S9253-AD-MMM-010

0910-LP-106-1000 **VOLUME 1**

[*SGML VERSION; SEE CHANGE RECORD*]

TECHNICAL MANUAL

USERS GUIDE AND GENERAL INFORMATION

VALVES, TRAPS, AND ORIFICES (NON-NUCLEAR)

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RECORD OF CHANGES

CHANGE NO.	DATE	TITLE OR BRIEF DESCRIPTION
C	15 NOV 1998	PROVIDED SUBSTITUTE NON-ASBESTOS PACKING AND GASKET MATERIALS TO REPLACE ASBESTOS PACKING AND GASKETS.
D	7 JUNE 2002	TO INCORPORATE CHANGES RESULTING FROM INSTALLATION OF NEW EQUIPMENT INSTALLED DURING USS NIMITZ (CVN 68) RCOH. THE FOLLOWING WAS CHANGED:

NOTE

THIS TECHNICAL MANUAL (TM) HAS BEEN DEVELOPED FROM AN INTELLIGENT ELECTRONIC SOURCE KNOWN AS STANDARD GENERALIZED MARKUP LANGUAGE (SGML). THERE IS NO LOEP. ALL CHANGES, IF APPLICABLE, ARE INCLUDED. THE PAGINATION IN THIS TM WILL NOT MATCH THE PAGINATION OF THE ORIGINAL PAPER TM; HOWEVER, THE CONTENT IS EXACTLY THE SAME. ANY CHANGES RECEIVED AFTER RECEIPT OF THIS TM WILL ONLY FIT IN THIS PAGINATED VERSION.

FOREWORD

This manual contains information necessary to maintain, troubleshoot, and repair non-nuclear valves, traps, and orifices at the organizational and intermediate levels. The manual consists of 14 volumes.

Volume I contains general information and cross-references to other volumes. It is arranged in seven chapters with an index as follows:

Chapter 1	General Information and Safety Precautions
Chapter 2	Introduction
Chapter 3	Valve, Trap, and Orifice Types and Cross-Reference Tables
Chapter 4	Functional Descriptions
Chapter 5	Valve Characteristics
Chapter 6	General Maintenance, Repair, and Overhaul
Chapter 7	General Testing Information Index

Volumes II through XIV cover specific types of valves, traps, and/or orifices as follows:

Volume II. Stop Valves (Manually Operated)

Volume III. Stop Valves (Power Actuated)

Volume IV. Stop Check Valves (Manually Operated)

Volume V. Stop Check Valves (Power Actuated)

Volume VI. Swing Check Valves

Volume VII. Lift Check Valves

Volume VIII. Y-Pattern Valves

Volume IX. Gate Valves (Manually Operated)

Volume X. Gate Valves (Power Actuated)

Volume XI. Needle Valves

Volume XII. Astern Throttle Valves

Volume XIII. Pressure-Reducing Valves, Actuators, and Relief Valves

Volume XIV. Steam Traps and Drain Orifices

Chapters within each of these volumes cover specific valves, traps, or orifices and are distinguished by manufacturer and/or by the manufacturer's drawing number. Each chapter is organized in sections, as follows:

Section 1	General Information and Safety Precautions
Section 2	Physical and Functional Description
Section 3	Scheduled Maintenance
Section 4	Corrective Maintenance

FOREWORD - Continued

Section 5 Illustrated Parts Breakdown

Subsection I. Introduction

Subsection II. Illustration and Group Assembly Parts List

Section 6 Engineering Drawings

This manual corrects deficiencies identified in the superseded manual, as noted in NAVSEA Technical Manual Deficiency/Evaluation Report (TMDER) N23515.

The technical content of this volume is based on existing engineering documents and configuration data available as of 9 September 1987.

Ships, 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 improvement to NAVSEA technical manuals shall be forwarded via E-mail to TMDER@phdnswc.navy.mil or via surface mail to:

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on NAVSEA Technical Manual Deficiency/Evaluation Report, form NAVSEA 4160/1 (TMDER). All feed-back comments shall be thoroughly investigated and originators will be advised of action resulting therefrom. One copy of form NAVSEA 4160/1 is at the end of each separately bound technical manual, 8-1/2 x 11 inches or larger. Copies of form NAVSEA 4160/1 may be requisitioned from the Naval Systems Data Support Activity, Code 310, at the above address. Users are encouraged to transmit deficiency submittals via the Naval Systems Data Support Activity Web page located at:

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CHAPTER 1

GENERAL INFORMATION AND SAFETY PRECAUTIONS

1-1. GENERAL INFORMATION.

1-1.1 INTRODUCTION. This multivolume manual provides maintenance personnel with general and detailed information pertaining to non-nuclear valves, traps, and orifices used in 1200- and 600-psi steam propulsion systems. Coverage provided in this manual represents the larger population of valves, traps, and orifices used in these systems. The purpose of this manual is to combine the available manufacturer and other information about these valves, traps, and orifices into one primary, easily accessible source, thus eliminating the need for acquiring and cataloging a multiplicity of documents that vary in size, shape, and format.

1-2. SAFETY SUMMARY.

1-2.1 GENERAL SAFETY NOTICES. The following general safety notices supplement the specific warnings and cautions appearing elsewhere in this volume. They are recommended precautions that must be understood and applied during maintenance of the equipment covered herein. Should situations arise that are not covered in the general or specific safety precautions, the commanding officer or other authority will issue orders as deemed necessary to cover the situation.

1-2.1.1 First Aid. An injury, no matter how slight, shall never go unattended. Always obtain first aid or medical attention immediately.

1-2.1.2 General Precautions. The following general precautions are to be observed at all times.

1. Ensure that all maintenance operations comply with OPNAVINST 5100 (series) and with OPNAVINST 3120.32.
2. Do not make any unauthorized alterations to equipment or components.
3. Ensure that area is well-ventilated when using cleaning solvent. Avoid prolonged breathing of fumes and solvent contact with skin or eyes.

1-2.2 WARNINGS AND CAUTIONS. The following warnings and cautions apply to the procedures provided in chapter 6 and chapter 7 of this volume. These warnings and cautions also appear in the chapters immediately preceding the text to which they apply. A summary of the warnings and cautions that apply to specific valves, actuators, and manifolds is provided in applicable chapters of volumes II through XIV.

WARNING

To prevent injury or death during removal or disassembly, isolate valve by closing two valves immediately upstream and two valves immediately downstream from valve to be removed or disassembled. Relieve line pressure and tag out of service. (Pages 6-11, 6-12)

Warning-*continued*

Warning - *precedes*

Asbestos is a health hazard. To prevent injury or death, ensure that appropriate breathing apparatus, coveralls, and gloves are worn when handling asbestos. (Pages 6-11, 6-49)

To prevent injury or death, ensure that adequate staging is provided and that all involved pipe and piping components have been supported with necessary rigging. (Page 6-15)

To prevent injury or death, ensure that all operating personnel, and others in immediate vicinity, wear protective goggles around cutting and beveling machine. Operating personnel shall remove all loose clothing and jewelry. (Page 6-18)

To prevent injury or death, ensure that valves to be tested are isolated and that system is drained and tagged out of service. (Page 7-4)

To prevent injury or death, ensure that extreme care is taken while operating hydrostatic pump, as high pressure exists. (Pages 7-4, 7-5)

CAUTION

To prevent equipment damage, do not score flange with scraper. (Page 6-12)

Dull or broken tool bit can cause pipe cutting and prep machine to jam. Ensure that tool bit is not damaged. (Page 6-15)

To ensure proper seating between disk and seat, ensure that grinding or lapping tool concentricity and seat angles are correct. (Pages 6-25, 6-26)

To prevent leak-by and subsequent material failure, when removing packing rings, do not scratch stem or bonnet packing ring sealing area. (Page 6-49)

To prevent leak-by and subsequent material failure when replacing packing rings, stagger packing ring joints 90 degrees apart. (Page 6-50)

To prevent damage to equipment, avoid scoring interior surfaces of valve when removing boring bar. (Page 6-69)

CHAPTER 2

INTRODUCTION

2-1. INTRODUCTION.

2-1.1 PURPOSE. This manual provides the necessary information required to maintain, troubleshoot, repair, and test non-nuclear valves, traps, and orifices used in steam propulsion systems.

2-1.2 SCOPE. This manual has been developed in accordance with the content requirements of MIL-M-15071 for a type I technical manual, and with the style and format requirements of MIL-M-38784. Physical and functional descriptions of each valve, trap, and orifice type used in steam propulsion systems are provided in this volume. This volume also provides troubleshooting, maintenance, repair, overhaul, testing criteria and procedures, and general information applicable to all types of valves, traps, and orifices. Corrective maintenance procedures, parts lists, and engineering drawings for specific valves, traps, and orifices are provided in volumes II through XIV. Cross-referencing, measurement conversion, and reference publication tables are provided in this volume, along with an abbreviation and acronym table for this volume. Abbreviations and acronyms used in subsequent volumes are defined in individual chapter tables.

2-1.3 SUPERSEDURE DATA. This manual supersedes S9253-AD-MMO-010, -020, and -030, first revision, dated 1 February 1979, and all changes thereto.

2-1.4 APPLICABILITY. The information contained in this manual is applicable to non-nuclear valves, traps, and orifices used in 1200- and 600-psi steam propulsion systems.

2-1.5 MAINTENANCE PHILOSOPHY. This manual provides complete coverage for two levels of maintenance (organizational and intermediate). There are three levels at which maintenance is normally performed, depending upon the complexity of the work and availability of support equipment. The first is the organizational levels where the work is performed by the ship force with no outside assistance other than routine supply services. The second is the intermediate level, which refers to maintenance and repairs performed by a repair ship, tender, repair facility, or shore intermediate maintenance activity. The third, which this manual does not include, is the depot level, such as a naval or private shipyard where the more difficult and complex maintenance and repairs are performed. This manual does not designate or determine at which maintenance level (organizational or intermediate) preventive and corrective maintenance should be performed, that being the prerogative of the forces afloat. Preventive maintenance procedures to be performed on a scheduled basis are provided in Planned Maintenance System (PMS) documentation and are not repeated in this publication. All components designated as repairable items have been addressed in the appropriate volumes. Sufficient coverage has been given to non-repairable items to provide an understanding of item purposes and functions. Levels of essentiality and controlled material requirements are defined in chapter 6 of this volume. Adequate information available in other official publications has been referenced rather than duplicated in this manual.

2-1.6 GENERAL INFORMATION. The following information is provided to assist personnel in using this multivolume manual.

2-1.6.1 Measurement Conversion. Conversion information for units of measure used throughout this manual is provided in table 2-1.

2-1.6.2 Reference Publications. The individual chapters of volumes II through XIV provide cleaning, inspection, disassembly, reassembly, parts listing, and other information specific to the valve, trap, or orifice covered in the chapter. Other general information necessary for corrective maintenance is provided in this volume and referenced from the subsequent volume chapters. A table of pertinent volume I information is provided in section 1 of each chapter for easy reference. Other official publications referenced in this manual are identified in table 2-2.

2-1.6.3 Abbreviations and Acronyms. Abbreviations and acronyms used in this volume are defined in table 2-3. Abbreviations and acronyms used in individual chapters of volumes II through XIV are defined in table 5-1 of each chapter.

Table 2-1. U.S.-to-Metric Conversion Factors*

When You Know U.S. Standard Measurements ↓	Multiply By Factor ↓	To Determine Metric Measurements ↓
	Length	
inches	2.540	centimeters
feet	30.480	centimeters
yards	0.914	meters
miles (survey)	1.609	kilometers
	Area	
square inches	6.452	square centimeters
square feet	0.093	square meters
square yards	0.836	square meters
square miles (survey)	2.590	square kilometers
	Volume	
fluid ounces	29.574	milliliters
pints	0.473	liters
quarts	0.946	liters
gallons	3.785	liters
cubic feet	0.028	cubic meters
cubic yards	0.765	cubic meters
	Weight	
ounces	28.350	grams
pounds	0.454	kilograms
tons-short	0.907	metric tons
	Pressure	
pound-force per square inch	0.07031	kilograms per square centimeter

Table 2-2. Reference Publications

Title	Number
Naval Ships' Technical Manual Chapters	
074 (Welding and Allied Processes) (volume I)	S9086-CH-STM-010
(Nondestructive Testing of Metals, Qualification and Certification Requirements for Naval Personnel) (volume II)	S9086-CH-STM-020
244 (Bearings)	S9086-HN-STM-000
635 (Thermal, Fire, and Acoustic Insulation)	S9086-VH-STM-010
505 (Piping Systems)	S9086-RK-STM-010
Welding and Brazing Procedure and Performance Qualification	MIL-STD-248

Table 2-2. Reference Publications - Continued

Title	Number
Nondestructive Testing Requirements for Metals	MIL-STD-271
Fabrication Welding and Inspection; and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels in Ships of the U.S. Navy	MIL-STD-278
Cleaning Requirements for Special Purpose Equipment, Including Piping Systems	MIL-STD-767
Thermal Insulation Requirements for Machinery and Piping	MIL-STD-769
Schedule of Piping, Valves, Fittings, and Associated Piping Components for Naval Surface Ships	MIL-STD-777
Air-Driven Piston Hydraulic Pump, Model S-440-35	NAVSEA 0347-LP-402-2000
Deposition of Electroplating, Brush On Method	NAVSEA 0900-LP-038-6010
Dexter Model Valve Reseating Grinders	NAVSEA 0948-LP-019-0010
Navy Standard Valves	NAVSEA 0948-LP-012-5000
Piston Air Motor, 70A-86 F/DLG-19, -20, and -23	NAVSEA 0948-LP-038-5010
Material Identification and Control (MIC) for Piping Systems (volume I) and Material Designator Catalog (volume II)	NAVSEA 0948-LP-045-7010
IPP for Packing Valves, High-Pressure Procedures for	NAVSEA 0948-LP-108-8010
Metal-Sprayed Coating System for Corrosion Protection Aboard Naval Ships	DOD-STD-2138
Standard Organization and Regulations of the U.S. Navy	OPNAVINST 3120.32
Ships' Maintenance and Material Management (3-M) Manual	OPNAVINST 4790.4
Navy Safety Precautions	OPNAVINST 5100 (Series)
COSAL Use and Maintenance Manual	SPCCINST 4441.170

Table 2-3. Abbreviations, Acronyms, and Symbols

Abbreviation/ Acronym/Symbol	Definition
ADJ	Adjusting
APL	Allowance Parts List
CHK	Check
CL	Class
CONT	Control
CRP	Carbon Ribbon Packing
DIAP	Diaphragm
DWG	Drawing
EXT	Extension/External/Exterior
FSCM	Federal Supply Code for Manufacturers
GFY	Graphite Filament Yarn
ID	Inside Diameter
IMA	Intermediate Maintenance Activity
LG	Length
MIC	Material Identification and Control
NAVSEA	Naval Sea (Systems Command)
NAVSHIPS	Naval Ships (Systems Command)
NDT	Nondestructive Testing
NICN	Navy Item Control Number
NO.	Number

Table 2-3. Abbreviations, Acronyms, and Symbols - Continued

Abbreviation/ Acronym/Symbol	Definition
NSN	National Stock Number
NSTM	Naval Ships' Technical Manual
OD	Outside Diameter
OPNAVINST	Office of the Chief of Naval Operations Instruction
OPR	Operated
PLT	Pilot
PLTG	Plating
PMS	Planned Maintenance System
PN	Part Number
PSI	Pound-force per Square Inch
PSIG	Pound-force per Square Inch Gage
RPM	Revolutions Per Minute
RMS	Root Mean Square
SAE	Society of Automotive Engineers
SQCM	Square Centimeters
TIR	Total Indicator Reading
TMIN	Technical Manual Identification Number
WALW	Walworth

CHAPTER 3

VALVE, TRAP, AND ORIFICE TYPES AND CROSS-REFERENCE TABLES

3-1. INTRODUCTION.

3-1.1 PURPOSE AND SCOPE. Tables provided in this chapter list the specific manufacturers, sizes, and types of non-nuclear valves, traps, and orifices covered in this manual. Table 3-1 provides a manufacturer to drawing number cross-reference and includes applicable Federal Supply Codes for Manufacturers (FSCM's). Table 3-2 through Table 3-14 list the valve, trap, and orifice sizes and types covered in each volume. Applicable drawing numbers, service levels, Allowance Parts List (APL) numbers, operating temperatures, and replacement APL numbers (APL's)/National Stock Numbers (NSN's) also are provided to assist maintenance personnel identifying applicable replacement valves, traps, and orifices when existing stocks are depleted.

3-1.2 VALVE, TRAP, AND ORIFICE REPLACEMENT INFORMATION. Specific replacement information for each valve, trap, and orifice is provided in its applicable chapter. In accordance with NAVSEA letter Serial 56Y235/857, dated 10 February 1986, valves manufactured to MIL-V-22094 specifications must be replaced with those meeting NAVSEA drawing 803-5184193 (1500 class) or NAVSHIPS drawing number 803-2177525 (600/900 class) specifications when existing stocks of current APL's, NSN's, and replacement APL's/NSN's are depleted. Valves manufactured to MIL-V-22094 specifications are identified in these tables with an asterisk. Refer to the specific valve chapter to determine which replacement drawing number (NAVSEA or NAVSHIPS) applies.

Table 3-1. Manufacturer to Drawing Number

Manufacturer	FSCM	Drawing Number
Anchor/Darling Valve Co.	85130	1S-1177-5, 1866-5A, 3S-593-5, 726-5A and 5B, 2060-5, 662-5E, 2S-882-5, 1S-658-5, 2028-5, 1988-5, 1843-5, PR-1842-5, 1450- 5B, 1S-1168-5, 2S-1875-5, 1592-5, 1138- 5, 1556-5, 1810-5, 755-5F, 1841-5, 1267-5, 2669-5, 1S-1392-5, 2053-5, 1681- 5, 1869-5, 2S-598-5, 598-5H, 2S-600-5C, 3S-600-5, 1365-5, 761-5, 757-5, 756-5E, 765-5
Atlas Valve Co.	70667	NAP609
Atwood and Morrill Co., Inc.	04537	20147-F
Cox Instruments	53553	52-A-54
Crane Co.	14959	29708, 29746, 29955, 29962, 30065, 30074, 30094, 30095, 32813
Dresser Industries, Inc.	16497	R-7390F-1-1/2-584, R7350F-1-1/2-584, -586, -1143, and-1144
Gimpel Corp.	93591	NP-440
Leslie Controls, Inc.	35795	12595N, 22388N, 15748N, 12878N, 15152N, 18365N, 21509N
Lonergan, J.E. Co.	75954	NMP-1500
Rockwell International Corp., Flow Control Div.	93495	PE-423964, D-470418
Spirax Sarco, Inc.	53059	Unavailable. See cover page in volume XIV.
Ships Parts Control Center	03950	S6501-73689, MS-18301
Velan Valve Corp.	57574	33310, 33311, 33764, 78319, 33351, 13673-3, 23256, 88324, 88426, 8872-11, 7844-0129 N0041-3, N0044-3
Waeco, Div. of Hunt Valve Co.	11859	D-512-1-B3
Walworth Co., The	63686	N710656, A-9781-M-119, N-10700C, N-11088, N-10750A
Yarway Corp.	66850	BO-21412-A, BO-21435

Table 3-2. Volume II: Stop Valves (Manually Operated)

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
3-1/2 inch	1S-1177-5	3	882002851	---	----
4-inch angle	1866-5A	3	882002893	875	----
4-inch globe	3S-593-5	3	882054099	975	
4-inch globe	32813	3	882056856	775	
4-inch stop x stop check	726-5A	3	882130070	---	----
4-inch stop x stop check	726-5B	3	882130072	---	----
1/4-inch globe	29962*	3	882055224	975	887055919
1/4-inch globe	29962*	1	887050033	775	----
1/2-inch angle	29962*	3	882002477	---	----
1/2-inch globe	29962*	3	882053476	850	----
1/2-inch globe	29962*	3	882054142	850	4820-00-484-8482
1/2-inch globe	29962*	3	882056598	975	4820-00-834-4676
1/2-inch globe	29962*	1	887050051	850	887055920
3/4-inch angle	29962*	1	887000025	775	----
3/4-inch globe	29962*	3	882054141	850	4820-00-964-4648
3/4-inch globe	29962*	3	882054798	775	4820-00-964-4648
1-inch angle	29962*	1	887000026	775	----
1-inch globe	29962*	3	882054140	850	4820-00-484-8477
1-inch globe	29962*	3	882054799	775	4820-00-484-8477
1-inch globe	29962*	3	882054879	---	----
1-inch globe	29962*	3	882056557	975	----
1-inch globe	29962*	1	887055404	---	----
1-1/4-inch angle	29962*	3	882001152	975	887005402
1-1/4-inch angle	29962*	1	887000027	775	----
1-1/4-inch globe	29962*	3	882051799	975	887055923
1-1/4-inch globe	29962*	3	882054567	850	4820-484-8479
1-1/4-inch globe	29962*	3	882055578	---	----
1-1/4-inch globe	29962*	1	887050035	775	----
1-1/2-inch angle	29962*	3	882001153	975	887005402
1-1/2-inch angle	29962*	1	887000028	775	4820-00-491-8051
1-1/2-inch globe	29962*	3	882051800	975	887055923
1-1/2-inch globe	29962*	1	887050036	775	----
2-inch angle	29962*	1	887000029	775	----
2-inch angle	29962*	3	882001154	975	887005403
2-inch angle	29962*	3	882002069	975	----
2-inch globe	29962*	3	882052945	775	4820-00-418-4802
2-inch globe	29962*	3	882053515	975	----
2-inch globe	29962*	3	882057226X	---	----
2-inch globe	29962*	1	887050093	750	----
2-inch globe	29962*	1	887055682	975	----
1/4-inch globe	29955*	3	882051871	975	887055919
1/4-inch globe	29955*	3	882054547	775	----
1/4-inch globe	29955*	1	887050038	775	887055919
1/4-inch globe	29955*	1	887055369	975	----
3/8-inch globe	29955*	3	882054371	775	----
1/2-inch angle	29955*	3	882001159	975	887005399
1/2-inch globe	29955*	3	882051809	975	887055920

Table 3-2. Volume II: Stop Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1/2-inch globe	29955*	3	882054369	775	4820-00-940-8417
1/2-inch globe	29955*	3	882054376	775	4820-00-940-8417
1/2-inch globe	29955*	3	882054730	775	4820-00-181-9443
3/4-inch angle	29955*	3	882001160	975	887005400
3/4-inch globe	29955*	3	882051810	975	887055921
3/4-inch globe	29955*	3	882053240	975	----
3/4-inch globe	29955*	3	882054568	975	4820-00-181-9445
3/4-inch globe	29955*	3	882054729	775	----
3/4-inch globe	29955*	1	887055764	975	----
1-inch angle	29955*	3	882001161	975	887005401
1-inch globe	29955*	3	882051811	975	887055922
1-inch globe	29955*	1	887050041	775	887055922
1-1/4-inch globe	29955*	3	882051812	975	887055923
1-1/2-inch angle	29955*	3	882002111	---	4820-00-405-1767
1-1/2-inch angle	29955*	3	882002113	775	----
1-1/2-inch angle	29955*	3	882002173	850	4820-00-405-1767
1-1/2-inch angle	29955*	3	882002467	775	4820-00-405-1767
1-1/2-inch globe	29955*	3	882051813	975	887055923
1-1/2-inch globe	29955*	3	882052093	775	----
1-1/2-inch globe	29955*	3	882053671	975	4820-00-824-8654
2-inch globe	29955*	3	882051894	975	887055924
2-inch globe	29955*	3	882053298	850	----
2-inch globe	29955*	3	882053672	975	4820-00-892-2039
2-inch globe	29955*	1	887050044	775	887055924
1-1/2-inch angle	R7390F-1- 1/2-584	3	882000854	775	4820-00-405-1767
1/4-inch angle	33310*	3	882001083	850	4820-00-808-0112
1/4-inch globe	33310*	3	882052045	775	4820-00-491-6779
1/4-inch globe	33310*	3	882053968	850	----
1/4-inch globe	33310*	3	882054013	975	4820-00-834-4680
1/4-inch globe	33310*	3	882054511	775	4820-00-491-6779
1/4-inch globe	33310*	3	882054651	775	4820-00-491-6778
3/8-inch globe	33310*	3	882052094	775	4820-00-484-8481
3/8-inch globe	33310*	3	882053981	775	887055920
3/8-inch globe	33310*	3	882054814	775	4820-00-484-8481
1/2-inch angle	33310*	3	882001189	975	887005399
1/2-inch angle	33310*	3	882001266	850	----
1/2-inch angle	33310*	3	882001371	775	887005399
1/2-inch angle	33310*	3	882002318	850	887005399
1/2-inch angle	33310*	3	882002515	775	4820-00-892-5698
1/2-inch angle	33310*	1	887005335	850	4820-00-494-7706
1/2-inch globe	33310*	3	882051765	850	887055920
1/2-inch globe	33310*	3	882051805	975	887055920
1/2-inch globe	33310*	3	882051955	775	4820-00-484-8482
1/2-inch globe	33310*	3	882053320	775	4820-00-484-8482
1/2-inch globe	33310*	3	882053962	775	4820-00-484-8482

Table 3-2. Volume II: Stop Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1/2-inch globe	33310*	3	882053969	850	4820-00-834-4676
1/2-inch globe	33310*	3	882054403	850	887055920
1/2-inch globe	33310*	3	882054443	775	----
1/2-inch globe	33310*	3	882054737	775	4820-00-484-4882
1/2-inch globe	33310*	3	882054815	775	----
1/2-inch globe	33310*	1	887055740	975	----
3/4-inch angle	33310*	3	882001135	850	887005400
3/4-inch angle	33310*	3	882001190	975	887005400
3/4-inch angle	33310*	3	882002452	775	4820-00-841-9966
3/4-inch angle	33310*	3	882002681	1,000	----
3/4-inch globe	33310*	3	882051865	975	887055921
3/4-inch globe	33310*	3	882053031	775	887055921
3/4-inch globe	33310*	3	882053963	775	4820-00-964-4648
3/4-inch globe	33310*	3	882053976	775	882059979
3/4-inch globe	33310*	3	882054320	850	4820-00-834-0783
3/4-inch globe	33310*	3	882054444	775	4820-00-964-4648
3/4-inch globe	33310*	1	887055743	775	----
1-inch angle	33310*	3	882002348	1,000	----
1-inch angle	33310*	3	882002518	775	4820-00-484-8473
1-inch globe	33310*	3	882051806	975	882055619
1-inch globe	33310*	3	882051840	850	887055922
1-inch globe	33310*	3	882051972	775	887055922
1-inch globe	33310*	3	882053056	775	4820-00-484-8477
1-1/4-inch globe	33310*	3	882051978	775	887055923
1-1/4-inch globe	33310*	3	882053466	1,000	----
1-1/4-inch globe	33310*	3	882053712	850	----
1-1/2-inch angle	33310*	3	882001209	850	887005402
1-1/2-inch angle	33310*	3	882001373	775	887005402
1-1/2-inch angle	33310*	3	882002202	775	----
1-1/2-inch globe	33310*	3	882051851	850	887055923
1-1/2-inch globe	33310*	3	882053330	975	887055923
1-1/2-inch globe	33310*	3	882053970	850	4820-00-079-5818
1-1/2-inch globe	33310*	3	882054872	775	4820-00-841-9968
1-1/2-inch globe	33310*	3	882054873	775	4820-00-841-9968
2-inch angle	33310*	3	882002204	775	4820-00-448-3406
2-inch angle	33310*	3	882002319	850	----
2-inch globe	33310*	3	882051801	975	887055924
2-inch globe	33310*	3	882051839	850	887055924
2-inch globe	33310*	3	882052095	775	887055924
2-inch globe	33310*	3	882053057	775	4820-00-418-4802
2-inch globe	33310*	3	882054638	775	----
2-inch globe	33310*	1	887055606	775	----
1/4-inch globe	33764*	1	887050017	1,000	887055919
1/4-inch globe	33764*	1	887050063	775	----
3/8-inch globe	33764*	1	887050018	1,000	887055920
1/2-inch globe	33764*	1	887050019	1,000	887055920

Table 3-2. Volume II: Stop Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1/2-inch globe	33764*	1	887050050	---	----
1/2-inch globe	33764*	1	887055800	---	----
1/2-inch globe	33764*	1	887055307	775	----
1/2-inch globe	33764*	1	887055833	---	----
3/4-inch globe	33764*	1	887050016	775	4820-00-464-2352
3/4-inch globe	33764*	1	887050020	1,000	887055921
3/4-inch globe	33764*	1	887050058	775	----
3/4-inch globe	33764*	1	887055739	---	887055921
1-inch globe	33764*	1	887050021	1,000	887055922
1-inch globe	33764*	1	887055376	1,000	----
1-inch globe	33764*	1	887055587	775	----
1-inch globe	33764*	1	887055832	---	----
1-1/4-inch globe	33764*	1	887050022	1,000	----
1-1/2-inch globe	33764*	1	887050023	1,000	----
1-1/2-inch globe	33764*	1	887050066	775	----
1-1/2-inch globe	33764*	1	887055333	1,000	----
1-1/2-inch globe	33764*	1	887055332	1,000	----
1-1/2-inch globe	33764*	1	887055834	---	----
2-inch globe	33764*	1	887055835	---	----
2-inch globe	33764*	1	887050024	1,000	----
1/4-inch globe	33764*	3	882055566	775	887055919
1/4-inch globe	33764*	3	882055571	1,000	4820-00-834-4680
1/4-inch globe	33764*	3	882055822	775	4820-00-491-6778
1/4-inch globe	33764*	3	882056039	775	4820-00-491-6779
1/4-inch globe	33764*	3	882056064	975	887055919
1/4-inch globe	33764*	3	882056074	775	887055919
1/4-inch globe	33764*	3	882056117	775	4820-00-181-9443
1/4-inch globe	33764*	3	882056249	775	4820-00-491-6779
1/4-inch globe	33764*	3	882056335	775	4820-00-491-6779
1/4-inch globe	33764*	3	882057930	775	----
3/8-inch globe	33764*	3	882055687	1,000	887055920
3/8-inch globe	33764*	3	882055761	775	4820-00-484-8481
3/8-inch globe	33764*	3	882056191	775	4820-00-484-8481
3/8-inch globe	33764*	3	882055846	775	887055920
3/8-inch globe	33764*	3	882056633	1,000	887055920
1/2-inch globe	33764*	3	882055565	775	4820-00-484-8482
1/2-inch globe	33764*	3	882055570	1,000	4820-00-834-4676
1/2-inch globe	33764*	3	882055823	775	4820-00-484-8482
1/2-inch globe	33764*	3	882055848	1,000	887055920
1/2-inch globe	33764*	3	882055892	975	887055920
1/2-inch globe	33764*	3	882055979	775	4820-00-484-8482
1/2-inch globe	33764*	3	882056035	775	887055920
1/2-inch globe	33764*	3	882056076	775	4820-00-484-8482
1/2-inch globe	33764*	3	882056085	775	4820-00-484-8482
1/2-inch globe	33764*	3	882056100	1,000	4820-00-834-4676
1/2-inch globe	33764*	3	882056118	775	----

Table 3-2. Volume II: Stop Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1/2-inch globe	33764*	3	882056234	775	4820-00-484-8482
1/2-inch globe	33764*	3	882057359	775	----
1/2-inch globe	33764*	3	882057359	775	----
1/2-inch globe	33764*	3	882057570	---	-----
1/2-inch globe	33764*	3	882057925	775	887055921
3/4-inch globe	33764*	3	882055564	775	4820-00-964-4648
3/4-inch globe	33764*	3	882055569	1,000	4820-00-834-0783
3/4-inch globe	33764*	3	882055618	1,000	887055921
3/4-inch globe	33764*	3	882055824	775	4820-00-964-4648
3/4-inch globe	33764*	3	882055980	775	4820-00-964-4648
3/4-inch globe	33764*	3	882056034	850	4820-00-964-4648
3/4-inch globe	33764*	3	882056084	775	4820-00-964-4648
3/4-inch globe	33764*	3	882056077	775	4820-00-964-4648
3/4-inch globe	33764*	3	882056090	975	887055921
3/4-inch globe	33764*	3	882056099	1,000	4820-00-834-0783
3/4-inch globe	33764*	3	882056119	775	4820-00-964-4648
3/4-inch globe	33764*	3	882056251	775	4820-00-964-4648
3/4-inch globe	33764*	3	882056639	775	----
3/4-inch globe	33764*	3	882057360	775	----
3/4-inch globe	33764*	3	882057572	775	887055921
3/4-inch globe	33764*	3	882057924	775	887055921
1-inch globe	33764*	3	882055563	775	4820-00-484-8477
1-inch globe	33764*	3	882055619	975	887055922
1-inch globe	33764*	3	882056010	775	4820-00-484-8477
1-inch globe	33764*	3	882055924	775	4820-00-484-8477
1-inch globe	33764*	3	882056013	---	887055922
1-inch globe	33764*	3	882056250	775	----
1-inch globe	33764*	3	882056316	1,000	4820-00-834-4679
1-inch globe	33764*	3	882057927	775	----
1-1/4-inch globe	33764*	3	882055562	775	4820-00-484-8479
1-1/4-inch globe	33764*	3	882055707	775	4820-00-484-8479
1-1/4-inch globe	33764*	3	882057929	775	4820-00-484-8479
1-1/2-inch globe	33764*	3	882055561	775	4820-00-841-9968
1-1/2-inch globe	33764*	3	882055568	1,000	4820-00-079-5818
1-1/2-inch globe	33764*	3	882055688	1,000	887055923
1-1/2-inch globe	33764*	3	882055732	775	4820-00-841-9968
1-1/2-inch globe	33764*	3	882055847	775	887055923
1-1/2-inch globe	33764*	3	882055961	---	4820-00-841-9968
1-1/2-inch globe	33764*	3	882056069	775	4820-00-841-9968
1-1/2-inch globe	33764*	3	882056098	1,000	----
1-1/2-inch globe	33764*	3	882056647	775	----
1-1/2-inch globe	33764*	3	882057508	775	----
1-1/2-inch globe	33764*	3	882057923	775	887055923
2-inch globe	33764*	3	882055560	775	4820-00-418-4802
2-inch globe	33764*	3	882055567	1,000	4820-00-834-0613
2-inch globe	33764*	3	882055572	775	4820-00-418-4802

Table 3-2. Volume II: Stop Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
2-inch globe	33764*	3	882055661	1,000	887055924
2-inch globe	33764*	3	882056057	850	4820-00-418-4802
2-inch globe	33764*	3	882056260	775	4820-00-418-4802
2-inch globe	33764*	3	882057928	775	----
2-inch globe	33764*	3	882057532	---	----
1/4-inch angle	33311*	3	882001224	1,000	----
1/4-inch angle	33311*	1	887000017	1,000	887005398
1/4-inch angle	33311*	1	887000030	775	887005398
1/4-inch globe	33311*	3	882051964	1,000	887055919
1/4-inch globe	33311*	3	882053034	1,000	----
1/4-inch globe	33311*	3	882053286	1,000	-----
1/4-inch globe	33311*	3	882053291	775	----
1/4-inch globe	33311*	3	882054829	775	----
1/4-inch globe	33311*	1	887055830	975	----
3/8-inch angle	33311*	3	882003443	775	887005399
3/8-inch globe	33311*	3	882051965	1,000	887055920
3/8-inch globe	33311*	3	882054012	775	----
3/8-inch globe	33311*	3	882057636	---	887055920
3/8-inch globe	33311*	3	882057989	---	887055920
1/2-inch angle	33311*	3	882001226	1,000	887005399
1/2-inch angle	33311*	3	882002994	775	----
1/2-inch angle	33311*	3	882003638	---	887005399
1/2-inch angle	33311*	1	887005366	975	887005399
1/2-inch angle	33311*	1	887005367	---	887005400
1/2-inch angle	33311*	1	887005399	975	----
1/2-inch globe	33311*	3	882053918	775	----
1/2-inch globe	33311*	3	882054046	1,000	----
1/2-inch globe	33311*	3	882054123	1,000	4820-00-824-8650
1/2-inch globe	33311*	3	882054653	775	4820-00-940-8417
1/2-inch globe	33311*	3	882057742	---	887055920
1/2-inch globe	33311*	3	882059151	---	887055920
1/2-inch globe	33311*	1	887055920	975	----
3/4-inch angle	33311*	3	882001227	1,000	887005400
3/4-inch angle	33311*	3	882002481	775	887005400
3/4-inch angle	33311*	3	882002995	775	----
3/4-inch angle	33311*	3	882003739	---	887005400
3/4-inch angle	33311*	1	887005400	975	----
3/4-inch globe	33311*	3	882051967	1,000	887055921
3/4-inch globe	33311*	3	882053284	1,000	----
3/4-inch globe	33311*	3	882054093	775	----
3/4-inch globe	33311*	3	882054117	1,000	----
3/4-inch globe	33311*	3	882055699	100	----
3/4-inch globe	33311*	3	882055831	---	887055921
3/4-inch globe	33311*	3	882057679	---	887055921
3/4-inch globe	33311*	1	887055831	---	887055921
3/4-inch globe	33311*	1	887055921	975	----

Table 3-2. Volume II: Stop Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1-inch angle	33311*	3	882001228	1,000	887005401
1-inch angle	33311*	3	882003614	1,000	887005401
1-inch angle	33311*	3	882003674	775	----
1-inch angle	33311*	1	887005401	975	----
1-inch globe	33311*	3	882051968	1,000	887055922
1-inch globe	33311*	3	882053283	700	----
1-inch globe	33311*	3	882055700	1,000	4820-00-824-8652
1-inch globe	33311*	3	882057665	775	----
1-inch globe	33311*	1	887005029	1,000	887055922
1-inch globe	33311*	1	887055922	975	----
1-1/4-inch angle	33311*	3	882003444	850	887005402
1-1/4-inch angle	33311*	3	882003618	775	----
1-1/4-inch globe	33311*	3	882051969	1,000	887055923
1-1/4-inch globe	33311*	3	882053939	775	----
1-1/4-inch globe	33311*	3	882055845	1,000	----
1-1/4-inch globe	33311*	3	882057680	775	887055923
1-1/4-inch globe	33311*	1	887055607B	1,000	----
1-1/2-inch globe	33311*	3	882001230	1,000	887005402
1-1/2-inch angle	33311*	3	882002203	775	----
1-1/2-inch angle	33311*	3	882002794	---	----
1-1/2-inch angle	33311*	1	887000035	775	887005402
1-1/2-inch angle	33311*	1	887005368	975	----
1-1/2-inch angle	33311*	1	887005402	975	----
1-1/2-inch globe	33311*	3	882051970	1,000	88055923
1-1/2-inch globe	33311*	3	882053287	1,000	----
1-1/2-inch globe	33311*	3	882053293	775	----
1-1/2-inch globe	33311*	3	882054261	775	----
1-1/2-inch globe	33311*	3	882057562	---	887055923
1-1/2-inch globe	33311*	3	882057808	---	887055923
1-1/2-inch globe	33311*	1	887055923	975	----
2-inch angle	33311*	3	882002082	---	----
2-inch angle	33311*	3	882002233	100	887005403
2-inch angle	33311*	1	887005298	---	887005403
2-inch angle	33311*	1	887005403	975	----
2-inch globe	33311*	3	882053294	775	887055924
2-inch globe	33311*	3	882054263	775	----
2-inch globe	33311*	3	882057365	---	----
2-inch globe	33311*	1	887050032	975	----
2-inch globe	33311*	1	887055353	1,000	----
2-inch globe	33311*	1	887055639	775	----
3-inch globe	78319	3	882056774	775	----
3-inch globe	78319	3	882056918	---	----
3-inch globe	78319	3	882057178B	---	----
3-inch globe	78319	3	882056763	1,000	----
4-inch globe	78319	3	882057179B	---	----
4-inch globe	78319	3	882057800	775	----

Table 3-2. Volume II: Stop Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
4-inch globe	78319	1	887055593	---	----
3/4-inch globe	D-512-1-B3*		887050097B	975	887055921
1-1/2-inch angle	BO-21412A		882000803	800	----

*MIL-V-22094 Valves

Table 3-3. Volume III: Stop Valves (Power Actuated)

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
3-inch globe	2060-5	3	882056005	850	----
4-inch globe	662-5E	3	882052831	850	----
5-inch globe	2S-882-5	3	882054097	925	----
6-inch angle	1S-658-5	3	882002556	850	----
8-inch angle	2028-5	1	887005158	975	----
10-inch globe	1988-5	1	887055245	975	----
3-inch globe	1843-5	1	887055304	975	----
5-inch angle	PR-1842-5	3	882002848	---	----
5-inch globe	1450-5B	1	887055597	1,000	----

Table 3-4. Volume IV: Stop Check Valves (Manually Operated)

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
3-1/2-inch globe	1S-1168-5	3	882035811	---	----
1/4-inch globe	33310*	3	882033930	775	4820-00-431-6328
3/8-inch globe	33310*	3	882033943	775	4820-00-431-8322
1/2-inch angle	33310*	3	882033021	775	----
1/2-inch globe	33310*	3	882031403	850	----
1/2-inch globe	33310*	3	882031619	775	887035830
1/2-inch globe	33310*	3	882032777	775	4820-00-431-8323
3/4-inch angle	33310*	3	882034187	775	4820-00-919-7331
3/4-inch angle	33310*	3	882034277	850	4820-00-919-7331
3/4-inch globe	33310*	3	882032719	875	----
3/4-inch globe	33310*	3	882032931	850	4820-00-463-2029
3/4-inch globe	33310*	3	882033885	850	4820-00-463-2029
3/4-inch globe	33310*	3	882034183	775	4820-00-919-7331
1-inch angle	33310*	3	882034060	775	4820-00-432-1671
1-inch angle	33310*	3	882034223	775	887035838
1-inch globe	33310*	3	882031404	850	887035832
1-inch globe	33310*	3	882033861	975	----
1-inch globe	33310*	3	882033929	775	4820-00-752-9526
1-1/4-inch globe	33310*	3	882034197	775	4820-00-455-1086
1-1/4-inch globe	33310*	3	882034384	775	4820-00-455-1086
1-1/2-inch angle	33310*	3	882031689	775	4820-00-472-4072
1-1/2-inch angle	33310*	3	882032494	775	4820-00-472-4072

Table 3-4. Volume IV: Stop Check Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1-1/2-inch globe	33310*	3	882032795	975	4820-00-463-2036
1-1/2-inch globe	33310*	3	882033503	775	4820-00-752-9958
1-1/2-inch globe	33310*	3	882033956	775	4820-00-752-9958
1-1/2-inch globe	33310*	3	882034390	775	4820-00-752-9958
2-inch angle	33310*	3	882034061	775	4820-00-432-1667
2-inch angle	33310*	3	882034186	775	4820-00-432-1667
2-inch globe	33310*	3	882033012	775	4820-00-432-1667
2-inch globe	33310*	3	882034072	775	4820-00-432-1667
2-inch globe	33310*	3	882034189	775	4820-00-432-1667
1/4-inch globe	33764*	3	882035916	775	887035829
1/4-inch globe	33764*	3	882035196	775	4820-00-431-6328
3/8-inch globe	33764*	1	887035336	775	----
3/8-inch globe	33764*	3	882035885	---	887035830
1/2-inch globe	33764*	1	887030018	1,000	887035830
1/2-inch globe	33764*	3	882035195	775	4820-00-431-8323
1/2-inch globe	33764*	3	882035199	600	4820-00-762-1228
1/2-inch globe	33764*	3	882035303	775	4820-00-431-8323
1/2-inch globe	33764*	3	882035884	---	4820-00-431-8823
1/2-inch globe	33764*	3	882035941	775	----
1/2-inch globe	33764*	3	882036380	1,000	----
1/2-inch globe	33764*	3	882036913	1,125	----
1/2-inch globe	33764*	3	882036952	1,125	----
1/2-inch globe	33764*	3	882039479	775	----
3/4-inch globe	33764*	3	882035533	775	4820-00-919-7331
3/4-inch globe	33764*	3	882035558	775	4820-00-919-7331
3/4-inch globe	33764*	3	882035883	---	887035831
3/4-inch globe	33764*	3	882035934	775	4820-00-919-7331
3/4-inch globe	33764*	3	882035940	775	----
3/4-inch globe	33764*	3	882035942	775	----
3/4-inch globe	33764*	3	882036973	1,125	----
3/4-inch globe	33764*	3	882037884	1,125	----
3/4-inch globe	33764*	3	882039210	775	887035831
3/4-inch globe	33764*	3	882039478	775	----
3/4-inch globe	33764*	3	882035194	775	4820-00-919-7331
3/4-inch globe	33764*	3	882035198	100	887035831
3/4-inch globe	33764*	1	887035339	1,000	----
3/4-inch globe	33764*	1	887035359	775	----
1-inch globe	33764*	1	887035340	775	----
1-inch globe	33764*	3	882035534	775	4820-00-752-9526
1-inch globe	33764*	3	882035882	---	887035883
1-inch globe	33764*	3	882036098	775	887035832
1-inch globe	33764*	3	882036367	775	----
1-inch globe	33764*	3	882036382	1,000	----
1-inch globe	33764*	3	882036951	1,125	----
1-inch globe	33764*	3	882037997	---	
1-inch globe	33764*	3	882035193	775	4820-00-752-9526

Table 3-4. Volume IV: Stop Check Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1-inch globe	33764*	3	882035966	775	4820-00-752-9526
1-inch globe	33764*	1	887030017	775	----
1-inch globe	33764*	1	887030019	1,000	----
1-1/4-inch globe	33764*	3	882035192	775	4820-00-455-1086
1-1/4-inch globe	33764*	1	887035749	---	----
1-1/4-inch globe	33764*	3	882035833	775	----
1-1/4-inch globe	33764*	3	882035939	775	887035833
1-1/2-inch globe	33764*	1	887035341	775	----
1-1/2-inch globe	33764*	1	887035349	1,000	----
1-1/2-inch globe	33764*	3	882035197	1,000	887035833
1-1/2-inch globe	33764*	3	882035191	775	4820-00-752-9958
1-1/2-inch globe	33764*	3	882035714	---	----
1-1/2-inch globe	33764*	3	882035734	---	4820-00-752-9958
1-1/2-inch globe	33764*	3	882035915	775	4820-00-752-9958
1-1/2-inch globe	33764*	3	882035980	775	4820-00-752-9958
1-1/2-inch globe	33764*	3	882036381	1,000	----
1-1/2-inch globe	33764*	3	882039305	1,125	----
1-1/2-inch globe	33764*	3	882039474	775	----
1-1/2-inch globe	33764*	3	882039475	775	----
2-inch globe	33764*	3	882035715	---	----
2-inch globe	33764*	3	882036047	775	887035834
2-inch globe	33764*	3	882036912	1,125	----
2-inch globe	33764*	3	882039046	---	----
2-inch globe	33764*	3	882039477	775	----
2-inch globe	33764*	3	882035190	775	4820-00-432-1667
2-inch globe	33764*	3	882035299	775	887035833
1/4-inch angle	33311*	3	882031784	775	----
1/4-inch globe	33311*	3	882032736	775	882035829
3/8-inch angle	33311*	3	882035511	775	----
3/8-inch globe	33311*	3	882034064	300	----
3/8-inch globe	33311*	3	882037334	775	887035830
1/2-inch angle	33311*	3	882035758	1,000	----
1/2-inch globe	33311*	3	882031749	975	887035830
1/2-inch globe	33311*	3	882033443	100	4820-00-078-6369
1/2-inch globe	33311*	3	882033494	1,000	----
1/2-inch globe	33311*	3	882035758	1,000	----
1/2-inch globe	33311*	3	882039244	---	887035830
1/2-inch globe	33311*	1	887035313	775	887035830
1/2-inch globe	33311*	1	887035696	775	887035830
1/2-inch globe	33311*	1	887035753	---	887035830
1/2-inch globe	33311*	3	882033310	775	----
3/4-inch globe	33311*	3	882033056	975	887035831
3/4-inch globe	33311*	3	882033706	775	----
3/4-inch globe	33311*	1	887035751	975	----
1-inch angle	33311*	3	882037329	775	887035838
1-inch angle	33311*	1	887035838	975	----

Table 3-4. Volume IV: Stop Check Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1-inch globe	33311*	3	882033650	775	887035832
1-inch globe	33311*	1	887030136	775	887035832
1-1/4-inch globe	33311*	3	882034042	1,000	--
1-1/4-inch globe	33311*	3	882039572	---	887035833
1-1/4-inch globe	33311*	1	887035851	---	----
1-1/2-inch angle	33311*	3	882032495	775	
1-1/2-inch angle	33311*	3	882033382	775	----
1-1/2-inch angle	33311*	3	882034806	775	887035839
1-1/2-inch angle	33311*	1	887035839	975	----
1-1/2-inch globe	33311*	3	882031782	775	----
1-1/2-inch globe	33311*	3	882034753	1,000	----
1-1/2-inch globe	33311*	1	887035752	975	----
2-inch angle	33311*	3	882033651	775	----
2-inch angle	33311*	3	882039246	---	887035840
2-inch angle	33311*	1	887035840	975	----
2-inch globe	33311*	3	882033997	1,000	----
2-inch globe	33311*	3	882034819	775	887035834
2-inch globe	33311*	3	882035251	1,000	----
2-inch globe	33311*	1	887035834	975	----
3-inch globe	78319	3	882036821	775	----
3-inch globe	78319	3	882037249B	---	----
3-inch globe	78319	3	882037644	975	----
3-1/2-inch globe	78319	3	882036829	1,000	----

*MIL-V-22094 Valves

Table 3-5. Volume V: Stop Check Valves (Power Actuated)

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
4-inch globe	1S-1392-5	3	882036231	---	----
5-inch globe	2053-5	1	887035268	---	----
3-inch angle	PE-423964	1	887035563	975	----
5- to 12-inch globe	78319	3	---	---	----
6-inch globe	78319	3	882037247B	---	----

Table 3-6. Volume VI: Swing Check Valves

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
5-inch swing check	20147-F	3	882032863	---	----

Table 3-7. Volume VII: Lift Check Valves

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/ NSN
1/2-inch piston	33351*	3	882034340	775	----
1/2-inch piston	33351*	3	882035159	775	----
3/4-inch angle	33351*	3	882037365	775	----
3/4-inch globe	33351*	3	882034370	775	4820-00-760-3650
3/4-inch piston	33351*	3	882034341	775	4820-00-760-3650
3/4-inch piston	33351*	3	882035320	775	----
1-inch globe	33351*	3	882034371	775	----
1-1/4-inch angle	33351*	3	882034336	775	----
1-1/4-inch piston	33351*	3	882034342	775	----
1-1/2-inch globe	33351*	3	882034310	775	4820-00-762-1270
1-1/2-inch globe	33351*	3	882035698	1,000	4820-00-463-2036
2-inch angle	33351*	3	882032692	850	----
2-inch piston	33351*	3	882034343	775	----
2-inch piston	33351*	3	882037306	---	----
4-inch angle	1681-5	3	882034206	---	4820-00-557-0074

*MIL-V-22094 Valves

Table 3-8. Volume VIII: Y-Pattern Valves

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
1-1/2 inch	R7350F-1-1/2-1143	3	882010347	775	----
1-1/2 inch	R7350F-1-1/2-584	3	882010223	775	----
1-1/2 inch	R7350F-1-1/2-1144	3	882010348	775	----
1-1/2 inch	R7350F-1-1/2-586	3	882010224	775	----
1-1/2 inch	D-470418	3	882010530	---	----
2 inch	D-470418	3	882010541	---	----
1-1/2 inch	13673-3	3	882010531	---	----
1-1/2 inch	BO-21435	3	882010194	800	----

Table 3-9. Volume IX: Gate Valves (Manually Operated)

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
3 inch	1869-5	3	882045833	975	----
4 inch	2S-598-5	3	882044009	865	----

Table 3-9. Volume IX: Gate Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
4 inch	598-5H	3	882046275	--	4820-00-445-4385
6 inch	2S-600-5C	3	882044957	1,000	----
6 inch	3S-600-5	3	882045941	875	----
8 inch	1365-5	3	882044007	865	----
1-1/2 inch	761-5	3	882042541	775	4820-00-764-7134
2 inch	757-5	3	882042375	975	4820-00-825-8893
2-1/2 inch	756-5E	1	887045194	975	----
3 inch	756-5	3	882042545	775	----
1/2 inch	30065	3	882043568	775	4820-00-491-6793
3/4 inch	30065	3	882043553	775	4820-00-222-8637
1 inch	30065	3	882043570	775	4820-00-682-8237
1-1/2 inch	30065	3	882043572	775	4820-00-230-3030
2 inch	30065	3	882043573	775	4820-00-765-3027
3 inch	30074	3	882043719	850	4820-00-765-2886
4 inch	30074	3	882043720	850	4820-00-445-4385
2 inch	29746	3	882041357	775	4820-00-444-1565
2-1/2 inch	30094	3	882044681	775	
3 inch	30094	1	887040044	775	----
3 inch	29708	3	882042581	775	4820-00-446-8371
6 inch	30095	3	882044699	1,000	4820-00-825-8897
1/4 inch	23256	3	882047716	775	----
1/4 inch	23256	3	882049566	775	----
3/8 inch	23256	3	882044170	775	----
1/2 inch	23256	3	882044058	700	----
1/2 inch	23256	1	887040020	1,000	887050027
1/2 inch	23256	1	887040027	775	4820-00-923-0845L1
1/2 inch	23256	3	882049205	995	----
1/2 inch	23256	3	882049216	1,000	----
3/4 inch	23256	3	882044234	775	----
3/4 inch	23256	1	887040021	1,000	887055921
3/4 inch	23256	1	887040029	775	887055922
3/4 inch	23256	3	882049230	---	----
1 inch	23256	3	882044235	775	----

Table 3-9. Volume IX: Gate Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
1 inch	23256	1	887040022	1,000	887055922
1 inch	23256	1	887040028	775	----
1 inch	23256	3	882049286	---	----
1 inch	23256	3	882044067	775	4820-00-682-8237
1-1/4 inch	23256	1	887040023	1,000	----
1-1/4 inch	23256	1	887040030	775	----
1-1/4 inch	23256	1	887045227	1,000	----
1-1/4 inch	23256	3	882047979	975	----
1-1/2 inch	23256	1	887045303	1,000	----
1-1/2 inch	23256	1	887045311	775	----
1-1/2 inch	23256	3	882049019	---	----
1-1/2 inch	23256	3	882049031	---	----
1-1/2 inch	23256	3	882049264	1,000	887055923
1-1/2 inch	23256	3	882049266	775	----
1-1/2 inch	23256	3	882044068	775	4820-00-230-3030
1-1/2 inch	23256	3	882044171	775	887055923
1-1/2 inch	23256	3	882047257	1,000	4820-00-825-8892
1-1/2 inch	23256	1	887040024	1,000	----
1-1/2 inch	23256	1	887040031	775	----
2 inch	23256	3	882044172	975	4820-00-444-1565
2 inch	23256	3	882047256	1,000	4820-00-825-8893
2 inch	23256	3	882049611	775	----
2 inch	23256	1	887040025	1,000	----
2 inch	23256	1	887040032	775	----
2 inch	23256	1	887045308	995	----
2 inch	23256	1	887045309	1,050	----
2 inch	23256	1	887045310	975	----
2 inch	23256	3	882049018	---	----
2 inch	23256	3	882049049	775	4820-00-444-1565
2 inch	23256	3	882049599	---	887055924
2 inch	23256	3	882044069	775	4820-00-765-3027
2 inch	23256	1	887040039	975	----
2-1/2 inch	88324	3	882047339	775	----
2-1/2 inch	88324	3	882047715	775	----
2-1/2 inch	88324	3	882047789	---	----
2-1/2 inch	88324	1	887045268	---	----
3 inch	88426	3	882047334	775	----
3 inch	88426	3	882047562	1,000	----
3 inch	88426	3	882047722	1,050	----
3 inch	88426	3	882049301	1,000	----

Table 3-9. Volume IX: Gate Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
3-1/2 inch	88426	3	882047333	775	----
4 inch	88426	3	882047320	---	----
5 inch	88426	3	882047905B	775	----
5 inch	88426	3	882049275	---	----
6 inch	88426	3	882047372	1,000	----
8 inch	88426	3	882047676	777	----
2 inch	N-10656	1	887040062	975	----
2-1/2 inch	N-10656	1	887045205	775	----
2-1/2 inch	N-10656	1	887045208	975	----
3 inch	N-10656	1	887040050	850	----
3 inch	N-10656	1	887045213	775	----
3-1/2 inch	N-10656	1	887045215	775	----
4 inch	N-10656	1	887045207	975	----
4 inch	N-10656	1	887045214	775	----
6 inch	N-10656	1	887045206	975	----
2 inch	N-10656	3	882040764	850	4820-00-765-3027
2 inch	N-10656	3	882043103	---	4820-00-765-3027
2 inch	N-10656	3	882043584	650	4820-00-765-3027
2-1/2 inch	N-10656	3	882043339	---	4820-00-444-7247
2-1/2 inch	N-10656	3	882043413	850	4820-00-444-7247
2-1/2 inch	N-10656	3	882043960	600	4820-00-444-7247
2-1/2 inch	N-10656	3	882045545	975	4820-00-541-7574
2-1/2 inch	N-10656	3	882045824	850	4820-00-444-7247
3 inch	N-10656	3	882041581	650	4820-00-765-2886
3 inch	N-10656	3	882041858	775	4820-00-765-2886
3 inch	N-10656	3	882042253	850	4820-00-765-2886
3 inch	N-10656	3	882042535	850	4820-00-765-2886
3 inch	N-10656	3	882042536	850	4820-00-765-2886
3 inch	N-10656	3	882043120	---	----
3 inch	N-10656	3	882043606	775	4820-00-765-2886
3 inch	N-10656	3	882043950	600	4820-00-765-2886

Table 3-9. Volume IX: Gate Valves (Manually Operated) - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
3 inch	N-10656	3	882044845	850	4820-00-765-2886
3 inch	N-10656	3	882045823	850	4820-00-765-2886
3-1/2 inch	N-10656	3	882043951	600	4820-00-444-7249
3-1/2 inch	N-10656	3	882045414	850	----
4 inch	N-10656	3	882043952	600	4820-00-445-4385
4 inch	N-10656	3	882043953	875	----
4 inch	N-10656	3	882044975	775	4820-00-445-4385
4 inch	N-10656	3	882045649	975	----
4 inch	N-10656	3	882046944	975	----
4 inch	N-10656	3	882049220	---	----
4 inch	N-10656	3	882049668	---	----
5 inch	N-10656	3	882042533	775	4820-00-445-4386
5 inch	N-10656	3	882049667	775	4820-00-445-4386
6 inch	N-10656	3	882043168	---	----
6 inch	N-10656	3	882043879	850	----
6 inch	N-10656	3	882043954	875	----
6 inch	N-10656	3	882045690	975	----
6 inch	A-9781-M-119	3	882046161	750	----
2 inch	N-10700C	1	887040061	975	----
2-1/2 inch	N-10700C	1	887040055	---	----
3 inch	N-10700C	1	887045326	---	----
4 inch	N-10700C	3	882042611	775	----
4 inch	N-10700C	3	882042612	975	4820-00-825-5609
4 inch	N-10700C	1	887045321	---	----

Table 3-10. Volume X: Gate Valves (Power Actuated)

Size/Type	Drawing No.	Level	APL	Temp (°F)	Replacement APL/NSN
6 inch	2S-1875-5	3	882046349	---	----
8 inch	1592-5	3	882044881	850	----
10 inch	1138-5	3	882043522	975	----
10 inch	1556-5	3	882044920	1,000	----
5 inch	1810-5	3	882046108	246	4820-00-825-8896
5 inch	1810-5	1	887045191	975	----
6 inch	755-5F	3	882042373	975	4820-00-825-8897
6 inch	1841-5	1	887045190	975	----

Table 3-10. Volume X: Gate Valves (Power Actuated) - Continued

Size/Type	Drawing No.	Level	APL	Temp (°F)	Replacement APL/NSN
3 inch	29768	3	882041583	750	----
5 inch	29756	3	882040967	975	4820-00-825-8896
5 inch	29756	3	882040968	975	4820-00-825-8896
5 inch	29756	3	882041112	975	4820-00-825-8896
5 inch	29756	3	882041883	975	4820-00-825-8896
5 inch	29756	3	882041885	975	4820-60-825-8896
5 inch	29756	3	882043431	975	4820-00-825-8896
6 inch	8872-11	3	882049475	975	4820-00-825-8897
6 inch	8872-11	1	887045354	---	----
6 inch	8872-11	3	882049464	---	----
4 inch	N11088	3	882043567	775	4820-00-445-4385
5 inch	N11088	3	882043566	775	4820-00-445-4386
6 inch	N11088	3	882043648	850	----
10 inch	N11088	3	882043649	850	4820-00-445-4387
10 inch	N11088	3	882043650	850	4820-00-445-4387
10 inch	N11088	3	882043651	850	4820-00-445-4387
5 inch	N10750A	3	882040805	975	4820-00-825-8896
5 inch	N10750A	3	882041906	975	----
6 inch	N10750A	3	882040806	975	----
8 inch	N10750A	3	882041057	600	----

Table 3-11. Volume XI: Needle Valves

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
2-1/2-inch globe	1267-5	3	882070847	700	----
2-1/2-inch globe	2669-5	3	882071787	---	----
1/4-inch globe	33311*	3	882070916	1,000	----
1/2-inch globe	33311*	3	882070728	775	----
1-1/4-inch globe	33311*	3	882072201	775	----
1-1/4-inch globe	33311*	1	887045412	---	----
1-1/2-inch globe	33311*	3	882070815	775	----
1/4-inch globe	33310*	3	882070816	1,000	----
1/4-inch globe	33310*	3	882070939	775	----

Table 3-11. Volume XI: Needle Valves - Continued

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
1/2-inch globe	33310*	3	882071024	1,000	----
3/4-inch globe	33310*	3	882070697	975	----
3/4-inch globe	33310*	3	882070817	775	----
1-inch globe	33310*	3	882070460	775	----
1-inch globe	33310*	3	882070611	775	----
1-inch globe	33310*	3	882071023	1,000	----
1-1/4-inch globe	33310*	3	882070681	775	----
1-1/2-inch globe	33310*	3	882070631	775	----
1-1/2-inch globe	33310*	3	882070996	1,000	----
2-inch globe	33310*	3	882070793	850	----
2-inch globe	33310*	3	882070983	775	----
2-inch globe	33310*	3	882071020	775	----
2-inch globe	33310*	1	887075408	---	----
1/4-inch globe	33764*	3	882071592	775	----
1/4-inch globe	33764*	3	882071549	1,000	----
1/4-inch globe	33764*	3	882071654	775	----
3/8-inch globe	33764*	3	882071769	775	----
3/8-inch globe	33764*	3	882071903	---	----
1/2-inch globe	33764*	3	882071543	775	----
1/2-inch globe	33764*	3	882072324	775	----
1/2-inch globe	33764*	3	882071601	1,000	----
1/2-inch globe	33764*	3	882071707	---	----
1/2-inch globe	33764*	3	882071391	775	----
3/4-inch globe	33764*	3	882071390	775	----
3/4-inch globe	33764*	3	882071466	775	----
3/4-inch globe	33764*	3	882071542	775	----
3/4-inch globe	33764*	3	882072327	775	----
1-inch globe	33764*	3	882071544	775	----
1-inch globe	33764*	3	882072328	775	----
1-inch globe	33764*	3	882071603	775	----
1-1/4-inch globe	33764*	3	882072102	775	----
1-inch globe	33764*	3	882071541	775	----
1-1/4-inch globe	33764*	3	882072325	775	----
1-1/4-inch globe	33764*	3	882071604	775	----
1-1/2-inch globe	33764*	3	882071535	775	----
1-1/2-inch globe	33764*	3	882071747	775	----
2-inch globe	33764*	3	882071529	775	----
2-inch globe	33764*	3	882071538	775	----
1-inch globe	33764*	3	882071389	775	----
1-1/4-inch globe	33764*	3	882071388	775	----
1-1/2-inch globe	33764*	3	882071387	775	----
2-inch globe	33764*	3	882071386	775	----

*MIL-V-22094 Valves

Table 3-12. Volume XII: Astern Throttle Valves

Size/Type	Drawing No.	Level	APL	Temp. (°F)	Replacement APL/NSN
4 inch	52-A-54	0	883000030	850	----
4 inch	NP-440	0	883000334	940	----

Table 3-13. Volume XIII: Pressure-Reducing Valves, Actuators, and Relief Valves

Size/Type	Drawing No.	APL	Replacement APL/NSN
Intl Plt-Opr, 3/4-inch Atlas	NAP609	882095822	----
Intl Plt-Opr, 1-1/4-inch Atlas	NAP609	882095830	----
Intl Plt-Opr, 2-1/2-inch Leslie	12595N	882093272	887095114
Diap Opr, 3-inch Leslie 1,500 psi	22388N	882191357	----
Diap Opr, 1-1/2-inch Leslie	15748N	882191280	----
Diap Opr, 2-inch Leslie	15748N	882191766	----
Intl Plt-Opr, 3-inch Leslie	12878N	882091678	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220277	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220307	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220354	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220363	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220367	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220369	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220384	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	882220517	----
Air-Opr Cont Plt, Leslie PRAN-2	15152N	887225101	----
Air-Opr Cont Plt, Leslie PRQN-2	15152N	882220276	----
Air-Opr Cont Plt, Leslie PRQN-2	15152N	882220350	----
Air-Opr Cont Plt, Leslie PRQN-2	15152N	882220352	----
Air-Opr Cont Plt, Leslie PRQN-2	15152N	882220433	----
Air-Opr Cont Plt, Leslie PRQN-2	15152N	882220499	----
Ext Plt-Opr, Actuator	18356N	Various APL's for Valves	
Ext Plt-Opr, Actuator	21509N	Various APL's for Valves	

Table 3-13. Volume XIII: Pressure-Reducing Valves, Actuators, and Relief Valves - Continued

Size/Type	Drawing No.	APL	Replacement APL/ NSN
1/2-inch relief valve	NMP 1500	883115814	----

Table 3-14. Volume XIV: Steam Traps and Drain orifices

Size/Type	Drawing No.	APL	Replacement APL/ NSN
1/2-inch steam trap	N0041-3	770240184	----
1/2-inch steam trap	N0041-3	770240203	----
3/4-inch steam trap	N0041-3	770240185	----
3/4-inch steam trap	N0041-3	770240204	----
1-inch steam trap	N0041-3	770240366	----
1/2-inch steam trap	N0044-3	770240217	----
1/2-inch steam trap	N0044-3	770240201	----
3/4-inch steam trap	N0044-3	770240218	----
3/4-inch steam trap	N0044-3	770240200	----
3/4-inch steam trap	N0044-3	770240183	----
3/4-inch steam trap	N0044-3	770240209	----
1-inch steam trap	N0044-3	770240219	----
1/2-inch restrictor unit	MS-18301	---	4730-00-217-7462
1/2-inch restrictor unit	MS-18301	---	4730-00-216-6152
1/2-inch restrictor unit	MS-18301	---	4730-00-216-6146
1/2-inch restrictor unit	MS-18301	---	4730-01-054-3762
3/4-inch restrictor unit	MS-18301	---	4730-00-217-7443
3/4-inch restrictor unit	MS-18301	---	4730-00-216-6151
3/4-inch restrictor unit	MS-18301	---	4730-00-216-6132
3/4-inch restrictor unit	MS-18301	---	4730-01-037-5036
1-inch restrictor unit	MS-18301	---	4730-01-133-8067

CHAPTER 4

FUNCTIONAL DESCRIPTIONS

4-1. INTRODUCTION.

4-1.1 SCOPE. This chapter provides a general functional description of the various types of non-nuclear valves, traps, and orifices used in steam propulsion systems. Functional descriptions of specific valves, traps, and orifices are provided in volumes II through XIV. Figures are provided in this chapter to illustrate the function of a typical valve, trap, and orifice of each type covered in this manual.

4-2. STOP VALVES.

