3. Missile Tube Control Cable or Weapon Control Cable Removal and Replacement.

Removal and replacement procedures contained herein provide the information necessary for the removal and replacement of a MTCC or WCC while the ship is waterborne. This procedure does not address any cable repair, as the molded cables are not user repairable. Use applicable drawings to support cable installation. Refer to CHAPTER 4 for cable identification information.

NOTE

Refer to Figure 5-6-24 for identification of WCC components and Figure 5-6-25 for identification of MTCC components. Figure 5-5-6 shows the location of the electrical hull penetrators for both weapon control and tube control cables.

NOTE

Prior to the start of the procedure, Ships Force will have verified and isolated the fault IN ACCORDANCE WITH CHAPTER 4 troubleshooting procedures. The fault will be between the inboard pigtail of the Electrical Hull Penetrator (EHP) and; (1) connector P1 of the MTCC or (2) connectors P2 and P3 of the WCC.

a. Ships Force disconnect the inboard cable, from the EHP pigtail for the effected tube.

CAUTION

Use care when disconnecting the control cable from the EHP, not to bend the pins in the EHP.

NOTE

Ensure the appropriate protective caps are installed (refer to Table 5-6-28).

b. Enter MBT, locate suspect EHP, unbolt and remove protective grate, disconnect MTCC connector P1 from EHP position 1 or position 2 (refer to Figure 5-5-7) or unbolt and remove protective grate taking care to support rolled up cable and remove WCC connector P1 from EHP (refer to Figure 5-5-8). (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

NOTE

Ensure cable connector face is dry prior to continuity and insulation resistance readings.

c. Visually inspect EHP connector for:

• Bent pins	Straighten
• Corrosion	Replace EHP connector
• Deteriorated plating material on pins	Replace EHP connector
• Burnt spots	Replace EHP connector
• Broken pins	Replace EHP connector
• Water intrusion	Clean/Dry
• Keyways	Clean/Repair
• Threads	Clean/Repair
• O-Ring sealing surface	Clean/Repair

d. Inspect WCC connector P1 or MTCC connector P1 O-Ring sealing surface on the outer diameter and flange of the connector shell, in accordance with Reference 56 (General Acceptance Criteria).

e. Inspect connector face for evidence of moisture. If required clean using alcohol and cotton swabs or acid brushes.

f. Disconnect the MTCC connector P2 from the outboard interconnection harness assembly or WCC connectors P2 and P3 from the missile tube and ITL/CAC switch for the effected tube. Ensure the appropriate protective caps are installed (refer to Table 5-6-28). (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

g. Conduct electrical check on suspect EHP. Perform continuity test first. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

h. If conducting WCC test install jumper between pins 3 and 4 of connector P3.

i. Conduct electrical checks on MTCC or WCC. Perform continuity test first, this will verify correct cable. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

NOTE

When a cable connector is disconnected for an insulation resistance test, ensure that the connector is attached to ship's hull ground to eliminate any false readings.

NOTE

Weapon Control Cable Shields are pins 10, 17, 44 and 78.

(1) If EHP and cable tested SAT, continue with step 5-5-24.3ac. to reassemble and test.

(2) If EHP fails, CASREP the Electrical Hull Penetrator and continue with step 5-5-24.3ac. to reassemble.

(3) (SHIPALT 4111D not installed). If cable fails, proceed to step 5-5-24.3l. to continue with cable replacement.

(4) (SHIPALT 4111D installed). If cable fails, remove WCC insulator assembly from the P1 connector in accordance with Reference Drawing 44.1 (VLS Weapon Control Cable Header Tool Operating Procedure) then continue with step 5-5-24.3j.

j. Visually inspect Weapon Control Cable connector for:

• Bent pins	Straighten
• Corrosion	Replace Weapon Control Cable
• Deteriorated plating material on pins	Replace Weapon Control Cable
• Burnt spots	Replace Weapon Control Cable
• Broken pins	Replace Weapon Control Cable
• Water intrusion	Clean/Dry
• Keyways	Clean/Repair
• Threads	Clean/Repair
• O-Ring sealing surface	Clean/Repair

k. Conduct electrical checks on WCC with insulator assembly removed. Perform continuity test first. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

NOTE

Ensure that the test jumper is installed between pins 3 and 4 of connector P3.

(1) If cable fails, proceed to Step 5-5-25.3l. to replace cable.

(2) If cable tested Satisfactory, install new insulator assembly in accordance with installation procedures contained in Reference Drawing 44.1 (VLS Weapon Control Cable Header Tool Operating Procedure) and retest cable in accordance with step 5-5-24.3i.

NOTE

Prior to continuing with WCC replacement it should be verified that the P2 connector of the WCC insulator assembly was removed and tested.

l. Remove access cover at the bottom of the stove pipe.

m. Remove the tie wraps and banding from the affected cable.

n. Remove cable tags from the old cable. Retain for attachment to new cable.

o. Pass the upper portion of the old cable into the ballast tank, feeding it through the stove pipe.

NOTE

If replacing a WCC proceed to step 5-5-24.3q.

p. Prepare new MTCC for installation as follows:

(1) Position MTCC topside near the VLS bathtub.

(2) Remove protective caps from the P1 and P2 connectors and inspect connectors as follows:

(a) Debris or corrosion on face of molded insert.

(b) Damaged sockets (i.e. corroded, deteriorated plating material, burn spots or broken sockets).

(c) Coupling threads (clean not damaged).

(d) Ny-loc insert present.

(e) O-ring groove and sealing surface clean and free of defects that would impair O-ring function (pits, dents, scratches, corrosion and contamination).

(3) Conduct electrical checks on cable. Continuity test acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Insulation resistance acceptance criteria test is 25 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

(4) Reinstall protective caps on MTCC P1 and P2 connectors.

(5) Proceed to step 5-5-24.3s.

NOTE

Leave new 56 conductor CAC WCC in box to perform electrical checks. Dispense only onboard submarine.

q. Prepare new WCC for installation as follows:

(1) Position the shipping container topside near the VLS bathtub access with the side access ports facing the access.

(2) Using suitable lashing ropes/cables secure the shipping container topside utilizing holes at the fore and aft end of the container skids.

(3) Remove screws securing the plywood cover and remove cover to gain access to cable connectors for inspection.

(4) Remove straps securing connectors to spool center and protective caps from WCC P1, P2, and P3 connectors and inspect connectors as follows:

(a) Debris or corrosion on face of molded insert.

(b) Damaged sockets (i.e. corroded, deteriorated plating material, burn spots or broken sockets).

(c) Coupling threads (clean not damaged).

(d) Ny-loc insert present.

(e) O-ring groove and sealing surface clean and free of defects that would impair O-ring function (pits, dents, scratches, corrosion and contamination).

(5) Install jumper between pins 3 and 4 of connector P3.

(6) Conduct electrical checks on cable. Continuity test acceptance criteria is less than 10 Ohms. Perform insulation resistance test, pin to pin and pin to ground. Insulation resistance acceptance criteria is 25 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

(7) Check continuity between pins 2 and 6 of the P3 connector to verify internal jumper is properly installed.

(8) Remove jumper in P3 connector and reinstall protective caps on WCC P1, P2, and P3 connectors.

(9) Remove screws from the shipping container side access port, swing open and secure in the open position using tape.

NOTE

Surfaces in the path of the cable that may cause damage should be temporarily covered with protective materials.

r. (WCC) Dispense the cable by rotating the cable reel clockwise while manually assisting the P1 connector and cable out of the box.

CAUTION

The cable is the primary interface between the control panels and missile tube/AUR. The useful life of the cable can be affected by damage caused during installation.

s. Station personnel along the cable path to assist the cable past turns and obstructions.

NOTE

For the WCC one person should be dedicated to manage the cable and assist in dispensing it from the container.

t. Install the cable through the stove pipe to the appropriate EHP without allowing large loops of cable to collect or snag and ensuring enough cable is left in the bathtub area to facilitate connecting the cable to the appropriate connector.

u. Route connectors P2 and P3 of the WCC or connector P1 of the MTCC from appropriate connection.

NOTE

Cable connectors should be connected to assist in properly laying out cable.

v. Temporarily connect WCC connector P3 to the HATCH OPEN/ITL/CAC switch and connect P2 to the missile tube penetrator or MTCC connector P2 to the outboard interconnection harness assembly. Install cable tags in approximate location as on the old cable. (Refer to Figure 5-5-5 or Figure 5-5-6 as applicable).

NOTE

Cable wraps, tray banding and bend radius to be in accordance with Reference Drawing 41.1 (External Wireways Installation Standard Methods).

w. Layout cable in the bathtub area, wrap the cable with rubber where it will be banded. Band the cable in place, feeding all cable slack into the ballast tank.

NOTE

It may be necessary to temporarily restrain cables not being replaced.

x. Remove the remaining tie-wraps and banding from the affected cable and cable trays in ballast tank. Match mark the cable tray covers to the cable trays, set covers aside until new cable is installed.

y. Remove old cable from wireway and pass topside for disposal.

z. Insert the new cable in the cable trays wrapping rubber around all cables where they enter and exit cable trays.

aa. Align match marks and install tray covers, insuring rubber edging is in place and band covers on cable trays.

ab. Ensure cable is properly secured at the bottom of the stove pipe, then install the lower stove pipe access cover.

ac. Connect WCC P1 or MTCC P1 to EHP in accordance with paragraph 5-5-26.

ad. Secure the cable to the nearest wireway or hanger at the earliest possible time to avoid strain on the cable and connector. Cable bend radius shall be:

(1) WCC (85 or 56 conductor) 9.0 in. minimum.

(2) MTCC (30 conductor type MWF-30) 9.0 in. minimum.

(3) WCC P3 Pigtail and MTCC 7 conductor cables (Type DSS-3 or MWF-7) 1.5 in. minimum.

NOTE

When a cable connector is disconnected for an insulation resistance test, ensure that the connector is attached to ships hull ground to eliminate any false readings.

NOTE

If both the EHP and WCC or MTCC were replaced, the insulation resistance minimum acceptance criteria is 25 MegOhms pin to pin and pin to ground (0 MegOhms on shield to shield and shield to ground.

ae. Conduct electrical checks on EHP and cable from the P2 connector to the inboard connection of the EHP. Perform continuity test first, this will verify correct cable. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

af. Connect WCC P2 to the missile tube penetrator and P3 to the ITL/CAC switch or MTCC P2 to the outboard interconnection harness assembly in accordance with paragraph 5-5-26.

ag. Ship's Force inspect bathtub area for any trash, sound shorts or rattles and clean/clear as required.

ah. Secure ballast tank entry in accordance with Reference 34 (SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

ai. Clear applicable tagouts in accordance with current shipboard instructions.

5-5-24.4. Test Requirements.

Refer to CHAPTER 2 for test requirements for missile tube control cable or weapon control cable.

5-5-25 MISSILE TUBE CONTROL CABLE OR WEAPON CONTROL CABLE (SSN 721 AND LATER).

Procedures contained herein provide the information necessary for the removal and reinstallation of the Missile Tube Control Cable (MTCC) or Weapon Control Cable (WCC). Cable replacement is accomplished either while the ship is in drydock or waterborne. This procedure was developed for accomplishment while waterborne with A&I 4068D, however, this procedure can be easily adapted for a ship in drydock. Use applicable drawings for specific installation, not covered in this volume.

NOTE

Figure 5-5-8 shows a typical weapon control cable arrangement for a single missile tube. Figure 5-5-9 shows a typical tube control cable arrangement for a single missile tube.

NOTE

Refer to Reference Drawing 41.1 (External Wireways Installation Standard Methods) for cable installation.

5-5-25.1. Initial Conditions.

Access to MBT established in accordance with Reference 34 (SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

PORT/STBD missile tube muzzle hatches open as applicable for access to cable trays.

The Vertical Launch System tagged out in accordance with current Shipboard instructions.

Topside access covers removed as required to access cableways, connectorized boxes, and bulkhead penetrators.

A&I 3199 completed.

5-5-25.2. Safety Precautions.

Observe safety precautions described in paragraph 5-5-4 and Reference 34 (SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

5-5-25.3. Missile Tube Control Cable or Weapon Control Cable Removal and Replacement.

Removal and replacement procedures contained herein provide the information necessary for the removal and replacement of a MTCC or WCC while the ship is waterborne. This procedure does not address any cable repair, as the molded cables are not user repairable. Use applicable drawings to support cable installation. Refer to CHAPTER 4 for cable identification information.

NOTE

Refer to Figure 5-6-24 for identification of WCC components and Figure 5-6-26 for identification of MTCC components. Figure 5-5-6 shows the location of the electrical hull penetrators for both weapon control and tube control cables.

NOTE

Prior to the start of the procedure, Ships Force will have verified and isolated the fault in accordance with CHAPTER 4 troubleshooting procedures. The fault will be between the inboard pigtail of the Electrical Hull Penetrator (EHP) and; (1) connector P1 of the MTCC or (2) connectors P2 and P3 of the WCC.

a. Ships Force disconnect the inboard cable, from the EHP pigtail for the effected tube.

CAUTION

Use care when disconnecting the control cable from the EHP, not to bend the pins in the EHP.

NOTE

Ensure the appropriate protective caps are installed (refer to Table 5-6-28).

b. Enter MBT 3 (A/B), locate suspect EHP, unbolt and remove protective grate, disconnect MTCC connector P7 from EHP position 1 or position 2 (refer to Figure 5-5-9) or unbolt and remove protective grate taking care to support rolled up cable and disconnect WCC connector P1 from EHP (refer to Figure 5-5-8). (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

c. Visually inspect EHP connector for:

• Bent pins	Straighten
• Corrosion	Replace EHP connector
• Deteriorated plating material on pins	Replace EHP connector
• Burnt spots	Replace EHP connector
• Broken pins	Replace EHP connector
• Water intrusion	Clean/Dry
• Keyways	Clean/Repair
• Threads	Clean/Repair
• O-Ring sealing surface	Clean/Repair

d. Inspect WCC connector P1 or MTCC connector P7 and O-Ring sealing surface on the outer diameter and the flange of the connector shell, in accordance with Reference 56 (General Acceptance Criteria).

e. Inspect connector face for evidence of moisture. If required clean using alcohol and cotton swabs or acid brushes.

f. Disconnect the MTCC connector P1 from the Connectorized Box or WCC connectors P2 and P3 from the missile tube and ITL/CAC switch for the effected tube. Ensure the appropriate protective caps are installed (refer to Table 5-6-28). (Refer to paragraph 5-5-27 for Outboard Cable Unmating).

g. Conduct electrical check on suspect EHP. Perform continuity test first, this will verify correct EHP. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

h. If conducting WCC test install jumper between pins 3 and 4 of connector P3.

i. Conduct electrical checks on MTCC or WCC. Perform continuity test first. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

NOTE

When a cable connector is disconnected for an insulation resistance test, ensure that the connector is attached to ship's hull ground to eliminate any false readings.

NOTE

Weapon Control Cable shields are pins 10, 17, 44 and 78.

(1) If EHP and cable tested SAT, continue with step 5-5-25.3ai. to re-assemble and test.

(2) If EHP fails, CASREP the Electrical Hull Penetrator and continue with step 5-5-25.3ai. to re-assemble.

(3) (SHIPALT 4111D not installed) If Cable fails, proceed to step 5-5-25.31. to continue with cable replacement.

(4) (SHIPALT 4111D installed) If Cable fails, remove WCC insulator assembly from the P1 connector in accordance with Reference Drawing 44.1 (VLS Weapon Control Cable Header Tool Operating Procedure).

j. Visually inspect Weapon Control Cable connector for:

• Bent pins	Straighten
• Corrosion	Replace Weapon Control Cable
• Deteriorated plating material on pins	Replace Weapon Control Cable
• Burnt spots	Replace Weapon Control Cable
• Broken pins	Replace Weapon Control Cable
• Water intrusion	Clean/Dry
• Keyways	Clean/Repair
• Threads	Clean/Repair
• O-Ring sealing surface	Clean/Repair

k. Conduct electrical checks on WCC with insulator assembly removed. Perform continuity test first. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

NOTE

that the test jumper is installed between pins 3 and 4 of connector P3.

(1) If cable fails, proceed to step 5-5-25.31. to replace cable.

NOTE

Verify that the P2 connector insulator assembly was removed and tested prior to replacement of WCC.

(2) If cable tested Satisfactory, install new insulator assembly in accordance with installation procedures contained in Reference Drawing 44.1 (VLS Weapon Control Cable Header Tool Operating Procedure) and retest cable in accordance with step 5-5-25.3i.

l. Unbolt the packing gland of the tank fitting from the MBT side or bathtub area as appropriate.

NOTE

If one piece packing gland ring is in use, cut ring in two taking care not to damage cables and discard.

m. Using soapy water solution, lubricate all the cables passing through the rubber grommet, on both sides of the tank fitting (see Figure 5-5-10).

NOTE

It may be necessary to temporarily restrain cables not being replaced.

n. Remove all the tie wraps and banding from the effected cable in the bathtub area and from the cable and cable trays in top of MBT 3. Match mark the cable tray covers to the cable trays, set covers aside until new cable is installed.

o. Remove packing gland assembly as follows:

CAUTION

Use care when removing grommet to prevent damaging cables.

(1) If packing gland bolts are outside MBT 3 use a 3/4 in. (approx.) brass rod and a hammer, from inside MBT, gently tap the AFT grommet plate around the edge to loosen the stuffing tube assembly. Remove forward grommet plate, rubber grommet and AFT grommet plate.

(2) If packing gland bolts are inside MBT 3, use a small porta-power to push the packing assembly into the tank. Remove AFT grommet plate, grommet and forward grommet plate.

NOTE

Modified grommet may be in use. The modified grommet will consist of six pie shaped sections instead of one whole piece.

(3) Discard one piece grommet and replace with new modified grommet during installation of new WCC or MTCC. See Table 5-6-26 for part numbers.

p. Remove cable tags from the old cable. Retain for attachment to new cable.

q. Pass the upper portion of the old cable into the MBT 3, feeding it through the packing gland assembly. Install the protective cap on the cable once it has come through the packing gland.

NOTE

If replacing a WCC proceed to step 5-5-25s.

r. Prepare new MTCC for installation as follows:

(1) Position MTCC topside near the MBT 3 access.

(2) Remove protective caps from the P1 and P7 connectors and inspect connectors as follows:

(a) Debris or corrosion on face of molded insert.

(b) Damaged sockets (i.e. corroded, deteriorated plating material, burn spots or broken sockets).

(c) Coupling threads (clean not damaged).

(d) Ny-loc insert present.

(e) O-ring groove and sealing surface clean and free of defects that would impair O-ring function (pits, dents, scratches, corrosion and contamination).

(3) Conduct electrical checks on cable. Continuity test acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Insulation resistance acceptance criteria test is 25 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

(4) Reinstall protective caps on MTCC P1 and P7 connectors.

(5) Proceed to step 5-5-25v.

NOTE

Leave new 56 conductor CAC WCC in box to perform electrical checks. Dispense only onboard submarine.

s. Prepare new WCC for installation as follows:

(1) Position the shipping container topside near the MBT 3 access with the side access ports facing the MBT 3 access.

(2) Using suitable lashing ropes/cables secure the shipping container topside utilizing holes at the fore and aft end of the container skids.

(3) Remove screws securing the plywood cover and remove cover to gain access to cable connectors for inspection.

(4) Remove straps securing connectors to spool center and protective caps from WCC P1, P2, and P3 connectors and inspect connectors as follows:

(a) Debris or corrosion on face of molded insert.

(b) Damaged sockets (i.e. corroded, deteriorated plating material, burn spots or broken sockets).

(c) Coupling threads (clean not damaged).

(d) Ny-loc insert present.

(e) O-ring groove and sealing surface clean and free of defects that would impair O-ring function (pits, dents, scratches, corrosion and contamination).

(5) Install jumper between pins 3 and 4 of connector P3.

(6) Conduct electrical checks on cable. Continuity test acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Insulation resistance acceptance criteria is 25 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

(7) Check continuity between pins 2 and 6 of the P3 connector to verify internal jumper is properly installed.

(8) Remove jumper in P3 connector and reinstall protective caps on WCC P1, P2, and P3 connectors.

(9) Remove screws from the shipping container side access port, swing open and secure in the open position using tape.

t. (WCC) Dispense the cable by rotating the cable reel clockwise while manually assisting the P1 connector and cable out of the box.

CAUTION

Do not drag cable on deck. Temporarily cover surfaces in the path of the cable that may cause damage with protective materials.

NOTE

The cable is the primary interface between the control panels and missile tube/AUR. The useful life of the cable can be affected by damage caused during installation.

u Station personnel along the cable path to assist the cable past turns and obstructions.

NOTE

For the WCC one person should be dedicated to manage the cable and assist in dispensing it from the container.

v. Install the cable through the MBT 3 access to the appropriate EHP without allowing large loops of cable to collect or snag and ensuring enough cable is left in the upper portion of the MBT to facilitate connecting the cable to the appropriate connector in the VLS bathtub area.

w. Install connectors P2 and P3 of the WCC or connector P1 of the MTCC from MBT 3 through the packing gland and route to appropriate connection in the VLS bathtub area.

NOTE

Cable connectors should be connected to assist in properly laying out cable.

x. Temporarily connect WCC connector P3 to the ITL/CAC switch and connector P2 to the missile tube penetrator or the MTCC connector P1 to the Connectorized Box. Install cable tags in the approximate location as on the old cable.

NOTE

Cable wraps, tray banding and bend radius to be in accordance with Reference Drawing 41.1 (External Wireways Installation Standard Methods).

y. Layout cable in the bathtub area, wrap the cable with rubber where it will be banded. Band the cable in place, feeding all cable slack into the MBT.

z. Insert the new cable in the grommet plate and push the first grommet plate in place.

NOTE

Soapy water solution may be used to assist in the installation of the rubber grommet pieces.

aa. Install the pie shaped rubber grommet pieces around the cables in the packing gland assembly.

ab. Insert the second grommet plate into housing.

ac. Install packing gland ring and secure to tank fitting housing with bolts.

ad. Remove the remaining tie-wraps and banding from the effected cable and cable trays in MBT 3. Match mark the cable tray covers to the cable trays, set covers aside until new cable is installed.

ae. When the tie wraps and band-it material are completely cut away, raise the old cable to the top of the ballast tank, to be passed out MBT access.

af. Remove old cable through MBT access.

ag. Insert the new cable in the cable trays from the top of the MBT to the bottom, wrapping rubber around all cables where they enter and exit cable trays.

ah. Align match marks and install tray covers, insuring rubber edging is in place and band covers on cable trays.

ai. Connect WCC P1 or MTCC P7 to EHP in accordance with paragraph 5-5-26.

aj. Secure the cable to the nearest wireway or hanger at the earliest possible time to avoid strain on the cable and connector. Cable bend radius shall be in accordance with Reference drawing 41.1 (External wireways Installation Standard Methods):

(1) WCC (85 or 56 conductor) 9.0 in. minimum.

(2) MTCC (30 conductor type MWF-30) 9.0 in minimum.

(3) WCC P3 Pigtail and MTCC 7 conductor cables (type DSS-3 or MWF-7) 1.5 in. minimum.

ak. Disconnect WCC connectors P2 and P3 or MTCC connector P1 and install appropriate protective caps.

NOTE

When a cable connector is disconnected for an insulation resistance test, ensure that the connector is attached to ships hull ground to eliminate any false readings.

NOTE

If both the EHP and WCC or MTCC were replaced, the insulation resistance minimum acceptance criteria is 25 MegOhms pin to pin and pin to ground (0 MegOhms on shield to shield and shield to ground.

al. Conduct electrical checks on EHP and cable from the P1 (MTCC) or P2 (WCC) connector to the inboard connection of the EHP. Perform continuity test first, this will verify correct cable. Acceptance criteria is less than 10 Ohms. Perform insulation resistance test (using 500 volts), pin to pin and pin to ground. Acceptance criteria is 5 MegOhms minimum (0 MegOhms on shield to shield and shield to ground).

am. Connect WCC P2 to the missile tube penetrator and P3 to the ITL/CAC switch or MTCC P1 to the connectorized box in accordance with paragraph 5-5-26.

an. Ship's Force inspect bathtub area for any trash, sound shorts or rattles and clean/clear as required.

ao. Secure ballast tank entry in accordance with Reference 34 (SSM Volume 6, Part 3, Book 12 OI 637-12, Main Ballast Tank No. 1, No. 2 and No. 3 Access Procedures).

ap. Clear applicable tagouts in accordance with current shipboard instructions.

5-5-25.4. Test Requirements.

Refer to CHAPTER 2 for test requirements for missile tube control cable or weapon control cable.

5-5-26 OUTBOARD CABLE CONNECTOR ASSEMBLY MATING.

Lightly lubricate new O-rings and rubber isolation membranes with silicone compound (MIL-S-8660) during cable connector mating.

Table 5-5-7. Outboard Cable Connector Assembly Mating Tools/Equipment

ITEM	DESCRIPTION	QUANTITY
1	Flashlight	1
2	Hammer, Plastic Tipped, 2 Lb.	1
3	Wrench, Spanner, Hook, Adjustable (1 1/4 - 3")	1
4	Tool, O-Ring Removal (Non Metallic)	1
5	Grease, Silicone MIL-S-8660	as required
6	Rags	as required
7	Alcohol	1 pt.
8	Swabs, Cotton, Tipped	1 pkg.
9	Brush, Acid	as required

NOTE

This procedure is intended to be conducted in step by step sequence.

NOTE

Refer to Figure 5-5-7, Figure 5-5-8, Figure 5-5-9, and Figure 5-5-11 for applicable connector identification.

a. Prior to assembling inspect cable assembly for damage to cable jacket or molded junction.

CAUTION

Use only non-metallic O-ring removal tools.

b. Remove and discard used O-rings and Parker seals (if installed) per Reference 57 (Removal of Parker Seals).

c. Remove rubber isolation membrane where applicable.

d. Clean connector mating and sealing surfaces using alcohol and cotton swabs/acid brushes.

e. Inspect connector/receptacle for bent pins. Using a female socket carefully straighten any bent pins.

f. Inspect connector/receptacle for:

(1) Debris or corrosion on face of molded insert.

(2) Damaged pins (i.e. corroded, deteriorated plating material, burn spots or broken pins).

(3) Coupling threads (clean not damaged).

(4) Ny-loc insert present.

(5) O-ring groove and sealing surface clean and free of defects that would impair O-ring function (pits, dents, scratches, corrosion and contamination).

CAUTION

Per Reference 57 (Removal of Parker Seals). Parker seals are no longer authorized for use.

g. Remove O-ring from package, inspect for defects and lightly lubricate.

NOTE

Refer to applicable figure (Figure 5-5-7, Figure 5-5-8, or Figure 5-5-9), for proper O-ring and rubber isolation membrane size and part number identification.

h. Install receptacle O-ring into groove of the connector.

i. For weapon control cable install o-ring onto the shoulder of the connector shell for plug P1 and P2.

CAUTION

Use only those rubber isolation membranes whose package is marked “Low Carbon”.

j. Remove rubber isolation membrane from package, inspect for defects and lightly lubricate.

NOTE

Rubber isolation membranes are for use on the Missile Tube Control Cable circuitry and P3 connection on WCC.

k. Install rubber isolation membrane with large embossments facing connector sockets.

CAUTION

Connector must be aligned carefully before mating to avoid bending of receptacle pins.

l. Align key way on the cable connector with the receptacle.

m. Mate connector to receptacle by hand, pushing gently to engage coupling threads.

NOTE

Coupling ring should thread easily until Ny-loc engages.

n. Hand tighten coupling ring by pushing on the cable connector with one hand and tightening the coupling ring with the other hand until it can no longer be rotated.

o. Continue tightening coupling ring with a spanner wrench while applying constant pressure on the cable connector.

CAUTION

Magnetic switch (non-ruggedized), may be damaged by over tightening connectors. Use only a spanner wrench for tightening magnetic switch connectors. Do not use a mallet.

p. Except for non-ruggedized magnetic switches, continue tightening coupling ring by moderately tapping spanner wrench with a mallet. Connectors are considered fully seated when the tapping causes no further tightening and the mallet bounces off of the wrench.

5-5-27 OUTBOARD CABLE CONNECTOR ASSEMBLY UNMATING.

NOTE

The following steps are required when removing Vertical launch System Outboard Cable Connectors to help prevent damaging outboard cables and associated components.

(1) Using a spray bottle, apply a stream of Green Mountain Scale Removing Compound (NSN 6850-00-148-7667) to base of coupling ring in region between ring and molded polyurethane and around opposite end of coupling ring at joint with connector body.

NOTE

360- Degree coverage in these areas will allow proper penetration of descaling compound.

(2) Tap coupling ring around its circumferance several times with a mallet to assist in penetration of descaling compound.

(3) Repeat Steps 1 and 2 after approximately 3 minutes then proceed to Step 4 after waiting approximately 30 minutes to allow descaling solution to soften material between coupling ring and connector plug body.

(4) Using a spanner wrench and a mallet loosen coupling ring by tapping spanner wrench sharply in a counterclockwise direction. Repeat Steps (1) through (3) as needed.

NOTE

The Impulse Method, provided by tapping spanner wrench, must be utilized and not a gradually applied force.

KAMATIC Parts versus Ship Applicability

Nomenclature	Manufacturers Part Number	Reference Figure	Ship Applicability By SSN No.
Actuator Bearing	5858418 PC8	5-6-8 Item 60	719, 720, 721 & Later
Actuator Pinion Bushing	KJB345552V	5-6-8 Item 63	719, 720, 721 & Later
Actuator (Lower) Clevis Sleeve Bushing	6557866-1 6510866-2	5-6-6 Items 8 & 10	721 & Later 719, 720
Actuator (Lower) Clevis Link Pin	KJS124300V-11 KJS125828V-43	5-6-6 Item 7	721 & Later 719, 720
Bearing Bracket Sleeve Bushing	KJB344700V-9	5-6-6 Item 4	719, 720, 721 & Later
Off Set Link (Lower) Bushing	6557867 6510867	5-6-6 Item 67	721 & Later 719, 720
Off Set Link (Upper) Bushing	6557868 6557867 6510867	5-6-6 Item 66	724, 725, 751, 752, 754, 755, 757, 760 - 763 721 - 723, 750, 753, 756, 758, 759, 764 - 773 719, 720
Hatch (Upper) Clevis Bushings	6557869 6557866-3 6557866-2 6510866-1	5-6-6 Items 13 & 14	724, 725, 751, 752, 754, 755, 757, 760 - 763 721 - 723, 750, 753, 756, 758, 759, 764 - 767 768 - 773 719, 720
Hatch (Upper) Clevis Link Pin	KJS124300V-10M KJS124300V-10 KJS125828V-21	5-6-6 Item 20	724, 725, 751, 752, 754, 755, 757, 760 - 763 721 - 723, 750, 753, 756, 758, 759, 764 - 773 719, 720

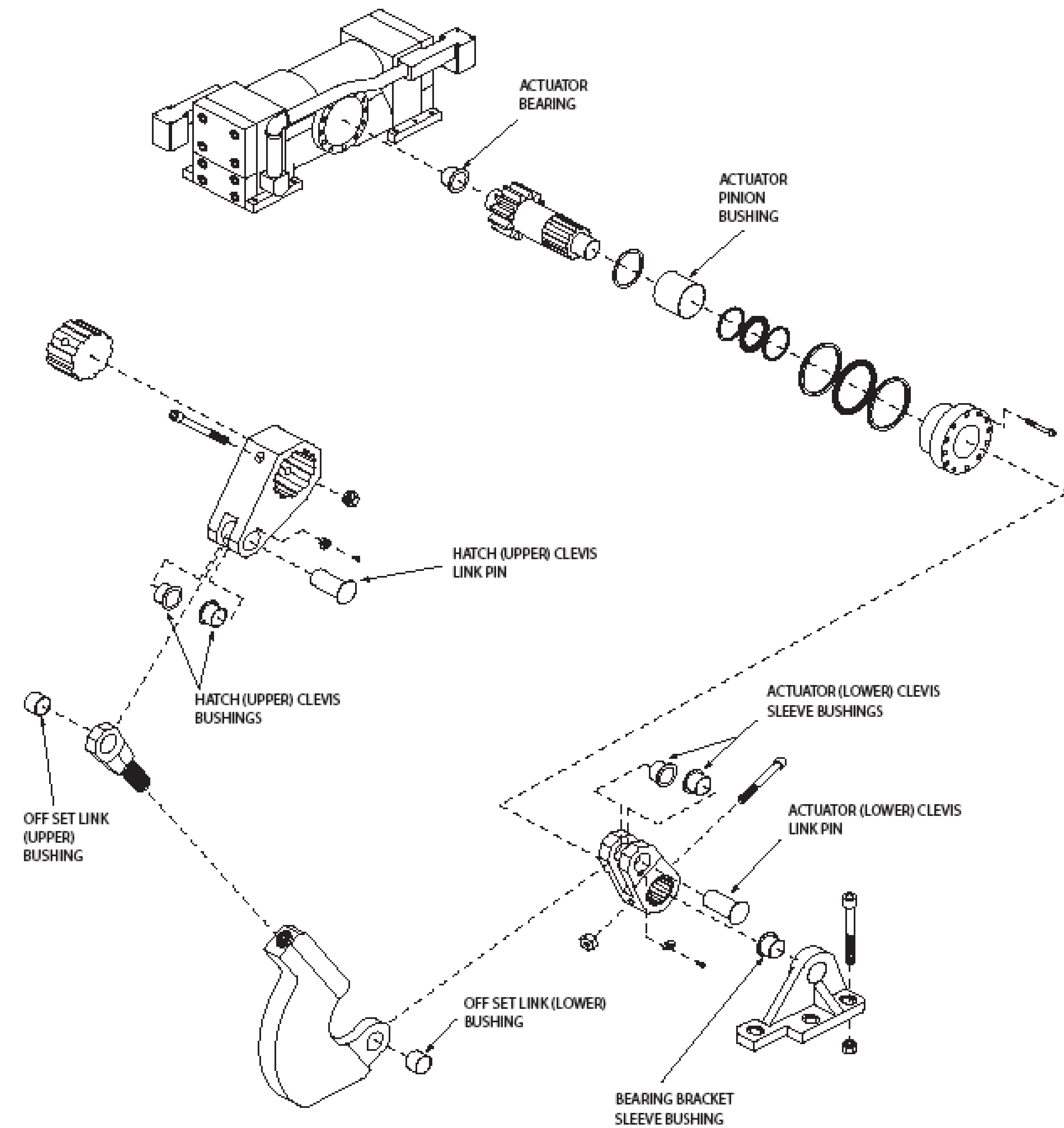


Figure 5-5-1. Muzzle Hatch Linkage Bushing and Pin Locations

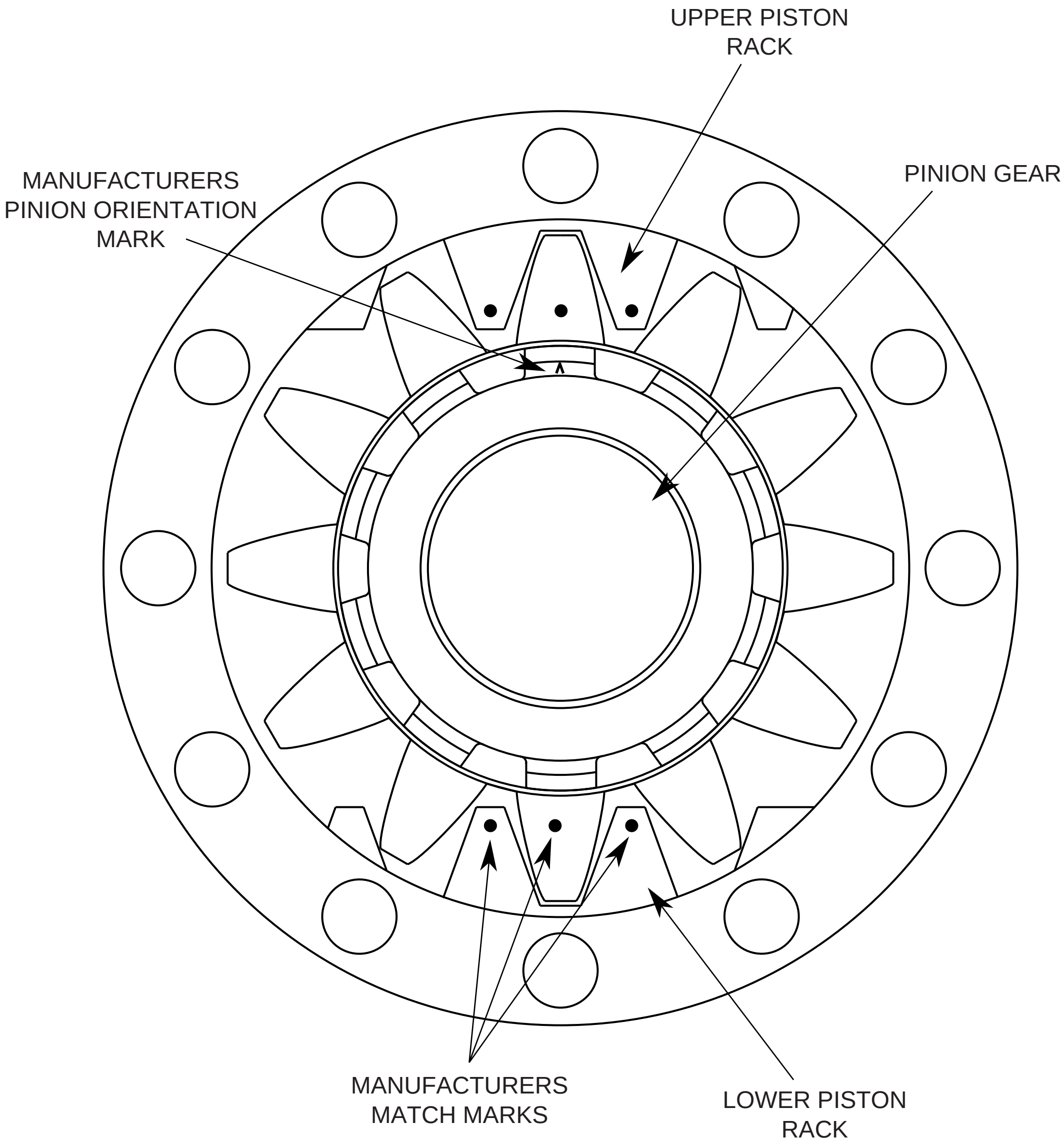


Figure 5-5-2. Hatch Actuator Gear Alignment

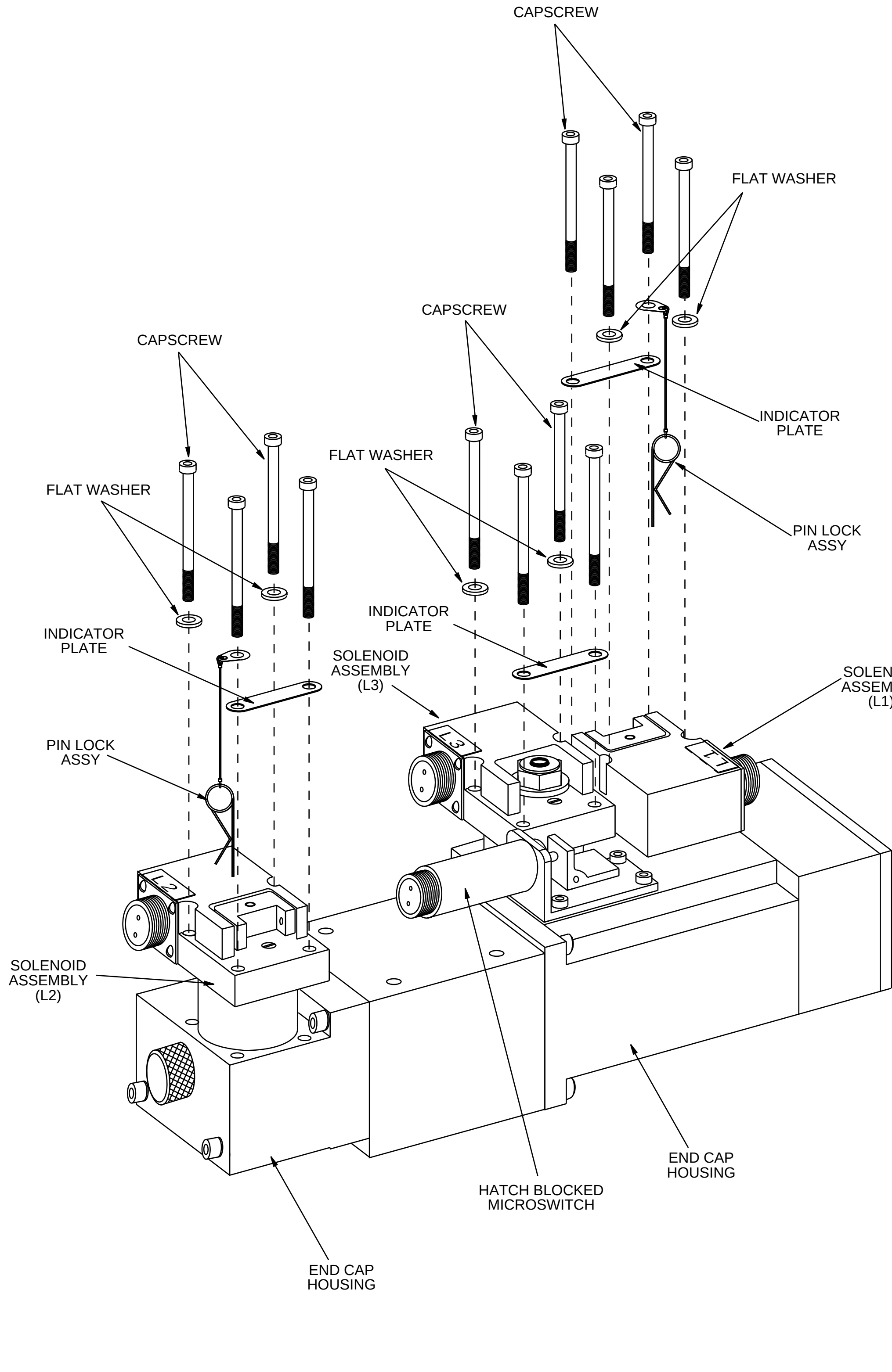


Figure 5-5-3. Solenoid Assembly Mounting Arrangement

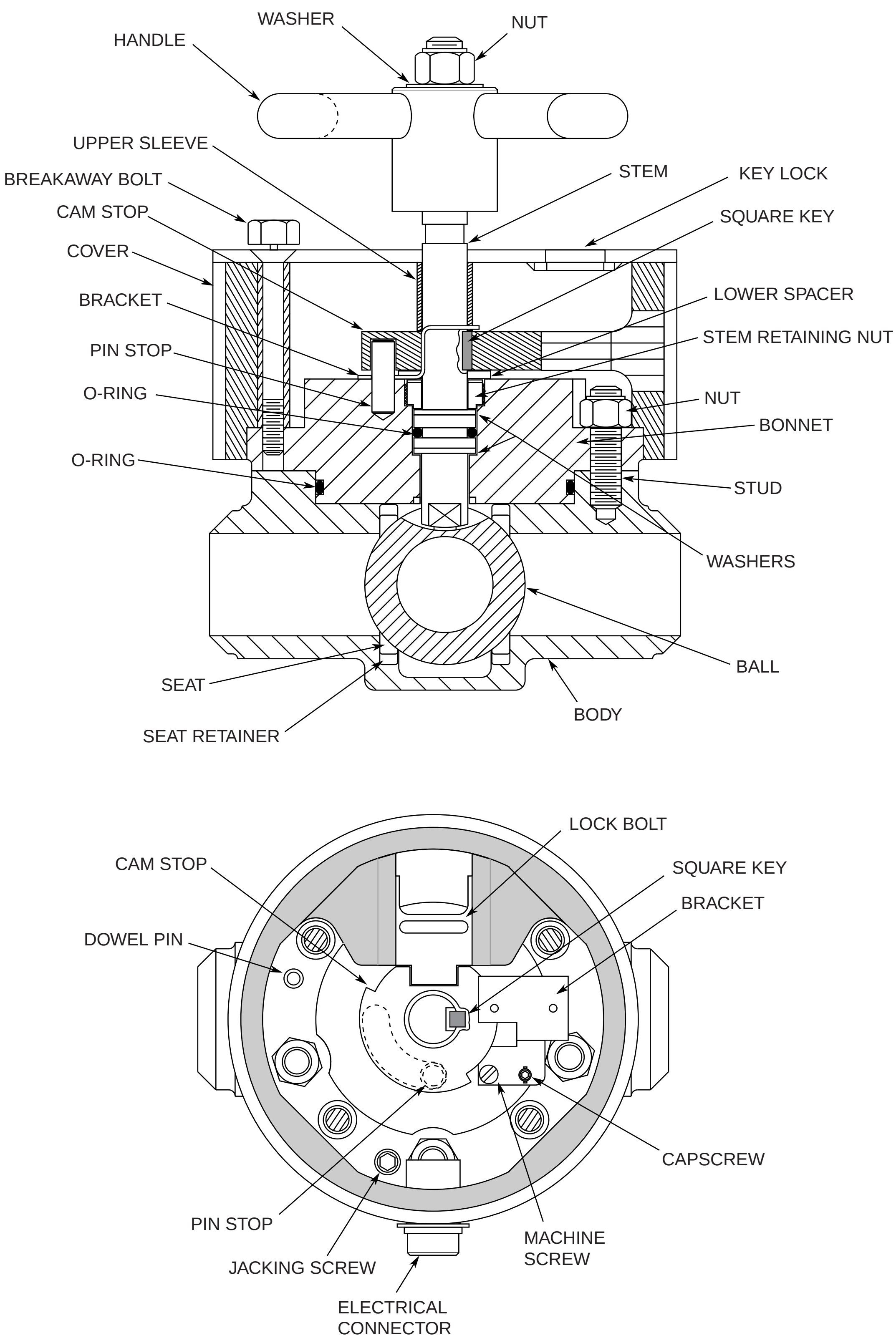


Figure 5-5-4. Pressurization/Vent Hull Stop Isolation Valve APV-(*)-2

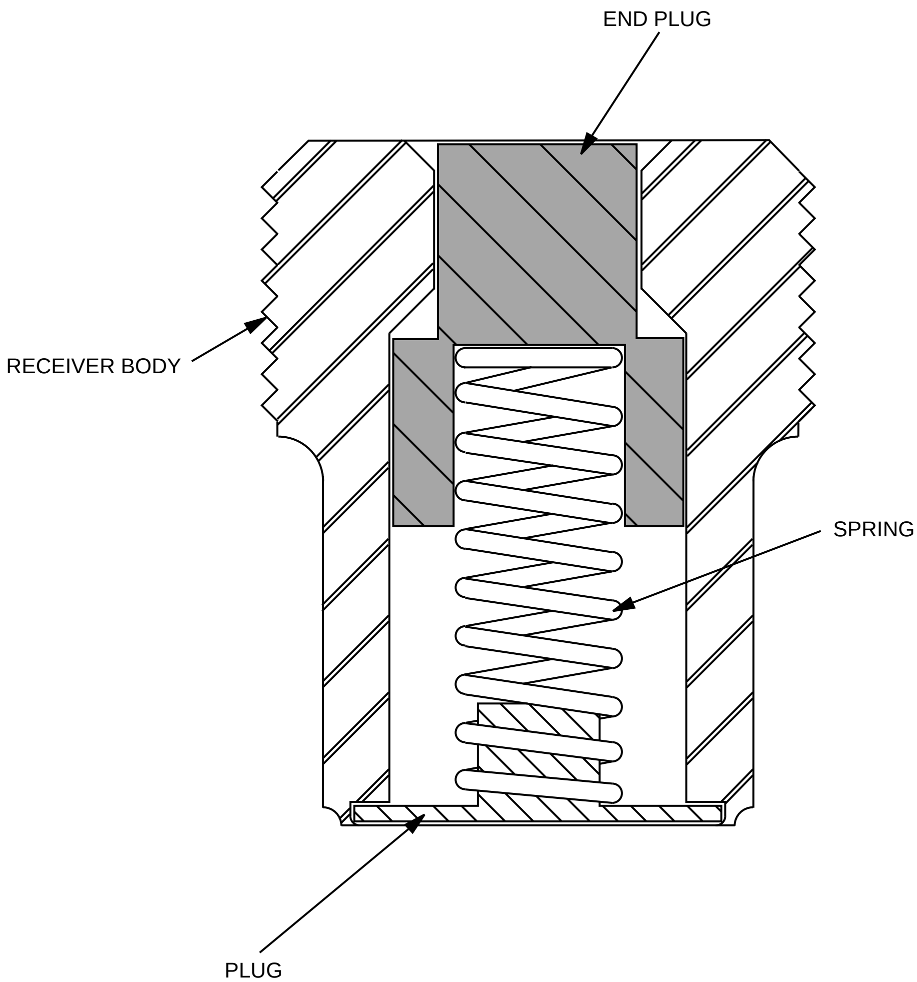


Figure 5-5-5. Platform Interlock Fitting Hull Receiver

WEAPON CONTROL CABLE (SSN 719 and 720)

