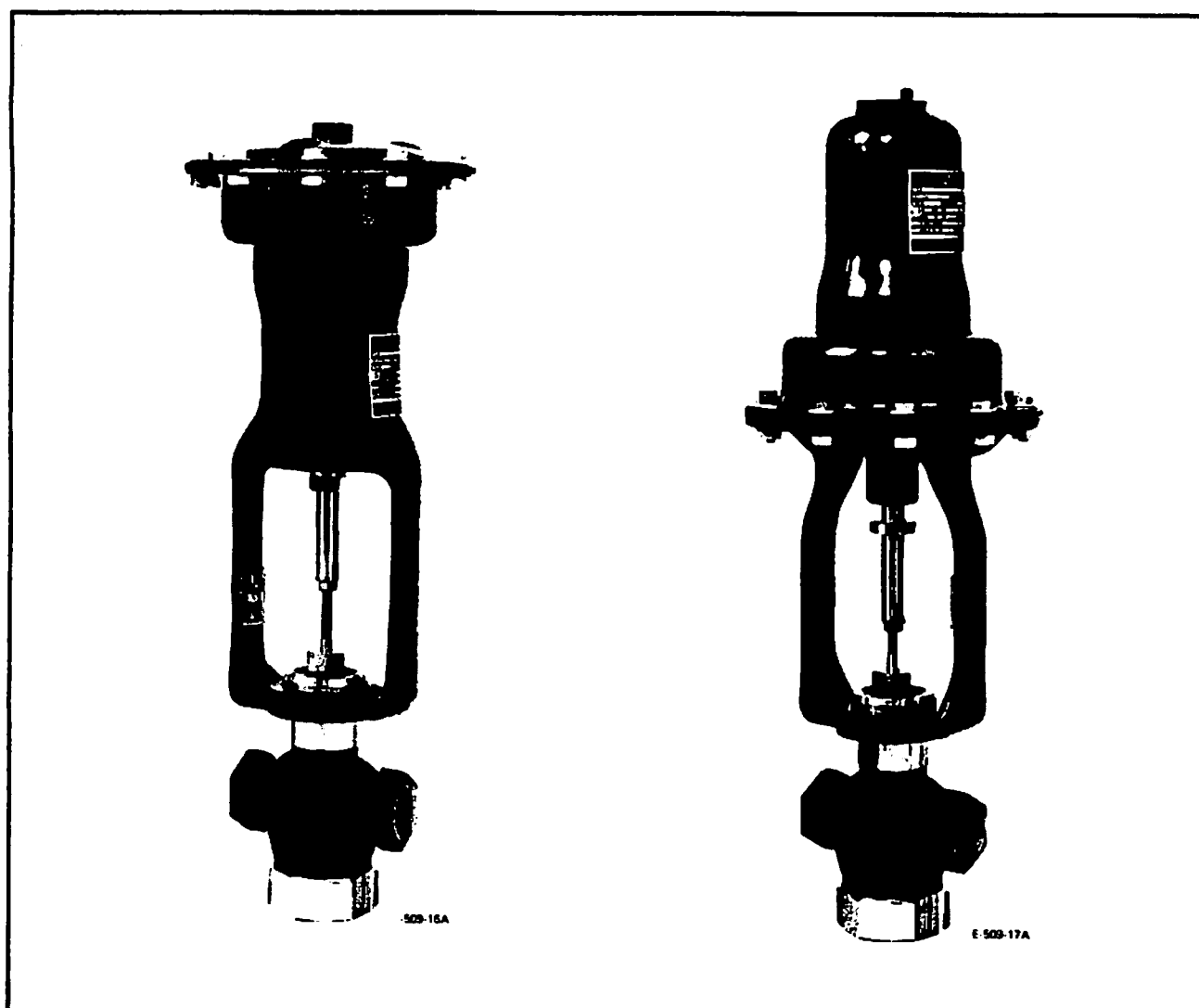


## INSTRUCTIONS

### **HI-FLOW™ VALVE WITH LIN-E-AIRE® ACTUATOR** 3000W thru 3005W Model A with Actuator Termination No. 220, 221, 222, 223, 230, 231 or 233



W.E. ANDERSON DIVISION

**DWYER INSTRUMENTS, INC.**  
P.O. Box 373, Michigan City, Indiana 46361  
Phone 219-875-0000 Fax 219-875-0000

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This publication includes **DANGER**, **WARNING**, **CAUTION** and **NOTE** information where appropriate to point out safety related or other important information.