4-2.1 MANUALLY OPERATED STOP VALVE DESCRIPTION. A manually operated stop valve (figure 4-1) is used in a piping system to fully open, fully close, or throttle (control) the flow of fluid. Packing rings form a seal around the stem. Some stop valves have a pressure seal ring (not shown) installed on a bonnet. The pressure seal ring seals the bonnet to the body. Fluid enters the valve inlet and is directed upward through the seat and against the disk. The disk may either prevent or allow fluid flow to the outlet. Quantity of fluid flow is controlled by the distance between the disk and seat. The distance is varied by handwheel, handles or T-wrench (handwheel) operation, wherein rotary motion is changed to linear motion in the stem by a yoke bushing. Handwheel rotation moves the stem up or down. Clockwise rotation of the handwheel moves the stem downward through the yoke bushing, moving the disk closer to the seat. This reduces flow through the valve and causes a throttling effect. Once the disk and seat are in contact, the valve is closed and no flow occurs. Counterclockwise rotation of the handwheel moves the stem upward through the yoke bushing, moving the disk away from the seat, opening the valve and allowing flow. A backseat seal prevents the stem from being unscrewed from the bonnet.

4-2.2 POWER-ACTUATED STOP VALVE DESCRIPTION. A power-actuated stop valve (figure 4-2) is used in a piping system to fully open, fully close, or throttle the flow of fluid. Packing rings form a seal around the stem. A power-actuated stop valve uses a handwheel or air motor in conjunction with a toggle or gear assembly for mechanical advantage in moving the stem to overcome system pressure. The stem, disk, and seat functions are similar to those described in paragraph 4-2.1. A backseat seal prevents the stem from being unscrewed from the bonnet.

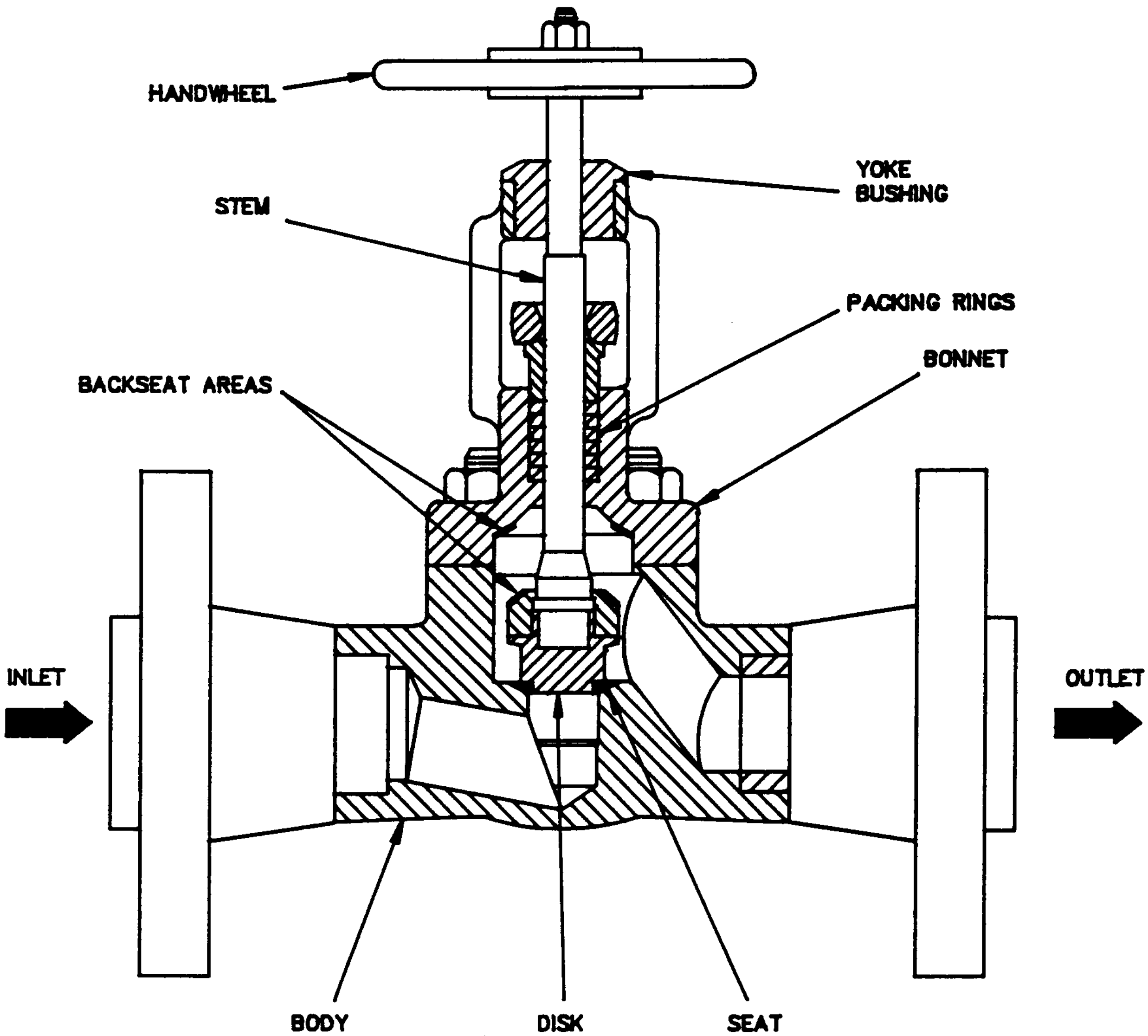


Figure 4-1. Manually operated Stop Valve (Typical)

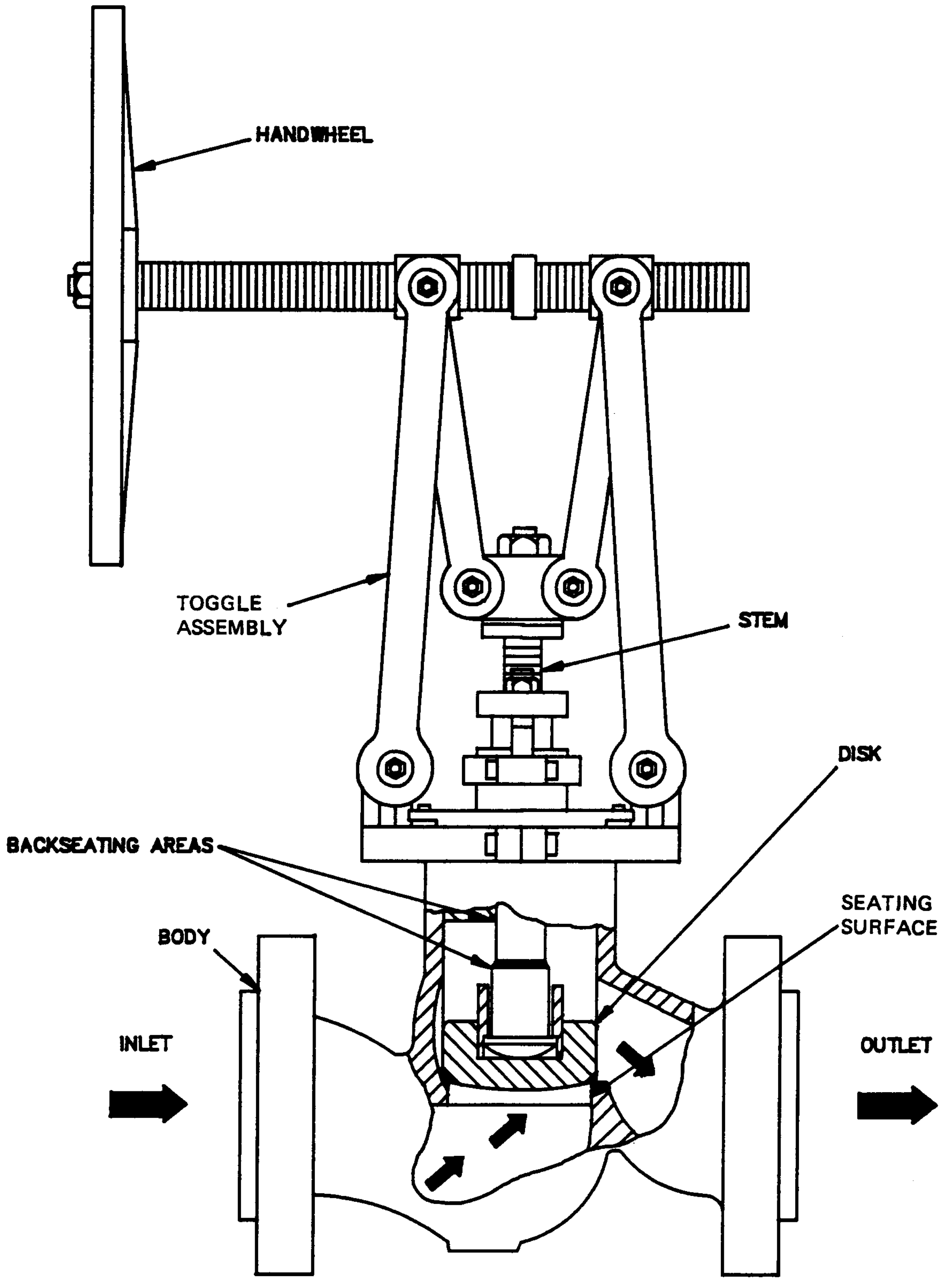


Figure 4-2. Power-Actuated Stop Valve (Typical)

4-2.2.1 Toggle Assembly. A toggle assembly (figure 4-3) creates a scissors-type motion. This motion is created by pivot positioning of the long and short links. The long links are attached to the stationary bonnet and two mobile trunnions (trunnions). The short links are also attached to the mobile trunnions and to a crosshead, which attaches to the valve stem. The trunnions are threaded internally to receive the threaded areas of the toggle stem. The toggle stem has right-hand and left-hand threads machined on opposite ends of the same shaft. When the toggle stem is rotated by the handwheel or by the air motor, the trunnions move in opposite directions along the toggle stem. When the handwheel is rotated in a counterclockwise direction, the trunnions move apart, causing the long and short link angle to increase at the mobile trunnion pivots. The short links lift the crosshead and valve stem upward. When the toggle stem is rotated in a clockwise direction, the trunnions move closer together, causing the long and short link angle to decrease at the mobile trunnion pivots. The short links push the crosshead and valve stem downward.

4-2.2.2 Gear Assembly. A gear assembly (figure 4-4) may be of a bevel gear (view A) or spur gear (view B) arrangement. Both function the same way. A gear assembly uses the mechanical advantage of a small drive gear and a larger driven gear. The gear assembly is mounted on the yoke. The yoke bushing is internally threaded to receive the threaded portion of the valve stem. The driven gear is keyed to the yoke bushing. This causes the yoke bushing to turn with the driven gear. The drive gear teeth mate with the driven gear teeth. The drive gear is keyed to the handwheel shaft. The handwheel is bolted to the handwheel shaft. When the handwheel is rotated the drive gear will turn in the same direction. Clockwise rotation of the drive gear turns the driven gear in a clockwise direction. This causes the stem to be raised through the yoke bushing. Counterclockwise rotation of the drive gear turns the driven gear in a counterclockwise direction. This causes the valve stem to be lowered through the yoke bushing. An air motor-driven gear assembly is also shown in view B.

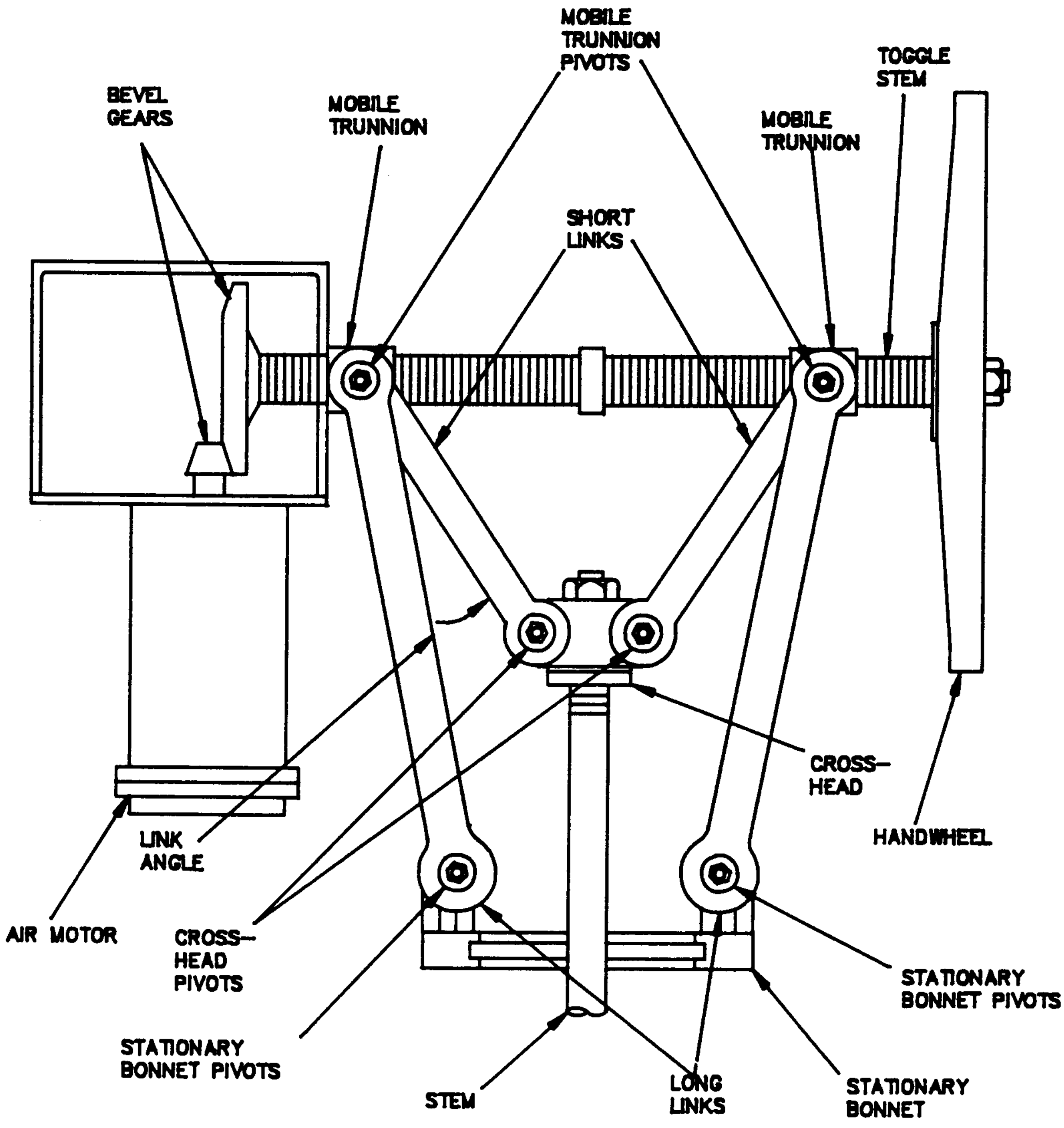


Figure 4-3. Toggle Assembly (Typical)

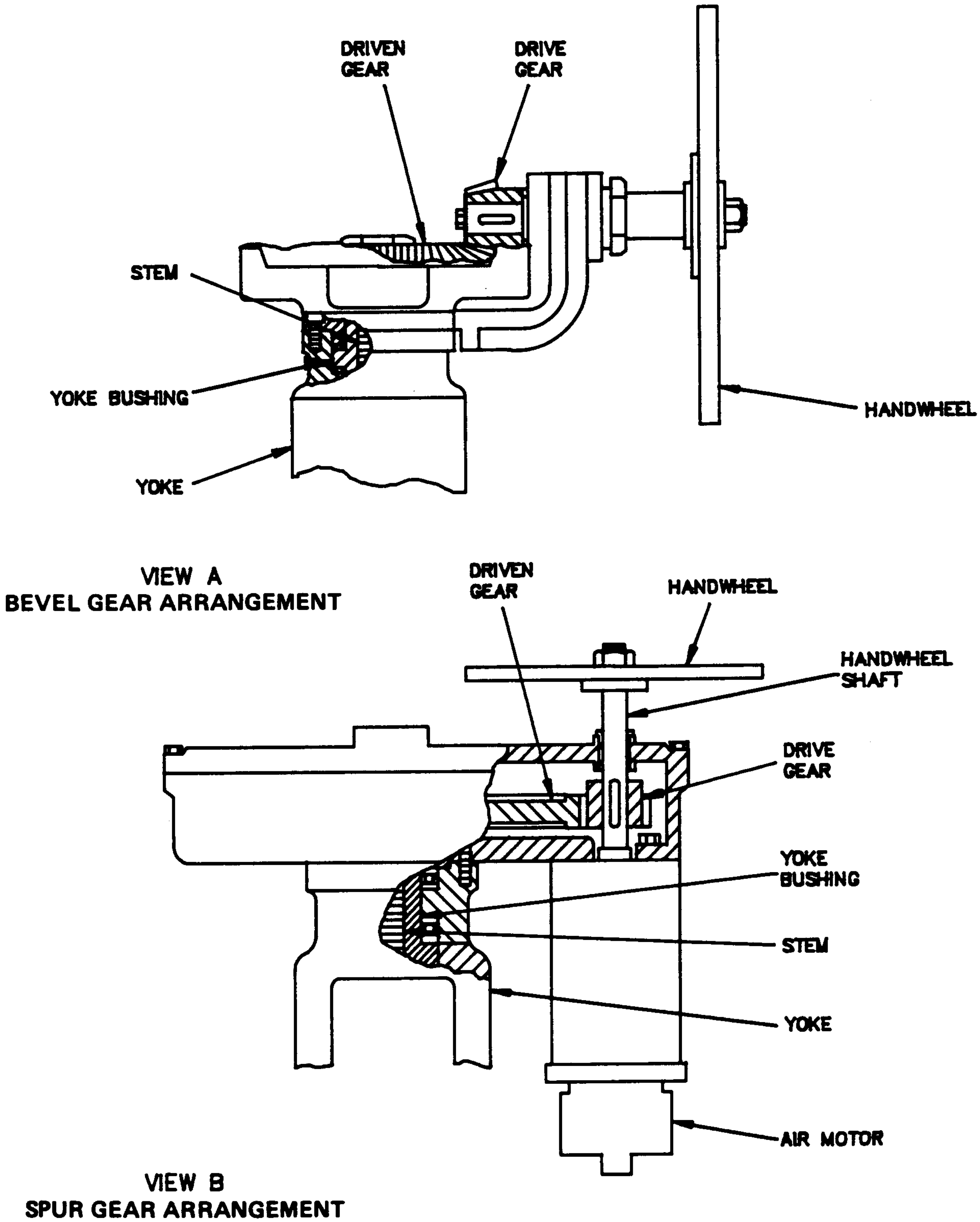


Figure 4-4. Gear Assemblies (Typical)

4-3. STOP CHECK VALVES.

4-3.1 MANUALLY OPERATED STOP CHECK VALVE DESCRIPTION. A manually operated stop check valve (figure 4-5) is used in a piping system to fully open, fully close, throttle, and prevent reversal of flow. Fluid enters the valve inlet and is directed through the seat by the body. The disk may either prevent or direct the flow to the outlet. Packing rings form a seal around the stem. Quantity of flow is controlled by the distance between the disk and seat. The distance is varied by either handwheel/stem operation or outlet pressure. The stem, disk, and seat functions are similar to those described in paragraph 4-2.1 for fully open, fully closed, or throttling functions. To prevent reverse flow, the disk floats free in the valve body. The disk, therefore, is not attached to the valve stem, but is guided by the stem. When pressure on the outlet side of the valve is greater than the inlet side, the higher pressure forces the disk downward. When the disk makes contact with the seat, the valve closes, preventing any reverse flow through the valve, regardless of the position of the valve stem. When inlet pressure overcomes outlet pressure the disk is forced upward, off the seat, allowing flow through the valve to the outlet. The disk will move upward only to the extent allowed by the position of the valve stem. A backseat seal prevents the stem from being unscrewed from the bonnet.

4-3.2 POWER-ACTUATED STOP CHECK VALVE DESCRIPTION. A power-actuated stop check valve (figure 4-6) is used in a piping system to fully open, fully close, throttle, and prevent reversal of flow. A power-actuated stop check valve uses a handwheel or air motor in conjunction with a gear assembly for mechanical advantage in moving the stem to overcome system pressure. The stem, disk, and seat functions are similar to those described in paragraph 4-3.1. The gear assembly has a spur gear arrangement and functions identically to that described in paragraph 4-2.2.2.

4-4. SWING CHECK VALVES.

4-4.1 SWING CHECK VALVE DESCRIPTION. A swing check valve (figure 4-7) is used in a piping system to prevent reverse flow. Fluid enters the inlet and is directed through the seat to the outlet. The disk either allows or prevents flow. When inlet pressure is greater than outlet pressure, the disk and disk arm will swing upward on the pivot and allow flow. When outlet pressure becomes equal to or greater than inlet pressure, the weight of the disk combined with fluid backflow inertia causes the disk to swing downward. When the disk makes contact with the seat, the valve is closed, preventing reverse flow through the valve.

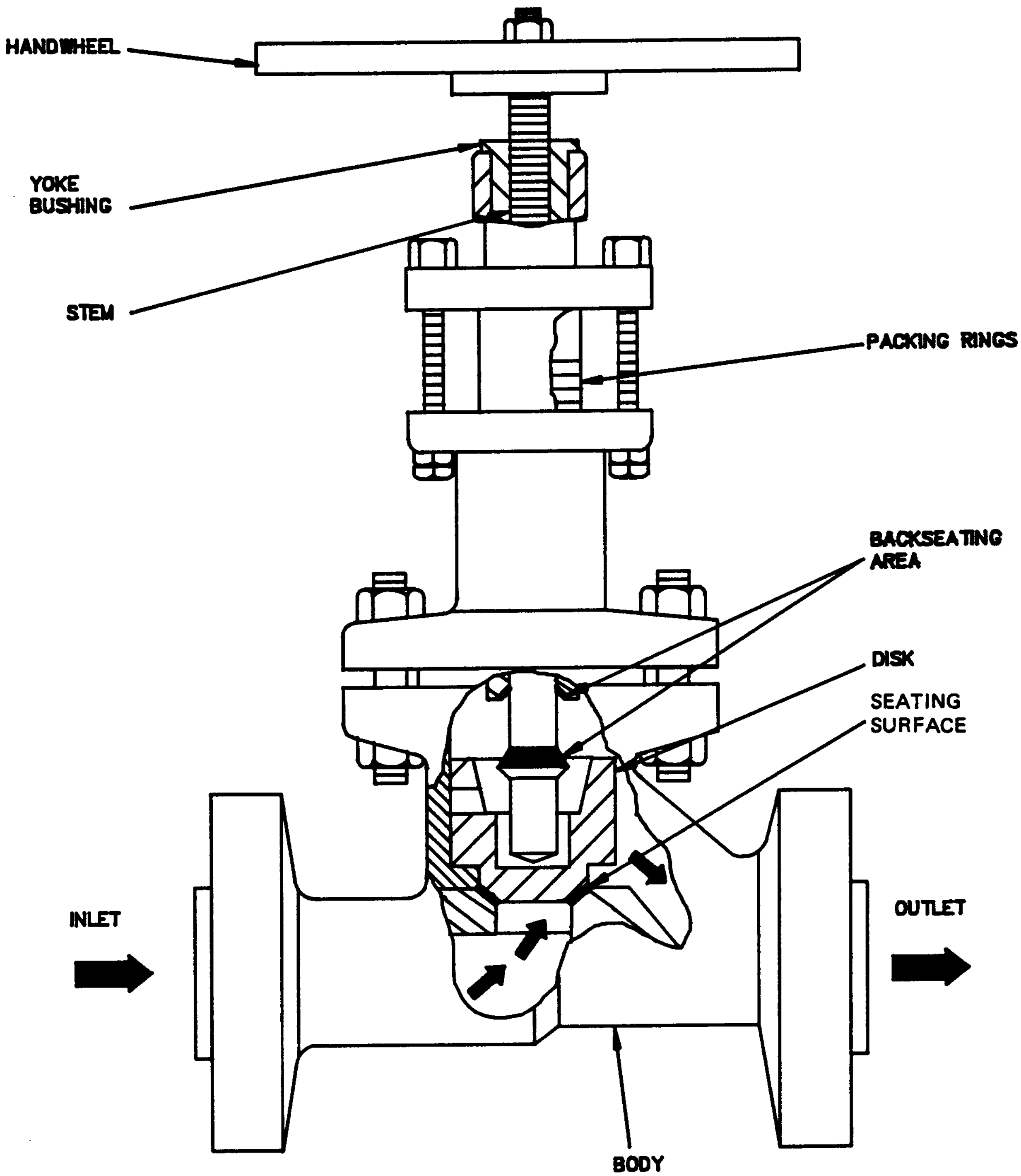


Figure 4-5. Manually Operated Stop Check Valve (Typical)

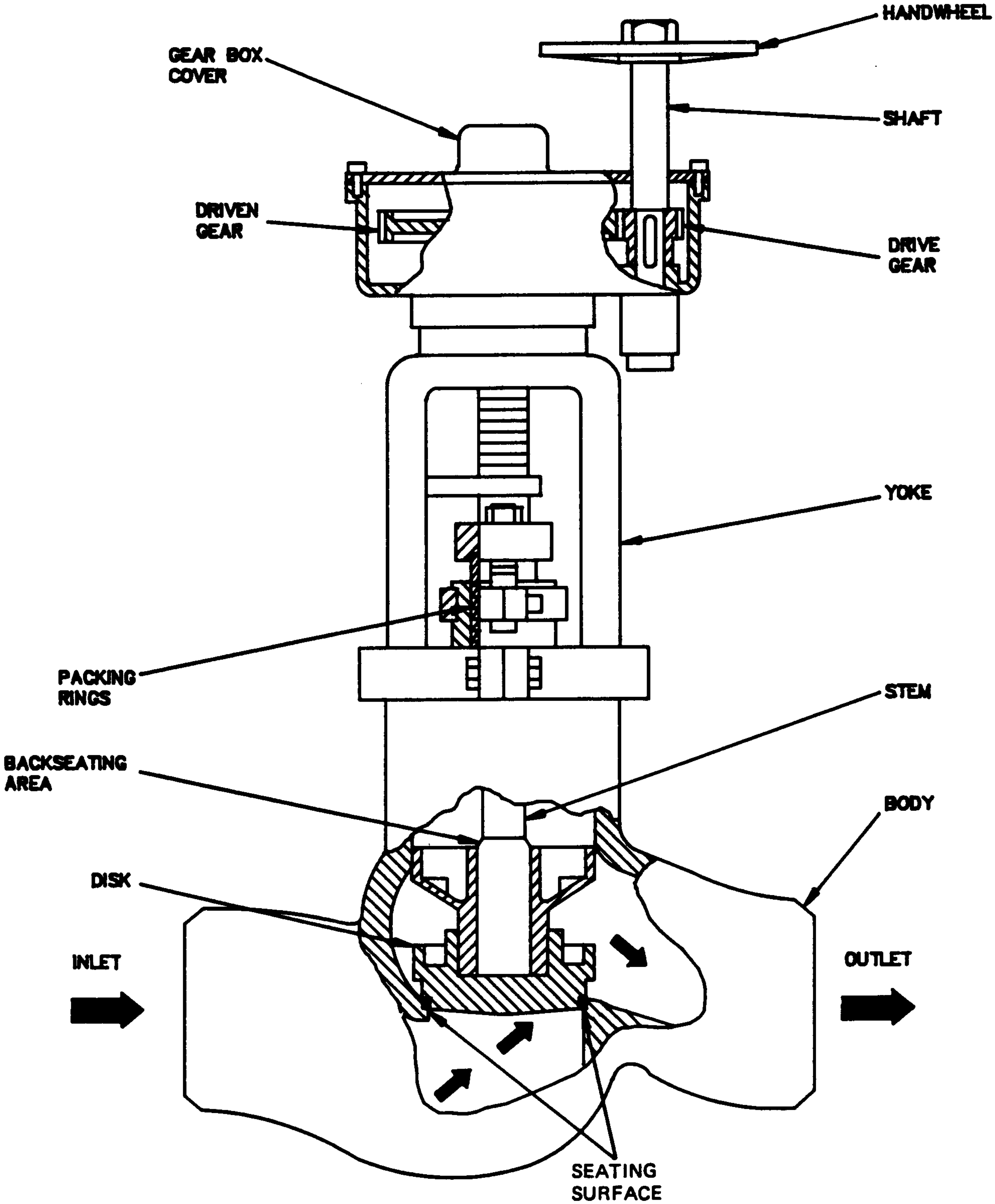


Figure 4-6. Power-Actuated Stop Check Valve (Typical)

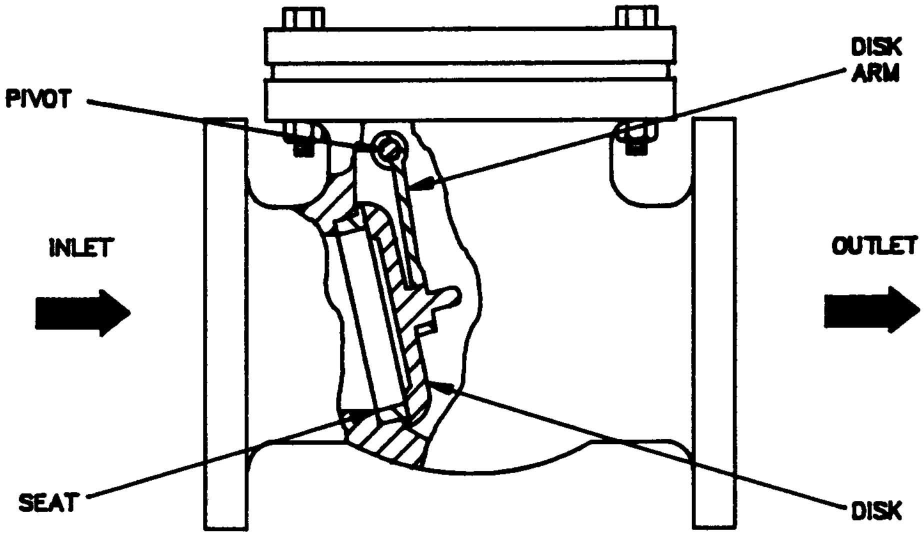


Figure 4-7. Swing Check Valve (Typical)

4-5. LIFT CHECK VALVES.

4-5.1 LIFT CHECK VALVE DESCRIPTION. A lift check valve (figure 4-8) is used in a piping system to prevent reverse flow. The disk floats in the valve body. The valve body acts as a guide for the disk. Fluid enters the inlet and is directed through the seat to the outlet. The disk either allows or prevents flow. When the inlet pressure is greater than the outlet pressure, the inlet pressure will force the disk up and allow flow through the valve. When outlet pressure becomes equal to or greater than inlet pressure, the weight of the disk combined with fluid backflow inertia causes the disk to settle to the seat. When the disk makes contact with the seat, the valve is closed, preventing reverse flow through the valve.

4-6. Y-PATTERN VALVES.

4-6.1 Y-PATTERN VALVE DESCRIPTION. A typical Y-pattern valve (figure 4-9) is installed in a piping system that has hard-to-reach places, and is used to fully open, fully close, or throttle the flow of fluid. The Y-pattern valve function is similar to that described in paragraph 4-2.1 for the manually operated stop valve. Packing rings form a seal around the stem. The body is designed to reduce pressure drop, to provide throttling capability, and to allow higher flow rate compared to straight globe valves. This results in reduced turbulence. Some Y-pattern valves have a backseating area to prevent the stem from being unscrewed from the body.

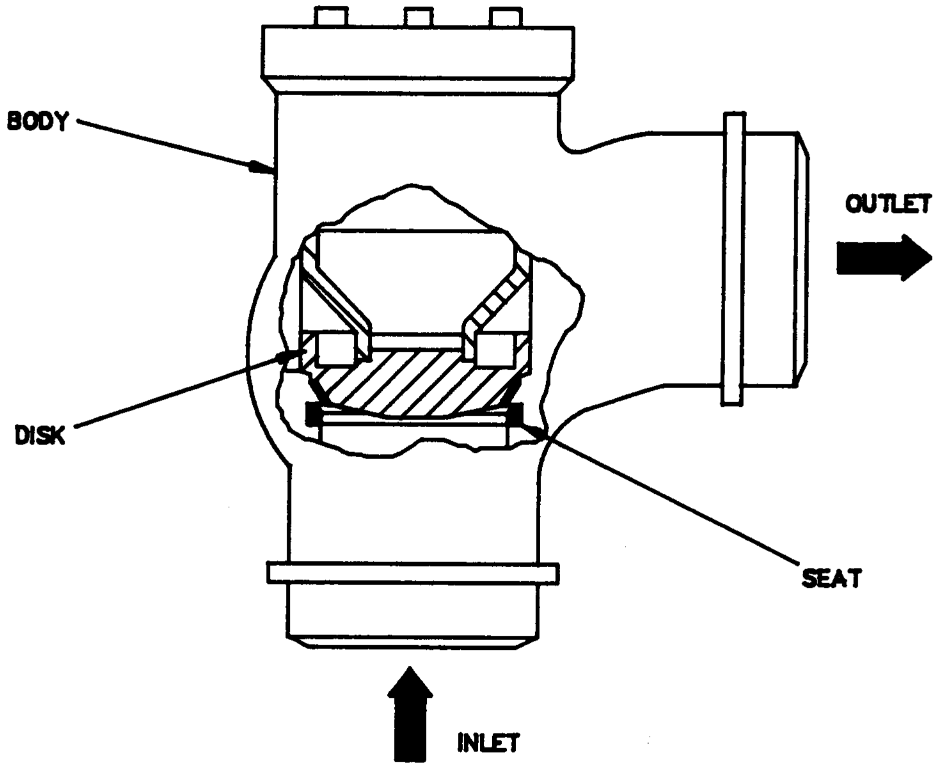


Figure 4-8. Lift Check Valve (Typical)

4-7. GATE VALVES.

4-7.1 MANUALLY OPERATED GATE VALVE DESCRIPTION. A manually operated gate valve (figure 4-10) is used in a piping system to fully open or fully close the flow of fluid. Fluid enters the inlet and flows through the inlet and outlet seats (seats). The disk/gate either prevents or allows flow through the outlet seat to the outlet. Packing rings form a seal around the stem. The stem, which is threaded through the handwheel, moves up and down when the handwheel is rotated. The handwheel, however, does not. Clockwise rotation of the handwheel moves the stem downward through the yoke bushing, lowering the gate between the seats. This prevents flow through the valve. Counterclockwise rotation of the handwheel moves the stem upward through the yoke bushing, raising the gate away from the seats, allowing flow. The gate valve disk is wedge shaped. Gate valves of 2-1/2 inches or less have solid disks, and gate valves of 3 inches or more have flexible disks. In high-pressure/temperature steam systems, pipe line expansion produces stresses and strains at valves and connections which tend to slightly distort the valve bodies. If the valve disk is solid, this distortion will cause the valve seats to press against the solid disk, and, in effect, clamp the valve shut. This problem is overcome with the flexible disk, which is best described as two circular plates attached to each other by an integral hub in the center. With this design, the disk will flex as the valve seats press against it, thus avoiding the clamping effect. Flexible disk gate valves are used in all cases where piping system expansion is a significant factor. Pressure on the gate is exerted at a right angle to the stem. Any positioning of the gate other than fully opened or fully closed will cause damage to the gate. A backseat seal prevents the stem from being unscrewed from the bonnet.

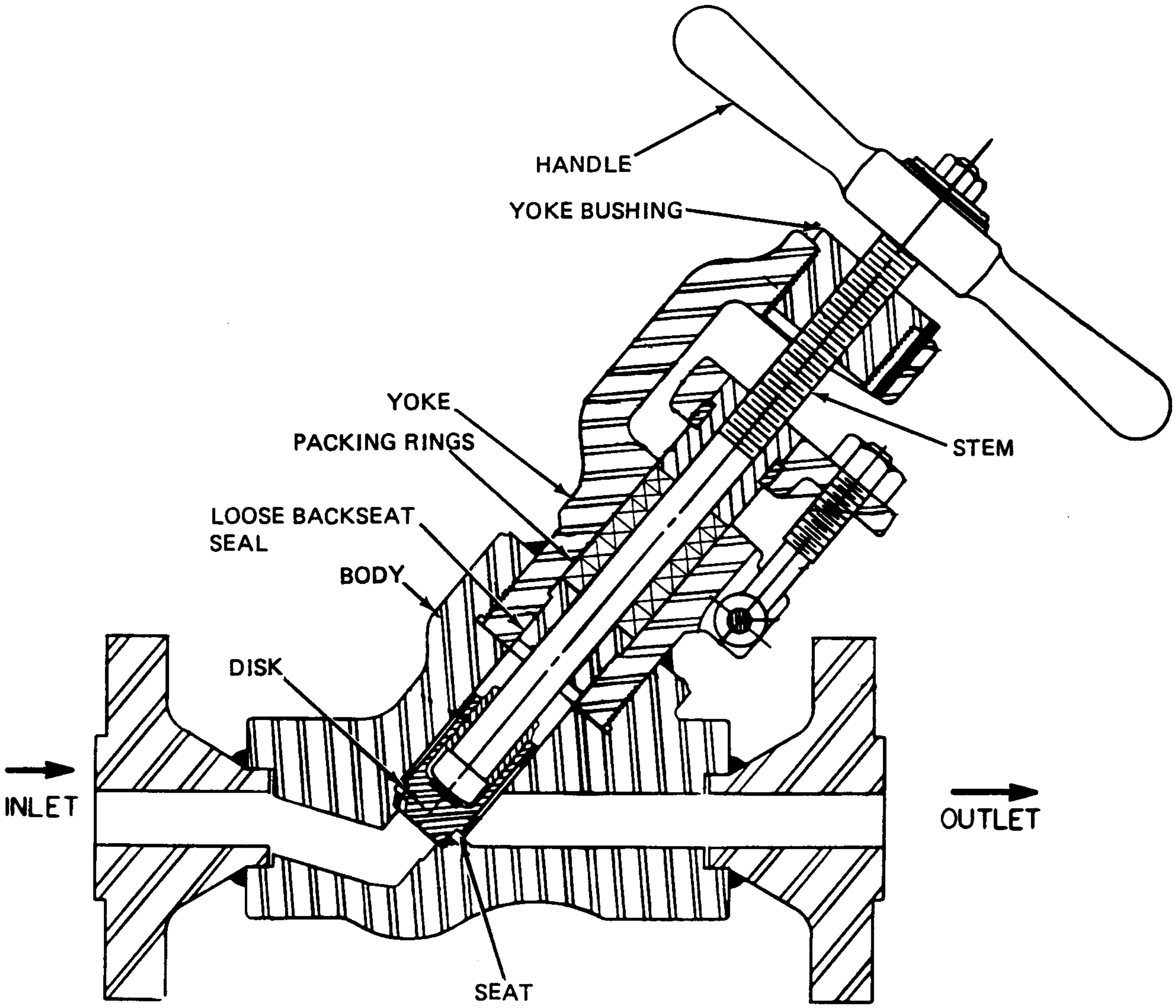


Figure 4-9. Y-Pattern Valve (Typical)

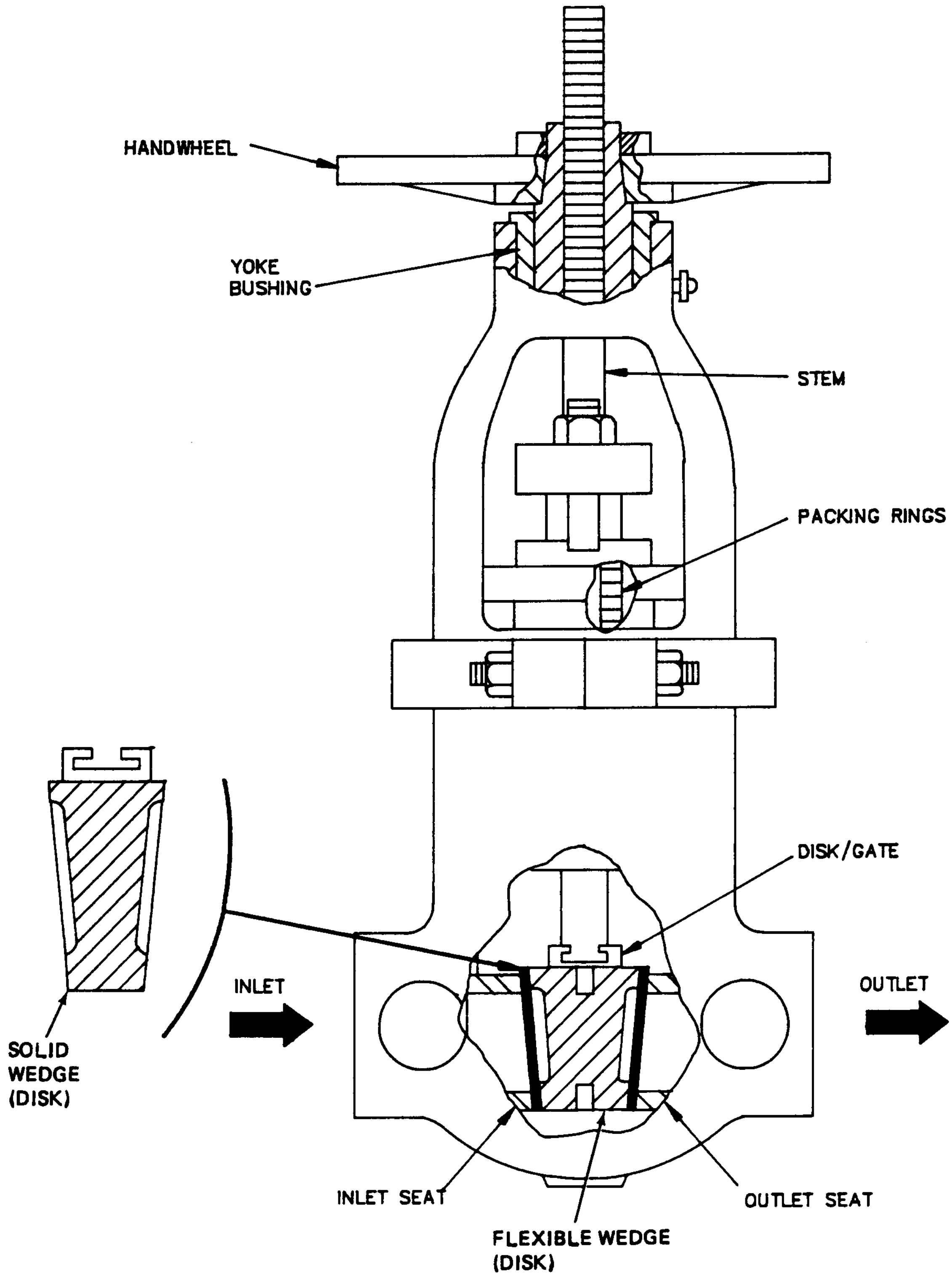


Figure 4-10. Manually Operated Gate Valve (Typical)

4-7.2 POWER-ACTUATED GATE VALVE DESCRIPTION. A power-actuated gate valve (figure 4-11) is used in a piping system to fully open or fully close the flow of fluid. A power-actuated gate valve uses a handwheel or air motor in conjunction with a toggle or gear assembly for mechanical advantage in moving the stem to overcome system pressure. The toggle assembly used with a gate valve functions identically to that described in paragraph 4-2.2.1. The gear assembly used with a gate valve functions identically to that described in paragraph 4-2.2.2. The stem, disk, and seat functions are identical to those described in paragraph 4-7.1.

4-8. NEEDLE VALVES.

4-8.1 NEEDLE VALVE DESCRIPTION. A needle valve (figure 4-12) is used in a piping system primarily to throttle/control the amount of flow. It is rarely used to start or stop the flow of fluid. The needle valve function is similar to that described in paragraph 4-2.1 for the manually operated stop valve. A needle valve has a valve stem which tapers into a cone-shaped point on the end. The pointed end of the stem must pass through the opening of the valve seat before seating. This allows precise flow control.

4-9. ASTERN THROTTLE VALVES.

4-9.1 ASTERN THROTTLE VALVE DESCRIPTION. A typical astern throttle valve (figure 4-13) is used in system piping to throttle, fully open, or fully close the flow of steam to the astern element of the main propulsion turbine. Steam enters the inlet and flows against the disk. The disk either prevents or allows the steam to flow through the seating surface to the outlet. The stem, disk, and seating surface functions are similar to those described in paragraph 4-2.1. A remote cable attaches the handwheel to the gear assembly. The seat has a guide for the lower end of the stem to fit through.

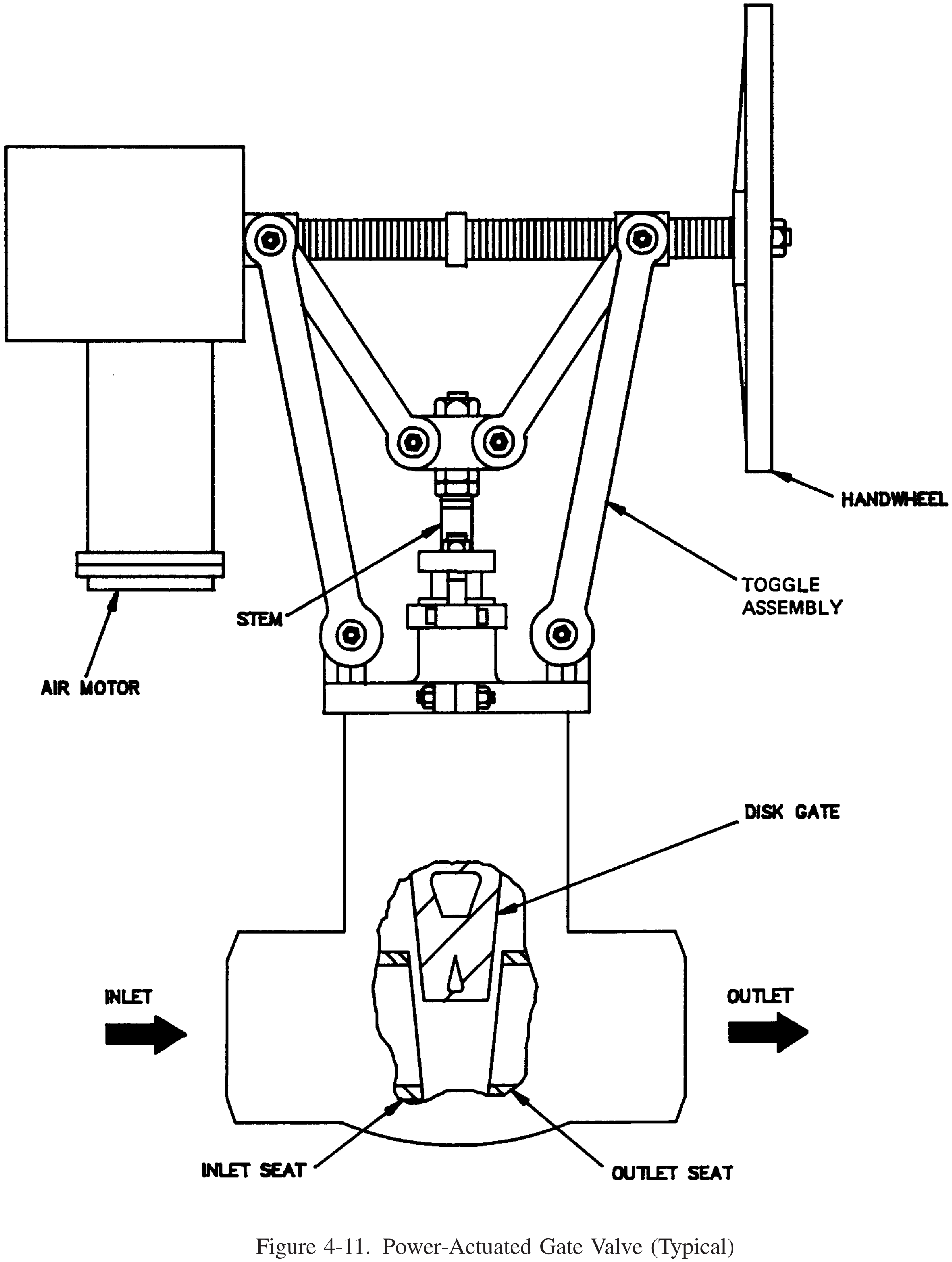


Figure 4-11. Power-Actuated Gate Valve (Typical)

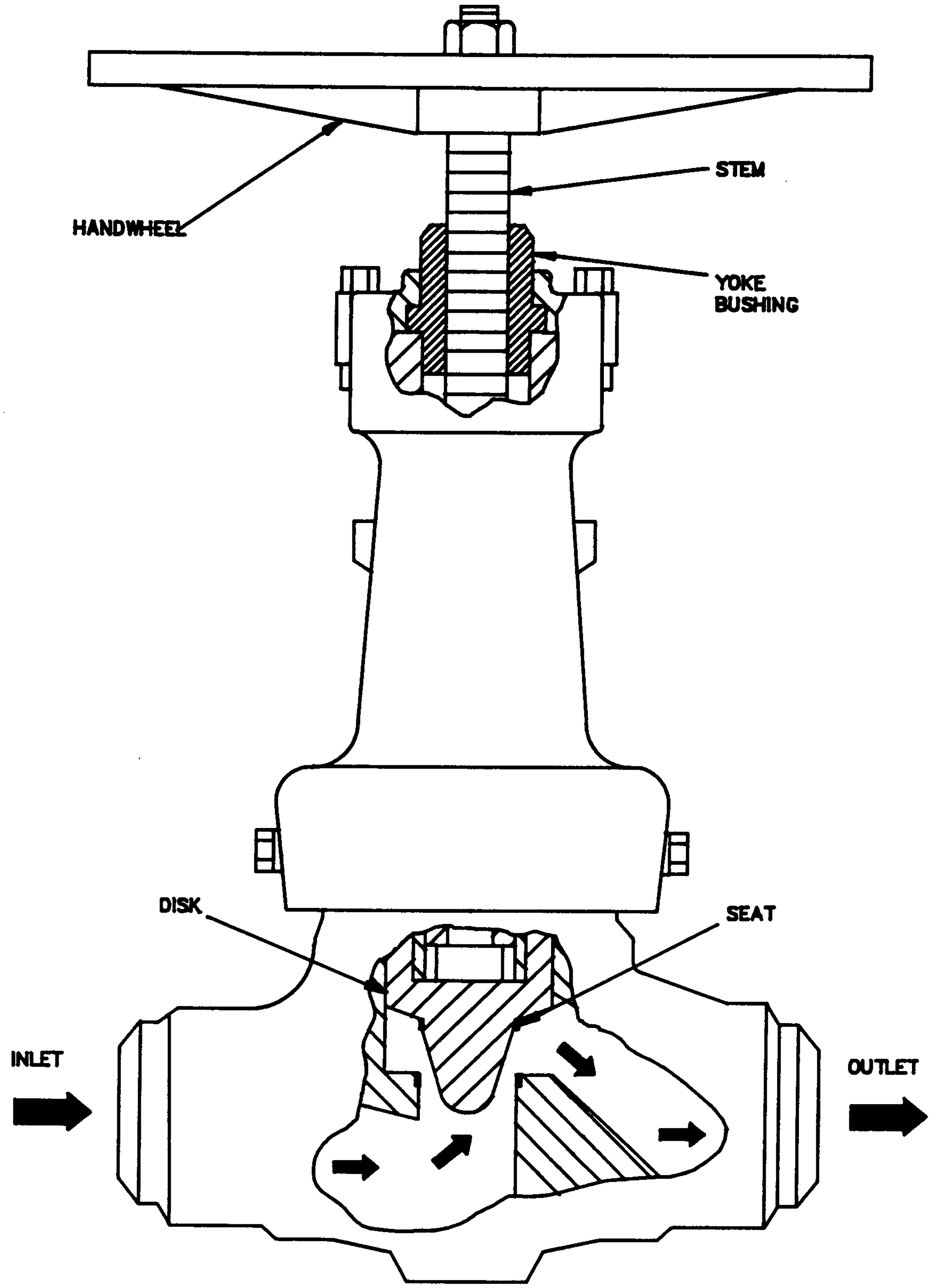


Figure 4-12. Needle Valve (Typical)

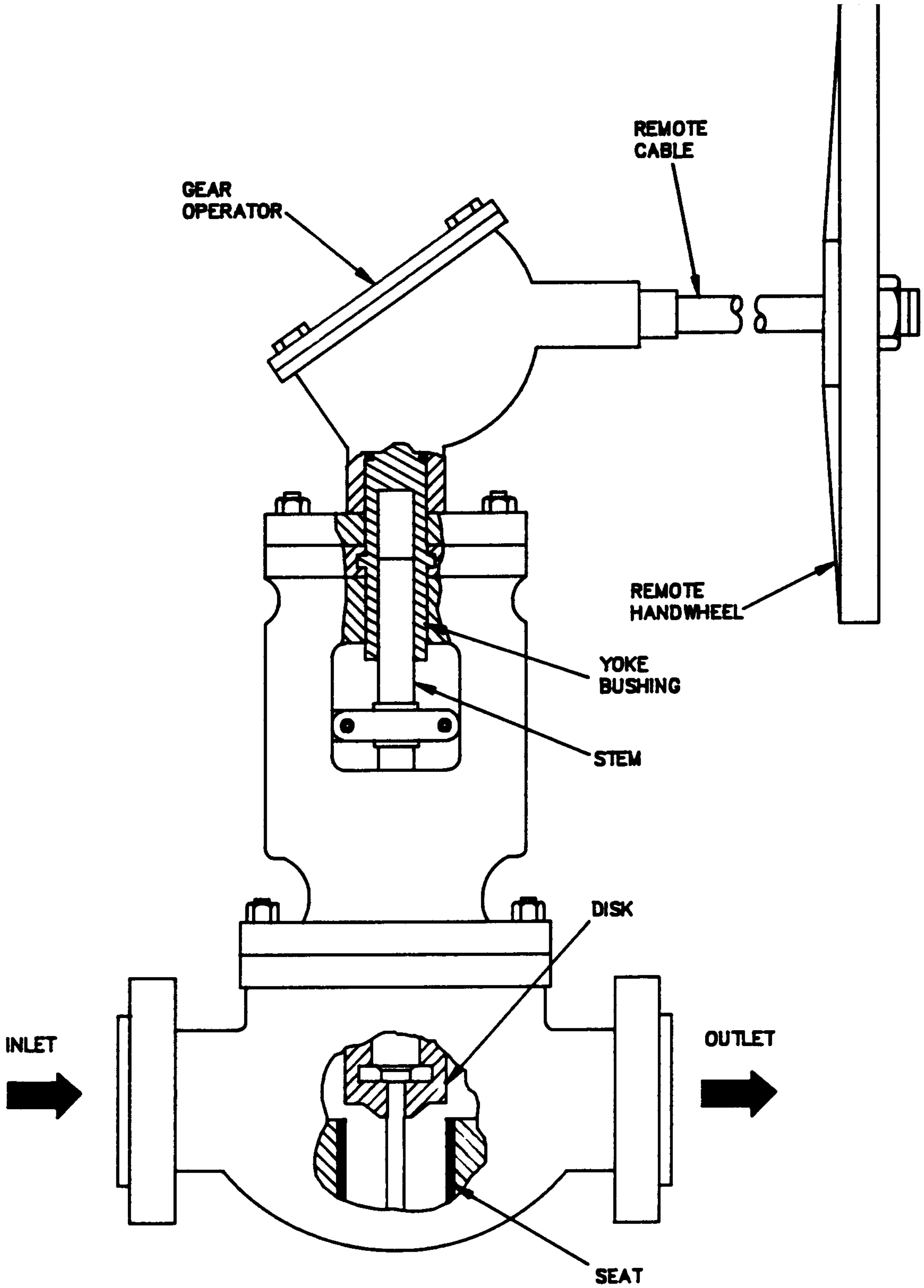


Figure 4-13. Astern Throttle Valve (Typical)

4-10. PRESSURE-REDUCING VALVES, ACTUATORS, AND RELIEF VALVES.

4-10.1 PRESSURE-REDUCING VALVE DESCRIPTION. A pressure-reducing valve is used in a piping system for automatic reduction and regulation of fluid (air, steam, or water) to maintain a desired constant output pressure. The pressure-reducing valve also provides a means of measuring the outlet pressure for comparison against a constant or set point pressure. The pressure-reducing valve may be controlled by an internal pilot, or by an external pilot controller through a diaphragm control valve actuator.

4-10.1.1 Internal Pilot-Controlled Pressure-Reducing Valve. An internal pilot-controlled pressure-reducing valve (figure 4-14) uses the fluid to be controlled as the control fluid for the valve. Fluid enters the inlet and flows under the disk to the pilot valve. Turning the adjusting screw clockwise screws the set point adjusting stem into the spring case, exerting tension on the set point spring. The set point spring forces the diaphragm to deflect downward, pushing the pilot valve off its seat. The control fluid flows through the pilot valve to the piston chamber. The control fluid forces the piston downward, opening the valve, allowing fluid flow through the pressure reducer valve. Outlet fluid is ported to the bottom of the diaphragm. As the outlet pressure increases, the diaphragm is deflected upward, allowing the pilot valve spring to close the pilot valve. This decreases inlet fluid flow through the pilot valve to the piston chamber, and allows the main spring to force the main valve stem and disk upward, reducing flow. When the pressure set point spring tension and outlet pressure are at equal values, the valve pressure will remain constant. Any fluctuation in outlet pressure will cause the valve to react to maintain set point.

4-10.1.2 External Pilot-Controlled Pressure-Reducing Valve. An external pilot-controlled pressure-reducing valve (figure 4-15) utilizes a diaphragm-type control valve actuator (actuator) and an external control pilot to measure output pressure, which feed back a control air signal to the actuator diaphragm. A sensing line is piped from the outlet side of the pressure-reducing valve to the upper diaphragm in the control pilot. The control pilot regulates the control air supply to the actuator diaphragm. When a set point pressure is applied to the adjusting spring of the control pilot by an adjusting rod, the stem is forced upward. The stem is in contact with a lever and nozzle disk pin. When the stem moves upward, a lever spring forces the lever to move downward. Downward motion of the lever forces the nozzle disk pin downward, deflecting the nozzle disk diaphragm. This blocks an exhaust port in the nozzle diaphragm and deflects the nozzle diaphragm even further. The nozzle diaphragm is in contact with the pilot valve, and downward movement overcomes pilot valve spring tension, opening the pilot valve. The open pilot valve allows control air flow through the pilot valve. As the pilot valve outlet pressure increases, the diaphragm of the actuator deflects upward, moving the stem and disk of the pressure-reducing valve away from its seat. Pressure-reducing valve outlet pressure increases and is sensed at the upper diaphragm of the control pilot, forcing the diaphragm and stem down. This downward movement moves the lever bar upward against the lever spring. The nozzle disk pin is free, which permits the nozzle disk diaphragm to return to its original shape. The pilot valve spring forces the pilot valve closer to its seat, reducing control air flow. The system continuously makes small adjustments to maintain the desired set point.

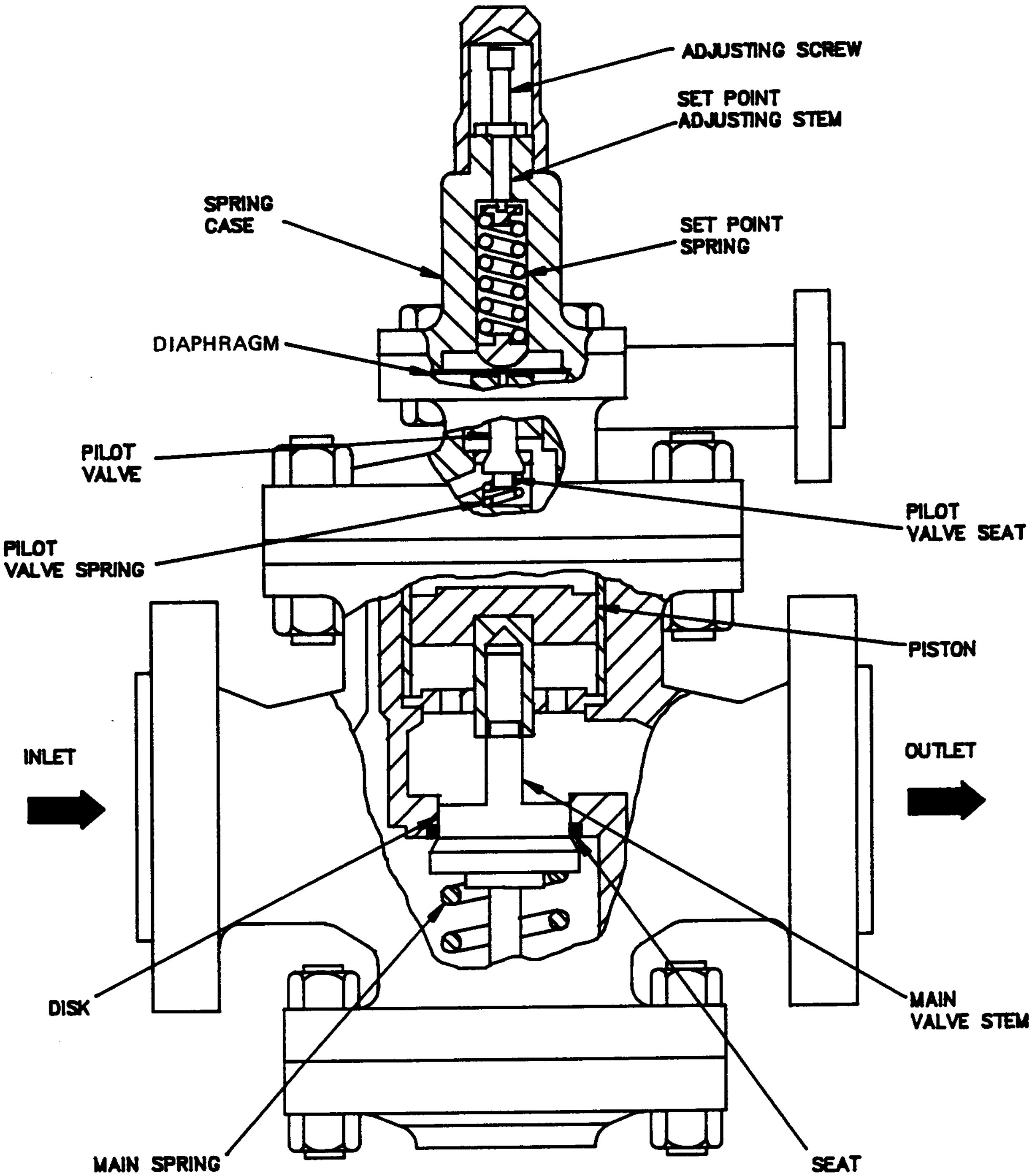


Figure 4-14. Internal Pilot-Controlled Pressure-Reducing Valve (Typical)

4-10.2 RELIEF VALVE DESCRIPTION. A relief valve (figure 4-16) is used in flow control to provide protection from overpressurization of piping. Fluid enters the inlet and flows through the seat to the disk, which either prevents or allows flow to the outlet. The outlet is piped to the atmosphere ensuring that back pressure is nonexistent. The set point spring is adjusted to a load tension by the adjusting screw. The set point spring applies downward force on the stem. The stem, attached to the disk, holds the disk against the seat. As the inlet pressure increases above the loaded spring tension of the set point spring, the disk rises, allowing flow to the outlet. When pressure is relieved by the flow through the valve, spring tension overcomes fluid pressure and forces the stem down, lowering the disk to the seat, closing the valve and stopping flow. The hand operator is provided to raise the stem and disk to relieve pressure manually.

4-11. STEAM TRAPS AND DRAIN ORIFICES.

4-11.1 STEAM TRAP DESCRIPTION. A steam trap is used to allow condensate to be automatically expelled from system piping without the loss of steam. Steam traps may be of bimetallic, thermodynamic, thermostatic, or impulse type.

4-11.1.1 Bimetallic Steam Trap. A bimetallic steam trap (figure 4-17) operates on the theory that dissimilar metals will expand differently when heated. Steam enters the inlet port and flows through the strainer. The steam then enters the element chamber, heating the bimetallic element. The bimetallic element (element) consists of two dissimilar metal strips fused together and attached to the strainer end of the body. The lower strip will expand more than the upper strip when heated. As the element is heated, it is deflected upward, lifting up on the rocker arm. The rocker arm lifts the stem, moving the disk upward toward the seat, preventing flow. Condensate entering the element chamber cools the element and falls to the bottom of the chamber. As the element cools, it will straighten to its normal shape. This allows the stem to lower, unseating the disk from the seat. The condensate, being heavier than steam, will flow across the seat to the outlet. As the condensate is expelled, the steam heats the element again, causing the disk and seat to make contact, closing the outlet. The strainer entraps any foreign particles (rust, dirt, etc.) that may foul the bimetallic element.