Missile Tube Number	Electrical Hull Penetrator Number	Outboard Cable Number
5	P26-19S	G-1GW8A
6	P26-23P	G-1GW14A
7	P26-18S	G-1GW9A
8	P26-22P	G-1GW15A
9	P26-17S	G-1GW10A
10	P26-21P	G-1GW16A
11	P26-16S	G-1GW11A
12	P26-20P	G-1GW17A
13	P26-12S	G-1GW12A
14	P26-15P	G-1GW18A
15	P26-13S	G-1GW13A
16	P26-14P	G-1GW19A

MISSILE TUBE CONTROL CABLE (SSN 719 AND 720)

Missile Tube Number	Electrical Hull Penetrator Number	Outboard Cable Number
5	P27-21S (Pos 1)	K-15EH39
6	P27-22P (Pos 1)	K-15EH45
7	P27-21S (Pos 2)	K-15EH40
8	P27-22P (Pos 2)	K-15EH46
9	P27-20S (Pos 1)	K-15EH41
10	P27-23P (Pos 1)	K-15EH47
11	P27-20S (Pos 2)	K-15EH42
12	P27-23P (Pos 2)	K-15EH48
13	P27-19S (Pos 1)	K-15EH43
14	P27-24P (Pos 1)	K-15EH49
15	P27-19S (Pos 2)	K-15EH44
16	P27-24P (Pos 2)	K-15EH50

WEAPON CONTROL CABLE (SSN 721 thru 725 & 750)

Missile Tube Number	Electrical Hull Penetrator Number	Outboard Cable Number
5	P26-12S	G-1GW8A
6	P26-14P	G-1GW14A
7	P26-13S	G-1GW9A
8	P26-15P	G-1GW15A
9	P26-16S	G-1GW10A
10	P26-20P	G-1GW16A
11	P26-17S	G-1GW11A
12	P26-21P	G-1GW17A
13	P26-18S	G-1GW12A
14	P26-22P	G-1GW18A
15	P26-19S	G-1GW13A
16	P26-23P	G-1GW19A

MISSILE TUBE CONTROL CABLE (SSN 721 thru 725, 750)

Missile Tube Number	Electrical Hull Penetrator Number	Outboard Cable Number
5	P27-19S (Pos 1)	K-15EH51
6	P27-22P (Pos 1)	K-15EH57
7	P27-19S (Pos 2)	K-15EH52
8	P27-22P (Pos 2)	K-15EH58
9	P27-20S (Pos 1)	K-15EH53
10	P27-23P (Pos 1)	K-15EH59
11	P27-20S (Pos 2)	K-15EH54
12	P27-23P (Pos 2)	K-15EH60
13	P27-21S (Pos 1)	K-15EH55
14	P27-24P (Pos 1)	K-15EH61
15	P27-21S (Pos 2)	K-15EH56
16	P27-24P (Pos 2)	K-15EH62

WEAPON CONTROL CABLE (SSN 751 & Later)

Missile Tube Number	Electrical Hull Penetrator Number	Outboard Cable Number
5	P26-12S	R-CS1092
6	P26-14P	R-CS1086
7	P26-13S	R-CS1093
8	P26-15P	R-CS1087
9	P26-16S	R-CS1094
10	P26-20P	R-CS1088
11	P26-17S	R-CS1095
12	P26-21P	R-CS1089
13	P26-18S	R-CS1096
14	P26-22P	R-CS1090
15	P26-19S	R-CS1097
16	P26-23P	R-CS1091

MISSILE TUBE CONTROL CABLE (SSN 751 & Later)

Missile Tube Number	Electrical Hull Penetrator Number	Outboard Cable Number
5	P27-19S (Pos 1)	K-15EH51
6	P27-22P (Pos 1)	K-15EH57
7	P27-19S (Pos 2)	K-15EH52
8	P27-22P (Pos 2)	K-15EH58
9	P27-20S (Pos 1)	K-15EH53
10	P27-23P (Pos 1)	K-15EH59
11	P27-20S (Pos 2)	K-15EH54
12	P27-23P (Pos 2)	K-15EH60
13	P27-21S (Pos 1)	K-15EH55
14	P27-24P (Pos 1)	K-15EH61
15	P27-21S (Pos 2)	K-15EH56
16	P27-24P (Pos 2)	K-15EH62

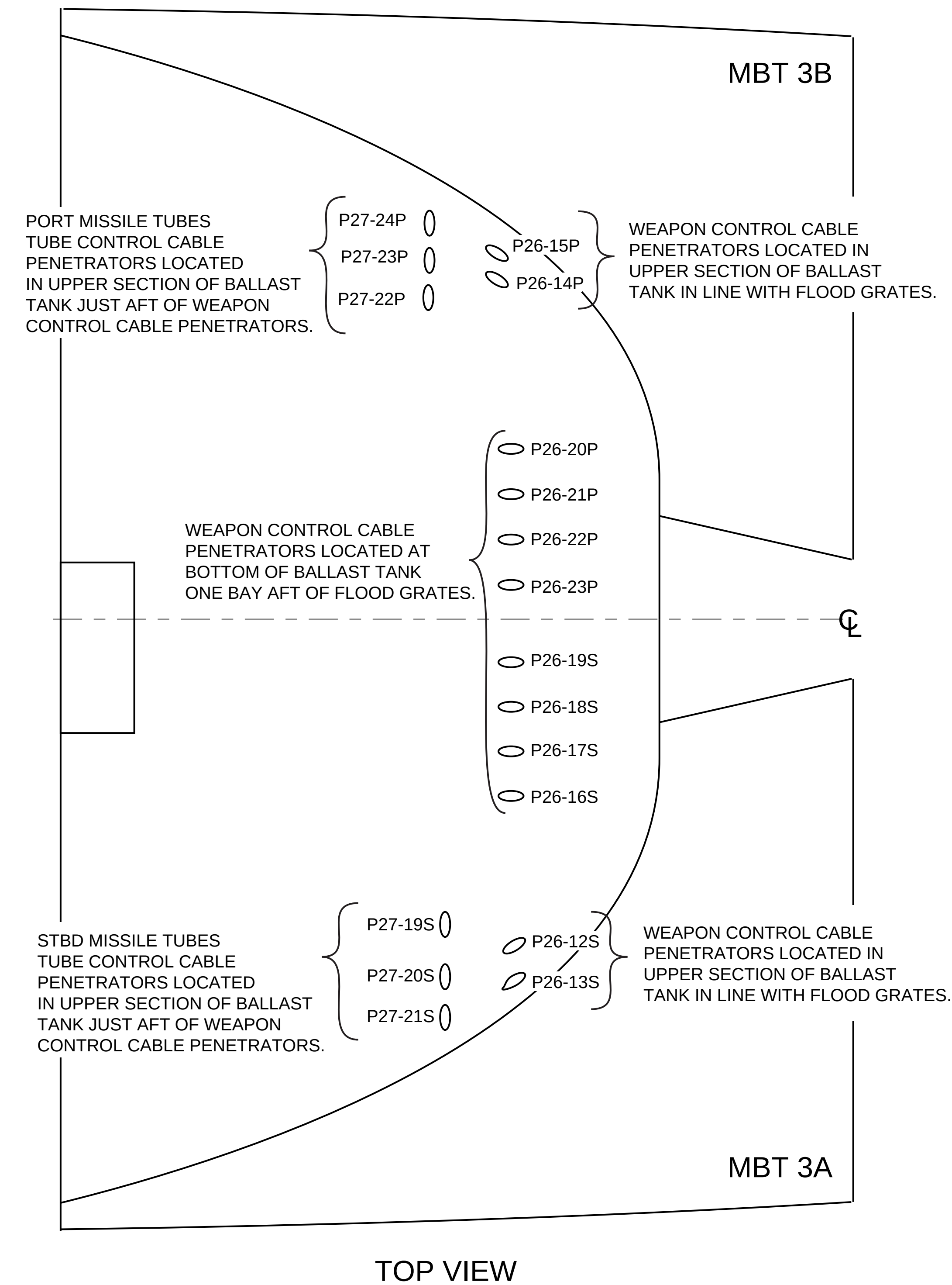
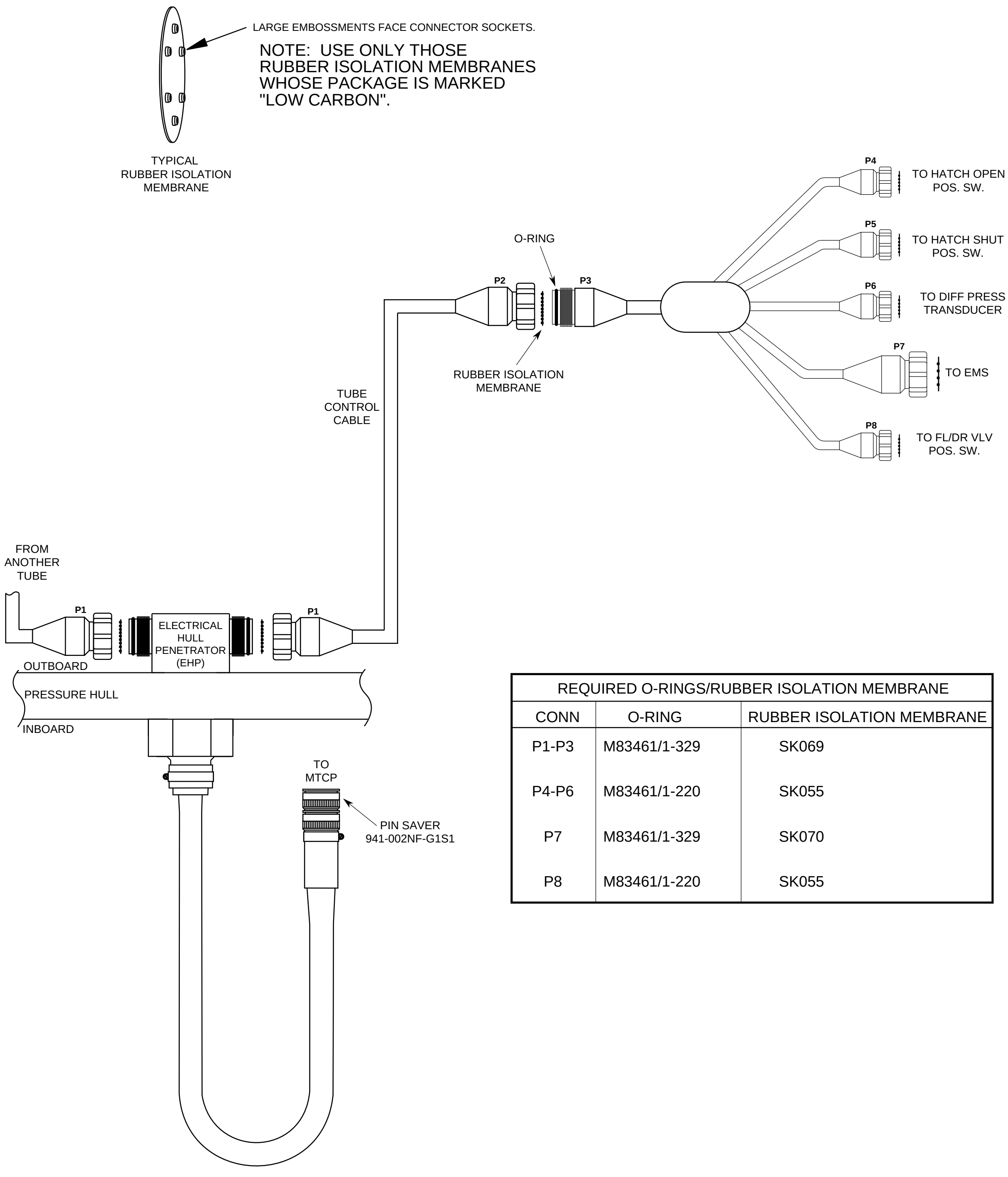
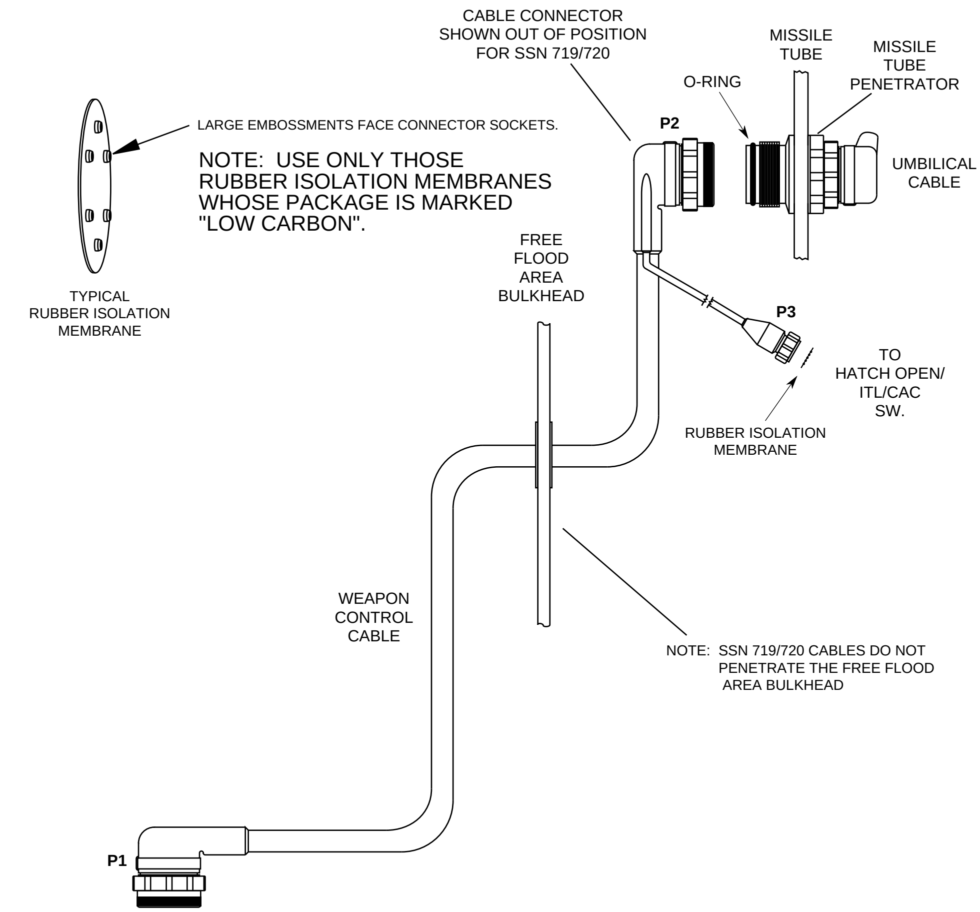


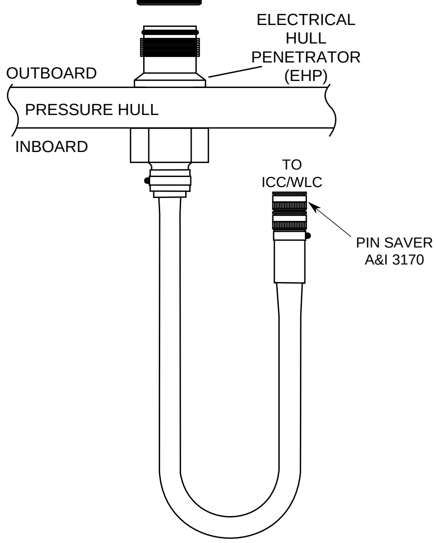
Figure 5-5-6. Electrical Hull Penetrator External Locations



REQUIRED O-RINGS/RUBBER ISOLATION MEMBRANE		
CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1-P3	M83461/1-329	SK069
P4-P6	M83461/1-220	SK055
P7	M83461/1-329	SK070
P8	M83461/1-220	SK055

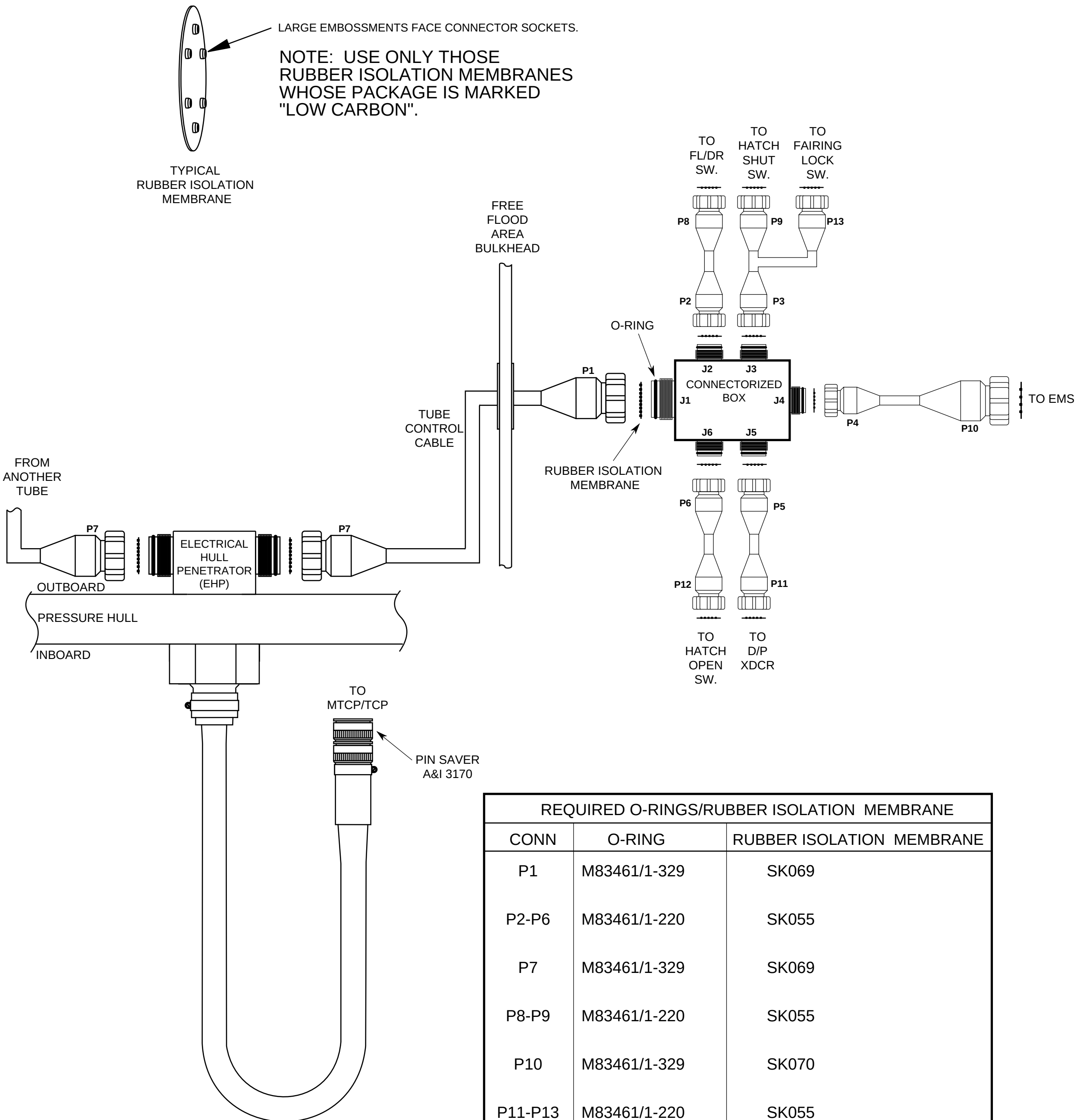
Figure 5-5-7. Missile Tube Control Cabling (SSN 719 and 720) (Typical)





REQUIRED O-RINGS/RUBBER ISOLATION MEMBRANE		
CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1	M83461/1-235 M83461/1-238	
P2	M83461/1-235 M83461/1-238	
P3	M83461/1-220	SK055
Umbilical Cable Connector	M83461/1-235 M83461/1-238	

Figure 5-5-8. Weapon Control Cabling (Typical)



REQUIRED O-RINGS/RUBBER ISOLATION MEMBRANE		
CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1	M83461/1-329	SK069
P2-P6	M83461/1-220	SK055
P7	M83461/1-329	SK069
P8-P9	M83461/1-220	SK055
P10	M83461/1-329	SK070
P11-P13	M83461/1-220	SK055

Figure 5-5-9. Missile Tube Control Cabling (SSN 721 and Later) (Typical)

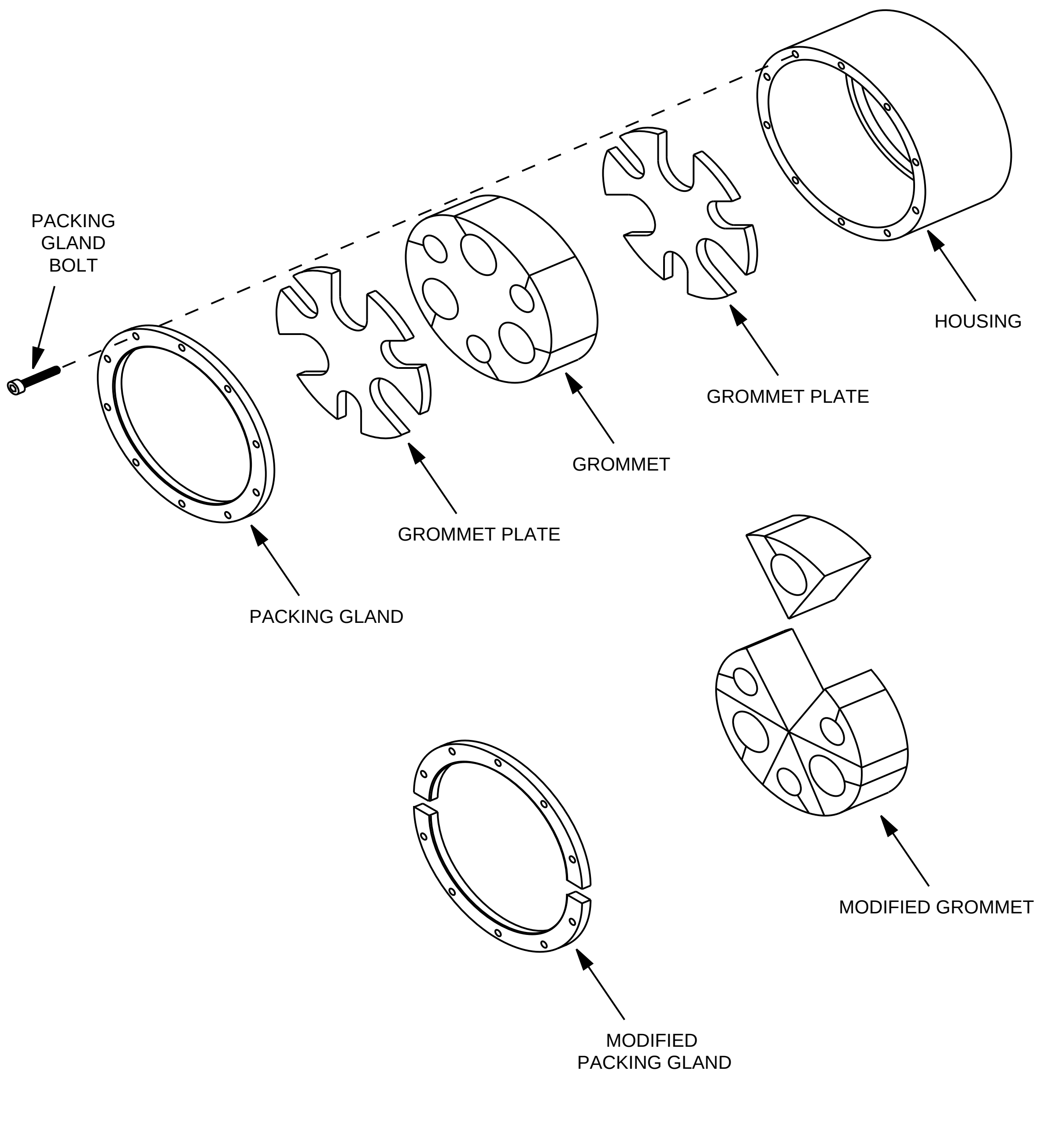
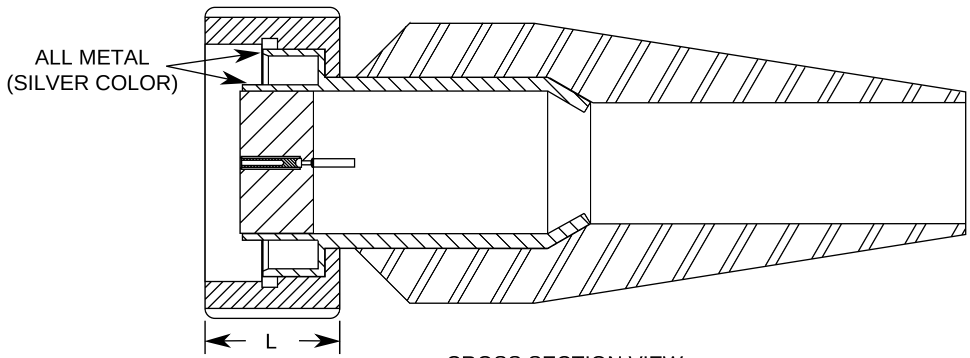
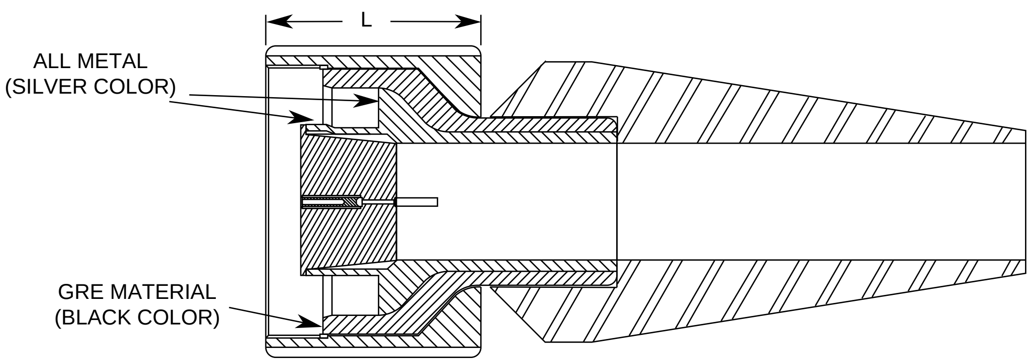


Figure 5-5-10. Tank Bulkhead Penetrator



CROSS SECTION VIEW
STANDARD PORTSMOUTH
CONNECTOR (TYPICAL)

NOTE: LENGTH "L" OF THE COUPLING NUT IS LONGER ON THE GRE CABLE CONNECTOR THAN IT IS ON THE STANDARD PORTSMOUTH CONNECTOR.



CROSS SECTION VIEW
GLASS REINFORCED EPOXY (GRE)
CONNECTOR (TYPICAL)

Figure 5-5-11. Connectors

CHAPTER 6 ILLUSTRATED PARTS BREAKDOWN

5-6-1. INTRODUCTION.

This chapter contains an Illustrated Parts Breakdown (IPB) and parts list for the Vertical Launch System (VLS) missile tubes and related equipment that support the maintenance and repair procedures contained in CHAPTER 5. Figures are used to identify and locate all items in the parts list.

The following paragraphs describe the arrangement and use of the IPB and parts list.

5-6-2. PARTS LIST.

The parts list is arranged in 5 columns as follows:

a. Item - The identifying number of the specific component in the corresponding figure.

b. Description - The noun name(s) of the item. Any deviation from the SSN688 Class design is shown with an asterisk (*) and is applicable to SSN 719 and 720 configurations only.

c. Quantity - Normally, the total number of components required for each missile tube. An "AR" in this column indicates the quantity is needed only as required.

d. Drawing Number - The NAVSEA or vendor drawing number for the part listed.

NOTE

Personnel should verify with the Ship's Drawing Index (SDI) the applicability of the listed NAVSEA drawings.

e. Remarks - Additional information is provided in this column to further identify a part, (Missile tube applicability, Mil Spec numbers, CID numbers, manufacturer part numbers, etc.).

5-6-3. HOW TO USE THE ILLUSTRATED PARTS BREAKDOWN.

There are two methods used to find a part; (a) by appearance and (b) by item number.

a. When a part is identified by appearance the following method is used:

(1) Locate the figure for the assembly.

(2) Identify the item number on the figure.

(3) Locate the table for the assembly.

(4) Read the row that contains the appropriate item number for additional information.

b. When the part is identified by item number the following method is used:

(1) Locate the table for the assembly.

(2) Read the row that contains the appropriate item number for additional information.

Table 5-6-1. Fairing Connecting Linkage

(Refer to Figure 5-6-1)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Fairing Connecting Linkage		704-5940676	
	Fairing Connecting* Linkage		704-5483960 704-5483964	
1	Slflkg Hex Nut	2	704-5940676 PC 26	MS17828-12C
	*	2	704-5483960 PC 31	MS17828-12C
2	Washer	2	704-5940676 PC 14	
	*	2	704-5483964 PC 19	
3	Link Pin	2	704-5940676 PC 13	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		1	704-5940676 PC 13	Tubes 11, 12, 15 & 16
		1	704-5940676 PC 28	Tubes 11, 12, 15 & 16
	*	1	704-5483964 PC 11	Tubes 9, 10, 11, 12, 15 & 16
	*	1	704-5483964 PC 29	Tubes 9, 10, 11, 12, 15 & 16
	*	2	704-5483964 PC 29	Tubes 5, 6, 7, 8, 13 & 14
4	Linkage Assembly	1	704-5940676	
	*	1	704-5483964	
5	Eccentric Bushing	4	704-5940676 PC 11	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		2	704-5940676 PC 12	Tubes 11, 12, 15 & 16
		2	704-5940676 PC 29	Tubes 11, 12, 15 & 16
	*	2	704-5483964 PC 10	Tubes , 10, 11, 12, 15 & 16
	*	4	704-5483964 PC 28	Tubes 5, 6, 7, 8, 13 & 14
	*	2	704-5483964 PC 32	Tubes 9, 10, 11, 12, 15 & 16
6	Sleeve	2	704-5940676 PC 27	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
	*	2	704-5483964 PC 24	Tubes 5, 6, 7, 8, 13 & 14
7	Hex Bolt	8	704-5940676 PC 15	
	*	8	704-5483960 PC 22	
Asterisk (*) applicable to SSN 719 and 720 Check Ship's Drawing Index (SDI) for applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-2. Fairing Hinge Bracket

(Refer to Figure 5-6-2)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Fairing Hinge Bracket Assembly		704-5858537	
	Fairing Hinge Bracket Assembly *		704-5483964 704-5483960	
1	Hinge Bracket	1	704-5858537 PC 2	Tubes 11, 12, 15 & 16
		1	704-5858537 PC 1	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
	*	1	704-5483964 PC 25	
2	Washer	1	704-5858537 PC 5	
	*	1	704-5483964 PC 19	
3	Slflkg Hex Nut	1	704-5858537 PC 9	
	*	1	704-5483960 PC 31	
4	Dowel	2	704-5858537 PC 6	
5	Slflkg Hex Bolt	6	704-5858537 PC 8	Tubes 11, 12, 15 & 16
		6	704-5858537 PC 7	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
	Hex Hd Bolt *	4	704-5483960 PC 28	Tubes 9, 10, 11, 12, 15 & 16
	*	4	704-5483960 PC 32	Tubes 13 & 14
6	Hinge Pin	1	704-5858537 PC 3	
	*	1	704-5483964 PC 4	
7	Slflkg Hex Nut	6	704-5858537 PC 9	Tubes 11, 12, 15 & 16
	*	4	704-5483960 PC 31	
8	Stud *	4	704-5483960 PC 29	Tubes 5, 6, 7 & 8
9	Slflkg Hex Nu *	4	704-5483960 PC 31	Tubes 5, 6, 7 & 8
10	Bushing	2	704-5858537 PC 4	
	*	2	704-5483964 PC 9	

Asterisk (*) applicable to SSN 719 and 720
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.

Table 5-6-3. Fairing Locking Mechanism (SSN 721 and Later)

(Refer to Figure 5-6-3)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Fairing Lock Mech		704-6294477	
1	Lock, outboard	1	704-6294477 PC 1, 7	Tubes 11 & 15
		1	704-6294477 PC 4, 10	Tubes 12 & 16
	Lock, inboard	1	704-6294477 PC 2, 8	Tubes 5, 9 & 13
		1	704-6294477 PC 3, 9	Tube 7
		1	704-6294477 PC 5, 11	Tubes 6, 10 & 14
		1	704-6294477 PC 6, 12	Tube 8
2	Bearing	1	704-6294477 PC 17	Tubes 5, 6, 7, 8, 9, 10 13 & 14
		1	704-6294477 PC 18	Tubes 11, 12, 15 & 16
3	Bearing Base	1	704-6294477 PC 19	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		1	704-6294477 PC 15	Tubes 11, 12, 15 & 16
4	Bearing Cap	1	704-6294477 PC 20	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		1	704-6294477 PC 16	Tubes 11, 12, 15 & 16
5	Pin	2	704-6294477 PC 27	
6	Bolt Hex Hd.	4	704-6294477 PC 56	
7	Pin retainer	2	704-6294477 PC 28	
8	Spacer	2	704-6294477 PC 83	Tubes 11, 12, 15 & 16
		2	704-6294477 PC 76	Tubes 5, 6, 7 & 8
		2	704-6294477 PC 79	Tubes 9, 10, 13 & 14
		2	704-6294477 PC 47	Tubes 13 & 14
		2	704-6294477 PC 78	Tubes 7, 8, 9 & 10
		2	704-6294477 PC 77	Tubes 5 & 6
		2	704-6294477 PC 46	Tubes 11, 12, 15 & 16
9	Mounting bolt	4	704-6294477 PC 62	Tubes 5, 6, 7 & 8
		2	704-6294477 PC 62	Tubes 9, 10, 13 & 14
		2	704-6294477 PC 75	Tubes 9, 10, 13 & 14
		6	704-6294477 PC 61	Tubes 11, 12, 15 & 16
10	Nut, Slflkg	4	704-6294477 PC 53	Tubes 5, 6, 7 & 8
		2	704-6294477 PC 53	Tubes 9, 10, 13 & 14
		6	704-6294477 PC 52	Tubes 11, 12, 15 & 16
11	Fitting, Lube	2	704-6294477 PC 41	Deleted with Shipalt 3936K

Table 5-6-3. Fairing Locking Mechanism (SSN 721 and Later) (Continued)

(Refer to Figure 5-6-3)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
		3	704-6294477 PC 41	Tubes 11, 12, 15 & 16
12	Dowel	2	704-6294477 PC 21	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		4	704-6294477 PC 22	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		6	704-6294477 PC 23	Tubes 11, 12, 15 & 16
		4	704-6294477 PC 24	Tubes 11, 12, 15 & 16
		2	704-6294477 PC 25	Tubes 5 & 6
		2	704-6294477 PC 26	
13	Spacer	1	704-6294477 PC 31	
14	Hydraulic Cylinder RH	1	704-6294477 PC 29	Tubes 5, 7, 9, 11, 13 & 15
	Hydraulic Cylinder LH	1	704-6294477 PC 30	Tubes 6, 8, 10, 12, 14 & 16
15	Bracket	1	704-6294477 PC 13	Tube 7
		1	704-6294477 PC 14	Tube 8
		1	704-6294477 PC 39	Tubes 5, 8, 9, & 13
		1	704-6294477 PC 40	Tubes 6, 7, 10 & 14
		1	704-6294477 PC 38	Tubes 11, 12, 15 & 16
16	Screw Fl Hd	2	704-6294477 PC 57	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		2	704-6294477 PC 56	Tubes 11, 12, 15 & 16
17	Spacer	2	704-6294477 PC 35	
18	Spacer, Magnet	2	704-6294477 PC 36	
19	Magnet	2	6510875	
20	Nut Slflkg	2	704-6294477 PC 50	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
		2	704-6294477 PC 49	Tubes 11, 12, 15 & 16
21	Rod End Male	1	704-6294477 PC 63	
22	Rod End Female	1	704-6294477 PC 64	
23	Cotter Pin	1	704-6294477 PC 84	
24	Screw rd hd	2	704-6294477 PC 54	
25	Nut	2	704-6294477 PC 49	
*26	Bushing	1	KJB346438V 8242874	S/A 3936K S/A 4292K
*27	Bushing	1	KJB346538V 8242875	S/A 3936K S/A 4292K
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings. * Note: If SHIPALT 4292K VLS Hatch Fairing and Linkage upgrades is complete, then refer to reference drawing 704-8206350				

Table 5-6-4. Fairing Lock Hydraulic Cylinder (SSN 721 and Later)

(Refer to Figure 5-6-4)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Fairing Lkg Hydr. Cylinder		704-6294478	
*1	Rod Clevis	1	704-6294478 PC 6	
2	Slflkg Hex Nut	8	704-6294478 PC 14	
3	Jacking Bolt	2	704-6294478 PC 25	
4	Bolt Hex Hd	6	704-6294478 PC 24	
5	Retainer Ring	1	704-6294478 PC 23	
6	Wiper Ring	1	704-6294478 PC 15	D-875
*7	End Cap	1	704-6294478 PC 5	
*8	Quad Ring Seal	2	704-6294478 PC 21	Q4212
*9	Backup Ring	4	704-6294478 PC 20	MS28782-17
10	O-Ring	2	704-6294478 PC 26	M83461/1-336
*11	Backup Ring	6	704-6294478 PC 18	MS28782-39
*12	Piston Rod	1	704-6294478 PC 4	
*13	Piston	1	704-6294478 PC 3	
14	Screw, Locking	1	704-6294478 PC 7	
*15	Quad Ring Seal	1	704-6294478 PC 19	Q4336
*16	Quad Ring Seal	1	704-6294478 PC 17	Q4333
*17	Backup Ring	2	704-6294478 PC 16	MS28782-36
18	Check Valve	1	704-6294478 PC 22	2206
19	O-Ring	1	704-6294478 PC 12	M83461/1-015
20	Locking Pellet	1	704-6294478 PC 11	704-6294478-11
21	Retainer, check valve	1	704-6294478 PC 10	
22	Stud	8	704-6294478 PC 13	
23	Cylinder Housing	1	704-6294478 PC 1	RH
		1	704-6294478 PC 2	LH
24	Screw locking	1	704-6294478 PC 8	

Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.

* Note: If SHIPALT 4292K VLS Hatch Fairing and Linkage upgrades is complete, then refer to reference drawing 704-8206350 and Table 5-6-5 for additional information.

Table 5-6-5. Fairing Lock Hydraulic Cylinder (ShipAlt 4292K)

(Refer to Figure 5-6-4)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING#	REMARKS
1	Rod Clevis	1	8242890	
2	Slflkg Hex Nut	8	704-6294478 PC 14	
3	Jacking Bolt	2	704-6294478 PC 25	
4	Bolt Hex Hd	6	704-6294478 PC 24	
5	Retainer Ring	1	704-6294478 PC 23	
6	Wiper Ring	1	704-6294478 PC 25 D-875	
7	End Cap	1	8242896	
8	O-Ring	2	M83461/1-212	
9	Backup Ring	4	8350555-2	N0300-90 8-212
10	O-Ring	2	M83461/1-336	
11	Backup Ring	6	8350555-4	N0300-90 8-336
12	Piston Rod	1	8242878	
13	Piston	1	8242895	
14	Screw, Locking	1	8242894	
15	O-Ring	1	M83461/1-336	
16	O-Ring	1	M83461/1-333	
17	Backup Ring	2	8350555-3	N0300-90 8-333
18	Check Valve	1	704-6294478 PC 22	2206
19	O-Ring	1	M83461/1-015	
20	Locking Pellet	1	704-6294478 PC 11	
21	Retainer, Check Valve	1	704-6294478 PC 10	
22	Stud	8	704-6294478 PC 13	
23	Cylinder Housing	1	704-6294478 PC 1 RH 704-6294478 PC 2 LH	
24	Screw Locking Pellet Clevis	1	8242893-1	
25	Locking	1	8242893-2	

Table 5-6-6. Muzzle Hatch T-Bar Locking Mechanism (SSN 719 and 720)

(Refer to Figure 5-6-5)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Muzzle Hatch T-Bar Lock Mechanism		704-5765850 thru 704-5765852	
1	Hatch Switch Closed Bracket	1	704-5483956 PC 33	Tubes 6, 8, 9, 11, 14 & 15
		1	704-5483956 PC 34	Tubes 5, 7, 10, 12, 13 & 16
2	Dowel Pin	2	704-5765850 PC 19	
3	Washer	2	704-5765850 PC 18	
4	Slflkg Capscrew	2	704-5765850 PC 17	
5	Insert	1	704-5765852 PC 11	
6	Special Bolt	1	704-5765852 PC 13	
7	Spring Mount	1	704-5765852 PC 14	
8	Flatbar Spring	1	704-5765852 PC 9	
9	Slflkg Capscrew	2	704-5765850 PC 14	
10	Slflkg Capscrew	1	704-5765850 PC 15	
11	Washer	1	704-5765850 PC 16	
12	Pivot Shaft	1	704-5765851 PC 35	Tubes 5, 6, 7, 8, 10, 11, 12, 13, 14, 15 & 16
		1	704-5765851 PC 34	Tube 9
13	Slflkg Capscrew	2	704-5765850 PC 27	
14	Journal Bearing	2	704-5765850 PC 31	Tubes 5, 6, 8, 9, 11, 14 & 15
15	Slflkg Setscrew	1	704-5765850 PC 13	Tubes 5, 6, 7, 8, 10, 11, 12, 13, 14, 15 & 16
16	Locking T-Bar	1	704-5765851 PC 1	Tubes 5, 6, 7, 8, 10, 11, 13, 14 & 15
		1	704-5765851 PC 2	Tubes 12 & 16
		1	704-5765851 PC 31	Tube 9
17	Hinge Bracket	1	704-5765851 PC 17	Tubes 5, 6, 8, 11, 14 & 15
		1	704-5765851 PC 18	Tubes 7, 10, 12, 13 & 16
		1	704-5765851 PC 19	Tubes 7, 10, 12, 13 & 16
		1	704-5765851 PC 33	Tube 9
18	See Item 17 PC 18			
19	Journal Bearing	2	704-5765850 PC 31	Tubes 7, 10, 12, 13 & 16
20	See Item 17 PC 19			
21	Slflkg Hex Nut	1	704-5765850 PC 32	Tube 9
22	Washer	1	704-5765850 PC 33	Tube 9

Table 5-6-6. Muzzle Hatch T-Bar Locking Mechanism (SSN 719 and 720) (Continued)

(Refer to Figure 5-6-5)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
23	T-Bar Clevis	1	704-5765851 PC 38	Tube 9
24	Journal Bearing	1	704-5765850 PC 31	Tube 9
25	Key	1	704-5765851 PC 39	Tube 9
26	See Item 12 PC 34			
27	Slflkg Capscrew	2	704-5765850 PC 30	Tube 9
28	Pin Retainer	1	704-5765851 PC 41	Tube 9
29	Pin	2	704-5765851 PC 40	Tube 9
30	Slflkg Capscrew	2	704-5765850 PC 30	
31	Pin Retainer	1	704-5765852 PC 10	
32	Pin	1	704-5765851 PC 23	
33	Rod Bearing	1	704-5765851 PC 25	
34	Tie Rod	1	704-5765851 PC 7	Tubes 5, 6, 7, 8, 13 & 14
		1	704-5765851 PC 13	Tubes 10, 11, 12, 15 & 16
		1	704-5765851 PC 32	Tube 9
35	Sch Capscrew	2	704-5765850 PC 21	
36	Special Spacer	2	704-5765850 PC 22	
37	Permanent U-Shape Magnet	2	6510875	
38	Magnet Housing	2	704-5483956 PC 3	
39	Spacer	2	704-5483956 PC 8	
40	Slflkg Hex Nut	2	704-5765850 PC 25	
41	Slflkg Capscrew	2	704-5765850 PC 23	
42	Hatch Magnet Closed Bracket	1	704-5483956 PC 35	Tubes 6, 8, 9, 11, 14 & 15
		1	704-5483956 PC 36	Tubes 5, 7, 10, 12, 13 & 16
43	Slflkg Hex Nut	2	704-5765850 PC 26	
44	Rod Bearing	1	704-5765851 PC 26	
45	Bellcrank	1	704-5765851 PC 3	Tubes 5, 6, 7, 8, 13 & 14
46	Special Bolt	2	704-5765851 PC 36	Tubes 5, 6, 7, 8, 13 & 14
		1	704-5765851 PC 36	Tubes 9, 10, 11, 12, 15 & 16
47	Rod Bearing	1	704-5765851 PC 25	Tubes 5, 6, 7, 8, 13 & 14
48	Pin	1	704-5765851 PC 24	Tubes 5, 6, 7, 8, 13 & 14
49	Pin Retainer	1	704-5765852 PC 10	Tubes 5, 6, 7, 8, 13 & 14

Table 5-6-6. Muzzle Hatch T-Bar Locking Mechanism (SSN 719 and 720) (Continued)

(Refer to Figure 5-6-5)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
50	Slflkg Capscrew	2	704-5765850 PC 30	Tubes 5, 6, 7, 8, 13 & 14
51	Fitted Bolt	1	704-5765852 PC 12	Tube 7
52	Slflkg Hex Nut	1	704-5765850 PC 32	Tube 7
53	Tie Rod	1	704-5765851 PC 8	Tube 7
		1	704-5765851 PC 10	Tubes 5, 6, 8, 13 & 14
54	Rod Bearing	1	704-5765851 PC 26	Tubes 5, 6, 7, 8, 13 & 14
55	Special Bolt	2	704-5765851 PC 36	Tubes 5, 6, 8, 13 & 14
56	Bellcrank	1	704-5765851 PC 4	Tube 7
		1	704-5765851 PC 5	Tubes 9, 10, 11, 12, 15 & 16
		1	704-5765851 PC 6	Tubes 5, 6, 8, 13 & 14
57	Slflkg Hex Nut	2	704-5765850 PC 26	Tubes 5, 6, 7, 8, 13 & 14
58	Pin Retainer	1	704-5765852 PC 10	Tubes 9, 10, 11, 12, 15 & 16
59	Slflkg Capscrew	2	704-5765850 PC 30	Tubes 9, 10, 11, 12, 15 & 16
60	Pin	2	704-5765851 PC 22	Tubes 9, 10, 11, 12, 15 & 16
61	Slflkg Hex Nut	1	704-5765850 PC 26	Tubes 5, 6, 7, 8, 13 & 14
62	Bellcrank	1	704-5765852 PC 5	Tubes 10, 11 & 15
		1	704-5765852 PC 6	Tubes 9, 12 & 16
		1	704-5765852 PC 7	Tubes 5, 6, 8, 13 & 14
		1	704-5765852 PC 8	Tube 7
63	Locking Contact Screw	1	704-5765851 PC 15	
64	Unlocking Contact Screw	1	704-5765851 PC 14	
65	Actuator Shaft Bearing	1	704-5765852 PC 1	Tubes 10, 11 & 15
		1	704-5765852 PC 2	Tube 9, 12, 7 & 16
		1	704-5765852 PC 3	Tubes 5, 6, 8, 13 & 14
		1	704-5765852 PC 4	Tube 7
66	Pin Retainer	1	704-5765852 PC 10	Tubes 5, 6, 8, 9, 10, 11, 12, 13, 14, 15 & 16
67	Slflkg Capscrew	2	704-5765850 PC 30	Tubes 5, 6, 8, 9, 10, 11, 12, 13, 14, 15 & 16
68	Slflkg Capscrew	2	113-5580200 PC 15	

Table 5-6-6. Muzzle Hatch T-Bar Locking Mechanism (SSN 719 and 720) (Continued)

(Refer to Figure 5-6-5)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
69	Slflkg Hex Nut	2	113-5580200 PC 18	
70	Pin	1	704-5765851 PC 20	Tubes 5, 6, 8, 9, 10, 11, 12, 13, 14, 15 & 16
71	See Item 30			
72	See Item 31			
73	Pin	1	704-5765851 PC 16	Tubes 5, 6, 8, 13 & 14
		1	704-5765851 PC 21	Tubes 7, 9, 10, 11, 12, 15 & 16
74	Special Bolt	1	704-5765851 PC 37	Tubes 5, 6, 7, 8, 13 & 14
75	Rod Bearing		704-5765851 PC 27	Tubes 9, 12 & 16
		1	704-5765851 PC 28	Tubes 5, 6, 7, 8, 10, 11, 13, 14 & 15
76	Tie Rod	1	704-5765851 PC 9	Tube 7
		1	704-5765851 PC 11	Tubes 5, 6, 8, 13 & 14
		1	704-5765851 PC 12	Tubes 9, 10, 11, 12, 15 & 16
77	Rod Bearing	1	704-5765851 PC 25	Tubes 5, 6, 8, 13 & 14
		1	704-5765851 PC 27	Tubes 7, 10, 11 & 15
		1	704-5765851 PC 28	Tubes 9, 12 & 16
Check Ship’s Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-7. Muzzle Hatch and Muzzle Hatch Operating Mechanism