**DANGER** — Hazards which will result in severe personal injury or death.

**WARNING** — Hazards which could result in personal injury.

**CAUTION** — Hazards which could result in equipment or property damage.

**NOTE** — Alerts user to pertinent facts and conditions.

Although **DANGER** and **WARNING** hazards are related to personal injury, and **CAUTION** hazards are associated with equipment or property damage, it should be understood that operation of damaged equipment could, under certain operational conditions, result in degraded process system performance leading to personal injury or death. Therefore, comply fully with all **DANGER**, **WARNING** and **CAUTION** notices.

## TABLE OF CONTENTS

## TABLE OF CONTENTS

Para	Page	Para	Page
<b>1 INTRODUCTION</b>		<b>4.2 Disassembling Valve</b> .....	<b>18</b>
1.1 Description .....	5	<b>4.3 Assembling Valve</b> .....	<b>20</b>
1.1.1 General .....	5	<b>4.4 Replacing Actuator Diaphragm</b> .....	<b>23</b>
1.1.2 Hi-Flow 3-Way Valve .....	5	4.4.1 Air-to-Lower Actuator .....	23
1.1.3 Lin-E-Aire Actuator .....	6	4.4.2 Air-to-Lower Actuator with Manual Operator .....	25
1.2 Serial and Catalog Numbers .....	8	4.4.3 Air-to-Raise Actuator .....	25
1.3 Technical Characteristics .....	9	<b>4.5 Changing Actuator Range Spring</b> .....	<b>25</b>
<b>2 INSTALLATION</b>		4.5.1 Air-to-Lower Actuator .....	25
2.1 Mounting .....	10	4.5.2 Air-to-Lower Actuator with Manual Operator .....	27
2.2 Pneumatic Connections .....	10	4.5.3 Air-to-Raise Actuator .....	27
<b>3 OPERATION</b>		<b>4.6 Adjusting Actuator Range-Shop Procedure</b> .....	<b>28</b>
3.1 Checking Valve Travel .....	16	4.6.1 Actuator with Throttling-Mixing Valve .....	28
3.2 Adjusting Actuator Range .....	16	4.6.2 Actuator with Two Position Diverting Valve .....	29
3.2.1 Air-to-Lower Actuator .....	16	4.6.3 Air-to-Lower Actuator with Hand Wheel .....	30
3.2.2 Air-to-Lower Actuator with Manual Operator .....	16		
3.2.3 Air-to-Raise Actuator .....	17		
<b>4 MAINTENANCE</b>			
4.1 Test Equipment and Tools Required .....	18		

## ILLUSTRATIONS

Fig.	Page	Fig.	Page
<b>1 Three-Way Valve Body, Throttling- Mixing Service</b> .....	<b>5</b>	<b>10 Travel Indicator Plate Showing Valve Plug Travel</b> .....	<b>16</b>
<b>2 Three-Way Valve Body, Two Position Diverting Service</b> .....	<b>5</b>	<b>11 Adjusting Actuator Range</b> .....	<b>17</b>
<b>3 Air-to-Lower Actuator</b> .....	<b>6</b>	<b>12 Exploded View of Control Valve</b> .....	<b>19</b>
<b>4 Air-to-Raise Actuator</b> .....	<b>7</b>	<b>13 Seat Ring Removal Tool, Part No. 153S22</b> .....	<b>20</b>
<b>5 Removal Clearance Required</b> .....	<b>11</b>	<b>14 Valve Packing Tool, Part No. 153P9</b> .....	<b>21</b>
<b>6 Mounting Dimensions for Air-to-Lower Actuator</b> .....	<b>12</b>	<b>15 Standard Packing Spring Loaded TFE V-Ring</b> .....	<b>22</b>
<b>7 Mounting Dimensions for Air-to-Lower Actuator with Manual Operator (Accessory C)</b> .....	<b>13</b>	<b>16 Optional Packing Catalog No. Code J2 Spring Loaded Graphite</b> .....	<b>22</b>
<b>8 Mounting Dimensions for Air-to-Raise Actuator</b> .....	<b>14</b>	<b>17 Optional Packing Catalog No. Code J3 Lubricated Graphite with Lubricator</b> .....	<b>22</b>
<b>9 Mounting Dimensions for 3000W thru 3005W Hi-Flow Valves</b> .....	<b>15</b>	<b>18 Optional Packing Catalog No. Code J7 TFE V-Ring for Vacuum Service</b> .....	<b>22</b>