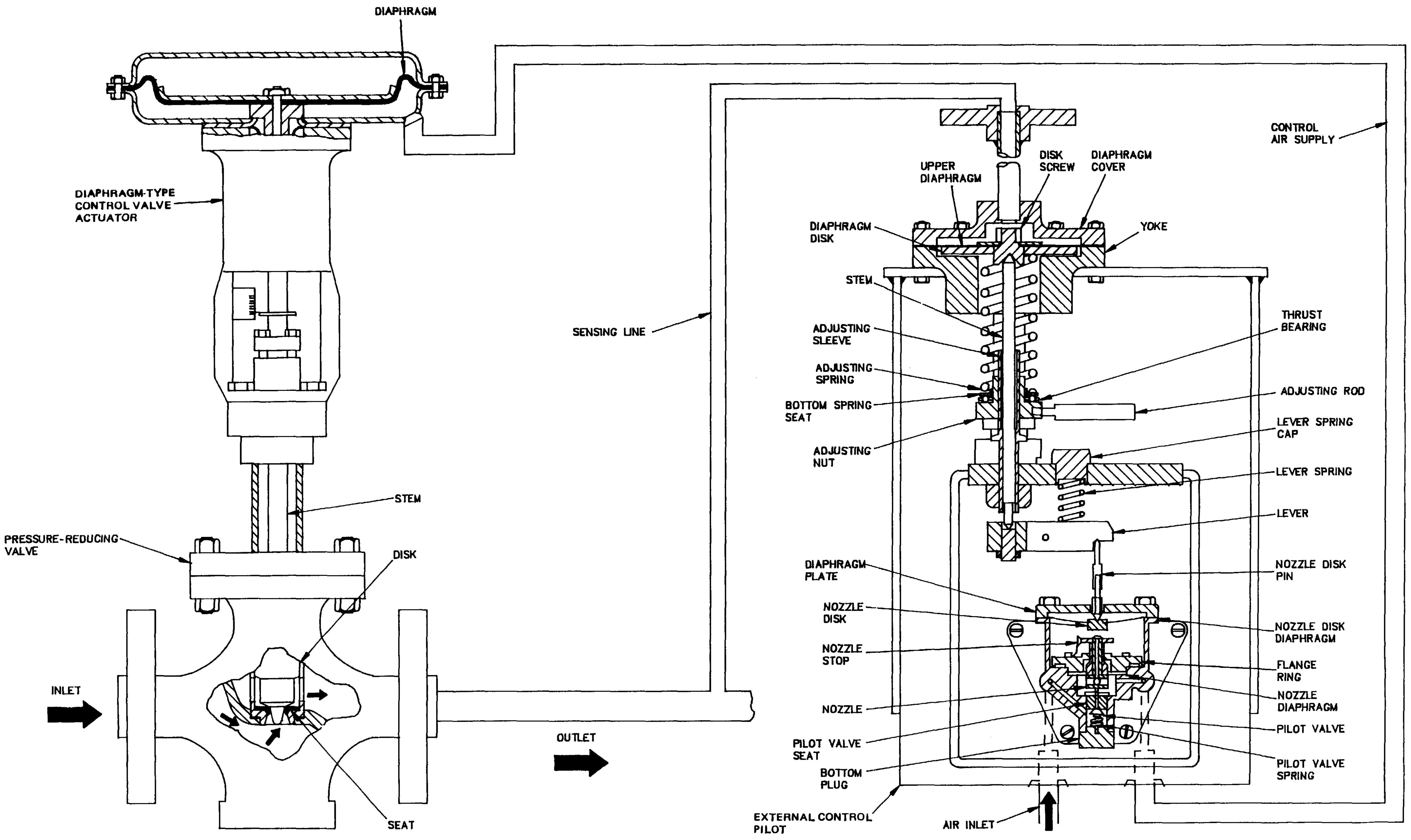


Figure 4-15. External Pilot-Controlled Pressure-Reducing Valve (Typical)

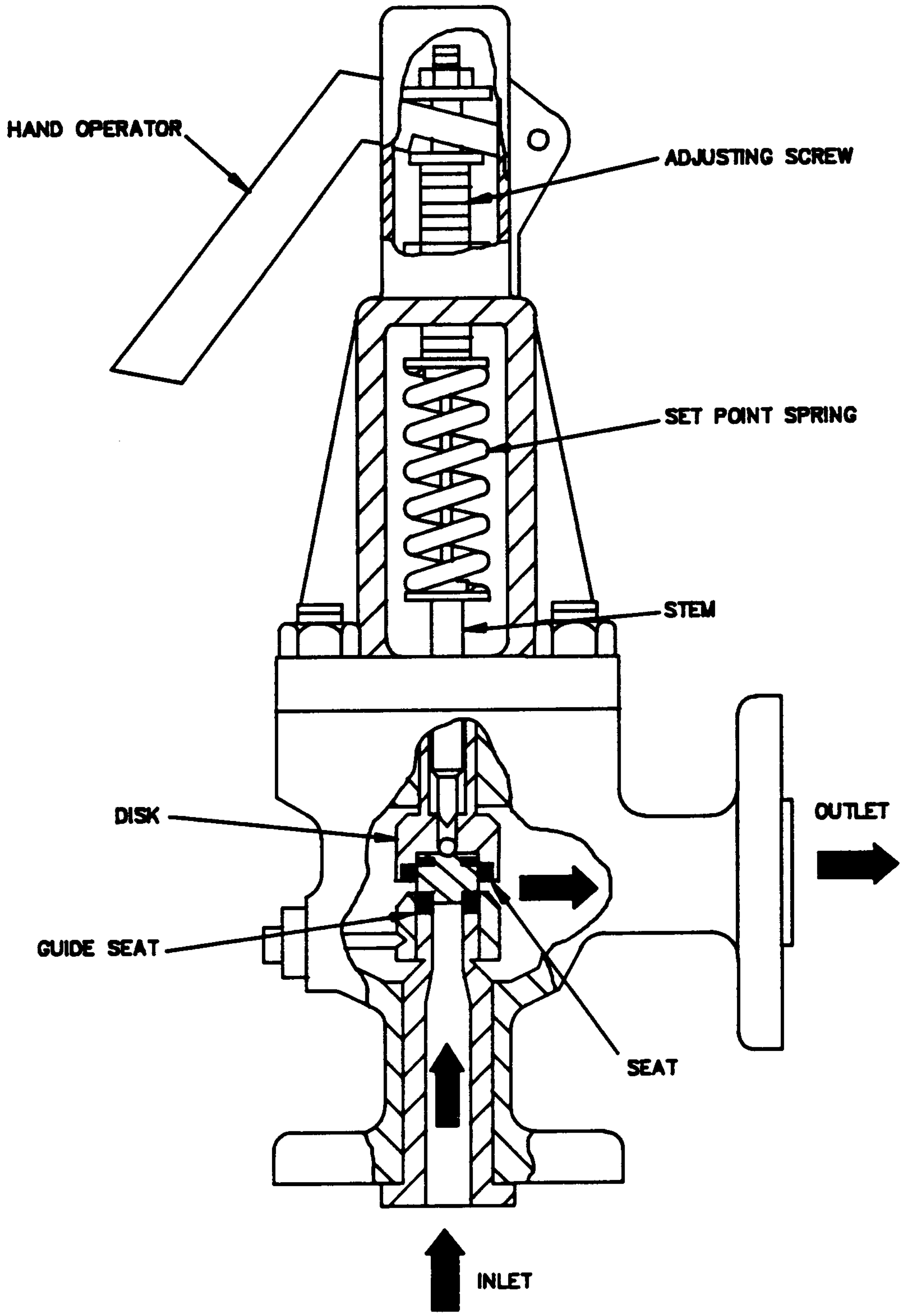


Figure 4-16. Relief Valve (Typical)

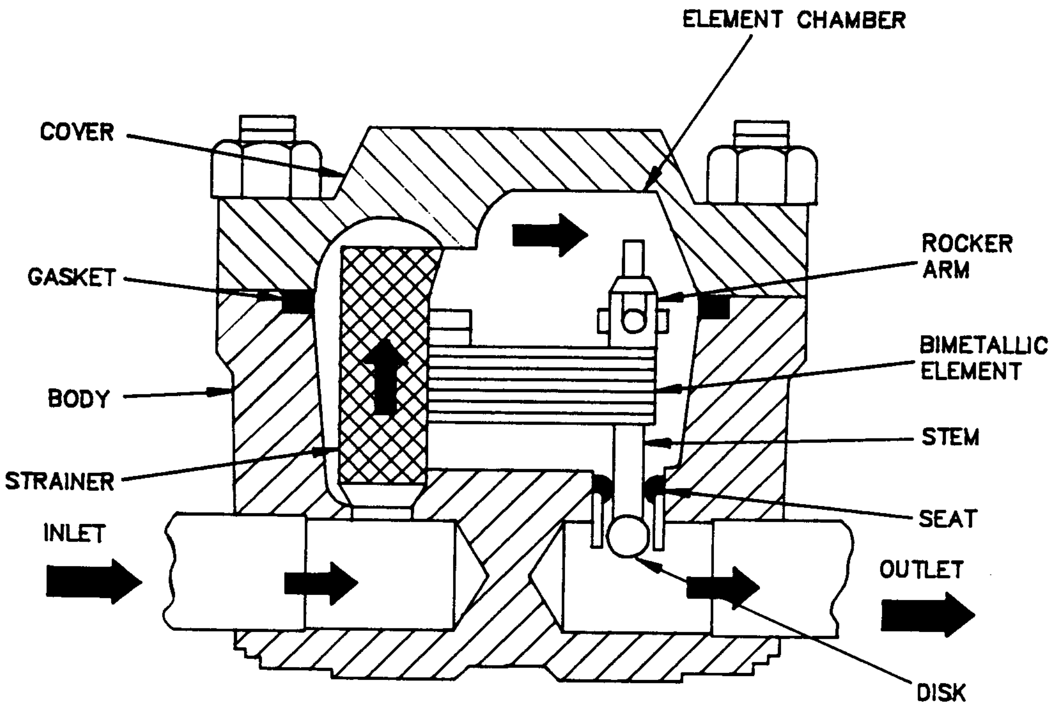


Figure 4-17. Bimetallic Steam Trap (Typical)

4-11.1.2 Thermodynamic Steam Trap. The thermodynamic steam trap (figure 4-18) has only one moving part, a hardened stainless steel disk. To eliminate the possibility of uneven or local wear, the trap is designed with three balanced outlet passages to assure parallel lift of the disk without tilting or rubbing. The thermodynamic principle is as follows: Pressure of condensate or air (view A) lifts the disk off its seating surface. Flow is across the underside of the disk to the three outlet passages. Discharge continues until flashing condensate approaches steam temperature. A high-velocity jet of flash steam (view B) reduces pressure under the disk and at the same times by recompression, builds up pressure in the control chamber above the disk. This drives the disk to the seating surface, assuring tight closure without steam loss. Steam pressure in the control chamber, acting over the total disk area, holds the disk closed against inlet pressure, acting over the smaller inlet seating surface. As soon as condensate collects (even at steam temperature) it reduces heat transferred to the control chamber. Pressure in the chamber decreases as the trapped steam condenses. The disk is lifted by inlet pressure and condensate is discharged.

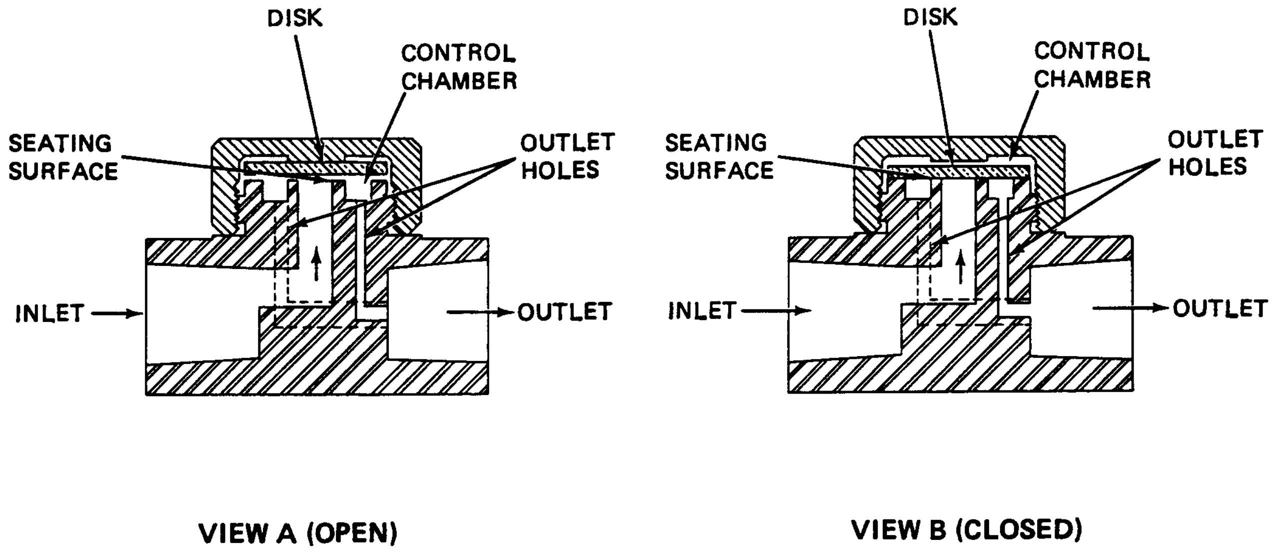


Figure 4-18. Thermodynamic Steam Trap (Typical)

4-11.1.3 Thermostatic Steam Trap. A thermostatic steam trap (figure 4-19) operates on the theory of expansion of a volatile liquid in a bellows. Steam enters the inlet and heats the bellows chamber. The bellows contains a volatile liquid and will expand within the bellows chamber when heated. This forces the stem end of the bellows downward to make contact with the seat, closing the outlet, and trapping steam in the valve body. As condensate enters the bellows chamber with the steam, the volatile liquid in the bellows cools, contracting the bellows, lifting the disk from the seat. Condensate, being heavier than steam, will fall to the bottom of the bellows chamber and flow across the seat to the outlet. When the condensate is expelled, steam again heats the volatile liquid, expanding the bellows, and bringing the disk and seat in contact, closing the outlet.

4-11.1.4 Impulse Steam Trap. The impulse steam trap (figure 4-20) operates on the fact that hot water under pressure will flash into steam when the pressure is reduced. Steam and condensate pass through a strainer before entering the trap. A circular baffle keeps the entering steam and condensate from impinging on the cylinder or on the disk. The only moving part in the impulse steam trap (trap) is the disk. This disk is rather unusual in design. Near the top of the disk, there is a flange that acts as a piston. The working surface above the flange is larger than the working surface below the flange. A control orifice runs through the disk from top to bottom, being considerably smaller at the top than at the bottom. The bottom part of the disk extends through and beyond the orifice in the seat. The upper part of the disk (including the flange) is inside a cylinder. The cylinder tapers inward, so the amount of clearance between the flange and the cylinder varies according to the position of the valve. When the valve is open, the clearance is greater than when the valve is closed. When the trap is first cut in, pressure from the inlet acts against the underside of the flange and lifts the disk off the valve seat. Condensate is thus allowed to pass out through the orifice in the seat, and, at the same time, a small amount of condensate flows up past the flange and into the cylinder chamber. The condensate discharges through the control orifice, into the outlet side of the trap, and the pressure in the cylinder chamber remains lower than the pressure in the inlet. As the line warms up, the temperature of the condensate flowing through the trap increases. The reverse taper of the cylinder varies the amount of flow around the flange until a balanced position is reached in which the total force exerted above the flange is equal to the total force exerted below the flange. It is important to note that there is still a pressure difference between the inlet and cylinder chamber. The force is equalized because the effective area above the flange is larger than the effective area below the flange. The difference in working area is such that the valve maintains an open, balanced position when the pressure in the cylinder chamber is 86 percent of the inlet pressure. As the temperature of the condensate approaches its boiling point, some of the condensate going to the cylinder chamber flashes into steam as it enters the low-pressure area. Since the steam has a much greater volume than the water from which it is generated, pressure builds up in the space above the flange cylinder chamber. When the pressure in this space is more than 86 percent of the inlet pressure, the force exerted on the top of the flange pushes the entire disk downward and closes the valve. With the valve closed, the only flow through the trap is past the flange and through the control orifice. When the temperature of the condensate entering the trap drops slightly, condensate enters the cylinder chamber without flashing into steam.

Pressure in the cylinder chamber is thus reduced to the point where the valve opens and allows condensate to flow through the orifice in the valve seat. Thus the entire cycle is repeated continuously. With a normal condensate load, the valve opens and closes at frequent intervals, discharging a small amount of condensate at each opening. With a heavy condensate load, the valve remains wide open and allows a continuous discharge of condensate.

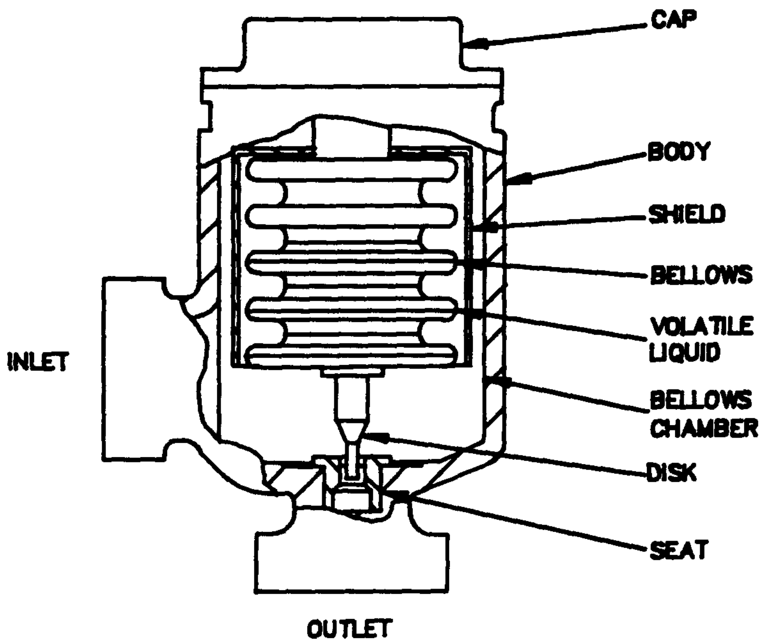


Figure 4-19. Thermostatic Steam Trap (Typical)

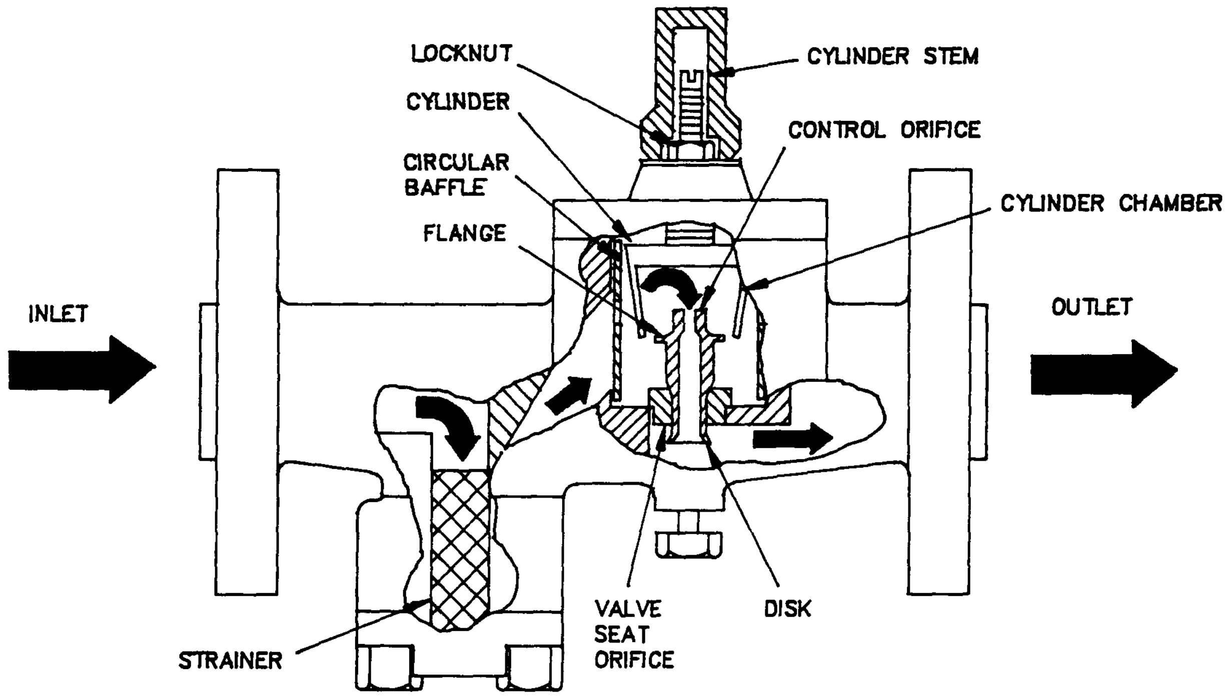


Figure 4-20. Impulse Steam Trap (Typical)

4-11.2 DRAIN ORIFICE DESCRIPTION. A drain orifice (figure 4-21) is used to expel condensate from systems in which condensation formation is continuous. When condensate is present at the inlet, pressure behind the condensate pushes it through the orifice. A small amount of steam always flows through the orifice into the drain system. Drain orifices contain no moving parts.

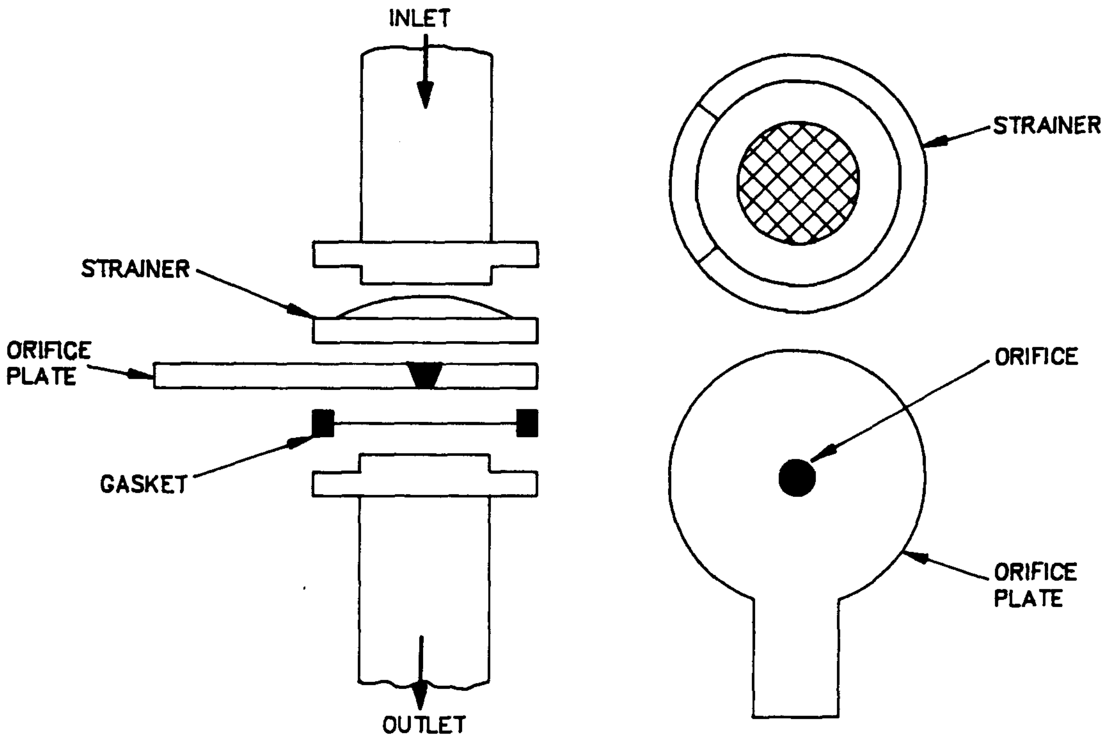


Figure 4-21. Drain Orifice (Typical)

CHAPTER 5

VALVE CHARACTERISTICS

5-1. INTRODUCTION.

5-1.1 SCOPE. This chapter provides general physical descriptions of the various types of non-nuclear valves, traps, and orifices used in steam propulsion systems. Detailed descriptions of these valves, traps, and orifices are provided in volumes II through XIV of this manual. Figures are provided in this chapter to illustrate the physical characteristics of a typical valve, trap, and orifice of each type and/or by each manufacturer (indicated in parentheses) covered in this manual.

5-2. STOP VALVES.

5-2.1 MANUALLY OPERATED STOP VALVE CHARACTERISTICS. The following paragraphs describe the characteristics of manually operated stop valves.

5-2.1.1 Pressure-Seal Stop Valve (Anchor). The primary components and subassemblies of an Anchor pressure-seal stop valve (figure 5-1) consist of a valve body, yoke assembly, bonnet assembly, and stem and disk assembly. The pressure-seal stop valve is handwheel operated. Refer to paragraph 6-9.4 for a detailed description of pressure seal rings.

5-2.1.1.1 Anchor Valve Body. The Anchor valve body is the main inline pressure vessel for the entire assembly. The valve body contains an inlet, outlet, and an integrated stellite seat. The body may have either flange, socket, or butt-welded ends, and may be fitted with a bypass valve.

5-2.1.1.2 Anchor Yoke Assembly. The Anchor yoke assembly provides upper support for the stem and forms the housing for the bonnet and gland components. A yoke bushing is anchored at the top of the yoke and provides stem support. A yoke clamp with yoke nuts and studs secures the yoke to the valve body.

5-2.1.1.3 Anchor Bonnet Assembly. The Anchor bonnet assembly acts as a guide and support for the stem and houses the packing rings and pressure seal ring. Packing rings form a seal to prevent a pressure leak from the valve. A gland acts as a sleeve to help compress the packing rings. Gland bolt rings, split in two sections, fit around the periphery of the bonnet. A gland flange provides for even compression of the gland and packing rings. The bonnet seats in the upper portion of the valve body. A pressure seal ring sits on the base of the bonnet and prevents any pressure leaks. For a detailed description of the pressure seal ring, refer to chapter 6, paragraph 6-9.4. A spacer ring is installed atop the gasket to fill the sealing cavity. A gasket retaining ring, which comes in sections, fits into a recess in the upper portion of the valve body. It prevents a blowout of the spacer ring and pressure seal ring. A thrust washer, which prevents sideway movement, wobble, or misalinement of the bonnet, is installed along with a bonnet retaining ring. The bonnet retaining ring is secured to the body with capscrews. The stellited area on the underside of the bonnet forms a backseat when mated to the shoulder of the stem.

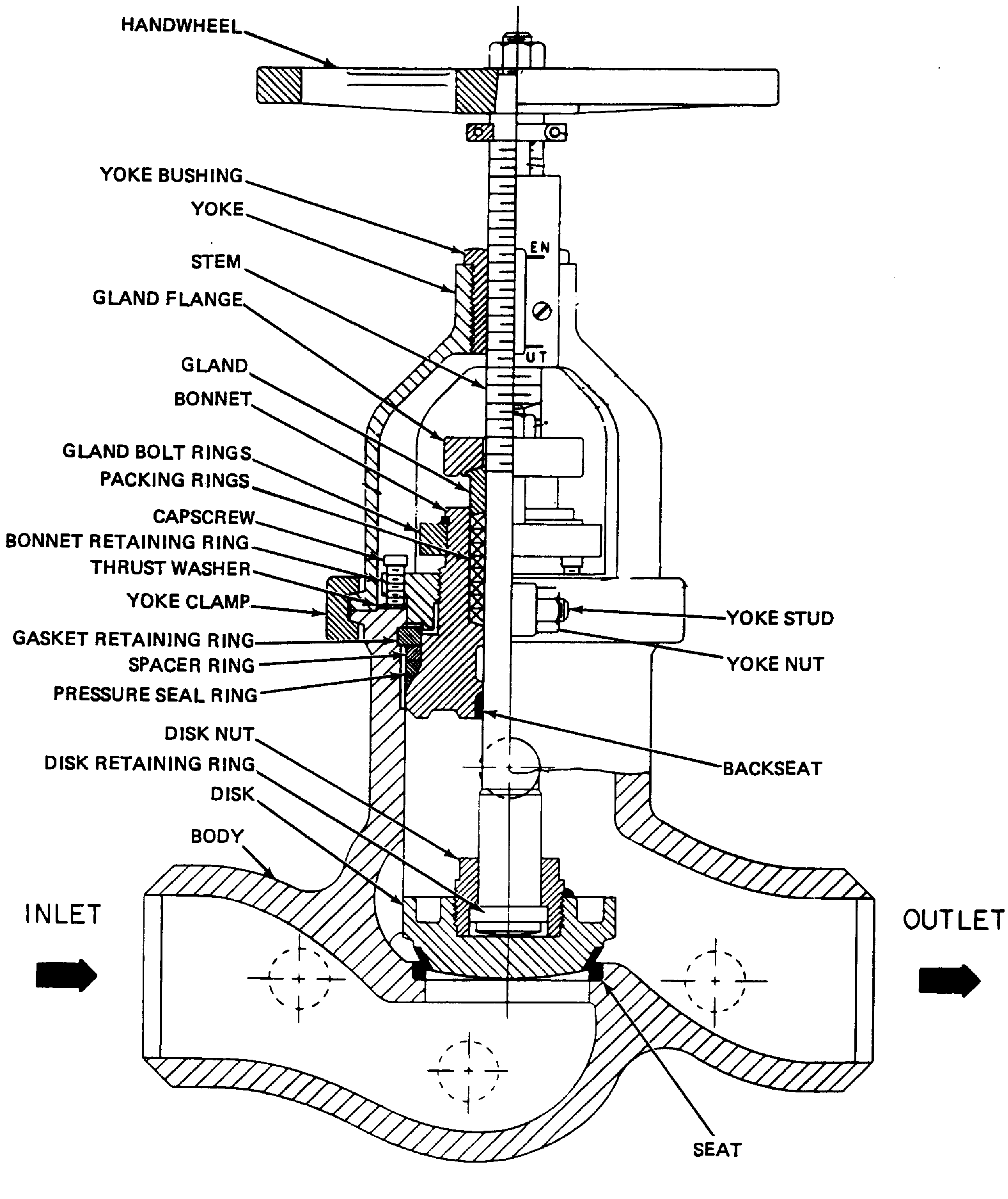


Figure 5-1. Pressure-Seal Stop Valve (Anchor) (Typical)

5-2.1.1.4 Anchor Stem and Disk Assembly. The Anchor stem and disk assembly provides for valve operation and transforms rotational movement of the handwheel into vertical movement of the stem. A disk nut is a threaded unit that slides over the stem and mates with the disk. It is secured to the stem by a disk retaining ring, and to the disk by threads and lockwelding. The disk is the opening and closing element of the valve.

5-2.1.2 Pressure-Seal Stop Valve (Velan). The primary components and subassemblies of a Velan pressure-seal stop valve (figure 5-2) are similar to those described in paragraph 5-2.1.1, except for the yoke and bonnet assemblies.

5-2.1.2.1 Velan Yoke Assembly. The Velan yoke assembly provides upper support for the stem and forms the housing for the bonnet and gland components. A yoke nut, keyed at the top of the yoke, serves as a guide for the stem. A yoke nut housing cover is bolted to the top of the yoke to retain the yoke nut in place. The yoke is secured to the valve body by yoke lock screws.

5-2.1.2.2 Velan Bonnet Assembly. The Velan bonnet assembly acts as a guide and support for the stem and houses the packing rings and pressure seal ring. The bonnet seats in the upper portion of the valve body and provides a support and sealing surface for the pressure seal ring. The pressure seal ring sits on the base of the bonnet and prevents any pressure leaks. A spacer ring is installed atop the pressure seal ring to fill the sealing cavity, and a thrust ring prevents sideway movement, wobble, or misalinement of the bonnet. The thrust ring expander assists in preventing a blowout of the pressure seal ring. A bonnet clamp secures the assembly in place. The stellited area on the underside of the bonnet forms a backseat when mated to the shoulder of the stem.

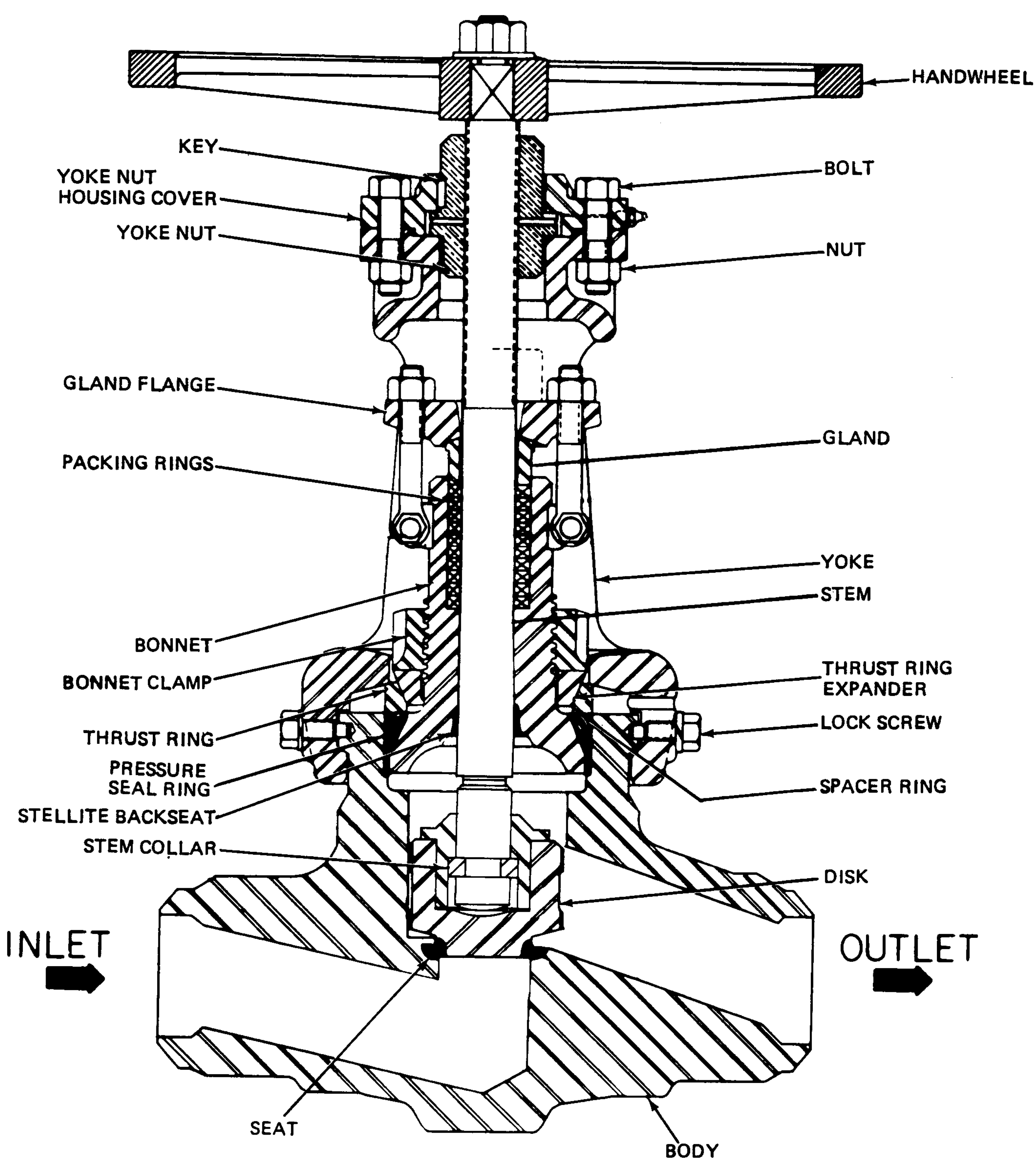


Figure 5-2. Pressure-Seal Stop Valve (Velan) (Typical)

5-2.1.3 Bolted-Bonnet Stop Valve. The primary components and subassemblies of a typical bolted-bonnet stop valve (figure 5-3) are similar to those described in paragraph 5-2.1, except for the bonnet and yoke assembly. The bonnet and yoke assembly is an integral unit that forms the upper portion of the valve. The yoke portion is provided with appendages which are used to secure the gland bolts. A yoke bushing is anchored at the top of the yoke and provides stem support. Packing rings form a seal around the stem to prevent a pressure leak from the valve. The gland and gland flange provide even compression of the packing rings. The bolted-bonnet stop valve also does not employ a bypass valve.

5-2.1.4 Integral-Bonnet Stop Valve. The primary components and subassemblies of a typical integral-bonnet stop valve (figure 5-4) consist of a valve body and a bonnet and yoke assembly. The stem and disk assembly is similar to that described in paragraph 5-2.1.1.4, and is handwheel operated.

5-2.1.4.1 Valve Body. The valve body is the main inline pressure vessel for the entire assembly. The body contains an inlet, outlet, and integral, stellite-faced seat. The body may have either flange-, socket-, or butt-welded ends. The yoke assembly is normally welded to the body.

5-2.1.4.2 Bonnet and Yoke Assembly. The bonnet and yoke assembly is an integral unit that forms the upper portion of the valve. It is provided with appendages which are used to secure the gland studs and nuts. A thread bushing is anchored at the top of the yoke and provides stem support. Packing rings form a seal around the stem to prevent a pressure leak. A gland and gland flange and gland ring provide for even compression of the packing rings, in addition to a packing stop ring, which also supports the packing rings. A yoke bushing nut is threaded to the yoke bushing to retain the stem.

5-2.2 POWER-ACTUATED STOP VALVE CHARACTERISTICS. The following paragraphs describe the characteristics of power-actuated stop valves.

5-2.2.1 Pressure-Seal Stop Valve (Anchor). The primary components and subassemblies of an Anchor pressure-seal stop valve (figure 5-5) are the same as those described in paragraph 5-2.1.1. The basic function of the pressure seal is to maintain a positive seal by being compressed between the bonnet and body. Refer to paragraph 6-9.4 for discussion of pressure seals. Power-actuator characteristics are described below.

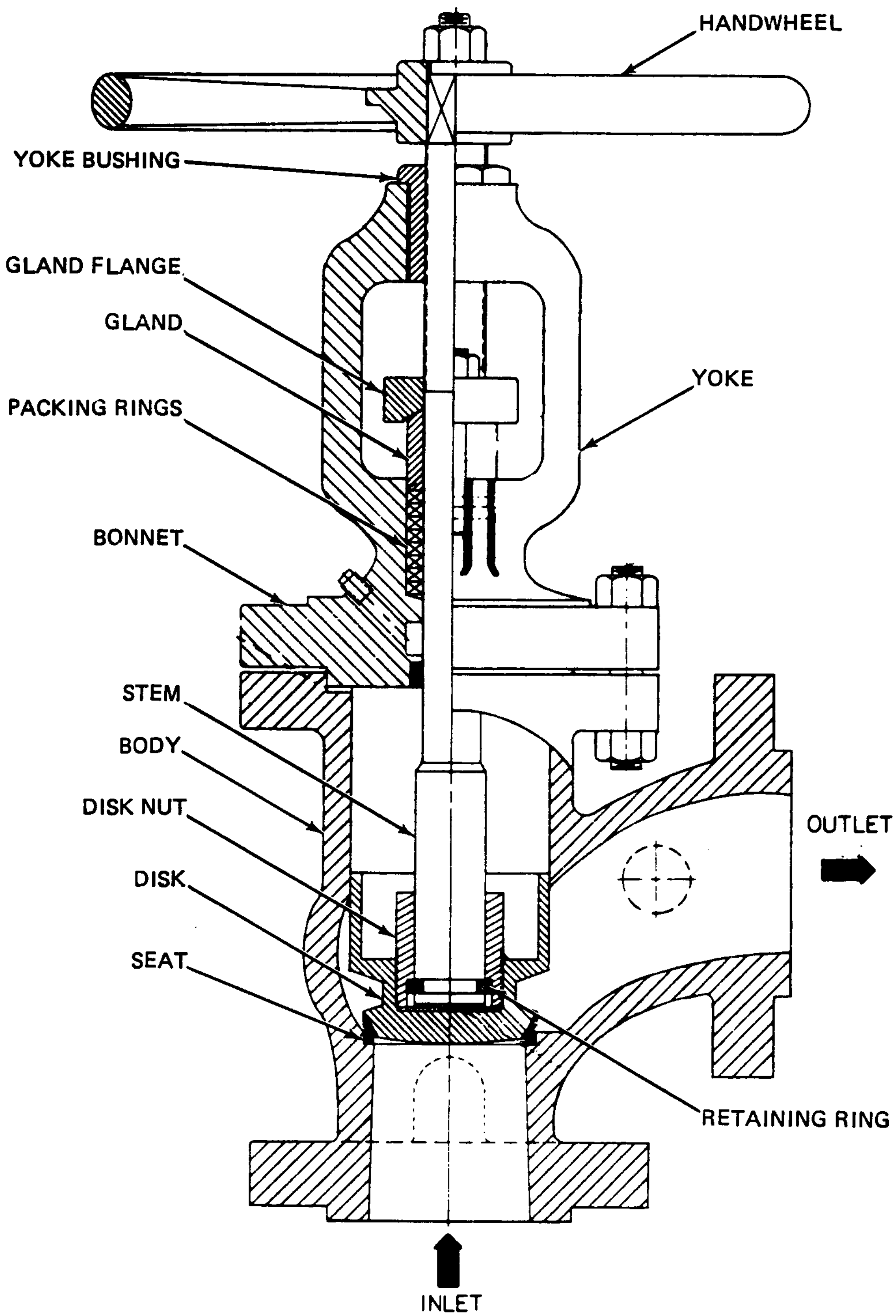


Figure 5-3. Bolted-Bonnet Stop Valve (Typical)

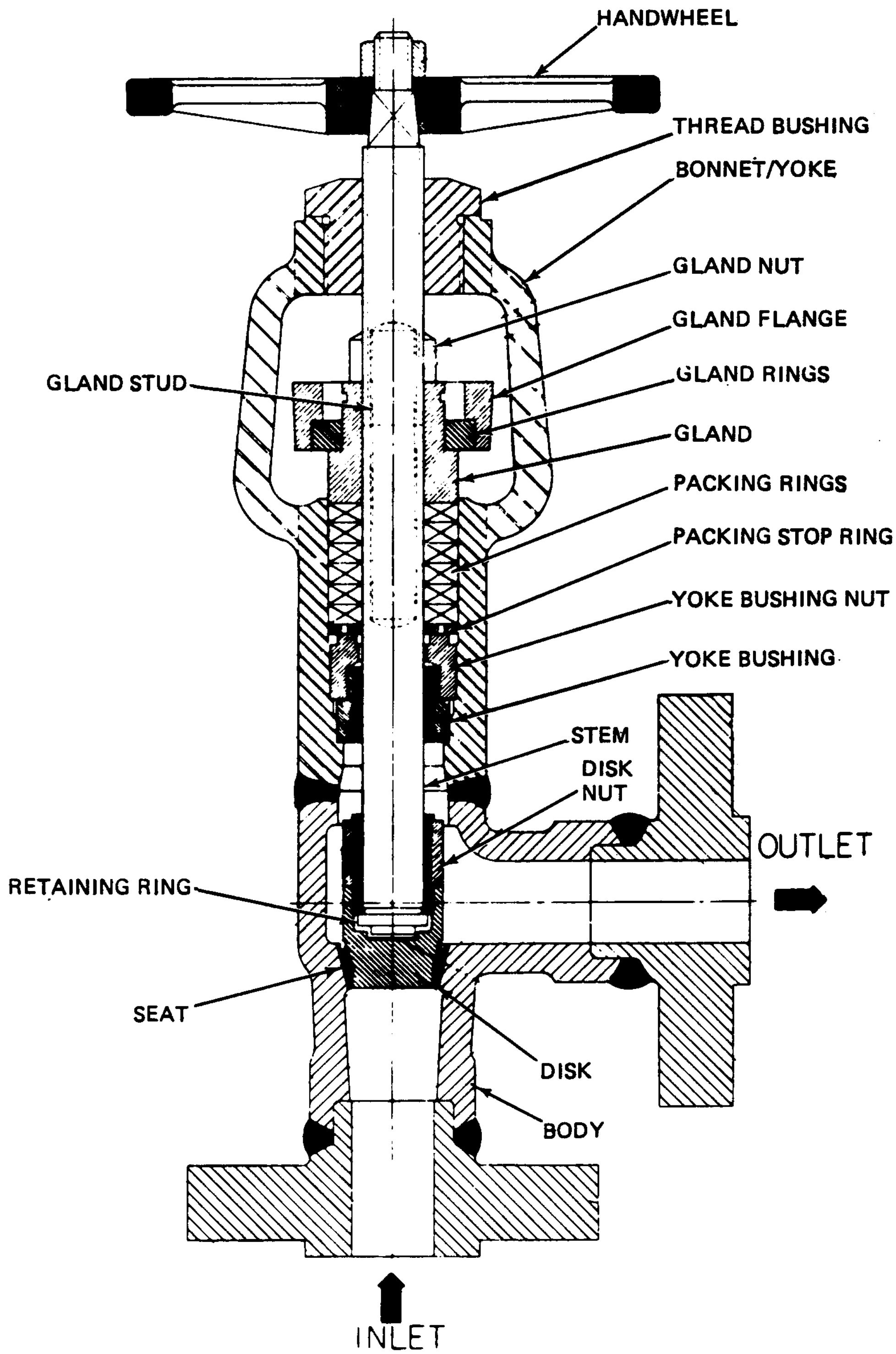


Figure 5-4. Integral-Bonnet Stop Valve (Typical)

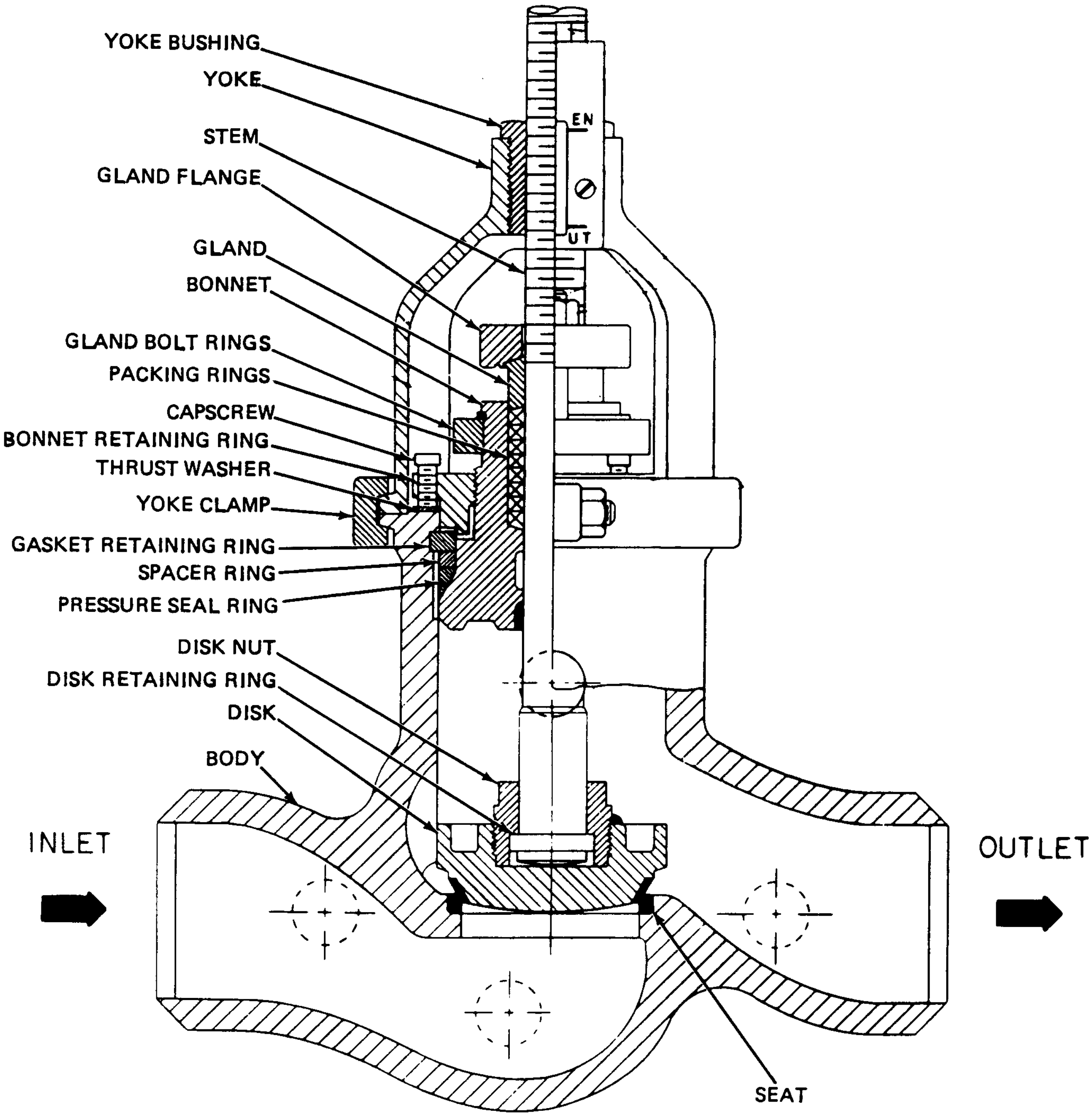


Figure 5-5. Pressure-Seal Stop Valve (Anchor) (Typical)

5-2.2.1.1 Gear Assembly. The gear assembly (figure 5-6) is the instrument used to assist in opening and closing the valve. Rotary motion of the handwheel is converted to rotary motion of the yoke sleeve, and becomes vertical movement of the valve stem. The gear assembly consists of a gear bracket which is secured to the top of the yoke with capscrews. It is made of cast steel and provides rigid support for the handwheel and shaft. A driven gear meshes with the drive gear to convert rotary motion from the horizontal to the vertical plane. The speed of rotation of the driven gear is controlled by a set ratio. The drive gear is keyed to the handwheel shaft and rides on bearings in the upper part of the gear bracket. The handwheel shaft is threaded on one end for a handwheel and handwheel nut. It is keyed, drilled, and tapped on the other end to receive the drive gear key and the drive gear securing cap. The handwheel opens and closes the valve through the gearing and the yoke sleeve. The gear assembly may also be motor driven.

5-2.2.1.2 Toggle Assembly. The toggle assembly serves two purposes. It provides the means of translating rotary motion into straight line motion, and serves as a support for the instruments that impart rotary motion. A typical toggle assembly (figure 5-7) consists of a clamp ring, which provides support for the toggle and for the hinged pivot points. The toggle linkage moves to develop a mechanical advantage for opening or closing the valve. The linkage acts as the connecting item and pivotal arms between the toggle yokes, the valve body, and the valve stem and disk assembly. The linkage pivot points are at the clamp ring, crosshead, and yokes. The linkage meets at the yokes. This arrangement provides two parallelograms of force resulting in greater closing force on the valve as it nears closing, and lessening force as the valve opens. The yokes and yoke bushings provide pivot points at the input to the toggle assembly. The yoke bushings ride on a threaded toggle stem as rotation of the toggle stem causes the yokes to close or separate. The toggle stem, supported through the yokes and linkage, is externally threaded to match the internal threads in the yoke bushings. Rotation of the handwheel moves the yokes together or apart to raise or lower the valve stem. A crosshead attaches the valve stem to the toggle assembly, and is secured to the valve stem by a stem nut. Toggle motion is directed to the valve stem through linkages to the stem nut. The short pins secure the short links to the crosshead. Toggle-operated valves may use air motors to assist in valve operation.

5-2.2.1.3 Air Motor. An air-driven motor (air motor) (shown in figure 5-8) rotates the toggle stem through a gear assembly. The air motor is a variable speed, reversible unit, and is lubricated by moisture in the air supply. It is mounted on the gear housing which is, in turn, supported on one of the toggle yokes. A gear assembly, enclosed in the gear housing, consists of a drive and driven gear. The drive gear, on the motor shaft, meshes with the driven gear to rotate the toggle stem. A slot in the toggle stem permits lateral movement of the driven gear as it rotates the stem. The slot also serves as a keyway for the key between the driven gear and the toggle stem.

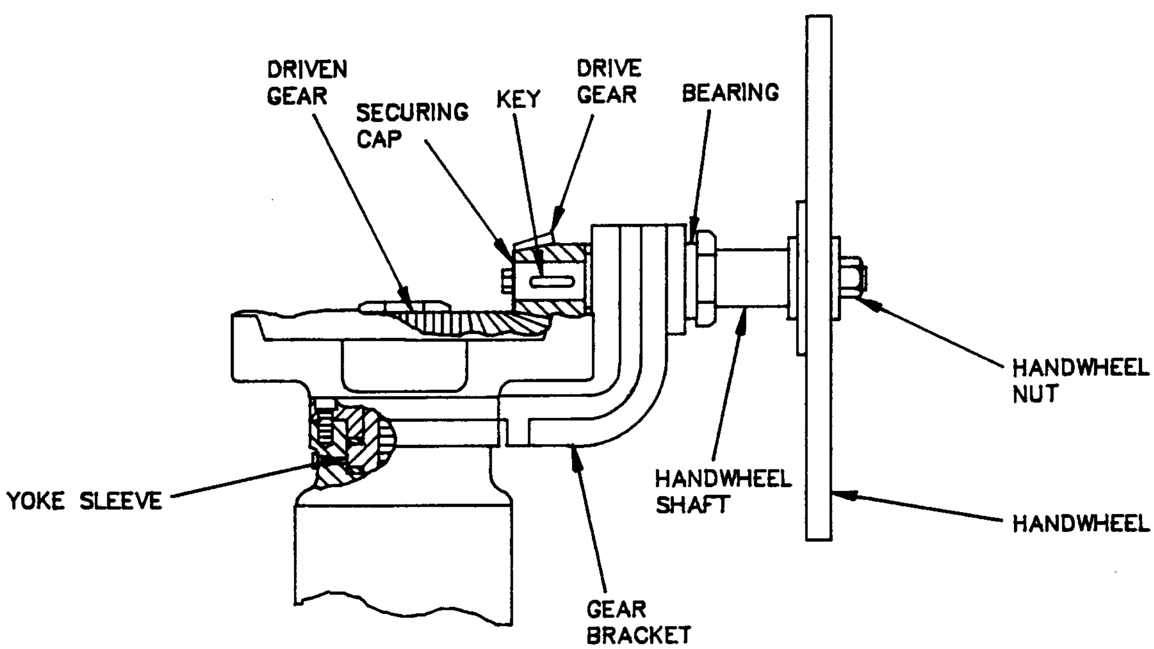


Figure 5-6. Gear Assembly (Typical)

5-3. STOP CHECK VALVES.

5-3.1 MANUALLY OPERATED STOP CHECK VALVE CHARACTERISTICS. The following paragraphs describe the characteristics of manually operated stop check valves.

5-3.1.1 Pressure-Seal Stop Check Valve (Anchor). The primary components and subassemblies of an Anchor pressure-seal stop check valve (figure 5-9) are the same as those in paragraph 5-2.1.1, except the disk slides onto the stem.

5-3.1.2 Pressure-Seal Stop Check Valve (Velan). The primary components and subassemblies of a Velan pressure-seal stop check valve (figure 5-10) are the same as those described in paragraph 5-2.1.1, except for the stem and disk assembly. The Velan pressure-seal stop check valve does not employ a bypass valve.

5-3.1.2.1 Stem and Disk Assembly. The Velan stem and disk assembly provides for valve operation and transforms rotational movement of the handwheel into vertical movement of the stem. The disk and spring fit over the end of the stem and are free to move up or down. The spring forces the disk closed to prevent reverse flow when the outlet pressure is greater than the inlet pressure.

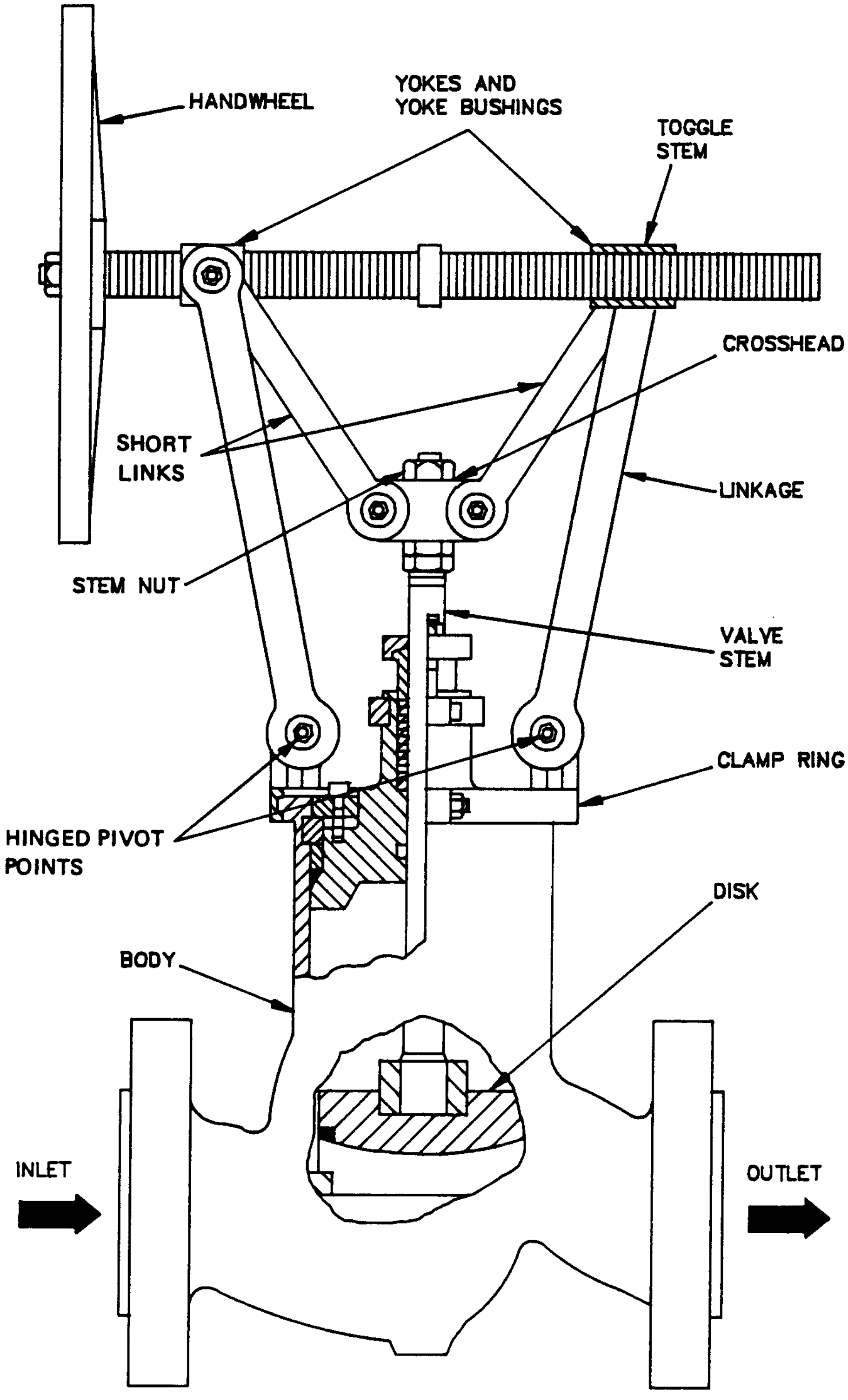


Figure 5-7. Toggle Assembly (Typical)

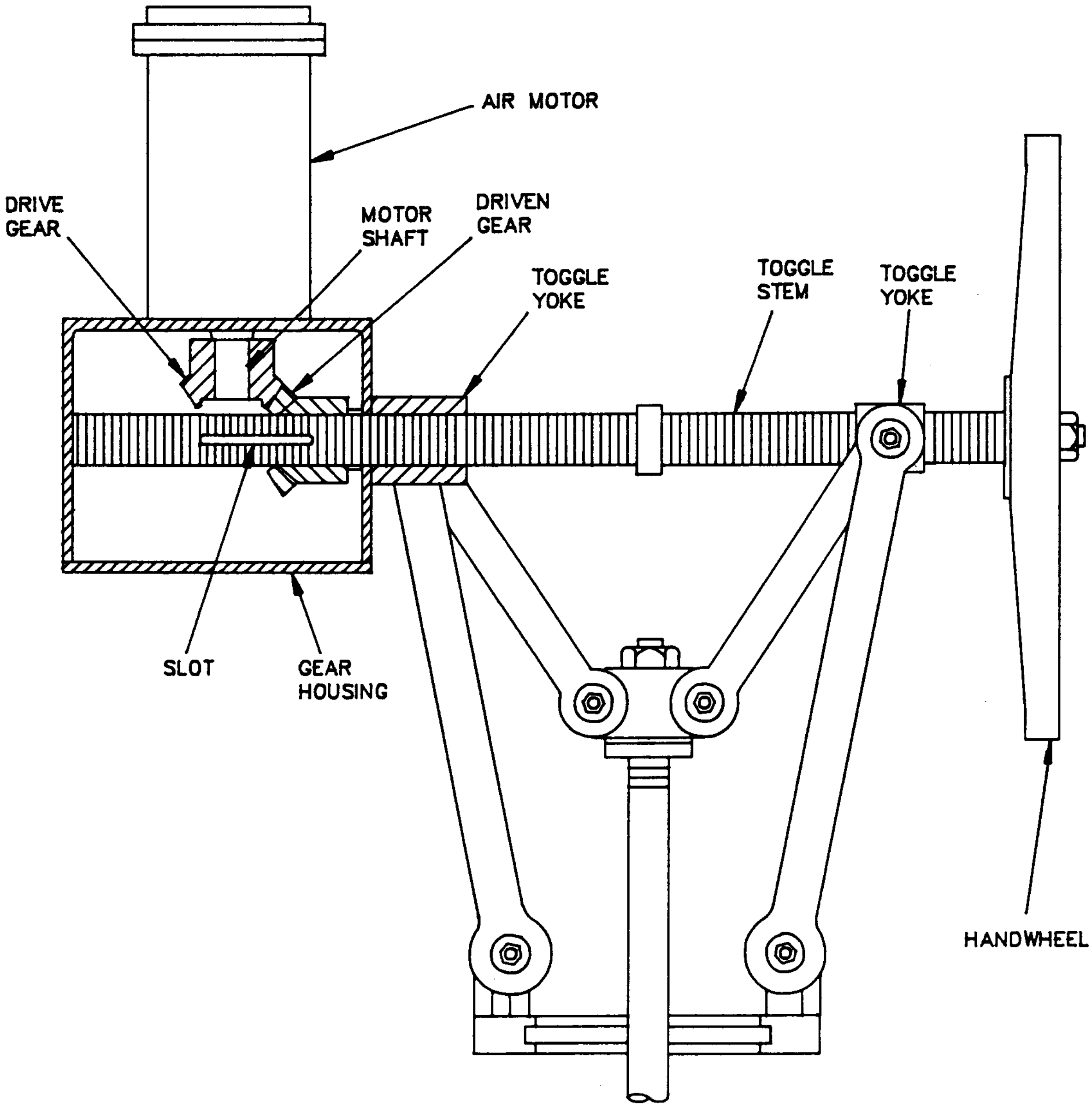


Figure 5-8. Air Motor-Driven Toggle Assembly (Typical)

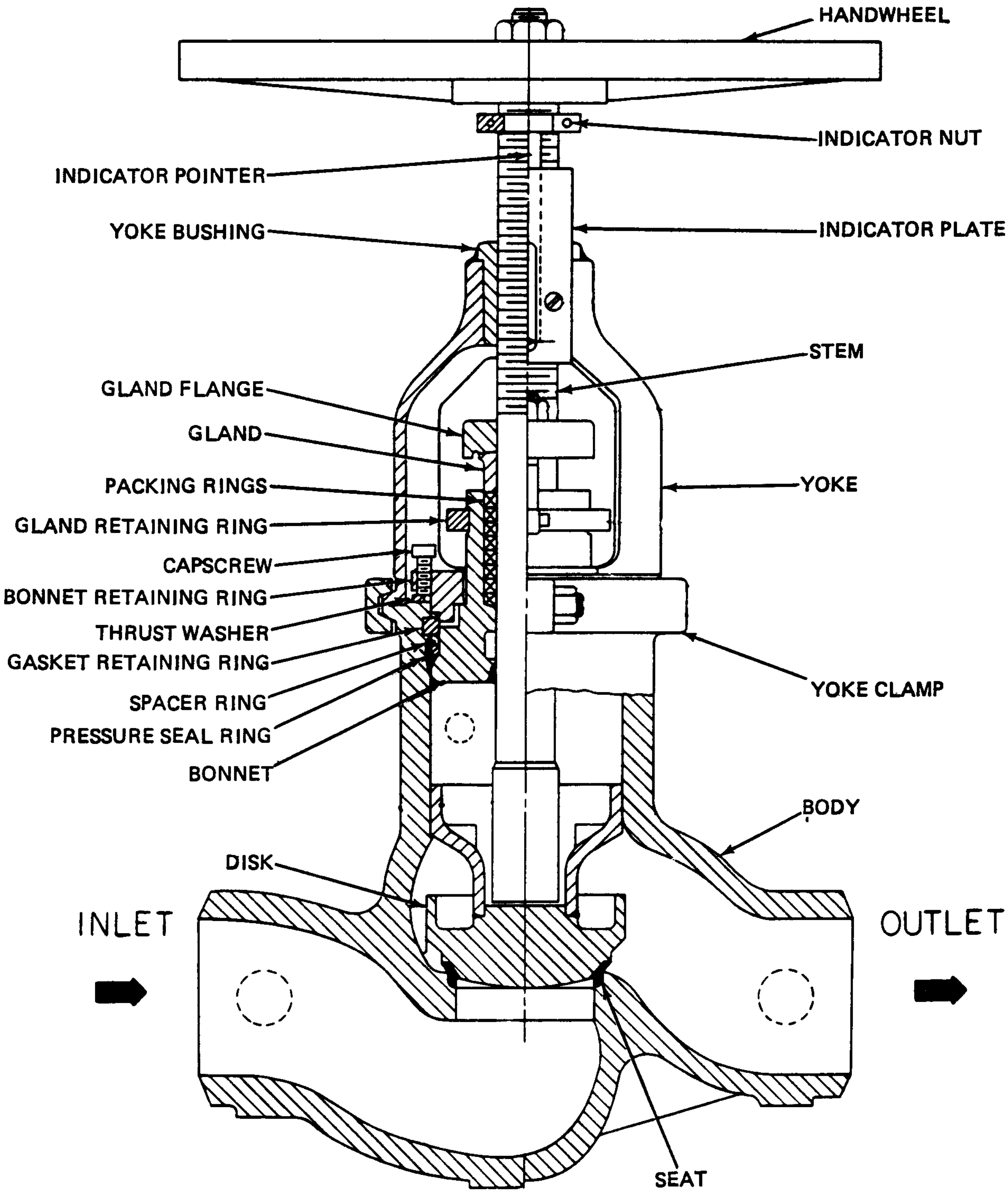


Figure 5-9. Pressure-Seal Stop Check Valve (Anchor) (Typical)

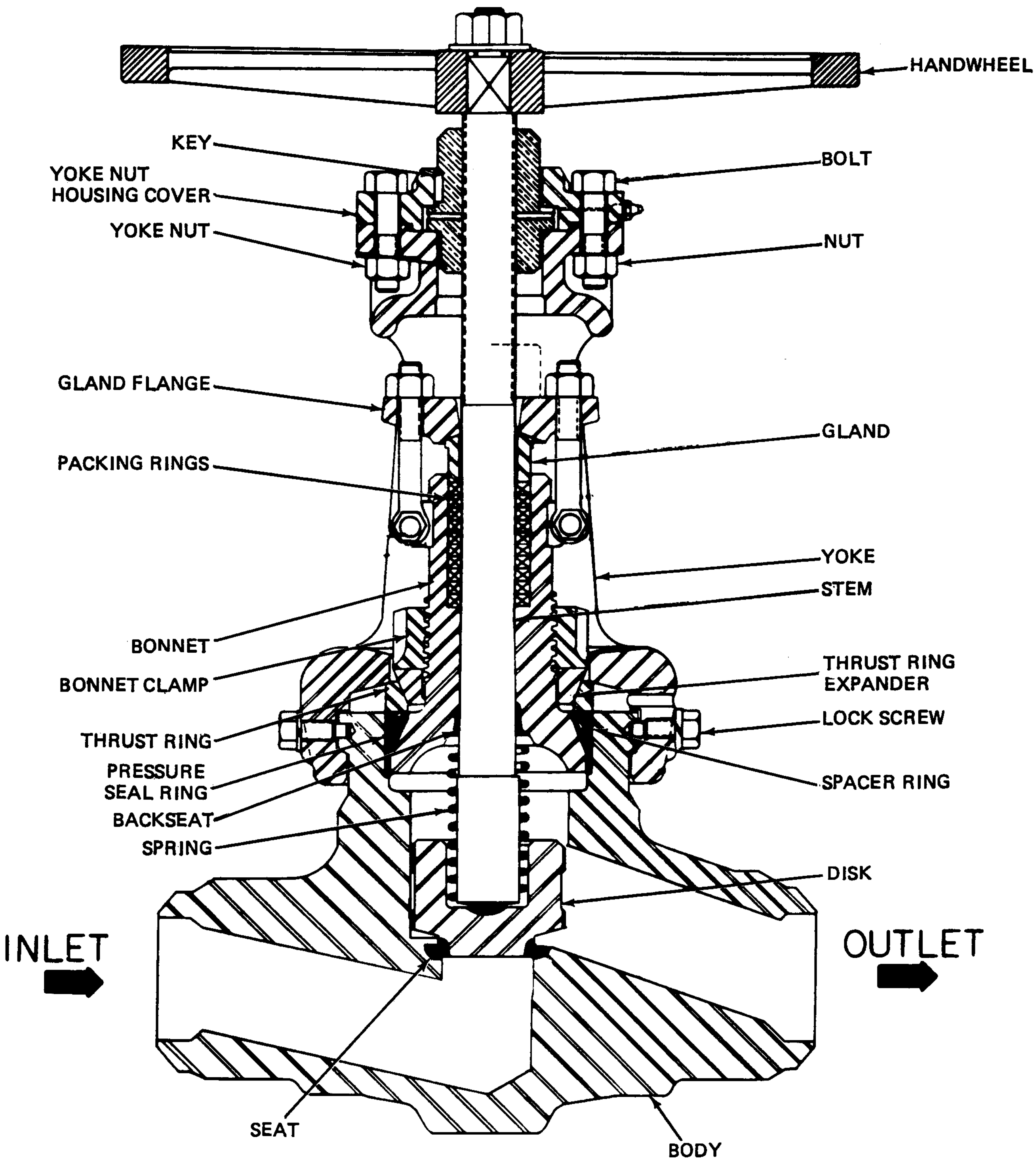


Figure 5-10. Pressure-Seal Stop Check Valve (Velan) (Typical)

5-3.1.3 Bolted-Bonnet Stop Check Valve. The primary components and subassemblies of a typical bolted-bonnet stop check valve (figure 5-11) consist of a valve body, yoke assembly, and stem and disk assembly. The body is similar to the one described in paragraph 5-2.1.1.1. The yoke assembly is similar to the one described in paragraph 5-2.1.3. The stem and disk assembly is similar to the one described in paragraph 5-3.1.2.1.

5-3.2 POWER-ACTUATED STOP CHECK VALVE CHARACTERISTICS. The following paragraph describes the characteristics of power-actuated stop check valves.

5-3.2.1 Power-Actuated Stop Check Valve (Anchor). The primary components and subassemblies of an Anchor power-actuated stop check valve (figure 5-12) are similar to those of the manually operated stop valve described in paragraph 5-2.1.1, except that the disk slides onto the stem. The gear assembly is identical to the one described in paragraph 5-2.2.1.1.

5-4. SWING CHECK VALVES.

5-4.1 SWING CHECK VALVE CHARACTERISTICS. The primary components and subassemblies of a typical swing check valve (figure 5-13) consist of a body, body cover, shaft and bearing assembly, and a disk and arm assembly.

5-4.1.1 Valve Body. The valve body has an inlet and outlet connection of the welded-end type, and is designed for horizontal mounting. Two drain connections are provided, one on each side of the seat. Two openings are also provided for bearing and disk arm shaft installation. The body is the main inline pressure vessel, and houses the various operating components.

5-4.1.2 Valve Body Cover. The valve body cover is manufactured of the same material as the valve body. It has a metallic spiral-wound gasket that forms a seal between the cover and body. The body cover is used for access to the internal components.