(Refer to Figure 5-6-6)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Muzzle Hatch Operating Mechanism		704-5795403 704-5795439 704-5795318	
	Muzzle Hatch Operating Mechanism *		704-5483954 704-5483956 704-5485957 704-5765852	
1	Slflkg Hex Nut	3	704-5795403 PC 39	Tubes 5, 6, 7, 8, 9, 10, 13, 14, 15 & 16
	*	2	113-5580200 PC 18	
2	Bearing Bracket	1	704-5795403 PC 12	Tubes 5, 6, 7, 8, 9, 10, 12, 13, 14, 15 & 16
		1	704-5795403 PC 40	Tube 11
	Actuator Shaft Bearing *	1	704-5765852 PC 1	Tubes 10, 11 & 15
	*	1	704-5765852 PC 2	Tubes 9, 12 & 16
	*	1	704-5765852 PC 3	Tubes 5, 6, 8, 13 & 14
	*	1	704-5765852 PC 4	Tube 7
3	Sch Bolt	3	704-5795403 PC 34	Tubes 5, 6, 7, 8, 9, 10, 13, 14, 15 & 16
		3	704-5795403 PC 35	Tubes 11 & 12
	*	2	113-5580200 PC 15	
4	Bushing	1	KJB344700V-9	S/A 3936K
5	Slflkg Capscrew	4	704-5795403 PC 31	
	*	4	704-5483954 PC 4	
6	Pin Retainer	2	704-5795403 PC 7	
	*	2	704-5483957 PC 16	
7	Link Pin	1	KJS124300V-11	S/A 3936K
	*	1	KJS125828V-43	
8	Bushing (Lower)	2	6557866-1	S/A 3936K
	Pin Bearing *	2	6510866-2	
9	Offset Link	1	704-5795403 PC 25	Tubes 7, 8, 15 & 16
		1	704-5795403 PC 26	Tubes 11 & 12
		1	704-5795403 PC 27	Tubes 5, 6, 9, 10, 13 & 14
	Hatch Link *	1	704-5483957 PC 40	Tubes 9, 10, 11, 12, 15 & 16

Table 5-6-7. Muzzle Hatch and Muzzle Hatch Operating Mechanism (Continued)

(Refer to Figure 5-6-6)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	*	1	704-5483957 PC 46	Tubes 5, 6, 7, 8, 13 & 14
10	See Item 8			S/A 3936K
11	Slflkg Hex Nut	2	704-5795403 PC 30	
	*	2	704-5483954 PC 8	
12	Turnbuckle	1	704-5795403 PC 22	Tubes 11 & 12
		1	704-5795403 PC 23	Tubes 5, 6, 15 & 16
		1	704-5795403 PC 24	Tubes 7, 8, 13 & 14
		1	704-5795403 PC 41	Tubes 9 & 10
	*	1	704-5483957 PC 18	
13	Bushing (Upper)	2	 6557869 6557866-3 6557866-2 6557866-1	S/A 3936K 724, 725, 751,752, 754, 755, 757, 760-763 721-723, 750, 753, 756, 758, 759, 765, 766 768-773 719, 720
14	See Item 13			S/A 3936K
15	Actuator Clevis	1	704-5795403 PC 16	Tubes 5 & 6
		1	704-5795403 PC 17	Tubes 7 & 8
		1	704-5795403 PC 18	Tubes 9 & 10
		1	704-5795403 PC 19	Tubes 11 & 12
		1	704-5795403 PC 20	Tubes 13 & 14
		1	704-5795403 PC 21	Tubes 15 & 16
	*	1	704-5483957 PC 39	Tubes 9, 12 & 16
	*	1	704-5483957 PC 44	Tubes 5, 6, 7, 8, 13 & 14
	*	1	704-5483957 PC 48	Tubes 10, 11 & 15
16	Capscrew	1	704-5795403 PC 28	
	*	1	704-5483954 PC 6	
17	Capscrew	1	704-5795403 PC 29	
	*	1	704-5483954 PC 7	
18	See Item 5			
19	See Item 6			

Table 5-6-7. Muzzle Hatch and Muzzle Hatch Operating Mechanism (Continued)

(Refer to Figure 5-6-6)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
20	Link Pin (Upper)	1	KJS124300v-10M KJS124300V-10 KJS125828V-21	S/A 3936K 724, 725, 751, 752, 754, 755, 757, 760-763 721-723, 750, 753, 756, 758, 759, 764-773 719, 720
21	Hatch Clevis	1	704-5795403 PC 1	Tubes 5 & 6
		1	704-5795403 PC 2	Tubes 7 & 8
		1	704-5795403 PC 3	Tubes 9 & 10
		1	704-5795403 PC 4	Tubes 11 & 12
		1	704-5795403 PC 5	Tubes 13 & 14
		1	704-5795403 PC 6	Tubes 15 & 16
	*	1	704-5483957 PC 15	Tubes 9, 10, 11, 12, 15 & 16
	*	1	704-5483957 PC 23	Tubes 5, 6, 7, 8, 13 & 14
22	See Item 11			
23	Spacer	2	704-5795563 PC 6	
	*	2	704-5483957 PC 6	
24	Tap Bolt	2	704-5795563 PC 38	
	Fitted Bolt	4	704-5795563 PC 3	
	*	4	704-5483957 PC 53	
25	Pillow Block	1	704-5795563 PC 2	Tubes 5, 6, 7, 8, 9, 10, 13, 14 & 15
		1	704-5795563 PC 4	Tube 16
		1	704-5795563 PC 34	Tubes 11 & 12
	*	1	704-5483957 PC 42	Tubes 5, 6, 7, 8, 13 & 14
	*	1	704-5483957 PC 45	Tubes 9, 10, 11, 12, 15 & 16
26	Bearing Half	2	704-5795563 PC 13	Tubes 5, 6, 7, 8, 9, 10, 13, 14 & 15
		2	704-5795563 PC 14	Tube 16
		2	704-5795563 PC 36	Tubes 11 & 12
	*	2	704-5483957 PC 13	Tubes 5, 6, 7, 8, 13 & 14
	*	2	704-5483957 PC 14	Tubes 9, 10, 11, 12, 15 & 16

Table 5-6-7. Muzzle Hatch and Muzzle Hatch Operating Mechanism (Continued)

(Refer to Figure 5-6-6)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
27	See Item 23			
28	Bearing Half	2	704-5795563 PC 12	
	*	2	704-5483957 PC 12	
29	Torque Shaft	1	704-5795563 PC 9	Tube 16
		1	704-5795563 PC 10	Tubes 5, 6, 7, 8, 9, 10 13, 14 & 15
		1	704-5795563 PC 35	Tubes 11 & 12
	*	1	704-5483957 PC 9	Tubes 9, 10, 11, 12, 15 & 16
	*	1	704-5483957 PC 10	Tubes 5, 6, 7, 8, 13 & 14
30	Gagging Pin Block	1	704-5795439 PC 12	
	*	1	704-5483956 PC 10	
31	Open Switch Bracket	1	704-5795439 PC 29	
	*	1	704-5483956 PC 42	Tubes 10, 12, 16
	*	1	704-5483956 PC 58	Tubes 9, 11, 15
	*	1	704-5483956 PC 43	Tubes 5, 6, 7, 8, 13 & 14
32	Open Magnet Switch	2	6557947	
	*	2	6557947	
33	Washer	2	704-5795318 PC 25	
	*	2	704-5483956 PC 54	
34	Slflkg Capscrew	2	704-5795318 PC 24	
	*	2	704-5483956 PC 53	
35	Slflkg Capscrew	4	704-5795318 PC 26	
	*	4	704-5483956 PC 49	
36	Dowel Pin *	2	704-5483957 PC 29	
37	Slflkg Hex Nut	4	704-5795318 PC 3	
	*	4	704-5483954 PC 10	
38	Hex Capscrew	2	704-5795318 PC 6	
	*	2	704-5483954 PC 13	
39	Hatch Assembly	1	704-5795764 PC 1	
40	Slflkg Hex Nut	2	704-5795318 PC 2	
	*	2	704-5483954 PC 9	
41	Hatch Arm	1	704-5795439 PC 3	Tubes 11, 12, 15 & 16
		1	704-5795439 PC 21	Tubes 5, 6, 7, 8, 9, 10, 13 & 14

Table 5-6-7. Muzzle Hatch and Muzzle Hatch Operating Mechanism (Continued)

(Refer to Figure 5-6-6)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	*	1	704-5483956 PC 1	
42	Bearing	4	704-5795563 PC 31	
	*	4	704-5483957 PC 31	
43	Shoulder Bolt	2	704-5795563 PC 30	
	*	2	704-5483957 PC 52	
44	See Item 42			
45	Stop Bolt	3	704-5795318 PC 4	
	*	3	704-5483956 PC 37	Tubes 9, 10, 11, 12, 15 & 16
	*	2	704-5483956 PC 37	Tubes 5, 6, 7, 8, 13 & 14
46	Magnet Bracket	4	704-5795439 PC 31	
	*	2	704-5483956 PC 45	
47	Slflkg Capscrew	4	704-5795318 PC 22	
	*	4	704-5483956 PC 53	
48	Washer, Flat	8	704-5795318 PC 21	
	*	2	704-5483956 PC 52	
49	Magnet Housing	4	704-5795439 PC 18	
	*	4	704-5483956 PC 46	
50	U-Shape Magnet	4	6510875	
51	Special Spacer	4	704-5795318 PC 15	
	*	4	704-5483954 PC 22	
52	Slflkg Capscrew	4	704-5795318 PC 19	
	*	4	704-5483956 PC 51	
53	Slflkg Capscrew	3	704-5795318 PC 1	
	*	3	704-5483954 PC 28	
54	Shaft Retainer	1	704-5795563 PC 40	Tubes 5, 6, 7, 8, 9, 10, 12, 13, 14 & 15
		1	704-5795563 PC 41	Tubes 11 & 16
	*	1	704-5483957 PC 49	Tubes 5, 6, 7, 8, 10, 11, 13, 14 & 15
	*	1	704-5483957 PC 50	Tubes 9, 12 & 16
55	Spacer	2	704-5795563 PC 5	
	*	2	704-5483957 PC 5	
56	Fitted Bolt	2	704-5795563 PC 39	
	*	2	704-5483957 PC 53, 54	
57	Pillow Block	1	704-5795563 PC 1	

Table 5-6-7. Muzzle Hatch and Muzzle Hatch Operating Mechanism (Continued)

(Refer to Figure 5-6-6)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	*	1	704-5483957 PC 51	
58	Slflkg Hex Nut	2	704-5795318 PC 17	
	*	2	704-5483954 PC 10	
59	Bearing	2	704-5795563 PC 11	
	*	2	704-5483957 PC 11	
60	See Item 55			
61	See Item 59			
62	Gagging Pin	1	704-5483956 PC 12	A&I 3194
	*	1	704-5795439 PC 14	A&I 3194
63	Gagging Pin Handle	1	704-5483956 PC 13	
	*	1	704-5795439 PC 15	
64	Bolt Hex Hd	1	704-5483954 PC 36	
65	Washer, Flat	4	704-5795318 PC 23	
	*	4	704-5483956 PC 61	
66	Bushing (Upper)	1	 6557868 6557867 6510867	S/A 3936K 724, 725, 751, 752, 754, 755, 757, 760-763 721-723, 750, 753, 756, 758, 759, 764-773 719, 720
67	Bushing (Lower)	1	 6557867 6510867	S/A 3936K 721 & Later 719,720
68	Bracket	4	704-5795439 PC 33	
Asterisk (*) applicable to SSN 719 and 720				
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-8. Muzzle Hatch and Fairing Gaskets

(Refer to Figure 5-6-7)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Muzzle Hatch Gasket		704-5795764	
	Muzzle Hatch Gasket*		704-5483955	
	Fairing Gasket		704-5940680 704-5940679	
	Fairing Gasket *		704-5483960	
1	Slflkg Capscrew	36	704-5795764 PC 5	
	*	36	704-5483955 PC 5	
2	Retaining Ring	1	704-5795764 PC 3	
	*	1	704-5483955 PC 3	
3	Gasket	1	704-5795764 PC 4	
	*	1	704-5483955 PC 4	
4	Slflkg Hex Nut	42	704-5940680 PC 14	Tubes 11, 12, 15 & 16
		36	704-5940679 PC 23	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
	*	26	704-5483960 PC 19	Tubes 5, 6, 7 & 8
	*	25	704-5483960 PC 19	Tubes 13 & 14
	*	32	704-5483960 PC 19	Tubes 9, 10, 11, 12, 15 & 16
5	Machine Screw	42	704-5940680 PC 13	Tubes 11, 12, 15 & 16
		36	704-5940679 PC 22	Tubes 5, 6, 7, 8, 9, 10, 13 & 14
	*	32	704-5483960 PC 37	Tubes 9, 10, 11, 12, 15 & 16
		26	704-5483960 PC 37	Tubes 5, 6, 7 & 8
	*	25	704-5483960 PC 37	Tubes 13 & 14
	*	3	704-5483960 PC 38	Tubes 13 & 14
	*	2	704-5483960 PC 38	Tubes 5, 6, 7 & 8
6	Gasket Assembly	1	704-5940680 PC 5	Tube 11
		1	704-5940680 PC 6	Tube 12
		1	704-5940680 PC 7	Tube 15

Table 5-6-8. Muzzle Hatch and Fairing Gaskets (Continued)

(Refer to Figure 5-6-7)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
		1	704-5940680 PC 8	Tube 16
		1	704-5940679 PC 9	Tube 5
		1	704-5940679 PC 10	Tube 6
		1	704-5940679 PC 11	Tube 7
		1	704-5940679 PC 12	Tube 8
		1	704-5940679 PC 13	Tube 9
		1	704-5940679 PC 14	Tube 10
		1	704-5940679 PC 15	Tube 13
		1	704-5940679 PC 16	Tube 14
	*	1	704-5483964 PC 30	Tubes 5, 6, 7, 8, 13 & 14
	*	1	704-5483964 PC 31	Tubes 9, 10, 11, 12, 15 & 16
7	Retaining Clip	42		Not on this Dwg but References 5940673 & 5940675
	*	42	704-5483964 PC 36	
Asterisk (*) applicable to SSN 719 and 720 Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-9. Muzzle Hatch and Fairing Rotary Actuator

(Refer to Figure 5-6-8)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Rotary Actuator Assy		704- 5858418	
1	Slflkg Capscrew	16	704-5858418 PC 9	
2	End Cap	1	704-5858419 PC 4	
3	O-Ring	6	704-5858418 PC 22	M83461/1-353
4	Backup Ring	12	704-5858418 PC 23	5483958-0023 # N0300-90 8-353
5	See Item 3			
6	See Item 4			
7	O-Ring	2	704-5858418 PC 14	M83461/1-348
8	Backup Ring	4	704-5858418 PC 15	465151-348
9	Piston Rack	2	704-5858418 PC 2	
10	Bearing Ball	2	704-5858418 PC 28	
11	Spring	2	704-5858418 PC 29	
12	Spring Retainer	2	704-5858418 PC 30	
13	Retainer Pellet	2	704-5858418 PC 31	
14	O-Ring	2	704-5858418 PC 12	M83461/1-334
15	Backup Ring	4	704-5858418 PC 13	465151-334
16	O-Ring	6	704-5858418 PC 24	M83461/1-340
17	Backup Ring	12	704-5858418 PC 25	MS28782-43 # N0300-90 8-340
18	See Item 16			
19	See Item 17			
20	O-Ring	4	704-5858418 PC 16	M83461/1-218
21	Backup Ring	8	704-5858418 PC 17	MS28782-23 # N0300-90 8-218
22	See Item 20			
23	See Item 21			
24	End Cap	1	704-5858419 PC 2	
25	See Item 1			
26	See Item 3			
27	See Item 4			
28	Cylinder Sleeve	2	704-5858419 PC 8	
29	Actuator Body	1	704-5858419 PC 1	RH
		1	704-5858419 PC 15	LH
30	Cylinder Sleeve	2	704-5858419 PC 9	

Table 5-6-9. Muzzle Hatch and Fairing Rotary Actuator (Continued)

(Refer to Figure 5-6-8)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
31	See Item 16			
32	See Item 17			
33	Adjustable Stop	2	704-5858418 PC 4	
34	Hex Hd Plug	2	704-5858418 PC 26	
35	See Item 1			
36	End Cap	1	704-5858419 PC 5	
37	See Item 16			
38	See Item 17			
39	See Item 16			
40	See Item 17			
41	See Item 16			
42	See Item 17			
43	See Item 30			
44	Slflkg Hex Nut		704-5795403 PC 38	
45	Sch Bolt		704-5795403 PC 33	
	Sch Capscrew		704-5795403 PC 37	
	Hex Bolt		704-5795403 PC 32	
	Hex Bolt		704-5795403 PC 36	
46	See Item 28			
47	See Item 3			
48	See Item 4			
49	See Item 14			
50	See Item 15			
51	See Item 12			
52	See Item 13			
53	See Item 11			
54	See Item 10			
55	See Item 9			
56	See Item 7			
57	See Item 8			
59	See Item 33			
60	Bearing	1	704-5858418 PC 8	
61	Pinion Gear	1	704-5858418 PC 6	
62	Spacer	1	704-5858418 PC 7	
63	Pinion Bearing	1	KJB345552V	S/A 3936K

Table 5-6-9. Muzzle Hatch and Fairing Rotary Actuator (Continued)

(Refer to Figure 5-6-8)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
64	O-Ring	1	704-5858418 PC 20	M83461/1-426
65	Backup Ring	2	704-5858418 PC 21	MS28782-53 # N0300-90 8-426
66	O-Ring	1	704-5858418 PC 18	M83461/1-339
67	Backup Ring	2	704-5858418 PC 19	MS28782-42 N0300-90 8-339
68	Pinion Retainer	1	704-5858419 PC 6	
69	Slflkg Capscrew	12	704-5858418 PC 11	
70	See Item 3			
71	See Item 4			
72	See Item 3			
73	See Item 4			
74	See Item 20			
75	See Item 21			
76	See Item 20			
77	See Item 21			
78	End Cap	1	704-5858419 PC 3	
79	See Item 1			
80	See Item 34			
81	O-Ring	2		MS28778-2
82	See Item 81			
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings. # Applicable if ECP NO# 412-07-033 is incorporated.				

Table 5-6-10. Environmental Monitoring Sensor Assembly

(Refer to Figure 5-6-9)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Environmental Monitoring Assembly		10-2002-2	
1	Captive Screw	3	10-2002-2 PC 6	
2	Cover	1	10-2002-2 PC 5	Slotted Cover # 6510964
3	Nut	1	10-2002-2 PC 3	
4	Washer	1	10-2002-2 PC 2	
5	O-Ring	1	10-2002-2 PC 9	M83461/1-226
6	O-Ring	1	10-2002-2 PC 8	M83461/1-230
7	Penetrator Body	1	10-2002-2 PC 1	D-2343
8	O-Ring	1	10-2002-2 PC 7	M83461/1-329
9	Rubber Isolation Membrane	1		SK070
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-11. Missile Tube Umbilical Penetrator

(Refer to Figure 5-6-10)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Umbilical Penetrator		2983/2-102, 2983-2-102, or 100308-0002	
1	Slflkg Nut	1	2983/2-102	2983/2-002
2	Washer	1	2983/2-102	2983/2-003
3	O-Ring	2	2983/2-102	M28775-242
4	O-Ring	2	2983/2-102	M83461/1-235
5	See Item 3			
6	Penetrator Assembly	1	2983/2-102	2983/2-010
7	See Item 4			
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-12. Pressurization/Vent Plug and Filter

(Refer to Figure 5-6-11)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Pressurization/Vent Plug		704-5755257	
	Pressurization/Vent * Plug		704-5483949	
	Pressurization/Vent Filter		EB SPEC. 3618	
1	Pressure Vent Plug	1	704-5755257 PC 81	
2	O-Ring	1	704-5755257 PC 84	M83461/1-329
	*	1	704-5483949 PC 12	M83461/1-329
3	Pressure/Vent Filter		6557881-1 6557881-2	 SSN 722 & 750
4	O-Ring – 1 O-Ring – 2		EB SPEC. 3618 PC	M83461/1-224 M83461/1-227
Asterisk (*) applicable to SSN 719 and 720 Check Ship’s Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-13. Differential Pressure Transducer Assembly

(Refer to Figure 5-6-12)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Differential Pressure Transducer Assy		A016660	
1	Transducer Assembly	1	A016660	
2	Sch Hd Screw	12	845-4865086	1/4 X 20 UNC-3A
3	Sensing Lines	3	845-4865086	
4	O-Ring	6	845-4865086	M83461/1-018
5	See Item 4			
6	O-Ring	1	A016660 PC 33	M83461/1-220
7	Bolt Hex Hd	2	513-5795661 PC 26	
8	Rubber Isolation Membrane	1		SK055
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-14. Missile Tube Shock Lands and Alignment Pins

(Refer to Figure 5-6-13)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Missile Tube		704-5483949	
	Missile Tube *		704-5483951	
	Epoxy		704-5483957	MIL-C-24176 Type 1
	*		704-5483949	MIL-C-24176 Type 1
	Adhesive Tape *	AR	704-5483949	Waterproof Cloth
1	Alignment Pin	2	704-5755257 PC 17	
	Alignment Screw *	2	704-5483951 PC 21	
2	O-Ring	114	704-5755257 PC 94	
	*	114	704-5483951 PC 18	
3	Hex Hd Bolt	114	704-5755257 PC 73	
	Slflkg Capscrew *	114	704-5483951 PC 7	
4	Internal Shock Land	1	704-5755257 PC 60	Upper Land
		1	704-5755257 PC 62	Upper Land
		1	704-5755257 PC 63	Upper Land
		1	704-5755257 PC 61	Middle Land
		1	704-5755257 PC 64	Middle Land
		1	704-5755257 PC 65	Middle Land
		1	704-5755257 PC 66	Lower Land
		1	704-5755257 PC 67	Lower Land
		1	704-5755257 PC 68	Lower Land
	*	1	704-5483951 PC 37	Upper Land
	*	1	704-5483951 PC 38	Upper Land
	*	1	704-5483951 PC 39	Upper Land
	*	1	704-5483951 PC 36	Middle Land
	*	1	704-5483951 PC 40	Middle Land
	*	1	704-5483951 PC 41	Middle Land
	*	1	704-5483951 PC 42	Lower Land
	*	1	704-5483951 PC 43	Lower Land
	*	1	704-5483951 PC 44	Lower Land
Asterisk (*) applicable to SSN 719 and 720 Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-15. Hatch & Flood/Drain Valve Control Valve

(Refer to Figure 5-6-14)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Hatch & FL/DR Vlv Cont Vlv		20722-001	
1	Sch Capscrew	2	20722-001 PC 77	
2	Flat Washer	12	20722-001 PC 98	
3	End Cap Housing	1	20722-001 PC 17	
4	Sch Capscrew	2	20722-001 PC 76	
5	Cover	1	20722-001 PC 54	
6	O-Ring	1	20722-001 PC 126	M83428/2-908
7	Nut Self-Locking Hex	1	20722-001 PC 103	
8	Filter Retainer	2	20722-001 PC 55	
9	O-Ring	3	20722-001 PC 125	M83428/2-906
10	Filter	2	20722-001 PC 56	
11	Pilot Valve Assy	1	20722-001 PC 14	APL 882220485
12	Capscrews	4	20350-001 PC 29	
13	Flat Washer	6	20350-001 PC 45	
14	Pin Lock Assy	2	20722-001 PC 13	
15	Indicator Plate	1	20722-001 PC 61	
16	O-Ring	3	20350-001 PC 43	M83428/1-018
17	Cartridge (Ball Pilot)	3	20350-001 PC 2	Mfr Dwg 21065-851 P/N 21065-851-1
18	O-Ring	12	20350-001 PC 42	M83428/1-014
19	Hollow-Hex Plug	1	20722-001 PC 66	
20	Plug	1	20722-001 PC 50	
21	O-Ring	5	20722-001 PC 111	M83428/1-012
22	Backup	10	20722-001 PC 135	MS28782-7
23	O-Ring	2	20722-001 PC 118	M83428/1-135
24	Stud	1	20722-001 PC 49	
25	O-Ring	1	20722-001 PC 108	M83428/1-008
26	O-Ring	2	20722-001 PC 113	M83428/1-110
27	Backup	2	20722-001 PC 133	MS28782-2
28	Backup	4	20722-001 PC 136	MS28782-8
29	Spring	2	20722-001 PC 51	
30	Spring Retainer	1	20722-001 PC 36	
31	Piston	1	20722-001 PC 38	

Table 5-6-15. Hatch & Flood/Drain Valve Control Valve (Continued)

(Refer to Figure 5-6-14)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
32	Slide/Sleeve	1	20722-001 PC 9	Matched Set
33	Sleeve Retainer	1	20722-001 PC 52	
34	O-Ring	3	20722-001 PC 124	M83428/2-903
35	O-Ring	4	20722-001 PC 117	M83428/1-128
36	Backup	8	20722-001 PC 130	MS28774-128
37	Ferrule	1	20722-001 PC 68	
38	Lee Jet	1	20722-001 PC 82	
39	Body Housing	1	20722-001 PC 8	
40	Plug	1	20722-001 PC 44	
41	O-Ring	1	20722-001 PC 115	M83428/1-112
42	Nut Self-Locking Hex	1	20722-001 PC 102	
43	Spring Retainer	1	20722-001 PC 37	
44	Piston	1	20722-001 PC 24	
45	O-Ring	1	20722-001 PC 114	M83428/1-111
46	Backup	2	20722-001 PC 137	MS28782-9
47	Pilot Valve Assy	1	20722-001 PC 16	APL 882220526
48	Capscrews	8	20350-001 PC 31	
49	Indicator Plate	1	20722-001 PC 63	
50	Hollow-Hex Plug	2	20722-001 PC 65	
51	Sch Capscrew	4	20722-001 PC 75	
52	Hatch Blocked Microswitch	1		
53	Sch Capscrew	4	20722-001 PC 72	
54	Switch Lever	1	20722-001 PC 40	
55	Switch Plate	1	20722-001 PC 39	
56	O-Ring	1	20722-001 PC 119	M83428/1-212
57	O-Ring	2	20722-001 PC 109	M83428/1-010
58	Spring Retainer	1	20722-001 PC 42	
59	Spring	1	20722-001 PC 43	
60	Spring Guide	1	20722-001 PC 45	
61	End Cap Housing	1	20722-001 PC 1	
62	Ferrule	1	20722-001 PC 67	
63	Sch Capscrew	4	20722-001 PC 73	
64	Retainer	1	20722-001 PC 22	

Table 5-6-15. Hatch & Flood/Drain Valve Control Valve (Continued)

(Refer to Figure 5-6-14)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
65	Backup	2	20722-001 PC 134	MS28782-5
66	O-Ring	1	20722-001 PC 112	M83428/1-022
67	Backup	2	20722-001 PC 129	MS28774-022
68	O-Ring	1	20722-001 PC 116	M83428/1-115
69	Backup	2	20722-001 PC 138	MS28782-13
70	Piston Lock	1	20722-001 PC 41	
71	Bolt Hex Head	2	20722-001 PC 87	
72	Flat Washer	6	20722-001 PC 96	
73	Flat Washer	2	20722-001 PC 97	
74	Nut Castellated	2	20722-001 PC 88	
75	Cotter Pin	2	20722-001 PC 105	
76	Override Lever	1	20722-001 PC 23	
77	Pin Lock Assy	1	20722-001 PC 18	
78	Pilot Valve Assy	1	20722-001 PC 15	APL 882220525
79	Indicator Plate	1	20722-001 PC 62	
80	Piston Lock Arm	1	20722-001 PC 25	
81	Lock Arm Shaft	1	20722-001 PC 27	
82	Thrust Washer	1	20722-001 PC 31	
83	O-Ring	1	20722-001 PC 120	M83428/1-228
84	O-Ring	1	20722-001 PC 110	M83428/1-011
85	Intermediate Cap	1	20722-001 PC 2	Housing
86	Sch Capscrew	4	20722-001 PC 74	
87	Switch Mtg Plate	1	20722-001 PC 33	
88	Mach. Screw Flh	2	20722-001 PC 100	
89	Flat Washer	2	20722-001 PC 94	
90	Nut Self-Locking Hex	2	20722-001 PC 107	
91	Flat Washer	2	20722-001 PC 95	
92	Sch Capscrew	2	20722-001 PC 71	
93	Clamp, Support	1	20722-001 PC 104	
94	Setscrew Half Dog	1	20722-001 PC 83	
95	Cam	1	20722-001 PC 26	
96	Gasket	1	20722-001 PC 32	
97	End Plate	1	20722-001 PC 21	
98	Screw Sleeve	4	20722-001 PC 29	

Table 5-6-15. Hatch & Flood/Drain Valve Control Valve (Continued)

(Refer to Figure 5-6-14)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
99	Twist Hd Capscrew	4	20722-001 PC 28	
100	Flat Washer	4	20722-001 PC 93	
101	Sch Capscrew	4	20722-001 PC 70	
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-16. Hatch And Flood/Drain Valve Adjustors (Manifold)

(Refer to Figure 5-6-15)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Manifold Assy		20938-400	
1	Plug Hex Hd	2		
2	O-Ring	2		M83428/2-912
3	Capscrew	4	20722-001 PC 78	
4	Flat Washer	4	20722-001 PC 99	AN 960-616
5	Ferrule	4	20938-400 PC 23	
6	O-Ring	8	20938-400 PC 32	M83428/1-114
7	Back-up	8	20938-400 PC 41	MS28782-12
8	Slide/Sleeve Matched Set	1	20938-400	
9	Slide/Sleeve Matched Set	1	20938-400	
10	Quiet Element	1	20938-400	
11	End Cap	1	20938-400	
12	Washer	1	20938-400	
13	Cover	2	20938-400	
14	End Cap	1	20938-400	
15	Capscrew	8	20938-400	
16	Locknut	2	20938-400	
17	O-Ring	1	20938-400	M83428/1-012
18	O-Ring	1	20938-400	M83428/1-112
19	O-Ring	1	20938-400	M83428/1-126
20	O-Ring	1	20938-400	M83428/1-220
21	O-Ring	1	20938-400	M83428/1-222
22	O-Ring	2	20938-400	M83428/2-910
23	Backup	2	20938-400	MS28782-7
24	Backup	2	20938-400	MS28782-10
25	Backup	2	20938-400	MS28774-126
26	Backup	2	20938-400	MS28782-25
27	Backup	2	20938-400	MS28782-27
Check Ship’s Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-17. Flood/Drain Valve Rotary Actuator

(Refer to Figure 5-6-16)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Rotary Actuator *		704-5483999	
			258761	
1	Actuator Body *	1	704-5483999 PC 3	
			258761 PC 3	
2	Bearing	1	704-5483999 PC 4	
3	Piston Rack *	1	704-5483999 PC 5	
			258761 PC 5	
4	Pinion *	1	704-5483999 PC 6	
			258761 PC 6	
5	Bearing Cap *	1	704-5483999 PC 7	
			258761 PC 7	
6	Slflkg Capscrew *	2	704-5483999 PC 11	
			258761 PC 11	
7	Slflkg Capscrew *	2	704-5483999 PC 12	
			258761 PC 12	
8	Slflkg Capscrew *	4	704-5483999 PC 13	
			258761 PC 13	
9	Scraper Ring *	1	704-5483999 PC 16	
			258761 PC 16	
10	O-Ring *	1	704-5483999 PC 19	M83461/1-114
			258761 PC 19	
11	Backup Ring *	2	704-5483999 PC 20	MS28782-12
			258761 PC 20	
12	O-Ring *	2	704-5483999 PC 21	M83461/1-213
			258761 PC 21	
13	Backup Ring *	4	704-5483999 PC 22	MS28782-18
			258761 PC 22	
14	O-Ring *	1	704-5483999 PC 23	M83461/1-217
			258761 PC 23	
15	O-Ring *	1	704-5483999 PC 24	M83461/1-225
			258761 PC 24	
16	Check Valve *	1	704-5483999 PC 27	
			258761 PC 27	
17	Backup Ring Retainer*	2	704-5483999 PC 30	MS28782-22
			258761 PC 30	
18	Backup Ring Retainer*	2	704-5483999 PC 29	MS28783-3

Table 5-6-17. Flood/Drain Valve Rotary Actuator (Continued)

(Refer to Figure 5-6-16)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
			258761 PC 29	
19	End Cap *	1	704-5483999 PC 31	
			258761 PC 35	
20	Capscrew *	4	704-5483999 PC 32	
			258761 PC 36	
21	O-Ring *	2	704-5483999 PC 34	M83461/1-120
			258761 PC 38	
22	Backup Ring Retainer*	4	704-5483999 PC 35	MS28774-120
			258761 PC 39	
23	Washer *	4	704-5483999 PC 33	
			258761 PC 37	
24	Spacer *	2	704-5483999 PC 10	
25	SLFLKG Capscrew *	4	704-5483999 PC 15	
			258761 PC 36	
26	Washer *	4	704-5483999 PC 17	
			258761 PC 17	
27	SLFLKG Capscrew *	2	704-5483999 PC 14	
28	Cover *	1	704-5483999 PC 25	
			25861 PC 25	
29	Slflkg Setscrew *	1	704-5483998 PC 28	
			258761 PC 34	
30	Tab *	2	704-5483999 PC 40	
	Washer	2	258761 PC 17	
31	Slflkg Screw *	2	704-5483998 PC 26	
			258761 PC 31	
32	Spacer *	2	704-5483998 PC 29	
			258761 PC 33	
33	Magnet U-shape *	2	704-5483998 PC 25	
			258761 PC 26	
34	Holder, Magnet *	1	704-5483998 PC 24	
			258761 PC 32	
	Switch, Magnetic	1	6557925	
	Rubber Isolation Membrane (Not Shown)	1		SK055
	O-Ring (Not Shown)	1		M83461/1-220

Asterisk (*) applicable to SSN 719 and 720
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.

Table 5-6-18. Pressurization/Vent Control Valve

(Refer to Figure 5-6-17)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Pressurization/Vent Valve Control Valve		S1E10106	
1	Body	1	S1E10106 PC 1	
2	Seat Retainer	1	S1E10106 PC 2	S2C10303-7NA
3	Transfer Tube	1	S1E10106 PC 3	S2C10304-01
4	Poppet	1	S1E10106 PC 7	
5	Spring	1	S1E10106 PC 8	
6	Sleeve	1	S1E10106 PC 9	
7	Stroke Adjustor	1	S1E10106 PC 10	S2B10212-3TA
8	Transfer Tube	1	S1E10106 PC 11	S2C10304-02
9	Slflkg Hex Nut	1	S1E10106 PC 12	S2B10215-3AA
10	Cap	1	S1E10106 PC 13	S2C10306-6NA
11	Stroke Stop	1	S1E10106 PC 14	S2B10213-6NA
12	Slflkg Hex Nut	1	S1E10106 PC 15	S2B10216-3AA
13	Cap	1	S1E10106 PC 16	S2D10450-6NA
14	Spring	1	S1E10106 PC 17	S2B10217-8RA
15	Poppet	1	S1E10106 PC 18	S2D10451-8DA
16	Sleeve	1	S1E10106 PC 19	S2E10134-6NA
17	Disc Assembly	1	S1E10106 PC 23	S3D10044-01
18	Disc Assembly	1	S1E10106 PC 24	S3D10043-01
19	Seat Retainer	1	S1E10106 PC 25	S2C10307-7NA
20	Seat	1	S1E10106 PC 26	S2B10218-TB
21	Seat	1	S1E10106 PC 27	S2B10219-TB
22	Cushion	1	S1E10106 PC 28	S2B10220-TB
23	Cushion	1	S1E10106 PC 29	S2B10221-NN
24	Solenoid Valve	1	S1E10106 PC 30	S1D10025-01
25	Solenoid Valve	1	S1E10106 PC 31	S1D10025-02
26	Slflkg Hex Hd Bolt	4	S1E10106 PC 32	V2C12204-46
27	Slflkg Hex Hd Bolt	10	S1E10106 PC 33	V2C12204-09
28	Slflkg Hex Hd Bolt	4	S1E10106 PC 34	V2C12203-14
29	Slflkg Sch Capscrew	1	S1E10106 PC 37	S2B10222-8BA
30	Slflkg Sch Capscrew	5	S1E10106 PC 38	V2C11113-3NLO
31	O-Ring	4	S1E10106 PC 39	M83461/1-010
32	O-Ring	1	S1E10106 PC 40	M83461/1-112

Table 5-6-18. Pressurization/Vent Control Valve (Continued)

(Refer to Figure 5-6-17)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
33	O-Ring	1	S1E10106 PC 41	M83461/1-115
34	O-Ring	1	S1E10106 PC 42	M83461/1-133
35	O-Ring	1	S1E10106 PC 43	M83461/1-117
36	O-Ring	1	S1E10106 PC 44	M83461/1-214
37	O-Ring	1	S1E10106 PC 45	M83461/1-228
38	O-Ring	1	S1E10106 PC 46	M83461/1-229
39	O-Ring	1	S1E10106 PC 47	M83461/1-231
40	O-Ring	1	S1E10106 PC 48	M83461/1-241
41	O-Ring	1	S1E10106 PC 49	M83461/1-225
42	O-Ring	2	S1E10106 PC 50	M83461/1-114
43	O-Ring	2	S1E10106 PC 51	M83461/1-138
44	Setscrew	2	S1E10106 PC 52	
45	Skt Setscrew	1	S1E10106 PC 53	
46	Transfer Tube	4	S1D10025 PC 16	
47	Sch Capscrew	4	S1D10025 PC 29	V2C11116-7NLO
48	O-Ring	4	S1D10025 PC 36	M83461/1-010
49	O-Ring	1	Not Shown	M83461/1-112
50	Body	1	S1D10025 PC 1	
51	Seat	2	S1D10025 PC 2	S2B10223-TB
52	Seat Retainer	1	S1D10025 PC 3	S2C10264-3TA
53	Poppet	1	S1D10025 PC 4	S2D10453-4MF
54	Sleeve	1	S1D10025 PC 5	S2C10308-3T2
55	Gland	1	S1D10025 PC 6	S2C10309-3EF
56	Stem	1	S1D10025 PC 9	S2B10224-3TA
57	Spring	1	S1D10025 PC 21	S5B10267-3BA
58	Washer	1	S1D10025 PC 27	S2B10229-3AA
59	Capscrew	6	S1D10025 PC 30	V2C11114-6NLO
60	O-Ring	3	S1D10025 PC 35	M83461/1-006
61	O-Ring	3	S1D10025 PC 37	M83461/1-016
62	Backup	4	S1D10025 PC 41	MS28774-006
63	Backup	6	S1D10025 PC 42	MS28774-016
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-19 Pressurization/Vent Hull Stop Isolation Valve

(Refer to Figure 5-6-18)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Pressure/Vent Hull Stop			
1	Nut	1	5580582-0018	
2	Washer	1	5580582-0019	
3	Handle	1	5580582-0035	
4	Bolt Break-Away	4	5765849-0026	
5	Cover	1	5765849-0001	
6	Bolt Lock	1	5765849-0019	
7	Upper Spacer	1	5765849-0022	
8	Cam Stop	1	5765849-0020	
9	Lower Spacer	1	5765849-0021	
10	Retaining Nut	1	5580582-0012/0013	
11	Thrust Washer	2	5580582-0014	
12	Stem	1	5580582-0032/0033	
13	Key	1	5765849-0027	
14	Cap Screw	1	5765849-0032	
15	Bracket	1	5765849-0026	
16	Screw, Flat Head	1	5765849-0033	
17	O-Ring	1	5580582-0025	M83461/1-210
18	Pin Stop	1	5765849-0023	
19	Nut	5	5580582-0017/0018	
20	Bonnet	1	5580582-0030/0031	
21	O-Ring	1	5580582-0024	M83461/1-340
22	Retaining Ring	2	5580582-0011	
23	Seat	2	5580582-0010	
24	Ball	1	5580582-0009	
25	Dowel Pin	1	5580582-0026	
26	Stud	5	5580582-0037/0038	
27	Set Screw (jacking screw)	2	5580582-0021	
28	Body	1	5580582-0001/0002/ 0003/0004	
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-20 Dewpoint Sensor

(Refer to Figure 5-6-19)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Dewpoint Sensor		7161-8	
1	Body	1	513-4456578 PC 89	
2	O-Ring	1	7161-8 PC 12	MS23773-10
3	Sensor Element	1	7161-8 PC 6	9643-2
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-21. Missile Tube Preece Fitting and Pressure Cap

(Refer to Figure 5-6-20)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	Male Nipple (Preece)	1	704-5755257 PC 99	
	*	1	704-5483949	
	Extended Reach (Preece)			For Extended Reach Preece contact NUWCDIVNPT Code 4124
1	Body	1		
2	O-Ring	1	704-5755257 PC 100	M83461/2-906
	*	1	704-5483949 PC 10	M83461/2-906
3	O-Ring	1		M83461/1-18
4	Spring Base	1		
5	Spring	1		
6	Poppet	1		
7	Nipple	1		
8	O-Ring	1		M83461/1-014
9	Pressure Cap	1	6510943	
Asterisk (*) applicable to SSN 719 and 720 Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-22. Retention Segments

(Refer to Figure 5-6-21)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
	AUR Retention Segments and Bolts		704-6016953	
	AUR Retention Segments and Bolts *		704-5768612	
1	Slflkg Capscrew	3	704-6016953 PC 4	
	*	3	704-5768612 PC 5	
2	Clamp	3	704-6016953 PC 3	
	*	3	704-5768612 PC 4	
3	Jacking Screw	16	704-6016953 PC 2	
	*	16	704-5768612 PC 2	
4	Retention Segment	8	704-6016953 PC 1	
	*	8	704-5768612 PC 1	
Asterisk (*) applicable to SSN 719 and 720 Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-23. Magnetic Switches and Mounting Hardware (Typical)

(Refer to Figure 5-6-22)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
1	Magnetic Switch (Hatch Open /ITL/ CAC)	2	6557947	All SSN 688 CL VLS
	Magnetic Switch (Ruggedized)	3 2	6557926	SSN 719 – 723 and 750 SSN 724, 725, 751 and later
	Magnetic Switch (Ruggedized)	1	6557925	SSN 724, 725, 751 and later (Hatch Shut Only)
2	Rubber Isolation Membrane	5		SK055
3	O-Ring	5		M83461/1-220
4	Socket, Head Capscrew	4	704-5795318 PC 19	Hatch Open, Intent-to-Launch
		2	704-5765850 PC 21	Hatch Shut
	RD-HD Machine Screw	2	704-6294477 PC 54	Fairing Lock Mechanism
		2	704-5483998 PC 26	Flood/Drain Valve
5	Spacer	2	704-6294477 PC 35	Fairing Lock Mechanism
		2	704-5483998 PC 29	Flood/Drain Valve
		6	704-5795318 PC 15	Hatch Open, ITL, CAC Hatch Shut
		2	704-5765850 PC 22	Hatch Shut (SSN 719,720)
6	Magnets	10	6510875	
7	Magnet Tab	4	5483954-48	Hatch Open, Intent-to-Launch
8	Spacer	4	704-5795402	Hatch Open, Intent-to-Launch (SSN 721-723, 750 and Later)
		4	704-5483954	Hatch Open, Intent-to-Launch (SSN 719, 720, 724 & 725)
		2	704-5483956 PC 8	Hatch Shut
		2	704-6294477 PC 36	Fairing Lock Mechanism

Table 5-6-23. Magnetic Switches and Mounting Hardware (Typical) (Continued)

(Refer to Figure 5-6-22)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
9	Nut, Selflocking	2	704-6294477 PC 50	Fairing Lock Mechanism(Tubes 5, 6, 7, 8, 9, 10, 13 & 14)
		2	704-6294477 PC 49	Fairing Lock Mechanism (Tubes 11, 12, 15 & 16)
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-24. Pressure Monitoring Test Rig and Emergency DPT Pressure Gage Assembly (SSN 751 & Later)

(Refer to Figure 5-6-23)

ITEM	DESCRIPTION	QTY	VENDOR/NAVSEA DRAWING #	REMARKS
1	Case, Instrument	1	6510871 PC 1	
2	Gage, Pressure(0-15 PSI)	1	6510871 PC 2	
3	Valve, Plug	1	6510871 PC 3	
4	Coupler, Hose.150 NPT (INT)	1	6510871 PC 4	
5	Reducer, Pipe	2	6510871 PC 5	
6	Elbow, Pipe(Street Elbow 90)	1	6510871 PC 6	
7	Tee, Pipe	1	6510871 PC 7	
8	Nipple, Pipe	1	6510871 PC 8	
9	Recoil Air Hose2-200 PSI	1	6510871 PC 9	
10	Valve, Safety	1	6510871 PC 10	
11	Mounting Plate	1	6510871 PC 11	
12	Screw, Pan Hd,Cres, .190-32UNF-2A	3	6510871 PC 13	
13	Gage, Pressure	1	6557885 PC 3	
14	Tee, Pipe	1	6557885 PC 5	
15	Valve, Safety	1	6557885 PC 2	
16	Hose, Air	1	6557885 PC 1	
17	Coupling, Hose	1	6557885 PC 4	
18	Washer, Thrust, Insulator Assembly	1	6557914	
19	Ring, Threaded, Insulator Assembly	1	6557914	
20	Contact Assy Size 16 Double Socket Pec Control Drawing	85	6557914	
21	Insulator, Rear	1	6557914	
22	Insulator, Front	1	6557914	
23	4. 112-24x1.00 Type AB Slotted Pan Hd Tapping screw Cres Passivated		6557914	
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.				

Table 5-6-25. VLS Supporting Allowance Parts Lists/Allowance Equipment List (APL/AEL)

Component	APL/AEL Number
Fairing Connecting Linkage	3172700016 thru 317270039
Fairing Locking Hydraulic Cylinder SSN 721 & Later	520560090 or 520560091
Muzzle Hatch T-Bar Lock Mech SSN 719 and 720	317080535 thru 317080546
Muzzle Hatch & Muzzle Hatch Operating Mechanism SSN 719, 720, 724 and 725	317080532 thru 317080534
Muzzle Hatch & Muzzle Hatch Operating Mechanism SSN 721, 722, 723 & 750	 317270015
Muzzle Hatch & Hatch Fairing Gaskets SSN 721 and Later	317270015 317080532 thru 317080534
Muzzle Hatch & Fairing Rotary Actuator	524000001 and 524000002
Environmental Monitoring Sensor SSN 719 SSN 720 and Later	317080531 317270014
Umbilical Penetrator SSN 719	890043023
Pressurization/Vent Plug SSN 719 & 720	317080531
Pressurization/Vent Filter SSN 722 SSN 750	890043026 890043026 890043030
Differential Pressure Transducer Type 3	611680027
VLS Hydraulic Accumulator	524540001
Missile Tube Shock Lands and Alignment Pins SSN 720 and Later SSN 719 & 720	 317270014 317080531
Hatch & Flood/Drain Valve Control Valve	882236174
Hatch & Flood/Drain Valve Adjustors (Manifold)	882352993
Flood/Drain Valve Rotary Actuator	524000003 or 520560073
Pressurization/Vent Valve Control Valve	88A980004
Dewpoint Sensor SSN 719 - 720 SSN 724 – 725	890043023 and 890043024 890043028 and 890043029
Preece Fitting SSN 719 & 720 SSN 721 & Later SSN 722 SSN 750	317080531 317270014 890043026 890043030
Pressure Cap	C-920013163
AUR Retention Segments	317080531
Pressure Monitoring Test Rig	C-920013163
Platform Interlock Fitting Hull Receiver	C-920013163
Muzzle Hatch Gagging Pin	999230397
Insert Assembly 85 Pin	999230397
NOTE: Actual APL number may vary from boat to boat. Verify correct APL number when ordering parts.	