5-4.1.3 Shaft and Bearing Assembly. The shaft and bearing assembly consists of a disk arm shaft (shaft) which is constructed of corrosion resistant steel. It is used to provide support for, and a means of pivoting, the disk assembly. The shaft is internally balanced to allow free swinging of the disk assembly. Two bearing cover bushings form the bearing surface for the shaft, and each bushing is pressed to fit into its bearing cover. The bushings are lipped and extend inward from the bearing cover. Each of the two bearing covers has a metallic spiral-wound gasket which forms a pressure seal. The covers serve as mounting for the bushings.

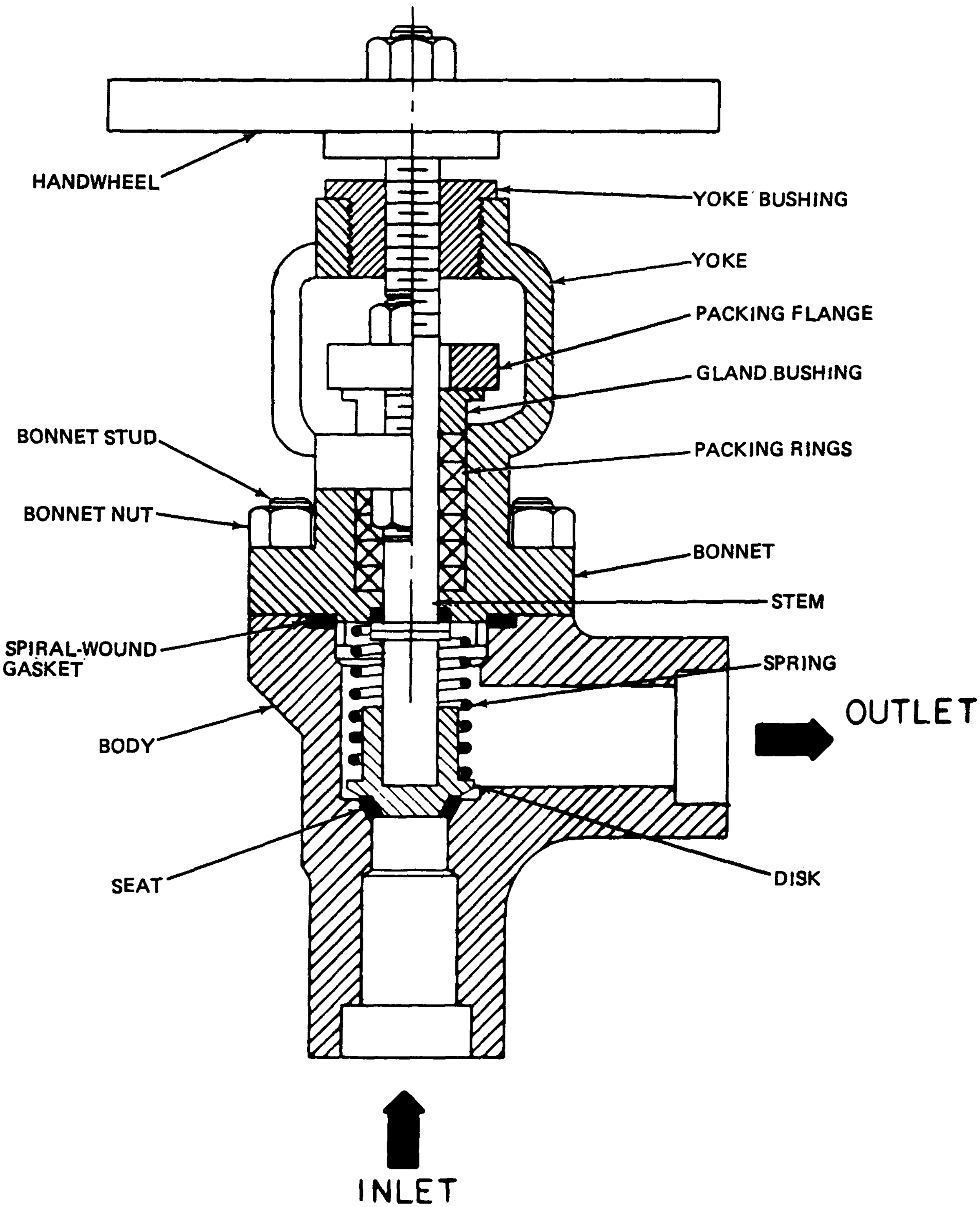


Figure 5-11. Bolted-Bonnet Stop Check Valve (Typical)

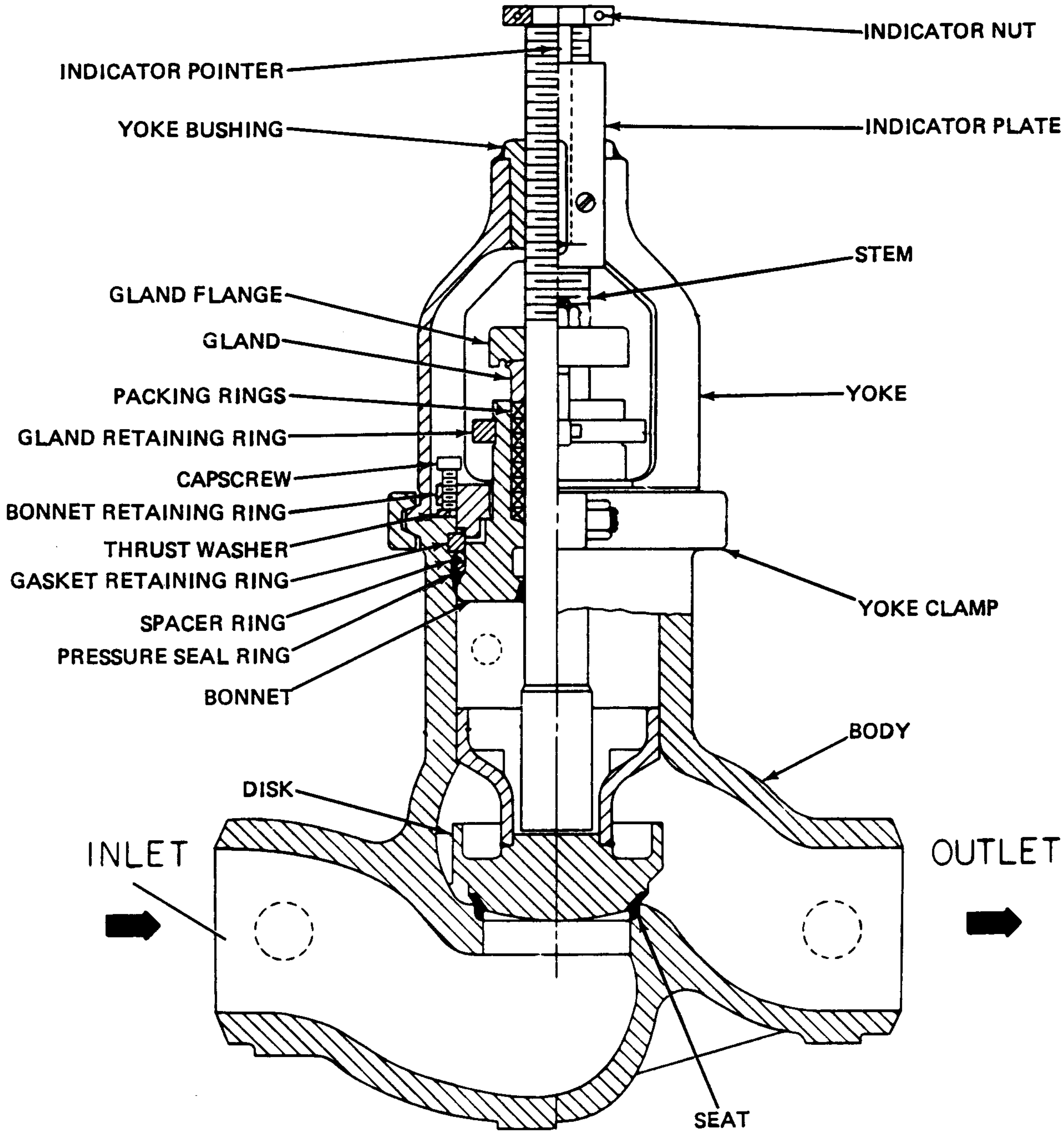


Figure 5-12. Power-Actuated Stop Check Valve (Anchor) (Typical)

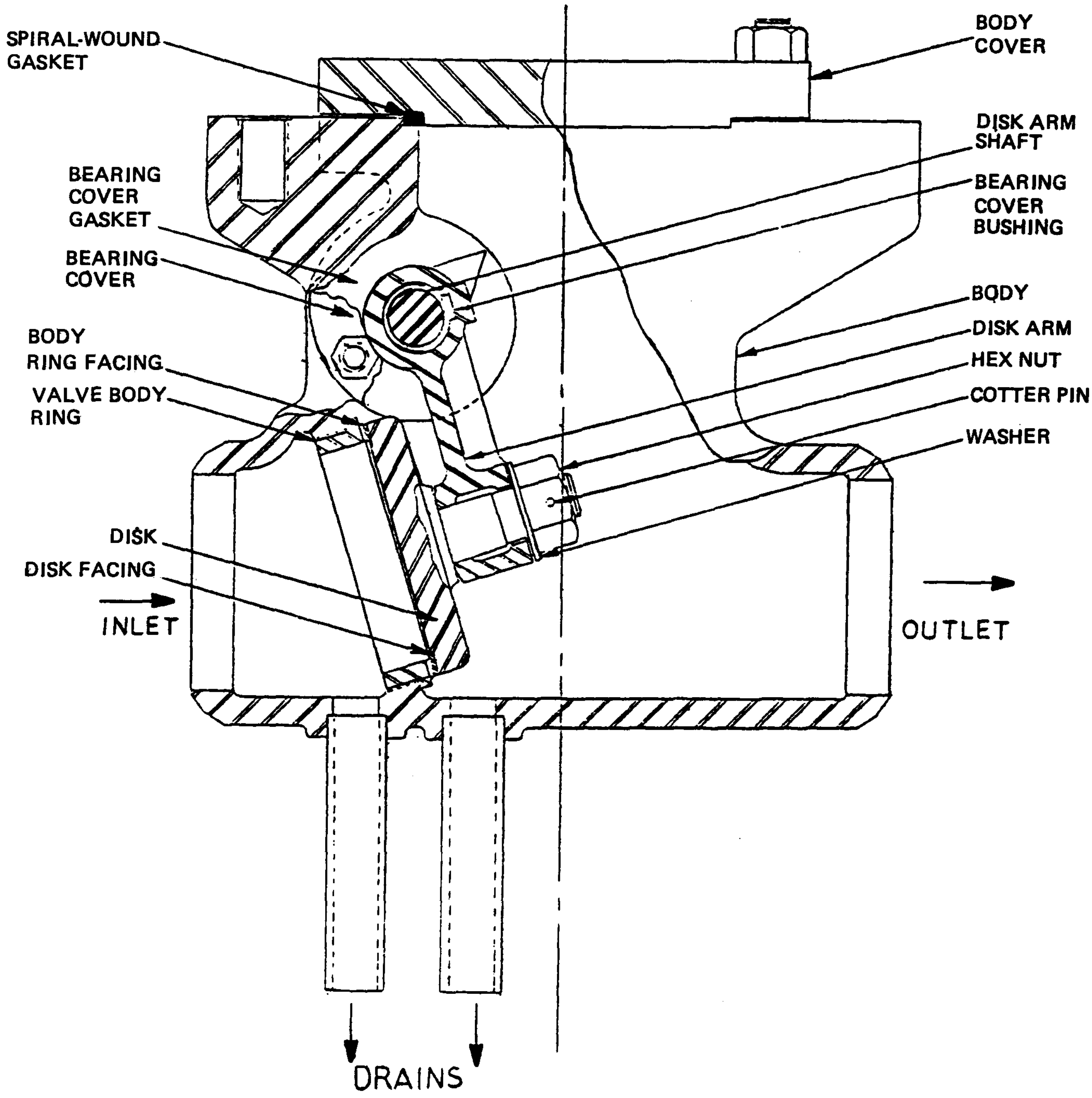


Figure 5-13. Swing Check Valve (Typical)

5-4.1.4 Disk and Arm Assembly. The disk and arm assembly comprise the primary moving parts of the swing check valve. The disk contains a stellite surface which seals with the surface of the valve body ring. The stellite is laid directly on the face of the disk by welding. The end of the threaded disk shaft is drilled for a cotter pin, and is attached to the disk arm by a hex nut and washer. The disk arm connects the disk to the disk arm shaft, and is the moving linkage of the valve.

5-5. LIFT CHECK VALVES.

5-5.1 PRESSURE-SEAL LIFT CHECK VALVE CHARACTERISTICS. The primary components and subassemblies of a typical pressure-seal lift check valve (figure 5-14) consist of a valve body, bonnet, and disk/disk skirt.

5-5.1.1 Valve Body. The valve body is the main inline pressure vessels and houses the various operating components. It contains an inlet, outlet, and an integral stellite-faced seat.

5-5.1.2 Bonnet Assembly. The bonnet constitutes a top closure for the valve. It also provides a seating surface for the pressure seal ring. The pressure seal ring forms a seal to prevent a pressure leak. A spacer ring is installed atop the pressure seal ring to help fill the sealing cavity. A gasket retaining ring, made up of sections, fits into a recess in the upper portion of the valve body. It prevents a blowout of the spacer ring and pressure seal ring. A bonnet retaining ring rests on the top of the valve body and is secured to the bonnet with capscrews.

5-5.1.3 Disk and Disk Skirt. The disk and disk skirt are the opening and closing elements of the valve. The disk skirt is welded to the disk and alines the disk within the body.

5-5.2 BOLTED-BONNET LIFT CHECK VALVE CHARACTERISTICS. The primary components and subassemblies of a typical bolted-bonnet lift check valve (figure 5-15) consist of a valve body, cap, spring, and disk.

5-5.2.1 Valve Body. The valve body is the main inline pressure vessel, and houses the various operating components. The body contains an inlet, outlet, and an integral, stellite-faced seat. The body may have either flange or socket ends.

5-5.2.2 Cap. The top-mounted body cap is secured to the body by studs and nuts. A spiral-wound gasket forms a pressure seal between the body and cap.

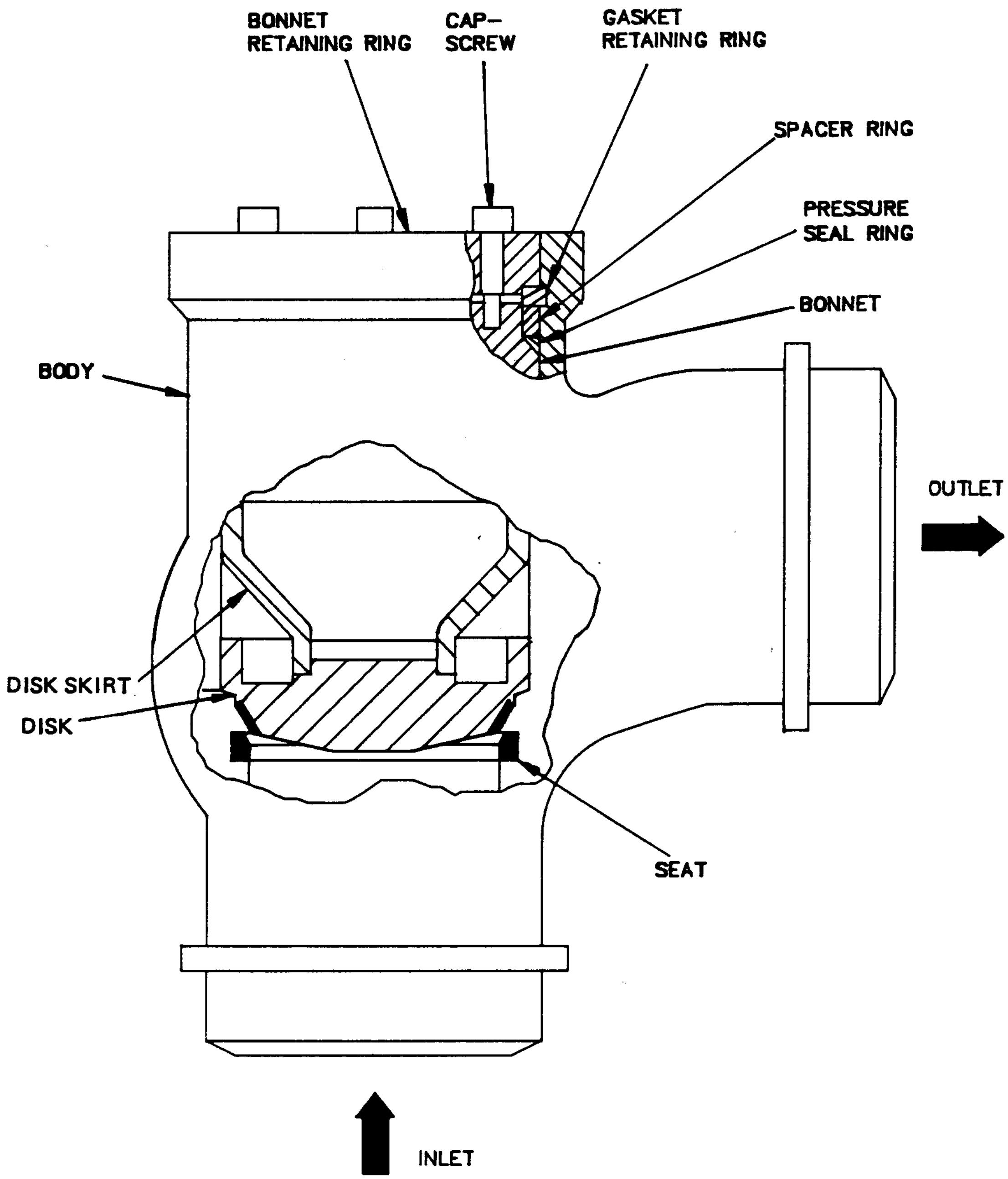


Figure 5-14. Pressure-Seal Lift Check Valve (Typical)

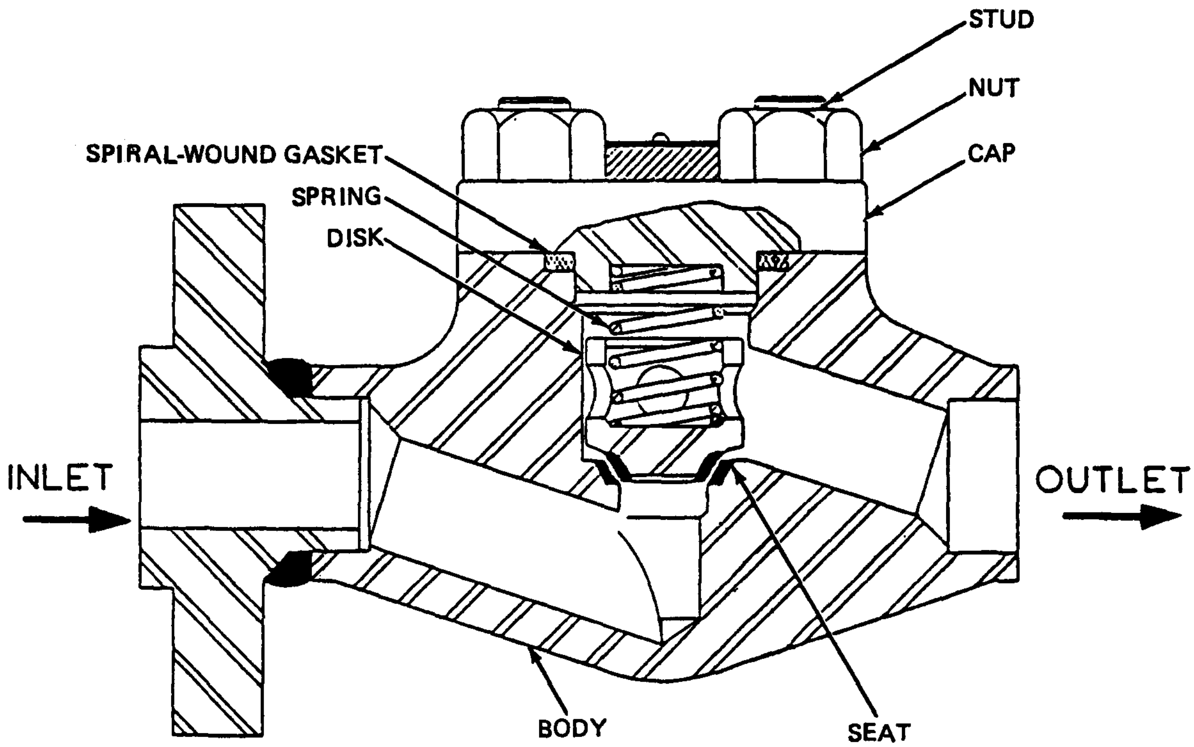


Figure 5-15. Bolted-Bonnet Lift Check Valve (Typical)

5-5.2.3 Spring. The spring is installed inside the disk, and seats the disk when no inlet pressure is present. Spring sizes will vary according to the valve size.

5-5.2.4 Disk. The disk is the opening and closing element of the valve. It is a spring-loaded, double-guided disk with four equalizing ports for pressure relief.

5-6. Y-PATTERN VALVES.

5-6.1 Y-PATTERN VALVE CHARACTERISTICS (DRESSER). The primary components and subassemblies of the Dresser Y-pattern valve (figure 5-16) consist of a valve body, yoke assembly, and stem and disk assembly. The body is similar to the one described in paragraph 5-2.1.1.1, except it is in a Y-pattern to accept the yoke at a 60-degree angle. The yoke assembly is similar to the one described in paragraph 5-2.1.3. The stem and disk assembly is similar to the one described in paragraph 5-3.1.2.1. A T-wrench, rather than a handwheel or handle, is used to open and close the valve in bottom blow valves only. The valve may also incorporate a locking cap as a safety feature.

5-6.2 Y-PATTERN VALVE CHARACTERISTICS (ROCKWELL). The primary components and subassemblies of the Rockwell Y-pattern valve (figure 5-17) are similar to those described in paragraph 5-2.1.1.1, except for the bonnet and yoke assembly.

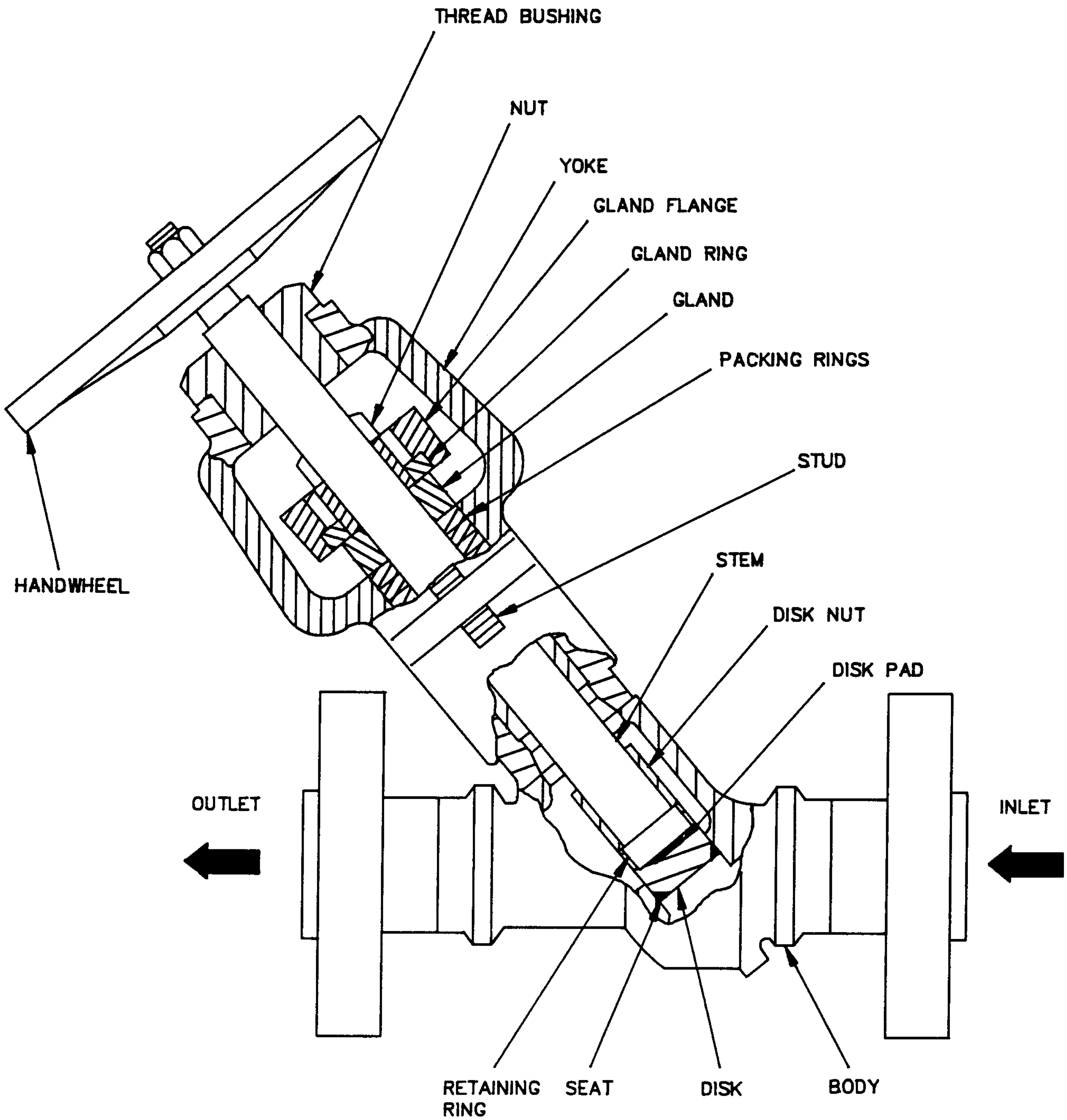


Figure 5-16. Y-Pattern Valve (Dresser) (Typical)

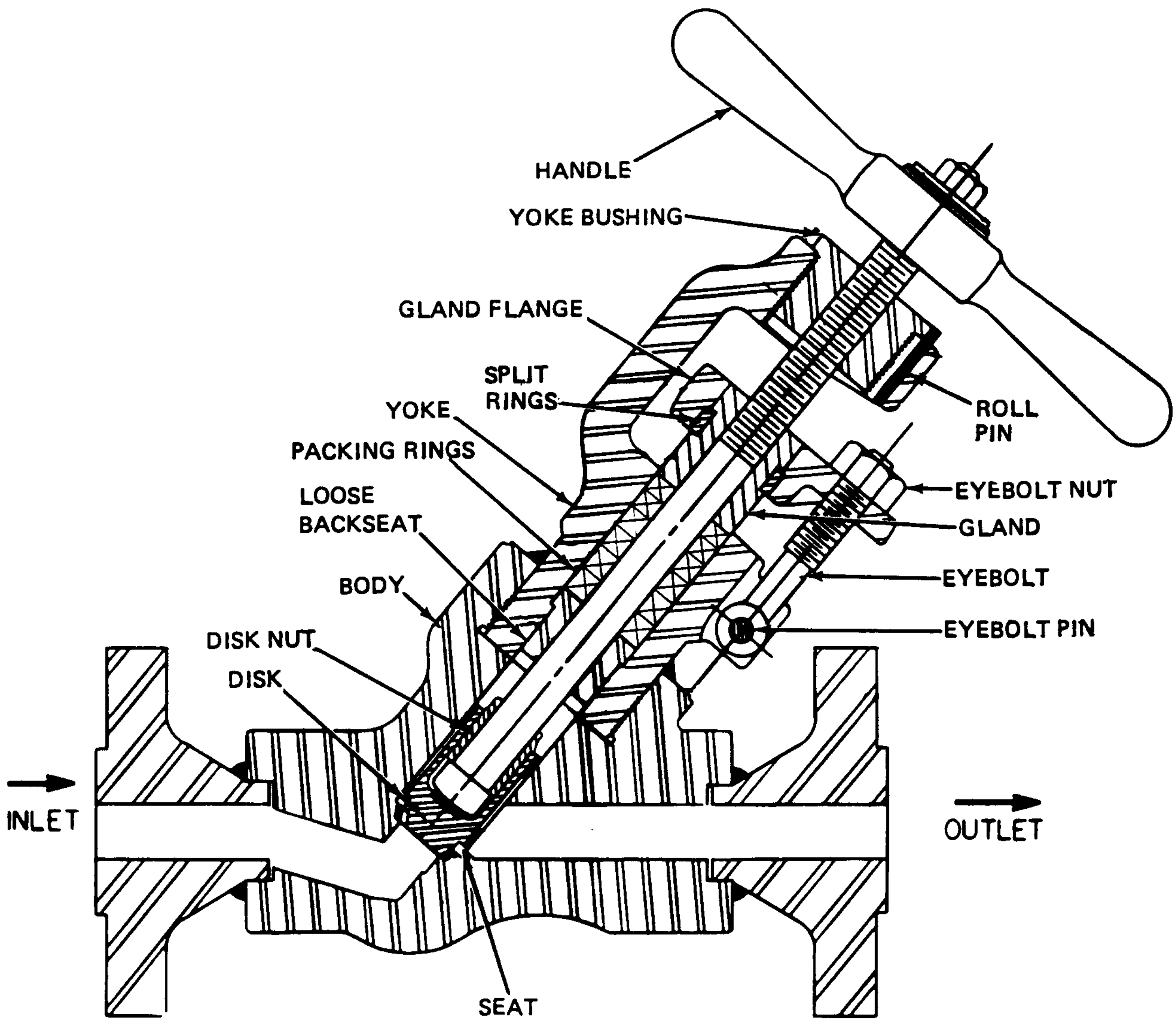


Figure 5-17. Y-Pattern Valve (Rockwell) (Typical)

5-6.2.1 Bonnet and Yoke Assembly. The bonnet and yoke assembly is an integral unit that forms the upper portion of the valve. It is provided with appendages which are used to secure the eyebolts, eyebolt nuts, and eyebolt pins. A yoke bushing is anchored and keyed by a roll pin at the top of the yoke to provide stem support. Packing rings in the bonnet form a seal around the stem to prevent a pressure leak. The packing rings rest on a loose backseat in the bonnet. A gland and gland flange apply even compression of the packing rings. Split rings inserted in the gland groove enable the gland flange to tighten in on the gland.

5-6.3 Y-PATTERN VALVE CHARACTERISTICS (VELAN). The primary components and subassemblies of the Velan Y-pattern valve (figure 5-18) consist of an integral bonnet and body, and a stem and disk assembly. The Y-pattern valve is T-wrench or handle operated.

5-6.3.1 Integral Bonnet and Body. The integral bonnet and body is the main in-line pressure vessel. The body contains a flanged inlet and outlet and an integral stellite-faced seat. A yoke bushing anchored at the top of the bonnet provides stem support. The bonnet also houses the packing rings that form a seal around the stem to prevent pressure leaks. A split gland bushing and packing flange apply even compression of the packing rings. The packing rings rest on a junk ring in the bonnet.

5-6.3.2 Stem and Disk Assembly. The stem and disk assembly provides valve operation. The stem transforms rotational movement of the handwheel into vertical movement to open or close the valve. The disk is secured to the stem by ball bearings and a plug. The disk is the opening and closing element of the valve.

5-6.4 Y-PATTERN VALVE CHARACTERISTICS (YARWAY). The primary components and subassemblies of the Yarway Y-pattern valve (figure 5-19) are similar to those described in paragraph 5-6.3.

5-7. GATE VALVES.

5-7.1 MANUALLY OPERATED GATE VALVE CHARACTERISTICS. The following paragraphs describe the characteristics of manually operated gate valves.

5-7.1.1 Pressure-Seal Gate Valve (Anchor). The primary components and subassemblies of the Anchor pressure-seal gate valve (figure 5-20) consist of a valve body, yoke assembly, bonnet assembly, stem and disk assembly, and handwheel.

5-7.1.1.1 Valve Body. The valve body is the main inline pressure vessel for the entire assembly. The body contains an inlet and outlet, with flanged or socket- or butt-welded ends, and may be fitted with a bypass valve. Disk guides may be installed as a separate component, or be integral to the body casting. Disk guides integral to the body cannot be replaced. Two stellite-faced seats are installed with the planes of their faces vertically angled. The pressure seal rings are seal welded to the body and are replaceable.

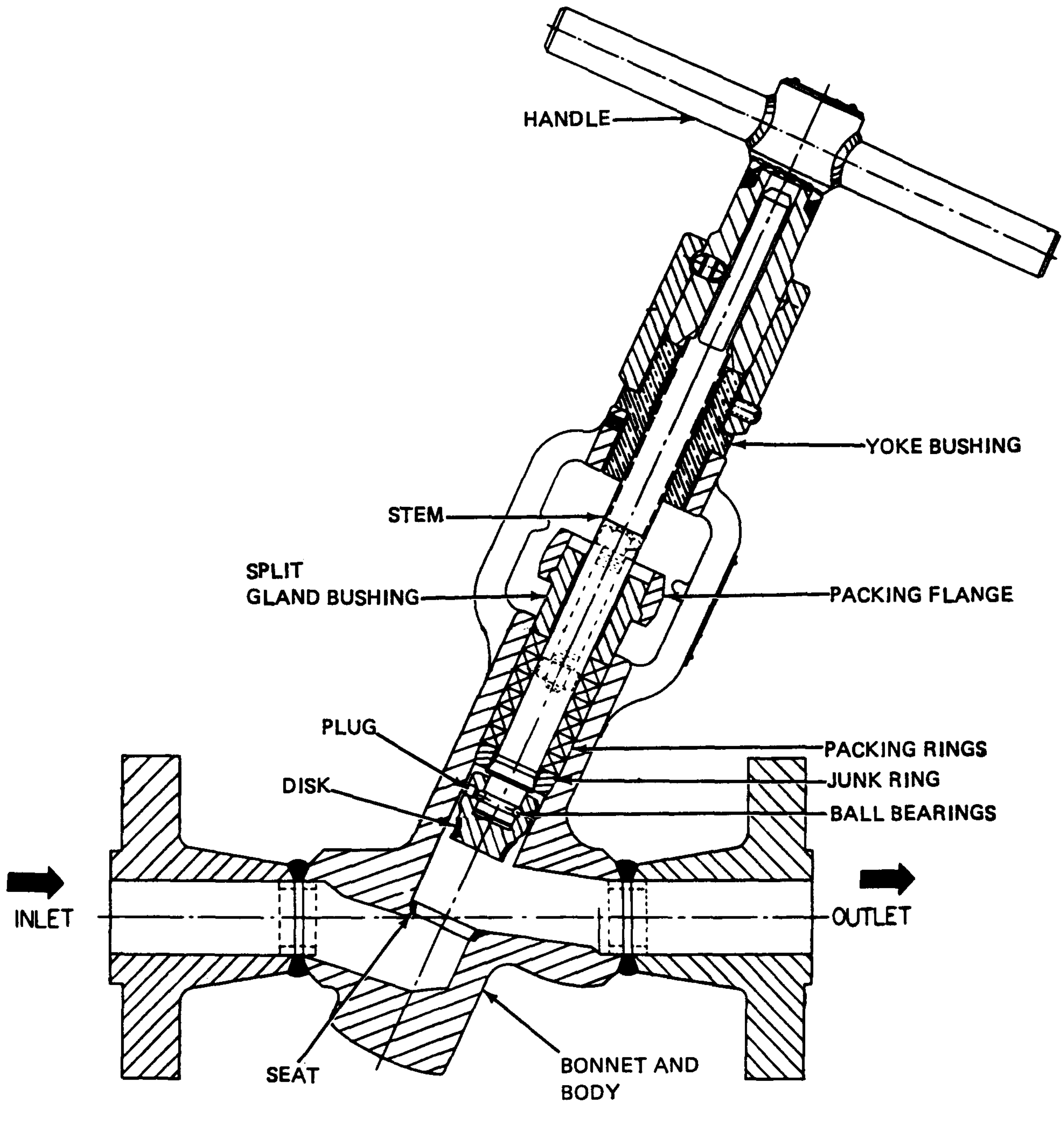


Figure 5-18. Y-Pattern Valve (Velan) (Typical)

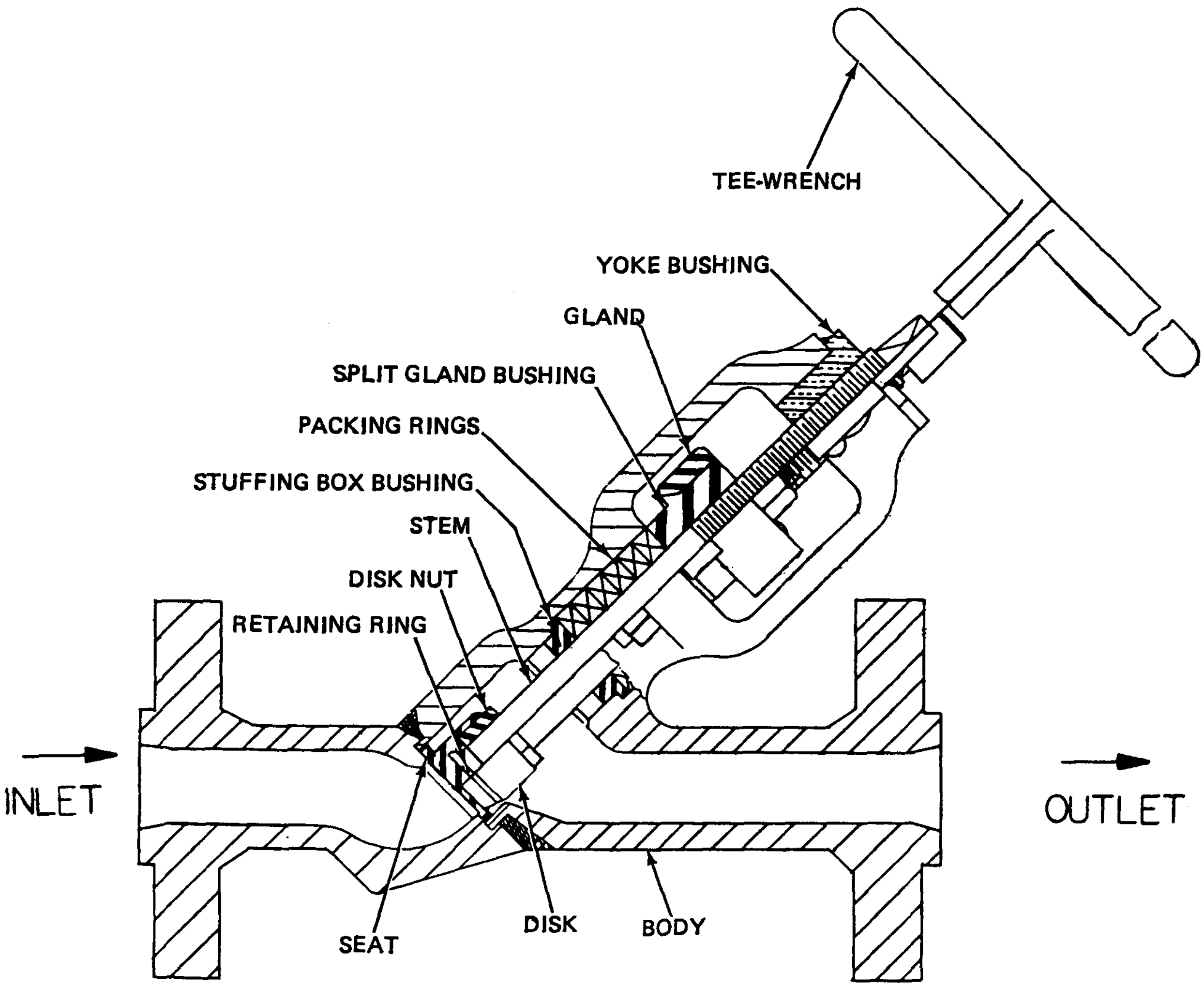


Figure 5-19. Y-Pattern Valve (Yarway) (Typical)

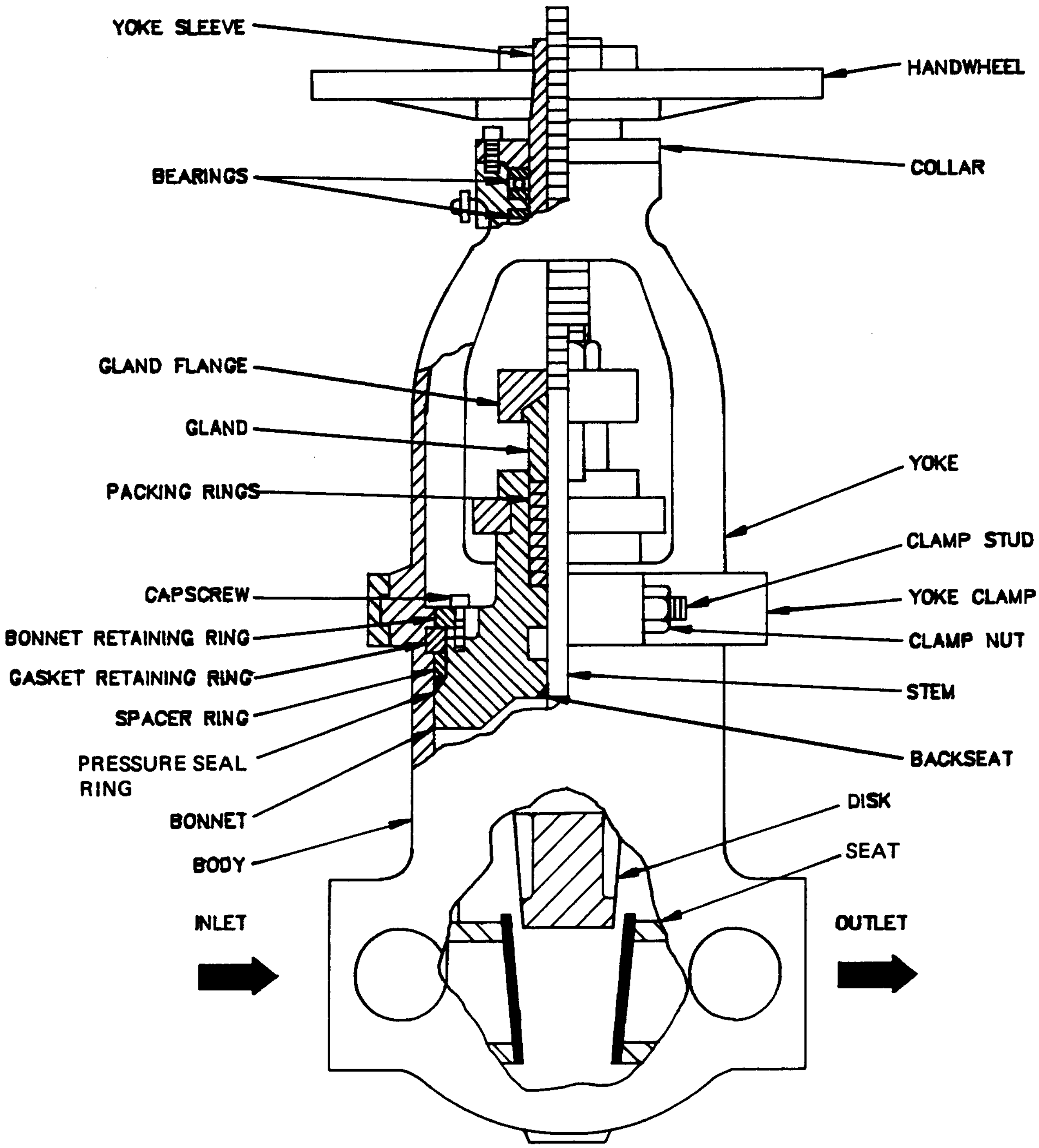


Figure 5-20. Pressure-Seal Gate Valve (Anchor) (Typical)

5-7.1.1.2 Yoke Assembly. The yoke assembly consists of a yoke which supports the stem and provides a housing for the bonnet and gland components. A yoke sleeve is anchored at the top of the yoke for stem support. Yoke clamps with clamp nuts and studs secure the yoke to the valve body. Some yokes contain bearings to accept vertical thrust imposed by the stem.

5-7.1.1.3 Bonnet Assembly. The bonnet assembly is similar to that described in paragraph 5-2.1.1.3, except that this valve does not include a thrust washer.

5-7.1.1.4 Stem and Disk Assembly. The stem and disk assembly provides for valve operation. It consists of the stem, which translates rotational movement of the handwheel into vertical movement to open or close the valve. A collar at the bottom of the stem, riding in an inverted tee-slot in the top of the disk, forms the stem to disk connection. The disk is wedge shaped, and is the opening and closing element of the valve. The faces of the disk are machined and stellite surfaced to match the seats in the valve body. The disk has slotted sides that ride on the disk guides in the body. The two faces of the disk are connected by an internal hub. It provides a flexible structure which allows a small degree of motion to eliminate sticking or jamming of the disk.

5-7.1.2 Pressure-Seal Gate Valve (Crane). The primary components and subassemblies of the Crane pressure-seal gate valve (figure 5-21) are similar to those described in paragraph 5-7.1.1, except for the bonnet assembly. On some valves the yoke is screwed into the body and will not have yoke clamps, and the gland bolt ring will come in one piece.

5-7.1.2.1 Bonnet Assembly. The bonnet assembly is the guide and support for the stem. It also houses the packing rings and the seal ring. The bonnet seats in the upper portion of the valve body and is the sealing surface and support for the seal ring. The seal ring sits on the base of the bonnet and prevents any pressure leak. The bonnet is secured against the yoke by a bonnet locking ring, and has a stellite-surfaced area on the underside. The stellite-surfaced area forms a backseat when mated to the shoulder of the stem.

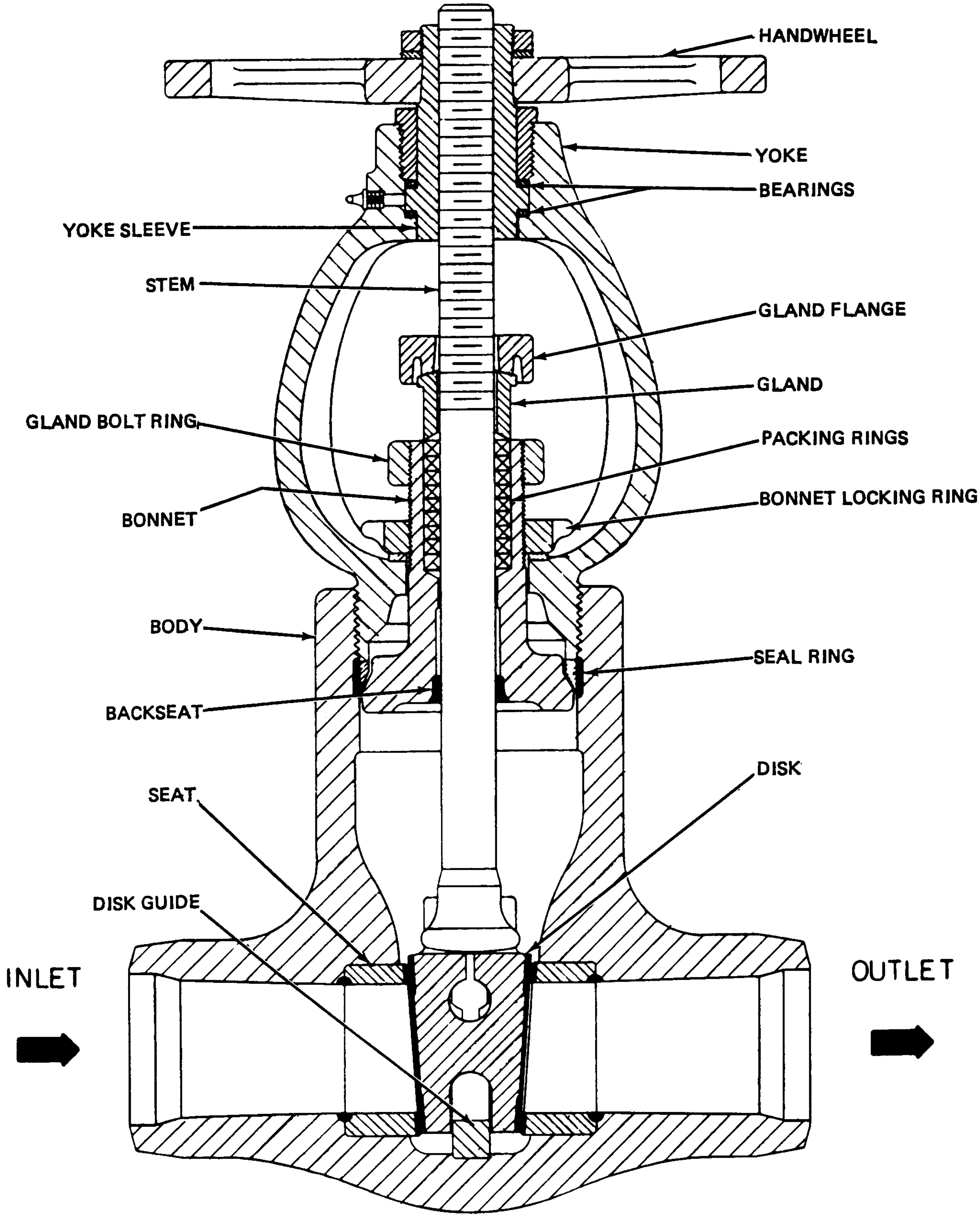


Figure 5-21. Pressure-Seal Gate Valve (Crane) (Typical)

5-7.1.3 Pressure-Seal Gate Valve (Velan). The primary components and subassemblies of the Velan pressure-seal gate valve (figure 5-22) are similar to those described in paragraph 5-7.1.1.

5-7.1.4 Pressure-Seal Gate Valve (Walworth). The primary components and subassemblies of the Walworth pressure-seal gate valve (figure 5-23) are similar to those described in paragraph 5-7.1.1. on some valves the bonnet is secured by a bonnet retaining ring and bonnet clamps with nuts and studs.

5-7.1.5 Bolted-Bonnet Gate Valve. The primary components and subassemblies of a typical bolted-bonnet gate valve (figure 5-24) consist of a valve body, bonnet and yoke assembly, and stem and disk assembly. The stem and disk are similar to that described in paragraph 5-7.1.1.4.

5-7.1.5.1 Valve Body. The valve body is the main in-line pressure vessel for the entire assembly. The body contains an inlet, outlet, stellite-surfaced seat rings, and integral disk guides. The body may have either flanged or socket- or buttwelded ends.

5-7.1.5.2 Bonnet and Yoke Assembly. The bonnet and yoke assembly is an integral unit that forms the upper portion of the valve. The upper portion is provided with appendages which are used to secure the gland bolts. A yoke sleeve is anchored at the top of the yoke and provides stem support. Packing rings form a seal around the stem to prevent a pressure leak. The gland and gland flange provide for even compression of the packing rings. A spiral-wound gasket forms a seal between the bonnet and body.

5-7.2 POWER-ACTUATED GATE VALVE CHARACTERISTICS. The following paragraph describes the characteristics of power-actuated gate valves.

5-7.2.1 Power-Actuated Gate Valves. The primary components and subassemblies of a typical power-actuated gate valve (figure 5-25) are similar to those described in paragraph 5-7.1, except it has no yoke assembly. The primary components and subassemblies of a gear assembly are similar to those described in paragraph 5-2.2.1.1. The primary components and subassemblies of a toggle assembly are similar to those described in paragraph 5-2.2.1.2. The primary components and subassemblies of an air motor are similar to those described in paragraph 5-2.2.1.3.

5-8. NEEDLE VALVES.

5-8.1 PRESSURE-SEAL NEEDLE VALVE CHARACTERISTICS (ANCHOR). The primary components and subassemblies of the Anchor pressure-seal needle valve (figure 5-26) are similar to those described in paragraph 5-2.1.1.

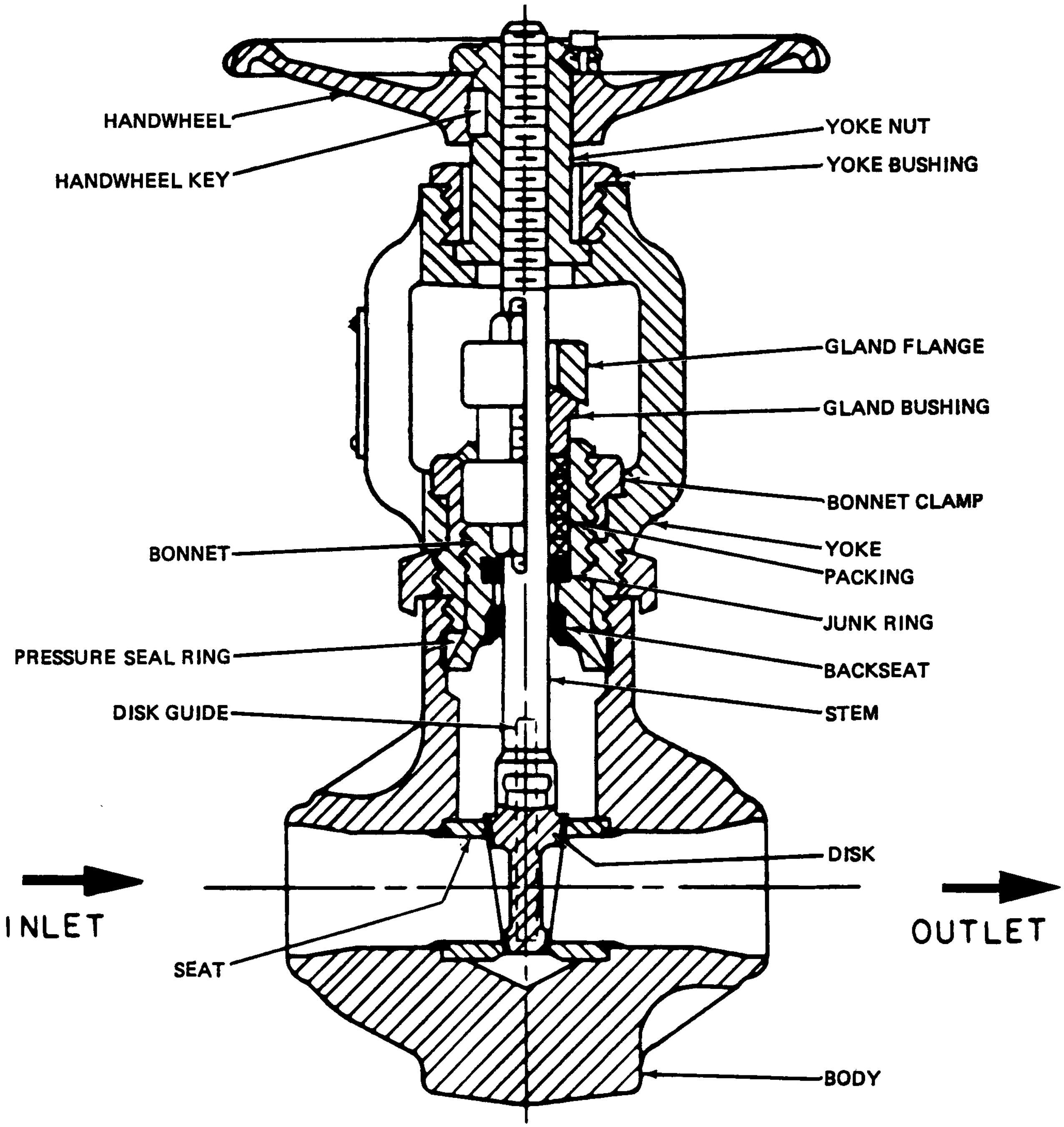


Figure 5-22. Pressure-Seal Gate Valve (Velan) (Typical)

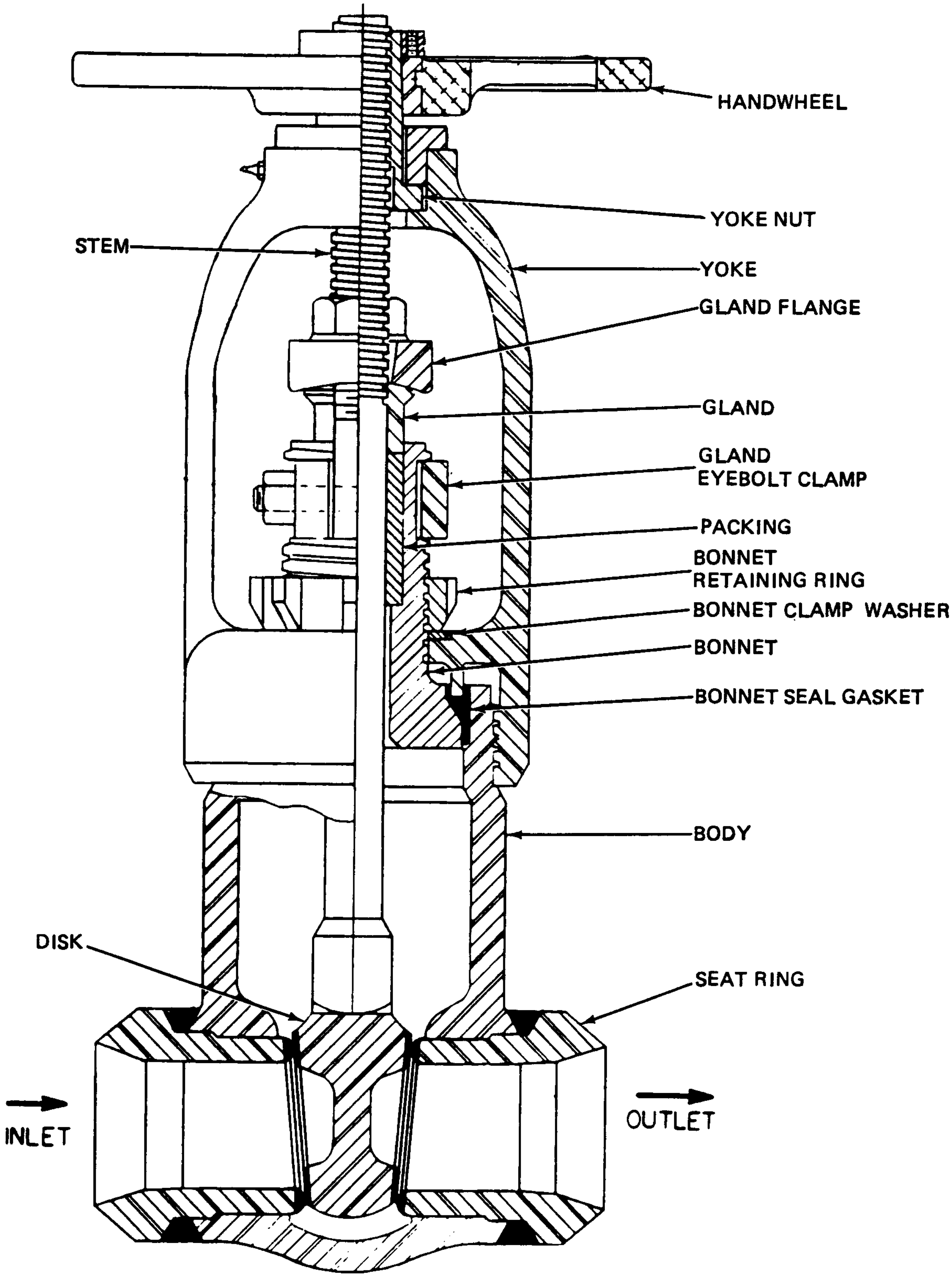


Figure 5-23. Pressure-Seal Gate Valve (Walworth) (Typical)

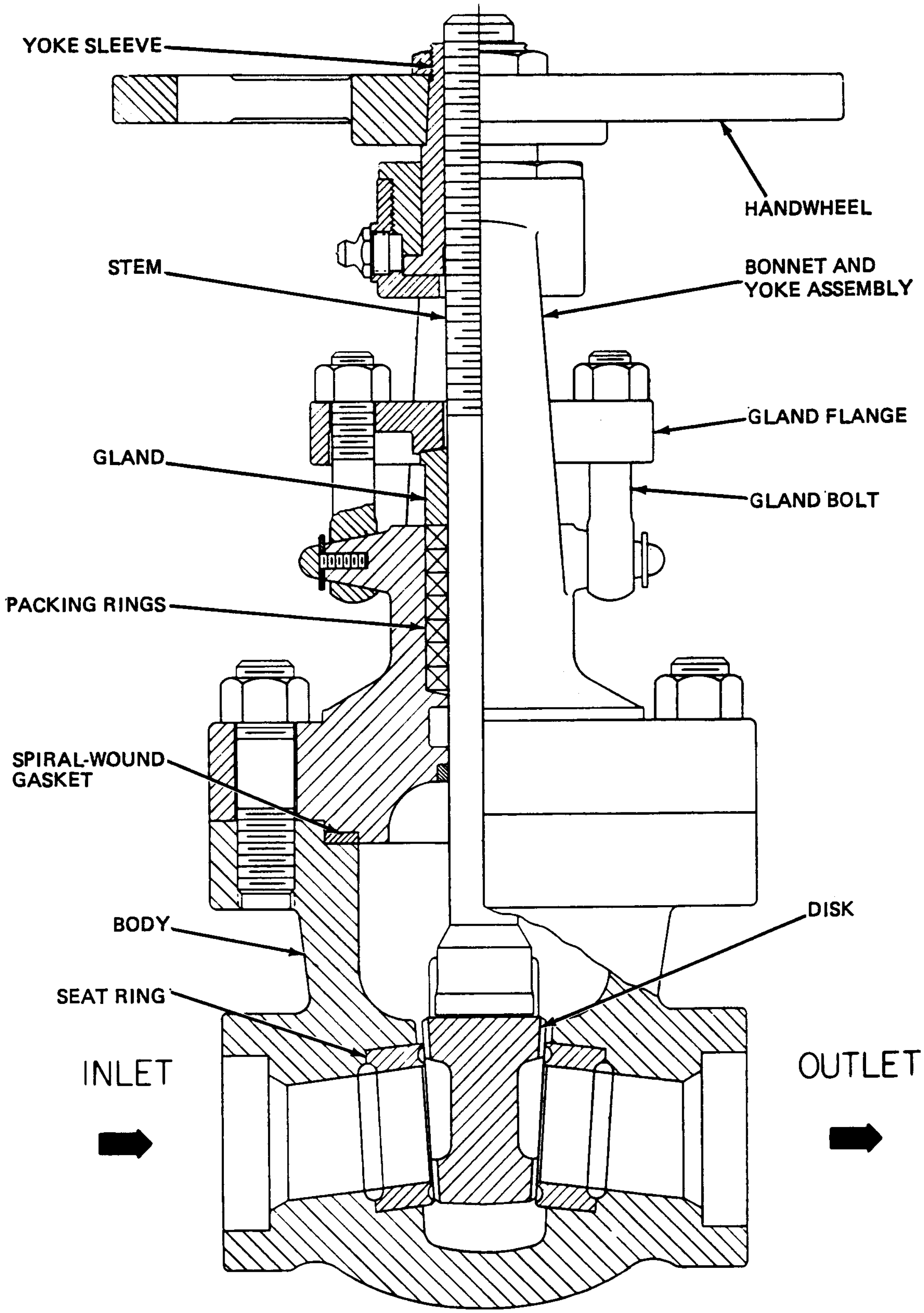


Figure 5-24. Bolted-Bonnet Gate Valve (Typical)

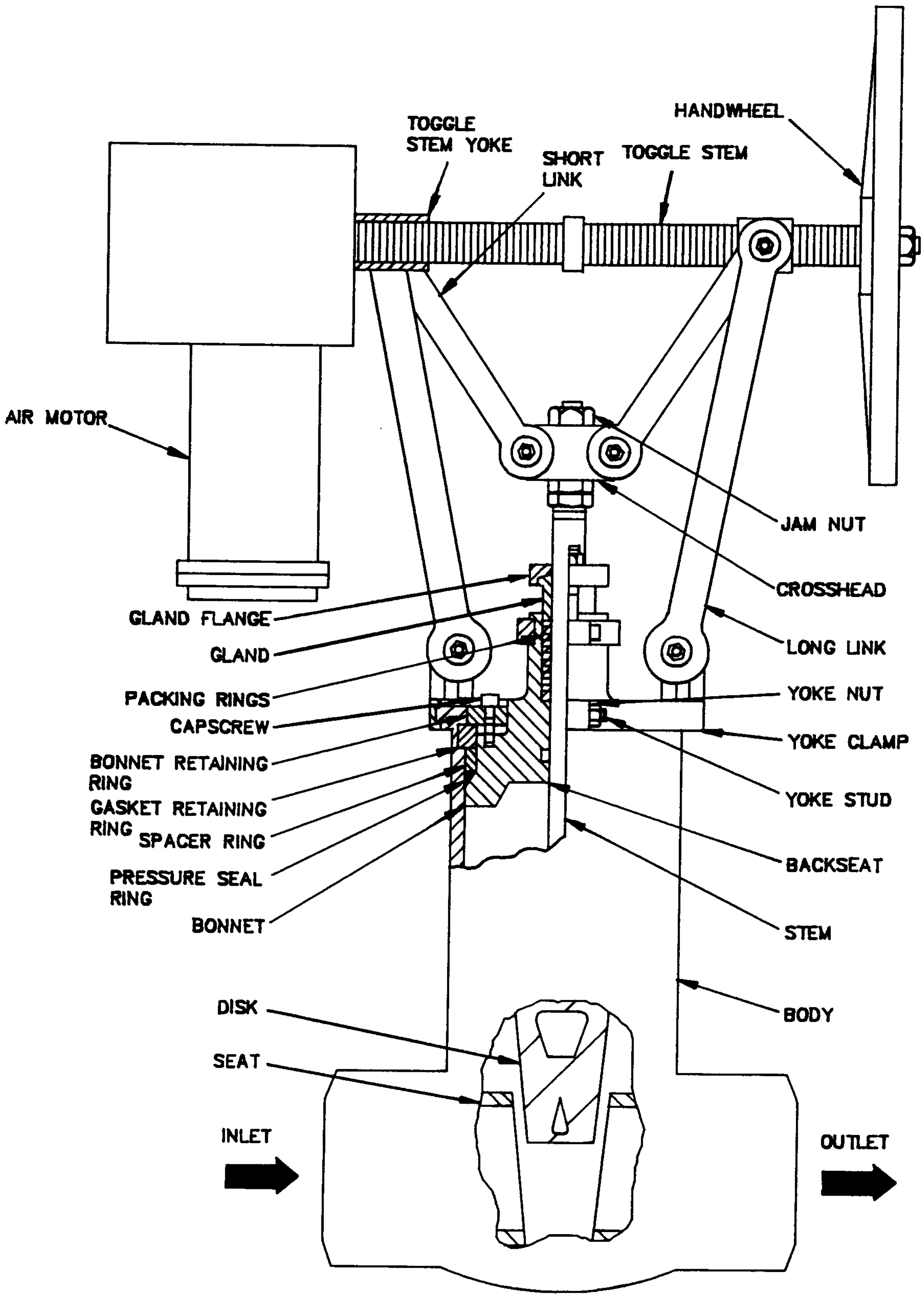


Figure 5-25. Power-Actuated Gate Valve (Typical)

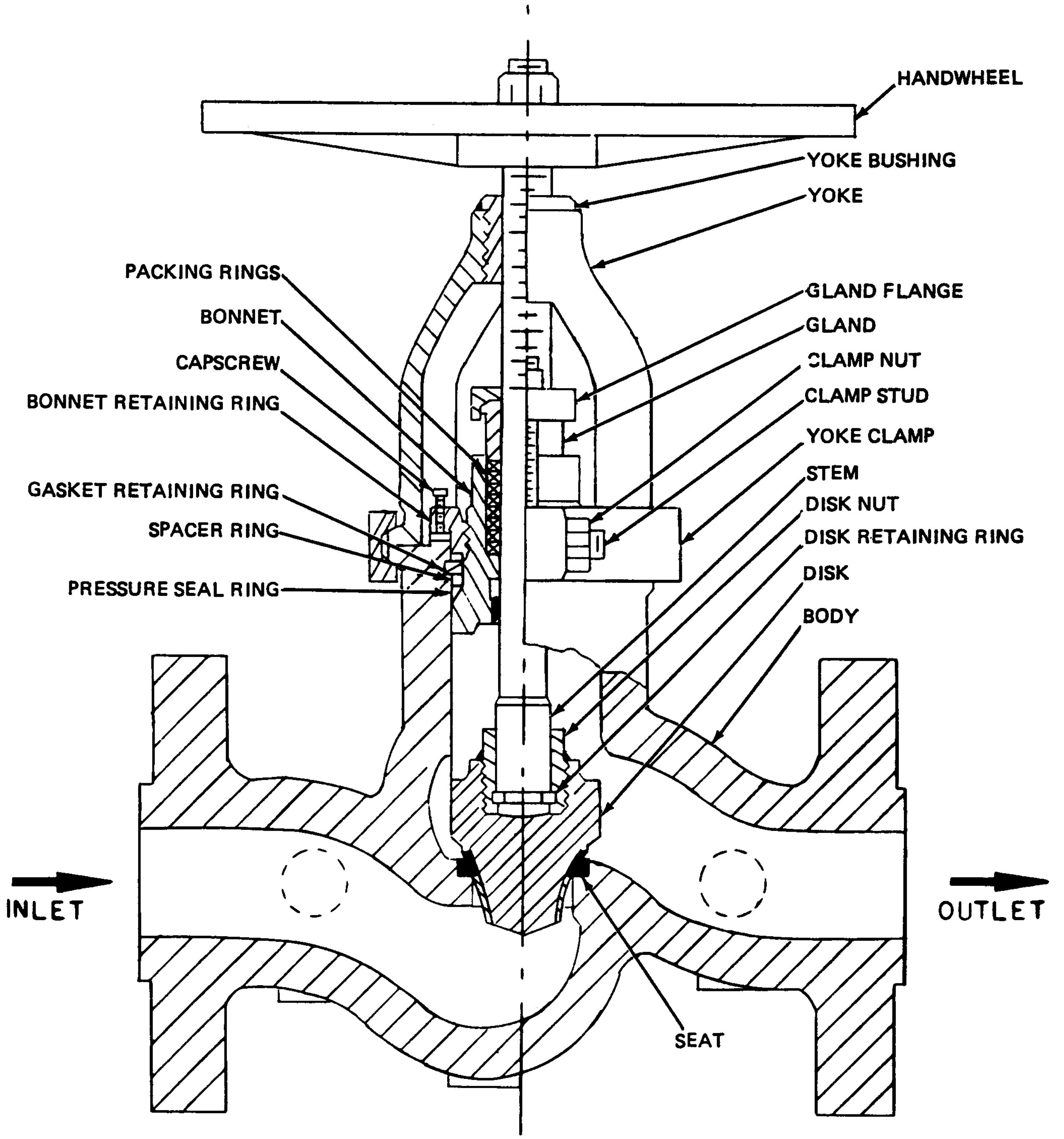


Figure 5-26. Pressure-Seal Needle Valve (Anchor) (Typical)

5-8.2 PRESSURE-SEAL NEEDLE VALVE CHARACTERISTICS (VELAN). The primary components and subassemblies of the Velan pressure-seal needle valve (figure 5-27) are similar to those of the manually operated stop valve described in paragraph 5-2.1.1, except for the yoke and bonnet assemblies. The yoke and bonnet assemblies are similar to those described in paragraph 5-2.1.2.1 and paragraph 5-2.1.2.2.