Table 5-6-26. Miscellaneous Parts Identification

DESCRIPTION	NSN/MS NO.
Alcohol (Antifreeze)	6505-00-104-9000
Bulkhead Grommet Assembly	6557923
Bulkhead Gland Ring	6557943-2
Cable Clamp	5342-01-277-4530
Connector Set, Electrical (new Connectorized Box)	5935-01-471-0994
D/P Transducer All Pipe Connection O-Rings Electrical Connection O-Ring	 M83461/1-018 M83461/1-220
Delta "P" Plug O-ring	M83461/2-906
Delta "P" Plug	5365-01-208-8262
Differential Pressure (AN/BSY-1 and MTCP BUD) Transducer Assy -3 Current Loop	 6695-01-386-9734
EMS Connector O-Ring	M83461/1-329
EMS Cover	5935-01-444-6700
EMS Screw	5305-00-390-0591
Hatch Block Micro Switch	5930-00-868-4223
HMLP(S)-23 Special Test Fitting	Dwg. #7378591
HMLP(S)-23 Special Test Fitting O-Ring	M83461/1-111
HMLP(S)-23 Special Test Fitting Back-Up	MS28782-9
HMLP(S)-21 Drain Plug O-Ring	M83461/2-912
Magnetic Switch	5930-01-452-9578
Magnetic Switch	5930-01-452-9533
Magnetic Switch (Hatch Open/ITL/CAC)	5930-01-467-1871
Magnets	5340-01-201-4578
Missile Tube Receptacle O-ring	M83461/1-235
O-Ring for Electrical connector on magnetic switch	M83461/1-220
Platform Interlock Fitting Hull Receiver	Pt #96169-R12941-1C
P/V Filter -1 -2	4330-01-437-8918 4330-01-436-7143
P/V Filter O-ring -1 -2	M83461/1-224 M83461/1-227
Segment Assembly	1440-01-325-1580
Tar-Sat Paint (1 gallon)	8030-01-125-9473
Tar-Sat Paint (5 gallon)	8030-01-124-9761
Umbilical/Security Cap O-ring	M83461/1-238
Umbilical Ratcheting Wrench	5120-01-333-3178
Y-Strainer O-ring (Outer)	MS28775-225
Y-Strainer O-ring (Inner)	MS28775-131

Table 5-6-26. Miscellaneous Parts Identification (Continued)

DESCRIPTION	NSN/MS NO.
Fairing Lock Cylinder - O-Rings C-1 C-2 C-3	 M83461/1-020 M83461/1-020 M83461/1-018
Fairing Lock Cylinder Back-ups (if required) C-1/C-2 C-1/C-2 (ShipAlt 4292K) C-3 C-3 (ShipAlt 4292K)	 MS28774-020 8-020 N0300-90 MS28774-018 8-018 N0300-90
Muzzle Hatch Actuator O-Rings C-1 C-2 C-3 (small) C-3 (large)	 M83461/1-218 M83461/1-223 M83461/1-215 M83461/1-223
Muzzle Hatch Actuator Back-ups C-1 C-2	 MS28774-218 MS28774-223
Flood/Drain Valve Actuator O-Rings C-1 C-2 C-3 (small) C-3 (large)	 M83461/1-117 M83461/1-120 M83461/1-215 M83461/1-223
Flood/Drain Valve Actuator Back-ups C-1 C-2	 MS28774-117 MS28774-120
30 Conductor Cable O-Ring	M83461/1-329
Rubber Isolation Membrane (SK070) 6 Pin	5342-01-452-6542
Rubber Isolation Membrane (SK055) 7 Pin	5342-01-452-6537
Rubber Isolation Membrane (SK069) 30 Pin	5342-01-452-6539
MBT #3 O-Ring	5330-01-006-2113
MBT #3 Cap Screw 5/8 – 11	5305-01-363-8473 5305-LL-H84-2529
MBT #3 Cap Screw 1/2 - 11	5305-LL-H84-2530
MBT #2 O-Ring	5331-01-006-0320
MBT #2 Cap Screw 5/8 – 11 UNC-3A x 1 ½ LG NICUAL (QQ-N-286)	123-58586-82 REV B
Preece Fitting	4730-01-273-1318
Extended Reach Preece	For Extended Reach Preece contact NUWCDIVNPT Code 4124
Preece Fitting O-Rings External Internal (Body) Internal (Poppet)	 M83461/2-906 M83461/1-18 M83461/1-014
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.	

Table 5-6-27. SHIPALTS/A&Is

SHIPALT/A&I ETC.	REMARKS
A&I 1925 - MSL Tube Cooling System Adapters.	Allows the installation of a standard 1 1/2" fire hose.
A&I 1953 - VLS Pressure/Vent Filters	Installed during Pressure/Vent system operation to prevent contamination.
A&I 1977 - Pilot Valve Cartridge Modification	Went from eight land to four land cartridge (5 digit serial number)
A&I 1993 - VLS Hatch Scribe Marks.	Installed on hatch torque arm for testing of the ITL switch.
A&I 3199 - Ruggedized Magnetic Switches.	Incorporates new mag switches wired in parallel for improved reliability.
A&I 3170 - P/N Savers	Prevents damaging the pins on the pig-tail of the Electrical Hull Penetrator.
A&I 4068D – MBT 3 A/B Access.	Allows for replacement of Weapon Control Cable and Tube Control Cable while waterborne.
A&I 3131 – Modified P/V Filters.	Reposition the O-ring groove to allow for better sealing.
A&I 3194 – New Muzzle Hatch Gagging Pin.	Improved strength for safety
SHIPALT 3633K - Aluminum Flame Spray of counterbore area.	Replaces the tar-sat paint on the counterbore area.
SHIPALT 3648K - MSL Tube Block-Update for P/V Control SHIPALT.	Moves the P/V control function from the MIC to MTCP. Replace voltage loop D/P transducers with current loop D/P transducers.
SHIPALT 3799D - VLS Gravity Drain Mods.	Eliminates back flow of gravity drains, which causes shorting of cables.
SHIPALT 3938F - HML-22 Control Valve Pilot Valve (Ball-Pilot) Replacement.	Replaces Slide - Sleeve cartridge with a Ball Pilot cartridge.
SHIPALT 3936K - VLS Self Lubricated Bearing.	Replaces existing bearings with Karon V bearings.
SHIPALT 3940D - MSL Tube Quick Disconnect (Preece Fitting) Pressure Cap.	Eliminates the need to remove the Preece fitting and installing the Delta-"P" plug when a missile is not loaded.
SHIPALT 3942F - VLS gagging pin hole modification.	Allows gagging pin to pass through the hinge arm hub and torque shaft to engage gagging block.
SHIPALT 3941D - Environmental Monitoring Sensor Cover.	Replaces the solid EMS Cover with a permanently mounted slotted cover.

Table 5-6-27. SHIPALTS/A&Is (Continued)

SHIPALT/A&I ETC.	REMARKS
SHIPALT 3939KP - Tube Control Panel (TCP) Upgrade.	a. Eliminate vertical PVC loss of Pressure In Band signal. b. Provide override to Missile Tube Alarms on empty tubes. c. Improve air filter replacement. d. Display Missile Differential Pressure in Monitor.
SHIPALT (Advance) A3989K - Install Hull Access Plates outboard of MSL Tube 15 & 16 (class arrangement).	Affords access for the repair of missile tubes #15 and 16 muzzle hatch actuators for maintenance.
SHIPALT 4111D – New 56 Conductor Weapon Control Cable.	a. Has a thicker outer insulating jacket. b. Reduced number of conductors from 85 – 56. c. Routes the CAC signal instead of ITL. d. Add split grommet and ring.
SHIPALT 4293 KP- Tube Control Panel (TCP) Phase II Upgrade.	a. Correct DC Power Distribution deficiencies b. Added Power Supply Test Connector c. Incorporates outboard circuit isolation card
SHIPALT 4292K - Fairing Hatch and Linkage Upgrade	a. Replaces fairing gasket with six (6) adjustable stops. b. Modifies fairing connecting linkage. c. Replaces fairing locking bar bushings with Orkot bearings. d. Modifies fairing lock cylinder.
Check Ship's Drawing Index (SDI) for the applicability of listed NAVSEA drawings and Technical Variance Documents (TVDs) for the applicability of listed NAVSEA drawings.	

Table 5-6-28. Miscellaneous Connector/Receptacle Caps.

DESCRIPTION	CAPS		NSN NO.
	Protective	Pressure Proof	
Missile Tube Penetrator	2983/2-004	2983/7-100	
Weapon Control Cable	2983/3-003	2983/6-100	
Environmental Monitoring Sensor Cable	M24231/4-012	M24231/4-020	
Environmental Monitoring Sensor Cable	M24231/4-011 (Plastic, PVC)	M24231/4-011 (Ni-Al-BRZ)	
Connectorized Box Cables (7 Pin)	*M24231/3-012 (Plastic, PVC)	M24231/4-020 (Ni-Al-BRZ)	*5935-00-070-9482
Connectorized Box Cables (30 Pin)	*M24231/4-012 (Plastic, PVC)	M24231/3-020 (Ni-Al-BRZ)	
Electrical Hull Penetrator (Tube Control)	M24231/14-011 (Plastic, PVC)	*M24231/14-011 (Ni-Al-BRZ)	
Electrical Hull Penetrator (Weapon Control)	2982/1-005	2982/1-005	
Magnetic Switch	*M24231/3-012	M2423/3-020	*5935-00-070-9482
Connectorized Box (7 Pin)	M24231/13-011 (Plastic, PVC)	*M24231/13-011 (Ni-Al-BRZ)	*5935-00-070-9487
Connectorized Box (30 Pin)	M24231/14-011 (Plastic, PVC)	*M24231/14-011 (Ni-Al-BRZ)	*5935-01-061-4628

*Associates Part Number with NSN.

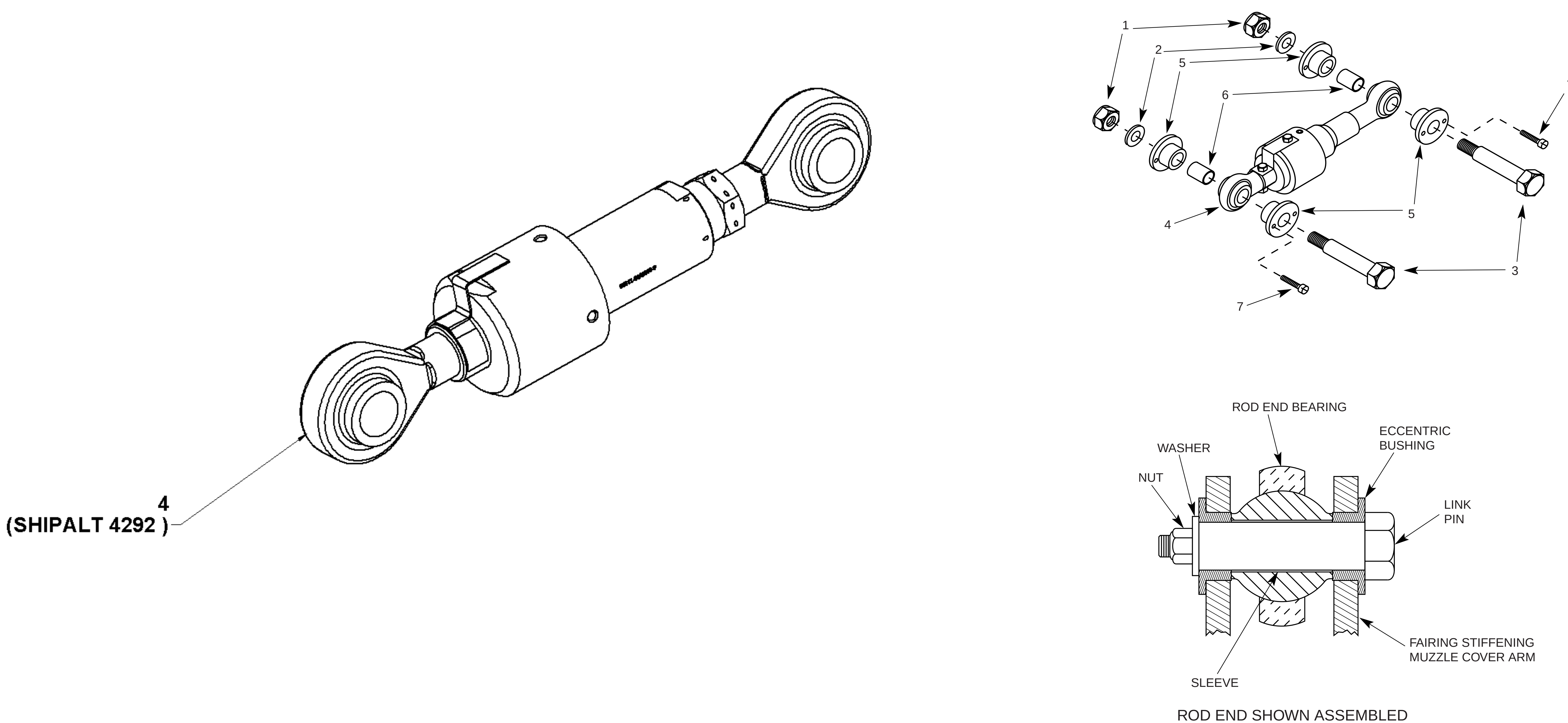


Figure 5-6-1. Fairing Connecting Linkage

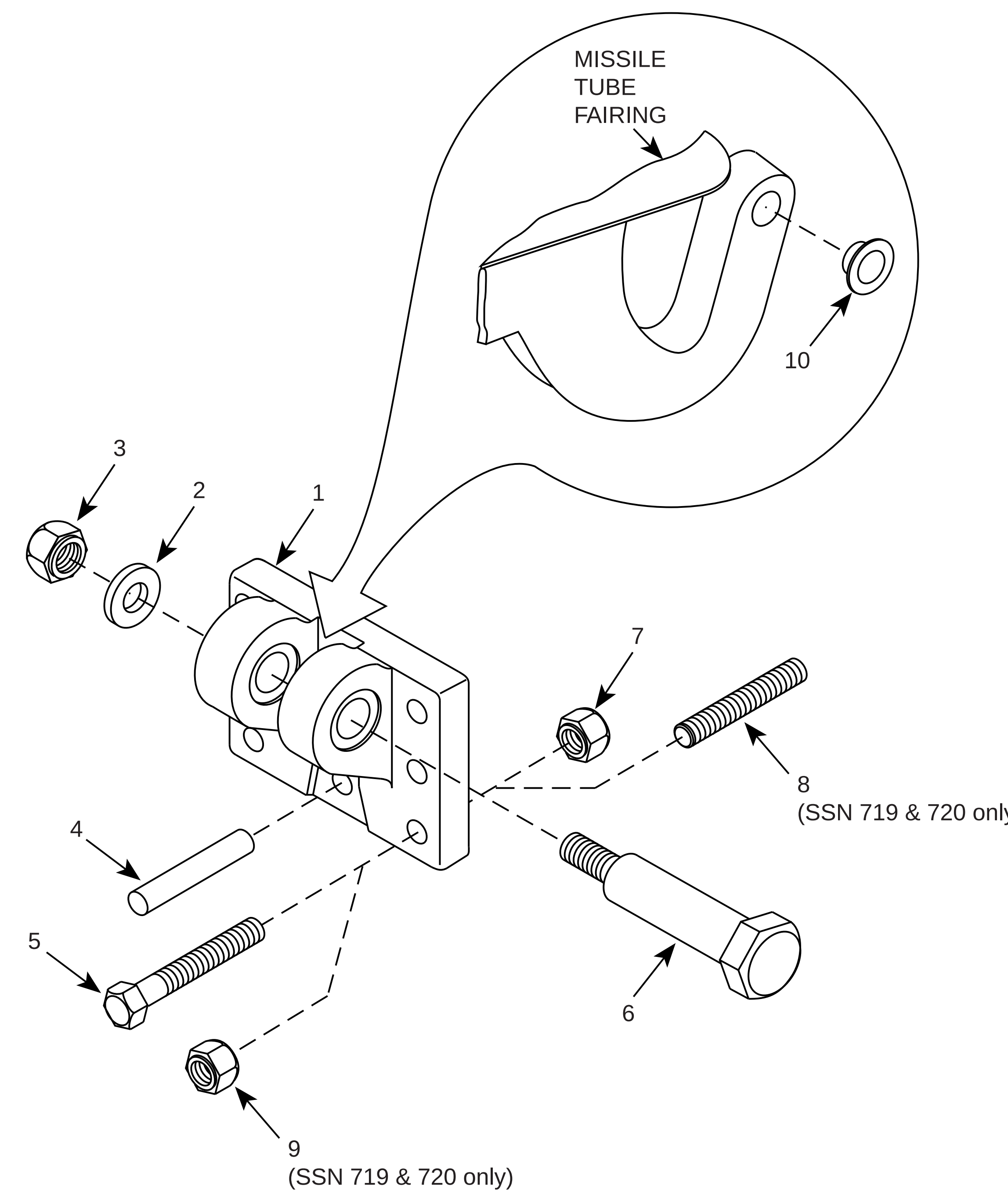


Figure 5-6-2. Fairing Hinge Bracket

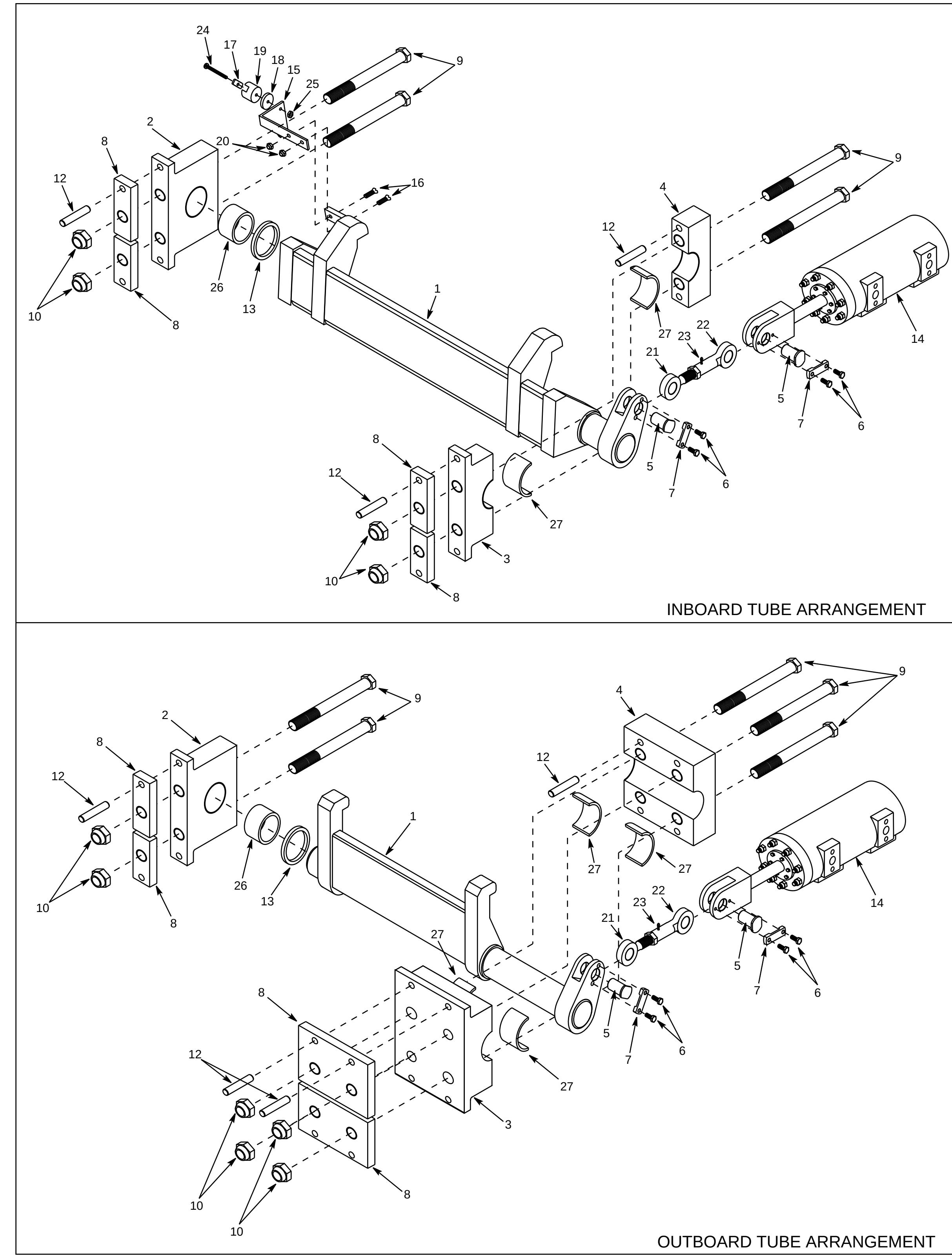


Figure 5-6-3. Fairing Locking Mechanism (SSN 721 and Later)

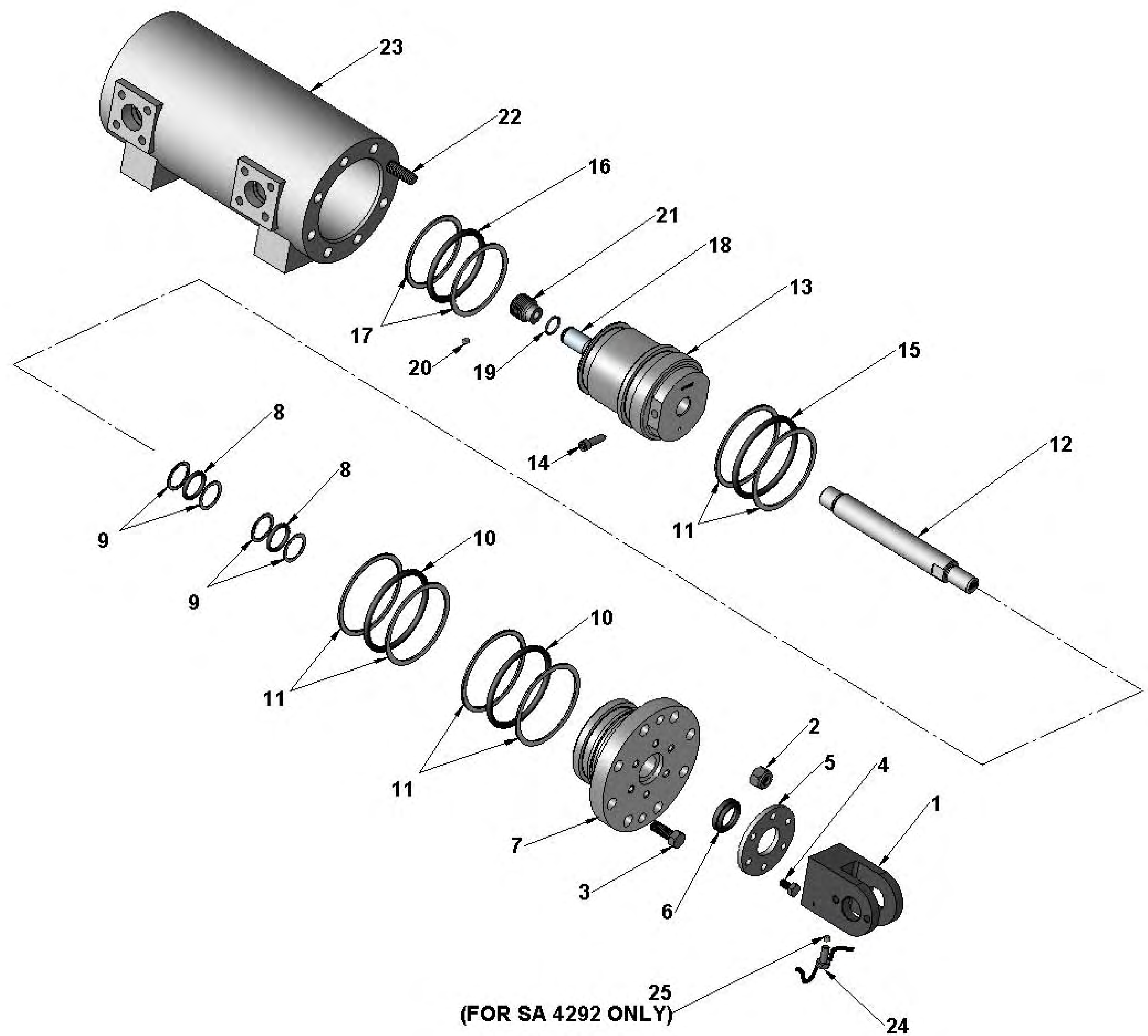


Figure 5-6-4. Fairing Lock Hydraulic Cylinder (SSN 721 and Later)

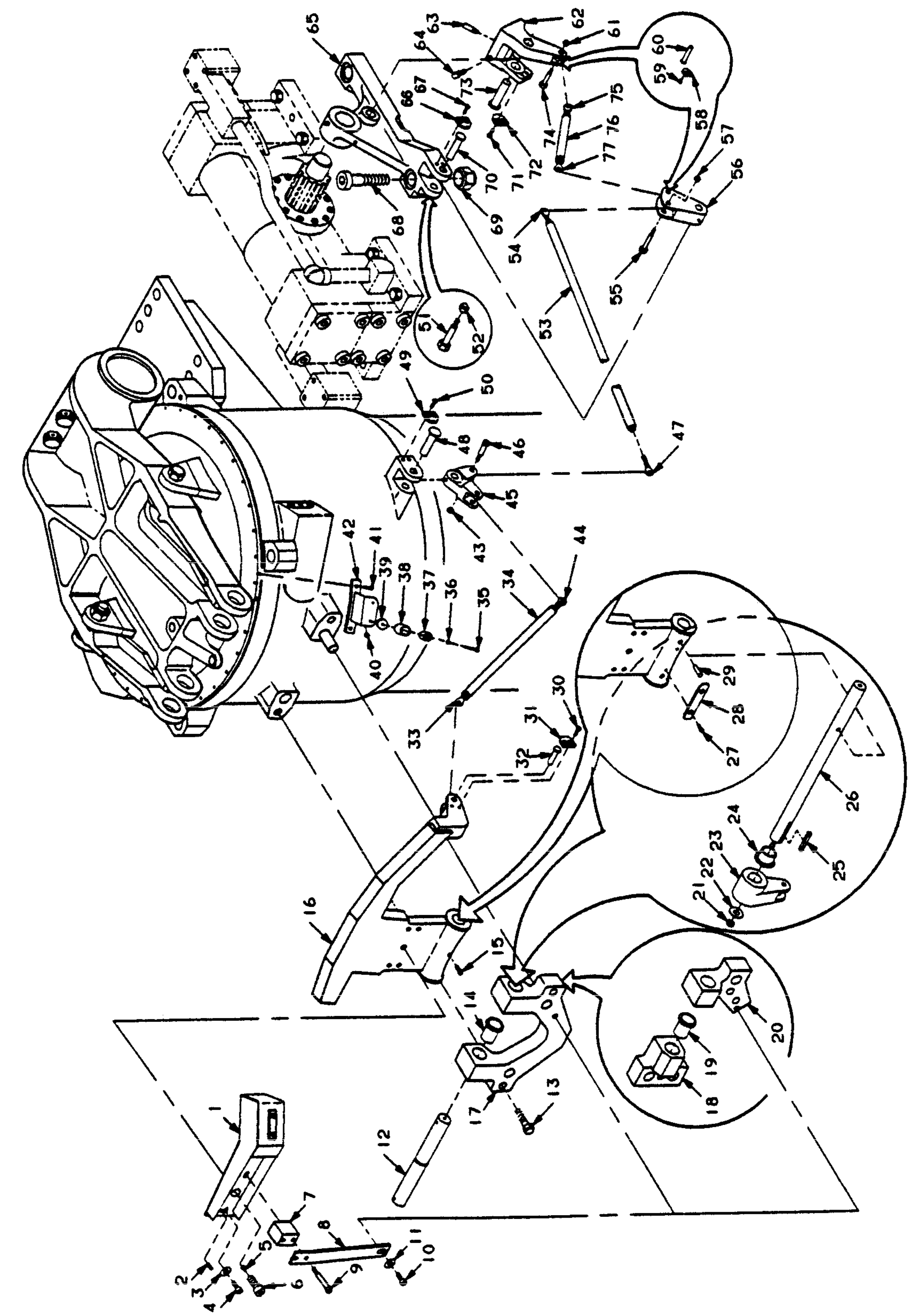


Figure 5-6-5. Muzzle Hatch T-Bar Locking Mechanism (SSN 719 and 720)

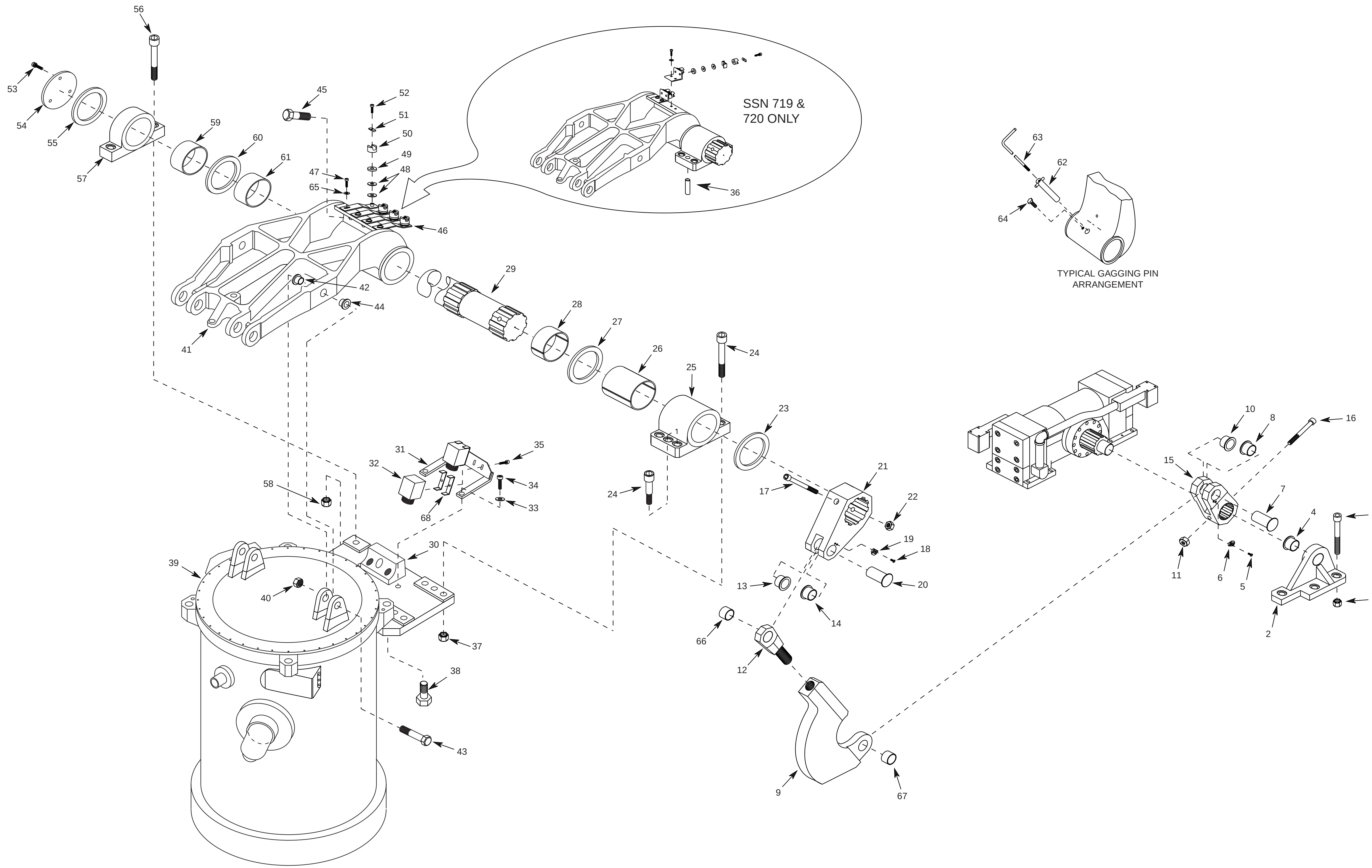
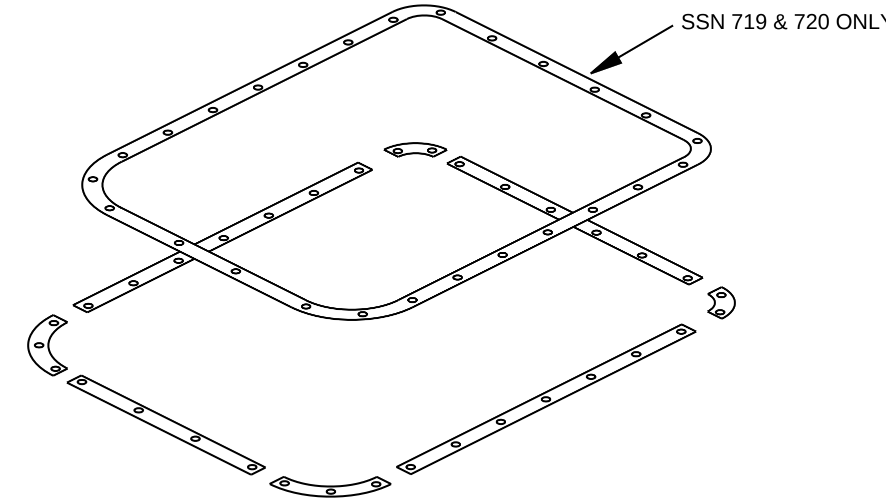
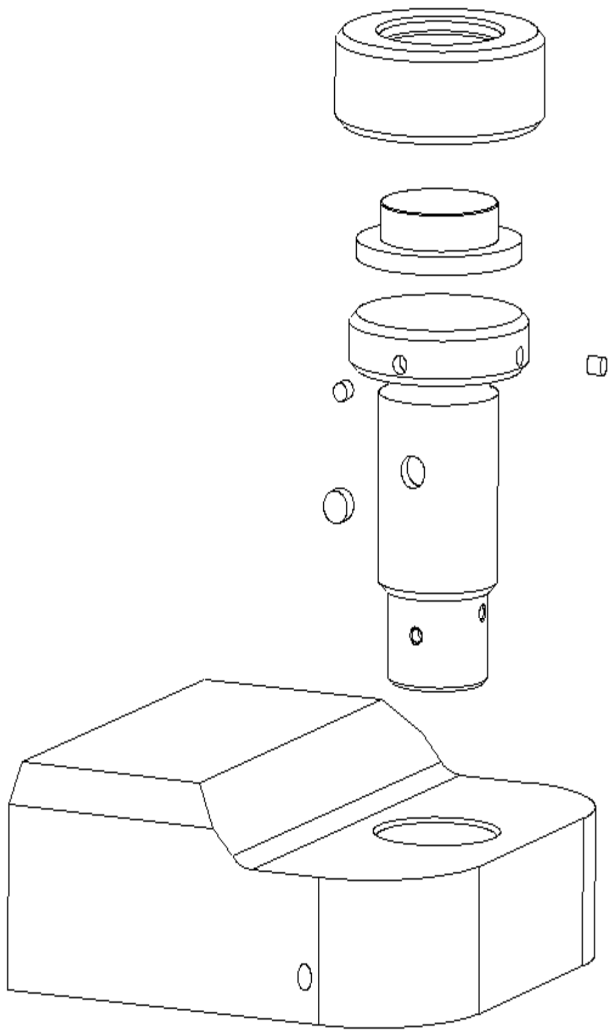


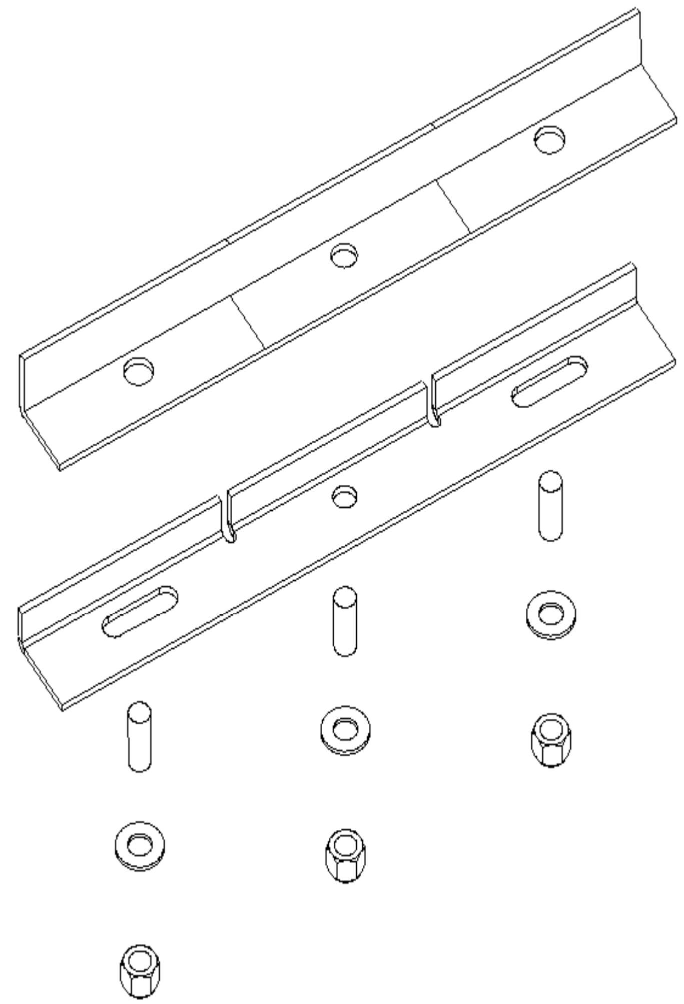
Figure 5-6-6. Muzzle Hatch and Muzzle Hatch Operating Mechanism



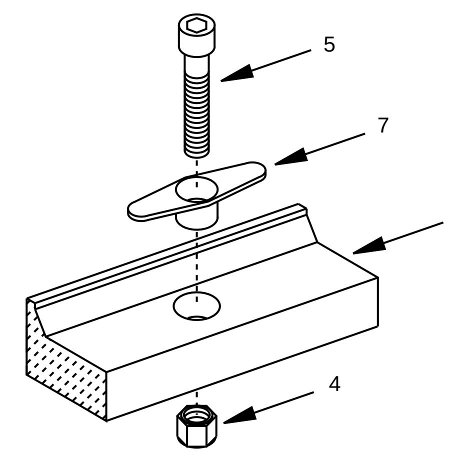
FAIRING GASKET (PERSPECTIVE PLAN VIEW)



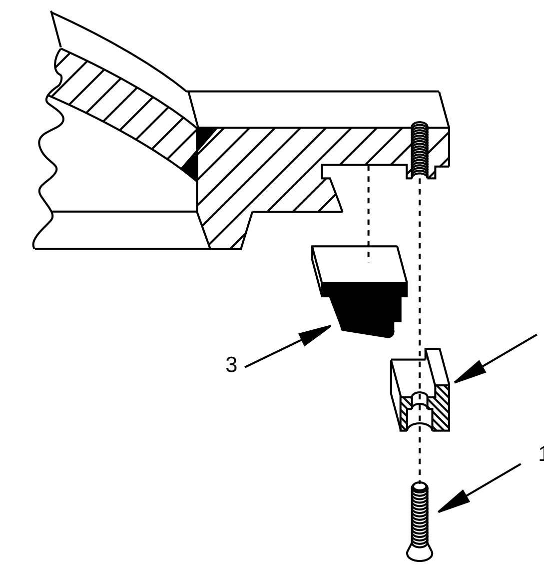
SHIPALT 4292 ADJUSTABLE STOP



SHIPALT 4292 GASKET SEGMENT



FAIRING GASKET (SECTIONAL VIEW)



MUZZLE HATCH GASKET (SECTIONAL VIEW)

Figure 5-6-7. Muzzle Hatch and Fairing Gaskets

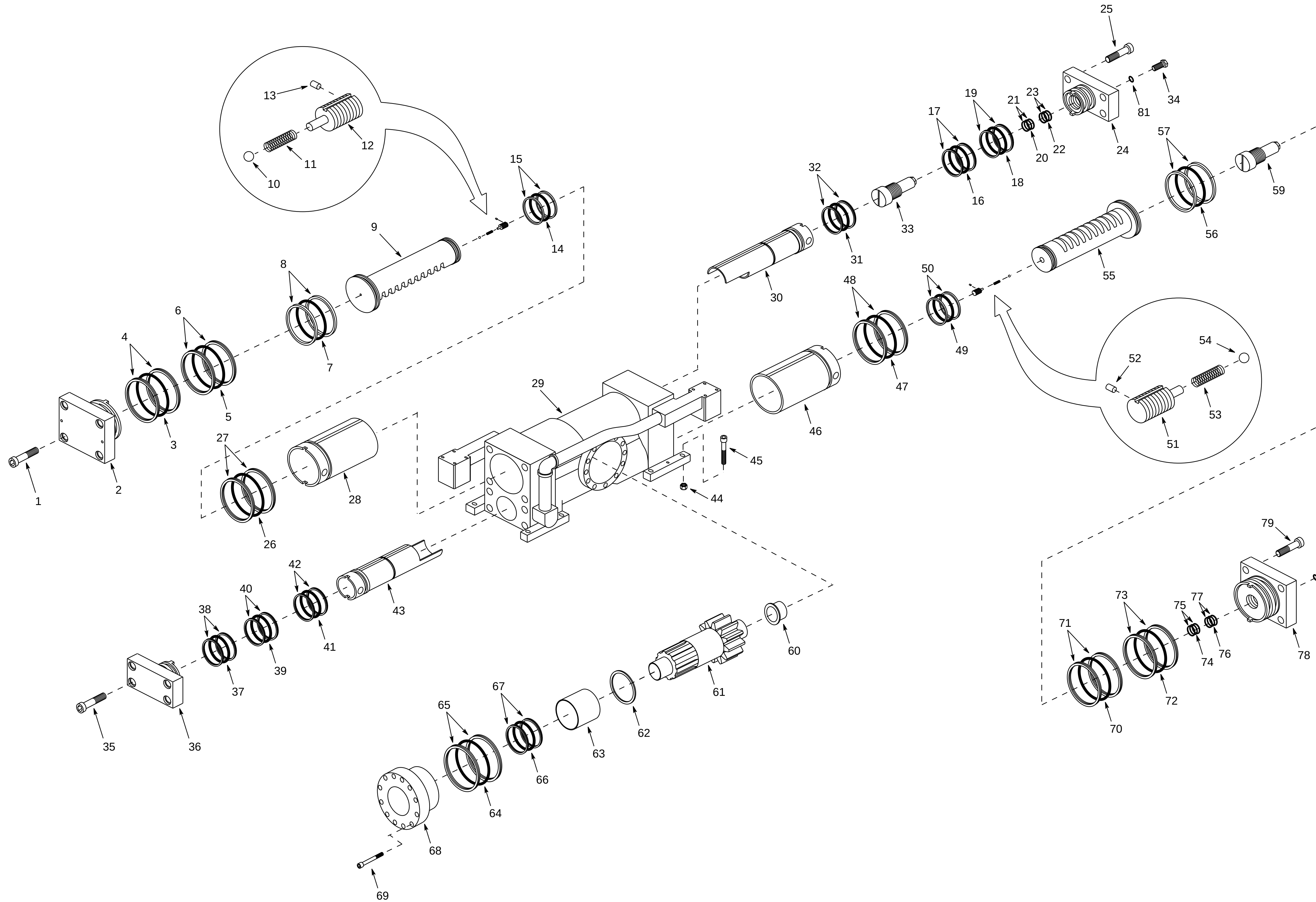


Figure 5-6-8. Muzzle Hatch and Fairing Rotary Actuator

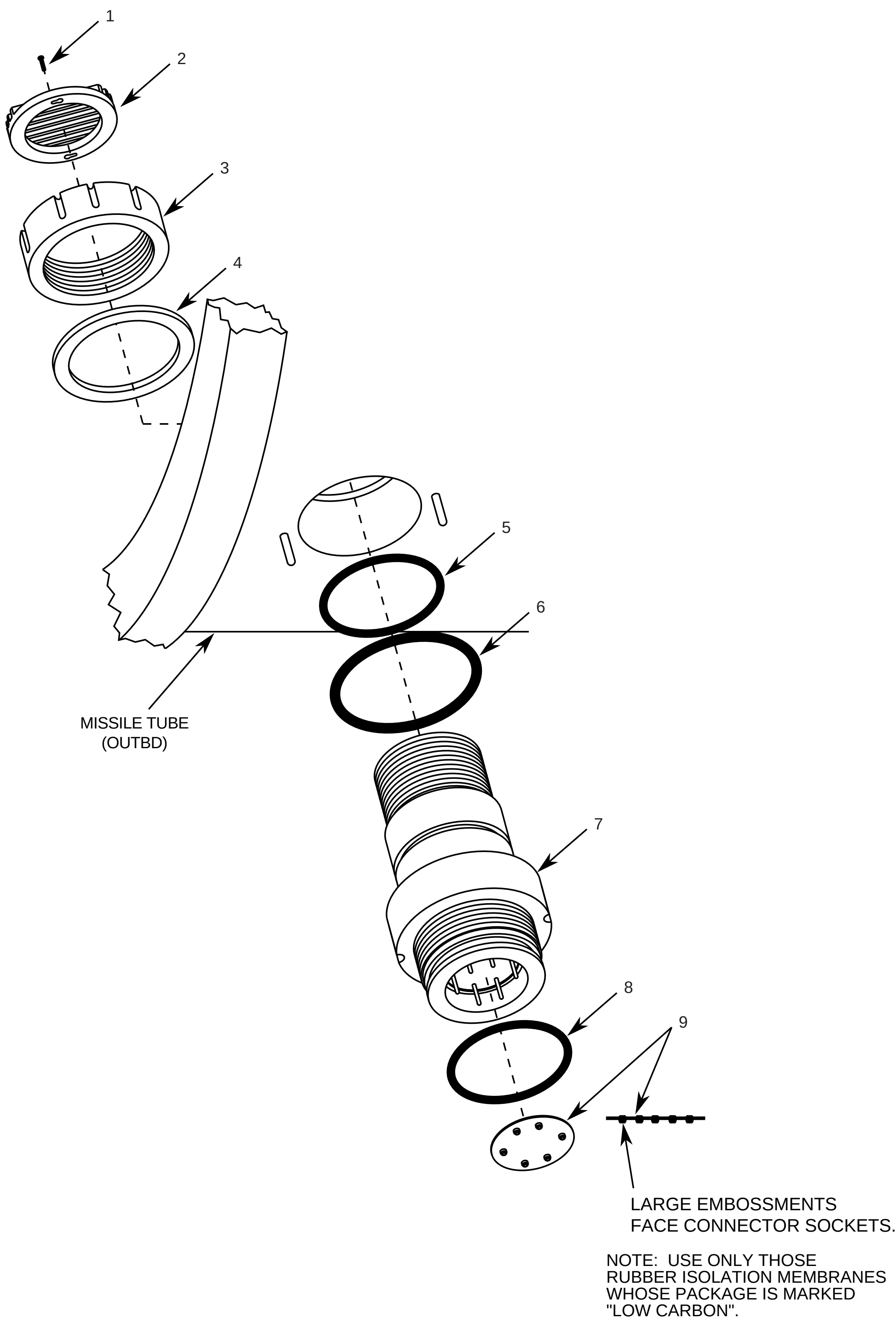


Figure 5-6-9. Environmental Monitoring Sensor Assembly

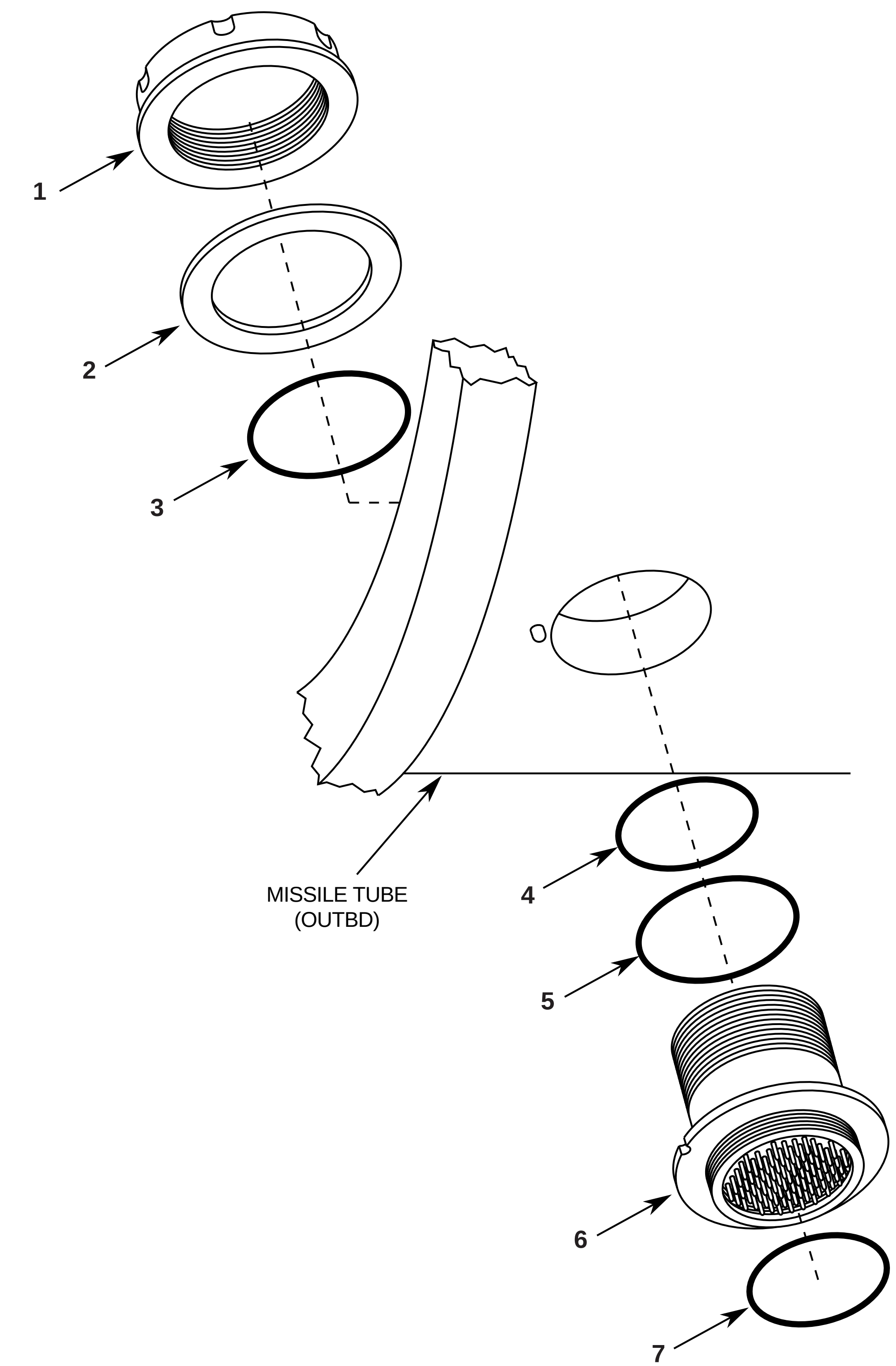


Figure 5-6-10. Missile Tube Umbilical Penetrator

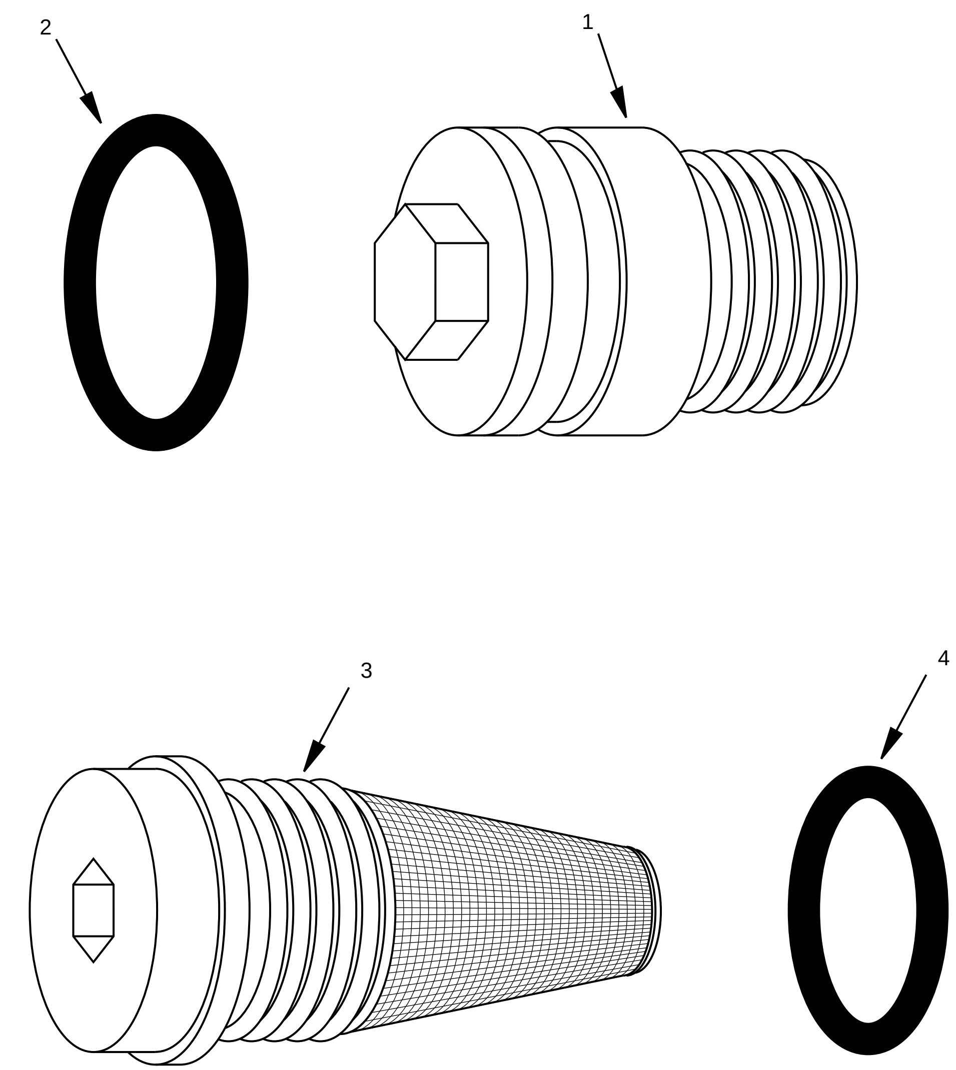


Figure 5-6-11. Pressurization/Vent Port Plug and Filter

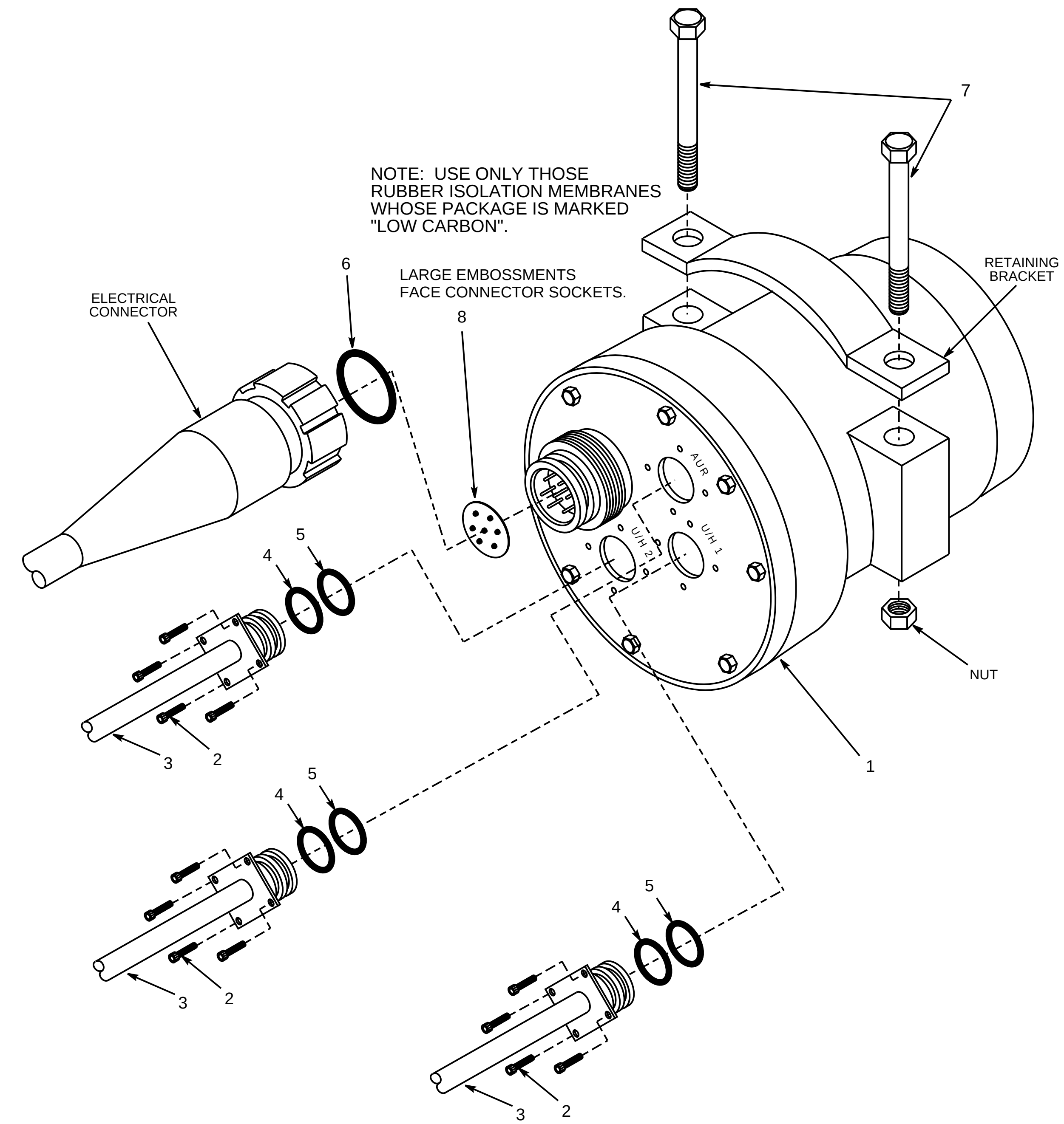


Figure 5-6-12. Differential Pressure Transducer Assembly

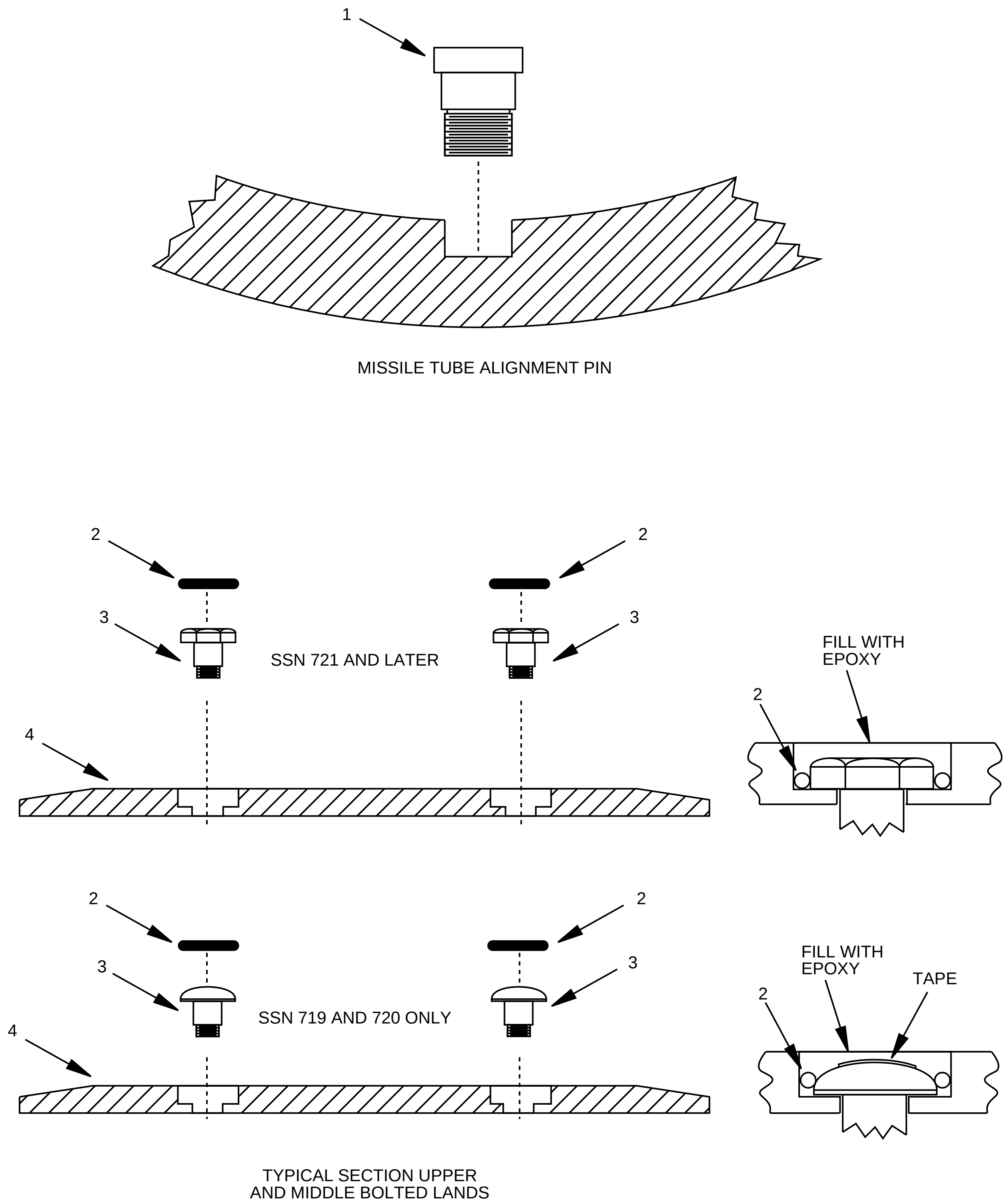


Figure 5-6-13. Missile Tube Shock Lands and Alignment Pins

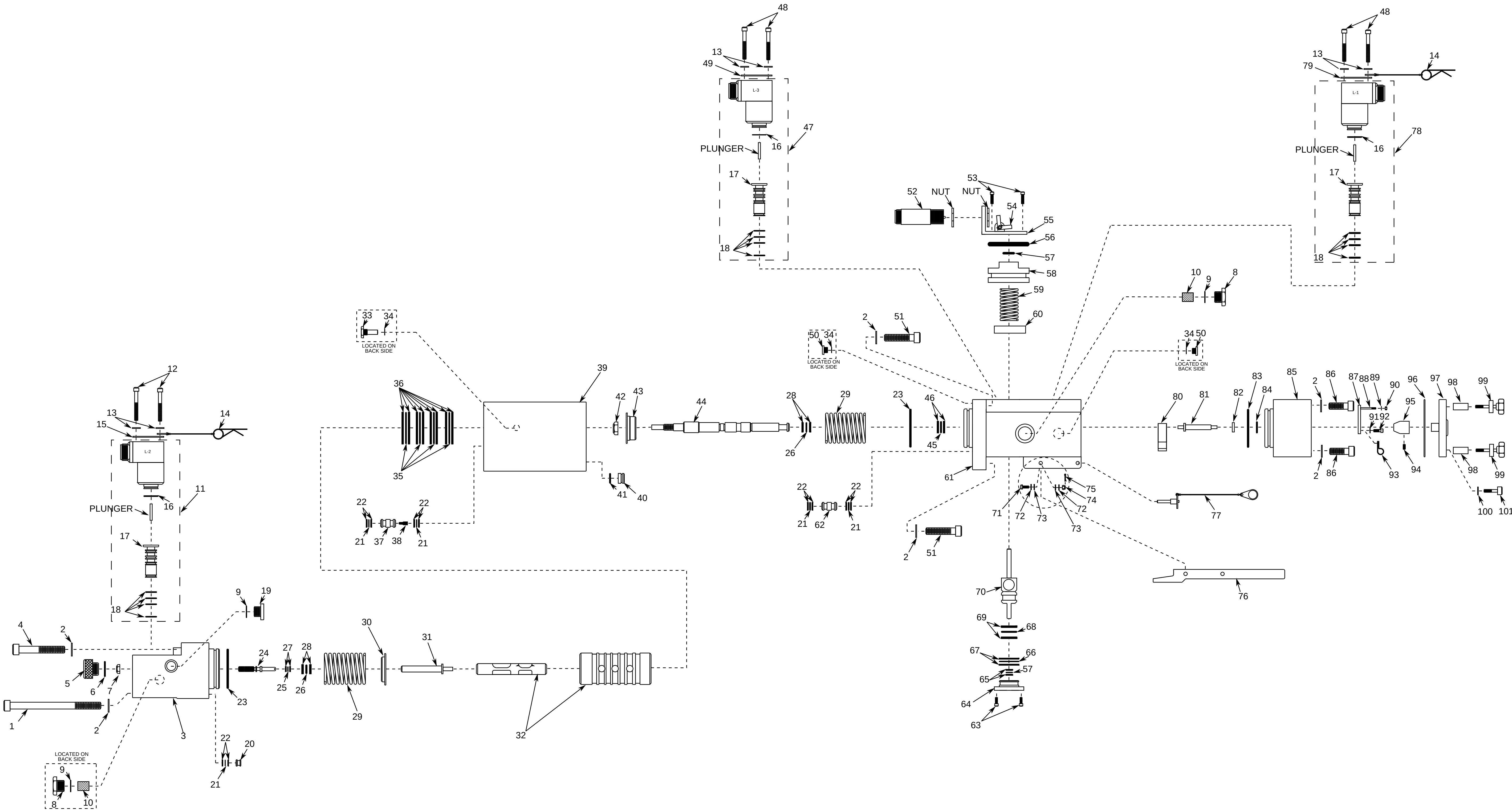


Figure 5-6-14. Hatch & Flood/Drain Valve Control Valve

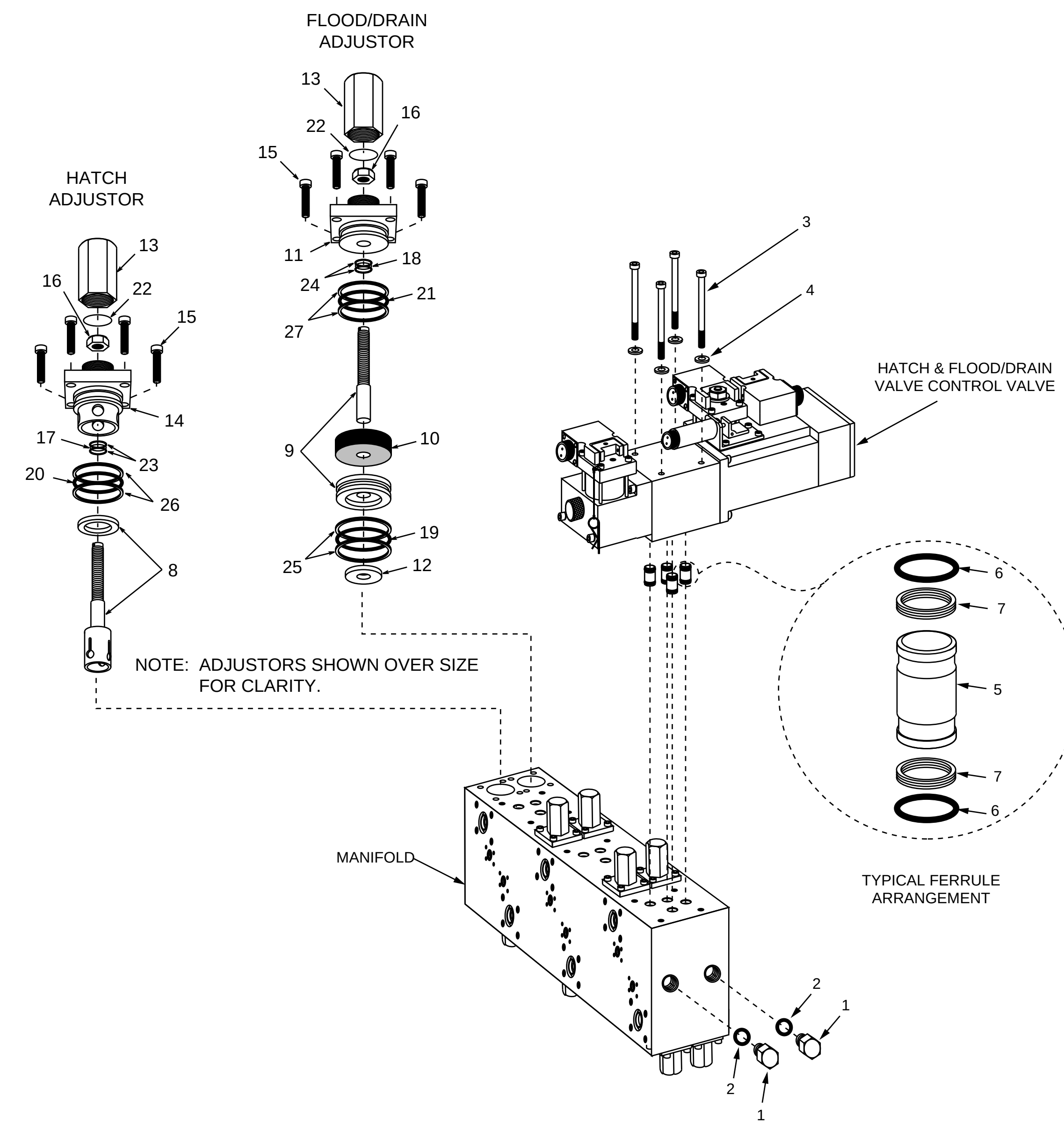


Figure 5-6-15. Six Valve Hydraulic Control Manifold

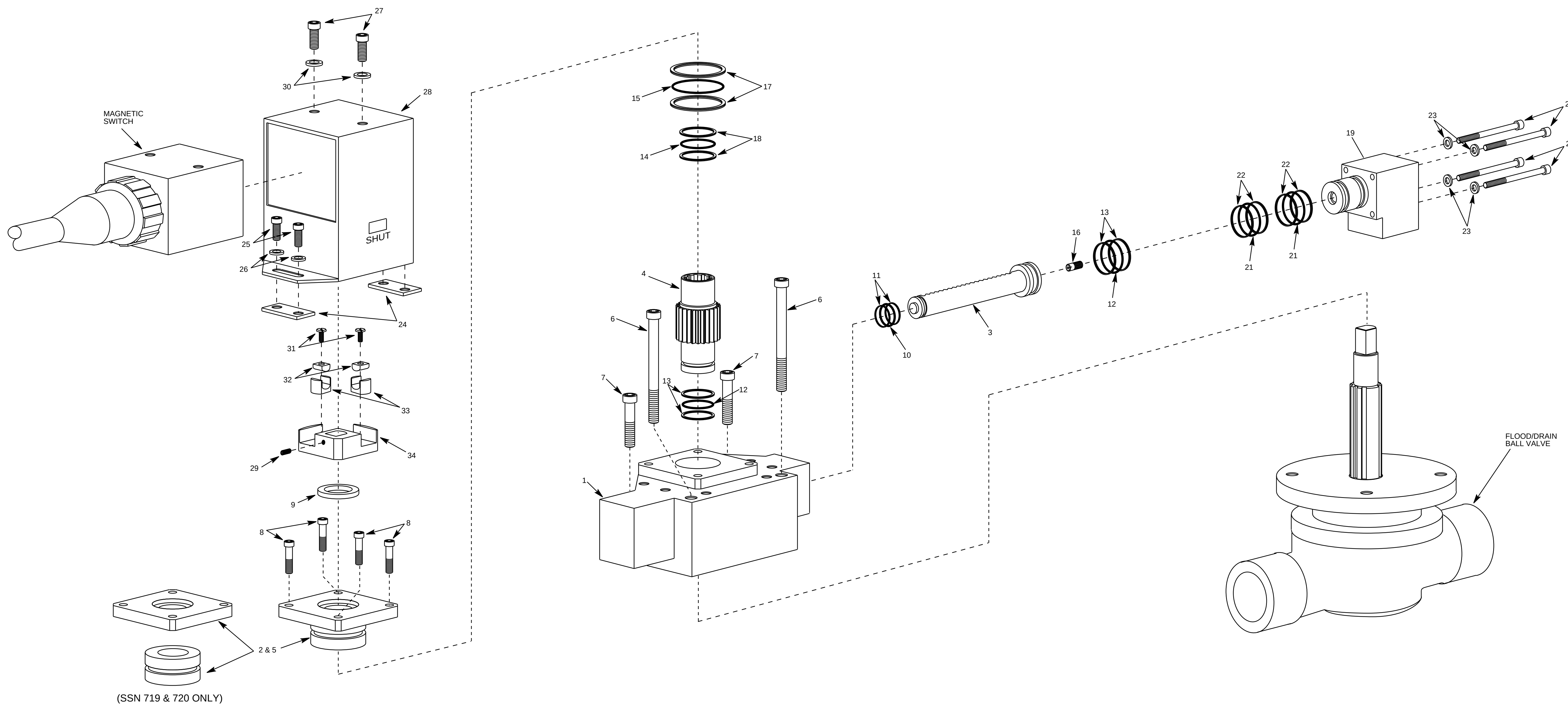
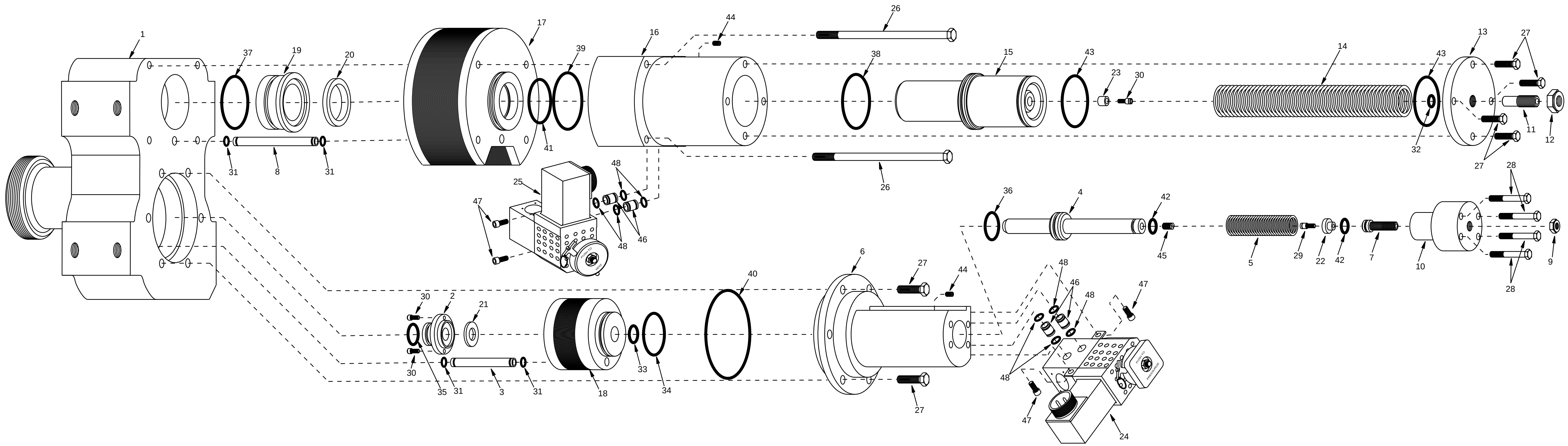


Figure 5-6-16. Flood/Drain Valve Rotary Actuator



PARTIAL EXPLODED VIEW OF SOLENOID PILOT VALVE (ITEMS 24 & 25)

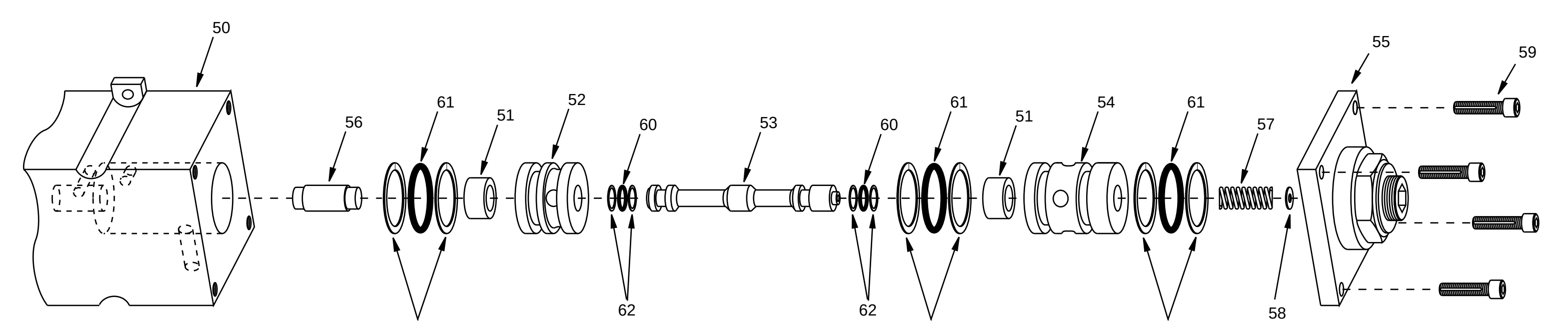


Figure 5-6-17. Pressurization/Vent Control Valve

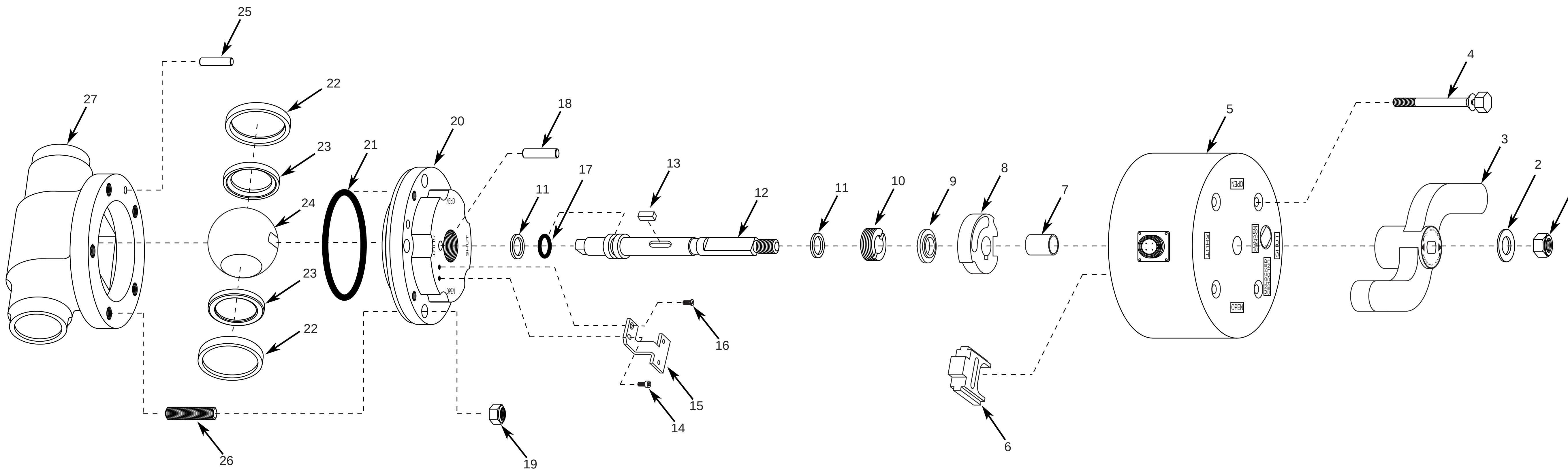


Figure 5-6-18. Pressurization/Vent Hull Stop Isolation Valve

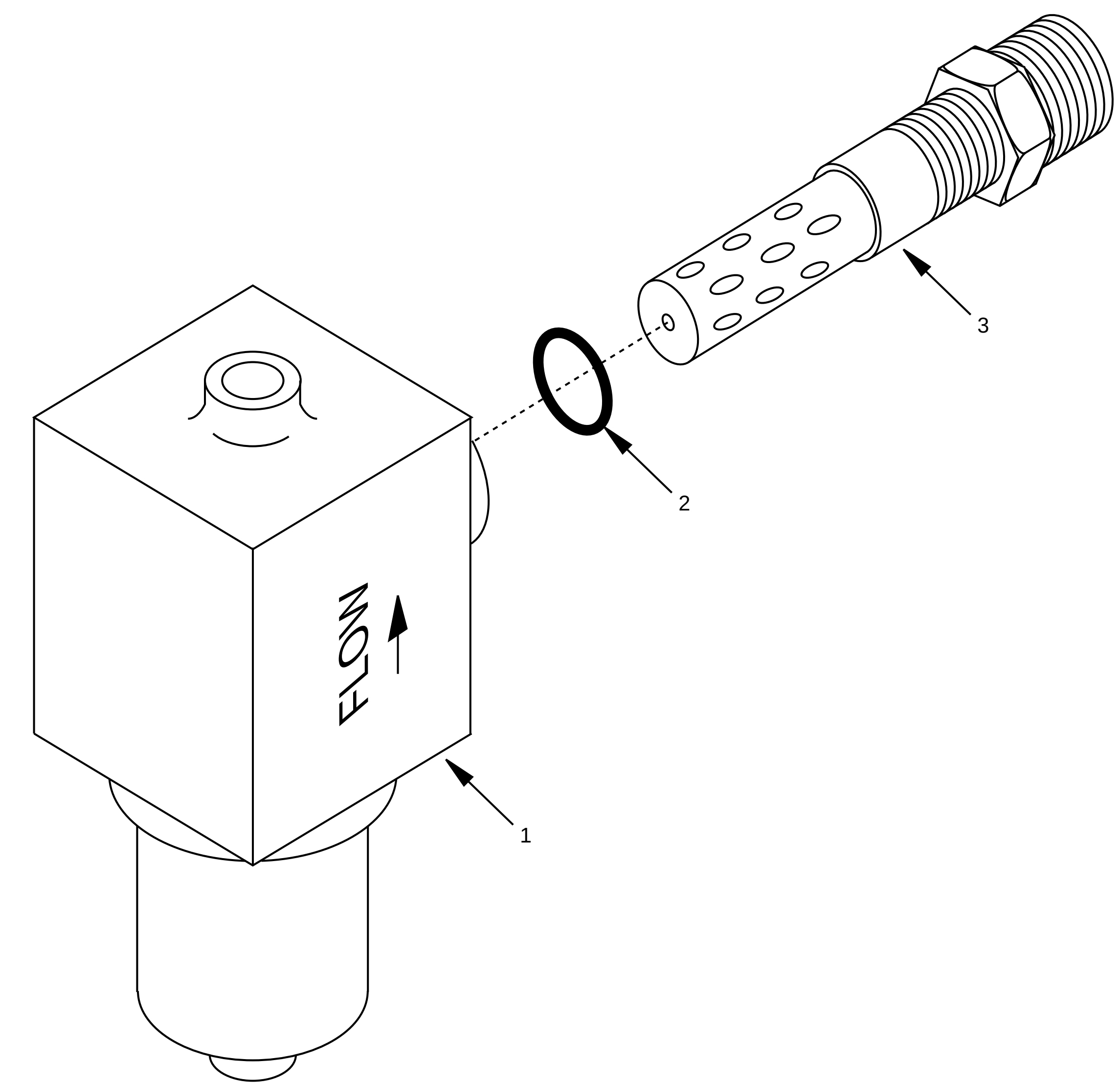


Figure 5-6-19. Dewpoint Sensor

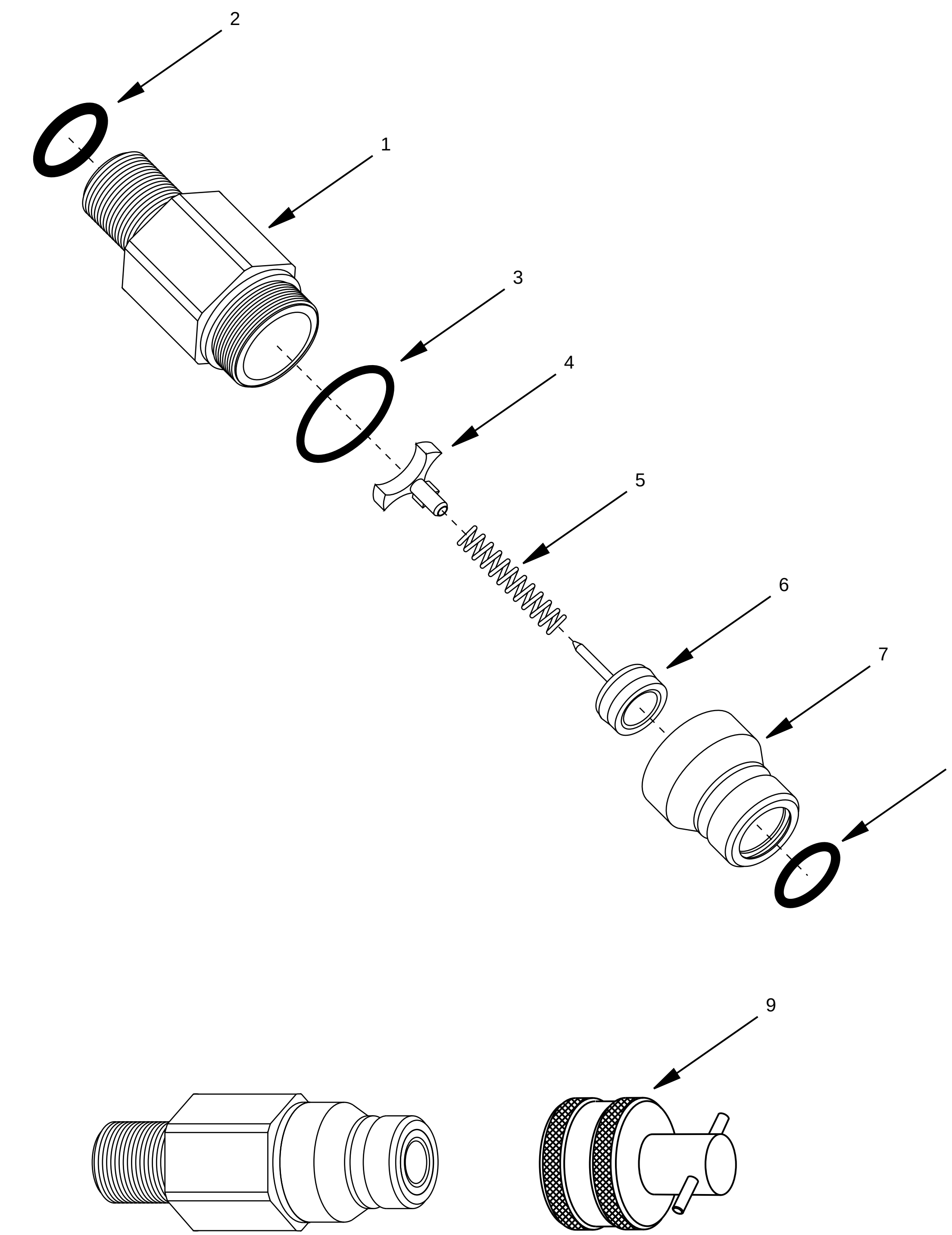


Figure 5-6-20. VLS Missile Tube Preece Fitting and Pressure Cap

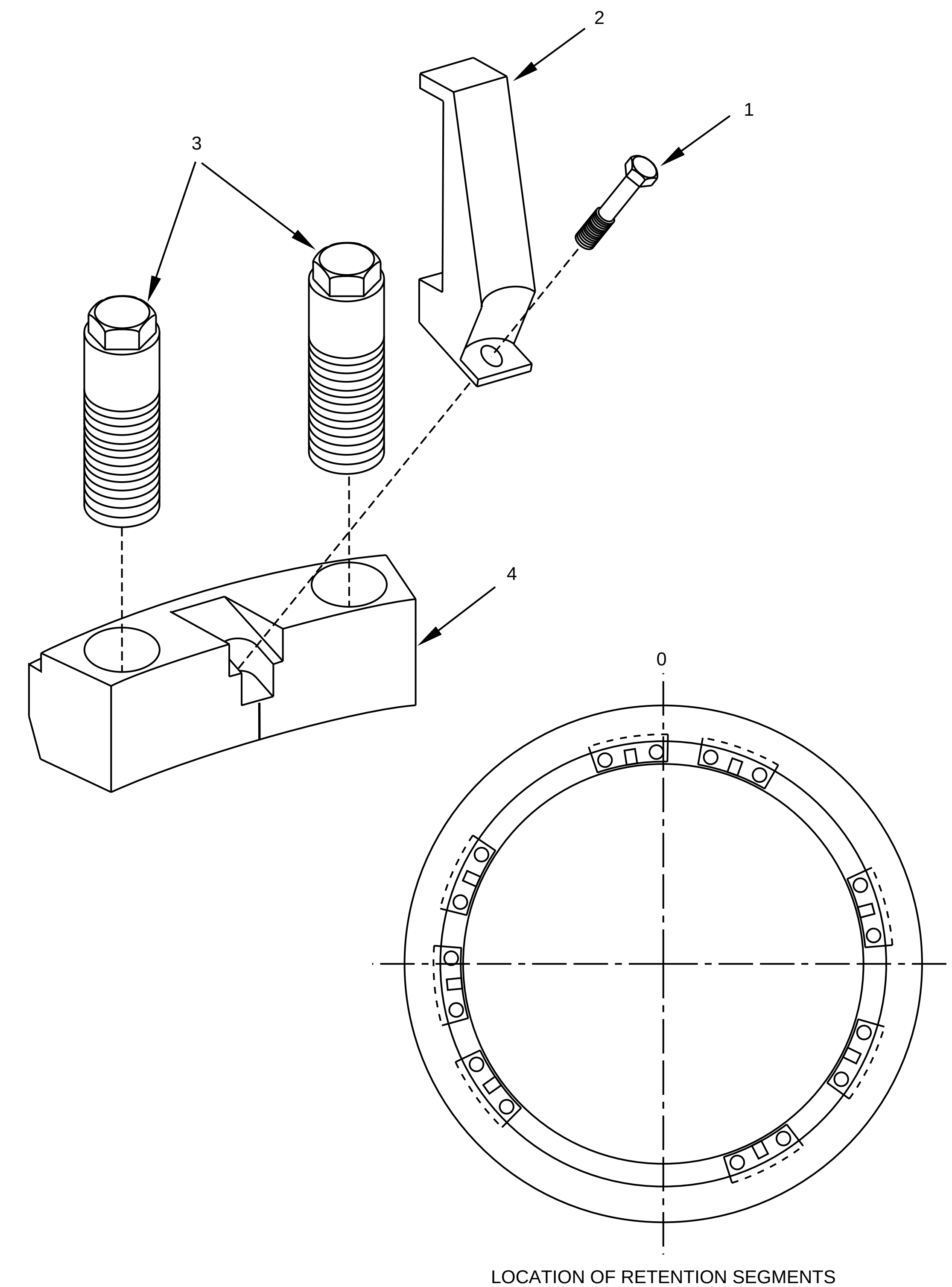


Figure 5-6-21. Retention Segments

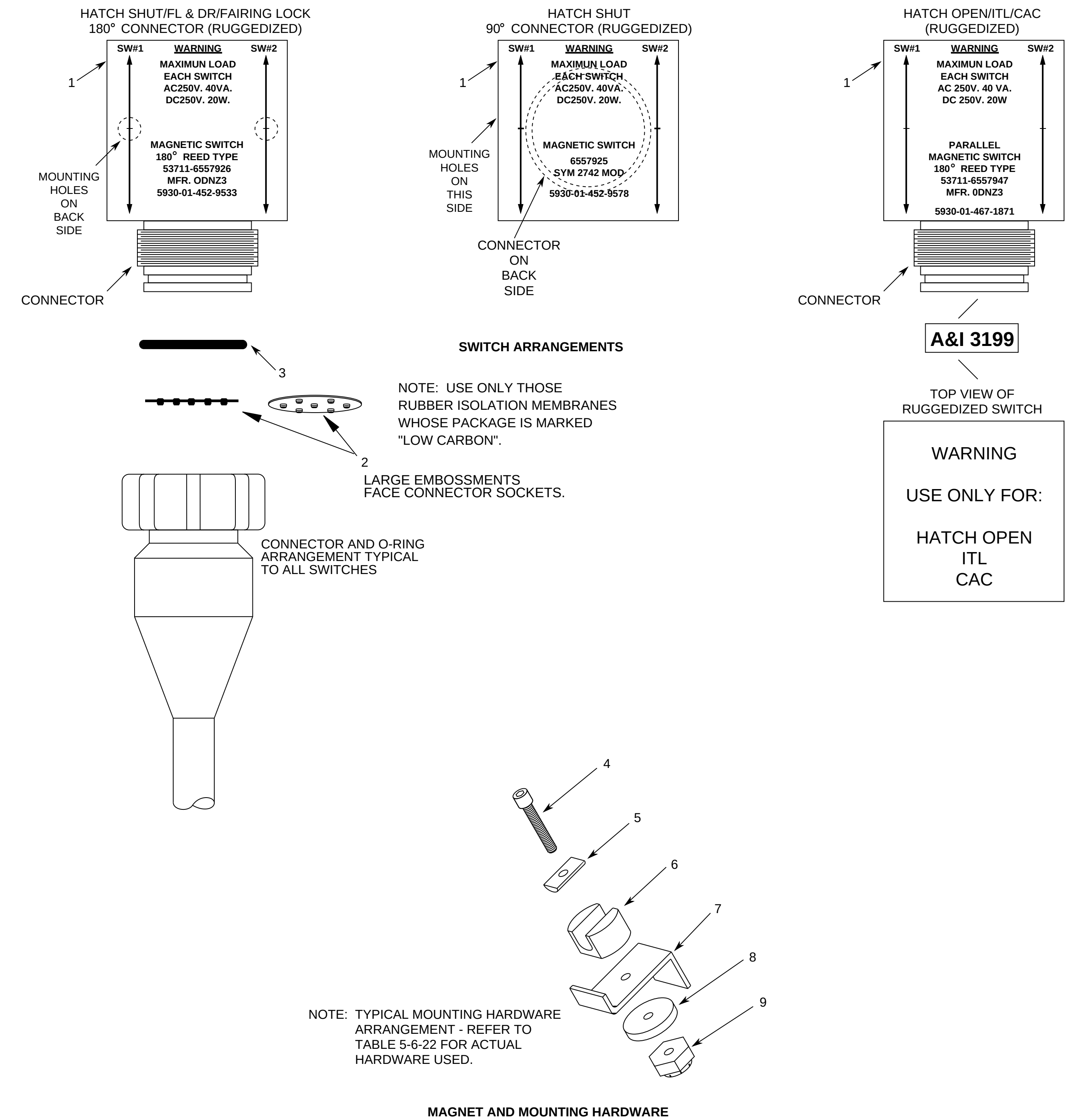


Figure 5-6-22. Magnetic Switches and Mounting Hardware (Typical)

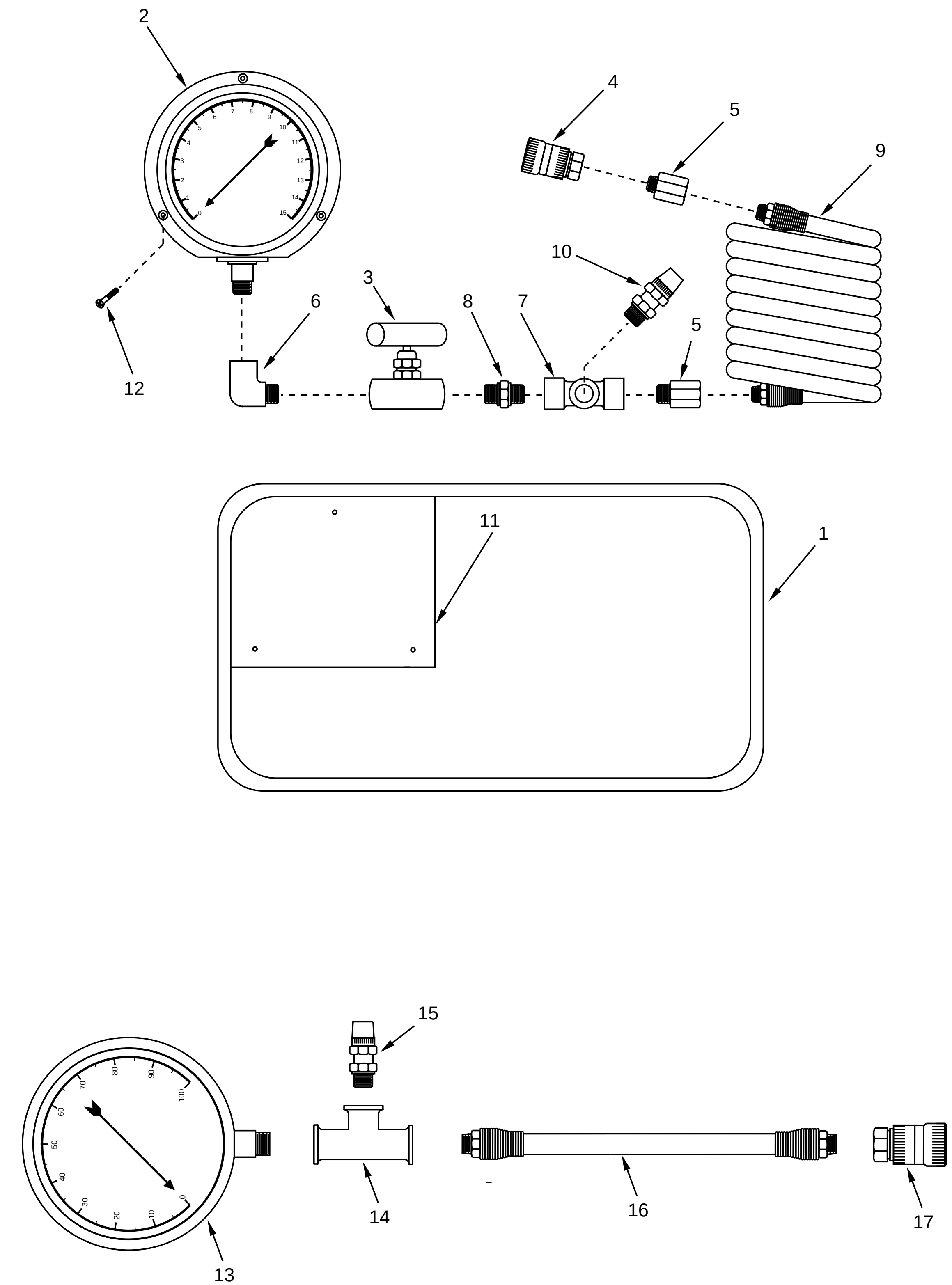
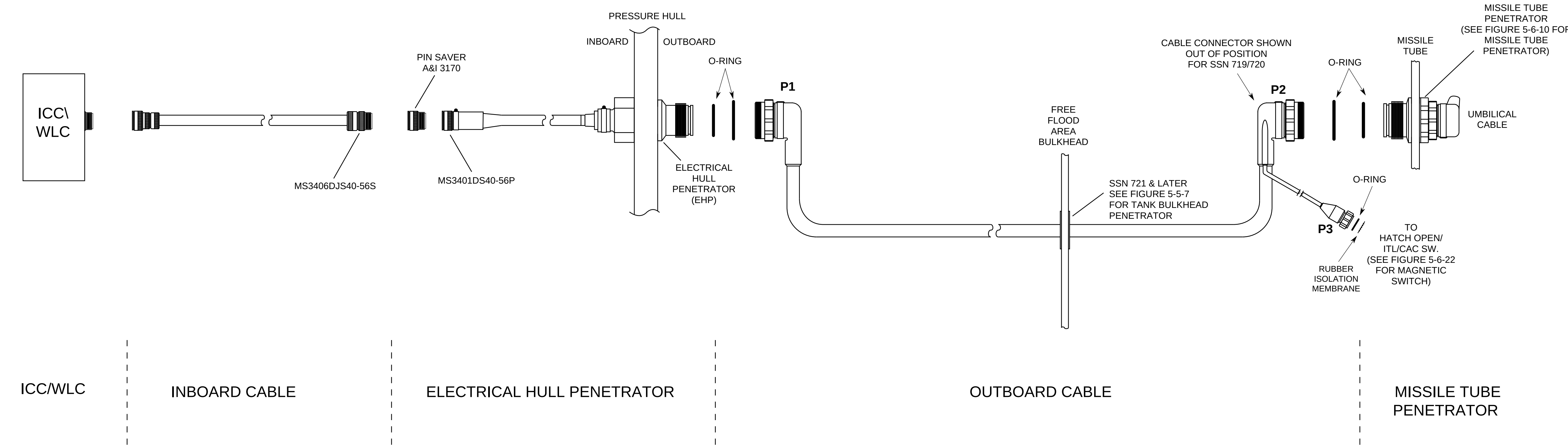


Figure 5-6-23. Pressure Monitoring Test Rig and Emergency DPT Pressure Gage Assembly (SSN 751 & Later)



NOTE: USE ONLY THOSE RUBBER ISOLATION MEMBRANES WHOSE PACKAGE IS MARKED "LOW CARBON".