5-8.3 BOLTED-BONNET NEEDLE VALVE CHARACTERISTICS. The primary components and subassemblies of a typical bolted-bonnet needle valve (figure 5-28) are similar to those described in paragraph 5-2.1.1, except for the yoke and bonnet assembly. The yoke and bonnet assembly is similar to that described in paragraph 5-2.1.3.

5-9. ASTERN THROTTLE VALVES.

5-9.1 ASTERN THROTTLE VALVE CHARACTERISTICS (COX INSTRUMENTS). The primary components and subassemblies of the Cox astern throttle valve (figure 5-29) consist of a valve body, yoke assembly, pilot valve spindle (spindle) and disk assembly, and gear assembly.

5-9.1.1 Valve Body. The valve body is the main inline pressure vessel for the entire assembly. The body has an inlet, outlet, and a stellite-faced seat spider that is seal welded on the body. The seat spider serves as a guide bearing for the valve spindle.

5-9.1.2 Yoke Assembly. The yoke assembly provides the top closure for the body, and supports the gear assembly, leakoff bushing, and associated leakoff connections. The yoke assembly also serves as a guide for the spindle. A gasket forms a seal between the yoke and body to prevent a pressure leak. The leakoff bushing is pressed into the yoke and serves as a seal between the spindle and the yoke. This allows steam leakage to be piped to the steam drain system.

5-9.1.3 Pilot Valve Spindle and Disk Assembly. The pilot valve spindle (spindle) transmits vertical thrust produced by rotary movement of the gear assembly to the disk assembly. The upper end is threaded and passes through the gland leakoff bushing. The vertical movement of the spindle in the leakoff bushing results in a corresponding motion between the disk assembly and the stellited seat spider. A guide finger limits the rotation of the spindle, allowing the gear assembly movement to be transferred into vertical movement of the spindle. The disk assembly consists of a disk flange, fasteners, and disk. The disk flange and fasteners secure the disk to the lower end of the spindle. The disk is the precision-closing element of the valve and is automatically alined to the seat spider by the spindle.

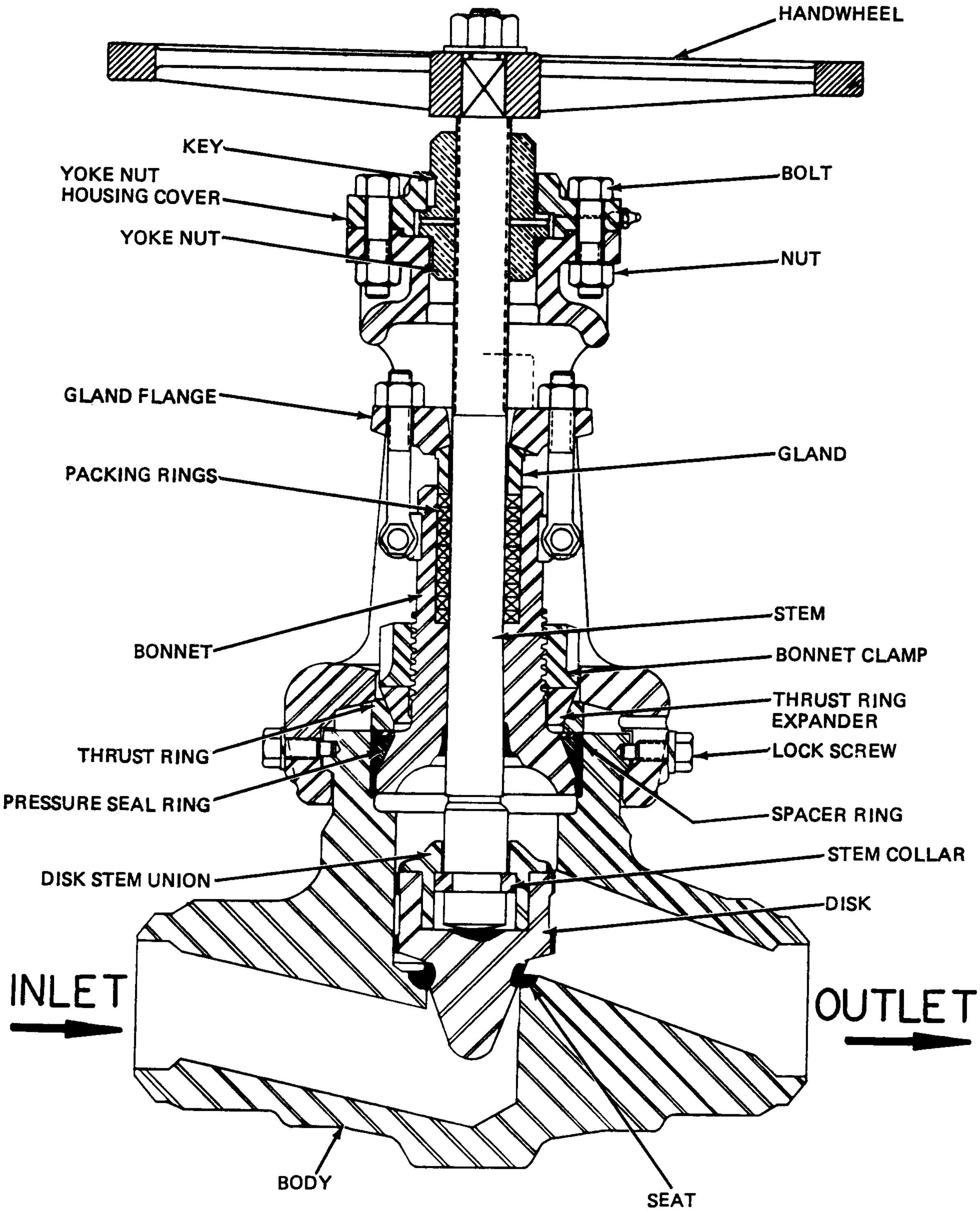


Figure 5-27. Pressure-Seal Needle Valve (Velan) (Typical)

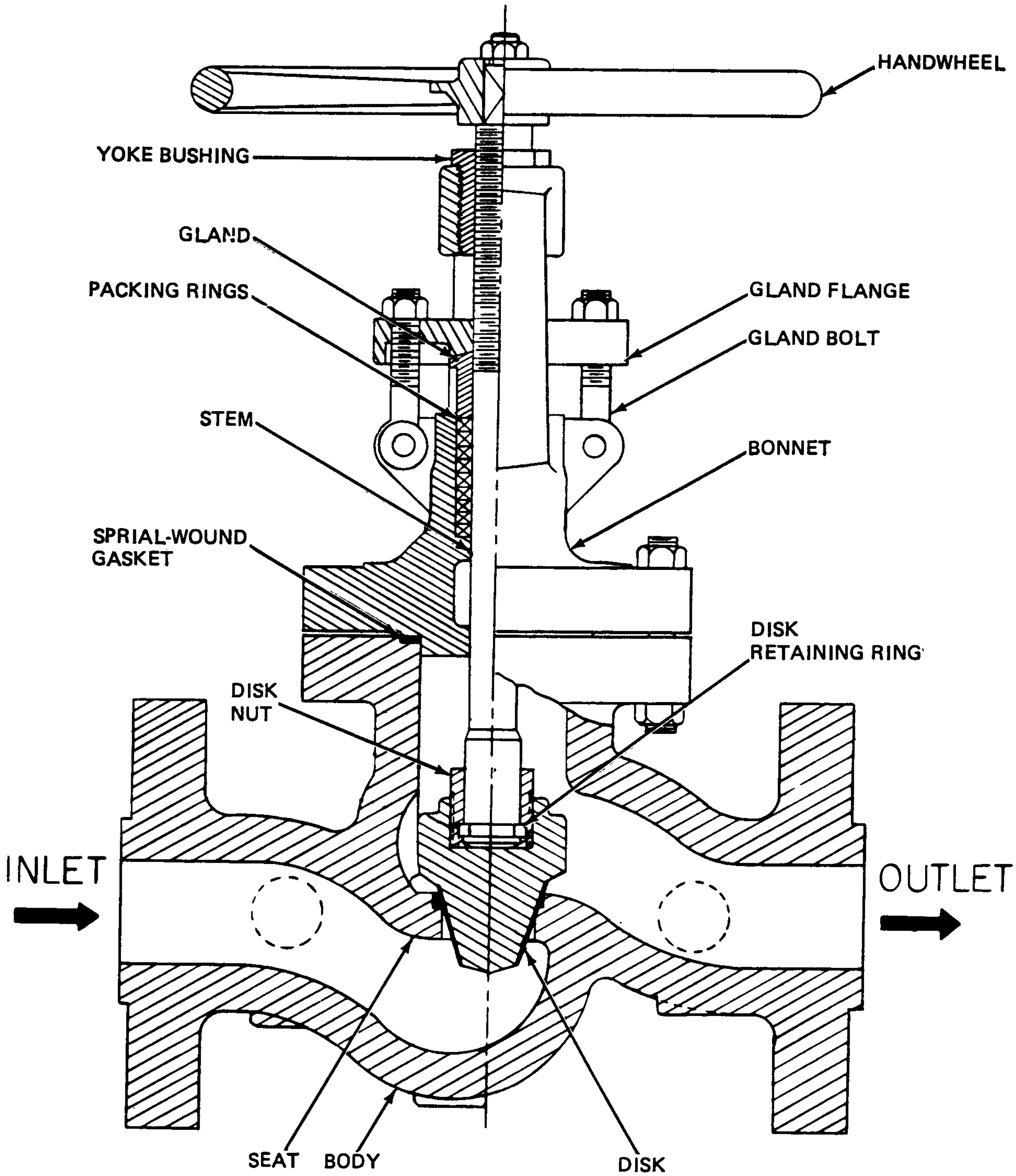


Figure 5-28. Bolted-Bonnet Needle Valve (Typical)

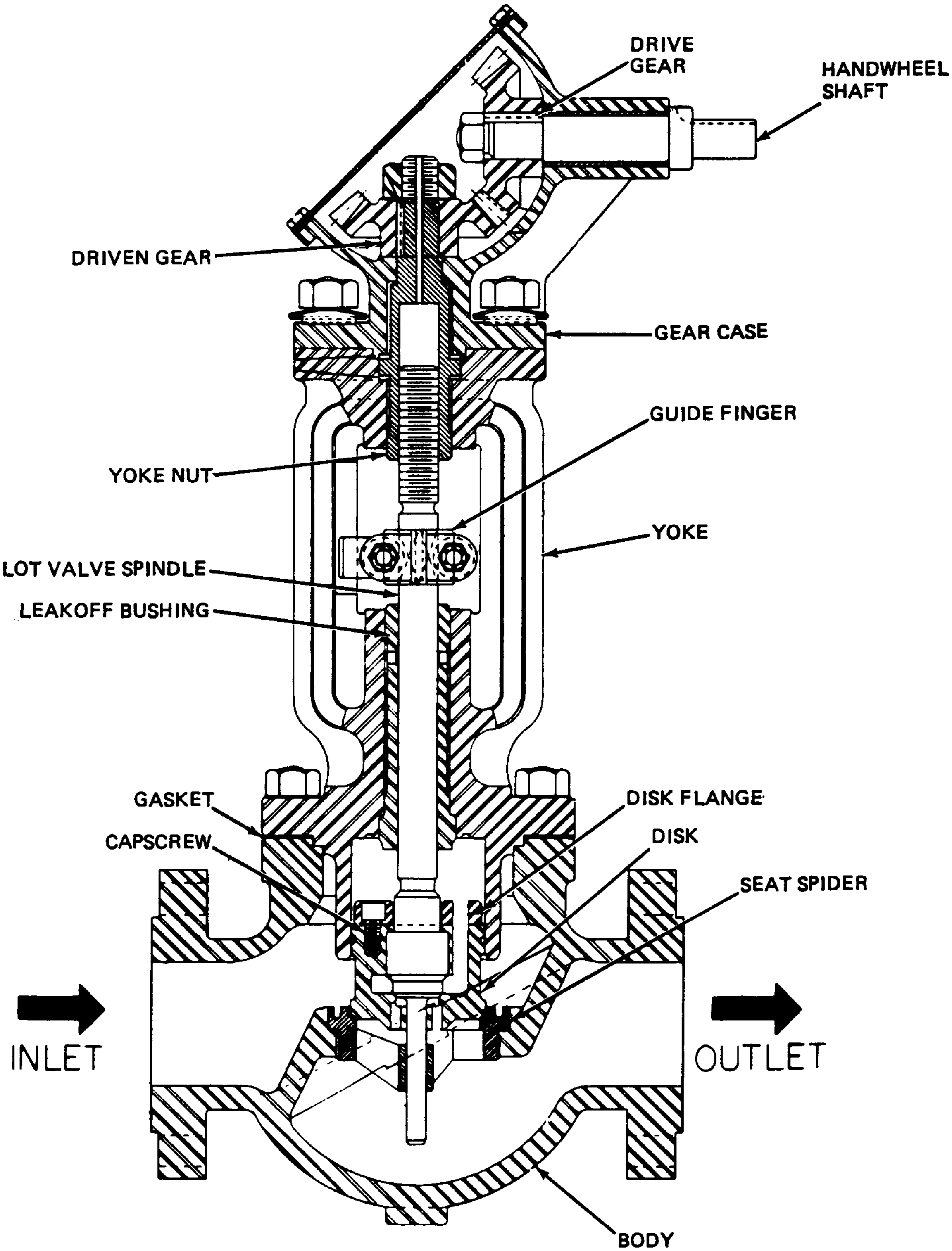


Figure 5-29. Astern Throttle Valve (Cox Instruments) (Typical)

5-9.1.4 Gear Assembly. The gear assembly is used to open and close the valve. It consists of a gear case, driven gear, yoke nut, drive gear, and handwheel shaft. The gear case is secured to the top of the yoke and supports the handwheel shaft which, through bevel gearing, rotates the yoke nut. The driven gear is fastened to the yoke nut and accepts the rotary motion of the drive gear. The drive gear is fastened to the handwheel shaft and meshes with the driven gear to open or close the valve.

5-9.2 ASTERN THROTTLE VALVE CHARACTERISTICS (GIMPEL). The Gimpel astern valve (figure 5-30) body is made of chrome molybdenum steel and has flanged inlet and outlet ends. The body is the main inline pressure vessel and serves as a mounting for the secondary internal astern valve assemblies. A yoke is fastened in the body by a split clamp ring and nuts and studs. The yoke houses a screw spindle, a yoke nut, ball bearings, a bevel gear, pinion and shaft, and nut. A cover is fastened to the yoke by screws. A hub bearing with bushings and thrust washer is fastened on the yoke by four capscrews. The body houses a pilot valve and stem, disk, leakoff bushing, disk nut, bonnet, lower and center seal rings, and a split ring. A bonnet flange is fastened to the bonnet by nuts and studs. A split coupling connects the pilot valve and stem to the screw spindle. A throttle screw is provided to regulate the differential pressure in the balance chamber of the disk.

5-10. PRESSURE-REDUCING VALVES, ACTUATORS, AND RELIEF VALVES.

5-10.1 INTERNAL PILOT-CONTROLLED PRESSURE-REDUCING VALVE CHARACTERISTICS (ATLAS). The primary components and subassemblies of the Atlas internal pilot-controlled pressure-reducing valve (figure 5-31) consist of a valve body, main valve spring assembly, adjusting spring assembly, pilot valve top assembly, piston and main valve assembly, and pilot supply line pipe and flange assembly.

5-10.1.1 Valve Body. The valve body is the main inline pressure vessel for the entire assembly. The valve body contains an inlet, outlet, and an integral chromium cobalt seat, and serves as a mounting surface for the secondary valve assemblies.

5-10.1.2 Main Valve Spring Assembly. The main valve spring assembly consists of a bottom flange that is the cover for the base of the body. The bottom flange houses the closing components of the main valve and is secured to the body by nuts and studs. A main valve spring closes the main valve when pressure is not applied to the top of the piston. A washer transmits tension from the main valve spring to the push rod. A push rod guide acts as a bushing to aline the push rod to the base of the main valve. A gasket forms a seal between the bottom flange and body.

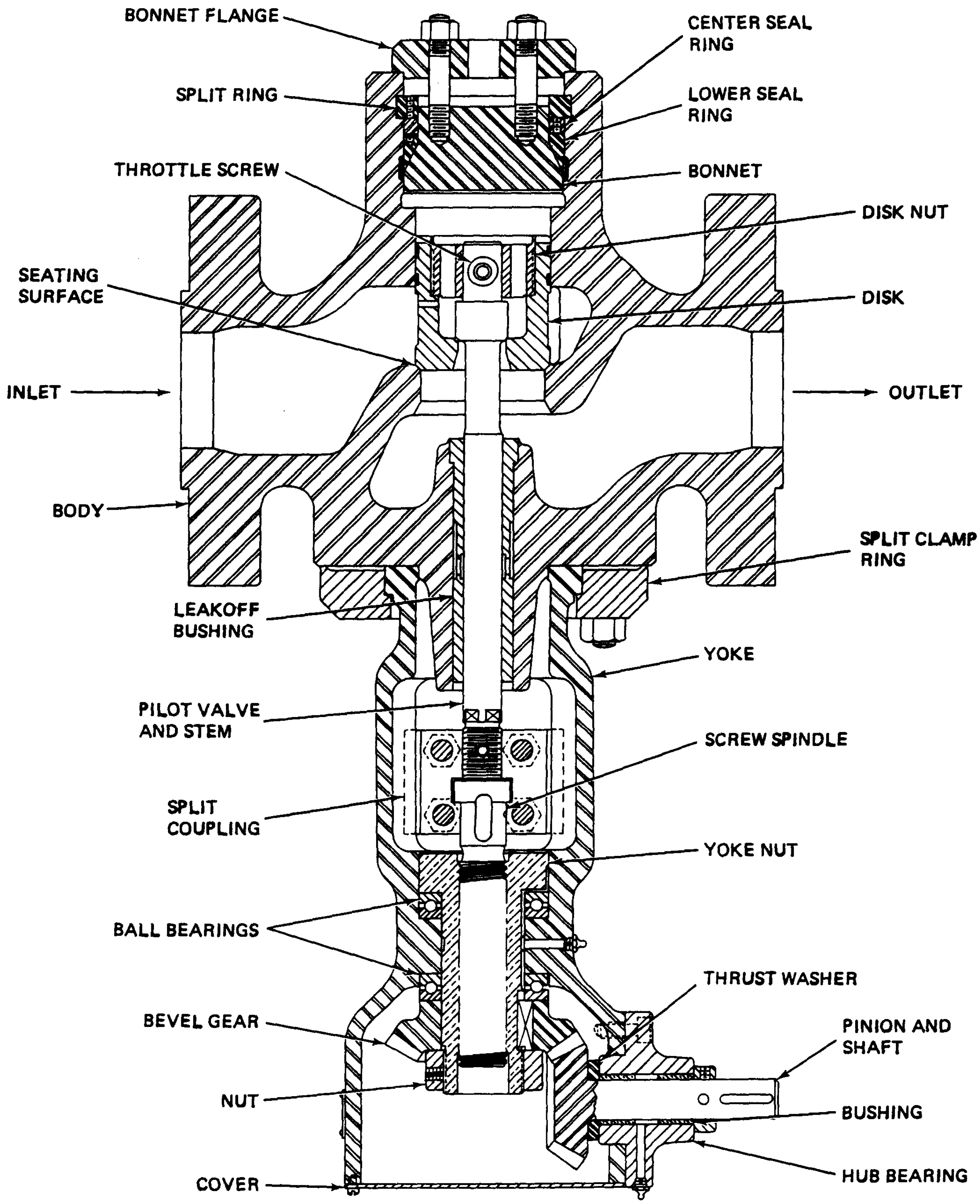


Figure 5-30. Astern Throttle Valve (Gimpel) (Typical)

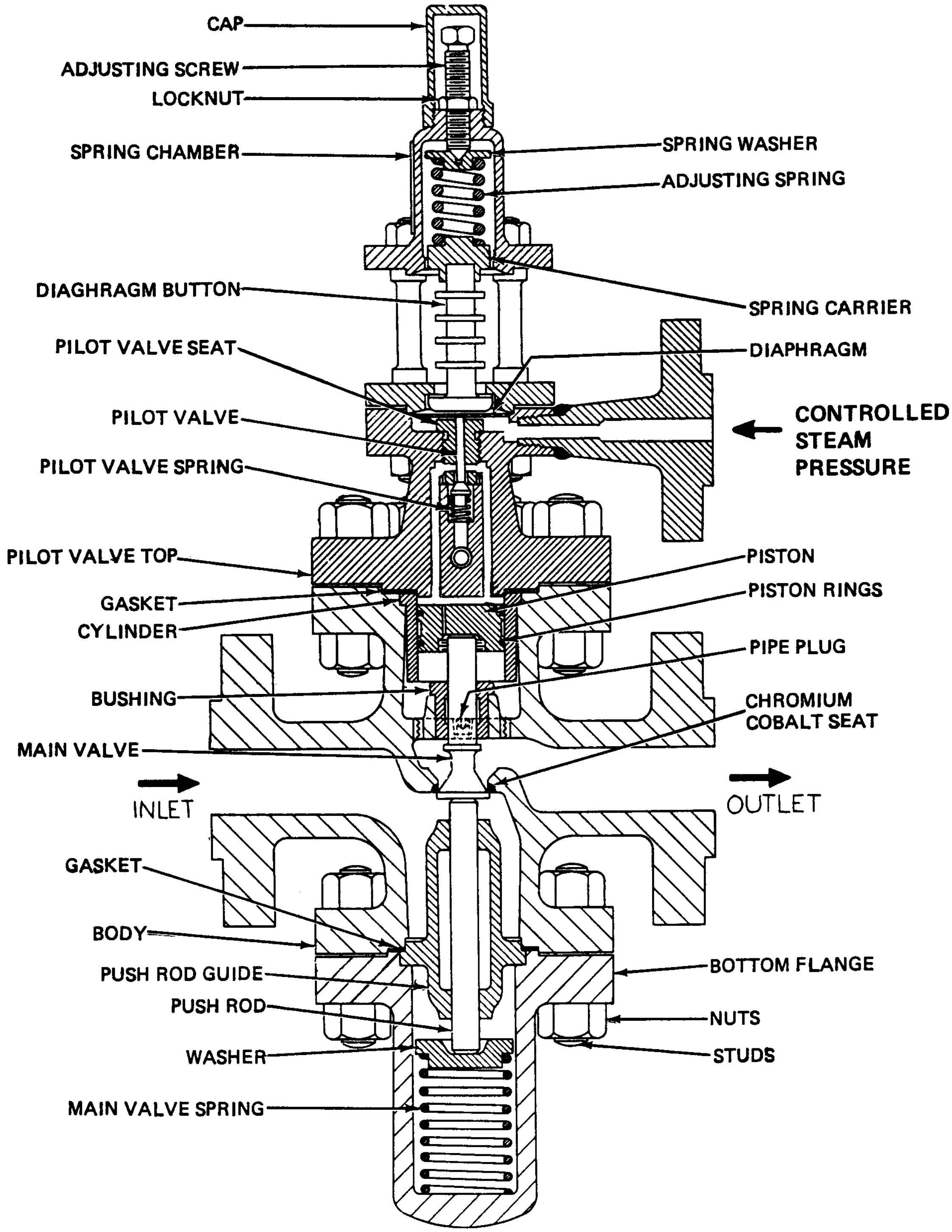


Figure 5-31. Internal Pilot-Controlled Pressure-Reducing Valve (Atlas) (Typical)

5-10.1.3 Adjusting Spring Assembly. The adjusting spring assembly is the cover for the pilot valve top and permits the opening of the pilot valve. A cap over the spring chamber protects the adjusting screw and locknut against any accidental change in valve setting. The adjusting screw is threaded into the spring chamber to adjust the outlet pressure of the valve. The locknut secures the adjusting screw at a set position. A spring washer transmits force from the adjusting screw to the adjusting spring, and centers the spring in the spring chamber. The adjusting spring, acting upon a steel diaphragm, opens the pilot valve when pressure is not applied to the bottom of the diaphragm. A spring carrier transmits tension from the adjusting spring to a diaphragm button to open the pilot valve. The pilot valve top flange holds the diaphragm in the pilot valve top. When pressure is applied beneath the diaphragm, the diaphragm is deflected upward against the adjusting spring tension, allowing the pilot valve to close. The diaphragm also serves as a seal between the pilot valve flange and the pilot valve top.

5-10.1.4 Pilot Valve Top Assembly. The pilot valve top assembly houses the pilot valve and covers the piston and piston rings. A pilot valve seat is the seating surface for the pilot valve, and has drilled passages which supply flow pressure to the piston. The pilot valve regulates the amount of flow to the top of the piston. The pilot valve spring provides the force to close the pilot valve when pressure is not exerted against the pilot valve stem by the diaphragm. A pilot valve top cap gasket forms a seal between the pilot valve top and body.

5-10-1.5 Piston and Main Valve Assembly. The piston and main valve assembly is positioned to close by the main valve spring and to open by flow pressure from the pilot valve. The piston changes flow pressure to vertical movement of the main valve. The piston chamber of the main valve assembly is a removable cylinder that guides the vertical movement of the piston. Piston rings form a seal between the piston and piston chamber. The main valve regulates the amount of flow through the chromium cobalt seat to the outlet. A bushing in the main valve assembly guides the main valve stem during its movement. The bushing is secured by a pipe plug.

5-10.1.6 Pilot Supply Line Pipe and Flange Assembly. The pilot supply line pipe and flange assembly consists of two flanges connected by a U-shaped pipe. Flanges are sealed to the main body flange and pilot valve top flange by gaskets, studs, and nuts. The pipe and flange assembly conducts high-pressure flow from the main body port to the pilot valve port.

5-10.2 INTERNAL PILOT-CONTROLLED PRESSURE-REDUCING VALVE CHARACTERISTICS (LESLIE 12595N AND LESLIE 12878N). The primary components and subassemblies of the Leslie internal pilot-controlled pressure-reducing valves (figure 5-32 and figure 5-33) are similar to those described in paragraph 5-10.1.

5-10.3 EXTERNAL CONTROL PILOT CHARACTERISTICS (LESLIE 15152N). The primary components and subassemblies of the Leslie 15152N external control pilot (control valve) (figure 5-34) consist of an upper diaphragm assembly, lever assembly, control valve assembly, cover and base assembly, and mounting plate. The cover and base assembly includes a cover and a base, and mounts the control valve assembly to the mounting plate. The mounting plate serves as the main foundation for the other components/ subassemblies.

5-10.3.1 Upper Diaphragm Assembly. The upper diaphragm assembly converts steam pressure from the reducing valve into upward or downward motion for the lever assembly. It consists of a yoke which is the foundation for mounting the components of the diaphragm assembly. A diaphragm cover is a sealed chamber which houses the diaphragm and protects the diaphragm from foreign matter. The diaphragm allows the control valve to close when pressure is applied above it. This forms a seal between the diaphragm and yoke. A diaphragm disk transmits pressure from the diaphragm to the stem to open or close the control valve. A disk screw transmits motion from the diaphragm disk to a lever. An adjusting spring opens the control valve when pressure is removed from the upper diaphragm. A bottom spring seat protects the thrust bearing from damage by the adjusting spring. The thrust bearing is the bearing surface between the adjusting spring and adjusting nut. A washer also protects the thrust bearing from damage by the adjusting nut. The adjusting nut is threaded to the adjusting sleeve to permit adjustment of operating pressure. The adjusting sleeve is a guide for the stem, and attaches the lower portion of the yoke to the body.

5-10.3.2 Lever Assembly. The lever assembly converts direct-acting motion from the upper diaphragm to reverse-acting upward or downward motion for the control valve. It consists of a lever spring cap that retains the lever spring against the lever. The lever spring acts against the lever to hold the nozzle disk pin assembly against the nozzle disk. The nozzle disk pin transmits up and down motion to the nozzle disk diaphragm.

5-10.3.3 Control Valve Assembly. The control valve assembly converts supply air pressure to operating air pressure for a diaphragm-type control valve actuator. It consists of a diaphragm plate that covers the body and holds the nozzle disk diaphragm in position. The nozzle disk diaphragm transmits linear motion from the nozzle disk pin to the nozzle. A flange ring supports the nozzle stop, which limits the movement of the nozzle diaphragm. The nozzle allows air to flow to the bottom of the nozzle disk diaphragm. A pilot valve is supported and guided in the body by a bottom plug and pilot valve seat. The pilot valve is opened by the nozzle and closed by the pilot valve spring to allow continuous operation of a diaphragm-type control valve actuator.

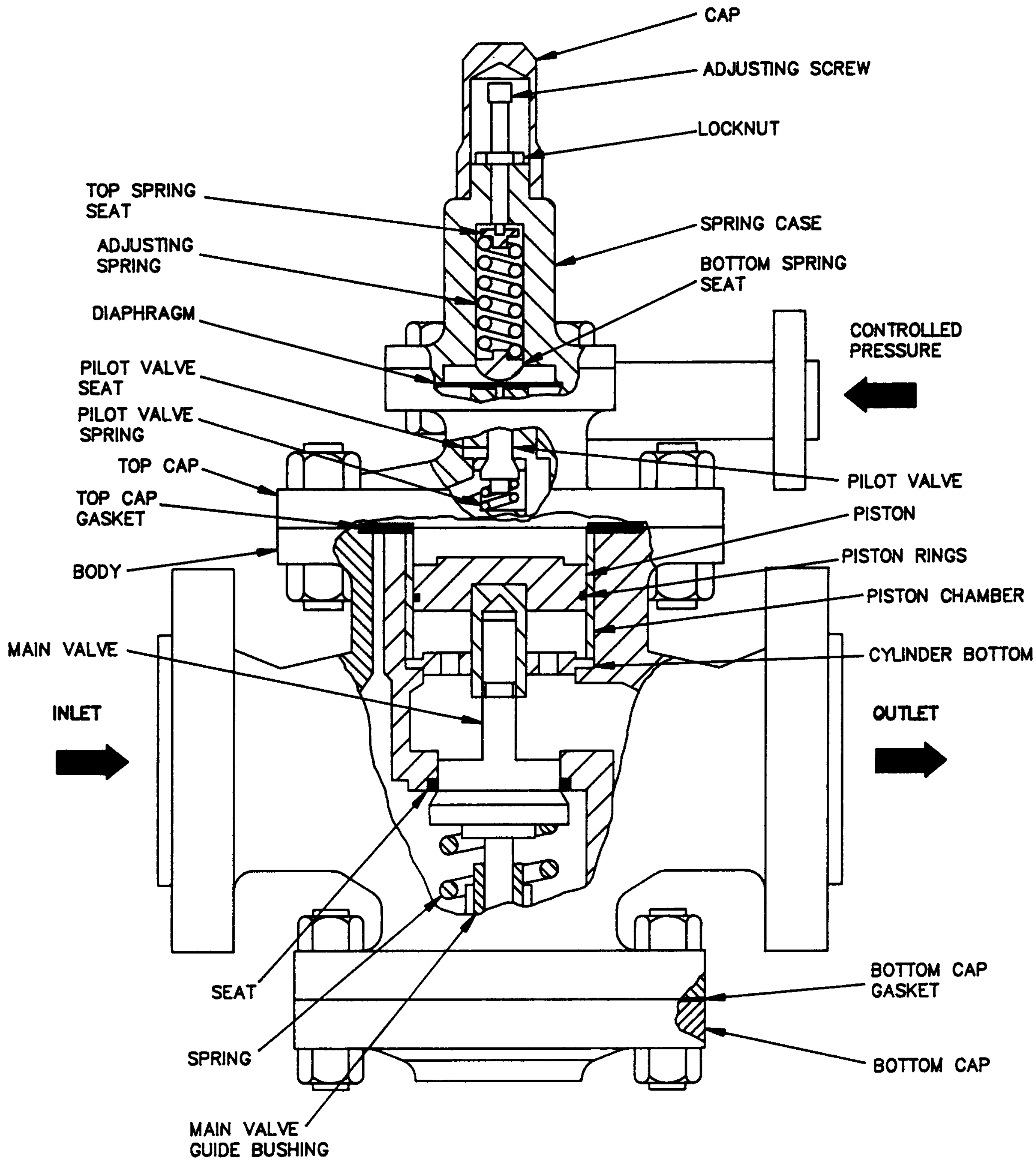


Figure 5-32. Internal Pilot-Controlled Pressure-Reducing Valve (Leslie 12595N)

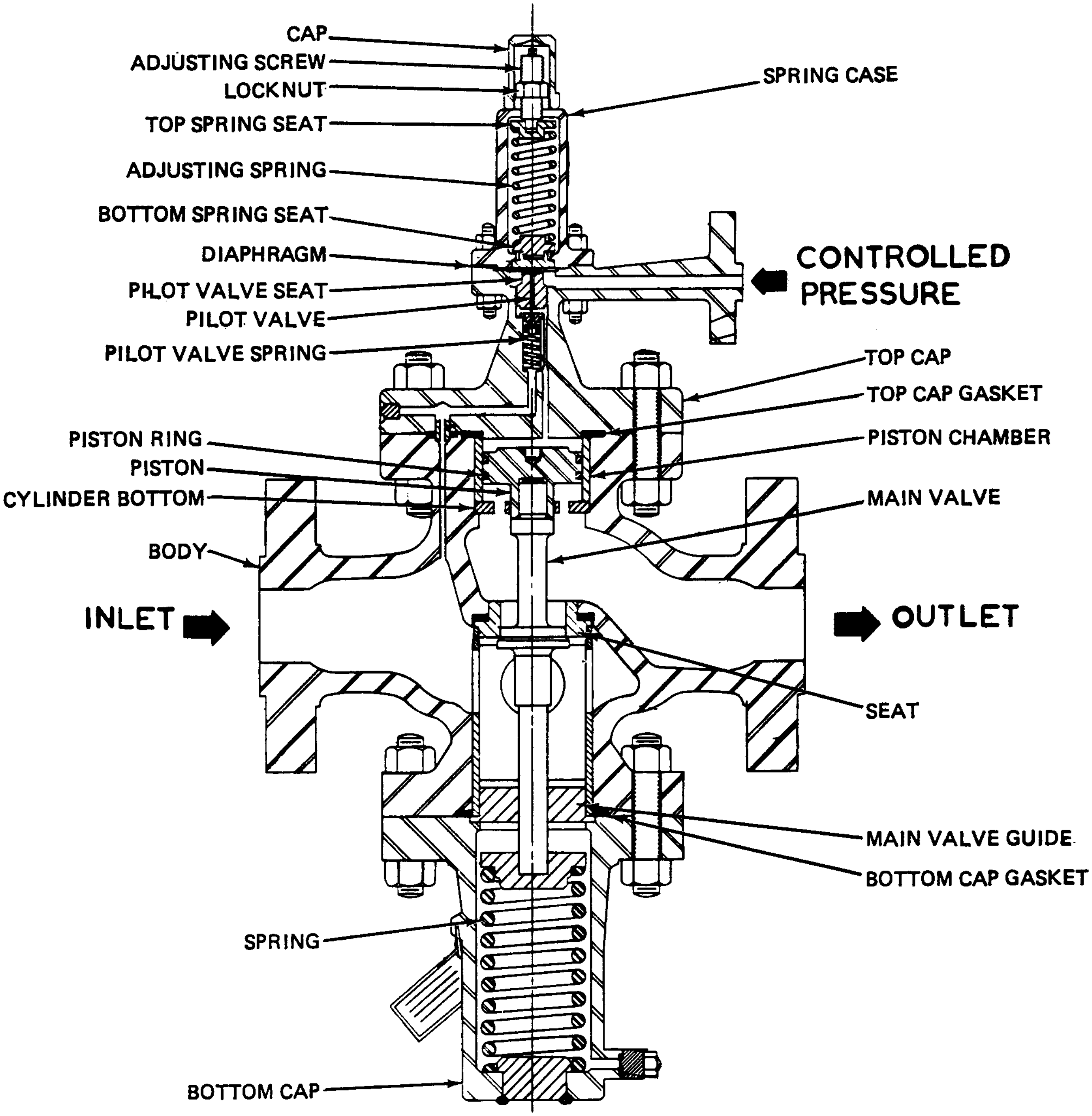


Figure 5-33. Internal Pilot-Controlled Pressure-Reducing Valve (Leslie 12878N)

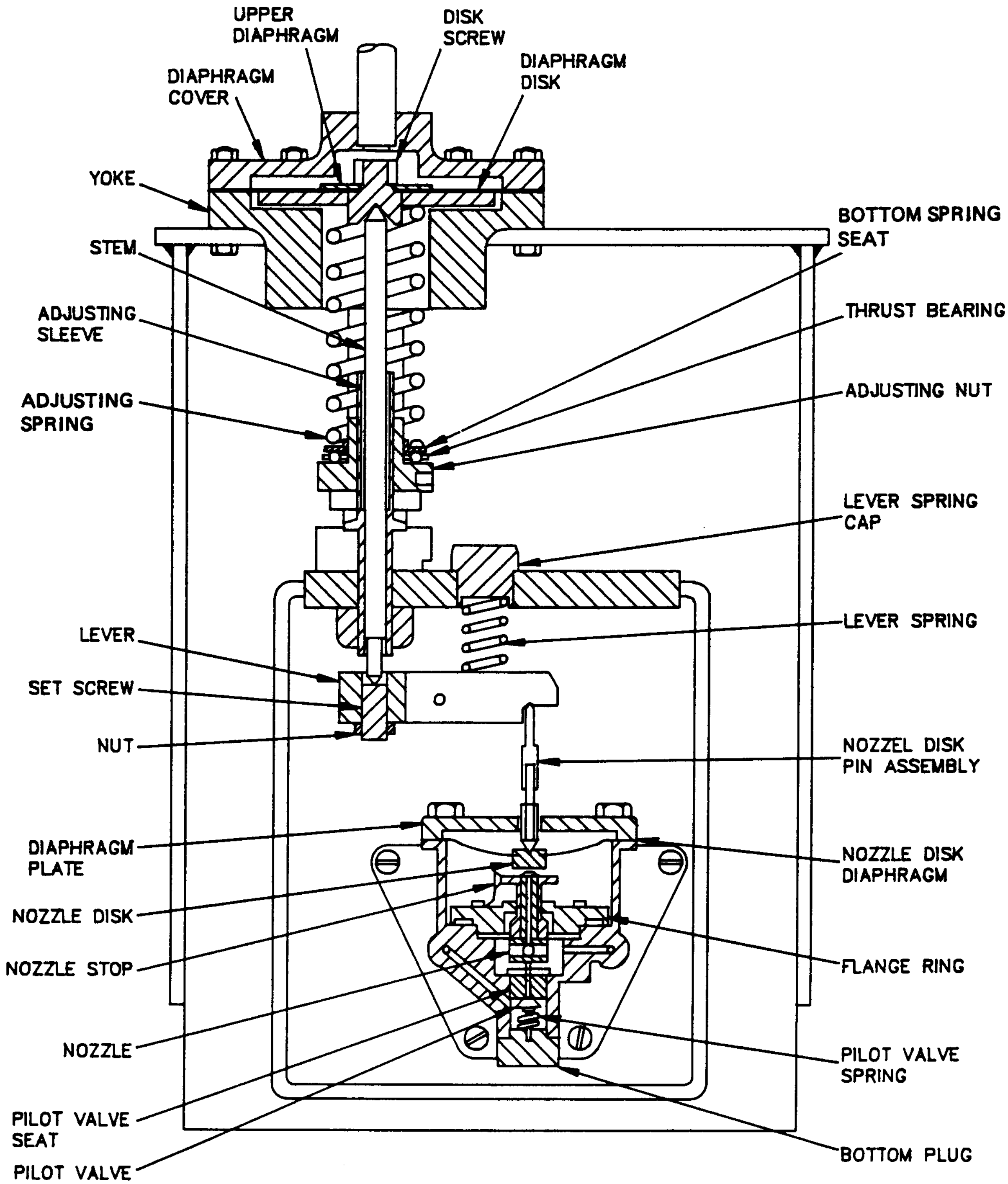


Figure 5-34. External Control Pilot (Leslie 15152N)

5-10.4 DIAPHRAGM-TYPE CONTROL VALVE ACTUATOR CHARACTERISTICS (LESLIE 18356N). The Leslie 18356N diaphragm-type control valve actuator (actuator) may be employed on several Leslie control valve bodies. The actuator (figure 5-35) is attached to the control valve with capscrews, and the stems of the actuator and control valve are coupled. A diaphragm case houses the diaphragm, and is ported to accept an operating air pressure signal. The diaphragm and actuator stem are held together by a diaphragm nut and stem seal collar through the lower diaphragm case and yoke. The stem seal prevents air leakage between the yoke, actuator stem, and lower diaphragm case. The actuator stem transmits motion of the diaphragm to open the control valve. A spring, top spring seat, and spring adjuster in the yoke housing, apply downward force on the actuator stem to close the control valve. A rod attached to the yoke can be positioned against the spring adjuster to limit travel of the actuator spring and stem. Rod positioning is used if the diaphragm requires replacing without losing the position of the stem through the diaphragm case.

5-10.5 DIAPHRAGM-TYPE CONTROL VALVE ACTUATOR CHARACTERISTICS (LESLIE 21509N). The Leslie 21509N diaphragm-type control valve actuator (figure 5-36) is similar to that described in paragraph 5-10.4, except it may be fitted with a handwheel for manualoperation.

5-10.6 DIAPHRAGM-ACTUATED PRESSURE-REDUCING VALVE CHARACTERISTICS (LESLIE 15748N). The primary components and subassemblies of the Leslie 15748N diaphragm-actuated pressure-reducing valve (figure 5-37) consist of a valve body, bonnet assembly, and plug valve.

5-10.6.1 Valve Body. The valve body is the main inline pressure vessel for the entire assembly. The body has a flanged inlet and outlet and contains a bonnet gasket that forms a seal between the body and bonnet. The seat ring is a removable stellite seat held in the body by a seat retaining guide which also guides the plug valve to the seat.

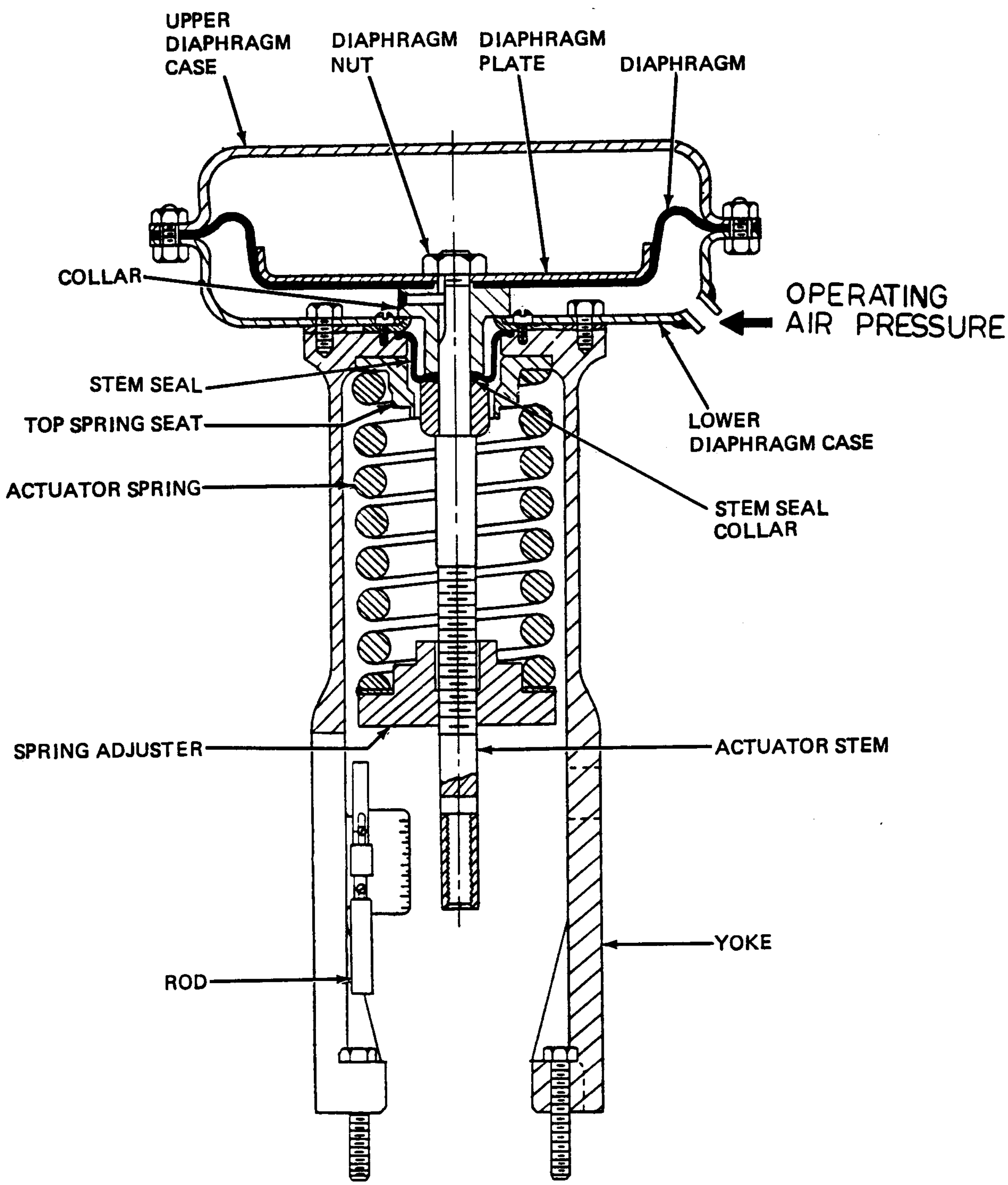


Figure 5-35. Diaphragm-Type Control Valve Actuator (Leslie 18356N)

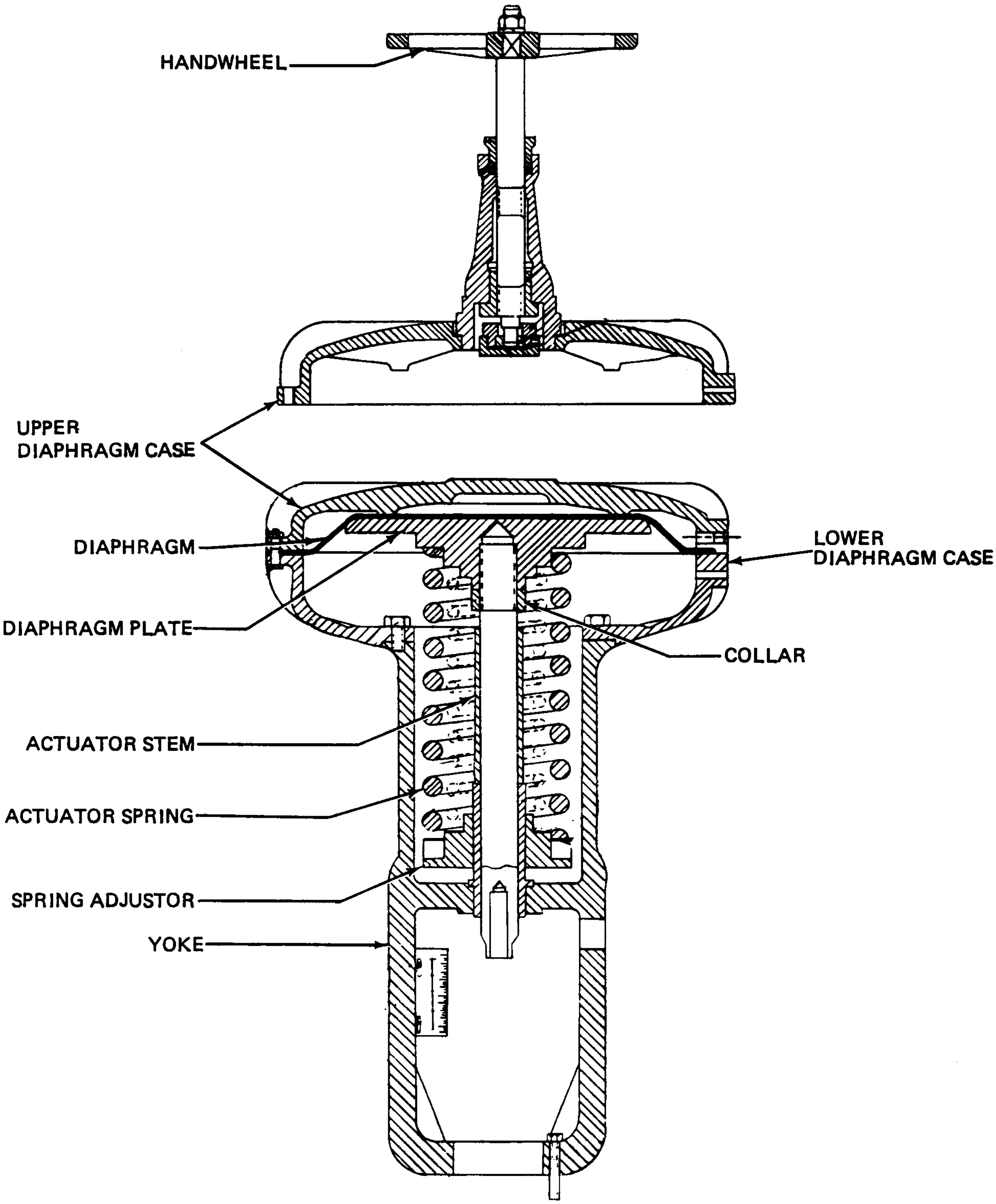


Figure 5-36. Diaphragm-Type Control Valve Actuator (Leslie 21509N)

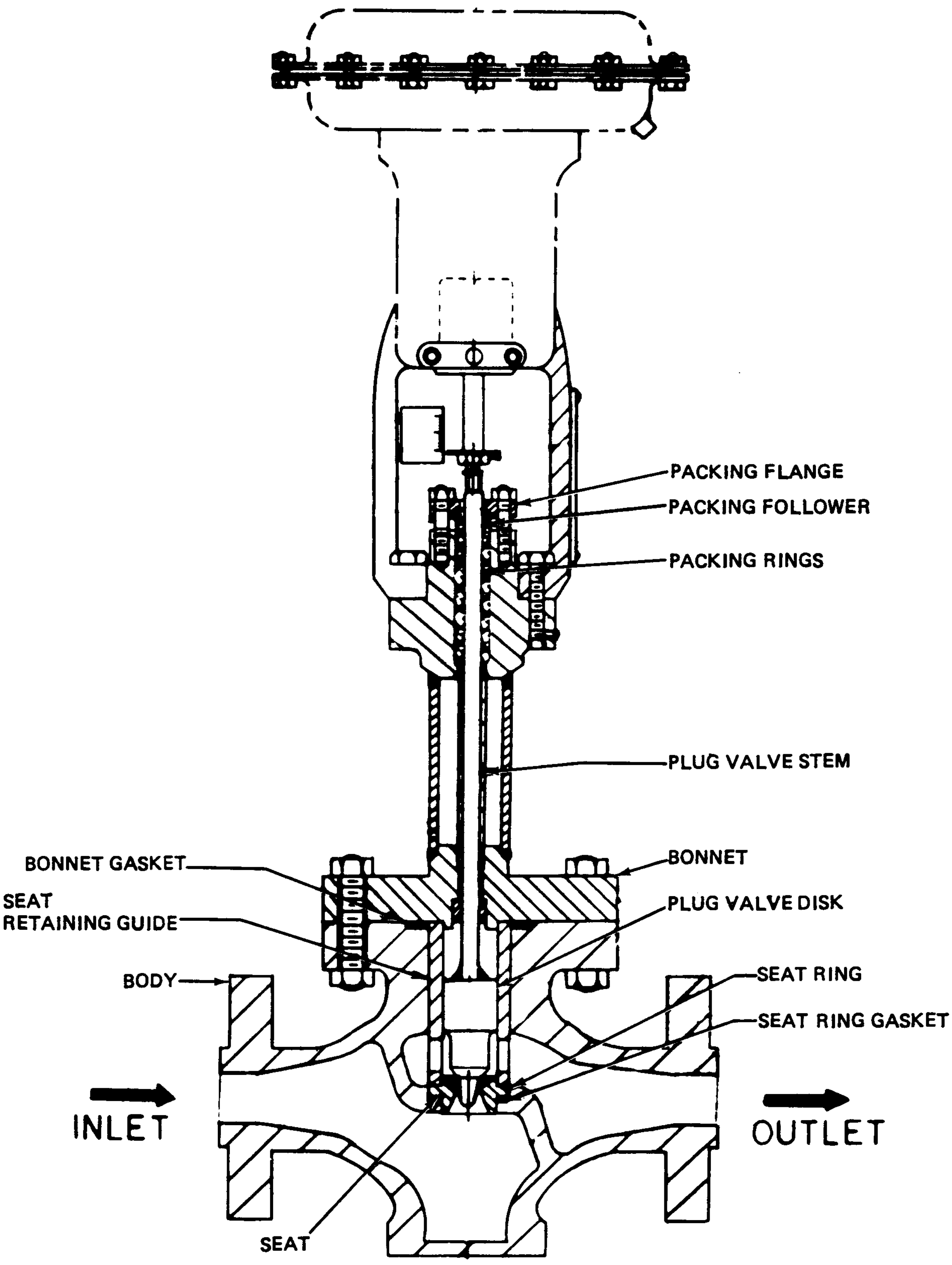


Figure 5-37. Diaphragm-Actuated Pressure-Reducing Valve (Leslie 15748N)

5-10-6.2 Bonnet Assembly. The bonnet assembly provides a mounting surface for the diaphragm control valve actuator, housing for the packing rings, and a guide for the plug valve. Packing rings form a seal around the plug valve stem to prevent any pressure leaks. A packing follower and packing flange provide for even compression of the packing rings.

5-10.6.3 Plug Valve. The plug valve is a threaded stem welded to the plug valve disk, which transmits thrust from an actuator stem to the valve to regulate flow.

5-10.7 DIAPHRAGM-ACTUATED PRESSURE-REDUCING VALVE CHARACTERISTICS (LESLIE 22388N). The primary components and subassemblies of the Leslie 22388N diaphragm-actuated pressure-reducing valve (figure 5-38) are similar to those described in paragraph 5-10.6.

5-10.8 RELIEF VALVE CHARACTERISTICS. The primary components and subassemblies of a typical relief valve (figure 5-39) consist of a valve body, disk holder assembly, and spring case assembly.

5-10.8.1 Valve Body. The valve body is the main in-line pressure vessel for the entire assembly, and has a flanged inlet and outlet. A nozzle is threaded into the body to form the inlet while the valve chamber end has a cone-shaped stellite seat. The cone shape stabilizes the disk when closing against the seat, and prevents chattering. A warn ring threads into the seat end of the nozzle and is adjusted to permit a sharp opening action. A warn ring screw is inserted through the body to prevent the warn ring from rotating after the valve has been adjusted.

5-10.8.2 Disk Holder Assembly. The disk holder assembly provides for the seating and unseating of the disk on the nozzle seat. It houses a ball, disk, disk retaining ring, and guide. The ball allows the disk to move in relation to the nozzle seat for a rapid, tight seating action. The disk is the closing element when mated to the nozzle seat, and is retained in the disk holder by a disk retaining ring. The guide alines the disk holder to the nozzle seat.

5-10-8.3 Spring Case Assembly. The spring case assembly houses the components which adjust the opening and closing setting and testing of the valve. A lever is used to raise the lifting disk off the nozzle seat to manually test the valve, and is fastened to the cap by a lever pin. The lifting disk applies pressure against a castle nut to lift the stem and open the valve. The stem keeps the valve closed, under spring tension, until the inlet pressure overcomes the spring setting. A compression screw adjusts the setting point of the valve, and is secured in place by a locknut. Two spring washers hold the spring in place and guide the stem.

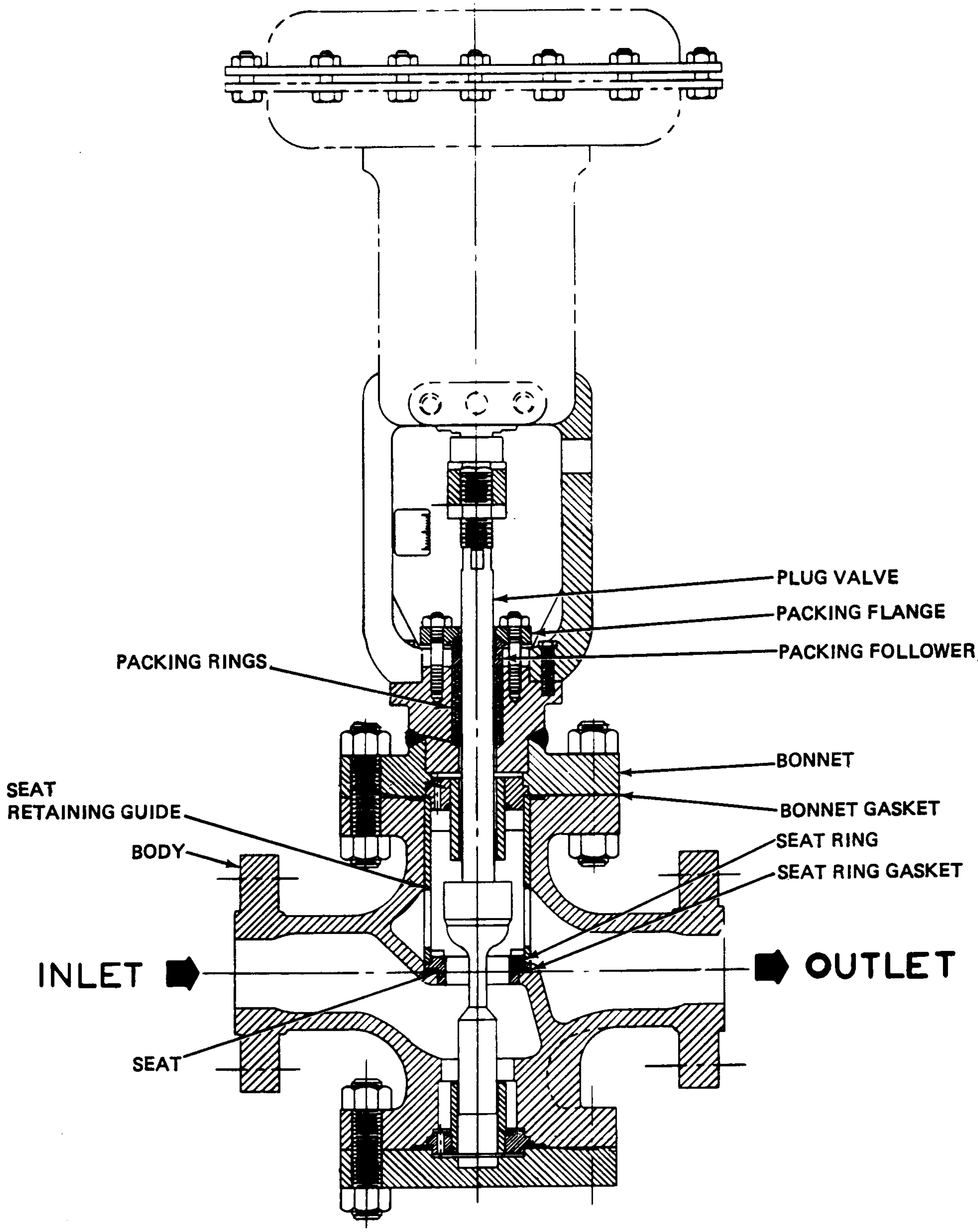


Figure 5-38. Diaphragm-Actuated Pressure-Reducing Valve (Leslie 22388N)

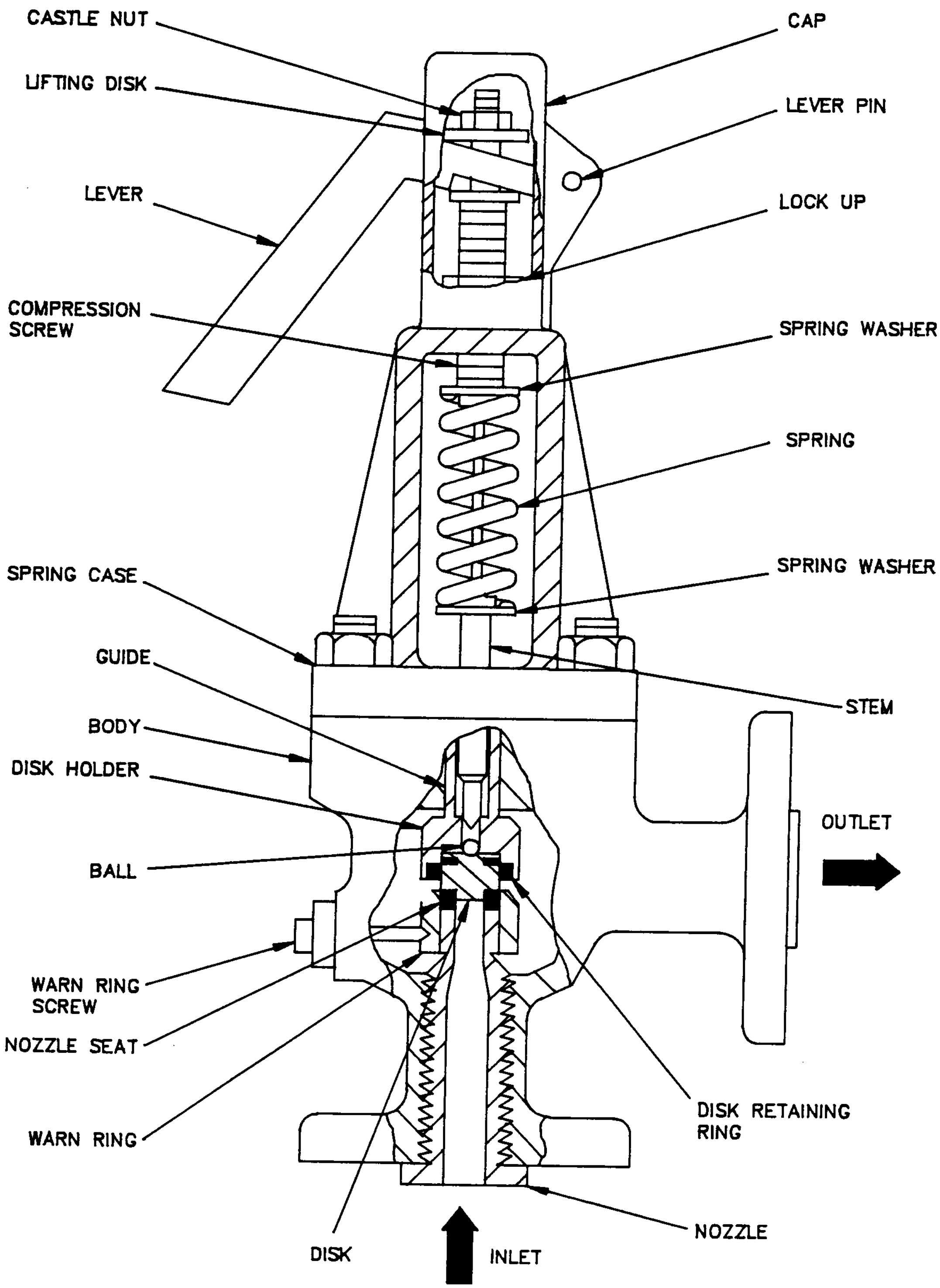


Figure 5-39. Relief Valve (Typical)

5-11. STEAM TRAPS AND DRAIN ORIFICES.

5-11.1 THERMOSTATIC STEAM TRAP CHARACTERISTICS. The primary components of a thermostatic steam trap (figure 5-40) consist of a body and bellows assembly.

5-11.1.1 Body. The body is the main inline pressure vessel and contains an inlet, outlet, and an integral seat. A cap with external threads forms the top closure of the body and allows access to the internal components.

5-11.1.2 Bellows Assembly. The bellows assembly is a sealed, flexible metal cylinder that contains a small amount of volatile liquid and is shield protected from erosion. The contracting and expanding effect of the bellows raises or lowers the disk from the seat to allow flow.

5-11.2 BIMETALLIC STEAM TRAP CHARACTERISTICS. The primary components of a bimetallic steam trap (figure 5-41) consist of a body assembly and a stem and disk assembly.

5-11.2.1 Body Assembly. The body is the main inline pressure vessel for the assembly and contains an inlet, outlet, and an integral seat. A cover forms the top closure of the body and allows access to the internal components. A spiral-wound gasket forms a seal between the body and cover to prevent a pressure leak. A strainer on the inlet side of the valve body prevents particles of rust and scale from entering the valve mechanism.

5-11.2.2 Stem and Disk Assembly. The stem and disk assembly is the opening and closing element of the steam trap. A bimetallic element (two layers of different types of metals, one of which expands more than the other when heated) raises the disk and closes the trap. When the steam trap cools and the metals contract, the disk lowers, opening the trap to allow flow. A rocker arm alines the disk to the seat.

5-11.3 THERMODYNAMIC STEAM TRAP CHARACTERISTICS. The primary components of a thermodynamic steam trap (figure 5-42) consist of a body and cap and a disk.

5-11.3.1 Body and Cap. The body is the main inline pressure vessel and contains inlet and outlet ports and integral seating surfaces. A cap with internal threads forms the top closure of the body and allows access to the disk. The body is also designed with three balanced outlet passages to assure parallel lift of the disk.

5-11.3.2 Disk. The disk is made from hardened steel and is the only moving part of the steam trap. It lays flat on top of the seating surfaces.

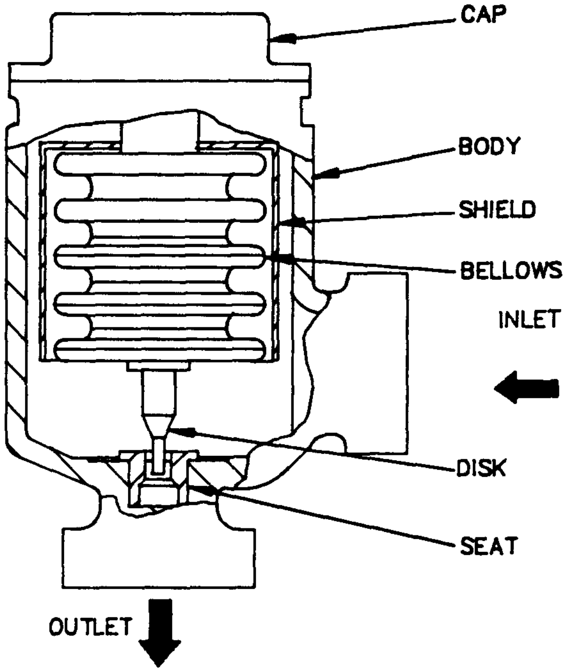


Figure 5-40. Thermostatic Steam Trap (Typical)

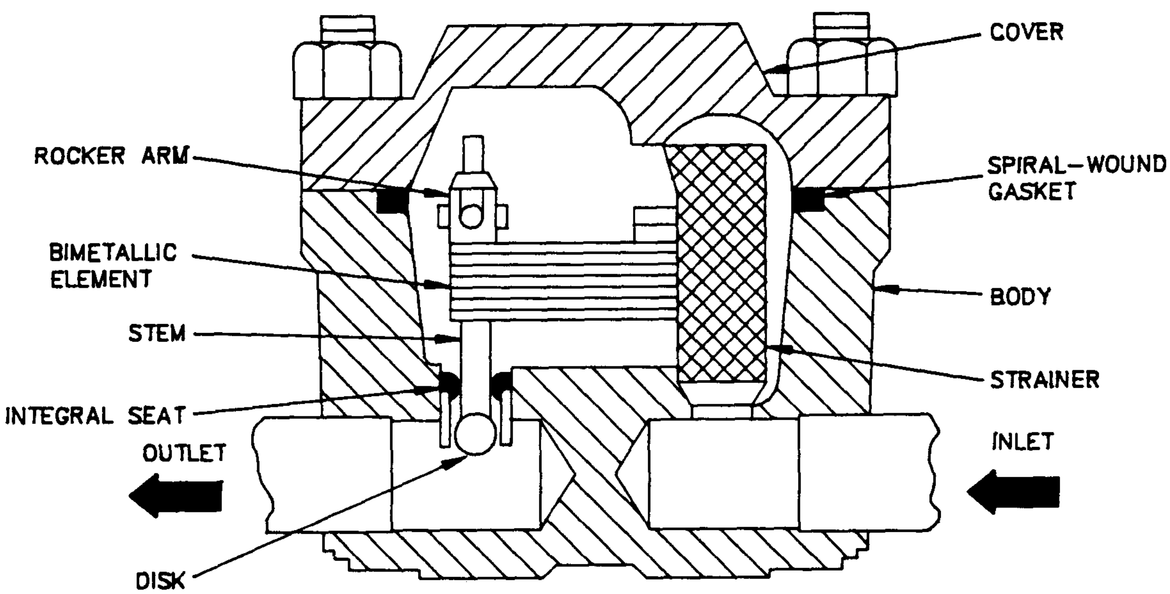


Figure 5-41. Bimetallic Steam Trap (Typical)

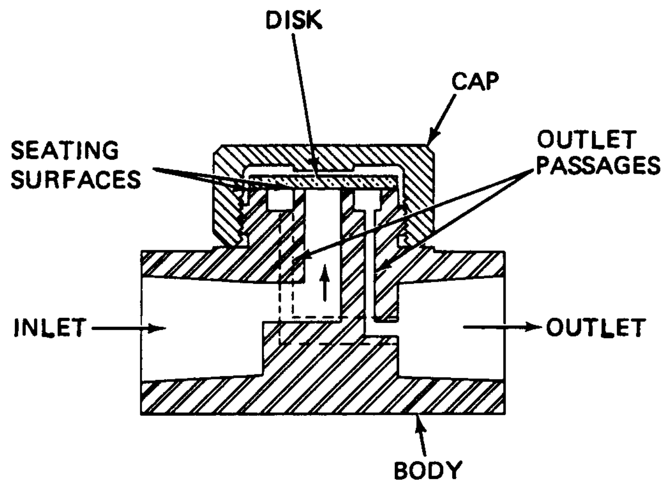


Figure 5-42. Thermodynamic Steam Trap (Typical)

5-11.4 IMPULSE STEAM TRAP CHARACTERISTICS. The primary components of the impulse steam trap (figure 5-43) consist of a body, strainer, and control cylinder. The operation of the trap is not affected by the pitch or roll of the ship. The trap is used in pressures up to 2500 psi and temperatures of 1050°F (566°C).

5-11.4.1 Body. The body is manufactured from chromium molybdenum and is either socket welded or flanged. The body has a valve seat orifice and disk attached. A circular baffle surrounds the disk.

5-11.4.2 Strainer. A fine mesh strainer is installed in the inlet of the body. It catches any foreign material that might be in the inlet steam.

5-11.4.3 Control Cylinder. A control cylinder is installed in the top of the body. The cylinder portion fits over the top of the disk. The control cylinder is held in the cap nut by a locknut and washer.

5-11.5 DRAIN ORIFICE CHARACTERISTICS. The primary components of a drain orifice (figure 5-44) consist of an orifice plate, strainer, and gasket.

5-11.5.1 Orifice Plate. The orifice plate has a small hole drilled in the center to permit a restricted yet continuous flow. The size of the orifice is determined by the operating pressure of the system in which it is being used.

5-11.5.2 Strainer. The strainer prevents rust and scale from plugging the orifice.

5-11.5.3 Gasket. The gasket forms a seal between the orifice plate and the piping.

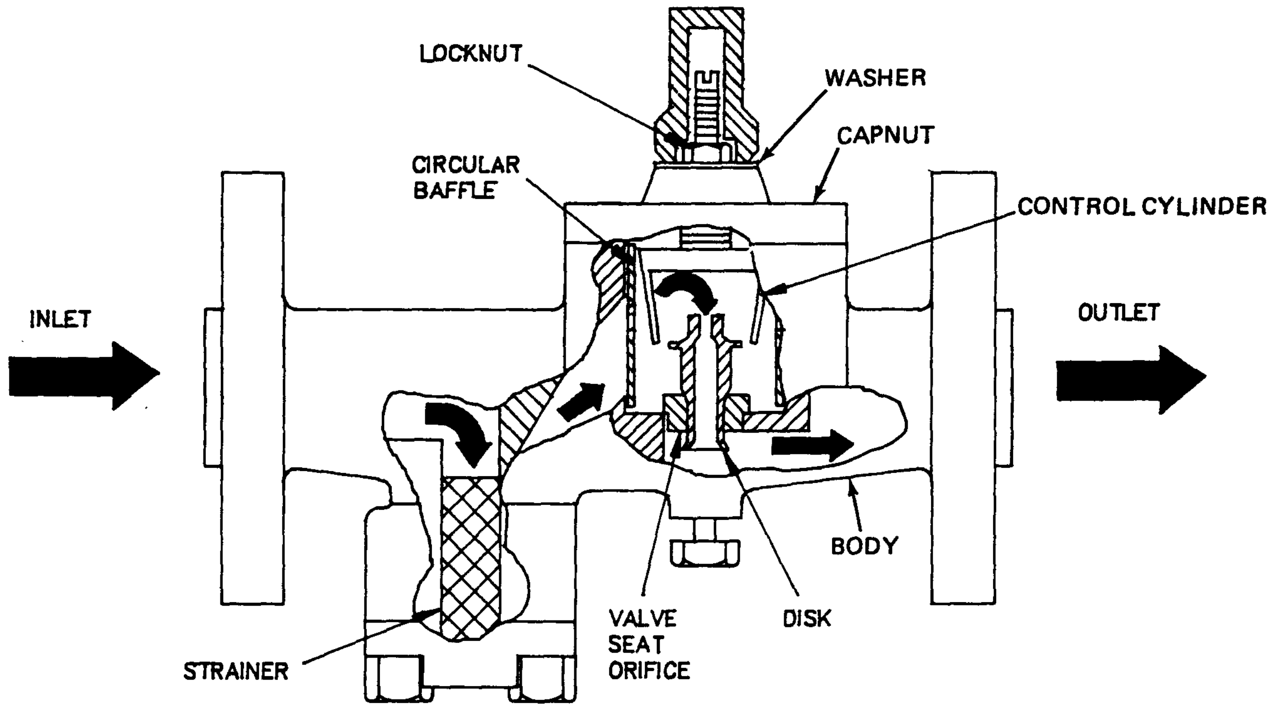


Figure 5-43. Impulse Steam Trap (Typical)

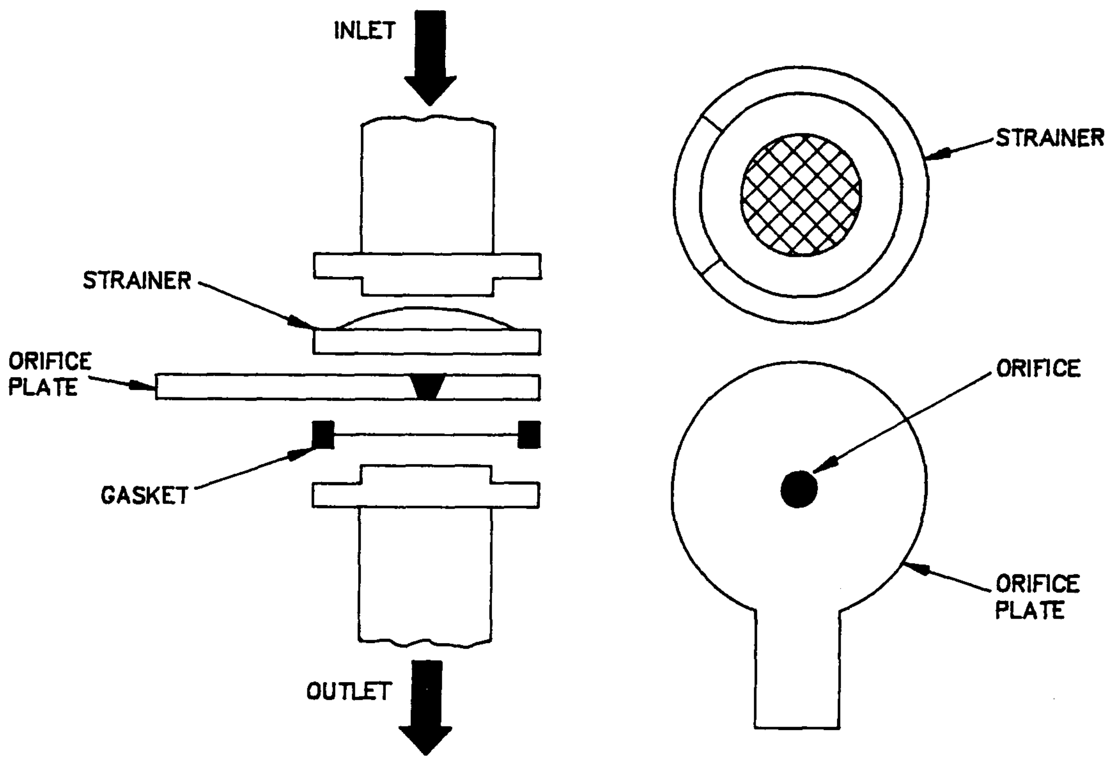


Figure 5-44. Drain Orifice (Typical)

CHAPTER 6

GENERAL MAINTENANCE, REPAIR, AND OVERHAUL

6-1. INTRODUCTION.

6-1.1 SCOPE. This chapter contains general information to assist personnel in identifying, troubleshooting, isolating, removing, and reinstalling non-nuclear valves, traps, and orifices used in steam propulsion systems. It describes the levels of essentiality and controlled material requirements for level I valves, and provides information about packing; valve seat and disk inspection and repair; steam leakage, inspection; welding; external corrosion control; and insulation. Technical manual numbers and titles for Naval Ships' Technical Manual (NSTM) chapters and other referenced publications are provided in table 2-2. Specific repair procedures are provided for each valve, trap, and orifice in applicable chapters of volumes II through XIV.

6-1.2 SAFETY REQUIREMENTS. Prior to performing any corrective maintenance on valves, personnel shall review and become thoroughly familiar with the Safety Summary provided in chapter 1. Specific procedures, warnings, and cautions provided in this chapter and in referenced publications shall be read in full before any corrective maintenance is attempted.

6-1.3 VALVE IDENTIFICATION AND MARKINGS. Valves are identified by means of nameplates or body markings.

6-1.3.1 Nameplates. A typical nameplate (figure 6-1) is attached to the valve and contains valve size, operating pressure, operating temperature, hydrostatic test pressure, body and stem material, manufacturer's drawing number, and military specification. On level I valves, Material Identification and Control (MIC) numbers are stamped on parts that must meet controlled material requirements when replaced. The MIC numbers are required on all parts that form the pressure boundary of a completed level I-designated assembly, unless Naval Sea Systems Command (NAVSEA) has approved an alternate marking system.

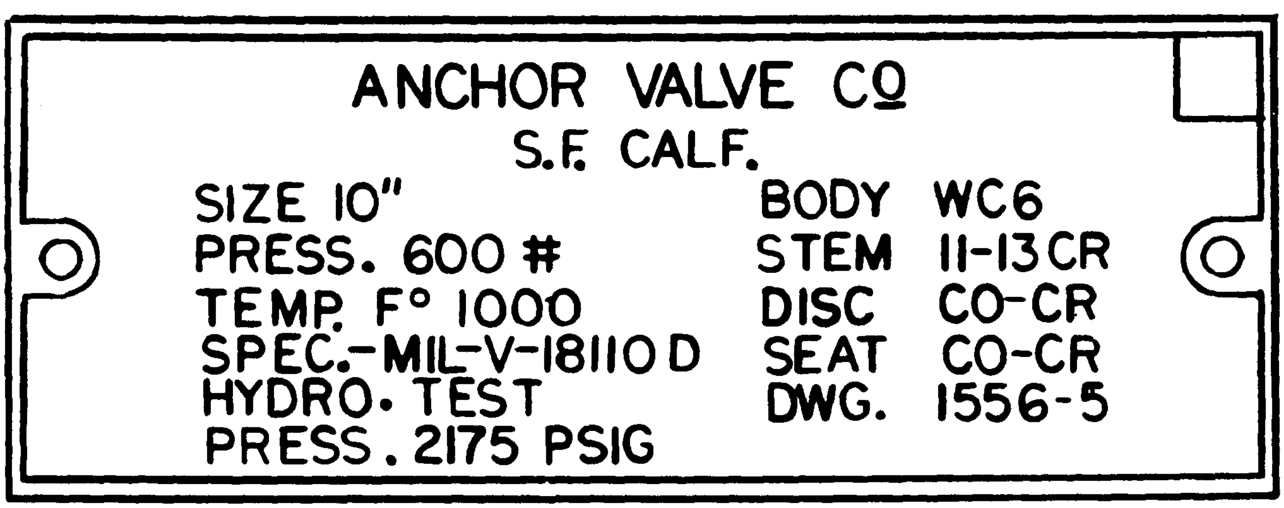


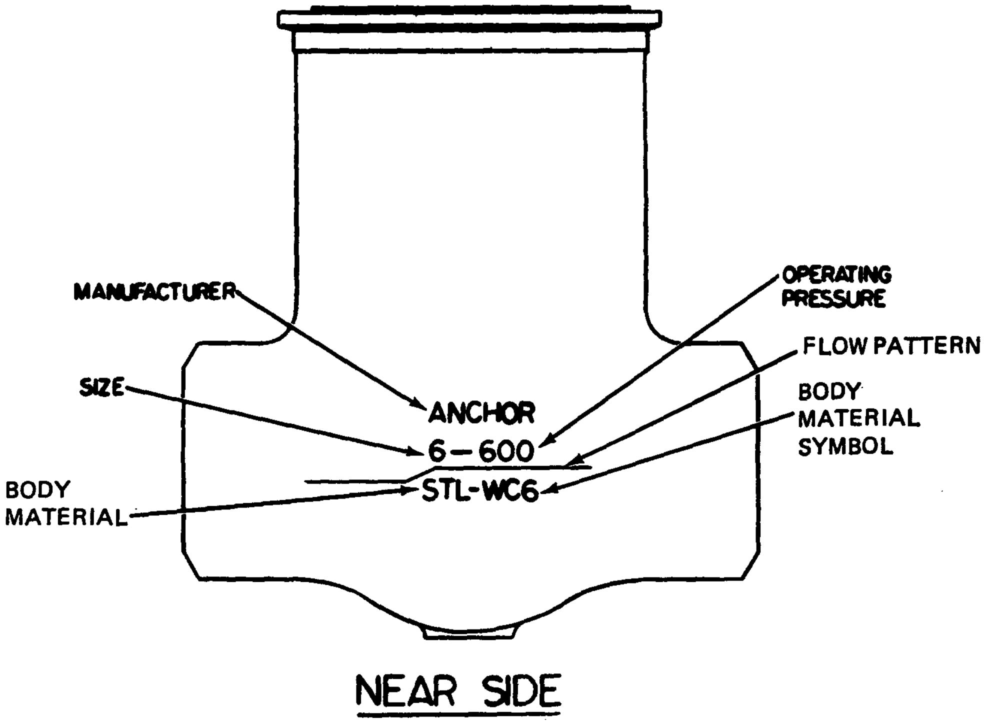
Figure 6-1. Valve Nameplate (Typical)

6-1.3.2 Body Markings. Typical body markings (figure 6-2) are cast or forged on the body and contain valve manufacturer, size, operating pressure, body material and body material symbol, manufacturer's pattern number, and flow pattern.

6-1.4 TOOLS, EQUIPMENT, AND MATERIALS. The following tools, equipment, and materials are recommended for general maintenance. Special tools and materials are listed and/or illustrated elsewhere in this chapter where applicable.

1. Analyzer, brush surface	-
2. Apron, toxicological	MIL-A-2334
3. Block, lapping	-
4. Blue, Prussian	-
5. Boring bar, portable	-
6. Brush, wire	-
7. Calipers, inside and outside	-
8. Caliper, slide	-
9. Chalk	-
10. Cloth, emery	Grit Nos. 20, 40, 60, 90, 120, and F
11. Clothing, toxicological	AEL-2-330075155
12. Comparator, microfinish	-
13. Compound, antiseize thread	MIL-A-907
14. Compound, cleaning	-
15. Compound, lapping	400, 600, and 1,000 grit
16. Cutters, diagonal	-
17. Cutting and beveling machine, portable	-
18. Die set	-
19. Drill, electric	-
20. Drill, pneumatic	-
21. File, smooth	-
22. Flange refacing machine	-
23. Flashlight	-
24. Gage, depth, 6 in.	-
25. Gage, feeler, 6 in.	-
26. Gage, telescoping	-
27. Gasket, spiral-wound metallic	MIL-G-24716, MIL-G-16265, Various sizes
28. Gloves, toxicological	MIL-G-12223
29. Hammer	-
30. Indicator, dial	-
31. Knife, pocket	-
32. Lapping tool	-
33. Lathe	-
34. Lubricant	-
35. Magnifier, hand held	-
36. Micrometer, depth	-
37. Mirror, inspection	-
38. Oil, penetrating	VV-P-216
39 Deleted	
40. Packing, corrugated ribbon	MIL-P-24503
41. Packing, graphite filament yarn	MIL-P-24583
42. Packing pusher	-

43. Pads, lagging	MIL-STD-769
44. Pencil, grease	-
45. Plate, surface	-
46. Plug, nonexpandable	-
47. Press, hydraulic	-
48. Profilometer	-
49. Puller, packing	-
50. Pump, hydrostatic	-
51. Rags, wiping	-
52. Reseating machine, globe and gate valve	-
53. Scale, steel	-
54. Scribe, machinist's	-
55. Seal, nonexpandable	-
56. Sleeves, carbon steel	-
57. Soapstone	-
58. Stylus, hand held	-
59. Solvent, dry cleaning	P-D-680
60. Spray, aluminum wire	DOD-STD-2138
61. Tags	Identification
62. Tags	Safety
63. Tape	Double sided
64. Tracer, motor driven	-
65. V-blocks	-
66. Vise	-
67. Wire	-
68. Wrench	Torque (foot-pound)
69. Wrench set	Open end/box end combination



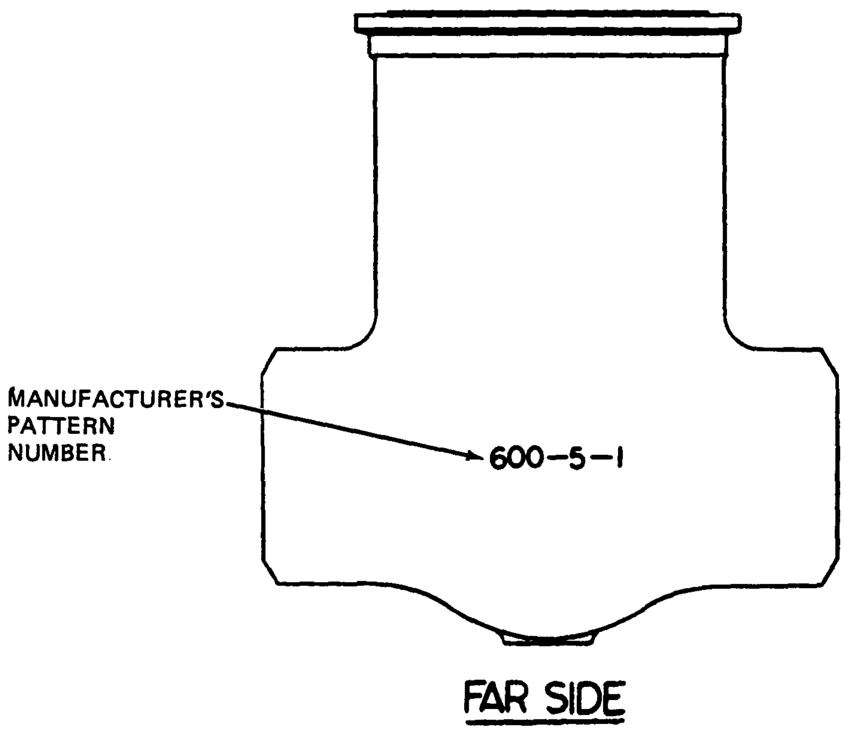


Figure 6-2. Valve Body Markings (Typical)

6-2. TROUBLESHOOTING.

6-2.1 TROUBLESHOOTING PROCEDURES. When a valve malfunctions, troubleshooting shall be undertaken. It must be assumed that, prior to the malfunction, system alinement was correct and the valve was operating satisfactorily. If a valve malfunctions, proceed to the troubleshooting guides (tables 6-1 through table 6-4).

6-2.2 TROUBLESHOOTING GUIDES. The troubleshooting guides tables 6-1 through table 6-4) shall be followed to isolate common malfunctions and to determine the proper corrective action. Use the left-hand column to identify the malfunction that beat describes the problem. Once a malfunction has been identified, proceed to the probable causes listed in the center column, and then take the corrective action listed in the right-hand column. Probable causes are listed in the approximate order in which they should be checked, but it is not mandatory that this order be maintained. Refer to the table of contents to locate applicable valve volumes and chapter repair coverage.

Table 6-1. Manually Operated Valve Troubleshooting Guide

Malfunction	Probable Cause	Corrective Action
Valve will not open	Disk jammed onto seat or disk jammed into seat rings	Repair valve.
	Disk hung up on disk guide, stem bent	Repair valve.
	Stem frozen in yoke bushing	Replace yoke bushing.
Valve will not close	Disk nut jammed onto backseat, stem shoulder jammed onto backseat	Repair valve.
	Stem frozen in yoke bushing	Replace yoke bushing.
Valve hard to open or close	Stem packing too tight	Replace stem packing.
	Valve stem threads scored	Repair or replace stem.
Valve will not stop fluid flow when closed	Disk and/or seat wire drawn or eroded	Repair disk and seat (para 6-7).
Valve leaks at stem	Low or high gland pressure	Replace stem packing (para 6-9.1 or para 6-9.2).
		Replace stem packing (para 6-9.1 or para 6-9.2). and torque gland flange to applicable torque value.
	Backseat erosion	Repair defective backseat (para 6-7) and replace stem packing (para 6-9.1 or para 6-9.2).
	Stem erosion	Repair or replace stem.
	Stuffing box erosion	Repair stuffing box.
	Stem wobble	Repair yoke bushing.
Valve leaks at bonnet and body	Defective bonnet gasket or pressure seal ring	Replace bonnet gasket or pressure seal ring.

Table 6-2. Power-Actuated Valve Troubleshooting Guide

Malfunction	Probable Cause	Corrective Action
Valve will not open or close	Air supply valve not open	Open air supply valve.
	Solenoid valve defective	Replace solenoid valve in electrical system.
	Sensitive switch defective Disk jammed onto seal or disk jammed into seal rings	Repair sensitive switch. Repair valve.
	Disk hung up on disk guide	Repair valve.
	Remote cable binding	Lubricate and remove cable in accordance with PMS.
	Toggle stem or toggle stem bushing threads scored or broken	Repair or replace toggle stem or toggle stem bushing.
	Toggle pins out of position	Reposition toggle pins and replace retaining rings.
	Bent links	Repair and adjust operator links.
	Bent toggle pins	Replace toggle pins.
	Drive or driven gear teeth defective	Repair or replace drive or driven gear.
	Yoke sleeve or stem threads scored or broken	Repair or replace yoke sleeve or stem.
Valve hard to open or close	Stem packing too tight	Replace stem packing (para 6-9.1 or para 6-9.2).
	Defective thrust washer or bearing	Replace thrust washer or bearing.
	Bowed stem	Repair stem.
Valve will not stop fluid flow when closed	Disk and/or seat wire drawn or eroded	Repair disk and seat (para 6-7.)
Valve leaks at stem	Defective packing	Replace stem packing (para 6-9.1 or para 6-9.2).
	Low or high gland pressure	Replace stem packing (para 6-9.1 or para 6-9.2) and torque gland flange to applicable torque value.
	Backseat erosion	Repair defective backseat (para 6-7) and replace stem packing (para 6-9.1 or para 6-9.2).
	Stem erosion	Repair or replace stem.
	Stuffing box erosion	Repair stuffing box.
	Stem wobble	Repair yoke bushing.
Valve leaks at bonnet and body	Defective bonnet gasket or pressure seal ring	Replace bonnet gasket or pres- sure seal ring.

Table 6-3. Actuator Troubleshooting Guide

Malfunction	Probable Cause	Corrective Action
Actuator will not close	Air supply valve not open	Open air supply valve.
	Ruptured diaphragm	Replace diaphragm.
Air leaks at mating surface of upper and lower diaphragm case	Loose nuts	Tighten nuts.
	Worn diaphragm	Replace diaphragm.
Air leaks at mating surface of lower dia- phragm case to yoke seal	Worn stem seal	Replace stem seal.

Table 6-3. Actuator Troubleshooting Guide - Continued

Malfunction	Probable Cause	Corrective Action
Sluggish operation	Air leaks Weak actuator spring Worn diaphragm	Tighten all nuts around mating surfaces. Replace actuator spring. Replace diaphragm.

Table 6-4. Steam Trap Troubleshooting Guide

Malfunction	Probable Cause	Corrective Action
Steam trap will not open or close	Disk jammed onto seat Ruptured bellows Stem disconnected from rocker arm Scale or rust plugging up seating area	Repair steam trap. Replace bellows. Repair steam trap. Clean steam trap or replace strainer.
Low pressure or low temperature	Disk jammed into seat rocker arm Scale or rust plugging up seating area Clogged orifice Plugged strainer	Repair steam trap. Clean steam trap or replace strainer. Clean or replace orifice plate. Clean or replace strainer.
High pressure or high temperature	Steam trap disconnected from rocker arm Ruptured bellows Eroded orifice	Repair steam trap. Replace bellows. Replace orifice plate.

6-3. LEVELS OF ESSENTIALITY AND CONTROLLED MATERIAL REQUIREMENTS.

6-3.1 LEVELS OF ESSENTIALITY. The increased cost of shipboard systems and equipment has generated a need for stricter controls over maintenance actions. these controls include guidelines that repair personnel must follow when performing maintenance on certain systems or equipment. some of these controls include maintenance requirements called levels of essentiality. The following three paragraphs describe the levels of essentiality.

6-3.1.1 Level A. Level A requires that maximum confidence be placed in the reliability of repairs made to specific systems and equipment. Level A includes systems and structures where failure would significantly and directly reduce a ship's operational capability, compromise mission effectiveness, or jeopardize the safety of the ship or ship's personnel. Also included are systems and major components that are considered vital to a ship's mission. Such systems and components are critical in that high pressure, high speed, high stress, a high degree of reliability, and safety of personnel are involved. Such systems and components must be considered critical enough locally to warrant inspection and testing certification. In addition, a tended unit or cognizant systems command may designate specific conformance inspections or tests, thereby placing an item in the level A category. Quality assurance receipts, and in-process and completion inspections and tests are required for Level A systems and components. Written quality assurance plans and test memoranda are developed and become a part of job order specifications.

6-3.1.2 Level B. Level B allows less confidence to be placed on the reliability of repairs made to specific systems and equipment than on level A repairs. Level B includes systems and structures whose failure could limit the ship's ability to maintain the intended efficiency, accuracy, and reliability of systems and structures. Such failure could directly jeopardize the safety of the ship or ship's personnel. Also included are systems and components not defined as vital, but which normally require inspections and tests to determine conformance with system and component requirements, performances, etc. Quality assurance receipts, and inprocess and final tests and inspections are permitted for level B systems and components. Nondestructive test (NDT) inspections may be required following welding or other material fabrication processes.

6-3.1.3 Level C. Repairs under the level C category are assumed to be correct unless there are obvious indications to the contrary. Level C includes systems and structures where failure due to installation of incorrect material will have little or no effect on the ship's performance. Also unaffected would be the safety of the ship or ship's personnel. Systems and components requiring a minimum of quality assurance checks are included in level C.

6-3.2 CONTROLLED MATERIAL REQUIREMENTS. The quality assurance program includes guidelines for processing components and materials used in level I systems. Level I is the designation given to systems that require maximum confidence that the composition of installed material is correct. The term non-level I as used in this manual refers to valves that are not certified for level I use and which, therefore, are not to be used in a level I system. Not every system is considered to be level I; however all replacement valves shall meet level I requirements. Detailed information about controlled material requirements is provided in NAVSEA 0948-LP-045-7010, volumes I and II. A general description of level I and non-level I materials and components used in steam propulsion systems follows.

6-3.2.1 Level I Materials and Components. Systems designated as level I include main steam systems with a design temperature greater than 775°F (413°C). Valves used in level I systems and/or designated as level I valves must meet certain controlled material requirements. These requirements generally apply to those components and materials that form the pressure boundaries of the level I-designated piping system and/or the level I valve assembly. Level I components and materials includes but are not limited to, the following:

1. Bodies (such as valve bodies, strainer bodies, and pipe fittings)
2. Covers (such as valve bonnets and caps)
3. Joint fasteners of 1/2-inch diameter or more, if used to join two pressure boundary parts
4. Extension pieces or branch systems connecting bodies and covers, and which are subject to piping system pressures and temperatures. These are often finished with end connections for installing into main or branch system piping.
5. Miscellaneous materials and components (such as brazing alloys and welding filler metals that form part of the pressure boundary, metallic balls, disks, bushings, and any other internal parts that are not completely contained within the system pressure boundary)

6-3.2.2 Non-Level I Materials and Components. Not all parts of level I-designated valves are classified as controlled materials. Materials and components that are specifically excluded from the level I requirements include, but are not limited to, the following:

1. Packing glands
2. Pressure seal rings and gaskets used in conjunction to join two pressure boundary parts
3. Balls, disks, seat rings, bushings, and backing rings for welded pipe joints and other internal parts that are completely contained within the system or valve pressure boundary

6-3.2.3 Miscellaneous Controlled Materials. Some level I materials are classified as miscellaneous controlled materials. These include welding, brazing, electroplating filler metal, and bonnet and end-connection union nuts.

6-4. VALVE ISOLATION.

6-4.1 PRINCIPLE AND THEORY. Isolation removes system pressure from valve(s) to be repaired and provides protection for personnel. Use of tagout procedure is mandatory when working on valves and shall be followed in accordance with ship's procedures. The technique of valve isolation depends on valve location in other words whether the valve is at the beginning of the piping run, between other valves in the flow line, or at the end of the piping run. In most cases systems have valves and piping that will permit isolation, inspection, and repair of a valve without the necessity of plant shutdown. The isolated valve must be at atmospheric pressure and ambient temperature, and two-valve protection is necessary for valve removal or repair. An isolated valve must be locked or wired shut and tagged prior to any repair. This safeguards against local or remote accidental opening.

6-4.2 SAFETY AND TAGOUT. All equipment to be repaired shall be properly tagged by ship's force prior to removal. When a repair activity is to work on equipment or a system that is the responsibility of ship's force, authorized representatives of both organizations shall ensure compliance with tagout procedures. However, removal of tags is the responsibility of ship's force only after repairs are completed. Proper tagout is necessary for the safety of repair personnel and protection of equipment. Use of system diagrams to ensure completeness of tagout procedure is recommended when isolating any system.

6-5. VALVE REMOVAL, REPAIR/REPLACEMENT, AND REINSTALLATION.

6-5.1 FLANGED VALVE. The following procedures shall be used to remove, repair/replace, and reinstall all flanged valves.

6-5.1.1 Removal.

WARNING

To prevent injury or death during removal or disassembly, isolate valve by closing two valves immediately upstream and two valves immediately downstream from valve to be removed or disassembled. Relieve line pressure and tag out of service.

1. Isolate valve (paragraph 6-4).
2. Note direction of flow through valve.
3. Mark valve to indicate whether pressure and/or vacuum is under or above disk (matchmark inlet and outlet flanges).
4. Remove all connecting or obstructing piping that prevents removal of valve.
5. Support valve and remove fasteners from flanges.

WARNING

Asbestos is a health hazard. To prevent injury or death, ensure that appropriate breathing apparatus, coveralls, and gloves are worn when handling asbestos.

6. Remove metallic-spiral wound gaskets and valve from system.

CAUTION

To prevent damage to equipment, do not score flange with scraper.

7. Use flat scraper or wire brush to remove old gasket.

6-5.1.2 Repair/Replacement. Repair or replace valves in accordance with applicable valve chapter requirements (volumes II through XIII).

6-5.1.3 Reinstallation.

1. Return valve to piping system and install enough fasteners to support gaskets. Apply thin coat of antiseize compound MIL-A-907 to threads.
2. Install metallic-spiral wound gaskets and remainder of fasteners.
3. Ensure alinement of piping and valve flanges.
4. Tighten fasteners to required torque (figure 6-3). Ensure that fasteners are tightened evenly. Refer to NAVSEA 0948-LP-012-5000 for thread protrusion specifications.

6-5.2 WELDED VALVE. The following procedures shall be used to remove, repair/replace, and reinstall welded valves.

6-5.2.1 Removal.

WARNING

To prevent injury or death during removal or disassembly, isolate valve by closing two valves immediately upstream and two valves immediately downstream from valve to be removed or disassembled. Relieve line pressure and tag out of service.

1. Isolate, drain line pressure, and tag systems out of service in accordance with ship's procedures and paragraph 6-4.
2. Remove all structural, sheet metal, or electrical interferences that prevent removal of valve.
3. Matchmark all mating surfaces.

4. Set up sufficient staging to support valve during removal.
5. Use support brackets to maintain correct pipe alinement.
6. Obtain portable pipe cutting and prep machine to cut valve from system.
7. To prevent slipping, remove oil and grease from pipe area to be cut.
8. Mark cut line with chalk, soapstone, or machinist’s scribe.

Type Gasket (Specification)	Operating Pressure (psi)	Size of Piping or Tubing	Bolt Stud Stress Required (psi)
MIL-G-16265	150	All sizes	30,000 ± 10%
	300 400 600	1/4 inch to 1 inch IPS and 16 inch OD	25,000 ± 10%
		1-1/4 inch to 12 inch IPS and 14 inch to 15 inch OD	30,000 ± 10%
MIL-G-24716	150 300 400 600 900 1500	1/4 inch to 1 inch IPS	25,000 ± 10%
		1-1/4 inch IPS and larger	30,000 ± 10%
	2500	All sizes	25,000 ± 10%

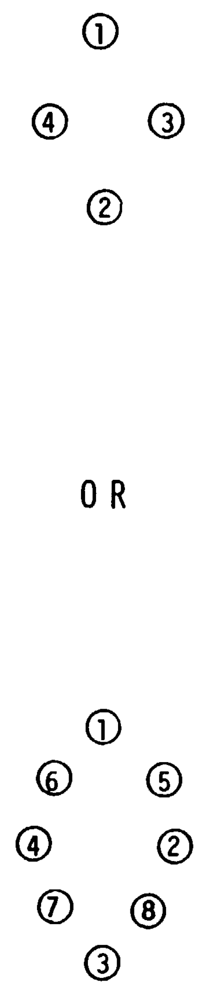
Nominal Alloy Steel Bolt Stud Size (Inches)	Torque Required to Obtain 25,000 psi Bolt Stud Stress (Foot Pounds, in 3 Steps)	Torque Required to Obtain 30,000 psi Bolt Stud Stress (Foot Pounds, in 3 Steps)	Tightening Pattern
1/2	6 to 7, 12 to 14, and 23 to 27	7 to 8, 14 to 17, and 27 to 33	
5/8	12 to 14, 23 to 28, and 45 to 55	14 to 17, 27 to 33, and 54 to 66	
3/4	19 to 23, 38 to 46, and 75 to 91	23 to 28, 45 to 55, and 90 to 110	
7/8	30 to 37, 60 to 73, and 120 to 146	36 to 44, 72 to 88, and 144 to 176	
1	47 to 57, 93 to 113, and 185 to 225	55 to 68, 111 to 135, and 221 to 269	
1-1/8	67 to 81, 133 to 162, and 266 to 324	80 to 97, 160 to 195, and 320 to 390	
1-1/4	103 to 114, 206 to 229, and 412 to 457	112 to 137, 225 to 275, and 450 to 550	
1-3/8	127 to 155, 255 to 311, and 511 to 623	145 to 177, 290 to 354, and 581 to 709	
1-1/2	150 to 183, 300 to 366, and 601 to 733	180 to 220, 360 to 440, and 720 to 880	

Figure 6-3. Valve and Piping Flange Hardware Torque Values

9. Lubricate machine parts carefully. Do not use an excess of oil or slipping may result.

CAUTION

Dull or broken tool bit can cause pipe cutting and prep machine to jam. Ensure that tool bit is not damaged.

10. Select proper tool bit for type of cut desired (figure 6-4, view A, B, or C), and inspect for damage.

11. Determine cutting edge depth, and select correct notch on tool bit (figure 6-4, view D).

12. Use notch A to cut maximum pipe size limits for each cutting machine.

13. Use notch B to cut minimum pipe size limits.

14. Use longer parting tool edge on tool bit for thicker pipe walls. This will allow proper cutting without breakage or slipping. Pipe having wall thickness of 3/8 inch or greater is fabricated by using minimum bevel of 37-1/2 degrees. Pipe of less than 3/8-inch wall thickness is fabricated using bevel of 60 degrees.

15. Install tool bit in tool holder and tighten setscrews.

16. For cutting accessible piping, loosen hinge pins (figure 6-5, view A), separate pip cutting and beveling machine. Place around pipe and tighten hinge pins.

17. For cutting pipe in tight spaces, loosen hinge pins (view B) and swing clamp. Separate pipe cutting and beveling machine in two halves, place around pipe, and tighten hinge pins and swing clamp.

WARNING

To prevent injury or death, ensure that adequate staging is provided and that all involved pipe and piping components have been supported with necessary rigging.

18. Check body clamp assembly for looseness. Ensure that it cannot be rotated using both hands.

19. If body clamp assembly rotates, check for oil, grease, or metal chips on pipe or cutting machine collet.

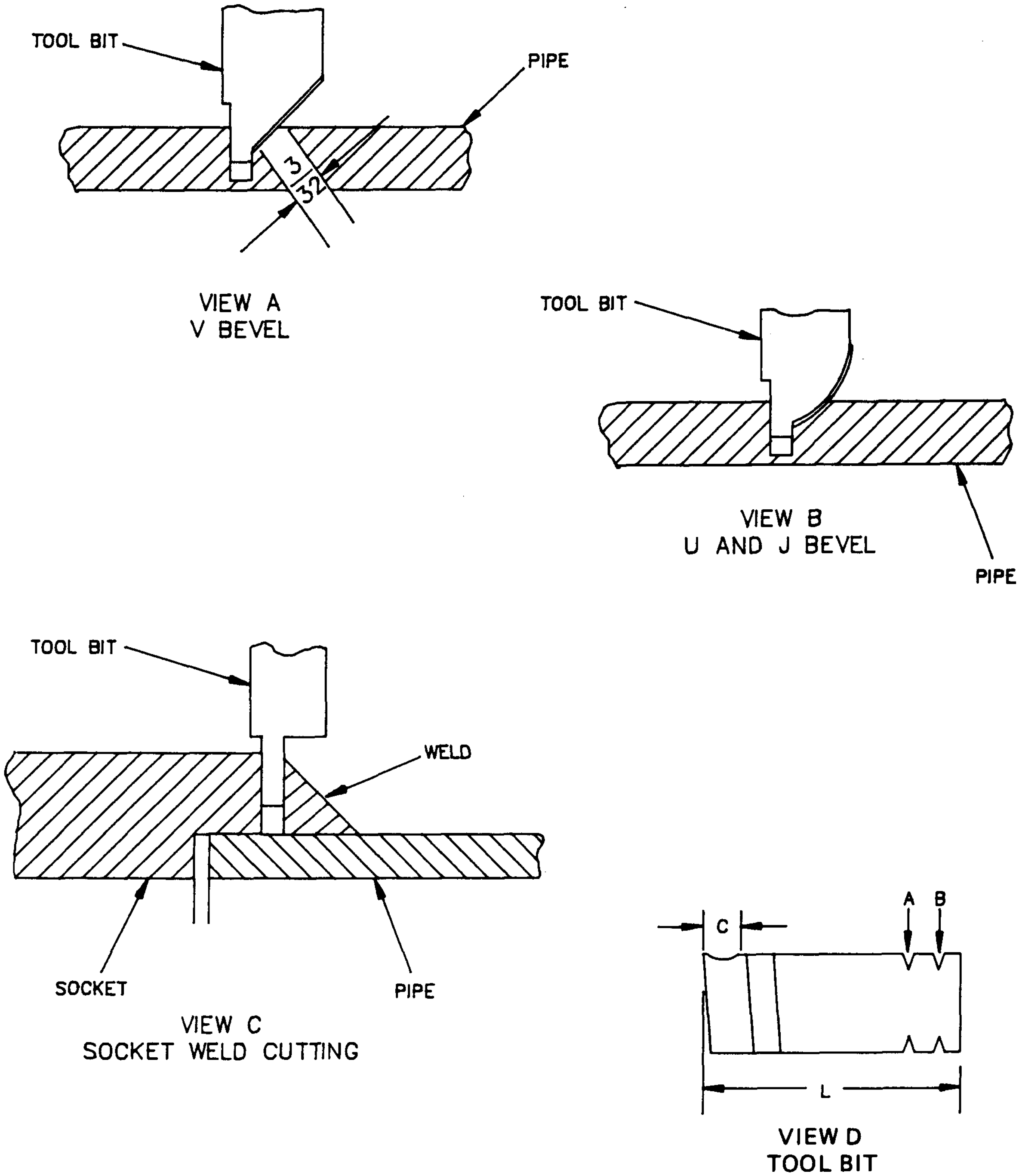


Figure 6-4. Tool Bit Types

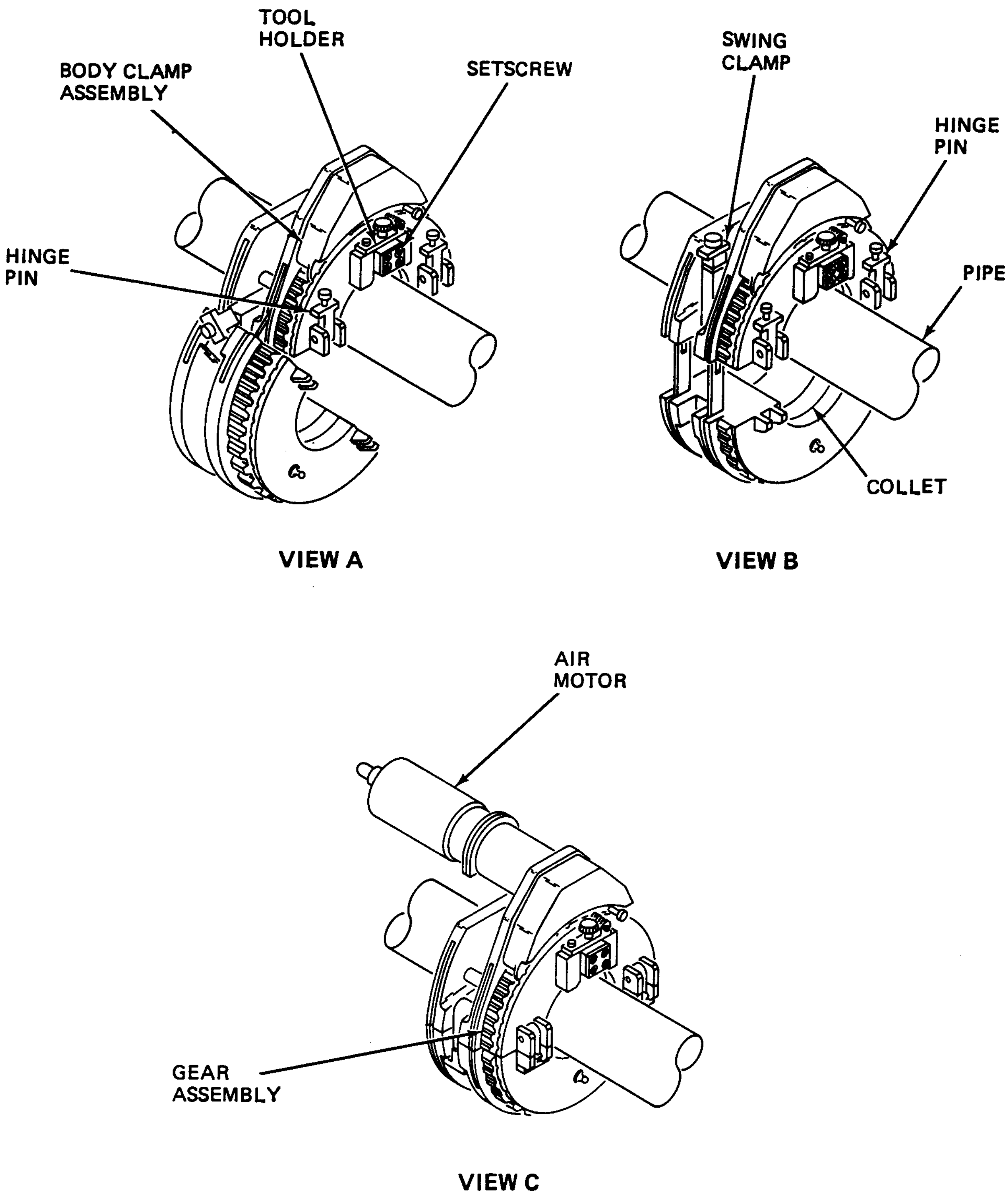


Figure 6-5. Cutting and Beveling Machine Components

20. Ensure that gear assembly and tool holder will rotate freely by hand all the way around pipe.

21. Ensure that 90 psi of low-pressure air at 40 cfm is available. This is necessary for proper cutting speed for stainless steel.

22. Install air motor as shown in view C.

WARNING

To prevent injury or death, ensure that all operating personnel, and others in immediate vicinity, wear protective goggles around cutting and beveling machine. Operating personnel shall remove all loose clothing and jewelry.

23. Depress feed engagement pin with index finger of hand holding air motor head. Most pipes are slightly out-of-round. As tool bit is fed in, it will contact high points on pipe before starting to cut all the way around.
24. As tool bit continues to cut, break long cutting chips by releasing feed engagement pin for one revolution and then re-engaging it. On some cuts, it may be necessary to relieve pressure of bit. Do not allow machine to rotate more than one revolution with feed engagement pin released, since work hardening of pipe may result.
25. Remove air motor from machine if jamming occurs. Rotate gear assembly and tool holder in reverse direction to free tool bit from cut. Back tool bit out and clear cut of debris. Examine tool bit for breaks or cracks. Replace, if necessary.
26. Install air motor and continue cutting. When cutting is complete, lower valve to deck.
27. Remove metal shavings from inside of pipe ends and place protective caps over opened ends.
28. Mark and tag valve for delivery to shop.
29. Conduct magnetic particle test of prepared pipe ends.
30. Measure and record distance between cut and prepared ends of steam system piping. Prepare ends of new pipe lengths to be inserted into inlet and outlet of valve, if new valve is to be installed.
31. Measure, cut, and prepare ends of valve piping to be connected to steam system piping.
32. Allow maximum of 1/2 inch between ends of steam system piping and ends of valve inlet and outlet piping.
33. If old valve is being reinstalled, machine ends and outside diameter of valve openings to remove existing metal.
34. Bore out backing ring halves, if applicable, and bevel valve openings.
35. Request NDT code to test valve ends for ensuring removal of all defects.

6-5.2.2 Repair/Replacement. Repair or replace valves in accordance with applicable valve chapter requirements (volumes II through XIII).

6-5.2.3 Reinstallation. Install valves in system in accordance with welding procedures provided in MIL-STD-278.

6-6. WELDING PROCEDURES.

6-6.1 QUALITY ASSURANCE. The quality assurance program is intended to improve the state of the equipment, safety of personnel, and configuration control, thereby increasing ship's readiness. The wide range of ship types and equipment differences complicates maintenance support. This increases the need for a formalized program that will provide a high degree of confidence that repair actions will consistently meet standards.

6-6.2 BASE AND FILLER MATERIALS. Valve seat, wedge, and disk seating surface are hard faced with stellite. To accomplish this, a base metal is welded to the seating surface and stellite is welded to the base metal in accordance with MIL-STD-278 and MIL-STD-248 procedures. The pressure seal ring seal area is inlaid with corrosion-resistant steel. Seats may be rolled in, threaded, or integral. Refer to NSTM chapter 074, volume I for detailed information on welding and allied processes.

6-6.3 WELDING PARAMETERS AND CONTROLS. All welding parameters and controls shall be in accordance with MIL-STD-278, except as specified by NSTM chapter 074, volume I.

6-6.4 WORKMANSHIP REQUIREMENTS. All workmanship requirements shall be accomplished using written procedures approved and qualified in accordance with MIL-STD-248. Refer to NSTM chapter 074, volume I.

6-6.5 INSPECTION REQUIREMENTS. Inspection requirements are found in NSTM chapter 074, volume I.

6-7. VALVE DISK AND SEAT REPAIR.

6-7.1 DISK AND SEAT INSPECTION. The disk and seat must be inspected each time a valve is disassembled. Inspect for uneven or excessive wear, pits, cracks, steam cuts, erosion, or improper fit of disk on seat. Determine the location, type, and depth of damage to disk or seating area. Use the spotting-in method to determine if disk and seat are mating properly.

6-7.1.1 Spotting In Globe Valves. The following procedure shall be used to spot in globe valves.

1. Apply thin coat of Prussian blue evenly over entire machined surface of disk.
2. Insert disk in body and mate with seat. Rotate disk 1/4 turn on seat and remove disk. Bluing will adhere to seating surface where contact is made. Refer to figure 6-6 for globe valve seat patterns.
3. Wipe all bluing off disk and seat surface.
4. Apply thin coat of bluing evenly over entire machined surface of seat.
5. Insert disk in body and mate with seat. Rotate disk 1/4 turn on seat and remove disk. Bluing will adhere to disk seating surface. Ring should be unbroken line of contact 100 percent around disk, and of uniform width. If blue ring is broken or not uniform in width, disk is not making proper fit.

6-7.1.2 Spotting In Gate Valves. The following procedure shall be used to spot in gate valves.

1. Apply thin coat of Prussian blue evenly over entire machined surface of disk.
2. Insert disk, attached to stem, in body. Rock disk slightly on seat and remove stem and disk. Bluing will adhere to seating surface where contact is made. Refer to figure 6-7 for gate valve seat patterns.
3. Wipe all bluing off disk and seat surface.
4. Apply thin coat of bluing over entire machined surface of seat.
5. Insert disk, attached to stem, in body. Rock disk slightly on seat and remove stem and disk. Bluing will adhere to disk seating surface. Ring should be unbroken line of contact 100 percent around disk, and of uniform width. If blue ring is broken or not uniform in width, disk is not making proper fit.

6-7.2 GRINDING AND LAPPING. When performing any maintenance on valves installed in the system extreme care must be exercised to prevent foreign particles from entering the system. Refer to MIL-STD-767 for methods of temporarily sealing valves during lapping operations using nonexpandable plugs or seals (figures 6-8and figure 6-9). A large tag should be attached to the valve body with instructions to remove any seals that were installed during repair operations. Minor damage such as nicks, scratches, or minor pitting can be removed by lapping. Major damage that cannot be repaired by lapping must be machined to a smooth surface, built up,by welding in accordance with MIL-STD-278, and then resurfaced to original specifications in accordance with the engineering drawing.

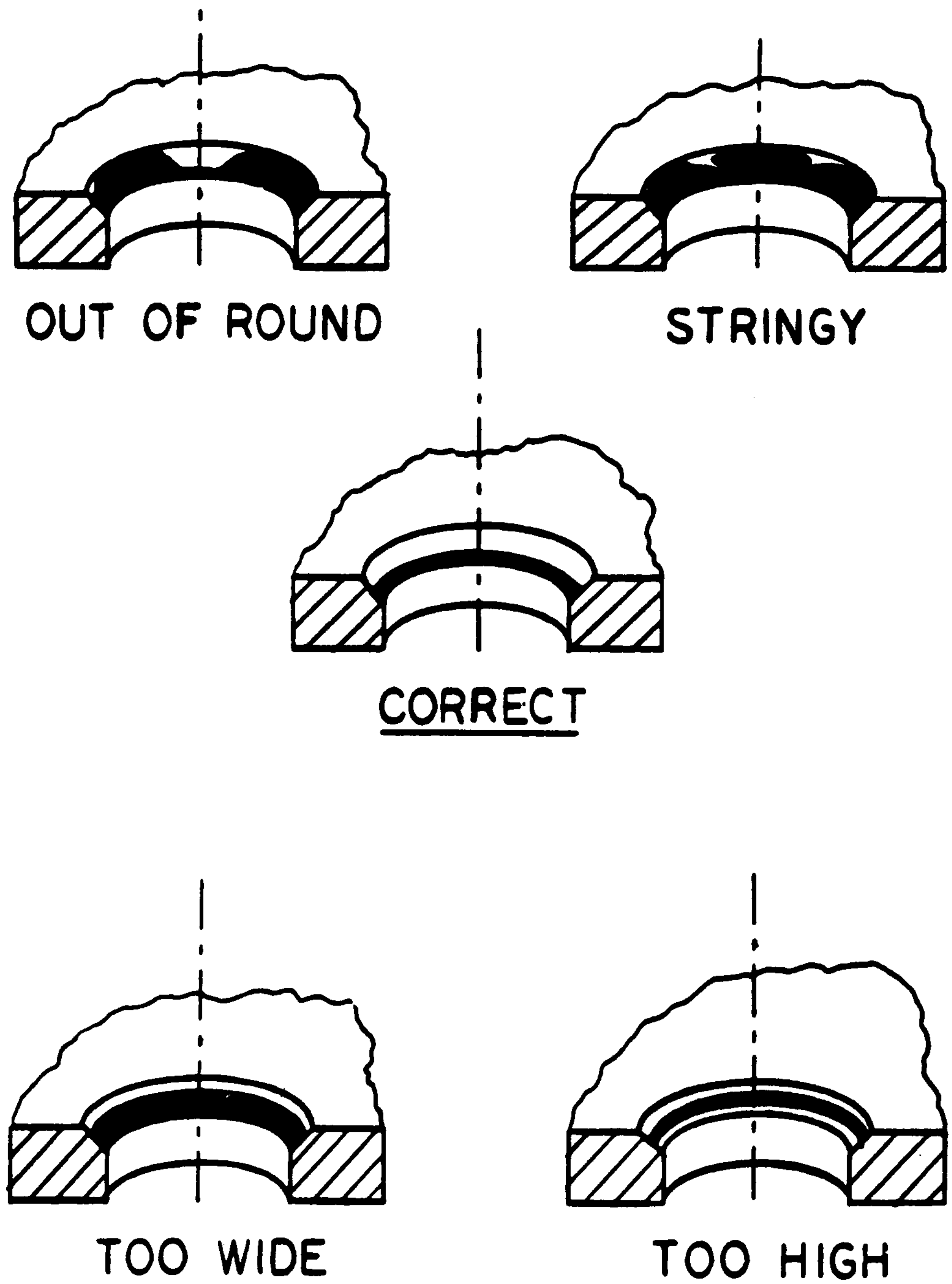


Figure 6-6. Globe Valve Seat Patterns

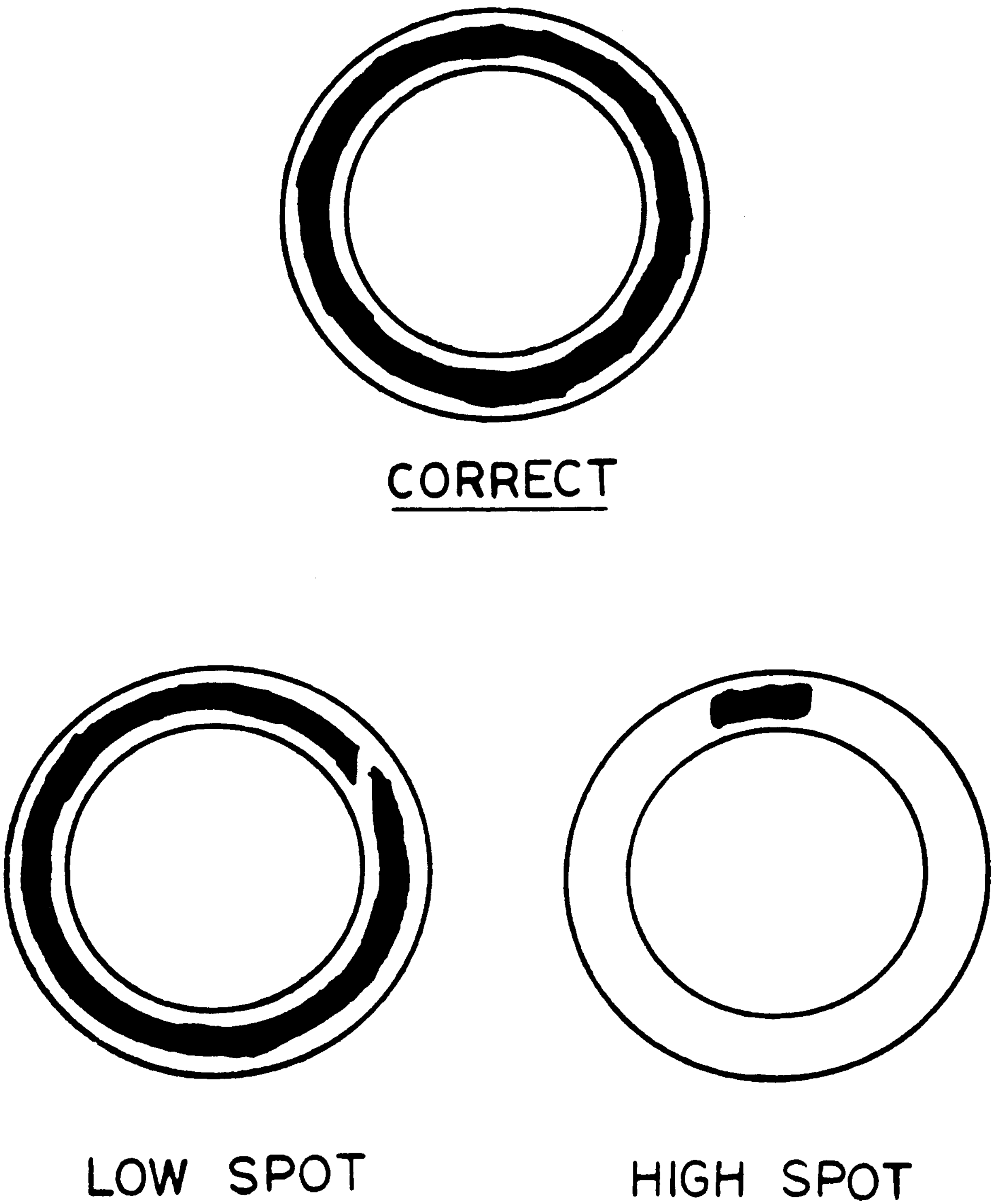


Figure 6-7. Gate Valve Seat Patterns

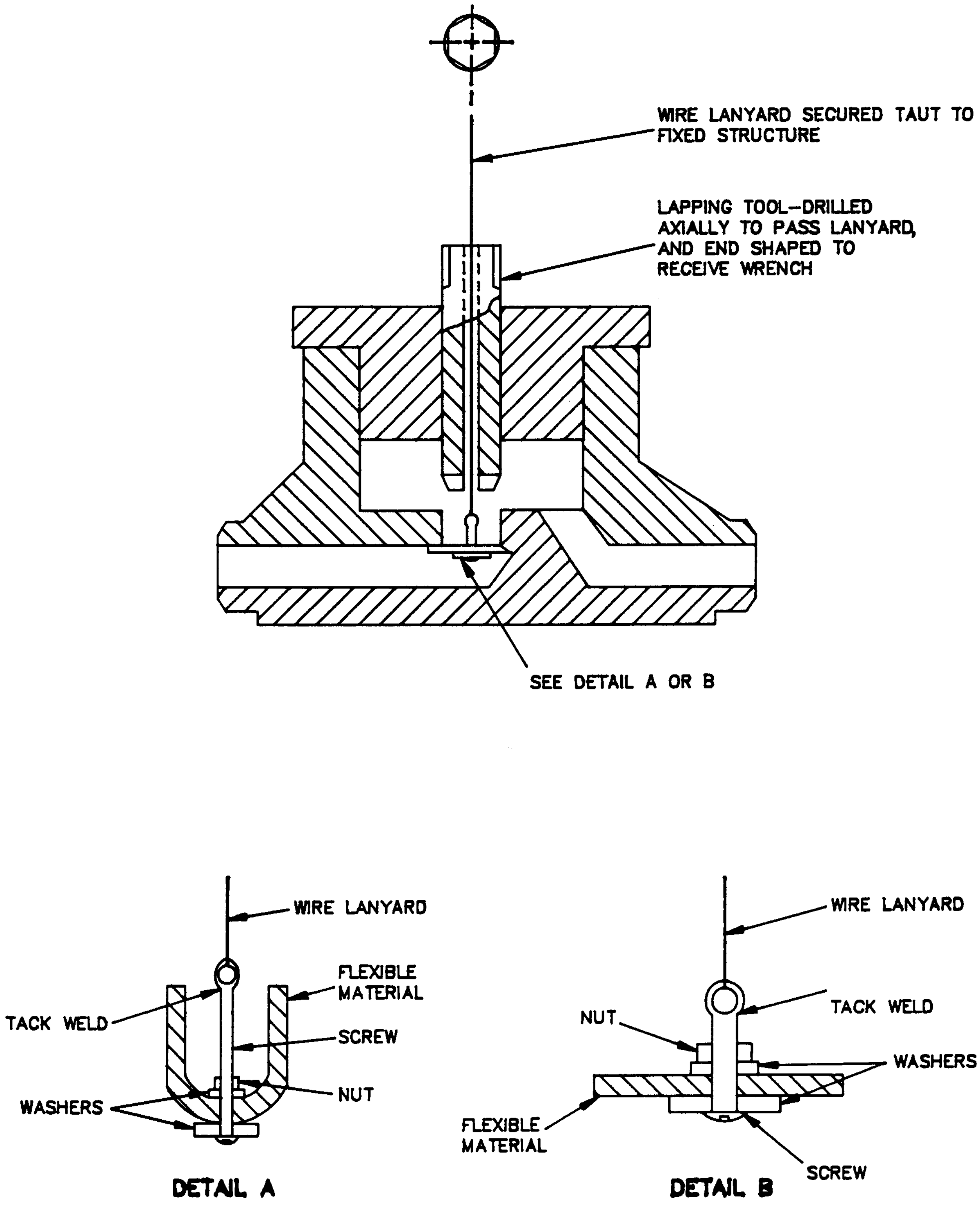


Figure 6-8. Nonexpandable Plug or Seal

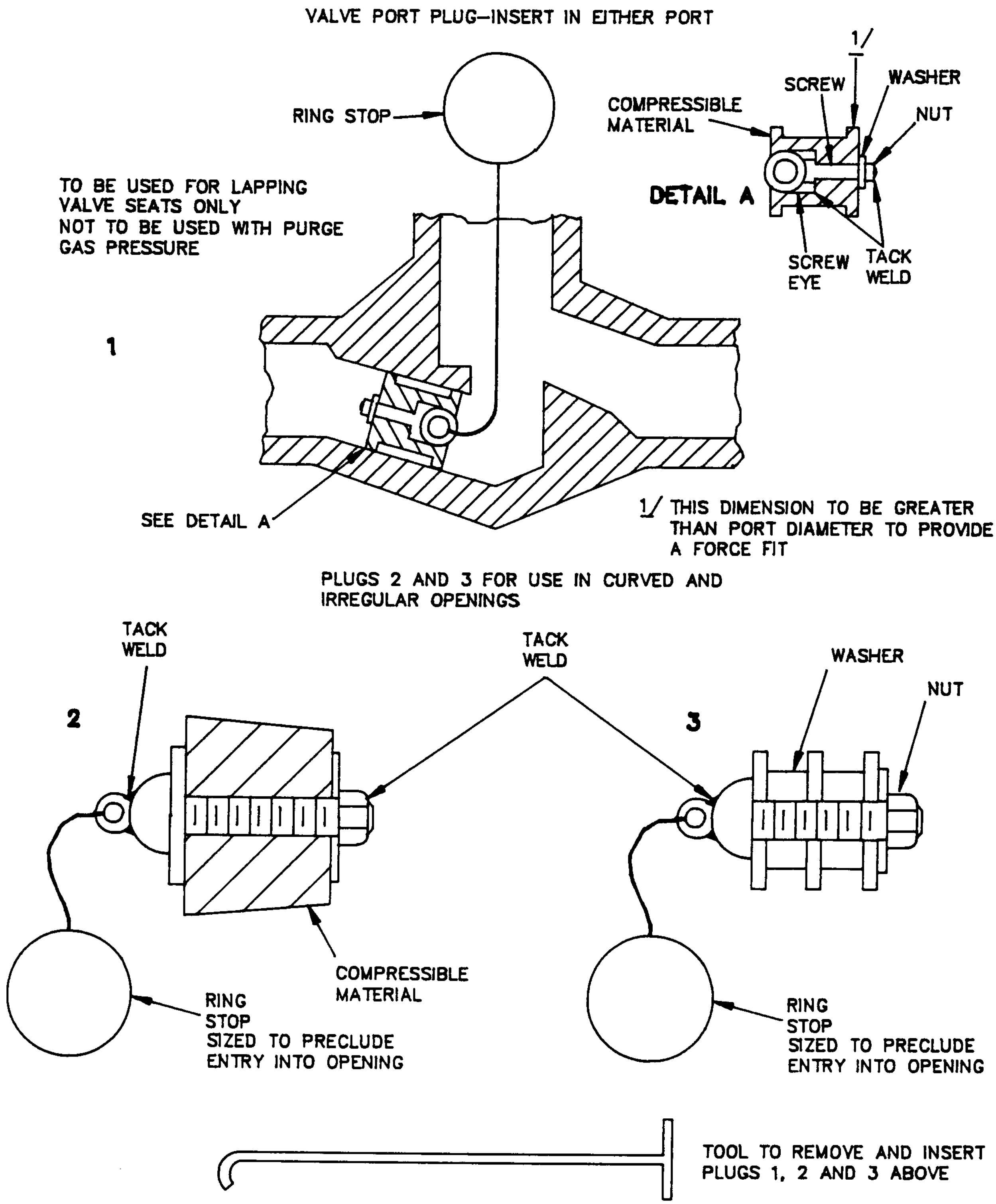


Figure 6-9. Nonexpandable Plug

6-7.2.1 Grinding In Disk and Seat. The following procedures shall be used to grind in disk and seat in globe and gate valves. If seating surface removal exceeds 25 percent of original thickness of disk or seat, the part should be replaced.