CABLE SOFTWARE

CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1	M83461/1-235 M83461/1-238	
P2	M83461/1-235 M83461/1-238	
P3	M83461/1-220	SK055
Umbilical Cable Connector	M83461/1-235 M83461/1-238	

(SSN 719 AND 720)

TUBE NO.	ICC RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.
5	J4	G-1GW8	P26-19S	G-1GW8A
6	J8	G-1GW14	P26-23P	G-1GW14A
7	J12	G-1GW9	P26-18S	G-1GW9A
8	J3	G-1GW15	P26-22P	G-1GW15A
9	J7	G-1GW10	P26-17S	G-1GW10A
10	J11	G-1GW16	P26-21P	G-1GW16A
11	J2	G-1GW11	P26-16S	G-1GW11A
12	J6	G-1GW17	P26-20P	G-1GW17A
13	J10	G-1GW12	P26-12S	G-1GW12A
14	J1	G-1GW18	P26-15P	G-1GW18A
15	J5	G-1GW13	P26-13S	G-1GW13A
16	J9	G-1GW19	P26-14P	G-1GW19A

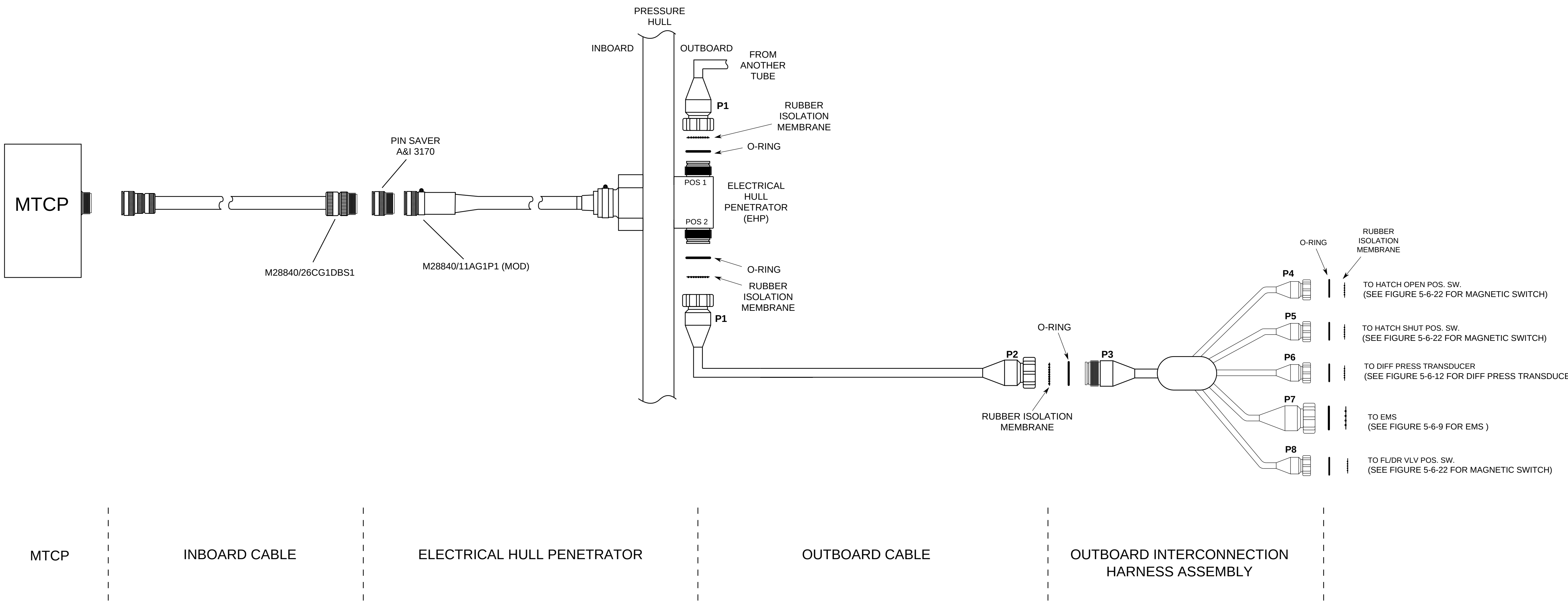
(SSN 721- 725 AND 750)

TUBE NO.	ICC RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	TANK BULKHEAD PENETRATOR
5	J4	G-1GW8	P26-12S	G-1GW8A	T26
6	J8	G-1GW14	P26-14P	G-1GW14A	T25
7	J12	G-1GW9	P26-13S	G-1GW9A	T26
8	J3	G-1GW15	P26-15P	G-1GW15A	T25
9	J7	G-1GW10	P26-16S	G-1GW10A	T24
10	J11	G-1GW16	P26-20P	G-1GW16A	T23
11	J2	G-1GW11	P26-17S	G-1GW11A	T26
12	J6	G-1GW17	P26-21P	G-1GW17A	T25
13	J10	G-1GW12	P26-18S	G-1GW12A	T24
14	J1	G-1GW18	P26-22P	G-1GW18A	T23
15	J5	G-1GW13	P26-19S	G-1GW13A	T24
16	J9	G-1GW19	P26-23P	G-1GW19A	T23

(SSN 751 AND LATER)

TUBE NO.	WLC RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	TANK BULKHEAD PENETRATOR
5	J11 Unit 2019	R-CS543	P26-12S	R-CS1092	T26
6	J11 Unit 2016	R-CS541	P26-14P	R-CS1086	T25
7	J12 Unit 2019	R-CS544	P26-13S	R-CS1093	T26
8	J12 Unit 2016	R-CS542	P26-15P	R-CS1087	T25
9	J16 Unit 2020	R-CS537	P26-16S	R-CS1094	T24
10	J16 Unit 2015	R-CS533	P26-20P	R-CS1088	T23
11	J17 Unit 2020	R-CS538	P26-17S	R-CS1095	T26
12	J17 Unit 2015	R-CS534	P26-21P	R-CS1089	T25
13	J11 Unit 2020	R-CS539	P26-18S	R-CS1096	T24
14	J11 Unit 2015	R-CS535	P26-22P	R-CS1090	T23
15	J12 Unit 2020	R-CS540	P26-19S	R-CS1097	T24
16	J12 Unit 2015	R-CS536	P26-23P	R-CS1091	T23

Figure 5-6-24. Weapon Control Cable Designation



NOTE: USE ONLY THOSE RUBBER ISOLATION MEMBRANES WHOSE PACKAGE IS MARKED "LOW CARBON".

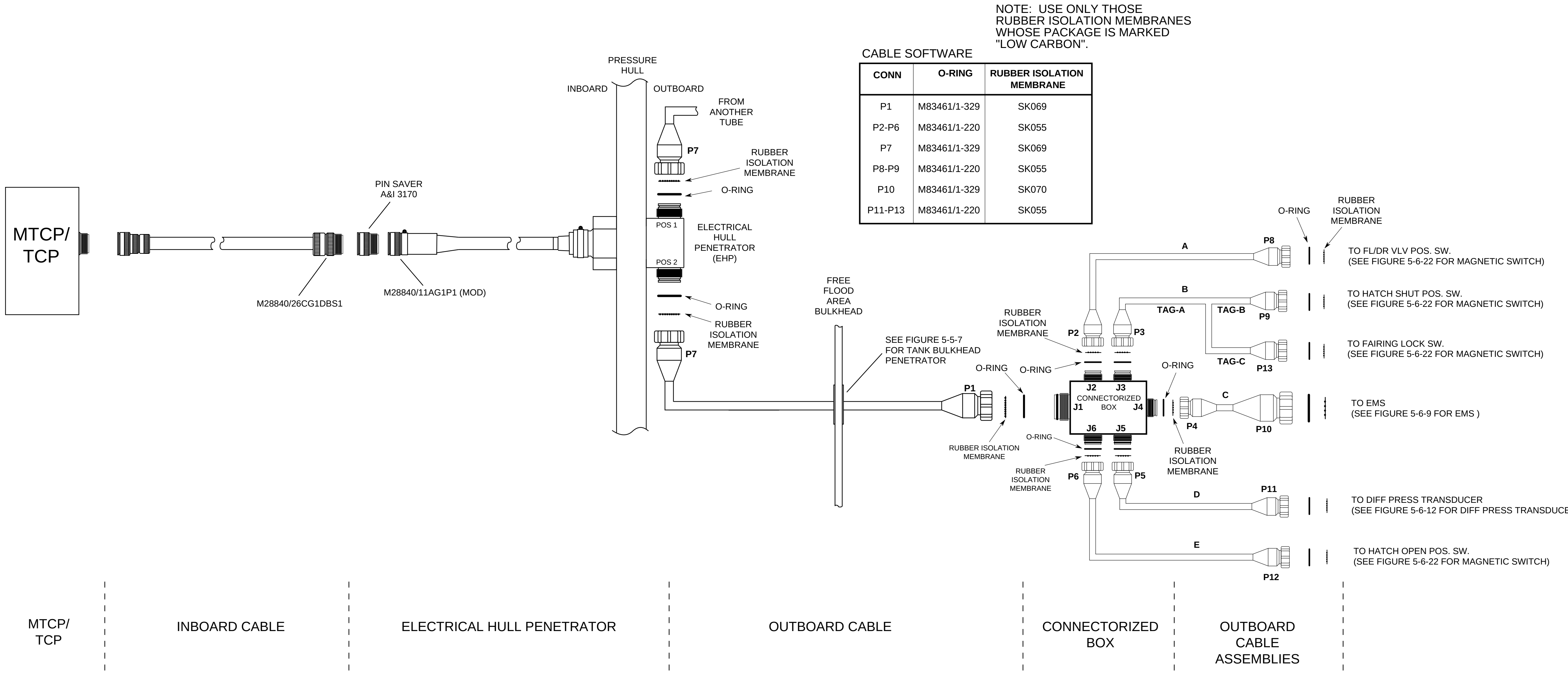
CABLE SOFTWARE

CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1-P3	M83461/1-329	SK069
P4-P6	M83461/1-220	SK055
P7	M83461/1-329	SK070
P8	M83461/1-220	SK055

MTCC DESIGNATION

TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	OUTBOARD INTERCONNECTION HARNESS ASSY No.
5	J4 STBD	K-15EH33	P27-21S POS 1	K-15EH39	K-15EH51
6	J4 PORT	K-15EH36	P27-22P POS 1	K-15EH45	K-15EH57
7	J4 STBD	K-15EH33	P27-21S POS 2	K-15EH40	K-15EH52
8	J4 PORT	K-15EH36	P27-22P POS 2	K-15EH46	K-15EH58
9	J5 STBD	K-15EH34	P27-20S POS 1	K-15EH41	K-15EH53
10	J5 PORT	K-15EH37	P27-23P POS 1	K-15EH47	K-15EH59
11	J5 STBD	K-15EH34	P27-20S POS 2	K-15EH42	K-15EH54
12	J5 PORT	K-15EH37	P27-23P POS 2	K-15EH48	K-15EH60
13	J10 STBD	K-15EH35	P27-19S POS 1	K-15EH43	K-15EH55
14	J10 PORT	K-15EH38	P27-24P POS 1	K-15EH49	K-15EH61
15	J10 STBD	K-15EH35	P27-19S POS 2	K-15EH44	K-15EH56
16	J10 PORT	K-15EH38	P27-24P POS 2	K-15EH50	K-15EH62

Figure 5-6-25. Missile Tube Control Cable Designation (SSN 719 and 720)



CABLE SOFTWARE

CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1	M83461/1-329	SK069
P2-P6	M83461/1-220	SK055
P7	M83461/1-329	SK069
P8-P9	M83461/1-220	SK055
P10	M83461/1-329	SK070
P11-P13	M83461/1-220	SK055

MTCC DESIGNATION
(SSN 721 THRU 725 & 750)

TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	TANK BULKHEAD PENETRATOR	OUTBOARD CABLE ASSEMBLIES				
						F/D VALVE	HATCH SHUT/ FAIRING LOCK	EMS	DPT	HATCH OPEN
5	J4 STBD	K-15EH33	P27-19S POS 1	K-15EH51	T26	K-15EH51A	K-15EH51B	K-15EH51C	K-15EH51D	K-15EH51E
6	J4 PORT	K-15EH36	P27-22P POS 1	K-15EH57	T25	K-15EH57A	K-15EH57B	K-15EH57C	K-15EH57D	K-15EH57E
7	J4 STBD	K-15EH33	P27-19S POS 2	K-15EH52	T26	K-15EH52A	K-15EH52B	K-15EH52C	K-15EH52D	K-15EH52E
8	J4 PORT	K-15EH36	P27-22P POS 2	K-15EH58	T25	K-15EH58A	K-15EH58B	K-15EH58C	K-15EH58D	K-15EH58E
9	J5 STBD	K-15EH34	P27-20S POS 1	K-15EH53	T24	K-15EH53A	K-15EH53B	K-15EH53C	K-15EH53D	K-15EH53E
10	J5 PORT	K-15EH37	P27-23P POS 1	K-15EH59	T23	K-15EH59A	K-15EH59B	K-15EH59C	K-15EH59D	K-15EH59E
11	J5 STBD	K-15EH34	P27-20S POS 2	K-15EH54	T26	K-15EH54A	K-15EH54B	K-15EH54C	K-15EH54D	K-15EH54E
12	J5 PORT	K-15EH37	P27-23P POS 2	K-15EH60	T25	K-15EH60A	K-15EH60B	K-15EH60C	K-15EH60D	K-15EH60E
13	J10 STBD	K-15EH35	P27-21S POS 1	K-15EH55	T24	K-15EH55A	K-15EH55B	K-15EH55C	K-15EH55D	K-15EH55E
14	J10 PORT	K-15EH38	P27-24P POS 1	K-15EH61	T23	K-15EH61A	K-15EH61B	K-15EH61C	K-15EH61D	K-15EH61E
15	J10 STBD	K-15EH35	P27-21S POS 2	K-15EH56	T24	K-15EH56A	K-15EH56B	K-15EH56C	K-15EH56D	K-15EH56E
16	J10 PORT	K-15EH38	P27-24P POS 2	K-15EH62	T23	K-15EH62A	K-15EH62B	K-15EH62C	K-15EH62D	K-15EH62E

MTCC DESIGNATION
(SSN 751 & LATER)

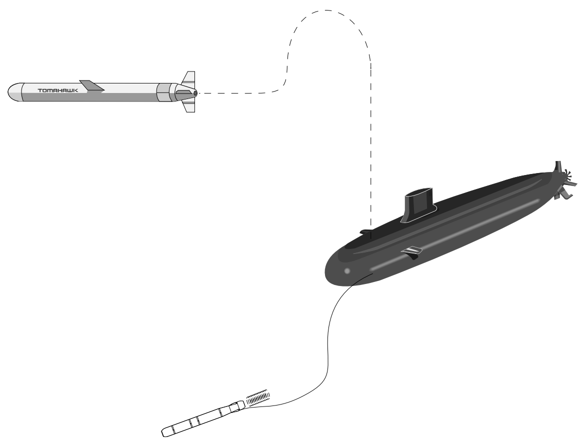
TUBE NO.	TCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	TANK BULKHEAD PENETRATOR	OUTBOARD CABLE ASSEMBLIES				
						F/D VALVE	HATCH SHUT/ FAIRING LOCK	EMS	DPT	HATCH OPEN
5	UNIT 5 J14	K-15EH1	P27-19S POS 1	K-15EH51	T26	K-15EH51A	K-15EH51B	K-15EH51C	K-15EH51D	K-15EH51E
6	UNIT 2 J14	K-15EH4	P27-22P POS 1	K-15EH57	T25	K-15EH57A	K-15EH57B	K-15EH57C	K-15EH57D	K-15EH57E
7	UNIT 5 J14	K-15EH1	P27-19S POS 2	K-15EH52	T26	K-15EH52A	K-15EH52B	K-15EH52C	K-15EH52D	K-15EH52E
8	UNIT 2 J14	K-15EH4	P27-22P POS 2	K-15EH58	T25	K-15EH58A	K-15EH58B	K-15EH58C	K-15EH58D	K-15EH58E
9	UNIT 6 J5	K-15EH2	P27-20S POS 1	K-15EH53	T24	K-15EH53A	K-15EH53B	K-15EH53C	K-15EH53D	K-15EH53E
10	UNIT 1 J5	K-15EH5	P27-23P POS 1	K-15EH59	T23	K-15EH59A	K-15EH59B	K-15EH59C	K-15EH59D	K-15EH59E
11	UNIT 6 J5	K-15EH2	P27-20S POS 2	K-15EH54	T26	K-15EH54A	K-15EH54B	K-15EH54C	K-15EH54D	K-15EH54E
12	UNIT 1 J5	K-15EH5	P27-23P POS 2	K-15EH60	T25	K-15EH60A	K-15EH60B	K-15EH60C	K-15EH60D	K-15EH60E
13	UNIT 6 J10	K-15EH3	P27-21S POS 1	K-15EH55	T24	K-15EH55A	K-15EH55B	K-15EH55C	K-15EH55D	K-15EH55E
14	UNIT 1 J10	K-15EH6	P27-24P POS 1	K-15EH61	T23	K-15EH61A	K-15EH61B	K-15EH61C	K-15EH61D	K-15EH61E
15	UNIT 6 J10	K-15EH3	P27-21S POS 2	K-15EH56	T24	K-15EH56A	K-15EH56B	K-15EH56C	K-15EH56D	K-15EH56E
16	UNIT 1 J10	K-15EH6	P27-24P POS 2	K-15EH62	T23	K-15EH62A	K-15EH62B	K-15EH62C	K-15EH62D	K-15EH62E

Figure 5-6-26. Missile Tube Control Cable Designation (SSN 721 and Later)

APPENDIX A
VERTICAL LAUNCH SYSTEM
QUICK REFERENCE MANUAL

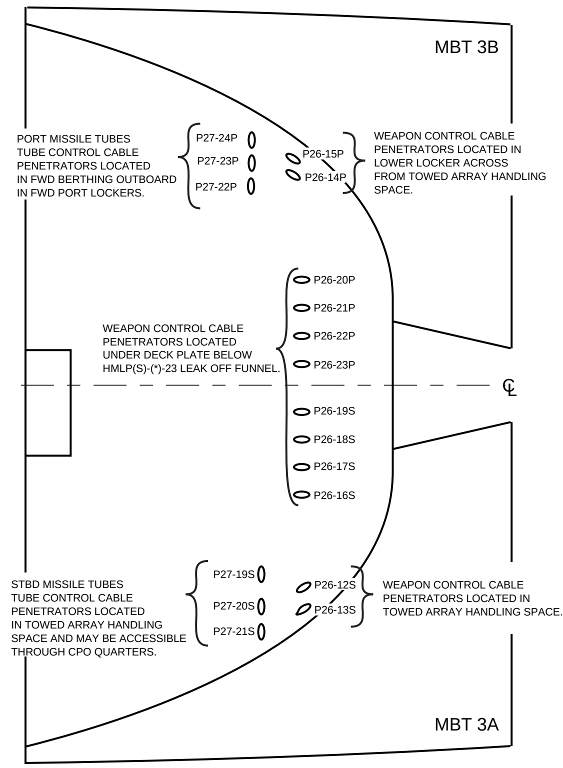
10 June 2008

VERTICAL LAUNCH SYSTEM QUICK REFERENCE MANUAL



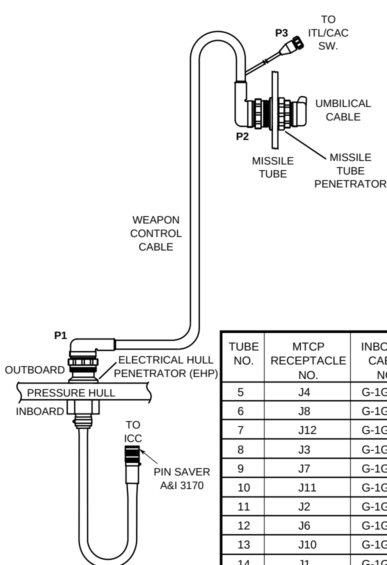
PREPARED BY

NAVAL UNDERSEA WARFARE CENTER, DIV. NPT
MISSILE LAUNCHER & PAYLOAD INTEGRATION DEPARTMENT
LAUNCHERS SYSTEMS & PAYLOAD DIVISION
EXTERNAL LAUNCHER SYSTEMS BRANCH



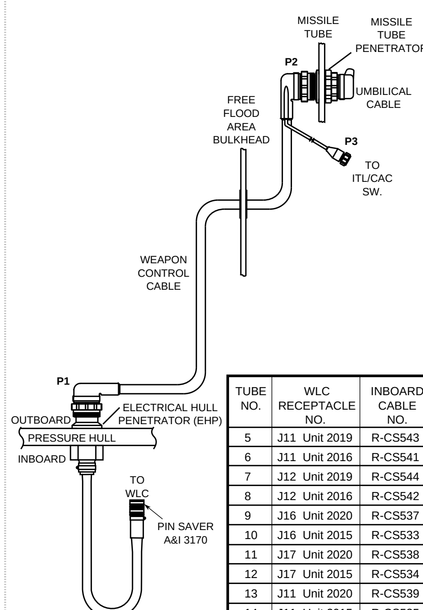
TOP VIEW

ELECTRICAL HULL PENETRATOR INTERNAL LOCATIONS



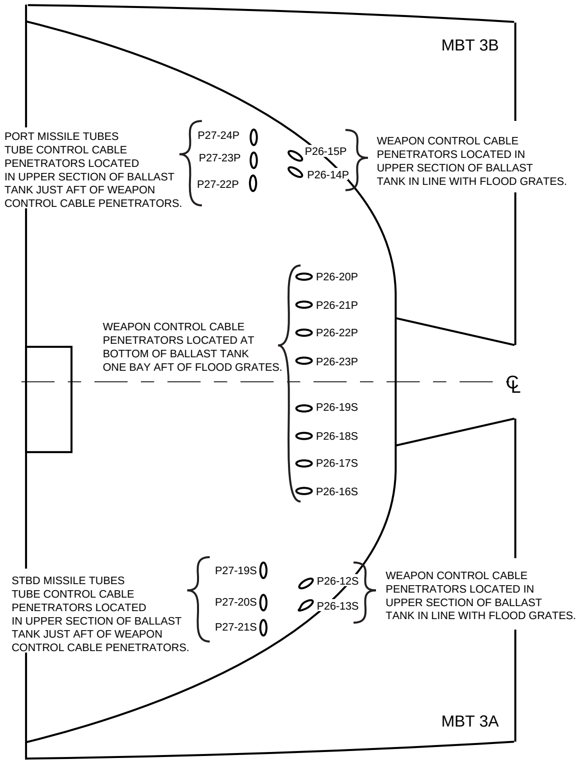
TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.
5	J4	G-1GW8	P26-19S	G-1GW8A
6	J8	G-1GW14	P26-23P	G-1GW14A
7	J12	G-1GW9	P26-18S	G-1GW9A
8	J3	G-1GW15	P26-22P	G-1GW15A
9	J7	G-1GW10	P26-17S	G-1GW10A
10	J11	G-1GW16	P26-21P	G-1GW16A
11	J2	G-1GW11	P26-16S	G-1GW11A
12	J6	G-1GW17	P26-20P	G-1GW17A
13	J10	G-1GW12	P26-12S	G-1GW12A
14	J1	G-1GW18	P26-15P	G-1GW18A
15	J5	G-1GW13	P26-13S	G-1GW13A
16	J9	G-1GW19	P26-14P	G-1GW19A

WEAPON CONTROL CABLING
(SSN 719 and 720)



TUBE NO.	WLC RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.
5	J11 Unit 2019	R-CS543	P26-12S	R-CS1092
6	J11 Unit 2016	R-CS541	P26-14P	R-CS1086
7	J12 Unit 2019	R-CS544	P26-13S	R-CS1093
8	J12 Unit 2016	R-CS542	P26-15P	R-CS1087
9	J16 Unit 2020	R-CS537	P26-16S	R-CS1094
10	J16 Unit 2015	R-CS533	P26-20P	R-CS1088
11	J17 Unit 2020	R-CS538	P26-17S	R-CS1095
12	J17 Unit 2015	R-CS534	P26-21P	R-CS1089
13	J11 Unit 2020	R-CS539	P26-18S	R-CS1096
14	J11 Unit 2015	R-CS535	P26-22P	R-CS1090
15	J12 Unit 2020	R-CS540	P26-19S	R-CS1097
16	J12 Unit 2015	R-CS536	P26-23P	R-CS1091

WEAPON CONTROL CABLING
(SSN 751 and Later)



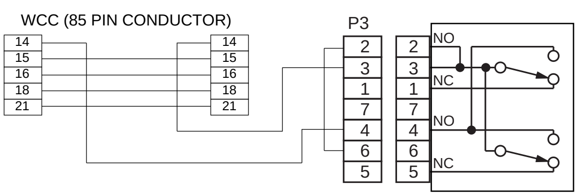
TOP VIEW

ELECTRICAL HULL PENETRATOR EXTERNAL LOCATIONS

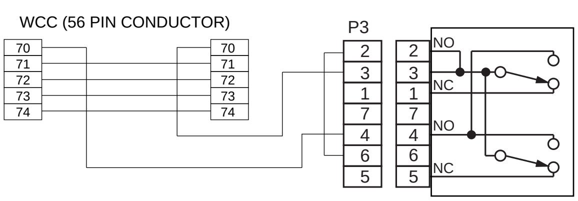
3

PHONE NUMBERS		
NAVSEA	Phone	Fax
J. Albert PMS392A13	202-781-2859	
Crawford Henderson SEA 07 07T11	202-781-1126	
Steve Hartley SEA 07 07T	202-781-2533	
NUWCDIVNPT Code 4124	Phone	Fax
Edward Baccei	401-832-1846	401-832-4329
James Allison	401-832-7234	401-832-4329
Mohammed Belakbir	401-832-1979	401-832-4329
Michael Flamino	401.832-4768	401-832-4329
Delfino Ferreira	401-832-2890	401-832-4329
David Giroux	401-832-8380	401-832-4329
Gregory Kocab	401-832-6348	401-832-4329
James (Ted) Kocab	401-832-6930	401-832-4329
Peter Machado	401-832-1820	401-832-4329
John Mart	401-832-4394	401-832-4329
Mary (Patty) O'Brien	401-832-7744	401-832-4329
Marc Sanford	401-832-1817	401-832-4329
Alan Sheridan	401-832-1842	401-832-4329
CSP On-Site Rep	808-473-5577 ext. 149	808-473-2697
NAVY COMMANDS	Phone	Fax
COMSUBLANT N453	757-836-1231	757-836-5340
COMSUBPAC N453	808-473-5577 ext. 118	808-473-2697
SSSU Norfolk	757-485-6315	757-485-6309
PMT Norfolk	757-445-6799	757-445-1691
SSSU New London	860-694-5185	860-694-4347
PMT New London	860-694-2258	860-694-9639
PMT Pearl Harbor	808-473-0300	808-474-7851
NSSC Pearl Harbor	808-473-1144	808-473-1151
CSS-11 San Diego	619-553-8952	619-553-0203
PMT San Diego	619-553-0672	619-553-0816

1

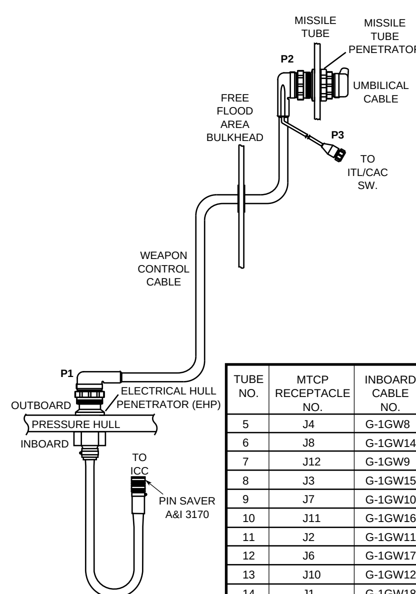


ITL Magnetic Switch Diagram



CAC Magnetic Switch Diagram

7

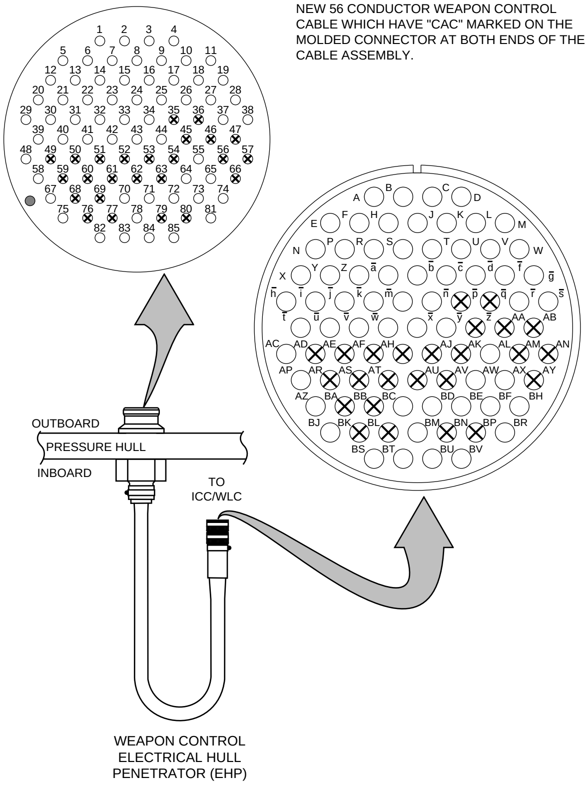


TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.
5	J4	G-1GW8	P26-12S	G-1GW8A
6	J8	G-1GW14	P26-14P	G-1GW14A
7	J12	G-1GW9	P26-13S	G-1GW9A
8	J3	G-1GW15	P26-15P	G-1GW15A
9	J7	G-1GW10	P26-16S	G-1GW10A
10	J11	G-1GW16	P26-20P	G-1GW16A
11	J2	G-1GW11	P26-17S	G-1GW11A
12	J6	G-1GW17	P26-21P	G-1GW17A
13	J10	G-1GW12	P26-18S	G-1GW12A
14	J1	G-1GW18	P26-22P	G-1GW18A
15	J5	G-1GW13	P26-19S	G-1GW13A
16	J9	G-1GW19	P26-23P	G-1GW19A

WEAPON CONTROL CABLING
(SSN 721-725 and 750)

5

NOTE: PINS WITH AN "X" ARE NOT USED WITH THE NEW 56 CONDUCTOR WEAPON CONTROL CABLE WHICH HAVE "CAC" MARKED ON THE MOLDED CONNECTOR AT BOTH ENDS OF THE CABLE ASSEMBLY.



WEAPON CONTROL CABLE EHP

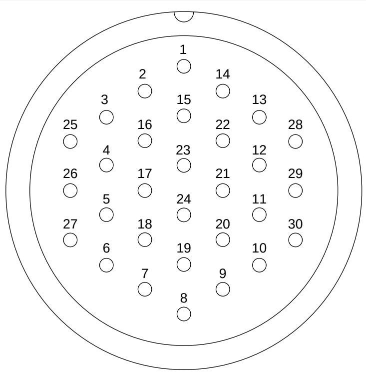
8

EHP				
PIGTAIL	OUTBOARD CABLE	OUTBOARD CONNECTION		TUBE PENETRATOR
y	44	44		44
z	45	45	X	45
AA	46	46	X	46
AB	47	47	X	47
AC	48	48		48
AD	49	49	X	49
AE	50	50	X	50
AF	51	51	X	51
AH	52	52	X	52
AJ	53	53	X	53
AK	54	54	X	54
AL	55	55		55
AM	56	56	X	56
AN	57	57	X	57
AP	58	58		58
AR	59	59	X	59
AS	60	60	X	60
AT	61	61	X	61
AU	62	62	X	62
AV	63	63	X	63
AW	64	64		64
AX	65	65		65
	66	66	X	66
AZ	67	67		67
BA	68	68	X	68
BB	69	69	X	69
BC	70	70		70
BD	71	71		71
BE	72	72		72
BF	73	73		73
BH	74	74		74
BJ	75	75		75
BK	76	76	X	76
BL	77	77	X	77
BM	78	78		78
BN	79	79	X	79
BP	80	80	X	80
BR	81	81		81
BS	82	82		82
BT	83	83		83
BU	84	84		84
BV	85	85		85

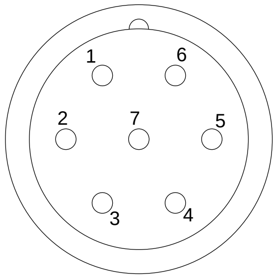
NOTE: Pins with an “X” are not used with the new 56 conductor cable

WEAPON CONTROL CIRCUIT PIN-OUTS “Cont’d”

10



30 Pin Electrical Connector
(Pin Arrangement)



7 Pin Electrical Connector
(Pin Arrangement)

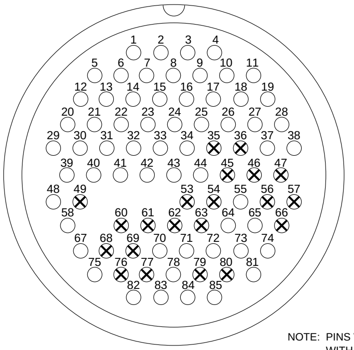
PIN ARRANGEMENT

12

PIN	FUNCTION	109C	109D
43	Operate Power Neutral	x	x
44	Power Shield Carry Through	x	x
45	Spare #2		
46	Spare #4		
47	Reserved CTE 1 (TECHEVAL)		
48	Coded Launch Signal	x	x
49	CD Fire		
50	PAL Regulator Control		
51	PAL Key and Data		
52	PAL Unlock Monitor		
53	REM Battery Heater Power	x	
54	REM Battery Heater Power Return	x	
55	Capsule Dry	x	x
56	Reserved CTE 2 (TECHEVAL)		
57	CD Clock		
58	Coded Launch Excitation	x	x
59	PAL Status Monitor		
60	Warhead Prearm Command (Sim)		
61	Spare #3		
62	CD Data		
63	CD Power		
64	Liquid Detector Power	x	x
65	Capsule Arm Command (Sim)		
66	PAL/CD Return		
67	Coded Charge Signal	x	x
68	Spare #5		
69	CD Monitor	x	x
70	Capsule Arm Command	x	x
71	Capsule Armed Monitor	x	x
72	Capsule Safed Monitor	x	x
73	Fire Pulse Detected	x	x
74	Liquid in Capsule	x	x
75	Coded Charge Excitation	x	x
76	Spare #6		
77	Spare #7		
78	Shield Carry Through	x	x
79	CCS Interface		
80	Integrity Monitor		
81	Missile Away	x	x
82	Capsule Converter Power	x	x
83	Capsule Monitor Power	x	x
84	Capsule Regulator Power	x	x
85	Capsule Power Return	x	x

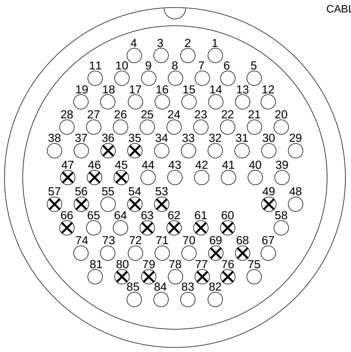
WCC (85 Conductor) PIN FUNCTION “Cont’d”

14



MISSILE TUBE PENETRATOR
WATER SIDE

NOTE: PINS WITH AN "X" ARE NOT USED WITH THE NEW 56 CONDUCTOR WEAPON CONTROL CABLE WHICH HAVE "CAC" MARKED ON THE MOLDED CONNECTOR AT BOTH ENDS OF THE CABLE ASSEMBLY.



MISSILE TUBE PENETRATOR
MISSILE SIDE

PIN ARRANGEMENT

11

EHP			
PIGTAIL	OUTBOARD CONNECTION	OUTBOARD CABLE	TUBE PENETRATOR
A	1	1	1
B	2	2	2
C	3	3	3
D	4	4	4
E	5	5	5
F	6	6	6
H	7	7	7
J	8	8	8
K	9	9	9
L	10	10	10
M	11	11	11
N	12	12	12
P	13	13	13
R	14	14	14
S	15	15	15
T	16	16	16
U	17	17	17
V	18	18	18
W	19	19	19
X	20	20	20
Y	21	21	21
Z	22	22	22
a	23	23	23
b	24	24	24
c	25	25	25
d	26	26	26
f	27	27	27
g	28	28	28
h	29	29	29
i	30	30	30
j	31	31	31
k	32	32	32
m	33	33	33
n	34	34	34
p	35	35 X	35
q	36	36 X	36
r	37	37	37
s	38	38	38
t	39	39	39
u	40	40	40
v	41	41	41
w	42	42	42
x	43	43	43

NOTE: Pins with an "X" are not used with the new 56 conductor cable

WEAPON CONTROL CIRCUIT PIN-OUTS

9

PIN	FUNCTION	109C	109D
1	Data Uplink (+)	x	x
2	Data Uplink (-)	x	x
3	Data Downlink (+)	x	x
4	Data Downlink (-)	x	x
5	Data Clock (+)	x	x
6	DC Monitor/Reset Power	x	x
7	DC Monitor/Reset Power Return	x	x
8	Chassis Static Ground	x	x
9	Booster Arm Command	x	x
10	Data Shield Carry Through	x	x
11	Spare	x	x
12	Data Clock Complement	x	x
13	Digital I/O Power Supply Return	x	x
14	Fire Command (Intent to Launch)	x	x
15	Booster Safe Command	x	x
16	Simulator Present (AUR Simulator)	x	x
17	PC Shield Carry Through	x	x
18	Missile Enabled	x	x
19	Spare	x	x
20	Data Enable True	x	x
21	Identification Power	x	x
22	Booster Armed Monitor	x	x
23	Booster Safe Monitor	x	x
24	Missile Bus Monitor	x	x
25	Spare	x	x
26	Spare	x	x
27	Spare	x	x
28	PCM Data (+) (If REM Missile)	x	x
29	Data Enable Complement	x	x
30	Weapon Ident Bit No. 0		
31	Weapon Ident Bit No. 1	x	
32	Weapon Ident Bit No. 2		
33	Operate Power Phase A 400 Hz	x	x
34	Operate Power Phase B 400 Hz	x	x
37	CMGS Reprogram Command	x	
38	PCM /data (-) (If REM Missile)	x	x
39	Weapon Ident Bit No. 3	x	x
40	Weapon Ident Bit No. 4	x	x

NOTE: Pins not shown are not used with the WCC 56 conductor cable.

WCC (56 Conductor) PIN FUNCTION

15

PIN	FUNCTION	109C	109D
1	Data Uplink (+)	x	x
2	Data Uplink (-)	x	x
3	Data Downlink (+)	x	x
4	Data Downlink (-)	x	x
5	Data Clock (+)	x	x
6	DC Monitor/Reset Power	x	x
7	DC Monitor/Reset Power Return	x	x
8	Chassis Static Ground	x	x
9	Booster Arm Command	x	x
10	Data Shield Carry Through	x	x
11	Warhead Safe Control (Command)		
12	Data Clock Complement	x	x
13	Digital I/O Power Supply Return	x	x
14	Fire Command (Intent to Launch)	x	x
15	Booster Safe Command	x	x
16	Simulator Present (AUR Simulator)	x	x
17	Warhead Shield Carry Through	x	x
18	Missile Enabled	x	x
19	Warhead Prearm Control (Command)		
20	Data Enable True	x	x
21	Identification Power	x	x
22	Booster Armed Monitor	x	x
23	Booster Safe Monitor	x	x
24	Missile Bus Monitor	x	x
25	REM Abort (If REM Missile)		
26	Warhead Prearm Monitor		
27	Warhead Safe Monitor		
28	PCM Data (+) (If REM Missile)		
29	Data Enable Complement	x	x
30	Weapon Ident Bit No. 0		
31	Weapon Ident Bit No. 1	x	
32	Weapon Ident Bit No. 2		
33	Operate Power Phase A 400 Hz	x	x
34	Operate Power Phase B 400 Hz	x	x
35	Spare #1		
36	Missile Continuity Loop		
37	CMGS Reprogram Command	x	x
38	PCM /data (-) (If REM Missile)		
39	Weapon Ident Bit No. 3	x	x
40	Weapon Ident Bit No. 4	x	x
41	Weapon Ident Bit No. 5		
42	Operate Power Phase C 400 Hz	x	x

WCC (85 Conductor) PIN FUNCTION

13

PIN	FUNCTION	109C	109D
41	Weapon Ident Bit No. 5		
42	Operate Power Phase C 400 Hz	x	x
43	Operate Power Neutral	x	x
44	Power Shield Carry Through	x	x
48	Coded Launch Signal	x	x
55	Capsule Dry	x	x
58	Coded Launch Excitation	x	x
64	Liquid Detector Power	x	x
65	Capsule Arm Command (Sim)		
67	Coded Charge Signal	x	x
70	Capsule Arm Command	x	x
71	Capsule Armed Monitor	x	x
72	Capsule Safed Monitor	x	x
73	Fire Pulse Detected	x	x
74	Liquid in Capsule	x	x
75	Coded Charge Excitation	x	x
78	Shield Carry Through	x	x
81	Missile Away	x	x
82	Capsule Converter Power	x	x
83	Capsule Monitor Power	x	x
84	Capsule Regulator Power	x	x
85	Capsule Power Return	x	x

NOTE: Pins not shown are not used with the WCC 56 conductor cable.