6-7.2.1.1 Globe Valve.

CAUTION

To ensure proper seating between disk and seat, ensure that grinding or lapping tool concentricity and seat angles are correct.

1. Ensure that concentricity and seat angles of grinding or lapping tools are correct.
2. Apply small amount of grinding compound to disk seating surface.
3. Insert disk into valve.
4. Rotate disk back and forth about 1/4 turn. Shift disk-seat relationship from time to time so disk will gradually move through several rotations.
5. Clean seat and disk with lint-free cloth and visually inspect seating surfaces.
6. Continue grinding in as required.
7. Clean seat and disk, and inspect seating surfaces using the spotting-in method (paragraph 6-7.1.1).
8. Continue grinding in as required until defect has been removed.

6-7.2.1.2 Gate Valve.

CAUTION

To ensure proper seating between disk and seat, ensure that grinding or lapping tool concentricity and seat angles are correct.

1. Ensure that concentricity and seat angles of grinding or lapping tools are correct.
2. Apply small amount of grinding compound to disk seating surface.
3. Insert disk into valve.
4. Rock disk slightly back and forth. Shift disk-seat relationship from time to time so disk will gradually move through several rotations.
5. Clean seat and disk with lint-free cloth and visually inspect seating surfaces.
6. Continue grinding in as required.
7. Clean seat and disk, and inspect seating surfaces using the spotting-in method (paragraph 6-7.1.2).
8. Continue grinding in as required until defect has been removed.

6-7.2.2 Lapping. Lapping tools are used to remove defects in the seating surfaces of the valve seat in globe or gate valves. The use of aluminum oxide abrasive cloth attached to the lapping tool is preferable to the use of lapping compound. Critical lapping tool surfaces will wear more rapidly when compound is used.

6-7.2.2.1 Globe Valve.

CAUTION

To ensure proper seating between disk and seat, ensure that grinding or lapping tool concentricity and seat angles are correct.

1. Ensure that concentricity and seat angles of grinding or lapping tools are correct. Lapping tools for flat seats and disks shall be checked to ensure that required flatness is maintained.
2. Obtain cast-iron or brass lapping tool as shown in figure 6-10. Dimension E shall be valve seat angle as required by engineering drawing.
3. Cut abrasive cloth into strips and attach to lapping tool seating surface using double-sided tape.
4. Insert lapping tool into valve shown in figure 6-11.
5. Rotate lapping tool handle back and forth about 1/4 turn. Move lapping tool so that it will eventually rotate around entire seat.
6. Clean seat with lint-free cloth and visually inspect seating area.
7. Continue to lap in until defect has been removed.
8. Clean seat and inspect seating surface using spotting-in method (paragraph 6-7.1.1).
9. Remove defects on disk seating surface using lathe, taking cleaning cut only.
10. Spot in disk to seat to ensure proper contact (shown in figure 6-6).

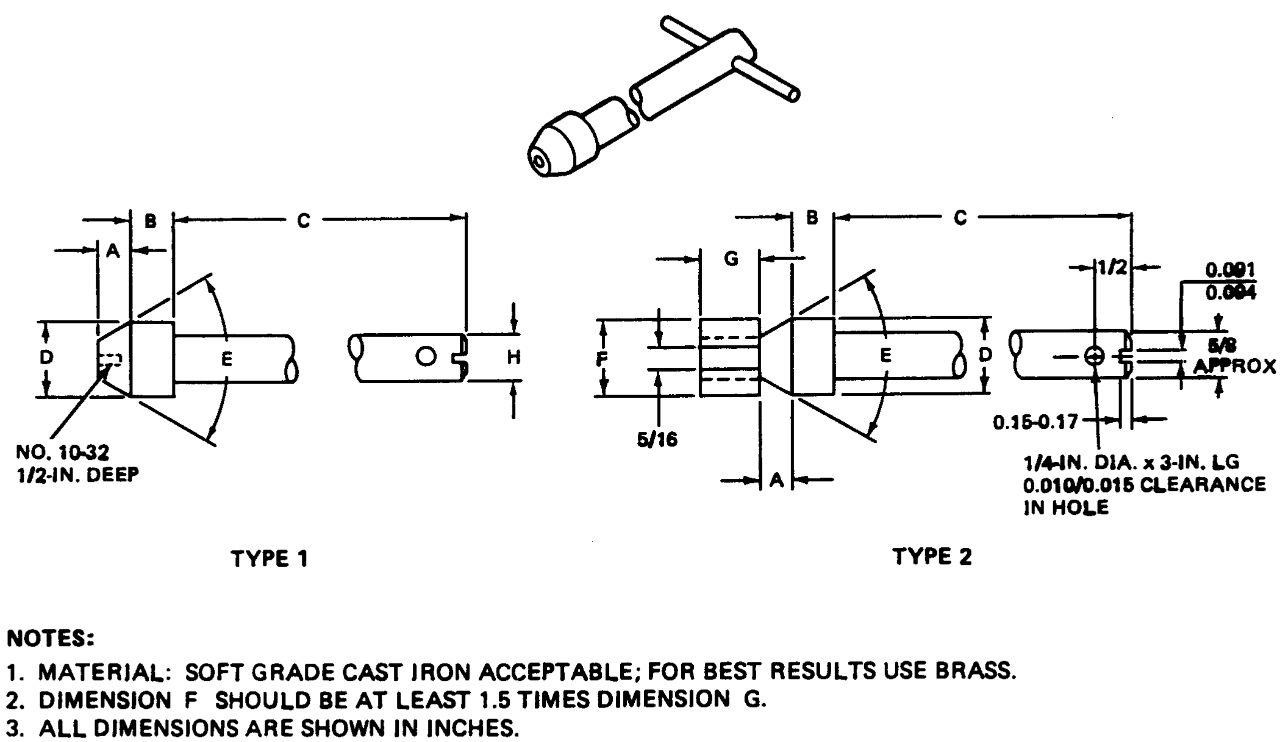


Figure 6-10. Lapping Tools for Seat and Backseat (Typical)

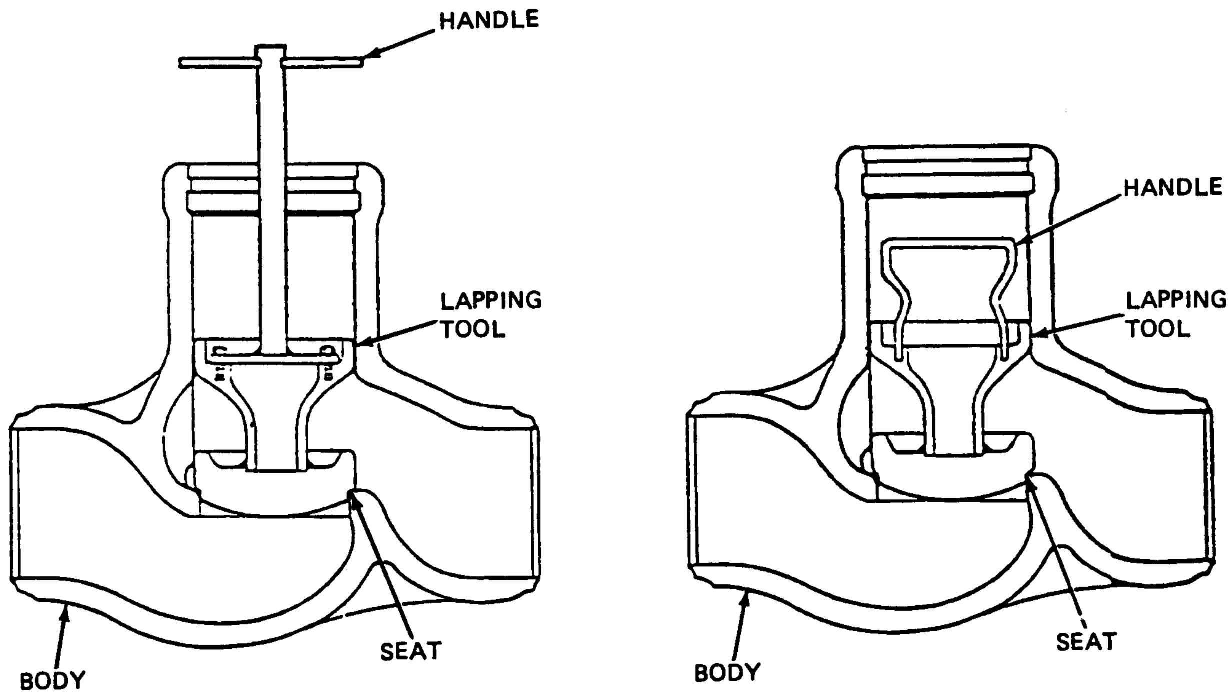


Figure 6-11. Lapping Globe Valves Using Lapping Tool

6-7.2.2.2 Gate Valve.

1. To lap seats, obtain flat cast-iron or brass lapping tool.
2. Cut abrasive cloth into strips and attach to flat lapping tool using double-sided tape.
3. Insert lapping tool into valve, covering one seat.
4. Rotate lapping tool handle back and forth about 1/4 turn. Move lapping tool so that it eventually rotates around entire seating area.
5. Clean seat with lint-free cloth and visually inspect seating area.
6. Continue to lap in seat until defect has been removed.
7. To lap disk, apply light even coat of lapping compound to one side of disk seating area and lapping block.
8. Press disk against lapping block with light pressure and move across lapping block with circular motion.
9. Turn disk slightly every few strokes to keep flat surface.
10. Lap disk until defect has been removed.
11. Clean disk and seat with acetone and lint-free cloth.
12. Spot in disk to seat using spotting-in method (paragraph 6-7.1.2) to ensure proper contact (shown in figure 6-7).

6-7.2.3 Backseat Inspection and Repair. Inspect backseat area for defects, such as pits, scratches, steam cuts, or corrosion, that might cause leakage. Backseat areas for both globe and gate valves are repaired using globe valve lapping procedures (paragraph 6-7.2.2.1). Backseat repairs that cannot be performed using lapping method must be machined and built up by welding in accordance with procedures in MIL-STD-278. After weld buildup, backseat area must be machined to engineering drawing specifications.

6-7.3 GLOBE AND GATE VALVE RESEATING MACHINES. Dexter Company globe and gate valve resealing machines can be used to repair valve seats without removing the valves from the system. There are two models for repairing globe valves and two models for repairing gate valves. Model 100R4 is for globe valves of 1/4 inch to 4 inches in size. Model 400 is for globe valves of 4 inches to 12 inches in size. Model 2000N is for gate valves of 1-1/2 inches to 4 inches. Model 4000N is for gate valves 4-1/2 inches to 12 inches. For globe valves that are 1/4 inch to 4 inches in size, repairs to seating surfaces usually can be limited to hand lapping of seat and disk. Refer to NAVSEA 0948-LP-019-0010 for complete details on description, instruction, operation, parts, and maintenance of a resealing machine.

6-8. STEAM LEAKAGE INSPECTION.

6-8.1 STEM PACKING/BONNET PRESSURE SEAL RING INSPECTION. With the system under pressure, stem packing leakage is caused by gland erosion, low or high gland pressure, short-length packing rings, backseat erosion, stem erosion, stuffing box erosion, yoke bushing or stem thread damage, bowed stem, and stem frozen in yoke bushing. Leakage between the valve body and the bonnet indicates a pressure seal ring leak. To determine the extent of damage, it may be necessary to disassemble the valve.

6-8.1.1 Gland Erosion. Gland erosion may be detected by observing an extrusion of packing or sheeting of steam from out of the topmost packing ring (figure 6-12, view A).

6-8.1.2 Low Gland Pressure. Low gland pressure is caused by uneven torquing of the gland flange which allows steam to damage the outside face of packing rings (figure 6-12, view B).

6-8.1.3 High Gland Pressure. High gland pressure is caused by over-torquing of the gland flange, which compresses one or more of the top-most packing rings (figure 6-12, view C). The lower packing rings remain in good but insufficient condition to prevent steam leakage.

6-8.1.4 Short-Length Packing Rings. Short-length packing rings cause adjacent packing rings to bulge into gaps between the ends of the short-length packing rings (figure 6-12, view D).

6-8.1.5 Backseat Erosion. Backseat erosion is caused by a sustained steam leakage at backseat area (figure 6-13, view A). Backseat erosion and excessive gland pressure cause packing to extrude from the bottom of the stuffing box at the stem and backseat.

6-8.1.6 Stem Erosion. Stem erosion is caused by a sustained steam leakage between the stem and packing rings (figure 6-13, view B). Stem erosion can also result from using the wrong size or type of packing ring material. Stem erosion causes damage to the inside face of packing rings, preventing a seal between the packing and stem.

6-8.1.7 Stuffing Box Erosion. Stuffing box erosion is caused by a sustained steam leakage between the outside face of packing rings and stuffing box (figure 6-13, view C).

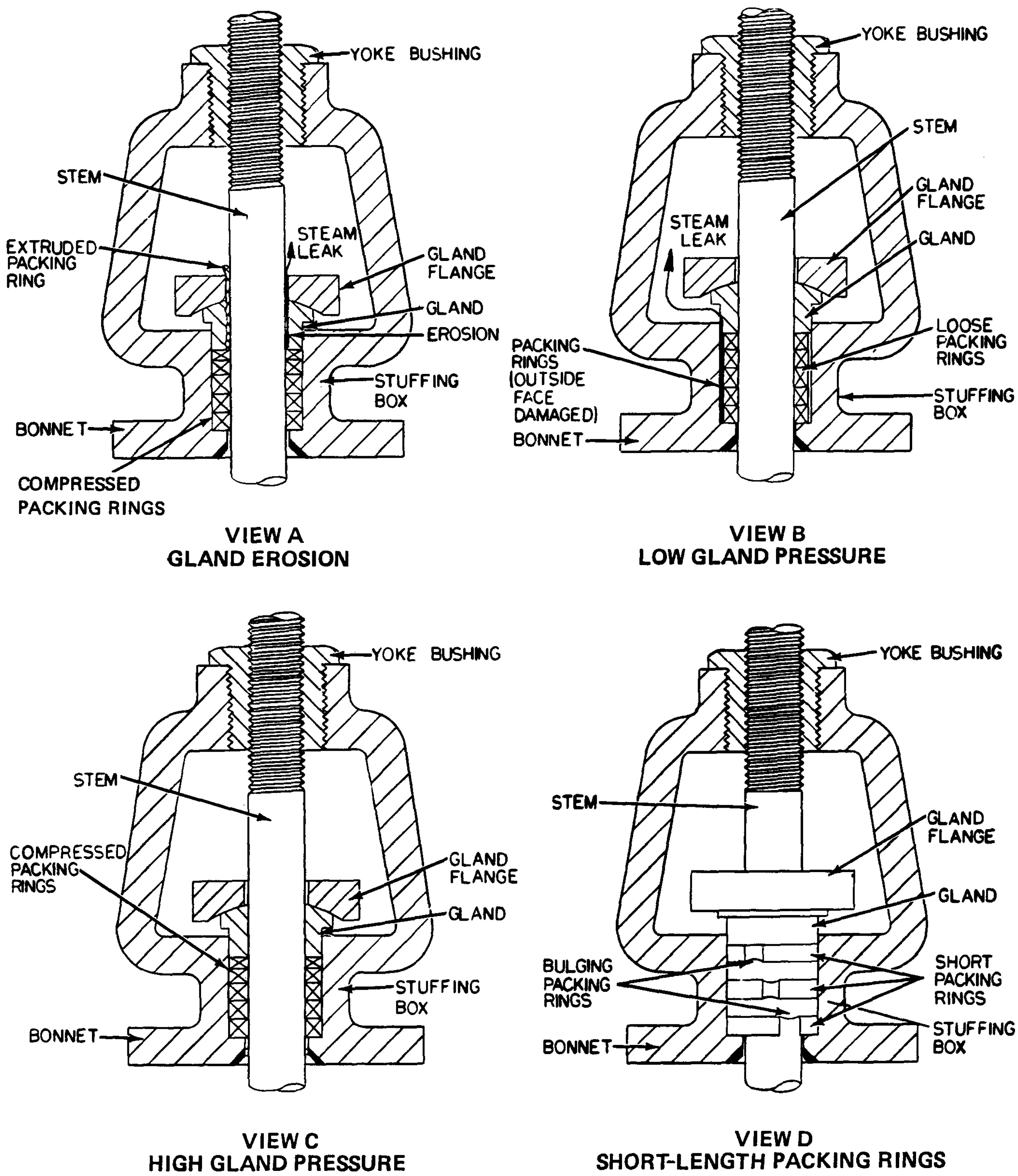


Figure 6-12. Gland and Packing Conditions

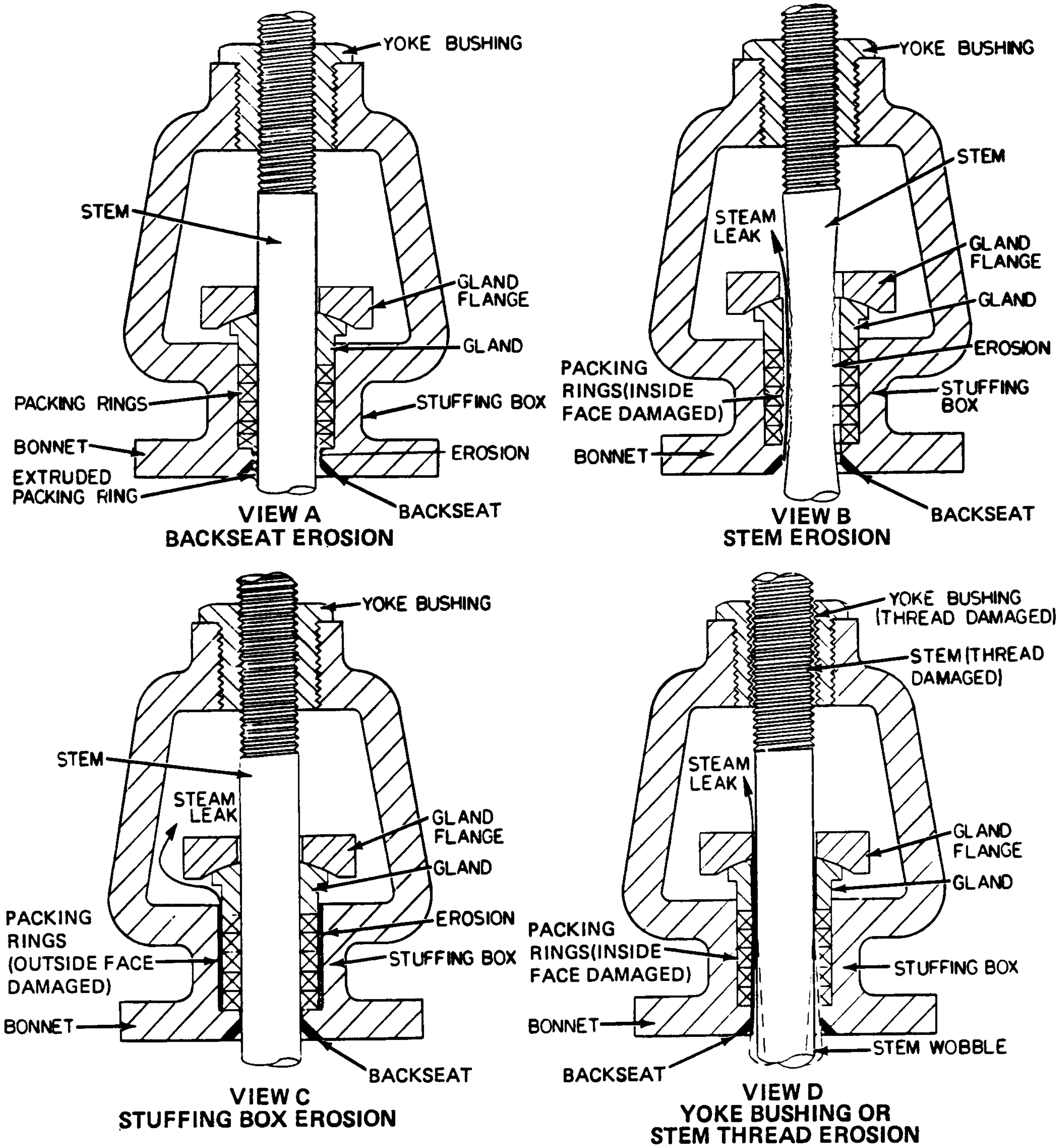


Figure 6-13. Stem and Bonnet Conditions

6-8.1.8 Yoke Bushing or Stem Thread Erosion. Yoke bushing or stem thread erosion is caused by improper closing or opening of the valve, or by uneven torque on the valve stem. Either factor causes a reduction of radial thickness in the lower packing rings (figure 6-13, view D).

6-8.1.9 Bowed Stem. A bowed stem is caused by improper torque on valve stem when opening or closing valve. This may cause damage to inside face of packing rings, yoke bushing thread damage, and gland erosion.

6-8.1.10 Stem Frozen in Yoke Bushing. A stem frozen in the yoke bushing is the result of yoke bushing and/or stem thread damage, which prevents the valve from opening or closing.

6-8.2 FLANGE INSPECTION. Much of the trouble experienced with flange leakage is due to flange erosion and steam cutting. Flange erosion and steam cutting are caused by poor alinement, incorrect gasket size and material, uneven raised flange faces, inconsistent number and size of bolts and nuts, flange design differences, flanges of different thicknesses, and improperly installed or missing pipe support hangers. To mate properly, valve flange and pipe flange must be of the same size and material required for system pressure and temperature. Raised flange faces must be the same size and have a serrated (phonographic) finish, and bolt together evenly. Bolts shall be of correct size for bolt holes, and mating flanges must be of the same thickness. Pipe support hangers shall be installed to evenly distribute weight throughout the length of pipe run.

6-9. PACKING AND GASKETS.

6-9.1 CORRUGATED RIBBON PACKING. Corrugated ribbon packing (CRP) (figure 6-14) is the preferred method for packing steam valves. However, braided asbestos may be used when CRP is unavailable. Corrugated ribbon packing is a 100 percent graphite material expressly suited for installation in steam, feedwater, and condensate valves. For a detailed description of CRP, see MIL-P-24503. The use of CRP in 1200- and 600-psi steam propulsion plants is authorized aboard conventionally powered naval vessels. These vessels have an installation capability certified by the cognizant Type Commander. Corrugated ribbon packing is used on steam valves in which the stuffing box temperature and pressure do not exceed 1,000°F (538°C) and 1250 psi, respectively. This packing contains no binders, resins, fillers, lubricants, or other additives that would be squeezed out, vaporized, or carbonized. It has the lubricating quality typical of pure graphite, with a capability for rapid heat dissipation, which reduces wear. It does not turn rock hard or shrink at any temperature. Unlike conventional graphite, which is brittle, CRP is flexible and highly resilient. It can easily be cut to any predetermined length. This packing has a restructuring capability that enables it to be wrapped around the valve stem in any size valve stuffing box, where it will be formed into a solid packing ring by compression. Once installed, and after run-in, CRP normally needs no further adjustment, which results in greatly reduced maintenance. Because CRP conducts electricity when stored, identification and warning stickers must be clearly visible on all containers to assure prevention of misuse for electrical insulation.

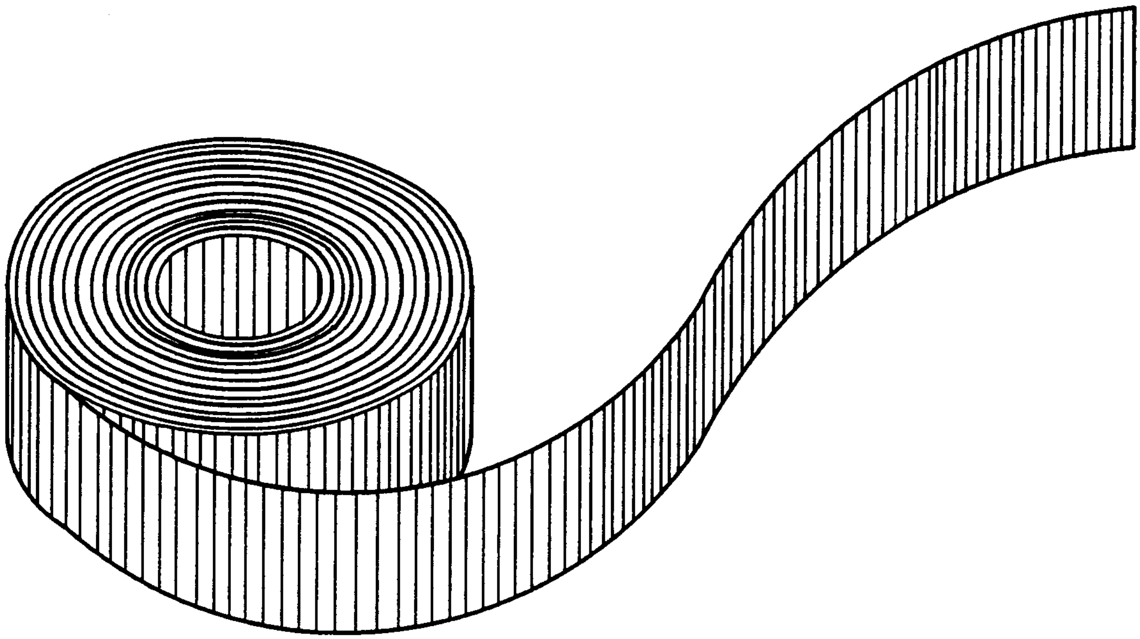


Figure 6-14. Corrugated Ribbon Packing

6-9.1.1 Packing Ring Installation Criteria. In compliance with NAVSEA LTR 04432/RT SER 344 of 6 May 1976, top and bottom anti-extrusion rings must be used when repacking manually operated steam valves for non-nuclear applications. This is also in accordance with NAVSEA 0948-LP-108-8010 and AEL-1-480100001. Corrugated ribbon packing shall be used with anti-extrusion rings made of graphite filament yarn (GFY) packing. If GFY is unavailable, a braided type of packing may be used but the valve must be repacked with appropriate material at the earliest opportunity. The rings must be installed at the bottom (first ring) and the top (last ring) of every stuffing box packing set. This prevents CRP from being forced out of the stuffing box (extruded) through stem-stuffing box, stem-gland, and gland-stuffing box clearances.However, steam valves previously packed with CRP do not require repacking to add anti-extrusion packing rings.

6-9.1.1.1 Graphite Filament Yarn Packing Rings. Graphite filament yarn (GFY) packing (figure 6-15) is a severe service packing ideal for use in difficult fluid handling applications. For a detailed description refer to MIL-P-24583. Graphite filament yarn packing is unaffected by the most destructive corrosive fluid substances and will withstand extreme temperatures of over 1,000°F (538°C) encountered in valve stuffing boxes. However, GFY should not be used in oxidizing environments above 775°F (413°C) such as gas turbine engine bleed air systems, or in nonoxidizing environments above 3,000°F (1,649°C). Graphite filament yarn packing is self-lubricating and possesses heat dissipation characteristics which allow tight packing adjustments to make leakage almost nonexistent. It also provides-protection against stem scoring, and reduces system fluid loss, maintenance, and down time. Graphite filament yarn packing is available in sizes from 1/8 to 1 inch square on spools. This packing is installed at the bottom of the valve stuffing box to provide a landing for CRP compression and at the top of the packing set. Both the bottom (first) and the top (last) GFY packing rings are compatible with, and will prevent extrusion of, the CRP.

6-9.1.1.2 Conventional Packing Rings. When GFY is not available, a ring of conventional, braided-type packing may be installed as the bottom (first) ring and as the top (last) ring of the stuffing box packing assembly. However, braided-type packing may contain wire binders, or it may become hard and brittle after use and score valve stem surface. In addition, braided asbestos packing is not authrozed. When procuring conventional packing, specify non-asbestos material. If conventional packing instead of GFY is used for anti-extrusion rings, valve must be disassembled inspected, and repacked with CRP and GFY anti-extrusion rings at the earliest opportunity.

6-9.1.2 Packing Tools and Materials. Tools and materials that shall be used to install packing are listed in tables 6-5 and table 6-6, respectively.

6-9.1.3 Valve Component Specifications. The best use of CRP and GFY is obtained by first ensuring that the valve components, surface finishes, and clearances are within the required tolerances.

6-9.1.3.1 Surface Finish. A 32-microinch (approximately 32 root mean square) surface finish is the maximum acceptable measured surface roughness value for both new and refurbished valve stems. To determine surface finish, comparison of the valve stem surface with a standard reference specimen may be made by the sense of touch. A simple method is by dragging a fingernail first over the standard reference block and then over the lay or ridges of the valve stem. A number of commercial manufacturing companies provide sets of machine specimen blocks for surface quality control evaluation. These sets often contain replicas of several roughness values that were produced by turning, milling, grinding, honing, and lapping. Standard surface finish reference specimens may be purchased presently from commercial sources only. An example is GAR Precision Products no. S-22 microfinish comparator. Repair activities may have other methods available to determine surface finish.

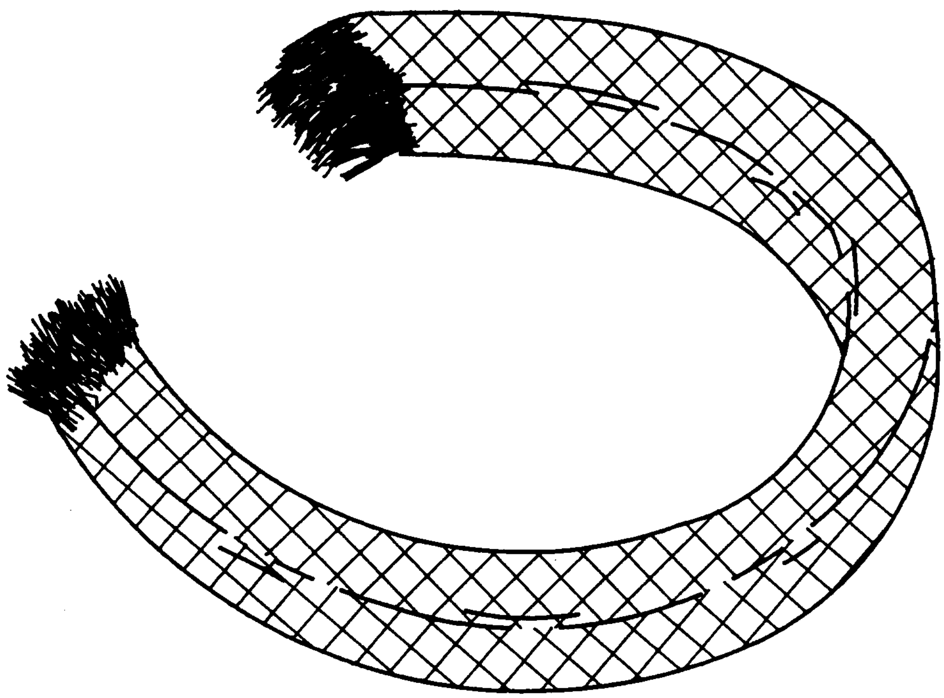


Figure 6-15. Graphite Filament Yarn Packing

Table 6-5. Packing Tools

Description	Size	Remarks
Slide caliper	6 inch	
Inside caliper	6 inch	
Outside caliper	6 inch	
Scale, steel	6 inch	
Depth Gage	6 inch, 1/4 inch wide	
Wrenches-open end	Various	
Wrenches-box end	Various	

Table 6-5. Packing Tools - Continued

Description	Size	Remarks
Packing pullers, corkscrew type	Various	
Machinist's scribes	Various	
Feeler gages	Various	
Inspection mirror	2 inch x 3 inch	
Diagonal cutters	8 inch	
Sharp knife, razor, etc.	----	
Surface plate, parallel bars, or lathe and dial indicator	----	
Packing pushers	Various	Two lengths required for each valve stuffing box
Flashlight	Various	
Emery cloth, grit nos. 60, 90, 120, F	----	
Cleaning fluid	----	
Rags	----	Lint free
Die set	----	For forming CRP wraps into rings. Includes all widths
Microfinish comparator, No. S-22	----	For comparing surface finish of valve stem

Table 6-6. Packing Materials

CRP Packing NSN	Width	Length
9Z5330-01-011-5050	1/4 inch	50 ft
9Z5330-01-011-5049	1/2 inch	50 ft
9Z5330-01-011-5048	3/4 inch	100 ft
9Z5330-01-004-6639	1 inch	100 ft

GFY Packing NSN (1-lb spool)	Size
9Z5330-01-033-3010	1/4 inch
9Z5330-01-033-3363	1/2 inch
9Z5330-01-033-1716	3/4 inch

6-9.1.3.1.1 Profilometer. The profilometer automatically produces the RKS average. (Arithmetical average may be optional.) This instrument, designed for shop use, takes readings from a hand-held stylus or a motor-driven tracer. The profilometer will handle roughness widths of up to 1/32 inch.

6-9.1.3.1.2 Brush Surface Analyzer. The brush surface analyzer will inspect most surface irregularities encountered in machining operations, but is normally limited to laboratory operations on small parts. The brush surface analyzer will handle roughness widths of up to 0.025 inch.

6-9.1.3.2 Valve Component Clearances. Satisfactory performance of CRP installations may be attained only when the valve component clearances are not exceeded. Figure 6-16 shows the maximum radial clearance allowed at the stem, gland, and stuffing box. Table 6-7 lists the diameter and radial clearances between each component. Diametrical clearance between each component must be obtained. The diametrical clearance between the stem and the bottom of the stuffing box is the value of the inside diameter at the bottom of the stuffing box less the outside diameter of the stem. The diametrical clearance between the stem and gland is the value of the inside diameter of the gland less the outside diameter of the stem. This value also applies to the gland at the top of the stuffing box less the outside diameter of the gland. These factors will determine the quantity of CRP rings to use when repacking the valve.

6-9.1.3.3 Valve Component Defects. Prior to the installation of CRP, the stem, gland, and stuffing box shall be inspected for defects.

6-9.1.3.3.1 Stem. The maximum diameter, length, width, or depth of any pit, cut, scratch, or nick allowable on a valve stem is 0.006 inch. A series of pits, cuts, scratches, or nicks that form a path for leakage is unacceptable regardless of the diameter or depth. Stem surface finish must be 32 microinches. The repair of valve stems to meet the surface finish of 32 microinches can sometimes be accomplished by polishing. Use no. 60 or no. F emery cloth or equivalent. When polishing does not provide an acceptable surface condition, it is permissible to remove up to 2 percent of the stem diameter by grinding or machining. However, the maximum allowable radial clearance from stem to gland bushing and stem to stuffing box at the bottom penetration must not exceed the tolerances listed in table 6-7. The decision to repair or replace valve stems to meet tolerances is left to the discretion of the installing activity. If instruments are not available to conduct the measurements discussed above, as general guidance, the stem should be virtually free of all pits, cuts, scratches, or nicks. Most steel valves have hardened, CR 13 steel stems which are difficult to machine or polish. Valve stem repairs other than simple machining and polishing shall be considered an interim fix until such time as a new stem can be procured. A repair such as weld buildup and machining of a stem is an example of an interim repair. The stem must not exceed a total indicator reading (TIR) of 0.003 inch radial measured along the surface of the stem. This measurement is taken between the stem thread and the end of the stem. Total indicator reading can be determined by using a true surface plate of parallel bar and feeler gage (shown in figure 6-17). Another TIR method involves using a dial indicator with the stem on a lathe chuck (shown in figure 6-18).

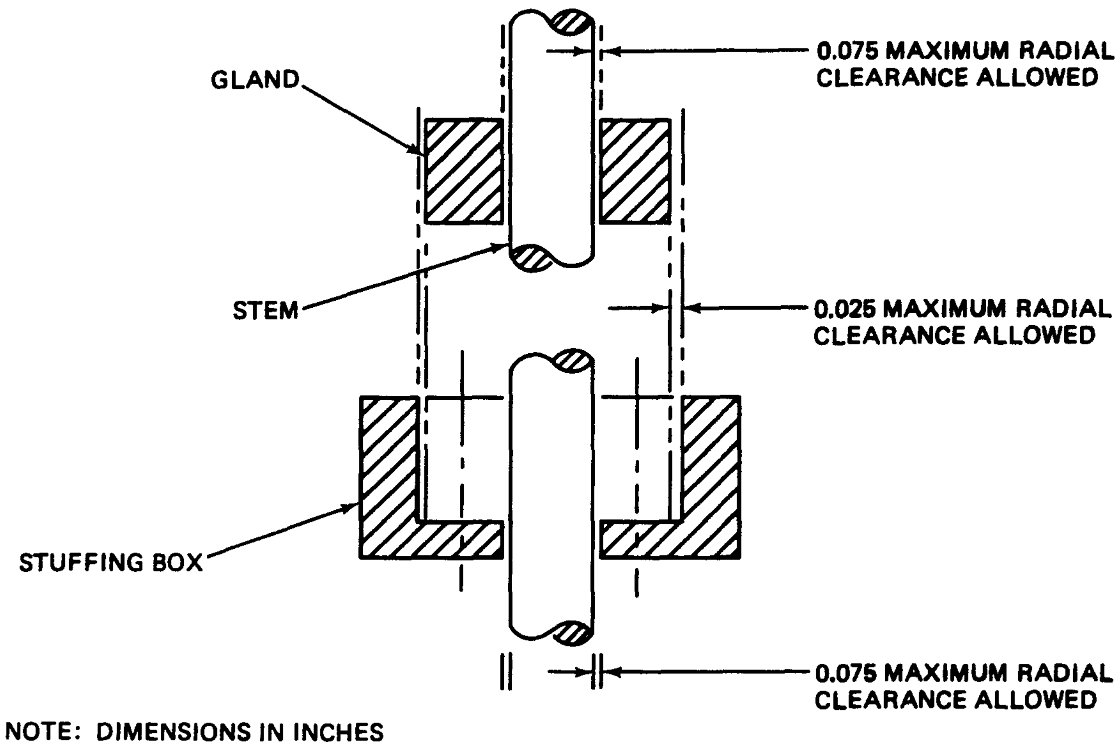


Figure 6-16. Maximum Clearance of Valve Components

Table 6-7. Component Radial and Diametral Clearances

Clearance Location	Radial (inch)	Diametral (inch)
Stem outside diameter/ Stuffing box inside diameter	0.075	0.150
Stem outside diameter/ Gland inside diameter	0.075	0.150
Gland outside diameter/ Stuffing box inside diameter	0.025	0.050

6-9.1.3.3.2 Gland. Gland surfaces, to include bottom flat, and the inside and outside portion of the gland that sits inside the stuffing box, shall be cleaned and smooth. Any defects shall be removed, and the bottom surface of the gland shall be flat. All serious gland problems shall be corrected by replacing or by cutting down the gland and force fitting a sleeve over the reduced diameter gland.

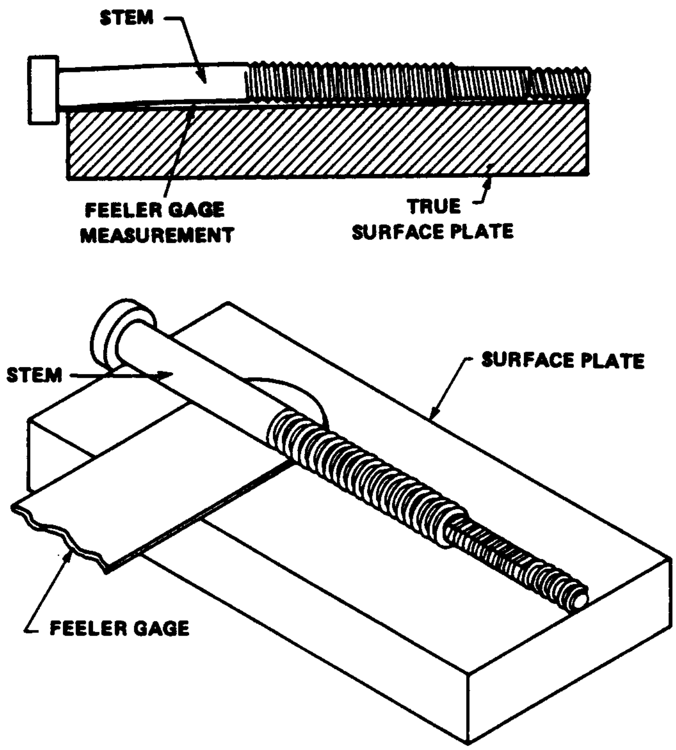


Figure 6-17. Surface Plate/Feeler Gage Method of Determining Stem Alinement Total Indicator Reading

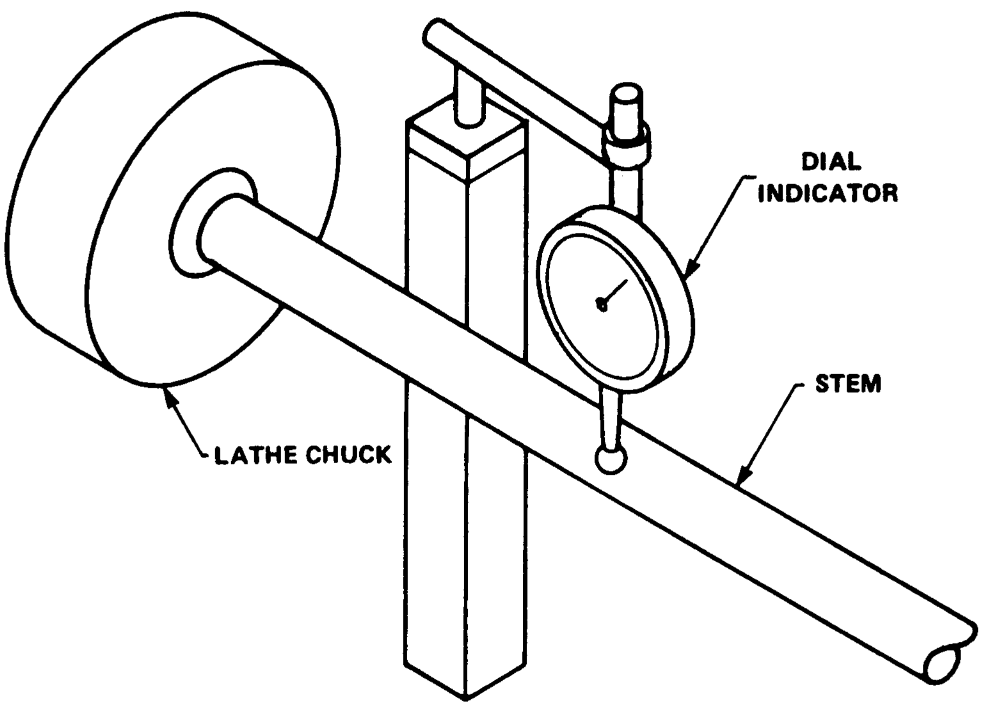


Figure 6-18. Lathe/Dial Indicator Method of Determining Stem Alinement Total Indicator Reading

6-9.1.3.3.3 Stuffing Box. The stuffing box should be free of excessive corrosion and rust buildup on the inside surfaces and where the gland to stuffing box clearances are measured. All surface high spots shall be removed to allow for easy packing installation.

6-9.1.4 Valve Preparation. The following procedure shall be used to prepare a valve for CRP installation.

1. Remove old conventional packing or GFY with corkscrew-type packing puller. Remove CRP with a machinist's scribe or packing puller, using either end to engage packing and pull or flip it out. If valve is not assembled, use care to prevent scratching metal finish of stem and inside surface of stuffing box.
2. Stem roughness and/or high spots will destroy packing. Scale can permit leakage through itself and around packing. Inspect valve stem and remove all corrosion, scaling, nicks, cuts, burrs, crowns, and scratches. Low, high, flattened, and out-of-round spots on surface shall be removed. Also, oil, grease, and abrasive dust particles shall be removed from any portion of the valve stem that passes through packing. Complete removal of stem from valve is required. Valve gland surface bearing against packing shall be restored to square if it has become bullet nosed or rounded.
3. Do not pack valve until stem, gland, and stuffing box deficiencies have been corrected and valve stem surface finish has met the requirements of paragraph 6-9.1.3.1. Also, ensure that valve component clearances do not exceed those specified in table 6-7.

6-9.1.5 Packing Selection Criteria. There are two factors involved in selecting CRP: packing width and packing length. The following procedures shall be used to select the appropriate sizes.

6-9.1.5.1 Width Selection. The following procedure shall be used to select the appropriate width.

1. Measure clearance between top of stuffing box and bottom of packing gland with gland moved as far from stuffing box as it will go (figure 6-19, view A, dimension A). This measurement will determine the maximum width of CRP that may be inserted into valve and wrapped around stem.

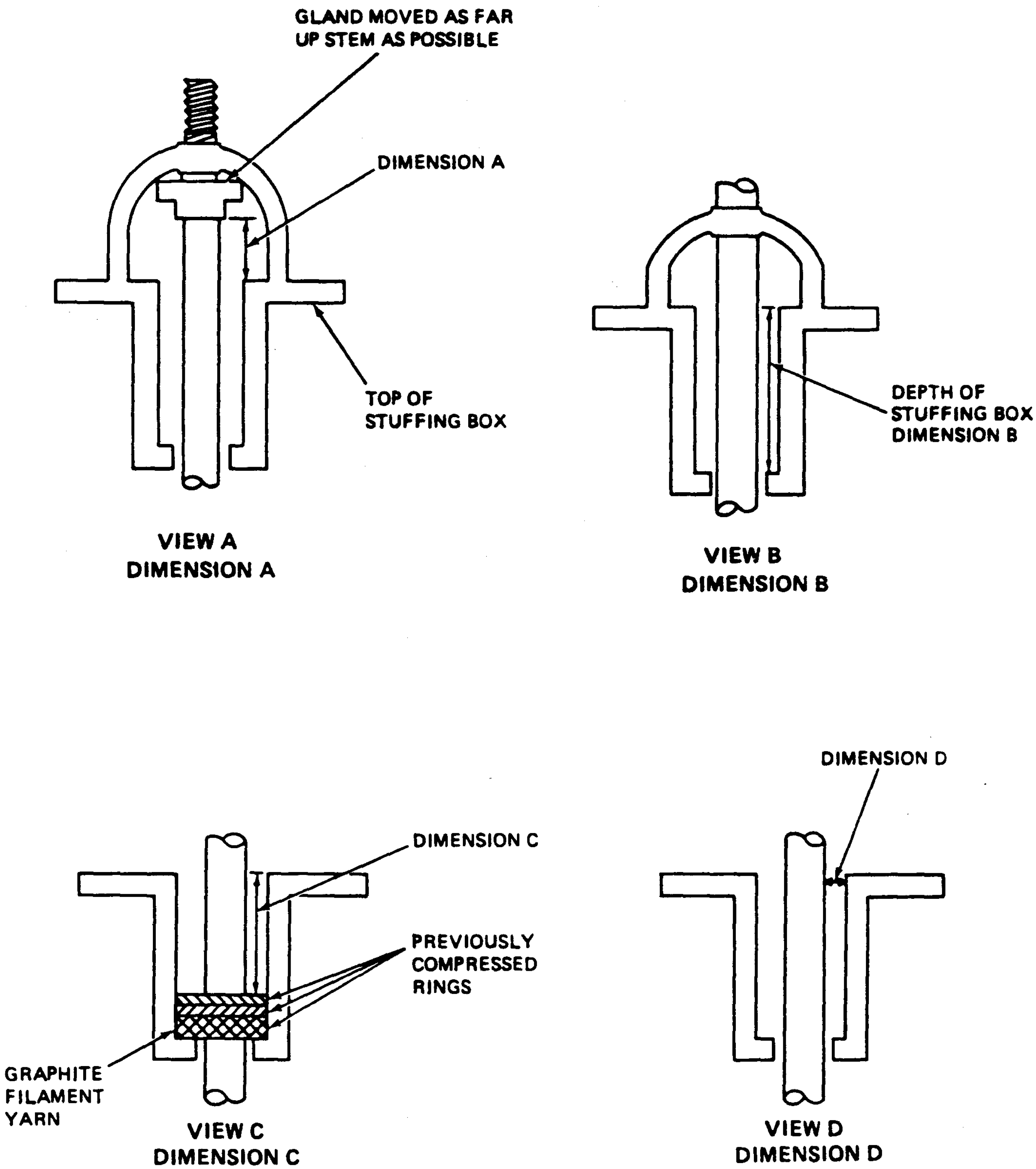


Figure 6-19. Determining Stuffing Box Dimensions

2. Determine adjusted stuffing box depth. To do this, measure depth of stuffing box (view B, dimension B) and deduct thickness of one GFY anti-extrusion ring. This measurement will allow for 50 percent compression of two GFY rings. Thickness of GFY to be used is determined by measuring distance between stem and inside of stuffing box (view D, dimension D). Select size of GFY closest to stem-to-stuffing box measurement.

3. Determine uncompressed thickness of CRP set required. To determine this, multiply the value of adjusted stuffing box depth by two. Select widths of CRP necessary to obtain this height. Table 6-8 provides a chart for some commonly used width selections. When installing and compressing packing rings, two or more sizes of packing may be required to prevent extrusion of final rings as they are being compressed. Top of uncompressed packing ring should never extend above top of stuffing box.

4. Determine distance from last ring of previously compressed CRP to top of stuffing box once packing has commenced (view C, dimension C). This measurement will determine the width of CRP that must be used to prevent extrusion of additional packing above top of stuffing box when packing is compressed.

6-9.1.5.2 Length Selection. Table 6-9 lists approximate CRP length requirements for some commonly encountered stem diameters and stuffing box clearances. The following procedure shall be used to select the appropriate length.

1. Wrap one ring of CRP to medium tightness around valve stem until ring of packing just slips easily into stuffing box.

2. Remove, measure, and cut all subsequent pieces of packing to this same length to produce a packing set of medium tightness for complete stuffing box installation.

6-9.1.6 Packing Installation Procedures. Corrugated ribbon packing and GFY can be installed in both rotating and sliding stem valve stuffing boxes. On stuffing boxes, it is desirable to use packing pushers (figure 6-20) to obtain the required compression of each CRP ring as the ring is inserted. The packing pushers are made with a specific diameter and length that will fit into the specific dimensions of the stuffing box. The packing pushers are split, gland-like brass, plastic, or wood bushings that add length to the gland. The shorter type of packing pusher is used to compress the CRP rings into shallow stuffing boxes, or the top rings into deep stuffing boxes. The longer split gland packing pusher and the tapped split-sleeve type packing pusher are used to compress the CRP bottom rings into deep stuffing.

Table 6-8. Corrugated Ribbon Packing Width Selection Chart

Packing Width (inches)					
Adjusted Stuffing Box Depth (in.)	**1 in.**	**3/4 in.**	**1/2 in.**	**1/4 in.**	**Total Rings**
1/2	-	-	1	2	3
5/8	-	-	2	2	3
3/4	-	1	1	1	3
7/8	1	-	1	1	3
1	1	1	-	1	3
1-1/8	1	1	1	-	3
1-1/4	2	-	1	-	3
1-3/8	2	-	1	1	4
1-1/2	2	1	-	1	4
1-5/8	2	1	1	-	4
1-3/4	3	-	1	-	4
1-7/8	3	-	1	1	5
2	3	1	-	1	5
2-1/8	3	1	1	-	5

Table 6-8. Corrugated Ribbon Packing Width Selection Chart - Continued

Packing Width (inches)					
Adjusted Stuffing Box Depth (in.)	**1 in.**	**3/4 in.**	**1/2 in.**	**1/4 in.**	**Total Rings**
2-1/4	3	1	1	1	6
2-3/8	4	-	1	1	6
2-1/2	4	1	-	1	6
2-5/8	4	-	2	1	7
2-3/4	4	1	1	1	7
2-7/8	5	-	1	1	7
3	5	-	2	-	7

The following, with reference to figure 6-19, is an example to assist in computing proper width selection: A valve has a 3-inch deep stuffing box (dimension B), a 1/4-inch clearance between stem and stuffing box (dimension D), and a 1-inch clearance between top of stuffing box and bottom of gland (dimension A). Based on dimension D, two 1/4-inch GFY anti-extrusion rings will be used. Assuming 50 percent compression of the GFY, the combined thickness of both GFY rings will be 1/4 inch after compression. The adjusted stuffing box depth is therefore 2-3/4 inches (3 inches minus 1/4 inch). If all CRP rings are compressed 50 percent, four 1-inch wide rings, one 3/4-inch wide ring, one 1/2-inch wide ring, and one 1/4-inch wide ring packing can be installed without the last extrusion rings. The total uncompressed height of the CRP and GFY is 5-1/2 inches. After the top GFY anti-extrusion ring is installed, gland nuts are to be tightened as necessary until packing gland extends into stuffing box at least 1/8 inch. boxes. The tapped split-sleeve-type pusher is retrieved from the bottom of the stuffing box by means of a long screw, bolt, or threaded rod. The size and construction of some valves make it difficult to insert packing pushers. In these cases, Teflon packing may be wrapped around the stem and used to push the CRP into the stuffing box. After the CRP is installed, the Teflon packing is removed and the packing pusher is used to compress the CRP.

Table 6-9. Corrugated Ribbon Packing Length Selection Chart

Stem Outside Diameter (inches)	**Stem to Stuffing Box Measurement (Figure 6-19, Dimension D) (inches)**									
	1/16	**1/8**	**3/16**	**1/4**	**5/16**	**3/8**	**7/16**	**1/2**	**9/16**	**5/8**
1/4	3	6	10	14	21.6	-	-	-	-	-
3/8	-	8	12	18	26	-	-	-	-	-
1/2	-	10	15	22	31	42	-	-	-	-
5/8	-	12	18	25	36	48	-	-	-	-
3/4	-	20	29	41	54	65	-	-	-	-
7/8	-	24	32	46	60	71	-	-	-	-
1	-	-	36	50	66	78	91	-	-	-
1-1/8	-	-	40	55	72	85	99	-	-	-
1-1/4	-	-	43	60	78	92	106	-	-	-
1-3/8	-	-	-	65	84	99	114	130	-	-
1-1/2	-	-	-	70	90	105	122	139	-	-
1-5/8	-	-	-	74	96	112	129	147	-	-
1-3/4	-	-	-	-	102	119	137	155	174	-
1-7/8	-	-	-	-	108	126	144	164	184	-
2	-	-	-	-	114	133	152	172	193	-
Lengths given in inches										

6-9.1.6.1 Installation Using Packing Pusher. The following procedure shall be used for installing CRP and GFY using a packing pusher.

1. Remove and inspect valve stem and bonnet for defects (paragraph 6-9.1.3.3).
2. Remove old packing using either a machinist's scribe or packing puller (paragraph 6-9.1.4).
3. If not previously determined, measure and record valve dimensions (shown in figure 6-19, views A, B, C, and D). When criteria have been met, reassemble bonnet and/or valve.
4. Wrap GFY around valve stem and mark for correct length. For ease in handling and installation, use a butt-joint cut.
5. Insert bottom GFY anti-extrusion ring as deeply as possible into stuffing box by using split packing pusher.
6. Place packing gland in position and seat bottom anti-extrusion ring by tightening gland nuts on gland studs.
7. Remove gland nuts, slide packing gland up against yoke bushing, and secure. Remove packing pusher.

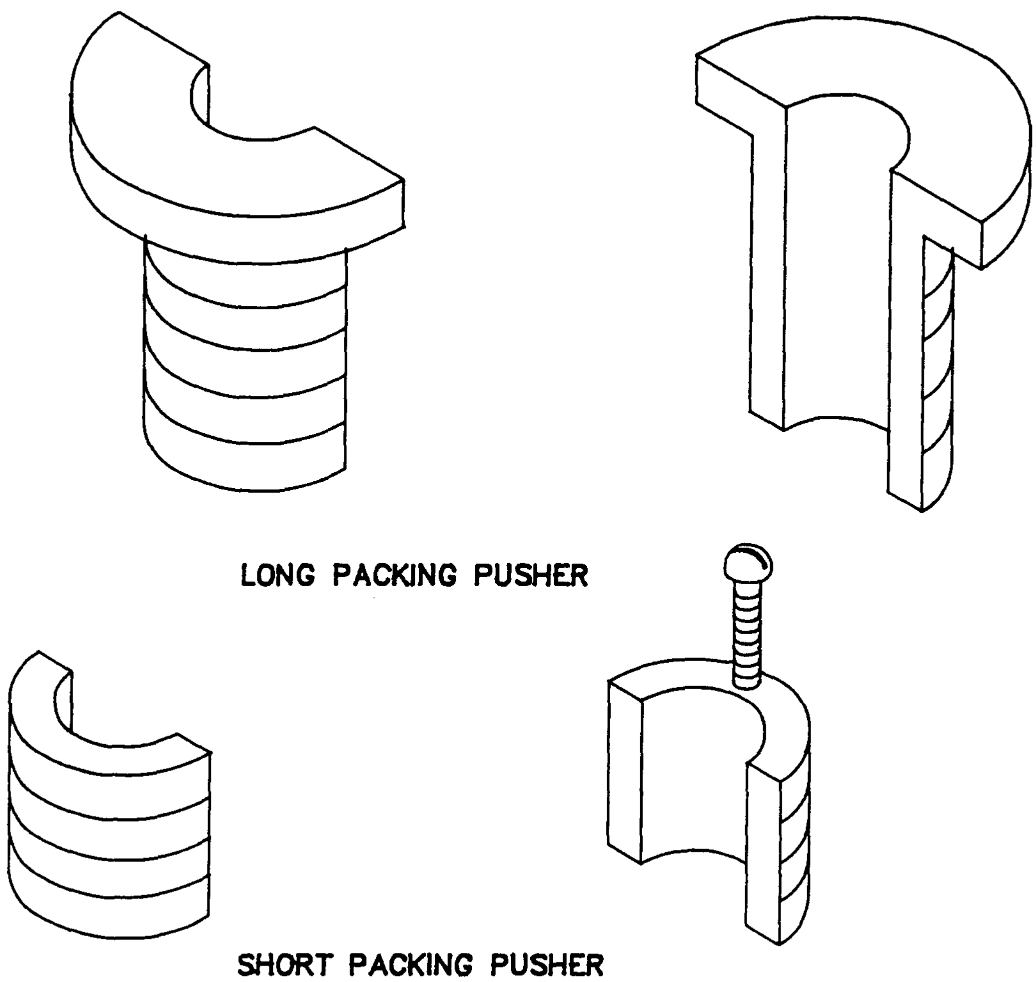


Figure 6-20. Packing Pushers (Typical)

8. Determine required CRP widths (paragraph 6-9.1.5.1).
9. Wrap CRP around valve stem until ring of packing will just slip easily into stuffing box as shown in figure

6-21. Although it is desirable for ease of installation, a continuous length of CRP is not required when forming packing ring around valve stem. If packing ribbon is torn, insert torn end under preceding wrap and continue to wrap CRP around valve stem. Wrap until packing ring will just slip easily into stuffing box.

10. Push CRP ring into stuffing box.

11. Install split packing pusher and push CRP ring to bottom of stuffing box.

12. Place packing gland in position and compress CRP to 50 percent of original width by tightening gland nuts on gland studs. Amount of compression can be determined by measuring distance between top of stuffing box and bottom of gland before and while compressing packing.

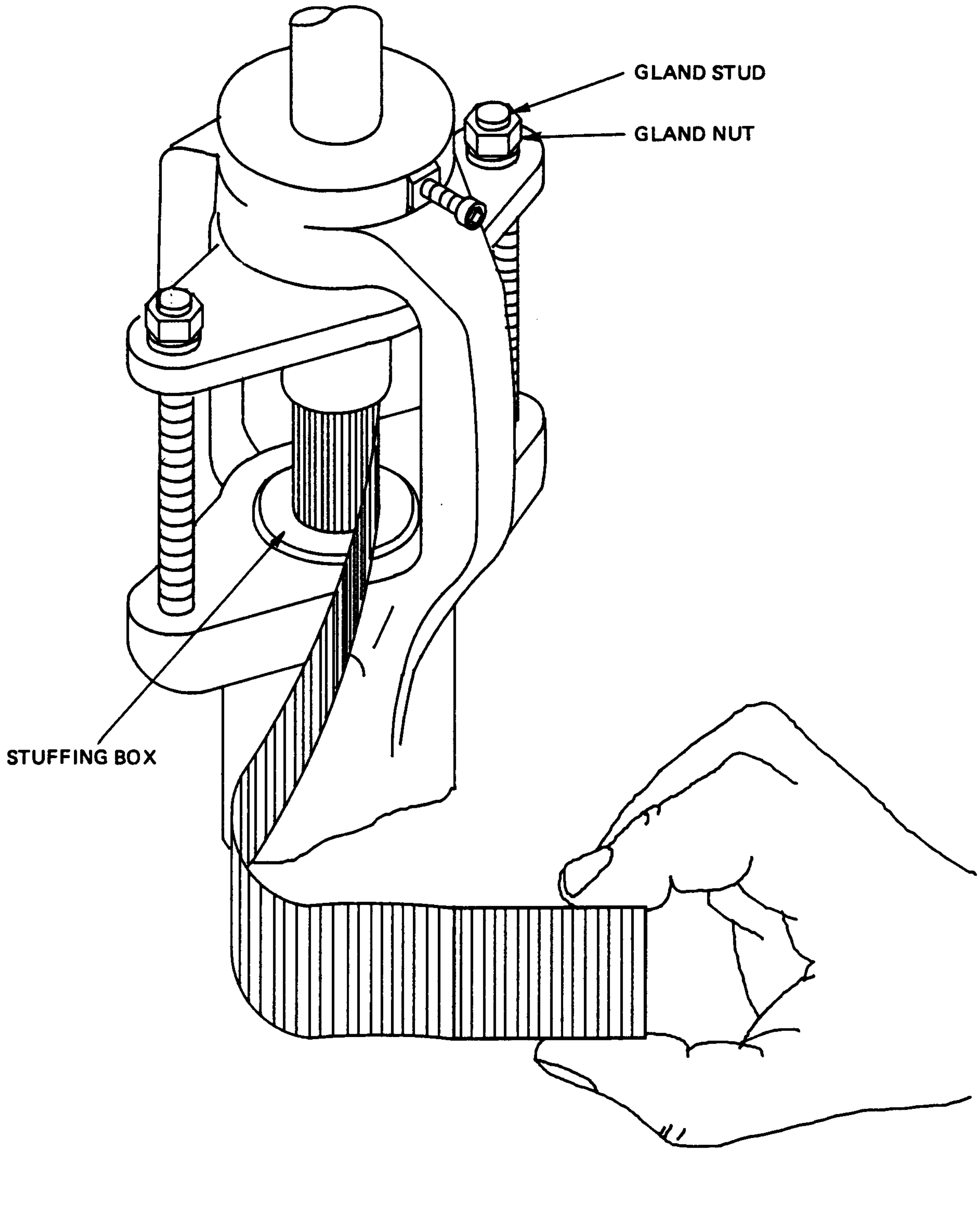


Figure 6-21. Packing Installed on Valve Stem

13. Packing must be compressed a minimum of 50 percent. It may be necessary to compress packing more than 50 percent to provide satisfactory seal, depending on tightness of the wrap. In this case, an increase in calculated number and/or width of subsequent rings may be required.
14. Cycle valve once from fully open to fully closed to fully open position.

15. Remove gland nuts, slide packing gland up against yoke bushing, and secure. Remove split packing pusher.

16. Inspect top surface of CRP and remove any packing that has extruded up valve stem or sides of stuffing box, using a piece of wood such as a tongue depressor.

17. Repeat steps 9 through step 16 until all required CRP rings are installed.

18. Measure and cut top GFY anti-extrusion ring as in step 4.

19. Insert top GFY anti-extrusion ring into stuffing box.

20. Place packing gland in position.

21. Coat threads of gland nuts and gland studs with MIL-A-907 anti-seize compound, and tighten gland nuts until gland starts to compress GFY.

22. Cycle valve once from fully open to fully closed to fully open position.

23. Tighten gland nuts. Final packing set should be compressed as shown in figure 6-22 (after full compression).

24. If packing leaks when valve is placed under system pressure, tighten gland nuts one flat at a time until leakage stops. Minimum clearance of 1/8 inch is allowed between gland and top of stuffing box; otherwise, additional rings of CRP must be added if leakage continues. Originally installed top anti-extrusion ring may be reused when adding packing if no evidence of damage is noted.

6-9.1.6.2 Installation Using Die-Formed Rings. Manufacture of die-formed packing rings is possible by using a small die set. It is designed to produce partially compressed packing rings to fit a specific valve stuffing box size, and is capable of compressing CRP wraps to different thicknesses. After compression, the CRP wrap is installed on the valve stem as a unit by installing it over the valve stem of a disassembled valve. The compressed ring can be also cut and slipped over the valve stem on assembled valves. The cut should be beveled for better sealing and staggered when installed so the cuts do not line up in the valve stuffing box. The cuts in the rings should be 180 degrees apart for two rings, 120 degrees apart for three rings, and 90 degrees apart for four or more rings. The following procedure shall be used to form CRP rings.

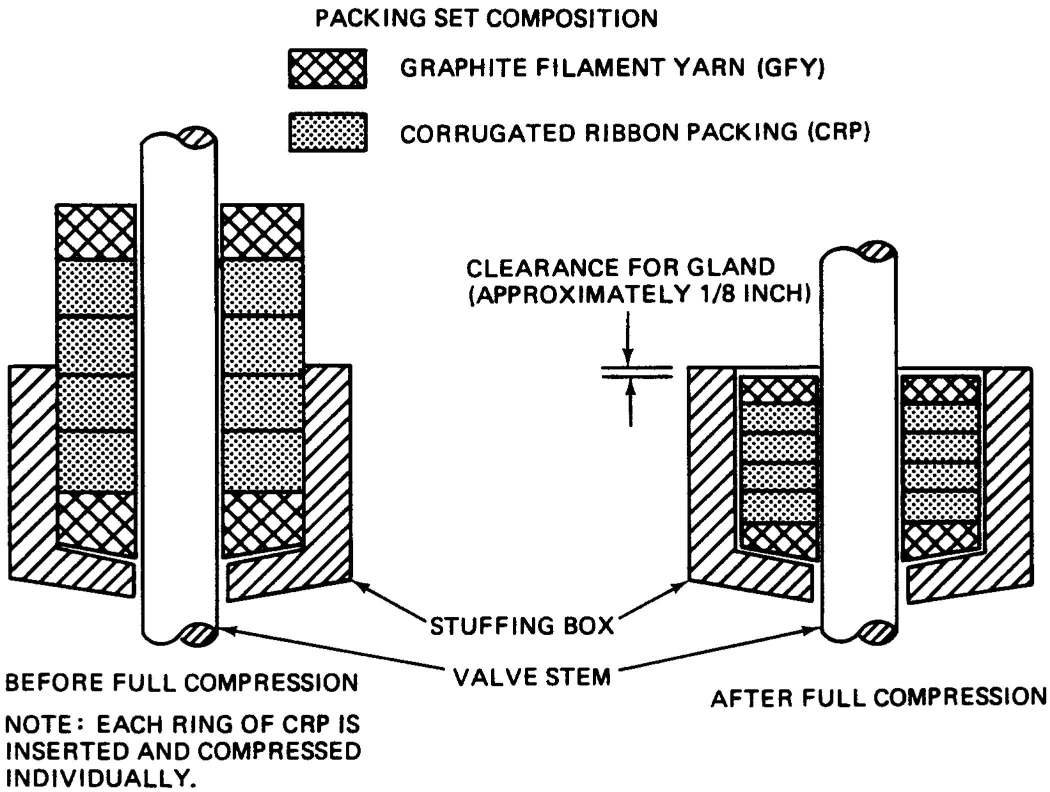


Figure 6-22. Compression Requirements for Packing Set in Stuffing Box

1. Using die set (figure 6–23) wrap calculated length of CRP around die stem.
2. Compress CRP to approximately 50 percent of its original width, using gland.
3. Remove compressed CRP from die set stuffing box.
4. Install formed CRP in valve stuffing box and tighten packing gland until it extends at least 1/8 inch into stuffing box.

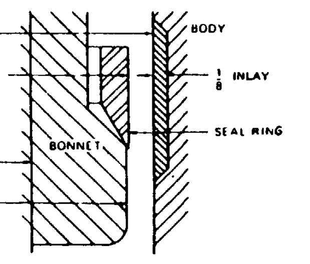
6-9.2 Deleted

6-9.3 SPIRAL-WOUND METALLIC GASKET.

6-9.3.1 Spiral-Wound Metallic Gasket With Retaining Ring. The spiral-wound metallic gasket with retaining ring is used to form a seal between two flange faces to prevent pressure leaks. It is composed of a single strip of dovetail-shaped metal and graphitic corrugated ribbon or textured tape which is spirally wound and inserted in a solid metal outer or retaining ring. The spiral-wound metal and graphitic corrugated robbon tape is called a refill and is replacable. When renewal of a gasket is required, the refill should be removed from the retaining ring and replaced. The retaining ring should not be discarded unless it is damaged.

6-9.3.2 Spiral-Wound Metallic Gasket Without Retaining Ring. The spiral-wound metallic gasket without retaining ring is used to form a seal between a bonnet and valve body to prevent pressure leaks. It is composed of the same materials as described in paragraph 6-9.3.1, except for the retaining ring, and is normally called a bonnet gasket. Ensure that the gasket meets the required pressure range and size for the appropriate valve being repaired.

6-9.4 PRESSURE SEAL RING. The bonnet sealing element of pressure seal valves consists of a soft iron, silver-plated seal ring. The ring is located and wedged between the bonnet and the valve body wall by a mechanical positioning arrangement. A diagram of both a typical standard, and oversize pressure seal junction cross-section is provided in figure 6-24, sheet 1. Depicted in the diagram are the body, bonnet, pressure seal ring, and stainless steel weld deposit on the body. The dimensional clearances indicated therein are measured from the body bore. All dimensions are indicated as a function of the diameter, not the circumference of the various parts. These tolerances are indicated for new or restored valves and pressure seal rings of all sizes, installed on board ships. A standard size seal ring can be stretched to accommodate a slight increase in body bore diameter. Sealing is obtained from system pressure acting through the bonnet, which permanently deforms the seal ring lip in such a manner that a tight seal is obtained. For this reason, the seal ring must not be reused, but must be replaced each time a valve is disassembled for repair. The silver plating on the seal ring is required for corrosion protection and, of greater importance, to help seal the metal to metal junctions. The malleable and ductile silver coating flows during mechanical loading at the system temperature and pressure, filling minute surface imperfections between the body and the seal rings. Also filled are any imperfections between the bonnet and the seal ring. The silver filling prevents the inception of a path that may result in steam cutting of the mating valve parts. Pressure seal ring sizes and fabrication, and oversize pressure seal rings are discussed in the following paragraphs.



PRESSURE SEAL ARRANGEMENT SCHEMATIC DIAGRAM
(SEE NOTE 1)

DIMENSIONAL TOLERANCES – UNLESS OTHERWISE SPECIFIED							
MACHINED				WELDMENT		CASTING	
DIMENSION	DECIMALS 2PL	DECIMALS 3PL	FRACTIONS	DIMENSION	TOLERANCE	DIMENSION	TOLERANCE
				UNDER 24"	± 1/16"	UNDER 2"	+1/16" – 1/16"
UNDER 6"	±.010"	±.005"	±1/64"	24" & OVER	± 1/8"	2" TO 5"	+3/32" – 1/16"
6" TO 24"	±.020"	±.010"	±1/32"			5" TO 8"	+1/8" – 3/32"
24" & OVER	±.030"	±.015"	±1/16"	ANGULAR ± 0°30'		8" TO 12"	+3/16" – 1/8"
ANGULAR ± 0°30'						12" TO 15"	+1/4" – 3/16"
						15" & OVER	+1/4" – 1/4"
FINISH SYMBOLS – ANSI - B46 1				CONTROL SYMBOLS – ANSI – Y14.5			
MACHINING OF THREADS NBS H – 28 & MIL – STD – 9							

GENERAL NOTES

1. THE INDICATED MANUFACTURERS HAVE PROVIDED THE INFORMATION ON THIS DRAWING TO THE NAVY TO PERMIT THE MANUFACTURE OF THE SEAL RINGS BY SHIP REPAIR ACTIVITIES. THE VALVE MANUFACTURERS ASSUME NO RESPONSIBILITY DIRECT OR INDIRECT FOR THE QUALITY OR PERFORMANCE OF VALVES USING SEAL RINGS MANUFACTURED BY THESE OR OTHER SOURCES.
2. RINGS SHALL BE MACHINED ALL OVER TO SURFACE TEXTURE SHOWN.
3. RINGS SHALL BE SILVER PLATED 0.002" TO 0.003" THICK SOFT STEEL 110 BRINNEL MAXIMUM. RECOMMENDED HARDNESS 90 TO 100 BRINNEL.
4. SILVER PLATING THICKNESS ON ANY ONE RING SHALL NOT VARY MORE THAN 0.001".
5. TOP OF RINGS SHALL BE SQUARE WITH AXIS.
6. THE REMAINING THREE SIDES OF RING SHALL BE MACHINED IN ONE MACHINE SETUP.
7. BREAK ALL CORNERS AT SHARP EDGE 1/64 MAXIMUM RADIUS.
8. OVERSIZE NO. 1 RINGS SHALL HAVE ONE GROOVE IN BORE.
9. OVERSIZE NO. 2 RINGS SHALL HAVE TWO GROOVES IN BORE.
10. DIMENSION C SHALL BE +0.005" -0.000".
11. DIMENSION D +0.5° -0.0° FOR CRANE, WALWORTH, ANCHOR/DARLING AND VELAN.
12. SEAL RING SIZE SHALL BE SELECTED FROM THE TABLES BASED UPON THE AVERAGE MEASUREMENT OF THE INSIDE DIAMETER OF THE VALVE BODY NECK IN THE AREA OF THE INLAY (SEE DIMENSION E IN DIAGRAM). THE LARGEST SEAL RING (SEE DIMENSION A IN TABLES) THAT WILL PERMIT A DIAMETRICAL CLEARANCE OF NOT LESS THAN 0.002" BETWEEN THE INLAY AND THE SEAL RING (E MINUS A MAXIMUM) SHALL BE SELECTED. IN THE EVENT THAT DIMENSION E IS MORE THAN 0.012" LARGER THAN THE MAXIMUM OUTSIDE DIAMETER OF THE OVERSIZE 2 SEAL RING, THE INLAY SHALL BE REPLACED. THE OLD INLAY MATERIAL SHALL BE MACHINED OUT AND REPLACED USING INCONEL PER MIL-E-21562. TYPE EN 625 OR RN 625. THE NEW INLAY SHALL BE MACHINED SUCH THAT DIMENSION E IS 0.002" TO 0.005" LARGER THAN THE MAXIMUM STANDARD RING DIAMETER. THE BONNET OUTSIDE DIAMETER SHALL ALSO BE RESTORED TO E MINUS 0.008" TO 0.011" WHEN THE INLAY IS REPLACED. REPAIR ACTIVITIES SHOULD CONTACT NAVSEA CODE 56Y23 FOR INFORMATION.
13. WHERE TOLERANCES ARE NOT SPECIFIED, TOLERANCES TABLE APPLIES.
14. WHEN RINGS ARE MANUFACTURED BY REPAIR FACILITIES, THE CUSTOMARY MARK OF THE FACILITY SHALL BE ETCHED OR IMPRINTED ON THE SURFACE FORMED BY DIMENSIONS A AND B.
15. THE SEAL RING DIAMETRICAL CLEARANCES INDICATED HEREIN ARE BASED UPON COMMERCIAL PRACTICE AND EXPERIENCE THAT OPTIMIZE EFFECTIVE SEALING AND ASSEMBLY. THE USE OF CUSTOM-FITTED SEAL RINGS WITH TIGHTER CLEARANCES IS NOT PRECLUDED. HOWEVER, WHEN CUSTOM-FITTED SEAL RINGS ARE USED, THE VALVE SHALL BE TAGGED TO INDICATE THE SPECIAL CONDITION AND THE NEXT CUSTOM OVERSIZE RING SHALL BE PROVIDED TO THE SHIP. IT SHALL BE PACKAGED TO PREVENT DAMAGE DURING STORAGE. THE MAXIMUM OVERSIZE DIMENSIONS OF THIS DRAWING SHALL NOT BE EXCEEDED.
16. IMPERFECTIONS ON THE SEALING EDGE OF RING SHALL NOT EXCEED 0.005"

ANCHOR/DARLING VALVE COMPANY STANDARD

VALVE SIZE	A	B	C	D	ANCHOR/DAR P/N	NSN
2 1/2	4.378 / 4.373	3.965 / 3.970	.500	24°	880 5A 8	9C4820-00 -820-3534
2 1/2	4.501 / 4.498	3.995 / 4.000	.600	24°	764-5B-8	9Z4820-00 -919-4954
3	4.871 / 4.868	4.385 / 4.390	.531	24°	1339-5 7	9Z5365-00 -956-7770
3	4.626 / 4.623	4.120 / 4.125	.615	24°	765 5C 8	9Z5330-01 -036-8994
4	6.126 / 6.123	5.620 / 5.625	.594	24°	1352 5A 8	9Z-5330-01 -989-0809
4	6.626 / 6.623	5.990 / 5.995	.812	24°	1418 5 8	9Z5330-01 -036-8675
5	7.251 / 7.248	6.720 / 6.725	.687	24°	692 5 8	9Z5330-01 -889-2331
5	6.993 / 6.990	6.307 / 6.312	.778	24°	1144 5 8	9Z5330-00 -978-2308
6	8.251 / 8.248	7.718 / 7.723	.687	24°	1139-5-8	9Z5330-01 -038-9739
6	8.250 / 8.247	7.500 / 7.505	.901	24°	1142-5A 8	9Z5330-01 -978-2309
8	9.626 / 9.623	8.885 / 8.890	.879	24°	1417-5 8	9Z5330-01 -036-8996
8	9.626 / 9.623	8.620 / 8.625	1.217	24°	1255-5-8	9Z-5330-01 -038-2501
10	12.371 / 12.368	11.485 / 11.490	1.064	24°	1145-5-8	9Z-5330-01 -038-2502

ANCHOR/DARLING VALVE COMPANY OVERSIZE #1

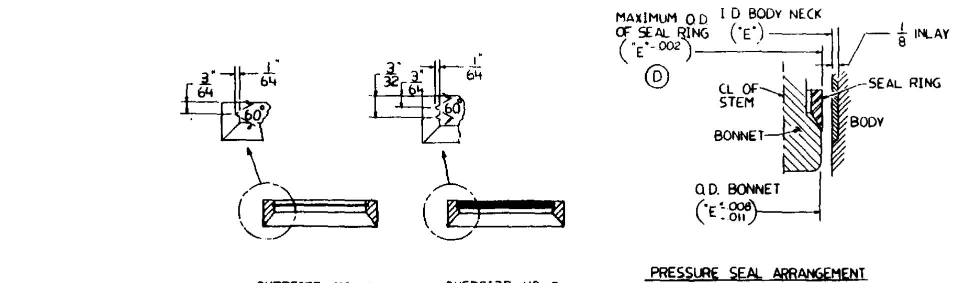
VALVE SIZE	A	B	C	D	ANCHOR/DAR P/N	NSN
2 1/2	4.386 / 4.383	3.965 / 3.970	.500	24°	880-5A-8A	9Z5330-01 -038-2226
2 1/2	4.511 / 4.508	3.995 / 4.000	.600	24°	764-5B-8A	9Z533-01 -039-0211
3	4.881 / 4.878	4.385 / 4.390	.531	24°	1339-5-7A	9Z5330-01 -038-2506
3	4.636 / 4.633	4.120 / 4.125	.615	24°	765-5C-8A	9Z5330-01 -038-2228
4	6.136 / 6.133	5.620 / 5.625	.594	24°	1352 5A-8A	9Z5330-01 -038-2507
4	6.636 / 6.633	5.990 / 5.995	.812	24°	1418-5-8A	9Z5330-01 -038-2508
5	7.261 / 7.258	6.720 / 6.725	.687	24°	692-5-8A	9Z5330-01 -038-2503
5	7.003 / 7.000	6.307 / 6.312	.778	24°	1144-5-8A	9Z5330-01 -038-2504
6	8.261 / 8.258	7.718 / 7.723	.687	24°	1139-5-8A	9Z5330-01 -038-2505
6	8.260 / 8.257	7.500 / 7.505	.901	24°	1142-5A-8A	9Z5330-01 -038-3907
8	9.636 / 9.633	8.885 / 8.890	.879	24°	1417-5-8A	9Z5330-01 -036-9734
8	9.636 / 9.633	8.620 / 8.625	1.217	24°	1255-5-8A	9Z5330-01 -036-9735
10	12.381 / 12.378	11.485 / 11.490	1.064	24°	1145-5-8A	9Z5330-01 -036-9736

ANCHOR/DARLING VALVE COMPANY OVER SIZE #2

VALVE SIZE	A	B	C	D	ANCHOR/DAR P/N	NSN
2 1/2	4.396 / 4.393	3.965 / 3.970	.500	24°	880-5A-8B	9Z5330-01 -038-2511
2 1/2	4.521 / 4.518	3.995 / 4.000	.600	24°	764-5B-8B	9Z5330-01 -038-2229
3	4.891 / 4.888	4.385 / 4.390	.531	24°	1339 5-7B	9Z5330-01 -038-2509
3	4.646 / 4.643	4.120 / 4.125	.615	24°	765-5C-8B	9Z-5330-01 -038-2230
4	6.146 / 6.143	5.620 / 5.625	.594	24°	1352-5A-8B	9Z-5330-01 -038-2510
4	6.646 / 6.643	5.990 / 5.995	.812	24°	1418 5 8B	9Z-5330-01 -038-2512
5	7.271 / 7.268	6.720 / 6.725	.687	24°	692-5-8B	9Z5330-01 -038-2513
5	7.013 / 7.010	6.307 / 6.312	.778	24°	1144 5-8B	9Z5330-01 -038-2514
6	8.271 / 8.268	7.718 / 7.723	.687	24°	1139-5-8B	9Z5330-01 -038-2515
6	8.270 / 8.267	7.500 / 7.505	.901	24°	1142-5A-8B	9Z5330-01 -038-2231
8	9.646 / 9.643	8.885 / 8.890	.879	24°	1417-5-8B	9Z5330-01 -038-2516
8	9.646 / 9.643	8.620 / 8.625	1.217	24°	1255-5-8B	9Z5330-01 -038-2517
10	12.391 / 12.388	11.485 / 11.490	1.064	24°	1145-5-8B	9Z5330-01 -038-2518

PRESSURE SEAL RING – STANDARD AND OVERSIZE –
VALVE PRESSURE CLASS 600-1500

Figure 6-24. Pressure Seal Ring, Standard and Oversize (Sheet 1 of 3)



STANDARD SEAL RING

OVERSIZE NO. 1 SEAL RING

OVERSIZE NO. 2 SEAL RING

PRESSURE SEAL ARRANGEMENT SCHEMATIC DIAGRAM SEE NOTE 1

CRANE COMPANY STANDARD

VALVE SIZE			"A"	"B"	"C"	"D"	CRANE P/N	NSN
2 1/2	3		3.214/3.209	2.630/2.640	.500	41°	D16089	9C4820-00383-6233
3			3.944/3.939	3.442/3.452	.563	41°	D16108	9C4820-00336-5478
4			4.943/4.938	4.317/4.327	.625	41°	D16130	9C4820-00316-4001
	4		4.120/4.115	3.510/3.520	.625	41°	D16784	9C4820-00592-0206
5			5.996/5.991	5.260/5.270	.750	41°	D16775	9C4820-00316-4002
6			6.871/6.868	6.130/6.140	.750	43°	D15876	9C4820-00316-4000
		8	7.621/7.616	6.885/6.895	.750	41°	D16806	4C4820-00606-2741
8			8.871/8.866	7.880/7.890	.875	43°	D15684	9C4820-00524-1385
8			9.434/9.429	8.448/8.458	.875	43°	D16512	9C4820-00039-5716
10		12	11.309/11.304	10.265/10.275	.875	43°	D16733	9C4820-00385-8986
12			12.746/12.741	11.506/11.515	1.125	43°	D15690	9Z5330-01-048-1040

WALWORTH STANDARD SIZE

VALVE SIZE			A	B	C	D	WALW. P/N	NSN
2 1/2			3.623/3.620	3.203/3.208	.438	30°	606430	9Z5330-00-391-8484
3			4.186/4.183	3.703/3.708	.500	41°	606267	9Z5330-00-680-8181
4			4.836/4.833	4.328/4.333	.625	41°	606233	9Z5330-00686-9154
5			5.873/5.870	5.265/5.270	.625	41°	606470	9Z5330-00-391-8603
6			6.873/6.870	6.140/6.145	.750	41°	606251	9Z5330-00671-9716
8			8.748/8.745	7.765/7.770	.875	41°	606215	9Z5330-00471-8280
10			10.748/10.745	9.515/9.520	1	41°	606400	9Z5330-00-116-3828
12			12.823/12.820	11.140/11.145	1.125	41°	606476	9Z5330-00-036-6708

CRANE COMPANY OVERSIZE #1

VALVE SIZE			"A"	"B"	"C"	"D"	CRANE P/N	NSN
2 1/2	3		3.224/3.219	2.630/2.640	.500	41°	D19141	9Z5330-01-037-4121
3			3.954/3.949	3.442/3.452	.563	41°	D19142	9Z5330-01-037-4122
4			4.953/4.948	4.317/4.327	.625	41°	D19143	9Z5330-01-037-4123
	4		4.130/4.125	3.510/3.520	.625	41°	D19144	9Z5330-01-037-4124
5			6.006/6.001	5.260/5.270	.750	41°	D19145	9Z5330-01-037-4125
6			6.881/6.876	6.130/6.140	.750	43°	D19147	9Z5330-01-037-1175
		8	7.631/7.626	6.886/6.896	.750	41°	D19148	9Z5330-01-037-1176
8-1500			8.881/8.876	7.880/7.890	.875	43°	D19149	9Z5330-01-037-1177
8-600			9.444/9.439	8.448/8.458	.875	43°	D19150	9Z5330-01-037-1178
10-600		12	11.319/11.314	10.265/10.275	.875	43°	D19152	9Z5330-01-037-1179
12			12.756/12.751	11.506/11.515	1.125	43°	D19153	9Z5330-01-037-1039

WALWORTH OVERSIZE #1

VALVE SIZE			A	B	C	D	WALW. P/N	NSN
2 1/2			3.833/3.830	3.203/3.208	.438	30°	650610	9Z5330-01-036-4822
3			4.196/4.193	3.703/3.708	.500	41°	643479	9Z5330-01-036-4823
4			4.946/4.943	4.328/4.333	.625	41°	650614	9Z5330-01-036-4820
5			5.883/5.880	5.265/5.270	.625	41°	650616	9Z5330-01-036-4824
6			6.883/6.880	6.140/6.145	.750	41°	644406	9Z5330-01-036-4825
8			8.763/8.760	7.765/7.770	.875	41°	650619	9Z5330-01-036-6727
10			10.763/10.760	9.515/9.520	1	41°	650622	9Z5330-01-036-6728
12			12.838/12.835	11.140/11.145	1.125	41°	650625	9Z5330-01-036-6729

CRANE COMPANY OVERSIZE #2

VALVE SIZE			"A"	"B"	"C"	"D"	CRANE P/N	NSN
2 1/2	3		3.234/3.229	2.630/2.640	.500	41°	D19156	9Z5330-01-037-1180
3			3.964/3.959	3.442/3.452	.563	41°	D19157	9Z5330-01-037-4126
4			4.963/4.958	4.317/4.327	.625	41°	D19158	9Z5330-01-037-4127
	4		4.140/4.135	3.510/3.520	.625	41°	D19159	9Z5330-01-037-4127
5			6.016/6.011	5.260/5.270	.750	41°	D19160	9Z5330-01-037-7353
6			6.891/6.886	6.130/6.140	.750	43°	D19162	9Z5330-01-038-7353
		8	7.641/7.636	6.885/6.895	.750	41°	D19163	9Z5330-01-038-7354
8			8.891/8.886	7.880/7.890	.875	43°	D19164	9Z5330-01-037-1184
8		10	9.454/9.449	8.448/8.458	.875	43°	D19165	9Z5330-01-037-1185
10		12	11.329/11.324	10.265/10.275	.875	43°	D19167	9Z5330-01-037-7138
12			12.766/12.761	11.506/11.515	1.125	43°	D19168	9Z5330-01-048-1038

WALWORTH OVERSIZE #2

VALVE SIZE			A	B	C	D	WALW. P/N	NSN
2 1/2			3.843/3.840	3.203/3.208	.438	30°	606611	9Z5330-01-036-6712
3			4.206/4.203	3.703/3.708	.500	41°	623744	9Z5330-01-036-5494
4			4.966/4.963	4.328/4.333	.625	41°	623746	9Z5330-01-036-5496
5			5.880/5.880	5.265/5.270	.625	41°	650617	9Z5330-01-036-6720
6			6.883/6.880	6.140/6.145	.750	41°	623748	9Z5330-01-0365496
8			8.778/8.775	7.765/7.770	.875	41°	650620	9Z5330-01-036-6721
10			10.778/10.775	9.515/9.520	1	41°	650623	9Z5330-01-036-6722
12			12.863/12.860	11.140/11.145	1.125	41°	613305	9Z5330-01-036-5497

Figure 6-24. Pressure Seal Ring, Standard and Oversize (Sheet 2 of 3)

VELAN VALVE COMPANIES STANDARD						
VELAN SIZE	A	B	C	D	VELAN P/N	NSN
3" & 3 1/2"	3 873 3 865	3 750 3 760	687	24°	8973 0 127	9Z5330-00 –083-7175
4"	4 998 4 990	4 175 4 135	937	24°	8975-0 127	9Z5330-00 –146-8514
5" & 6"	7 870 7 862	6 875 6 885	1 062	24°	8977 0 127	9Z5330-00 –175-4933
8"	9 990 9 982	8 934 8 947	1 125	24°	8978-0 127	9Z5330-09 –480-4114
10"	11 485 11 477	10 490 10 500	1 062	24°	8979-006 127	9Z5330-00 –425-2413
12"	14 740 14 732	13 245 13 255	1 625	24°.	8979-4 127	9C4820-01 –007-5833

VELAN VALVE COMPANIES OVERSIZE#1						
VELAN SIZE	A	B	C	D	VELAN P/N	NSN
3" & 3 1/2"	3 901 3 893	3 248 3 253	.687	24°	8974-011-127	9Z5330-01 –037-4116
4	5 026 5 023	4 125 4 130	.937	24°	8975-013-127	9Z5330-01 –037-0659
5" & 6"	7 898 7 895	6 873 6 878	1.062	24°	8977-013-127	9Z5330-01 –038-7352
8"	10 020 10 012	8 947 8 937	1.125	24°	8978-012-127	9Z5330-01 –037-4117
10"	11 515 11 512	10 500 10 490	1.062	24°	8979-034-127	9Z5330-01 –0374118
12"						

VELAN VALVE COMPANIES OVERSIZE #2						
VELAN SIZE	A	B	C	D	VELAN P/N	NSN
3" & 3 1/2"	3 931 3.928	3.248 3.253	687	24°	8974-012-127	9Z5330-01 –037-4119
4"	5.056 5.053	4.125 4.130	.937	24°	8975-014 127	9Z5330-01 –037-0661
5" & 6"	7.928 7.925	6.873 6.875	1.062	24°	8977-014-127	9Z5330-01 –037-4120
8"	10.050 10.042	8.947 8 937	1.125	24°	8978 013-127	9Z5330-01 –038-7349
10"	11.545 11.592	10.500 10.490	1.062	24°	8979 035-127	9Z5330-01 –037-0661
12"						

NAVY MECHANICAL STANDARD DWG 810 2177518 · 600 AND 1500 PSI						
STANDARD						
VALVE TYPE AND SIZE	A	B	C	D	PART NO.	NSN
5"	6.894 6.889	6 124 6 136	.687	43°		
6"	6.894 6 889	6 124 6 136	.687	43°		
8"	8.892 8.887	7 880 7 892	875	43°		
10"	10.773 10.768	9 760 9 772	.812	43°		
12"	12.773 12.768	12 510 12 522	1.062	43°		
14"	13.773 13.768	12 510 12 522	1.062	43°		
16"	15.773 15.768	14 510 14 522	1.062	43°		

NAVY MECHANICAL STANDARD DWG 810-2177518 · 600 AND 1500 PSI						
OVERSIZE #1						
VALVE TYPE AND SIZE	A	B	C	D	PART NO.	NSN
5"	6.909 6 904	6.124 6.139	.687	43°		
6"	6.909 6 904	6.124 6.139	.687	43°		
8"	8.907 8.902	7.880 7.895	.875	43°		
10"	10.788 10.783	9.760 9 775	.812	43°		
12"	12.788 12.783	11.510 11.525	1.062	43°		
14"	13.788 13.783	12.510 12.525	1.062	43°		
16"	15.788 15.783	14 510 14.525	1.062	43°		

NAVY MECHANICAL STANDARD DWG. 810-2177518 · 600 AND 1500 PSI						
OVERSIZE #2						
VALVE TYPE AND SIZE	A	B	C	D	PART NO.	NSN
5"	6.924 6.919	6.124 6.154	687	43°		
6"	6.924 6.919	6.124 6.154	1.062	43°		
8"	8.922 8.917	7.880 7.910	1.125	43°		
10"	10.803 10.778	9.760 9.790	1.062	43°		
12"	12.803 12.778	11.510 11.540	1.062	43°		
14"	13.803 13.778	12.510 12.540	1.062	43°		
16"	15.803 15 778	14.510 14.540	1.062	43°		

THE "NAVY STANDARD" DIMENSIONAL TABLE IS PROVIDED FOR USE IN CONJUNCTION WITH THE PRESSURE SEAL ARRANGEMENT SCHEMATIC DIAGRAM TO INDICATE STANDARD AND OVERSIZE RINGS WHICH MAY BE SUBSTITUTED FOR THE SPECIAL RINGS DESCRIBED IN GEN'L NOTE 12.
THE DIMENSIONS SHOWN IN THE "NAVY STANDARD" TABLE WERE DEVELOPED FROM NAVY STD DWG NO. 810-2177518.

SIZE	CODE IDENT. NO.	NAVSEA DRAWING NO.	REV
F	53711	803-5001021	D
SCALE NONE			SHT 2 OF 2

Figure 6-24. Pressure Seal Ring, Standard and Oversize (Sheet 3 of 3)

6-9.4.1 Pressure Seal Ring Sizes. Table 6-10 contains a listing of Allowance Parts List numbers (APL's), National Stock Numbers (NSN's), and interim Navy Item Control Numbers (NICN's) assigned to the standard and oversize rings procured and stocked in the supply system. Until NSN's are assigned to all the standard and oversize seal rings, units may use the interim NICN's cited in the table for requisitioning the required seal ring sizes.

6-9.4.2 Pressure Seal Ring Fabrication. Tenders, shipyards, and repair facilities have the capability to manufacture the required size pressure seal ring from carbon steel sleeves when necessary. National stock numbers that have been assigned to the carbon steel sleeve material are identified in table 6-11. When fabricating seal rings, every effort must be made to select a steel containing as low a carbon content as possible (carbon content in steels is a significant factor in determining hardness and yield point). Selection should also include a Brinell hardness of as low as possible. The recommended steel hardness is 90 to 100 Brinell. In some instances, materials other than steel, or steel with Brinell hardness of approximately 120, have been used, but with limited success. The use of harder steels than recommended should be restricted to emergency situations only. The use of harder steels increases the risk of external steam leakage past the seal and possible steam cutting of the body, seal ring, and bonnet. Table 6-11 also contains the maximum and minimum dimensions and material specifications suitable for annealed low carbon steel tubes. These tubes may be used for field fabrication of seal rings.

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
Anchor/ Dar-ling	Gate/600	2-1/2	882042725	9Z5330-00-820-3534	9Z5330-01-038- 2226	9Z5330-01-038- 2511
			882042728			
	1500	2-1/2	882042374	9Z5330-00-919-4954	9Z5330-01-039- 0211	9Z5330-01-038- 2229
			882043834			
			882044936			
			882044969			
			882045710			
			882045786			
			887045194			
			887045196			
	600	3	882043823	9Z5330-00-956-7770	9Z5330-01-038- 2506	9Z5330-01-038- 2509
	600	4	882044245	9Z5330-01-036-8675	9Z5330-01-038-2508	9Z5330-01-038-2512
	600/900	4	882043873	9Z5330-00-989-0809	9Z5330-01-038- 2507	9Z5330-01-038- 2510
			882045940			
	900	5	882043874	9Z5330-00-869-2331	9Z5330-01-038- 2503	9Z5330-01-038- 2513
			882045197			
	1500	5	882043448	9Z5330-00-978-2308	9Z5330-01-038- 2504	9Z5330-01-038- 2514
	600	6	882043523	9Z5330-01-036-9739	9Z5330-01-038- 2505	9Z5330-01-038- 2515
	1500	6	882043447	9Z5330-00-978	9Z5330-01-039- 3907	9Z5330-01-038- 2231
			882045840			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
	600	8	882044279	9Z5330-01-036-8995	9Z5330-01-036- 9734	9Z5330-01-038- 2516
	1500	8	882042328	9Z5330-01-038-2501	9Z5330-01-036- 9735	9Z5330-01-038- 2517
	600	10	882043468	9Z5330-01-038-2502	9Z5330-01-036- 9736	9Z5330-01-038- 2518
Crane	Gate/ Globe/ Stop- Chk 600/ 1500	2-1/2 and 3	882010201	9C4820-00-383-6233	9Z5330-01-037- 4121	9Z5330-01-037- 1180
			882010227			
			882030577			
			882031138			
			882031249			
			882031611			
			882040543			
			882040628			
			882040633			
			882040761			
			882040972			
			882041212			
			882041531			
			882041652			
			882041801			
			882041876			
			882041877			
	Gate/ Globe/ Stop- Chk 600/ 1500	2-1/2 and 3	882042580	9C4820-00-383-6233	9Z5330-01-037- 4121	9Z5330-01-037- 1180
			882042895			
			882044262			
			882044474			
			882044681			
			882045209			
			882045220			
			882045288			
			882045614			
			882045615			
			882046687			
			882046794			
			88204724			
			882050974			
			882051209			
			882051316			
			882051317			
			882051322			
			882051446			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
			882052917			
			882052918			
			882052951			
			882053795			
			882056597			
			882071792			
			882180438			
			887035288			
	Gate 600/ 900/ 1500	3	882031343	9C4820-00-336-5478	9Z5330-01-037- 4122	9Z5330-01-037- 4126
			882040360			
			882040544			
			882040545			
			882040591			
			882040630			
			882040694			
			882040762			
			882040809			
			882040810			
			882040811			
			882041206			
			882041211			
			882041583			
			882041600			
			882041788			
			882041800			
			882042194			
			882042581			
			882043719			
			882044473			
	Gate 600/ 900/ 1500	3	882045217	9C4820-00-336-5478	9Z5330-01-037- 4122	9Z5330-01-037- 4126
			882045218			
			882045219			
			882046586			
			882046688			
			882046795			
			887040044			
			887045176			
			887045244			
			882000650			
			882030003			
			882030742			
			882030926			
			882031207			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
			882032964			
	Gate/ Stop- Chk/ Lift- Chk	3-1/2 and 5	882040546	9C4820-00-316-4001	9Z5330-01-037- 4123	9Z5330-01-037- 4127
			882040739			
			882040752			
			882045210			
			882045287			
			882040547			
			882040548			
			882040634			
			882040739			
			882040752			
			882040763			
			882040770			
			882041787			
			882043422			
			882043423			
			882043720			
			882043749			
			882043861			
			882044472			
			882044695			
			882044703			
			882045079			
			882045210			
			882045287			
			882045452			
			882180483			
			882180541			
			882180542			
			887045175			
			887055276			
	Lift-Chk Globe	4	882030354	9C4820-00-592-0205	9Z5330-01-037- 4124	9Z5330-01-037- 4128
			882052700			
	Gate/ Stop- Chk 600/ 900/ 1500	5	882030576	9C4820-00-316-4002	9Z5330-01-037- 4125	9Z5330-01-038- 7353
			882031398			
			882040041			
			882040290			
			882040323			
			882040549			
			882040550			
			882040769			
			882040967			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
			882040968			
			882040969			
			882041530			
			882041534			
			882041568			
			882041634			
			882041785			
			882041789			
			882041790			
			882041883			
			882041885			
			882042146			
			882042660			
			882043431			
			882043517			
			882044696			
			882044697			
			882044704			
			882045216			
			882045612			
			882045453			
			882045612			
	Gate	6	882040317	9C4820-00-316-4000	9Z5330-01-037- 1175	9Z5330-01-038- 7354
			882040592			
			882040593			
			882040753			
			882041650			
			882041804			
			882042133			
			882043167			
			882044698			
			882044699			
			882045286			
			882045610			
			882045611			
			882049065			
			882180459			
	Globe	8	882051321	9C4820-00-506-2741	9Z5330-01-037- 1176	9Z5330-01-037- 1184
	Gate 1500	8	882000800	9C4820-00-524-1395	9Z5330-01-037- 1177	9Z5330-01-037- 1185
			882041125			
			882041878			
			882041879			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
			882045285			
			882051208			
			882051519			
			882051520			
	Gate 600	7	882040656	9C4820-00-039-5716	9Z5330-01-037- 1178	9Z5330-01-037- 7137
			882040768			
			882041610			
		8	882040964			
			882041301			
			882042579			
			882042675			
			882043642			
			882043866			
			882043867			
			882043883			
			882047953			
			884040008			
			887040051			
			887045158			
		10	882040551	9C4820-00-385-9366	9Z5330-01-037- 1179	9Z5330-01-037- 7138
			882040552			
			882040561			
			882040562			
			882043476			
			882180362			
			882180543			
			882180544			
		12	882040553	9Z5330-01-048-1040	9Z5330-01-048- 1039	9Z5330-01-048- 1038
			882040554			
			882042118			
			882042119			
			882042120			
			882042121			
			882042122			
			882042123			
Velan	Gate/ Globe 600/ 900/ 1500	3	882037382	9Z5330-00-083-7175	9Z5330-01-037- 4116	9Z5330-01-037- 4119
			882037644			
			882047698			
			882047722			
			882056774			
			882057178B			
			887045250			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
	600/900	2-1/2 3	887075242	9Z5330-00-146-9514	9Z5330-01-037- 0659	9Z5330-01-037- 0660
			887035415			
			887055405			
			887055427			
			887075243			
			887075244			
		4	882047320			
			882047466			
			882047713			
			882057179B			
			887045251	9Z5330-00-146-9514	9Z5330-01-037- 0659	9Z5330-01-037- 0660
			887055593			
			887055406			
			887075245			
		5	882037248B	9Z5330-00-175-4933	9Z5330-01-038- 7352	9Z5330-01-037- 4120
			882047889			
			882047905B			
			887045252			
		6	882037247B			
			882047653B			
			882056791			
			887045253			
			887045264			
			887055406			
			887075245			
	Gate	8	882047676	9Z5330-00-480-4114	9Z5330-01-037- 4117	9Z5330-01-038-
			882047732B			
			887045254			
			887045255			
		10	882047499			
		10	887045256	9Z5330-00-425-2413	9Z5330-01-037- 4118	9Z5330-01-037- 0661
			887045265			
		12	887045266	9C4820-01-007-5933		
Wal- worth	Gate	2-1/2	882040060	9Z5330-00-391-8494	9Z5330-01-036- 4622	9Z5330-01-036- 6712
			882040700			
			882040701			
			882040766			
			882040767			
			882040793			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
			882040927			
			882041110			
			882041577			
			882041692			
			882041693			
			882042101			
			882042102			
			882042186			
	Gate	2-1/2	882043339	9Z5330-00-391-8494	9Z5330-01-036- 4622	9Z5330-01-036- 6712
			882043370			
			882043413			
			882043544			
			882043960			
			882045505			
			882045545			
			882045568			
			882045824			
			882046165			
			882046281			
			882046348			
			882047239			
			887045205			
			887045208			
		6	882041848			
		3	882047858B	9Z5330-00-596-8181	9Z5330-01-036- 4623	9Z5330-01-036- 5495
			882047859B			
		4	887045279B	9Z5330-00-598-9154	9Z5330-01-036- 4626	9Z5330-01-036- 5495
		5	882040757	9Z5330-00-391-8503	9Z5330-01-036- 4624	9Z5330-01-036- 6720
			882040792			
			882040805			
			882041068			
			882041069			
			882041850			
			882041902			
			882041906			
			882042533			
			882042710			
			882043566			
			882046280			
			882046642			
			882047441			

Table 6-10. Valve APL's, NSN's, and NICN's Assigned to Standard and Oversized Pressure Seal Rings - Continued

Mfr	Type/ No.	Size (in.)	APL's	Std Ring	1st Oversize	2nd Oversize
			887045152			
			887045153			
		6	882047835B	9Z5330-00-571-9716	9Z5330-01-036- 4625	9Z5330-01-036- 5496
			882047857B			
	Gate	8	882047348	9Z5330-00-471-9290	9Z5330-01-036- 6727	9Z5330-01-036- 6721
			882047834B			
			882047860B			
			882047907			
			887045278B			
		10	882045119	9Z5330-00-115-3826	9Z5330-01-036- 6728	9Z5330-01-036- 6722
		12	882041846	9Z5330-01-036-6708	9Z5330-01-036- 6729	9Z5330-01-036- 5497
			882042134			
			882042369			
Standard Drawings	Gate 900	6	887045240	9Z5330-00-763-0427	9Z5330-01-051- 0335	9Z5330-01-051- 0336
			887045241			
			887045242			
			887045243			
			887045275			
		8	887045276	9Z5330-00-465-6591	9Z5330-01-096- 7394	9Z5330-01-117- 3466
		10	887045238	9Z5330-00-404-4163	9Z5330-01-096- 1272	9Z5330-01-097- 8050
			887045239			
			887045273			
		12	887045236	9Z5330-00-854-2683	9Z5330-01-096- 1273	9Z5330-01-051- 0337
			887045237			
			887045272			
		16	887045234	9Z5330-00-486-8410	9Z5330-01-096- 1274	9Z5330-01-051- 0338
			887045235			
			887045271			

Table 6-11. NSN's Applicable to Carbon Steel Sleeves Suitable for the Manufacture of Pressure Seal Rings

National Stock Number	Item
9C4820-01-032-5787	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 2-1/2-inch pressure seal bonnet ring 8 inches to 12 inches long with 3.75 minimum OD and 3.1 maximum ID.

Table 6-11. NSN's Applicable to Carbon Steel Sleeves Suitable for the Manufacture of Pressure Seal Rings - Continued

National Stock Number	Item
9C4820-01-032-4650	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 3-inch pressure seal bonnet ring 8 inches to 12 inches long with 4.33 minimum OD and 3.20 maximum ID.
9C4820-01-032-5788	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 4-inch pressure seal bonnet ring 8 inches to 12 inches long with 5.10 minimum OD and 4.20 maximum ID.
9C4820-01-032-5789	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 5-inch pressure seal bonnet ring 8 inches to 12 inches long with 6.25 minimum OD and 5.12 maximum ID.
9C4820-01-032-4651	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 6-inch pressure seal bonnet ring 8 inches to 12 inches long with 7.1 minimum OD and 5.90 maximum ID.
9C4820-01-032-5792	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 8-inch pressure seal bonnet ring 8 inches to 12 inches long with 9.1 minimum OD and 7.50 maximum ID.
9C4820-01-032-5793	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 8-inch pressure seal bonnet ring 8 inches to 12 inches long with 9.6 minimum OD and 8.25 maximum ID.
9C4820-01-032-5790	Carbon steel sleeves, in accordance with SAE 1006. Maximum Brinell hardness of 90 for 10-inch pressure seal bonnet ring 8 inches to 12 inches long with 11.0 minimum OD and 9.30 maximum ID.

When seal rings are field fabricated, and means for silver plating are not available, commercial sources may be used. The plating thickness shall be approximately 0.002 inch.

6-9.4.3 Oversized Pressure Seal Rings. The pressure ring sealing surface of the body opposite the seal ring has a hard face weld deposit to ensure a uniform and consistent, corrosion-resistant surface. Due to system cycling, some wear eventually takes place on this inlaid surface and on the contacting bonnet surface. When replacing seal rings, these surfaces must be polished. The wearing and the polishing may increase the inside diameter of the bonnet, thereby necessitating the use of oversized seal rings as indicated in figure 6-24, sheets 1 through 3. No seal ring larger than oversize no. 2 is permitted. When the inlay diameter exceeds that compatible with the second oversize seal ring, the inlay shall be machined out and the sealing surface restored to the original dimensions. At this time the bonnet shall also be examined and restored as necessary. All welding shall be accomplished in accordance with MIL-STD-278.

6-9.4.4 Inlay Area Repair. Pressure seal bonnet valves of 2-1/2 inches and larger (gate, globe, or angle) in high-pressure systems may have problems around the inlay area that can create problems elsewhere. When valve bonnet is removed to renew pressure seal rings, the inlay area must be machined. Machining removes minor defects such as scoring, nicks, wire drawing, or silver fused to the surface. A portable boring bar assembly can perform the machining operation while the valve is still in the system.

6-9.4.5 Boring Bar Operation. The following procedure shall be used to operate the portable boring bar assembly (figure 6-25), APL No. 417140001, manufactured by Grimsley's House of Tools, when repairing inlay areas.

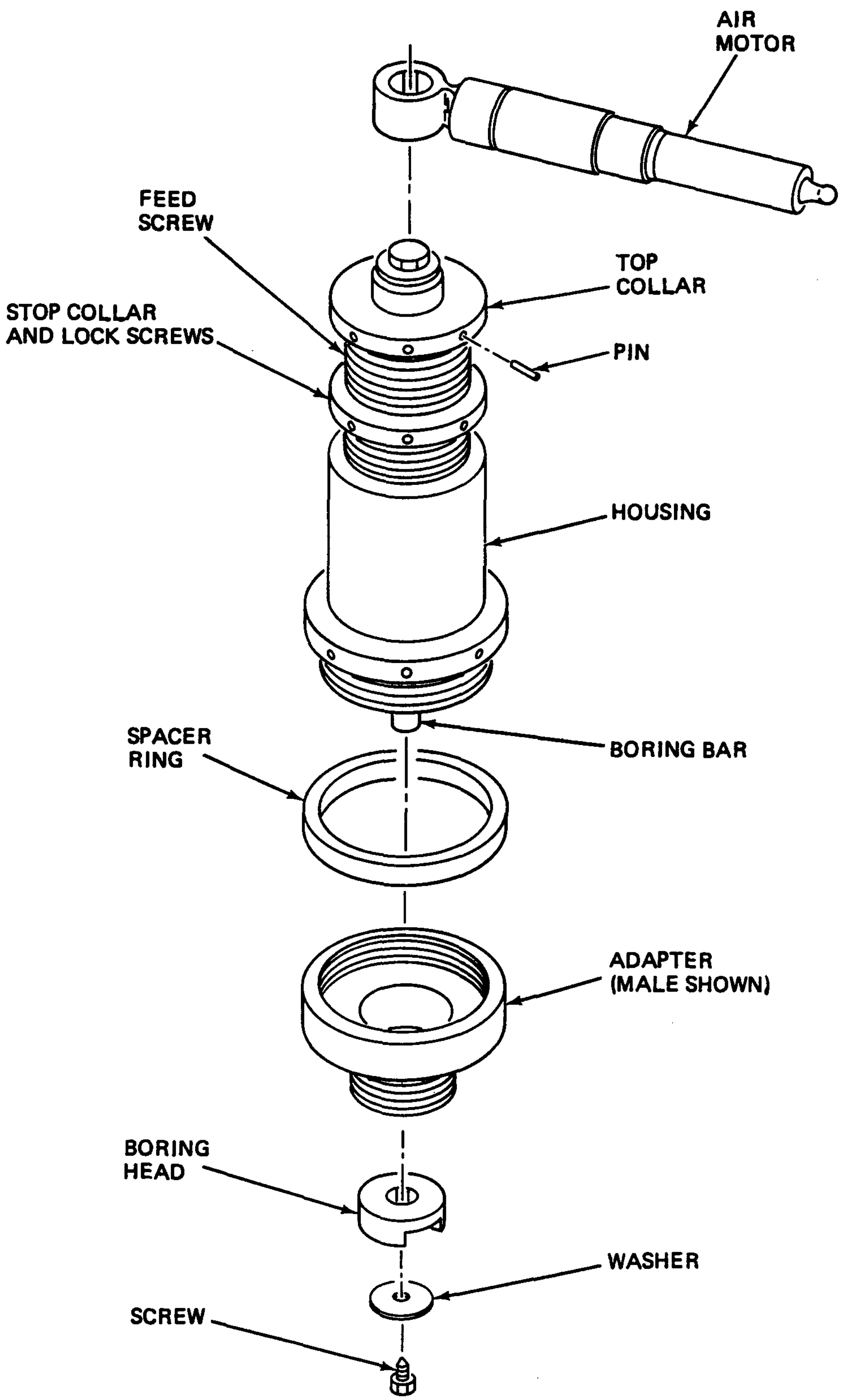


Figure 6-25. Portable Boring Bar Assembly

1. Determine depth of valve throat down to pressure seal area using blueprint, valve sheet, or valve throat measurement.

2. Select type of adapter and proper size (if valve is 5-inch Walworth, no adapter is necessary). Use female adapter for valve throat with outside threads, and male adapter for valve throat with inside threads.

3. Install spacer ring, if necessary, and mount adapter onto valve.

4. With grease pencil, matchmark adapter to valve body.

5. Select boring head that is as large as possible and that will accommodate valve throat when tool bit is attached to boring head.

6. To determine first cut, measure diameter of inlay area with telescope gage and outside micrometer.

7. Take three measurements 1200 apart in three locations; three at top, three in middle, and three at bottom of inlay area (figure 6-26, view A). Observe and record measurements to determine if inlay surface is out of round.

8. Calculate depth of cut from above measurements. First cut should not be more than 0.002 inch deep plus amount of out of roundness. Subsequent cuts are determined by total amount of metal to be removed.

9. To determine position of tool bit on boring head, measure outside diameter (OD) of boring head (B) and subtract boring head OD from valve throat inside diameter (ID). Divide result by 2 (shown in view B) to determine amount tool bit should protrude from boring head. Add boring head OD to amount tool bit should protrude, then add depth of first cut. Set outside micrometer to figure just computed.

10. Set tool bit to conform to above calculations by releasing two hex head screws that secure tool bit. Using micrometer, set tool bit to above calculation and tighten holding screws. Use hex head wrench to ensure that screws are firmly set. Check tool bit again with micrometer to ensure that it is at correct setting.

11. Mount boring head onto boring bar and secure with holding capscrew and washer.

12. Position stop collar on feed screw to measured depth of valve throat and tighten lock screws on stop collar.

13. Check stop collar position as previously determined in step 12.

14. Install boring bar into valve body and tighten adapter with pin.

15. Aline matchmarks on adapter and valve body and attach air motor.

16. Manually rotate boring bar shaft to ensure that it turns freely.

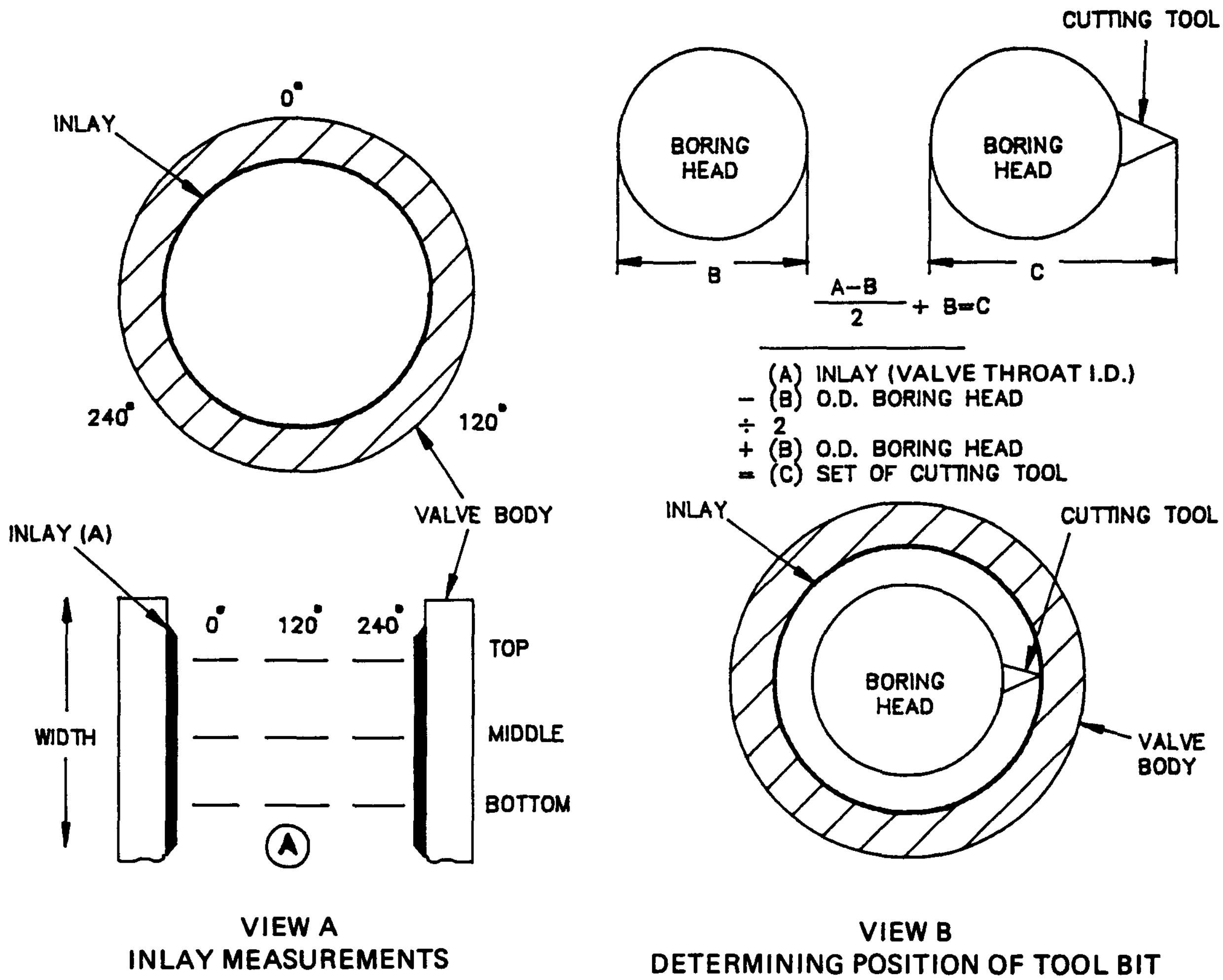


Figure 6-26. Inlay Measurements and Positioning of Tool Bit

17. Insert pin into top collar, and with air motor engaged, slowly turn top collar clockwise until tool bit makes contact.
18. Continue to turn top collar slowly and evenly until housing contacts stop collar.
19. Stop motor.
20. Back top collar out length of inlay area. Use pin to loosen adapter.

CAUTION

To prevent damage to equipment, avoid scoring interior surfaces of valve when removing boring bar.

21. Unscrew adapter and carefully remove boring bar.
22. Use telescoping gage and outside micrometer to check valve throat roundness.
23. If further cuts are necessary, repeat measurements in step 7 to reset tool bit for another cut. Ensure that matchmarks are alined before beginning cut.

24. If machining is complete, clean chips and shavings from interior of valve.
25. Determine pressure seal ring size necessary for new valve throat diameter. Also determine whether throat area will have to be built up. Standard pressure seal rings will cover valve throat area oversize up to 0.010 inch. Oversize number 1 will cover from 0.010 to 0.020 inch oversize. Oversize number 2 will cover from 0.020 to 0.030 inch.
26. Check with supply department to determine if appropriate pressure seal ring (standard, oversize 1, or oversize 2) is available for applicable valve. If not available, notify machine shop as soon as possible so that new one can be fabricated. It will be necessary to furnish manufacturer's drawing of seal ring.
27. Ensure that at least two spare seal rings are manufactured from low carbon steel (SAE 1006) with Brinell hardness of 90-100. Dimensions shall agree with table 6-11. Seal rings shall be plated with 0.002 inch of silver.
28. If work on valve throat is complete, remove valve plugs.
29. Ensure that valve is free of grease and oil, and is very clean.
30. Cover valve with plastic material to keep piping system and valve clean.
31. Clean boring bar thoroughly and coat components with light machine oil.
32. Place boring bar and its components in carrying case.

6-10. VALVE FLANGE REFACING.

6-10.1 RAISED FACE FLANGE. The following procedure shall be used to reface the raised flange using a flange refacing machine.

1. Clean rust, scale, and corrosion from flange face.
2. Select correct size adapter plate.
3. Mount adapter plate with shoulder to outside of flange.
4. Mount tool bit in tool holder.
5. Mount flange refacer on shoulder of adapter plate and secure with C clamps.
6. Adjust depth of cut. Do not remove more than 0.010 inch.
7. Release down feed lock and raise or lower spindle by turning down feed screw. Reset lock.
8. Position tool for cross feed by turning knob.
9. Use electric or pneumatic drill of 1/2 inch or larger with approximately 400 rpm delivery. Mount on drive shaft.
10. Start drill, hold knob while cutter head rotates (this starts power crossfeed operating, to feed tool across flange face at 0.020 inch per revolution).
11. To stop feed, release knob. If finer feed is required, slip feed reducer and reverser over knob (this will reduce feed to 0.008 inch per revolution and reverse direction of feed).

6-10.2 PLAIN FACE FLANGE. The following procedures shall be used to reface the plain face flange using the flange refacing machine.

1. Clamp adapter plate, flat face down, to either face of four-jaw chuck.
2. Place chuck over flange, holding adapter plate firmly against flange face.

3. Screw in four jaws to clamp on outside of flange.
4. Remove adapter plate and mount flange refacer to four-jaw chuck with bolts.
5. Adjust depth of cut. Do not remove more than 0.010 inch.
6. To adjust, release down feed lock and raise or lower spindle by turning down feed screw. Reset lock.
7. Position tool for cross feed by turning knob.
8. Use electric or pneumatic drill of 1/2 inch or larger with approximately 400 rpm delivery. Mount on drive shaft.
9. Start drill, hold knob while cutter head rotates (this starts power crossfeed operating, to feed tool across flange face at 0.020 inch per revolution).
10. To stop feed, release knob. If finer feed is required, slip feed reducer and reverser over knob (this will reduce feed to 0.008 inch per revolution and reverse direction of feed).

6-10.3 FLANGE REFACING EVALUATION.

1. If flange thickness has been reduced by 10 to 15 percent, identify flange composition, build up by electroplating (see NAVSEA 0900-LP-038-6010), and machine flange to original thickness.
2. Ensure that flange finish is circular lay (concentric or phonographic).
3. If flange thickness is reduced by more than 15 percent, install new flange in accordance with MIL-STD-278 and MIL-STD-777.

6-11. EXTERNAL CORROSION CONTROL.

6-11.1 SURFACE PREPARATION. A great deal of importance must be placed on the condition of valve surface. A coating system is only as good as the care that was taken in its application. The greatest portion of application time and effort should be devoted to surface preparation. Approximately 90 percent of all coating failures can be attributed to poor surface preparation. The application of a coating over a corroded surface should never be attempted. The corrosion products destroy the bond between the coating and the base metal. In addition, any moisture that is present in the corrosion product, no matter how minute, will cause further corrosion of metal, and blistering of the coating will occur. The metal surface should also be free from contaminants such as grease and oil. Even fingerprints can cause coating failures, because the smallest amount of oil present on the hand is enough to prevent a bond of the coating to the metal surface. Prepared surfaces should be handled with clean gloves or rags, if possible. A good clean surface preparation should remove all corrosion products and contaminants so that the coating can be applied on bare, clean metal. This provides a roughened surface for a good mechanical bond between the coating and the metal. The best means of obtaining such a surface is by abrasive (grit) blasting. Abrasive or grit blasting is a process by which tiny particles of abrasive material are propelled against a surface to be cleaned. Either compressed air or a mechanical means is the most common type of propulsion. Usually a gun or nozzle of some type is used as the exit port from which the grit is propelled against the surface to be cleaned. Depending on the type of abrasive used, the blast material may be discarded after use or reclaimed. Blasting materials which have been used to remove scale shall not be used for the final blast. Never reuse grit which has been used to blast a very greasy surface. The contamination introduced in this case can be very detrimental to the coating applied over the blasted surface. Angular chilled iron grit that is clean and reasonably sharp may be used. Old grit which is rusty and noticeably worn or dull when compared with new grit shall not be used. Grit having a mesh size of SAE G-25 to G-40 shall be used. An individual size or a mixture of sizes may be used. Force-feed pressure blasting equipment shall be used. Nozzle size shall be such that a pressure of not less than 75 psi is maintained at the blast generator. Centrifugal blasting equipment may be used with angular chilled iron grit. However, abrasive velocity must be equivalent to that produced by force-feed pressure blasting equipment at 75 psi. Air supply must be sufficiently free of oil and moisture so that no visible oil or moisture appears on the blasted surfaced. Abrasive shall be checked periodically to see that it conforms to requirements.

6-11.2 HIGH-TEMPERATURE ALUMINUM PAINT. Surface preparation and the use of high-temperature aluminum paint shall be accomplished using NSTM chapter 9480.

6-11.3 ALUMINUM WIRE SPRAY. Aluminum wire spray is used for the protection of valve bodies in air, water, and steam systems on all ships. For detailed descriptions of and procedures for using aluminum wire spray, refer to DOD-STD-2138.

6-12. INSULATION.

6-12.1 PERMANENT INSULATION. Thermal Insulation must be used in order to minimize the transfer of heat from, or to, a body or surface which is hotter or colder, respectively, than the surrounding atmosphere. Thermal insulation has a low thermal conductivity, which increases the economy of a machinery plant. It also reduces the quantity of air necessary for ventilating and cooling requirements, and prevents injury of personnel due to burns from contact with hot parts of apparatus. Thermal insulation insures more uniform heat distribution within equipment and prevents sweating of cold surfaces on which atmospheric moisture condenses. The latter function prevents the accelerated corrosion of metal due to dripping moisture. Insulation must be sufficiently effective to reduce heat loss and lower surface temperatures to a degree which will permit habitable conditions in a specific space. Permanently insulated valves and fittings should be covered to the same total thickness as the adjacent piping. Valves and fittings which are welded into the line are permanently insulated. Flanged valves and flanged fittings may have permanent or removable insulation. For complete details on materials, removal, repair, and installation of permanent insulation, refer to NSTM chapter 635.

6-12.2 REMOVABLE LAGGING PADS. In order to ensure that the pipe covering will not interfere with the servicing of a flanged joint, permanent insulation shall stop short of the flange joint. A short removable and reusable pad shall be installed to cover the flanged joint. Refer to MIL-STD-769 for details.

CHAPTER 7

GENERAL TESTING INFORMATION

7-1. INTRODUCTION.

7-1.1 PURPOSE. This chapter provides general and specific information for testing non-nuclear valves used in steam propulsion systems.

7-1.2 SCOPE. This chapter identifies basic nondestructive testing methods and their applications and provides procedures for hydrostatic testing. Technical manual numbers and titles for Naval Ships' Technical Manual (NSTM) chapters and other referenced publications are provided in table 2-2.

7-2. TESTING.

7-2.1 NONDESTRUCTIVE TESTING. Nondestructive test (NDT) methods are used to determine the presence of surface and internal flaws in metals. A11 NDT inspections performed in support of ship's force or intermediate maintenance activity (IMA) repairs shall be in accordance with applicable fabrication documents. Test personnel shall be qualified in accordance with NSTM chapter 074, volume 2. The various NDT methods and applications are described in the following paragraphs. A11 NDT's shall be performed in accordance with MIL-STD-271 requirements.

7-2.1.1 Visual Examination. Calibrated measuring devices, magnifying aids, and the naked eye are used to ensure that the welding surface is properly prepared and to determine the need for additional testing.

7-2-1.2 Liquid Penetrant Testing. Liquid penetrant testing methods are used to detect the presence of surface flaws in ferrous and nonferrous materials.

7-2.1.3 Magnetic Particle Testing. Magnetic particle testing methods are used to detect surface or near surface flaws in ferromagnetic material.

7-2-1.4 Ultrasonic Testing. Ultrasonic testing methods are used to locate flaws in various metals using the transmission and return of high-frequency sound waves.

7-2.1.5 Radiographic Testing. Radiographic testing methods use X-rays or gamma rays to detect flaws in materials. Gamma rays and X-rays have the ability to present images of the material on a recording medium suitable for interpretation by a qualified inspector. Radiographic inspections determine the presence of flaws in all ferrous and nonferrous metals.

7-2.2 HYDROSTATIC TESTING. Hydrostatic testing involves pressurizing a valve with water to a predetermined pressure to inspect for leaks and deformities. A hydrostatic pump is used to supply the pressure. For hydrostatic pump operation and maintenance information, refer to NAVSEA 0347-LP-402-2000, or to an available boiler technical manual. All hydrostatic testing shall be performed in accordance with NSTM chapter 505. Refer to section 4 in applicable valve chapter in volumes II through XIII for recommended test pressure.

7-2.2.1 Hydrostatic Test Requirements.

1. Prior to hydrostatic testing, a sign (DANGER-HYDROSTATIC TESTING IN PROGRESS) shall be posted in vicinity of test area.
2. Prior to and throughout test, participating personnel shall be in communication with test supervisor, and conditions shall be established as required to ensure that test will be performed without danger to personnel or damage to equipment.
3. Prior to test, participating personnel shall be instructed in test plan and emergency procedures.
4. Pressure gage shall be provided to indicate pressure at which action is to be taken to prevent overpressurization. A red band or other suitable mark on face of gage may be employed.
5. Two methods of pressure release must be provided for overpressure protection, one of which shall be manually operated.
6. A relief valve must be provided on pump for overpressure protection. Relief valves and their inlet and discharge piping shall have a greater relieving capacity at test pressure than source used to pressurize system. Relief valve to be used shall be set point tested within 30 days prior to being used for hydrostatic test. Set point shall be no greater than 100 psi or 10 percent above test pressure, whichever is less.
7. All hoses and fittings used on hydrostatic pump should be clearly labeled, FOR USE WITH HYDROSTATIC TEST PUMP ONLY.
8. Blank flanges used for isolation shall be fabricated of a suitable metal and thickness, and be constructed with prominent tab for tagging. Red tags attached to tab shall have notation that blank has been inserted for hydrostatic testing. (Refer to NSTM 505 for required test record checkoff.)
9. Expansion joints shall be provided with a temporary restraint for additional test pressure load, if required.
10. Clean freshwater shall be used unless otherwise indicated.
11. Each system shall be hydrostatically tested annually to detect leaks in valves that cannot be readily removed. Sections shall be pressurized one at a time until all valves have been tested.
12. Hydrostatic testing is not required on valves after replacing packing, bonnet gasket, disk, stem, packing gland nuts, packing gland studs, or pressurized rings. Hydrostatic testing is not required on a replaced yoke bushing unless it is the only barrier-retaining stem. The components shall be checked on a test stand for leakage at system operating pressure.
13. Hydrostatic testing shall be performed on all new or overhauled valves installed in a system.

7-2.2.2 Acceptance Criteria. Criteria for an acceptable hydrostatic test is that there shall be no leakage and no permanent deformation of pressure containing parts as determined by visual inspection.

7-2.2.2.1 Seat Tightness. Valves that have been repaired to improve seat tightness are allowed a specified amount of leakage. Unless otherwise specified in the contract, applicable specification, standard plan or ordering data, or unless valves are used in hazardous service where leakage cannot be tolerated, permissible seat leakage is a maximum of 10 cubic centimeters per hour per inch of nominal pipe size. For acceptable valve seat leakage rate refer to NSTM chapter 505.

7-2.2.2.2 Packing. Valve packing leakage does not render hydrostatic testing un-satisfactory, but packing should be adjusted or replaced as soon as practicable.

7-2.2.3 Body Assembly, Packing, Joints, and Seat Leakage Testing Procedure (Installed). The following procedure shall be used to hydrostatically test the valve body, packing, joints, and seat while the unit is installed in the system.

WARNING

To prevent injury or death, ensure that valves to be tested are isolated and that system is drained and tagged out of service.

1. Isolate, drain, and tag system out of service in accordance with ship's procedures.
2. Fill system with appropriate fluid through any available drain or pressure gage located in system.
3. Open valve to be tested and loosen packing nuts to vent all air from system.
4. When system is full, tighten packing nuts. Wait at least 10 minutes to allow packing to stabilize before inspecting for leaks.

WARNING

To prevent injury or death, ensure that extreme care is taken while operating hydrostatic pump, as high pressure exists.

5. Attach hydrostatic pump and using extreme caution, apply pressure in the direction tending to open the valve. Raise pressure in equal increments to test pressure of 135 percent of system design pressure. After each increment, inspect valve body and joints for leaks, and check pressure gage for any drop in pressure.
6. If valve packing leaks excessively during hydrostatic test, correct condition immediately. If a pressure drop or leak is detected, stop test and repair leak. If no leak appears, increase pressure to next increment.
7. Maintain maximum test pressure for at least 30 minutes. Inspect valve body, joints, and packing; if no leak or pressure drop appears, then test is considered satisfactory.
8. Record test results on Hydrostatic Test Record form and have quality assurance personnel verify satisfactory completion of test.
9. Relieve pressure from system and close valve to be tested for seat tightness.
10. Start hydrostatic pump and raise pressure to 300 psig.
11. Check drain downstream from valve for seat leakage.
12. If leaks appear, stop test and repair valve. If no leaks appear, raise pressure in equal increments to recommended test pressure provided in applicable valve chapter. Inspect valve for seat tightness after each increment increase.
13. Maintain maximum test pressure for 3 minutes. If no leakage appears, or if leakage does not exceed the acceptable seat leakage rate as per NSTM chapter 505, test is considered satisfactory.
14. Record results on Hydrostatic Test Record form, and have quality assurance personnel verify satisfactory completion of test.
15. Stop hydrostatic pump and relieve pressure from system.

16. Disconnect hydrostatic pump.

7-2.2.4 Body Assembly, Packing, Joints, and Seat Leakage Testing Procedure (In Shop). The following procedure shall be used to hydrostatically test the valve body, packing, joints, and seat when the unit is removed from the system.

1. Set up valve on test stand and connect hydrostatic pump with test fitting to inlet side of valve.
2. Attach blank flange to outlet side of valve and fully open valve.
3. Start hydrostatic pump, fill valve with water, and vent at test connection. While filling, examine valve for leaks.

WARNING

To prevent injury or death, ensure that extreme care is taken while operating hydrostatic pump, as high pressure exists.

4. Using extreme caution, pressurize valve in equal increments to test pressure designated in Table 505-23 of NSTM Chapter 505. After each increment, inspect valve body and joints for leaks.
5. Maintain maximum test pressure for at least 30 minutes. Inspect valve body, joints, and packing; if no leaks appear, then test is considered satisfactory.
6. Record results on Hydrostatic Test Record form, and have quality assurance personnel verify satisfactory completion of test.
7. Stop hydrostatic pump and relieve pressure.
8. Remove blank flange from outlet side of valve.
9. Using low-pressure air, dry outlet side of valve seat area so that any leakage can be detected.
10. Start hydrostatic pump and raise pressure to 300 psig.
11. Check for seat leakage. If leak appears, stop test and repair valve. If no leak appears, raise pressure in equal increments to recommended test pressure provided in applicable valve chapter. Inspect valve for seat tightness after each increment.
12. Maintain maximum test pressure for 3 minutes. If no leakage appears, or if leakage does not exceed acceptable seat leakage rate as per NSTM chapter 505, test is considered satisfactory.
13. Record results on Hydrostatic Test Record forms and have quality assurance personnel verify satisfactory completion of test.
14. Stop hydrostatic pump and relieve pressure from valve.
15. Disconnect hydrostatic pump and test fitting from inlet and remove valve from test stand.

REAR SECTION

INDEX

Ref: NAVSEAINST 4160.3A NAVSEA S0005-AA-GYD-030/TMMP

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