WCC (56 Conductor) PIN FUNCTION "Cont'd"

16

CABLE SOFTWARE (SSN 719 & 720)

CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1-P3	M83461/1-329	SK069
P4-P6	M83461/1-220	SK055
P7	M83461/1-329	SK070
P8	M83461/1-220	SK055

CABLE SOFTWARE (SSN 721 & LATER)

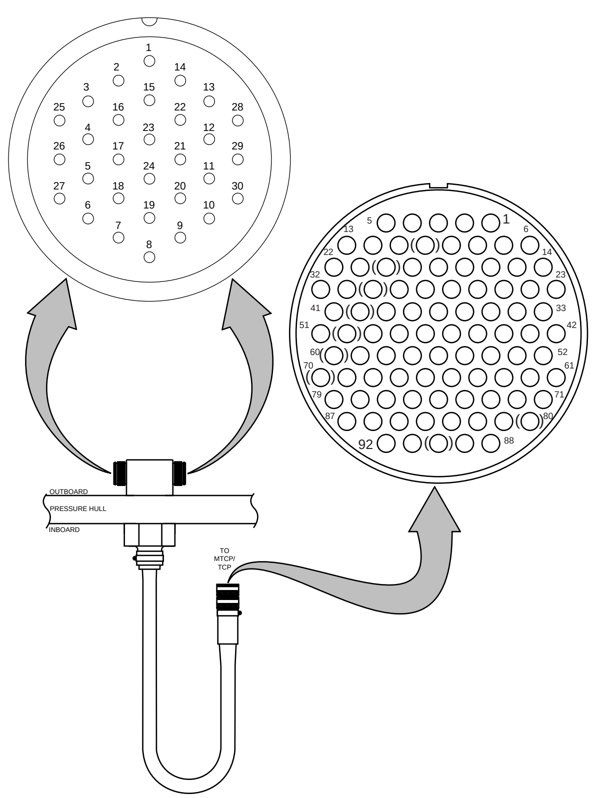
CONN	O-RING	RUBBER ISOLATION MEMBRANE
P1	M83461/1-329	SK069
P2-P6	M83461/1-220	SK055
P7	M83461/1-329	SK069
P8-P9	M83461/1-220	SK055
P10	M83461/1-329	SK070
P11-P13	M83461/1-220	SK055

MTCC DESIGNATION (SSN 719 & 720)

TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	OUTBOARD INTERCONNECTION HARNESS ASSY No.
5	J4 STBD	K-15EH33	P27-21S POS 1	K-15EH39	K-15EH51
6	J4 PORT	K-15EH36	P27-22P POS 1	K-15EH45	K-15EH57
7	J4 STBD	K-15EH33	P27-21S POS 2	K-15EH40	K-15EH52
8	J4 PORT	K-15EH36	P27-22P POS 2	K-15EH46	K-15EH58
9	J5 STBD	K-15EH34	P27-20S POS 1	K-15EH41	K-15EH53
10	J5 PORT	K-15EH37	P27-23P POS 1	K-15EH47	K-15EH59
11	J5 STBD	K-15EH34	P27-20S POS 2	K-15EH42	K-15EH54
12	J5 PORT	K-15EH37	P27-23P POS 2	K-15EH48	K-15EH60
13	J10 STBD	K-15EH35	P27-19S POS 1	K-15EH43	K-15EH55
14	J10 PORT	K-15EH38	P27-24P POS 1	K-15EH49	K-15EH61
15	J10 STBD	K-15EH35	P27-19S POS 2	K-15EH44	K-15EH56
16	J10 PORT	K-15EH38	P27-24P POS 2	K-15EH50	K-15EH62

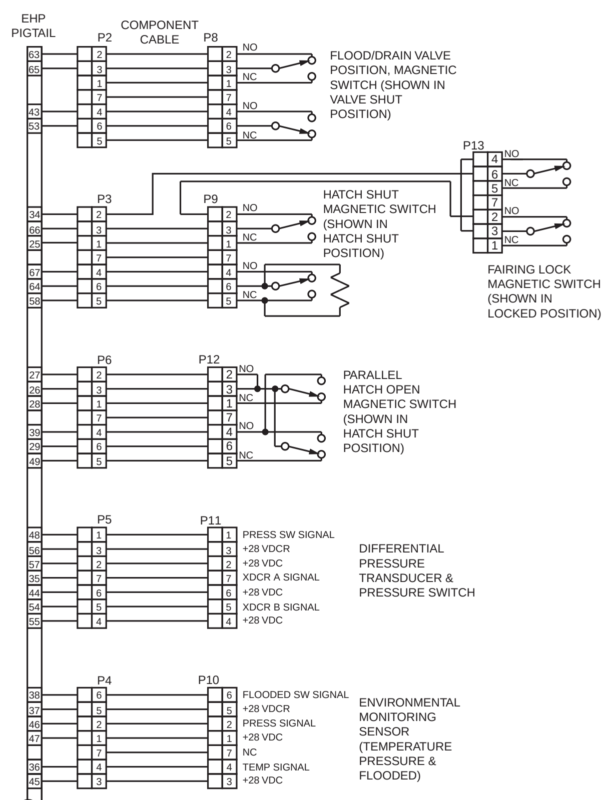
CABLE DESIGNATIONS

18



MISSILE TUBE CONTROL CABLE EHP

20



MTCC PIN OUT EHP POS 1
(TUBES 5, 6, 9, 10, 13 & 14)

22

MTCC DESIGNATION (SSN 721 THRU 725 & 750)

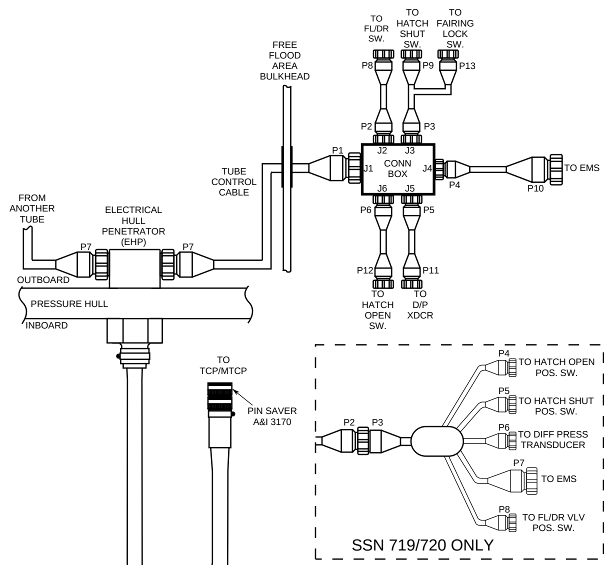
TUBE NO.	MTCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	TANK BULKHEAD PENETRATOR	OUTBOARD CABLE ASSEMBLIES				
						F/D VALVE	HATCH SHUT/ FAIRING LOCK	EMS	DPT	HATCH OPEN
5	J4 STBD	K-15EH33	P27-19S POS 1	K-15EH51	T26	K-15EH51A	K-15EH51B	K-15EH51C	K-15EH51D	K-15EH51E
6	J4 PORT	K-15EH36	P27-22P POS 1	K-15EH57	T25	K-15EH57A	K-15EH57B	K-15EH57C	K-15EH57D	K-15EH57E
7	J4 STBD	K-15EH33	P27-19S POS 2	K-15EH52	T26	K-15EH52A	K-15EH52B	K-15EH52C	K-15EH52D	K-15EH52E
8	J4 PORT	K-15EH36	P27-22P POS 2	K-15EH58	T25	K-15EH58A	K-15EH58B	K-15EH58C	K-15EH58D	K-15EH58E
9	J5 STBD	K-15EH34	P27-20S POS 1	K-15EH53	T24	K-15EH53A	K-15EH53B	K-15EH53C	K-15EH53D	K-15EH53E
10	J5 PORT	K-15EH37	P27-23P POS 1	K-15EH59	T23	K-15EH59A	K-15EH59B	K-15EH59C	K-15EH59D	K-15EH59E
11	J5 STBD	K-15EH34	P27-20S POS 2	K-15EH54	T26	K-15EH54A	K-15EH54B	K-15EH54C	K-15EH54D	K-15EH54E
12	J5 PORT	K-15EH37	P27-23P POS 2	K-15EH60	T25	K-15EH60A	K-15EH60B	K-15EH60C	K-15EH60D	K-15EH60E
13	J10 STBD	K-15EH35	P27-21S POS 1	K-15EH55	T24	K-15EH55A	K-15EH55B	K-15EH55C	K-15EH55D	K-15EH55E
14	J10 PORT	K-15EH38	P27-24P POS 1	K-15EH61	T23	K-15EH61A	K-15EH61B	K-15EH61C	K-15EH61D	K-15EH61E
15	J10 STBD	K-15EH35	P27-21S POS 2	K-15EH56	T24	K-15EH56A	K-15EH56B	K-15EH56C	K-15EH56D	K-15EH56E
16	J10 PORT	K-15EH38	P27-24P POS 2	K-15EH62	T23	K-15EH62A	K-15EH62B	K-15EH62C	K-15EH62D	K-15EH62E

MTCC DESIGNATION (SSN 751 & LATER)

TUBE NO.	TCP RECEPTACLE NO.	INBOARD CABLE NO.	EHP NO.	OUTBOARD CABLE NO.	TANK BULKHEAD PENETRATOR	OUTBOARD CABLE ASSEMBLIES				
						F/D VALVE	HATCH SHUT/ FAIRING LOCK	EMS	DPT	HATCH OPEN
5	UNIT 5 J14	K-15EH1	P27-19S POS 1	K-15EH51	T26	K-15EH51A	K-15EH51B	K-15EH51C	K-15EH51D	K-15EH51E
6	UNIT 2 J14	K-15EH4	P27-22P POS 1	K-15EH57	T25	K-15EH57A	K-15EH57B	K-15EH57C	K-15EH57D	K-15EH57E
7	UNIT 5 J14	K-15EH1	P27-19S POS 2	K-15EH52	T26	K-15EH52A	K-15EH52B	K-15EH52C	K-15EH52D	K-15EH52E
8	UNIT 2 J14	K-15EH4	P27-22P POS 2	K-15EH58	T25	K-15EH58A	K-15EH58B	K-15EH58C	K-15EH58D	K-15EH58E
9	UNIT 6 J5	K-15EH2	P27-20S POS 1	K-15EH53	T24	K-15EH53A	K-15EH53B	K-15EH53C	K-15EH53D	K-15EH53E
10	UNIT 1 J5	K-15EH5	P27-23P POS 1	K-15EH59	T23	K-15EH59A	K-15EH59B	K-15EH59C	K-15EH59D	K-15EH59E
11	UNIT 6 J5	K-15EH2	P27-20S POS 2	K-15EH54	T26	K-15EH54A	K-15EH54B	K-15EH54C	K-15EH54D	K-15EH54E
12	UNIT 1 J5	K-15EH5	P27-23P POS 2	K-15EH60	T25	K-15EH60A	K-15EH60B	K-15EH60C	K-15EH60D	K-15EH60E
13	UNIT 6 J10	K-15EH3	P27-21S POS 1	K-15EH55	T24	K-15EH55A	K-15EH55B	K-15EH55C	K-15EH55D	K-15EH55E
14	UNIT 1 J10	K-15EH6	P27-24P POS 1	K-15EH61	T23	K-15EH61A	K-15EH61B	K-15EH61C	K-15EH61D	K-15EH61E
15	UNIT 6 J10	K-15EH3	P27-21S POS 2	K-15EH56	T24	K-15EH56A	K-15EH56B	K-15EH56C	K-15EH56D	K-15EH56E
16	UNIT 1 J10	K-15EH6	P27-24P POS 2	K-15EH62	T23	K-15EH62A	K-15EH62B	K-15EH62C	K-15EH62D	K-15EH62E

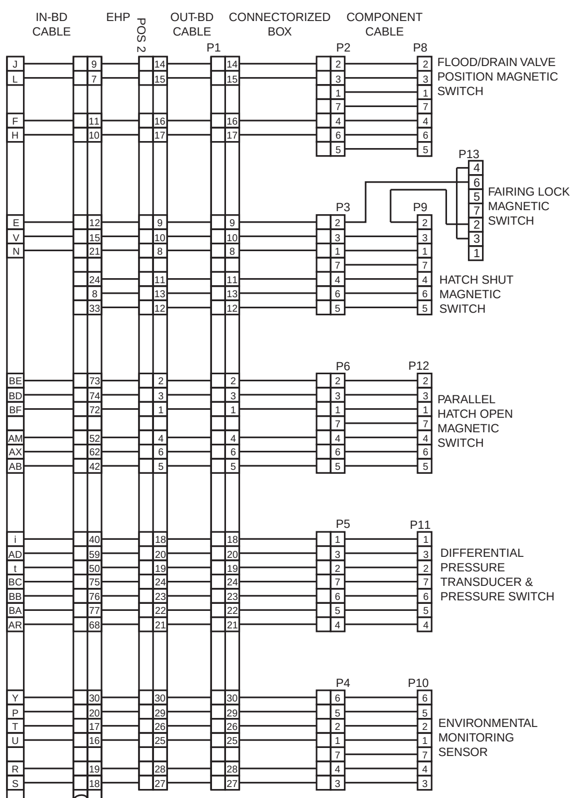
CABLE DESIGNATIONS

19



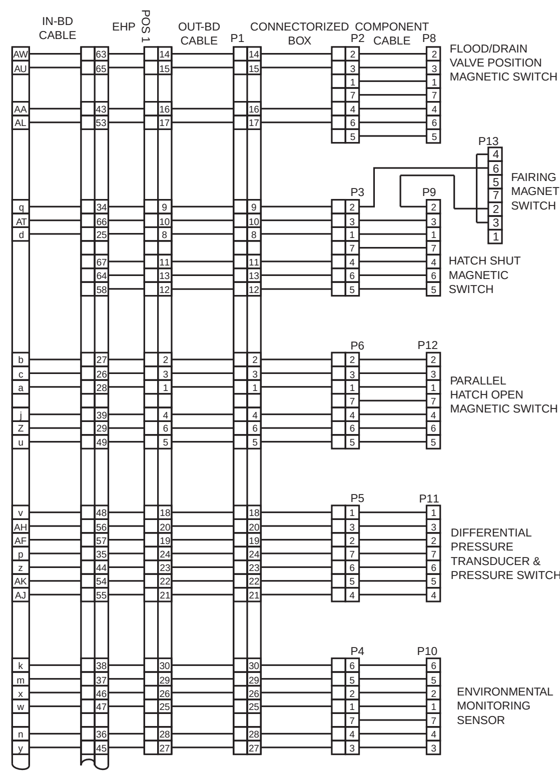
MISSILE TUBE CONTROL CABLING (TYPICAL)

17



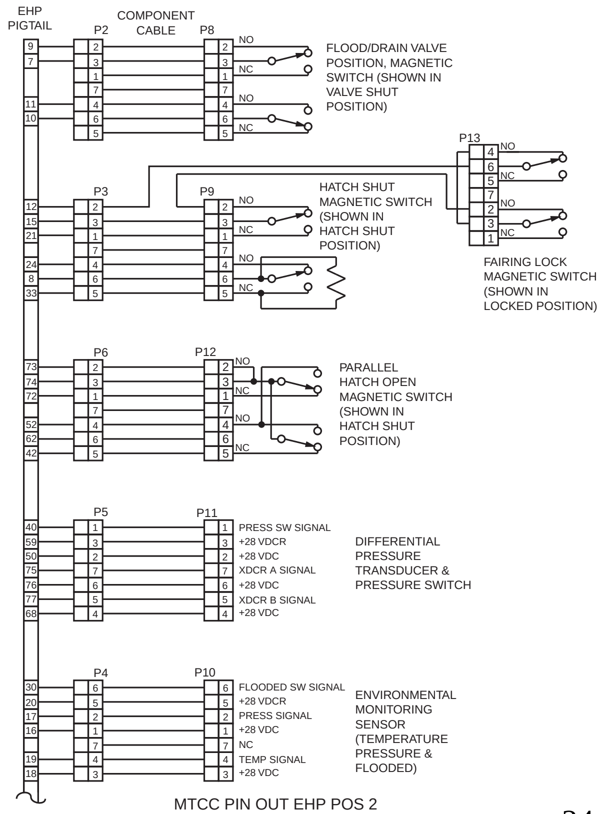
MTCC WIRING DIAGRAM POS 2
(TUBES 7, 8, 11, 12, 15 & 16)

23



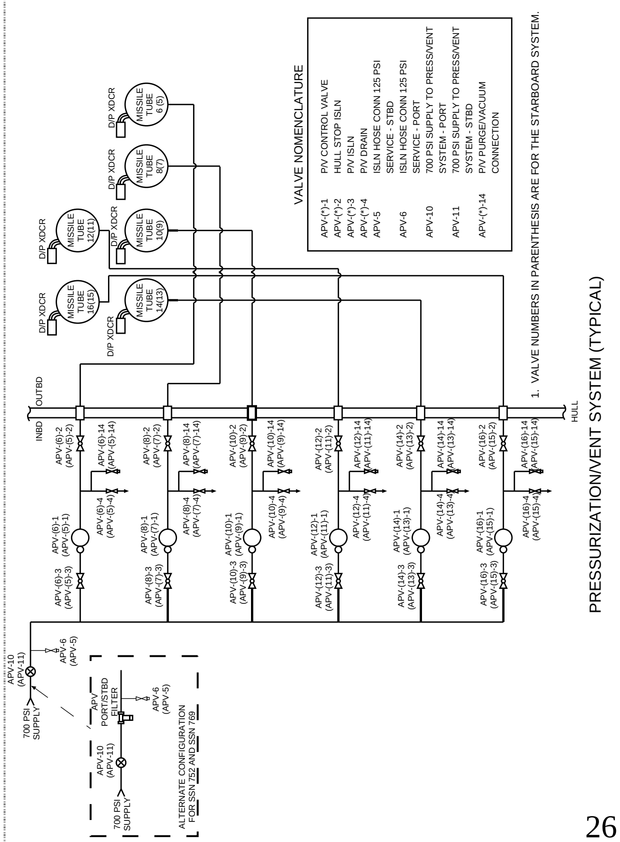
MTCC WIRING DIAGRAM POS 1
(TUBES 5, 6, 9, 10, 13 & 14)

21



MTCC PIN OUT EHP POS 2
(TUBES 7, 8, 11, 12, 15 & 16)

24



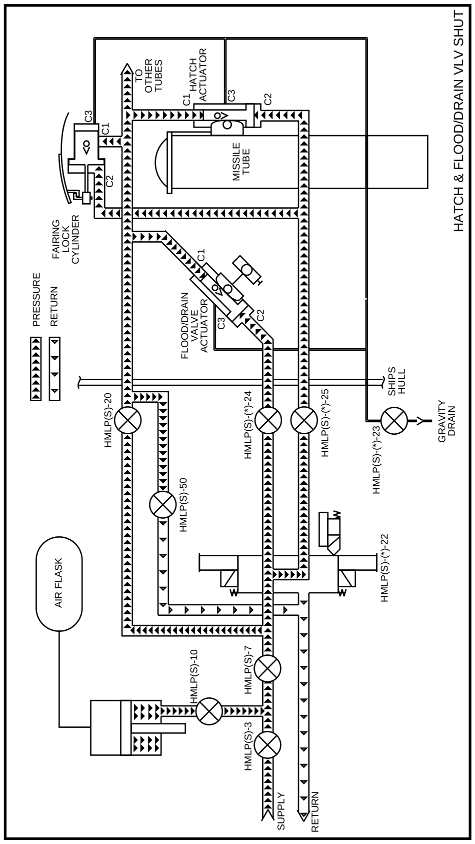
PRESSURIZATION/VENT SYSTEM (TYPICAL)

26

DESCRIPTION	NSN/MS NO.
Delta "P" Plug	5365-01-208-8262
Delta "P" O-ring	M83461/2-906
O-Ring for 7 Pin Connectors	M83461/1-220
Missile Tube Receptacle O-ring	M83461/1-235
Umbilical/Security Cap O-ring	M83461/1-238
P/V Filter O-ring -1 -2	M83461/1-224 M83461/1-227
Umbilical Ratcheting Wrench	5120-01-333-3178
Fairing Lock Cylinder - O-Rings C-1 C-2 C-3	 M83461/1-020 M83461/1-020 M83461/1-018
Fairing Lock Cylinder Back-ups (if required)	MS28774-018/020
Muzzle Hatch Actuator O-Rings C-1 C-2 C-3 (small) C-3 (large)	 M83461/1-218 M83461/1-223 M83461/1-215 M83461/1-223
Muzzle Hatch Actuator Back-ups C-1 C-2	 MS28774-218 MS28774-223
Flood/Drain Valve Actuator O-Rings C-1 C-2 C-3 (small) C-3 (large)	 M83461/1-117 M83461/1-120 M83461/1-215 M83461/1-223
Flood/Drain Valve Actuator Back-ups C-1 C-2	 MS28774-117 MS28774-120
D/P Transducer Pipe Connections	M83461/1-018
Environmental Monitoring Connector O-Ring	M83461/1-329
30 Pin Conductor Cable O-Ring	M83461/1-329
Rubber Isolation Membrane 6 Pin	SK070
Rubber Isolation Membrane 7 Pin	SK055
Rubber Isolation Membrane 30 Pin	SK069
Preece Fitting O-Rings External Internal (body) Internal (poppet)	 M83461/2-906 M83461/1-18 M83461/1-14
Bulkhead Grommet Assembly	6557923
Bulkhead Gland Ring	6557943-2
HML-23 Test Plug O-Ring	M83461/1-111
HML-23 Test Plug Back-Up	MS28782-9

MISCELLANEOUS PARTS IDENTIFICATION

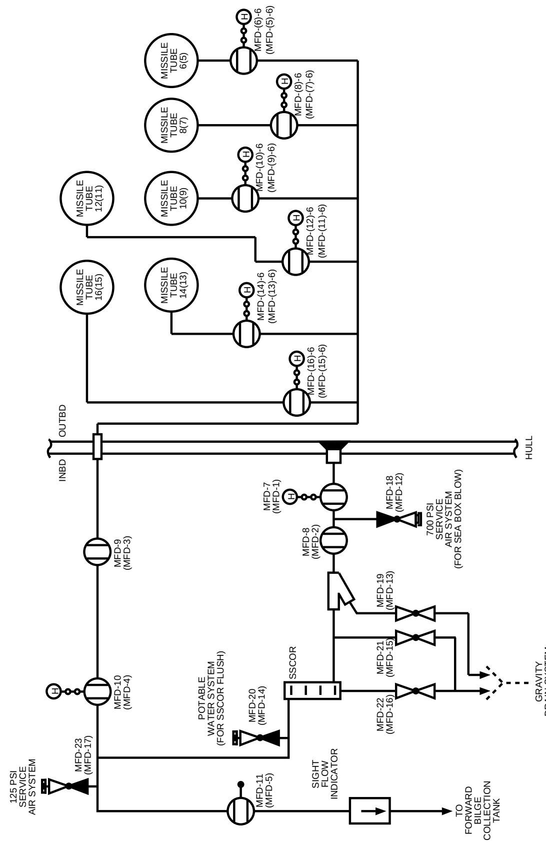
28



NOTES: 1. (S) IN VALVE NUMBERS ARE FOR THE STARBOARD TUBES.
2. * INDICATES TUBE NUMBER.

HYDRAULIC SYSTEM (TYPICAL)

27



FLOOD/DRAIN SYSTEM (TYPICAL)

25

NUWC CODE 4124

29

APPENDIX B
MISSILE TUBE CONTROL PANEL (MTCP)
FAULT TROUBLESHOOTING GUIDE

MTCP Fault Troubleshooting.

This guide is intended to provide insight to the VLS MTCP interface and should provide knowledge for determining the most likely cause of a problem. Prior to performing this guide ensure the appropriate general troubleshooting is complete. The technician must then utilize applicable procedures located in this appendix and additional technical manuals as required to find the exact cause. This guide consists of 2 figures and 3 tables to aid in troubleshooting.

Since most problems have occurred in the hatch shut not flooded condition (i.e. station keeping), troubleshooting is approached starting in Figure B- 1, which provides the normal MTCP display that an operator should see during normal operation while underway in station keeping line-up with an AUR pressurized to IN BAND. For added help, Figure B-2 is included to show the peculiar MTCP display that an operator should see if the tube +28VDC circuit breaker were tripped during this same period and under these same conditions.

a. Locate the indication in question on Figure B- 1 and cross it over to Table B-1.

NOTE

Table B-1 provides alphabetic character fault codes associated with the faulty indicator or meter.

b. Locate the first fault code listed on Table B-1 and cross it over to Table B-2 for the fault description.

c. Repeat APPENDIX B step b. for the remaining listed fault codes until the problem is isolated.

NOTE

All notes referenced in Table B-1 and Table B-2 are listed in Table B-3. Refer to Note 4 for Foldouts (FO) reference.

Table B-1. MTCP Fault Code Identification

Indication: Note (1)		Abnormal Indication:	Fault Code Identity (Possible Causes): Notes (3), (4), (5) and (9)
Nomenclature	**No.**		
FAIL A	2	ON or FLASHING	AB, AN, AM, AO, AL, AU, AC
A	3	Both ON	AB
B	4	Both OFF	AB
		Do not Toggle properly	AB, AC, AS, AU
FAIL B	5	ON or FLASHING	AB, AN, AM, AO, AL, AU, AC
Hatch Open Mimic	6	ON	A, J, K(a), W
		FLASHING	K(b)
HATCH BLOCKED	7	ON	R, J, K(c), W
Hatch Shut Mimic	8	OFF	B, AL, J, K(d), Note (11)
		FLASHING	(B, W) and (K(e), AF), (AF and AL) Notes (11 & 12)
FLOOD/DRAIN Valve	10	ON	C, U, V(a), X
"OPEN"		FLASHING	V(b)
FLOOD/DRAIN Valve	11	OFF	U, V(c)
"SHUT"		FLASHING	D, V(d), X
FLOOD READY	13	ON	Z, Y
DRAIN READY	14	ON	Z, Y
STANDBY	15	ON	L, N, P, Q
IN BAND	16	OFF	O, AO, AN, AL, AJ, AK, AB, AC, AD, AM, AU
DRAIN INHIBITED	17	ON	AG, AL, X, Z, Y, AC
Missile In Tube Mimic	18	OFF	AH, N, P, Q, AU
Tube Flooded Mimic	19	ON	H, N, S, AA, AJ
VENT	20	ON	AB, AY, AC, AD, (AF and AE) Note (13)
PRESS	21	ON	AB, AY, AC, AD
CONFLICT	22	ON	O, AO, AB, AY, AN, AC, AD, AM, AU
(Tube #) ALARM	27	ON	F, E, G, H, AL, AJ, T, S, AA
ALARM SILENCED	28	ON	AP, AQ, AR(b), AW

Meters

Digital Display: Note (1)		Normal Display:	Abnormal Display:	Fault Code Identity (Possible Causes): Notes (3), (4), (5) and (9)
Nomenclature	**No.**			
SYSTEM	1	+ 3.8 to + 7.2 PSID	+3.8 > PSID > +7.2	O, AO, AL, AX, AY, AM, AN, AJ, AK, AE, M, AX
PRESSURE		PSID		AT, AU, AV, AD
PSID			Decreases, while TUBE PRESS display increases	AK, AJ
			Flashing Error Number	M Note 15
			Constant -6.5 PSID	AO, AL, AN, AM
			Blank	AT, AV, AU
TUBE PRESS	30a	9 to 21 PSIA	Out-of-band	E, AT, AV, AJ, AK, T, AR(a)
			Increases with depth and tracks sea pressure	AJ
			Increases, while SYSTEM PRESSURE display decreases, but does not track sea pressure	AK
			Blank	AT, AV
TUBE TEMP	30b	0 to 100, ± 9 °F	Out-of-Band	G, AT, AV, T, AR(a)
			Blank	AT, AV

Table B-2. MTCP Fault Descriptions

Fault Code	**Indications Affected** Note (1)	**Fault Description:** Note (3)
A	6	**Inadvertent Hatch Open Signal Received from Tube:** Note (5) - Hatch Open Magnetic Switches #1 and #2, N.O. and Common contacts shorted together. - Partial or complete signal short to +28 vdc, between the Magnetic Switch and MTCP: B3 Card, Pin 36 (>14vdc) and Pins 8 & 9 (Low). (FO-14)
B	8	**Hatch Shut & Locked Signal Not Received from Tube:** Notes (5 & 11) - Hatch Shut Mag Switch and/or Hatch Fairing Locked Mag Switch magnets out of adjustment or magnets are corroded. - Hatch Shut Mag Switch or Fairing Lock Mag Switch damaged. - Signal degradation or open in the outboard Hatch Shut/Fairing Lock circuit: B3 Card, Pin 38 (Low) and Pin 6 (High), Hatch Shut mimic indicator Off. (FO-14) - Open in the Norm/Sim Switch or Norm/Sim Select Switch Enclosure. (FO-14) - Loss of +28 vdc outboard power to Hatch Shut or Fairing Locked Magnetic Switch Common contact, possibly caused by fault code AL, +28 vdc Fuse Blown. (FO-35)
C	10	**Inadvertent Flood/Drain Valve Open Signal Received from Tube:** Note (5) - Flood/Drain Valve Magnetic Switch #2, N.O. and Common contacts shorted together. - Partial or complete signal short to +28 vdc between the Magnetic Switch and MTCP: B3 Card, Pin 13 (>14vdc) and Pin 25 (Low): Flood/Drain Valve "OPEN" ON. (FO-14 & FO-22)
D	11	**Flood/Drain Valve Shut Signal Not Received from Tube:** Note (5) - Flood/Drain Valve Magnetic Switch #1 magnets out of adjustment or corroded. - Flood/Drain Valve Magnetic Switch damaged. - Signal degradation or open in the outboard Flood/Drain Valve Shut circuit: B3 Card, Pin 12 (Low) and Pin 24 (High): Flood/Drain Valve "SHUT" Flashing. (FO-14) - Open in the Norm/Sim Switch or Norm/Sim Select Switch Enclosure. (FO-14)

Table B-2. MTCP Fault Descriptions (Continued)

Fault Code	**Indications Affected** Note (1)	**Fault Description:** Note (3)
D	11 (Contd)	Loss of +28 vdc outboard power to Flood/Drain Valve Magnetic Switch #1 Common contact, possibly caused by fault code AL, +28 vdc Fuse Blown. (FO-35)
E	27, 30a	**EMS Pressure Signal Does Not Reflect Actual Underhatch Pressure:** Note (5) - Fault in outboard EMS pressure circuit. - EMS Pressure Sensor damaged. - Open in the Norm/Sim Switch, Norm/Sim Select Switch Enclosure. (FO-23) - Loss of +28 vdc power to EMS, possibly caused by fault AL, +28 vdc Fuse Blown. (FO-35)
F	27	**True Alarm Condition:** - Alarm condition present: take appropriate action in accordance with SSM Vo. 6 Pt. 3 OI 631-18 or OD44979, as required.
G	27, 30b	**EMS Temperature Signal Doesn't Reflect Actual Underhatch Temperature:** Notes (5 & 6) - Fault in outboard EMS temperature circuit. - EMS temperature sensor damaged. - Open in the Norm/Sim Switch, Norm/Sim Select Switch Enclosure. (FO-24) - Loss of +28 vdc power to EMS, possibly caused by fault AL, +28 vdc Fuse Blown. (FO-35) - See fault codes: AX, AY, as applicable.
H	19, 27	**Inadvertent Flooded Signal Received from EMS:** Note (5) - EMS flooded sensor damaged. - Partial or complete signal short to +28 vdc between EMS and MTCP: - B3 Card, Pin 39 (>14vdc) and Pin 5 (Low): Tube Flooded mimic indicator ON. (FO-26)
J	6, 7, 8	**Relay Fault: Hatch & Hatch Valve Position Indications:** - Tube Relay, B5 Card. (FO-14) - See fault codes AY, AX, as applicable.
K	6, 7, 8	**Logic Fault: Hatch Open, Hatch Shut and Hatch Blocked Indications:**
(a)		- Tube Logic #1, B1 Card, U5-10 (Low): Hatch Open ON. (FO-14)
(b)		- Tube Logic #1, B1 Card, U17-1 (High): Hatch Open Flashing. (FO-14 & FO-18)
(c)		- Tube Logic #1, B1 Card, U6-4 (Low): Hatch Blocked ON (FO-14 & FO-16)

Table B-2. MTCP Fault Descriptions (Continued)

Fault Code	**Indications Affected** Note (1)	**Fault Description:** Note (3)
(d)	(Contd)	- Tube Logic #1, B1 Card, U5-6 (High): Hatch Shut Off. (FO-14 & FO-18)
(e)	6, 7, 8	- Tube Logic #1, B1 Card, TP3, U3-15 (Low): Hatch Shut Flashing. (FO-14 & FO-18) - See fault codes: AX, AY, as applicable.
L	15	**Inadvertent Standby Signal Received from ICC:** - Partial or complete signal short to +28 vdc between the MTCP and ICC or inside the ICC: B3 Card, Pin 11 (>14vdc) and Pin 23 (Low): Standby indicator ON. (FO-12, Sht. 1)
M	1	**“Error” Detected by MTCP PVC Diagnostic Routines:** Note (15)
N	15, 18, 19	**Drvr/Rcvr Card Fault, Missile In Tube, Standby & Tube Flooded Indicators:** - Tube Drvr/Rcvr B3 Card (FO-12, Sht. 1 & FO-26)
O	1, 16, 22	**DPT Operational, but Signal Doesn’t Reflect Actual Differential Pressure Between Capsule and Underhatch Volume:** - Fault in outboard cabling, affecting the DPT A or B, 4-20 ma signal. Note (5) - Blocked, leaky or disconnected U/H1, U/H2 or AUR sense line(s).
P	15, 18	**Relay Card Fault, Missile In Tube & Standby Indications:** - Tube Relay, B5 Card. (FO-12, Sht. 1) - See fault codes: AX, AY, as applicable.
Q	15, 18	**Logic Card Fault, Missile In Tube & Standby Indications:** - Tube Logic #1, B1 Card. (FO-12, Sht. 1) - See fault codes: AX, AY, as applicable.
R	7	**Inadvertent Hatch Blocked Signal Received from HML-(*)-22 Valve:** - Hatch Blocked position switch out of adjustment or damaged. - Partial or complete signal short to +28 vdc between the MTCP and the HML-(*)-22 Valve: B3 Card, Pin 37 (>14vdc) and Pin 7 (Low). (FO-16)
S	19, 27	**Relay Card Fault, Tube Flooded Mimic and Missile Tube Alarm Indications:** - Tube Relay B5 Card. (FO-26) - See fault code AY.
T	27, 30a, 30b	**Analog Circuit Fault, EMS Temperature or Pressure:** - Analog signal conditioner or comparator fault: Temperature, Tube Logic B2 Card. (FO-24) - Analog signal conditioner or comparator fault: Pressure, Tube Logic B2 Card. (FO-23)

Table B-2. MTCP Fault Descriptions (Continued)

Fault Code	**Indications Affected** Note (1)	**Fault Description:** Note (3)
U	10, 11	**Relay Card Fault, Flood/Drain Valve Indications:** - Tube Relay B5 Card, U16-9 (Low): Flood/Drain Valve “OPEN” ON. (FO-14) - Tube Relay B5 Card, U15-9 (High): Flood/Drain Valve “SHUT” OFF. (FO-14) - See fault codes: AX, AY, as applicable.
V (a) (b) (c) (d)	10, 11	**Logic Card Fault, Flood/Drain Valve Indications:** - Tube Logic #1, B1 Card, U13-8 or U5-12 (Low): Flood/Drain Valve “OPEN” ON. (FO-14) - Tube Logic #1, B1 Card, U9-5/6 (Low): Flood/Drain Valve “OPEN” Flashing. (FO-14 & FO-16) - Tube Logic #1, B1 Card, U5-10 (High): Flood/Drain Valve “SHUT” OFF. (FO-14) - Tube Logic #1, B1 Card, U13-13 (High): Flood/Drain Valve “SHUT” Flashing. (FO-14) - See fault codes: AX, AY, as applicable.
W	6, 7, 8	**Drvr/Rcvr Card Fault, Hatch Open, Hatch Shut and Hatch Blocked Indications:** - Tube Drvr/Rcvr, B3 Card. (FO-14 & FO-16) - See fault codes: AX, AY, as applicable.
X	10, 11, 17	**Drvr/Rcvr Card Fault, Flood/Drain Valve Position or Drain Inhibited Indications:** - Tube Drvr/Rcvr, B3 Card. (FO-14, FO-20 & FO-22) - See fault codes: AX, AY, as applicable.
Y	13, 14, 17	**Logic Card Fault, Flood Ready, Drain Ready or Drain Inhibited Indications:** - Tube Logic #2, B2 Card. (FO-15 & FO-16) - Common Logic, B9 or B4 Cards. (FO-15) - PVC D3 Card, AUR Vented: Drain Inhibited Indicator. (FO-21 Sht.2) - See fault codes: AY, AX, as applicable.
Z	13, 14, 17	**Relay Card Fault, Flood Ready, Drain Ready or Drain Inhibited Indications:** - Tube Relay B5 Card. (FO-15) - See fault code AY.
AA	19, 27	**Logic Card Fault, Tube Flooded and Missile Tube Alarm Indications:** - Tube Logic B2 Card. (FO-26) - See fault codes AX, AY, as applicable.
AB	2, 3, 4, 5, 16, 20, 21,	**Relay Card Fault, PV Indications:** Note (14) - PVC Relay D4 Card. (FO-21, Shts. 3 & 1)

Table B-2. MTCP Fault Descriptions (Continued)

Fault Code	**Indications Affected** Note (1)	**Fault Description:** Note (3)
AB	22 (Contd)	- See fault codes AX, AY, as applicable.
AC	2, 3, 4, 5, 16, 17, 20, 21, 22	**Microcontroller Fault, DPT Indications:** - Incorrect processing of DPT signals, PVC D3 Card. (FO-21, Sht. 2)
AD	1, 16, 20, 21, 22	**Catastrophic Failure, PVC D3 Card:** - Multiple point failure in the logic or microcontroller of the D3 Card. (FO-21, Shts. 1 & 2)
AE	20	**PVC Mode Toggle Switch Fault:** Note (13) - Short to Gnd on pin 3 (MAN) of the PVC MODE Toggle Switch. (FO-21, Sht. 1)
AF	8, 20	**Monitor/Operate Keyswitch Fault:** Notes (11 & 12) - Short to Gnd on pin 2 of Monitor/Operate Key switch. (FO-5, Sht. 1, Zone 18C-D)
AG	17	**Capsule Vented Signal Not Received from Tube:** Note (5) - DPT Capsule Vented Pressure Switch failed open. - Open in the Norm/Sim Switch or Norm/Sim Select Switch Enclosure. (FO-20) - Partial or complete open circuit on the power or signal lines between the DPT Pressure Switch and MTCP: B3 Card, Pin 30 (Low) and Pin 67 (High): “DRAIN INHIBITED” ON. (FO-20) - Loss of +28 VDC outboard power to the Pressure Switch, possibly caused by fault code AL, +28 vdc Fuse Blown. (FO-35)
AH	18	**Inadvertent Missile Away Signal Received:** - Missile Away signal partial or complete short to +28 vdc between the MTCP and ICC or inside the ICC: B3 Card, Pin 10 (>14vdc) and Pin 22 (Low): Missile In Tube mimic indicator Off. (FO-12) - Faulty or shorted AUR Missile Away Switch.
AJ	1, 16, 19, 27, 30a	**Unseated Hatch or Leaky Muzzle Seal Caused Underhatch Volume to Flood, and Underhatch Pressure Tracks Sea Pressure, causing any of the following:** Note (7) - Loss of IN BAND indication (SYSTEM PRESS Meter displays < 3.8 PSID). - Flooded Alarm (Tube Flooded Mimic & ALARM indicators are lit). - Pressure Alarm, when underhatch press ≥ 55 psia (keel depth > 125’; ALARM indicator is lit). - Capsule diaphragm will rupture, if max launch depth is exceeded (Missile $\Delta P \leq 0.0$ PSID).

Table B-2. MTCP Fault Descriptions (Continued)

Fault Code	**Indications Affected** Note (1)	**Fault Description:** Note (3)
AK	1, 16, 30a	**Faulty or damaged AUR Pressure System:** - Disconnected or leaky: AUR sensing hose, preece fitting(s) or capsule diaphragm seal. - Ruptured capsule diaphragm (SYSTEM PRESS Meter displays approximately 0.0 PSID).
AL	1, 2, 5, 8, 16, 17, 27	**Tube +28 vdc Fuse Blown:** Figure 2 & Note (5) - Short to Gnd on +28 vdc power line between MTCP and Magnetic Switches, EMS or DPT, or +28 vdc power shorted to Gnd inside Magnetic Switches, EMS or DPT. e.g. flooded cable
AM	1, 2, 5, 16, 22	**Analog Circuit Fault, P/V Indications:** - DPT A or B analog signal conditioner fault on the PVC D3 Card. (FO-21, Sht. 1) - Open K1 (K12) or K2 (K13) Relay Contacts on the PVC D3 Card. (FO-21, Sht. 1) - See fault codes AX, AY, as applicable.
AN	1, 2, 5, 16, 22	**Norm/Sim Switch Fault, DPT Circuit:** - Open DPT A or B signal circuit from Tube or Norm/Sim Select Switch Enclosure. (FO-20)
AO	1, 2, 5, 16, 22	**DPT Fault:** - DPT A or B damaged. - Loss of +28 vdc power to DPT, possibly caused by fault AL, +28 VDC Fuse Blown. (FO-35)
AP	28	**Relay Card Fault, Alarm Silenced:** - Tube Relay, B5 Card. (FO-11). - See fault code AY
AQ	28	**DIP Switch Fault, Alarm Silence:** - Open circuit, S2 or S3 DIP Switches, Tube Temp Memory, B8 Card. (FO-25, Sht. 2) - See fault code AY
AR (a) (b)	 30a, 30b 28	**Logic Card Fault, Tube Temperature Memory:** - U6 Latch fault, Tube Temp Memory, B8 Card. (FO-25, Sht. 1) - U8 Latch fault, Tube Temp Memory, B8 Card. (FO-25, Sht. 2)
AS	3, 4	**XDCR Toggle Switch Fault, when toggled:** - Open circuit on pin 3 (B) or pin 4 (A) of XDCR Toggle switch. (FO-21, Sht. 2) - See fault code AX.
AT	1, 30a, 30b	**Faulty System Pressure Meter or Tube Press/Temp Meter** (See, as well, fault codes AX, AY, as applicable)

Table B-2. MTCP Fault Descriptions (Continued)

Fault Code	**Indications Affected** Note (1)	**Fault Description:** Note (3)
AU	1, 2, 3, 4, 5, 16, 18, 22	**Logic Card Fault: System Pressure Meter Data Signals, & Missile Tube Indicator Module:** - U2 Latch Fault, PVC D3 Card. (FO-21, Shts. 2 & 3) - See fault codes AX, AY, as applicable.
AV	1, 30a, 30b	**Loss of +12vdc/12vdc Rtn (Gnd) to System Pressure or Tube Press/Temp Meter.** Note (8) (See, as well, fault code AX)
AW	28	**Microcontroller Fault, Tube Temp/Press Meter** - Tube Temp Mem, B8 Card. (FO-25, Sht. 2)
AX	All Indicators & Meters	**Indicator or Meter Fails to Light:** Note (8) - Unseated or faulty indicator lamp assembly, contact, incandescent bulb or meter LED display. - Open in power distribution or signal wiring to switches, indicators or meter circuits. - Indicators: unseated or broken contact on Tube Drvr/Rcvr B3, Logic B1, Logic B2 or Relay B5 Card or associated harness connectors, as applicable. - System Pressure Meter: unseated or broken contact on PVC D3 or PVC Relay D4 Card or associated harness connectors, as applicable. - Tube Press/Temp Meter: unseated or broken contact on Common Logic B4, Tube Logic B2 or Press/Temp B8 Card or associated harness connectors, as applicable. - Depth Meter: unseated or broken contact on Common Logic B4 Card or associated harness connectors, as applicable.
AY	All Indicators & Meters	**Indicator or Meter Abnormally Lit:** - Gnd or power fault within interconnecting harness wiring, between the rear connector panel, Norm/Sim Switch Panel, Card Rack Assys and/or Front Panel indicators or meters. - Gnd fault on the associated Drvr/Rcvr or Logic Card output circuit. - Gnd fault on the associated Relay Card input circuit. - Gnd or power fault within either the Upper or Lower Card Rack Assembly backplane wiring. - Power fault on the +28 vdc or Lampcheck input signal to the Drvr/Rcvr Card circuit. - 5vac (FO-33) or +28vdc (FO-35) fault via the Lamp Test Switch or associate Card Rack Assy.

Table B-3. MTCP Fault Code Identification "Notes"

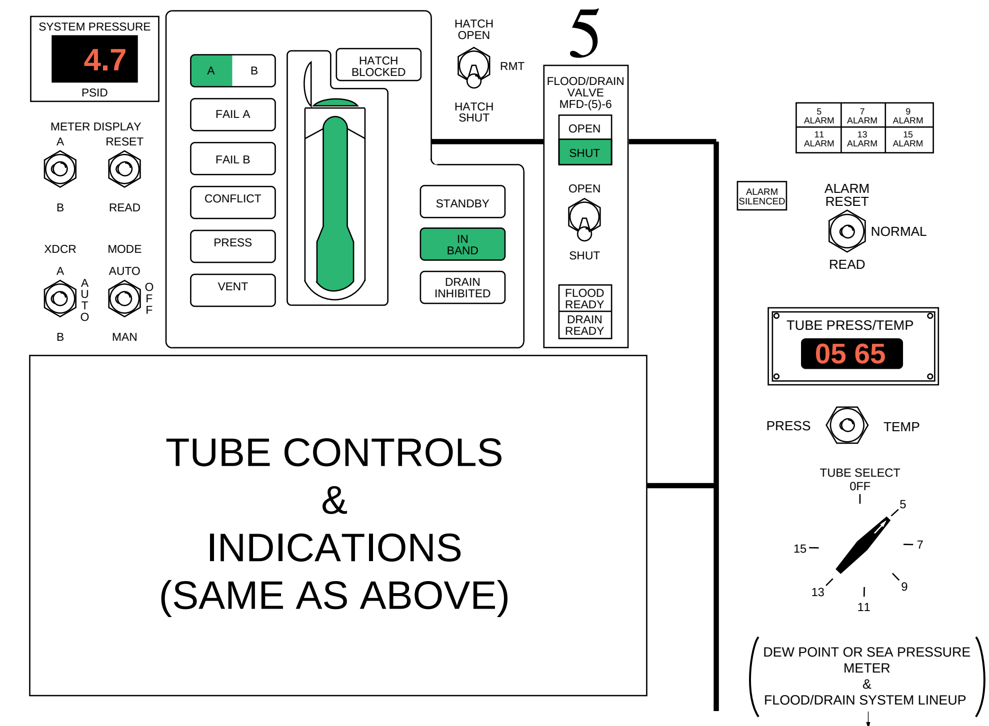
NOTE	REMARKS
1	Reference, MTCP Tech Manual No. S9727-AA-MMA-010, Vol. 1, Table 2-2, "MTCP Operator Controls and Indicators".
2	Reference SSM Vol. 6, Pt. 3, Bk. 3, O/I 631-18 "VLS Operating Instructions" functional procedures (FP) 1 through 4 and "AUR Replenishment", FP 15, were used to determine the "normal" conditions for MTCP controls, indications and displays shown in Figure B-1. Abnormal indications and displays, as identified in Figure B-2 and Table B-1, and described in Table B-2, reflect the possible conditions and causes for "abnormal" MTCP indicators and displays, when or if a fault occurs.
3	Fault Code Identification Table B-1 associates fault code letters with front panel indicators and meters for possible causes of abnormal indications and displays. The fault code letters, found under the "Fault Code Identity" column, are arranged "left-to-right" in order of likelihood. Fault Description Table B-2 provides descriptions of the fault codes identified in Table B-1. Possible causes of abnormal indications and displays, described under the "Fault Description" column, are arranged "top-to-bottom" in order of likelihood. In either table the fault codes and fault descriptions listed ("left-to-right" or "top-to-bottom") shall imply an "either/or" condition, unless otherwise noted by "and".
4	The following chapters and aids within the MTCP Tech Manual (NAVSEA No. S9727-AA-MMA-010, Vol. 1) may be used in conjunction with MTCP fault Tables 1 and 2 for fault isolation, correction and repair: a. Chapter 3 "Functional Description" b. Chapter 4 "Scheduled Maintenance" c. Chapter 5 "Troubleshooting": Offline standalone testing of the MTCP may be accomplished via the MTCP Maintenance Panel. With the applicable MTCP NORM/SIM SELECT Switches in the SIMULATE/MAINT position, the cause of an interface problem can be generally isolated to either the MTCP or to ship's cabling and outboard components. Further troubleshooting will be required, however, to isolate the problem to a single component. d. MTCP circuit diagram Foldouts (FO) FO-1 through FO-35.
5	Water or moisture may have entered the outboard cabling and/or component connectors, causing faulty indications and/or meter displays. Partial shorts (conductor/conductor or conductor/ground) or intermittent opens in outboard circuits, due to sea pressure, can cause intermittent indications and/or meter displays. If faults are depth related, faulty indications and displays may go away as ship surfaces. e.g. a pin-sized hole in an outboard cable opens at certain sea pressures (depths), allowing sea water to enter and cause a short between conductors and ship's ground. As ship surfaces, sea pressure decreases, allowing the hole to reseal itself, removing the sea water short to ship's ground.

Table B-3. MTCP Fault Code Identification "Notes" (Continued)

NOTE	REMARKS
6	Example: An open within the +28 vdc or 28 vdc power lines to the EMS Temperature Sensor, or an open within the 4-20 ma signal line from the EMS Temperature Sensor to the MTCP D3 card signal conditioning circuit, with MTCP powered on, will generate visual and/or audible environmental alarms at the MTCP, BCP and over the 1MC.
7	An unseated hatch may or may not cause the Hatch Shut (mimic) indicator to go OFF i.e. indicator status ultimately depends on adjustment of the outboard Hatch Shut & Fairing Lock mag-switches and magnets.
8	Specific examples of opens in switch, indicator or meter circuits, which would impact panel indications and/or operation are as follows: a. Missing 12vdc Return (Gnd) from line or load sides of tube control toggle-switches (Hatch, Flood/Drain). b. Missing 5vac Lamp Supply from Relay Cards (e.g. B5), or missing either 5vac Lamp Supply or Lamp Return from front panel indicators or meters. c. Missing 28vdc Reference Return (Gnd) from Drvr/Rcvr Cards. d. Missing 12vdc Bus or Reference Return (Gnd) from Drvr/Rcvr or Relay Cards, or meters.
9	See Fault Description Table, fault codes AX and AY for descriptions of typical internal faults that apply to all MTCP indicators and displays.
10	SSM Vol. 6, Pt. 3, Bk. 3, O/I 631-18, "AUR Replenishment", FP 15, requires that the pressure/vent valves APV-(*)-1, APV-(*)-2 and APV-(*)-3 be secured after AUR replenishment to prevent accidental pressurizing or venting of the capsule.
11	Fault Codes "B", "AL" and "W" apply to Hatch Shut mimic indicator Off, when the MONITOR/OPERATE keyswitch is in the MONITOR position only; and applies to the Hatch Shut mimic indicator Flashing when the keyswitch is in the OPERATE position only.
12	Fault "AF" applies, when the Tube MONITOR/OPERATE keyswitch is in MONITOR and a short to ground exists on pin 2 of the keyswitch; 12vdc Return (Gnd) on pin 2 of the keyswitch is normal when the tube is in OPERATE (FO-5, Sht. 1).
13	Fault Code "AE" (PVC MODE Switch fault) applies to VENT indicator ON, when the MONITOR/OPERATE keyswitch is in the OPERATE position only, or if fault code "AF" (Monitor/Operate Keyswitch fault) exists as well.

Table B-3. MTCP Fault Code Identification "Notes" (Continued)

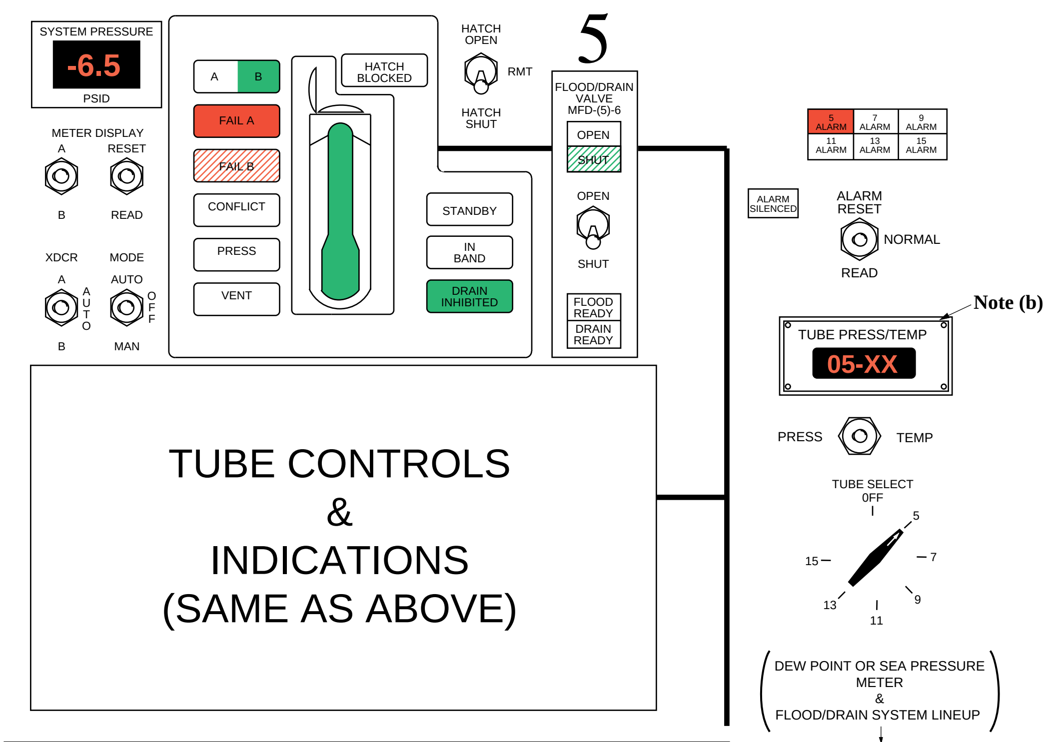
NOTE	REMARKS
14	When the MONITOR/OPERATE keyswitch is in OPERATE, two (2) P/V **"control relays"** on the D4 PCB would have to fail in order for 115 VAC to reach & energize the pressurize or vent solenoids: (See Ref. FO-21, Sht. 1) Pressurize Relays: K10 & K11 (Tubes: 5, 6, 9, 10, 13 and 14) K18 & K20 (Tubes: 7, 8, 11, 12, 15 and 16) Vent Relays: K9 & K11 (Tubes: 5, 6, 9, 10, 13 and 14) K19 & K20 (Tubes: 7, 8, 11, 12, 15 and 16) Only one of the following P/V **"indication relays"** would have to fail for an inadvertent PRESS (or VENT) ON indication, regardless of the position of the MONITOR/OPERATE keyswitch; however, neither the pressurize or vent solenoids will energize if these relays fail. (See Ref. FO-21, Sht. 3): PRESS Indication: K2 (Tubes: 5, 6, 9, 10, 13 and 14) K13 (Tubes: 7, 8, 11, 12, 15 and 16) VENT Indication: K1 (Tubes: 5, 6, 9, 10, 13 and 14) K12 (Tubes: 7, 8, 11, 12, 15 and 16)
15	For specific information and guidance in troubleshooting "error numbers" displayed on the System Pressure Meter, refer to the following within MTCP Tech. Manual, NAVSEA No. S9727-AA-MMA-010, Vol. 1 : a. Chapter 3, paragraphs 3-3.10.8 through 3-3.10.8-4. b. Chapter 5, Table 5-8 "PVC Microprocessor Diagnostic Tests".



Actuator / Indicator / Meter: Note(1)		Normal Condition
Nomenclature	**No.**	
SYSTEM PRESSURE PSID Meter	1	+3.8 to +7.2, ±0.4
FAIL A	2	
A	3	ON
B	4	
FAIL B	5	
Hatch Open Mimic	6	
HATCH BLOCKED	7	
Hatch Shut Mimic	8	ON
FLOOD/DRAIN VALVE "OPEN"	10	
FLOOD/DRAIN VALVE "SHUT"	11	ON
FLOOD READY	13	
DRAIN READY	14	
STANDBY	15	
IN BAND	16	ON
DRAIN INHIBITED	17	
Missile in Tube Mimic	18	ON
Tube Flood Mimic	19	
VENT	20	
PRESS	21	
CONFLICT	22	
PVC MODE Switch	23	OFF
(Tube No.) ALARM	27	
ALARM SILENCED	28	
TUBE PRESS	30a	9 to 21 PSIA
TUBE TEMP	30b	0 to 100, ±9 ˚F
MONITOR/OPERATE Keyswitch	55	MONITOR

Notes: Above indications and displays are considered OFF unless otherwise noted.

Figure B- 1. Underway with AURs Pressurized, and Monitor/Operate Switch in Monitor



Actuator / Indicator / Meter: Note(1) Nomenclature	No.	Normal Condition
SYSTEM PRESSURE PSID Meter	1	-6.5
FAIL A	2	ON
A	3	
B	4	ON
FAIL B	5	FLASHING
Hatch Open Mimic	6	
HATCH BLOCKED	7	
Hatch Shut Mimic	8	
FLOOD/DRAIN VALVE "OPEN"	10	
FLOOD/DRAIN VALVE "SHUT"	11	FLASHING
FLOOD READY	13	
DRAIN READY	14	
STANDBY	15	
IN BAND	16	
DRAIN INHIBITED	17	ON
Missile in Tube Mimic	18	ON
Tube Flood Mimic	19	
VENT	20	
PRESS	21	
CONFLICT	22	
PVC MODE Switch	23	OFF
(Tube No.) ALARM	27	ON
ALARM SILENCED	28	
TUBE PRESS	30a	PSIA
TUBE TEMP	30b	˚F
MONITOR/OPERATE Keyswitch	55	MONITOR

Note (b)

Notes: (a) Above indications and displays are considered OFF unless otherwise noted.
(b) Disregard: Signals are interrupted and meter displays erroneous data.

Figure B-2. Underway with AURs Pressurized, Monitor/Operate Switch in Monitor and Tube +28 VDC Fuse Blown

APPENDIX C
TUBE CONTROL PANEL (TCP)
FAULT TROUBLESHOOTING GUIDE

TCP Fault Troubleshooting

This guide is intended to provide insight to the VLS TCP interface and should provide knowledge for determining the most likely cause of a problem. Prior to performing this guide ensures the appropriate general troubleshooting is complete. The technician must then utilize applicable procedures located in this appendix and additional technical manuals as required to find the exact cause. This guide consists of 2 figures and 3 tables to aid in troubleshooting.

Since most problems have occurred in the hatch shut not flooded condition (i.e. station keeping), troubleshooting is approached starting in Figure C-1, which provides the normal TCP display that an operator should see during normal operation while underway in station keeping line-up with an AUR pressurized to IN BAND. For added help, Figure C-2 is included to show the peculiar TCP display that an operator should see if the tube +28VDC circuit breaker were tripped during this same period and under these same conditions.

a. Locate the indication in question on Figure C-1 and cross it over to Table C-1.

NOTE

Table C-1 provides alphabetic character fault codes associated with the faulty indicator or meter.

b. Locate the first fault code listed on Table C-1 and cross it over to Table C-2 for fault description.

c. Repeat Appendix C step b. for the remaining listed fault codes until the problem is isolated.

NOTE

All notes referenced in Table C-1 and Table C-2 are listed in Table C-3. Refer to Note 4 for Foldouts (FO) reference.

Table C-1. TCP Fault Code Identification

Indication: Note (1)		**Abnormal Indication:**	**Fault Code Identity (Possible Causes):** Notes (2), (3) & (6)
Nomenclature	**No.**		
HATCH OPEN (Circle)	2a	ON	A, AU
HATCH SHUT (Bar)	2b	OFF	B, U, AP, AT, G
F/D VALVE OPEN (Circle)	3a	ON	C, AU
F/D VALVE SHUT (Bar)	3b	OFF	D, U, AP, AT
PRESS of PRESS/ALARM & TEMP of TEMP/ALARM	4a 5a	Both ON	E, AU
		Both OFF	E, AT
		Do not Toggle	AT, AU, E
ALARM of PRESS/ALARM	4b	FLASHING	H, F, G, W, Z, AB
		ON	AU
ALARM of TEMP/ALARM	5b	FLASHING	H, I, U, AP, W, AB
		ON	AU
MOIST ALARM	6	FLASHING	J, G
		ON	AU
RESET of RESET/ALARM	7a	FLASHING	K, L
		ON	AU
ALARM of RESET/ALARM	7b	ON	H, F, I, J, U, AP, AU, G, W, AB, Z, M, L
INTLK BYPASS	8	ON	AU
		FLASHING	N
HATCH LOCAL SEL HATCH REMOTE SEL	10 11	Both ON	AU, O
		Both OFF	AT, P
		Do not Toggle	AT, AU, Q
PRESS	12a	ON	S, AU
VENT	12b	ON	T, AU
IN BAND	13	OFF	R, U, AP, AS, AT, W, V, G, X, Y
CPSL VENTED	14	OFF	AA, U, AP, AT, S
HIGH DIFF PRESS	15	FLASHING	H, R, W, E
		ON	AU, E
XDCR CNFLT	16	ON	R, AS, AU, W, AB
XDCR FAILED	17	ON	R, U, AP, AU, W, AB
XDCR A SEL XDCR B SEL	18a 18b	Both ON	Y, AU
		Both OFF	X, AT
		Do not Toggle	AT, AU, Q
READY TO FLOOD	19	ON	AU, AC
FLOOD TUBE ORD	21	ON	AU, AD
FLOOD/EQL TUBE	22	ON	AU, AE, (AC and C)
		FLASHING	AC and AF
REMOTE READY	24	ON	AU, AG
OPEN HATCH ORD	25	ON	AU, AH, AJ
OPEN HATCH	26	FLASHING	AE
		ON	AU, AE and B
HATCH BLKD	27	ON	AU, AK
TUBE READY	28	ON	AU, AL
MSL AWAY	29	ON	AU, AM

Table C-1. TCP Fault Code Identification (Continued)

Indication: Note (1)		**Abnormal Indication:**	**Fault Code Identity (Possible Causes):** Notes (2), (3) & (6)
Nomenclature	**No.**		
HANGFIRE	30	FLASHING	AN
		ON	AU
SHUT HATCH	31	FLASHING	A, U, AB, G
		OFF	AT, AE
DRAIN INHB	32	ON	AA, U, AP, AU, S
SHUT FLOOD DRAIN VALVE	33	FLASHING OFF	D, U, AP
POWER AVAIL	36	ON	AT, AP
CB TRIP	37	ON	AP
LAMP CHECK	38	FLASHING	AU
		ON	AU

TCP Fault Code Identification (Meters)

Digital Display: Note (1)		**Normal Display:**	**Abnormal Display:**	**Fault Code Identity (Possible Causes):** Notes (2), (3) & (6)
Nomenclature	**No.**			
TUBE PRESS (Meter)	1a	9 to 21 PSIA	Out-of-Tolerance	F, W, AA, E, AQ
			Increases, while MSL DIFF PRESS display decreases, but does not track sea pressure	V
			Increases with depth and tracks sea pressure	G
			HTHP Error Code (s)	See Note (6)
			All Square 8s	AU
			Blank	F, U, AP, Z, AR, E
TUBE TEMP (Meter)	1b	0 to 100, ± 9 °F	Out-of-Tolerance	I, W, AB, E or AQ
			HTHP Error Code (s)	See Note (6)
			All Square 8s	AU
			Blank	I, U, AP, Z, AR, E
MSL DIFF PRESS (Meter)	9	+3.8 to +7.2, ±0.4 PSID	Out-of-Tolerance	R, AS, W, AB, E, AQ, Y
			Decreases, while TUBE PRESS display increases	V, G
			HTHP Error Code (s)	See Note (6)
			Constant -1.5 PSID	R, U, AP, G, E, X, Z
			All Square 8s	AU
			Blank	AQ, AR

Table C-2. TCP Fault Descriptions

Fault Code: Note (2)	**Indications Affected:** Note (1)	**Fault Description:** Notes (2) (3) & (6)
A	2a, 26	**Both Hatch Open signals received from Tube:** Note (4) - In the Hatch Open magnetic-switch: SW #1 and SW #2, N.O. and Common +28 VDC contacts are shorted together. - Signal lines shorted to +28 VDC between the magnetic switch and TCP
B	2b, 31	**No Hatch Shut signal from Tube:** - Hatch Shut and/or Hatch Fairing Locked switches and/or magnets are out of adjustment or magnets are corroded. - Hatch Shut switch or Fairing Lock switch bad. - Open in the outboard cabling for the Hatch Shut/Fairing Lock circuit.
C	3a, 22	**F/D Valve Open signal received:** Note (4) - In the F/D Valve magnetic switch: SW # 2, N.O. and Common +28 VDC contacts shorted together. - Signal line shorted to +28 VDC between the magnetic switch and TCP.
D	3b, 33	**F/D Valve Shut signal not received from Tube:** - F/D Valve magnetic switch and magnets are out of adjustment or magnets are corroded. - F/D Valve switch bad - An open in the outboard F/D valve shut circuit.
E	1a, 1b, 4a, 5a, 9, 15	**ETA (ETAA) card microcontroller fault:** - Incorrect processing of analog input or data output signals for differential pressure, EMS pressure, EMS temperature. - Fault in microcontroller PRESS/ALARM or TEMP/ALARM A/I selection circuits.
F	1a, 4b, 7b,	**EMS pressure signal does not reflect actual underhatch pressure:** Note (4) - EMS pressure sensor bad. - Fault in outboard cabling, causing the pressure signal to indicate > 55 PSIA.
G	1a, 4b, 6, 7b, 9, 13, 35	**Unseated hatch or leaky muzzle seal caused underhatch volume to flood. Underhatch pressure tracks sea pressure, causing any of the following:** Note (7) - MOIST ALARM flashes, (Reset) ALARM is ON and DRAIN TUBE A/I is OFF.

Table C-2. TCP Fault Descriptions (Continued)

Fault Code: Note (2)	**Indications Affected:** Note (1)	**Fault Description:** Notes (2) (3) & (6)
G	(Contd)	- IN BAND is OFF, when MSL DIFF PRESS displays < +3.8, ± 0.4 PSID. - TCP TUBE PRESS Meter tracks SEA PRESS Meter, ± 5 PSI. - Underhatch pressure alarm, when tube pressure > 55 PSIA (keel depths > 125). - Capsule diaphragm ruptures (implodes), when max launch depth is exceeded.
H	4b, 5b, 7b, 15	**True Alarm Condition: (Environmental Alarms or High Diff Press Alarm)** - Alarm condition present: take appropriate action in accordance with SSM Vol. 6 Pt. 3 OI 631-18A or OD44979.
I	1b, 5b, 7b	**EMS temperature signal does not reflect actual underhatch temperature:** Notes (4 & 8) - EMS temperature sensor bad. - Fault in outboard cabling, causing the temperature signal to indicate < 0°F or > 100°F.
J	6, 7b, 35	**Flooded signal received from EMS:** Note (4) - EMS flooded sensor bad. - EMS flooded signal line shorted to +28 VDC. - Fault in the MRG card logic. - Ground on the interconnecting wiring between the MRG and MRA cards.
K	7a	**True Alarm Condition: (Environmental Alarms)** - Prior alarm condition cleared: RESET (Alarm) A/I, when depressed, will reset the TCP environmental alarm circuits and cause the RESET indicator to go OFF.
L	7a, 7b	**Environmental alarm relay erroneously set and no other alarm indications present:** - MRB card relay fault in the set position (will not reset).
M	7b	Environmental alarm relay erroneously set and no other alarm indications present: - MRH (MRHH) card environmental alarm logic fault.
N	8	Interlock Bypass signal received at MRA lamp-driver: - Ground fault on signal circuit from Interlocks Bypass Keyswitch. - Logic fault on MRG card.
O	10, 11	Launch Mode Select Relay bad: - Relay N.O. and/or N.C. contacts shorted to Relay Common contacts.

Table C-2. TCP Fault Descriptions (Continued)

Fault Code: Note (2)	**Indications Affected:** Note (1)	**Fault Description:** Notes (2) (3) & (6)
P	10, 11	Launch Mode Select Relay bad: - Neither Relay N.O. or N.C. contacts shorted to Relay Common contacts.
Q	10, 11, 18a, 18b	Select Relay (Launch mode or XDCR A/B) does not change state: - Switch contacts do not make, when A/I pressed. - Relay (set or reset) bad. - Relay control logic fault.
R	9, 13, 15, 16, 17	**DPT signal does not reflect actual PSID between capsule and underhatch area:** Note (4) - DPT is bad. - Fault in outboard cabling, affecting the selected XDCR 4-20 ma signal.
S	12a, 14, 32	**Erroneous Pressurize Relay output control signal:** Note (11) - Ground fault on Relay coil between MRB (LMRB) and MRH (MRHH) cards, causing Pressurize Relay to energize. - Open circuit along the "Pressurize Not" signal line between the MRB (LMRB) and MRH. (MRHH) cards, causing CPSL VENTED to go OFF and DRAIN INHB to go ON (capsule pressurization N/A) . - Fault on MRH (MRHH) card pressurize control logic, causing Pressurize Relay to energize. - MRB (LMRB) card Pressurize Relay bad: Relay N.O. contacts shorted to Relay Common contacts, sending 115 VAC to pressurize control valve solenoid. - Ground fault on the P/V Mode Switch "AUTO" position circuit and selected XDCR signal is < 4.0 ± 0.4 PSID, causing Pressurize Relay to energize.
T	12b	**Erroneous Vent Relay output control signal:** Note (11) - Ground fault on relay coil, between the MRB (LMRB) and MRH (MRHH) cards, causing Vent Relay to energize. - Fault on MRH (MRHH) card vent control logic, causing Vent Relay to energize. - MRB (LMRB) card Vent Relay bad: Relay N.O. contacts shorted to Relay Common contacts, sending 115 VAC to vent control valve solenoid. - Ground fault on the P/V Mode Switch "MAN VENT" position circuit.

Table C-2. TCP Fault Descriptions (Continued)

Fault Code: Note (2)	**Indications Affected:** Note (1)	**Fault Description:** Notes (2) (3) & (6)
T	12b (Contd)	- Ground fault on the “AUTO” position circuit and selected XDCR signal is > 6.7 ± 0.4 PSID.
U	1a, 1b, 2b, 3b, 5b, 7b, 9, 13, 14, 17, 31, 32, 33	**Loss of +28 VDC outboard power to EMS, DPT and/or magnetic switches:** Note (4) Note: may be accompanied by fault code AP (Circuit Breaker Tripped). - Open on any applicable power (+28 VDC or 28 VDCR) or signal circuit in the outboard component or cable. - Short between any applicable power (+28 VDC or 28 VDCR) or signal circuit in the outboard component or cable (conductor to conductor, or conductor to ground). - Open in +28 VDC or 28 VDCR TJ Block bus circuit wiring within the TCP.
V	1, 9, 13	- Disconnected or leaky: AUR sensing hose, preece fitting, or capsule diaphragm seal. - Ruptured capsule diaphragm
W	1a, 1b, 4b, 5b, 7b, 9, 13, 15,16, 17	**MRH (MRHH) card analog signal conditioner output failure:** - Unbalanced or missing either (not both) ± 15 VDC reference power to MRH (MRHH) card.
X	9, 13, 18a, 18b	XDCR A/B Select Relay bad: - Neither Relay N.O. or N.C. contacts shorted to Relay Common contacts.
Y	9, 13, 18a, 18b	XDCR A/B Select Relay bad: - Relay N.O. and/or N.C. contacts shorted to Relay Common contacts.
Z	1a, 1b, 4b, 7b, 9	- Loss of both ± 15 VDC to MRH (MRHH) card signal conditioning circuit e.g. ± 15 VDC CB Tripped.
AA	14, 32	**Capsule Vented signal not received from Tube:** - DPT Capsule Vented pressure-switch circuit open. - Open circuit in the power or signal lines between the pressure-switch and the TCP.
AB	1, 4b, 5b, 7b, 9, 13, 16, 17,	MRH (MRHH) card, comparator circuit fault causes erroneous alarm, indication or meter display.
AC	19, 22	**Ready to Flood signal received from Missile Tube Support (MTS):** - Fault in the MTS MRF card logic. - Signal grounded (active) in the cabling between the MT and MTS sections. - MTS MRB card relay or relay circuit bad

Table C-2. TCP Fault Descriptions (Continued)

Fault Code: Note (2)	**Indications Affected:** Note (1)	**Fault Description:** Notes (2) (3) & (6)
AD	21	Flood Tube Ordered signal received from WLC: - Signal line shorted to +28 VDC between the TCP and WLC - Relay or relay control logic fault inside the WLC.
AE	22, 26, 31	Hatch Control Relay set on the MRB card, causing the hatch to be commanded open: - Ground fault on the interconnecting wiring between the MRG and MRB cards. - Fault in the MRG card logic. - MRB card relay bad.
AF	22, 33, 35	**F/D Control Relay set on the MRB card, causing the F/D Valve to be commanded open:** - Ground on the interconnecting wiring between the MRG and MRB cards. - Fault in the MRG card logic. - MRB card relay bad.
AG	24	- Logic fault on MRG card, Remote Ready circuit.
AH	25	Hatch control mode is Local, and Open Hatch Ordered signal received from WLC: - Signal line shorted to +28 VDC between the TCP and WLC. - Relay or relay control logic fault inside the WLC.
AJ	25	Hatch control mode is set to Remote, and Intent to Fire signal received from WLC: - Signal line shorted to +28 VDC between the TCP and WLC. - Relay or relay control logic fault inside the WLC.
AK	27	**Hatch Blocked signal received:** - Hatch Blocked switch deactuated, i.e. out of adjustment, causing signal to be returned to TCP via the N.C. switch contacts. - Switch defective: switch Common and N.C. contacts shorted at all times. - Signal line shorted to +28 VDC between the TCP and the HML-22 valve.
AL	28	Logic fault on MRG card, Tube Ready circuit.
AM	29	Missile Away signal received from WLC: - Signal line shorted to +28 VDC between the TCP and WLC. - Relay or relay control logic fault inside the WLC.

Table C-2. TCP Fault Descriptions (Continued)

Fault Code: Note (2)	**Indications Affected:** Note (1)	**Fault Description:** Notes (2) (3) & (6)
AN	30	**Hang Fire signal received from WLC:** - Signal line shorted to +28 VDC between the TCP and the WLC. - Relay or relay control logic fault inside the WLC. - MRB card Hangfire Relay set: did not reset, when IMO switch last placed in INIT.
AO	34, 35	**Header Drain Ready signal received from Missile Tube Support (MTS):** - Ground on the interconnecting wiring between the MTS MRF and MRB cards. - Fault in the MTS MRF card logic. - Signal grounded (signal active) in the cabling between the TCP MT and MTS sections. - MRB card relay bad.
AP	1a, 1b, 2b, 3b, 5b, 7b, 9, 13, 14, 17, 31, 32, 33, 37	**Circuit breaker (CB) tripped and the CB TRP indicator ON:** Figure C-1 & Notes (4 & 6) - Fault causing a circuit load in excess of CB rating for any Component Panel 1 CB. - Tube +28 VDC/0.5 Amp CB: a circuit load in excess of 0.5A occurred on an outboard cable or component power or signal line, between conductors or between conductor and ship's ground. - Faulty CB, evident by excessive VDC drop across line and load sides of breaker. - Tube +28 VDC CB is not tripped: fault exists on the CB TRP indication circuit wiring only, causing the CB TRP indicator to come ON (applicable to indicator No. 37 only).
AQ	1, 9	Bad TUBE PRESS-TEMP meter, or MSL DIFF PRESS.
AR	1a, 1b, 9	**Blank digital meter display:** - Loss of +5 VDC meter display power. - Open circuit on the 5 VDCR OPER power return line due to faulty INIT/MON/OPERATE (IMO) keyswitch or circuit.
AS	9	Blocked U/H1, U/H2 or AUR sensing line(s).

Table C-2. TCP Fault Descriptions (Continued)

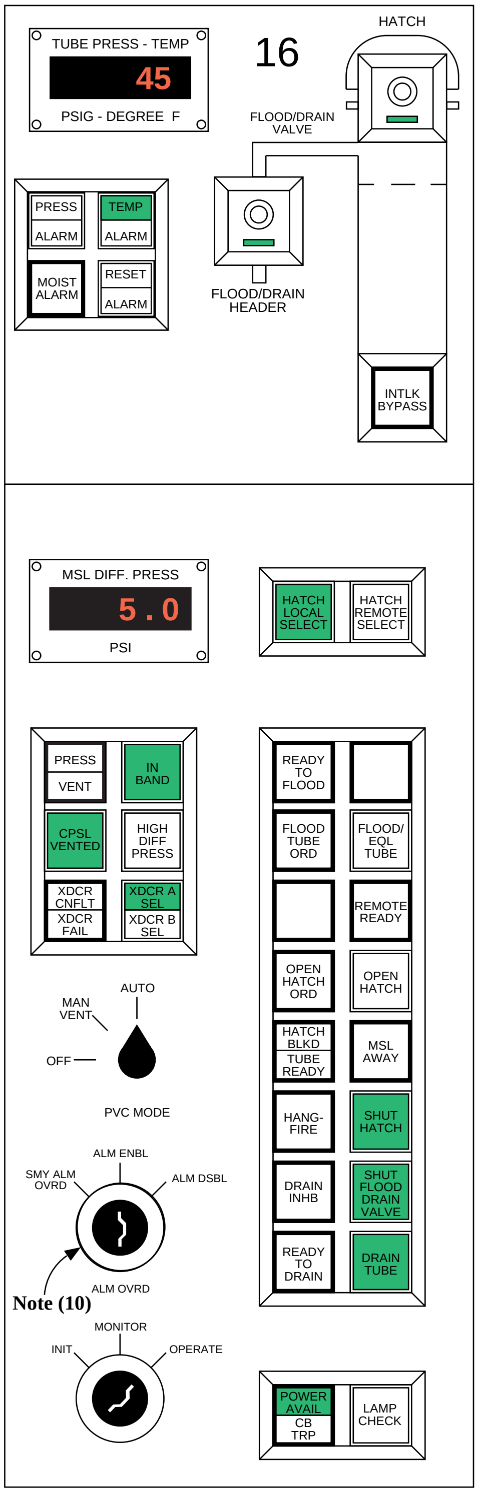
Fault Code: Note (2)	**Indications Affected:** Note (1)	**Fault Description:** Notes (2) (3) & (6)
AT	All Indicators	Indicator fails to light: - Unseated or faulty A/I or indicator. - Open in A/I or indicator or interconnecting circuit wiring or in internal power distribution circuit. See Note (5). - Unseated or faulty MRA circuit card input-buffer. - Unseated or faulty logic or relay circuit card.
AU	All Indicators	**Indicator abnormally lit:** - Ground fault within the Module Rack Assembly (MRA) backplane wiring. - Ground fault on interconnecting harness wiring, between the rear Connector Panel, MRA, Component Panel and/or Front Panel indicators. - Ground fault on the MRA card lamp-driver input or output circuit. - Ground fault on the input signal line of the MRA card Lampcheck circuit for Indicators. - Ground fault on the ETA/ETAA card Lampcheck circuit for Meters.

Table C-3. TCP Fault Code Identification “Notes”

NOTE	**REMARKS**
1	Reference, TCP Tech Manual No. SW395-AG-MMM-010, Vol. 1, Table 2-1, “Description Missile Tube Section’s Controls and Indicators”.
2	The Fault Code Identification Table C-1 associates fault code letters with front panel indicators and meters for possible causes of abnormal indications and displays. The fault code letters, found under the “Fault Code Identity” column, are arranged “left-to-right” in order of likelihood. The Fault Description Table C-2 provides descriptions of the fault codes identified in Table C-1. Possible causes of abnormal indications and displays, described under the “Fault Description” column, are arranged “top-to-bottom” in order of likelihood. In either table the fault codes and fault descriptions listed (“left-to-right” or “top-to-bottom”) shall imply an “either/or” condition, unless otherwise noted by “and”.
3	See Fault Description Table, faults AT and AU for descriptions of typical internal faults that apply to all TCP indicators.
4	Water or moisture may have entered the outboard cabling and/or component connectors, causing faulty indications and/or meter displays. Partial shorts (conductor/conductor or conductor/ground) or intermittent opens in outboard circuits, due to sea pressure, can cause intermittent indications and/or meter displays. If faults are depth related, faulty indications and displays may go away as ship surfaces. e.g. a pin-sized hole in an outboard cable opens at certain sea pressures (depths), allowing sea water to enter and cause a short between conductors and ship’s ground. As ship surfaces, sea pressure decreases, allowing the hole to reseal itself, removing the sea water short to ship’s ground.
5	Examples of opens in Actuator/Indicator (A/I), indicator or interconnecting circuit wiring are as follows: Missing 5 VDCR signal on the line or load side of A/I or indicator; missing +15 VDC relay power on the line or load side of A/I; or +5 VDC bussed lamp power is missing from A/I or indicator i.e. open exists in the +5 VDC buss, series circuit (daisy-chain) for groupings of front panel indicators.
6	TCP Tech Manual, NAVSEA No. SW395-AG-MMM-020, Vol. 2 Part 1, Table 5-7, “HTHP Error Index” may be used in conjunction with TCP fault Table C-1 and Table C-2. Vol. 2 Part 1, Table 5-4 “Maintenance Turn On Index” and Tables 5-10 through 5-35 “... Fault Dictionaries” may be used in conjunction with TCP fault Table C-1 and Table C-2, as well.
7	An unseated hatch may or may not cause the Hatch Shut (Bar) indicator to go OFF i.e. indicator status ultimately depends on adjustment of the outboard Hatch Shut & Fairing Lock mag-switches and magnets.
8	Example: An open within the +28 VDC or 28 VDCR power lines to the EMS Temperature Sensor, or an open within the 4-20 ma signal line from the EMS Temperature Sensor to the TCP MRH card signal conditioning circuit, with TCP powered on, will generate environmental alarms at the TCP, WLC, BCP and over the 1MC.

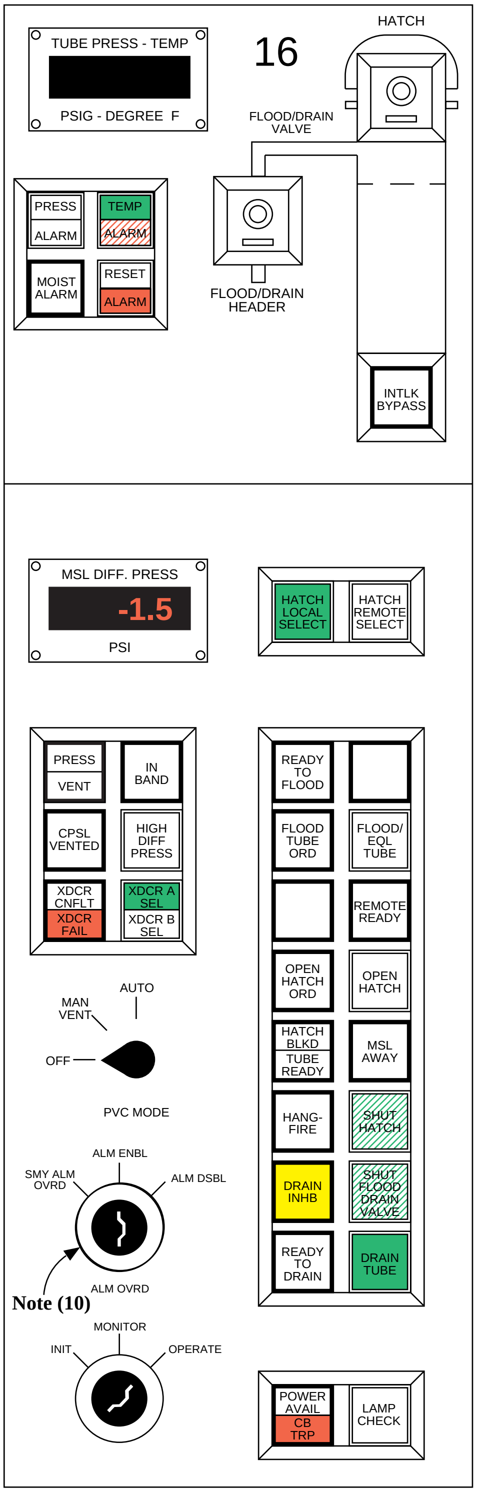
Table C-3. TCP Fault Code Identification “Notes” (Continued)

NOTE	**REMARKS**
9	Reference SSM Vol. 6, Pt. 3, Bk. 3, O/I 631-18A “VLS Operating Instructions” functional procedures (FP) 1 through 4 and “AUR Replenishment”, FP 15, were used to determine the “normal” conditions for TCP controls, indications and displays shown in Figure C-1. Abnormal indications and displays, as identified in Table C-1 and described in Table C-2, reflect the possible conditions and causes for “abnormal” TCP indicators and displays, when or if a fault occurs.
10	S/A3939KP installed shall have the following TCP components: LMRB (PVC only), MRHH and ETAA circuit cards, and Alarm Override keyswitch. Alarm Override Switches are assumed to be in the “ALM ENBL”.
11	SSM Vol. 6, Pt. 3, Bk. 3, O/I 631-18A , “AUR Replenishment”, FP 15, requires that the pressure/vent valves APV-(*)-1, APV-(*)-2 and APV-(*)-3 be secured after AUR replenishment to prevent accidental pressurizing or venting of the capsule.



Actuator / Indicator / Meter: Nomenclature	No.	Normal Condition
TUBE PRESS	1a	9 - 21 PSIG
TUBE TEMP	1b	0 - 100 ˚F
HATCH OPEN (Circle)	2a	
HATCH SHUT (Bar)	2b	ON
F/D VALVE OPEN (Circle)	3a	
F/D VALVE SHUT (Bar)	3b	ON
PRESS of PRESS/ALARM	4a	
ALARM of PRESS/ALARM	4b	
TEMP of TEMP/ALARM	5a	ON
ALARM of TEMP/ALARM	5b	
MOIST ALARM	6	
RESET of RESET/ALARM	7a	
ALARM of RESET/ALARM	7b	
INTLK BYPASS	8	
MSL DIFF PRESS	9	3.8 - 7.2 PSID
HATCH LOCAL SEL	10	ON
HATCH REMOTE SEL	11	
PRESS of PRESS/VENT	12a	
VENT of PRESS VENT	12b	
IN BAND	13	ON
CPSL VENTED	14	ON
HIGH DIFF PRESS	15	
XDCR CNFLT	16	
XDCR FAILED	17	
XDCR A SEL	18a	ON
XDCR B SEL	18b	
READY TO FLOOD	19	
FLOOD TUBE ORDER	21	
FLOOD/EQL TUBE	22	
REMOTE READY	24	
OPEN HATCH ORD	25	
OPEN HATCH	26	
HATCH BLKD	27	
TUBE READY	28	
MSL AWAY	29	
HANGFIRE	30	
SHUT HATCH	31	ON
DRAIN INHB	32	
SHUT FLOOD DRAIN VALVE	33	ON
READY TO DRAIN	34	
DRAIN TUBE	35	ON
POWER AVAIL	36	ON
CB TRP	37	
LAMP CHECK	38	
INIT/MONITOR/OPERATE	39	OPERATE
PVC MODE	40	OFF

Figure C-1. Underway with AURs Pressurized



Actuator / Indicator / Meter: Nomenclature	No.	Normal Condition
TUBE PRESS	1a	BLANK
TUBE TEMP	1b	BLANK
HATCH OPEN (Circle)	2a	
HATCH SHUT (Bar)	2b	
F/D VALVE OPEN (Circle)	3a	
F/D VALVE SHUT (Bar)	3b	
PRESS of PRESS/ALARM	4a	
ALARM of PRESS/ALARM	4b	
TEMP of TEMP/ALARM	5a	ON
ALARM of TEMP/ALARM	5b	FLASHING
MOIST ALARM	6	
RESET of RESET/ALARM	7a	
ALARM of RESET/ALARM	7b	ON
INTLK BYPASS	8	
MSL DIFF PRESS	9	-1.5 PSID
HATCH LOCAL SEL	10	ON
HATCH REMOTE SEL	11	
PRESS of PRESS/VENT	12a	
VENT of PRESS VENT	12b	
IN BAND	13	
CPSL VENTED	14	
HIGH DIFF PRESS	15	
XDCR CNFLT	16	
XDCR FAILED	17	ON
XDCR A SEL	18a	ON
XDCR B SEL	18b	
READY TO FLOOD	19	
FLOOD TUBE ORDER	21	
FLOOD/EQL TUBE	22	
REMOTE READY	24	
OPEN HATCH ORD	25	
OPEN HATCH	26	
HATCH BLKD	27	
TUBE READY	28	
MSL AWAY	29	
HANGFIRE	30	
SHUT HATCH	31	FLASHING
DRAIN INHB	32	ON
SHUT FLOOD DRAIN VALVE	33	FLASHING
READY TO DRAIN	34	
DRAIN TUBE	35	ON
POWER AVAIL	36	
CB TRP	37	ON
LAMP CHECK	38	
INIT/MONITOR/OPERATE	39	OPERATE
PVC MODE	40	OFF

Figure C-2. Fault Code AP, +28 VDC Circuit Breaker Tripped with AURs Pressurized

APPENDIX D
GENERAL VERTICAL LAUNCH SYSTEM (VLS)
ILLUSTRATIONS

This appendix contains various figures which support and strengthen the text to visually impart greater system understanding.

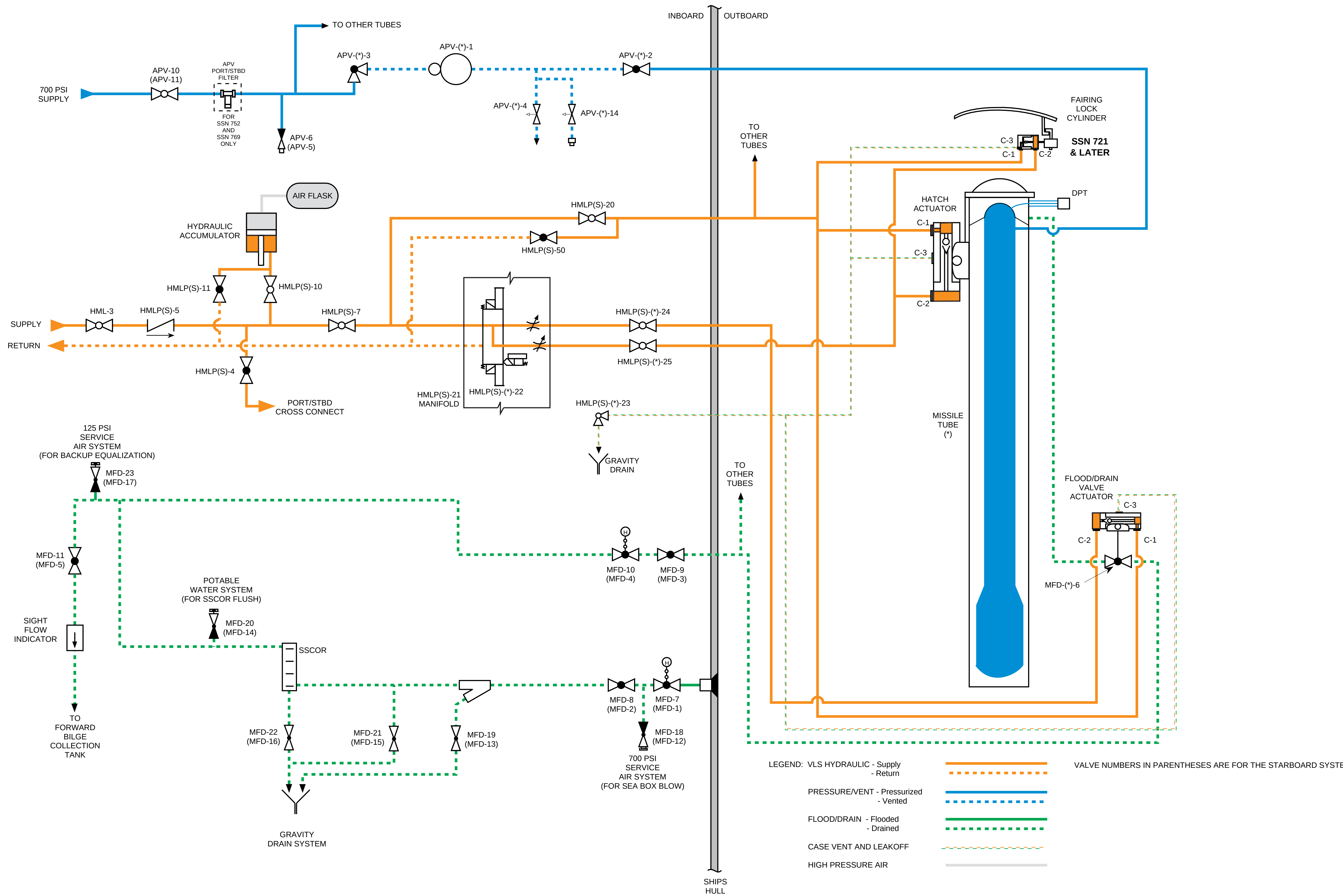


Figure D-1. VLS Missile Tube Hatch and Flood/Drain Valve Shut

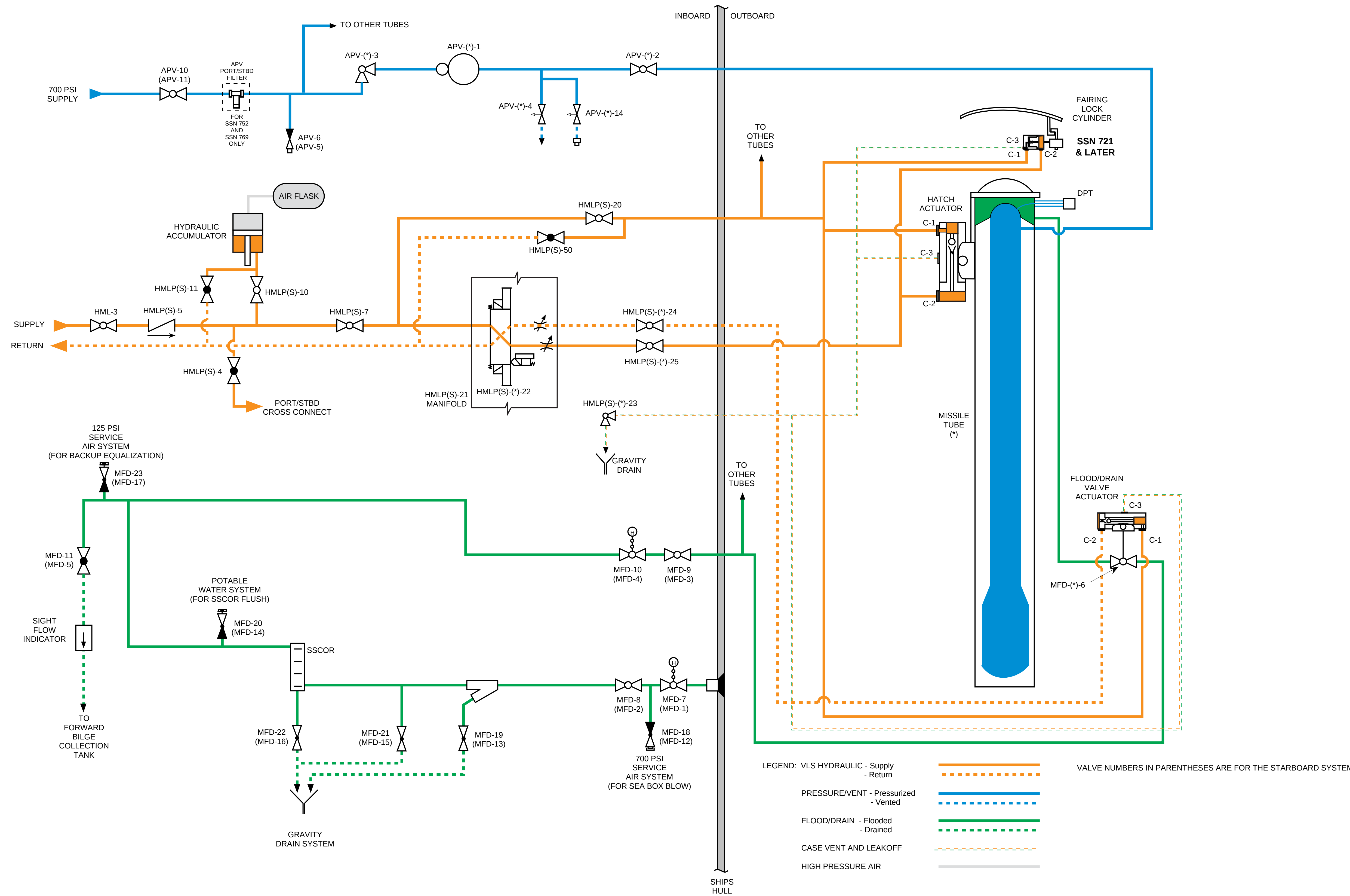


Figure D-2. VLS Missile Tube Flood/Drain Valve Open

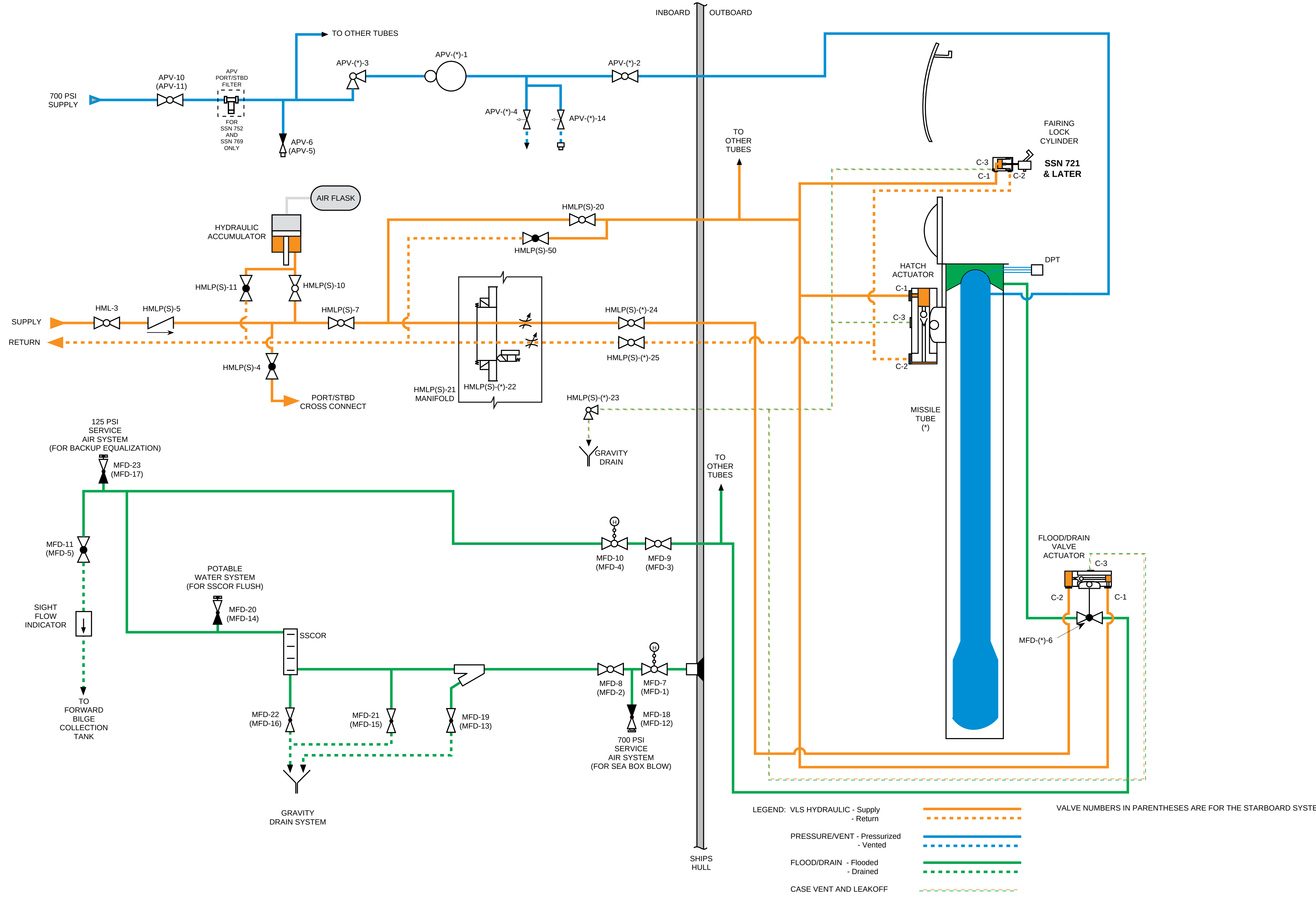


Figure D-3. VLS Missile Tube Hatch Open

Ref: NAVSEAINST 4160.3A NAVSEA S0005-AA-GYD-030/TMMP

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