## TABLE OF CONTENTS

## ILLUSTRATIONS (Cont'd)

Fig.	Page	Fig.	Page
19	Optional Packing Catalog No. Code J8 Double TFE V-Ring for Positive Pressure .....23	25	Throttling-Mixing Valve .....29
20	Optional Packing Catalog No. Code J9 Double TFE V-Ring for Negative Pressure .....23	26	Two Position Diverting Valve .....30
21	Optional Packing Catalog No. Code J10 Double TFE V-Ring for Alternate Positive and Negative Pressure .....23	27a.	Actuator Input Pressure Versus Maximum Differential Pressure for Termination Nos. 220, 230 (20 Sq. In. Std) .....31
22	Exploded View of Air-to-Lower Actuator ....24	27b.	Actuator Input Pressure Versus Maximum Differential Pressure for Termination Nos. 221, 221C, 231 (45 Sq. In. Senior), 222, 222C (45 Sq. In. Std) .....32
23	Exploded View of Air-to-Raise Actuator ....26	27c.	Actuator Input Pressure Versus Maximum Differential Pressure for Termination Nos. 223, 233C, 233 (80 Sq. In. Senior) ....33
24	Test Hookup .....28		

## TABLES

Table	Page	Table	Page
1	Maximum Air Supply Pressure and Maximum Stroke .....9	2	Tools Required .....18
		3	Torque Values for Assembling Valve .....21

## INTRODUCTION

## 1.1 DESCRIPTION

## 1.1.1 General

The primary function of the 3-Way Hi-Flow valve is to throttle two incoming fluids to obtain a blended flow or to divert one or two fluids for process control purposes.

The 3-Way Hi-Flow valve is not recommended for throttling-diverting service, because forces acting in the valve body will cause erratic action of the valve plug.

The Lin-E-Aire Valve Actuator is used for automatic operation of the Hi-Flow valve. The opening, closing or throttling of the valve plug in the valve body is accomplished by varying the air pressure to the diaphragm in the actuator.

The actuator spring and diaphragm are completely enclosed to protect them from dirt, dust or other foreign matter. Spring adjustments are made with a ball bearing spring adjustment sleeve. Diaphragm and spring assembly may easily be removed for replacement or substitution.

The construction and operating pressure range for the valve and actuator are listed on a data plate mounted on the actuator. Actuator size and spring are selected to meet the requirements of the application. In service the actuator should move the valve plug through its full travel when the pressure range stamped on the data plate is applied. This pressure range is generally 3 to 15 psi (20 to 100 kPa), but other ranges are available.

For precise control of valve plug position or where two valves are to be operated in sequence by one control device, a W.E Anderson valve positioner, Catalog Number 100N is recommended.

## 1.1.2 Hi-Flow 3-Way Valve

There are two applications for this style of valve, Throttling-Mixing or Two Position Diverting.

**Throttling-Mixing type, Figure 1** — In this type of application, two incoming fluids from ports "U" and "L" are mixed or blended. Using the air-to-lower actuator in the normal position, port "U" is closed, ports "L" and "C" are connected. When the actuator is fully inflated, port "L" is closed, ports "U" and "C" are connected.

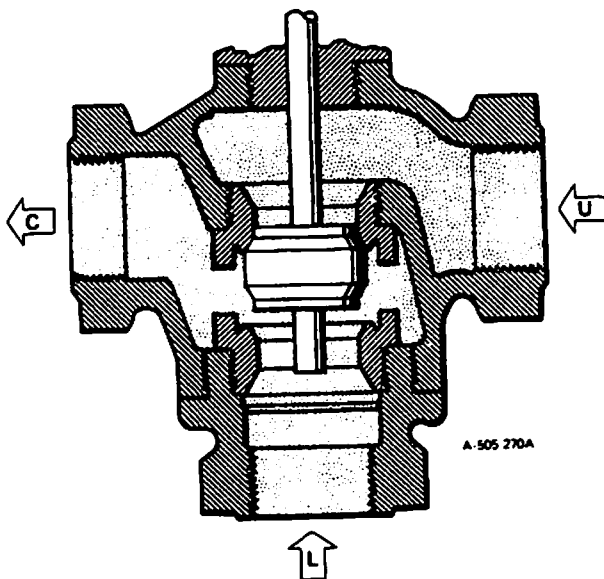


Figure 1. Three-Way Valve Body, Throttling-Mixing Service

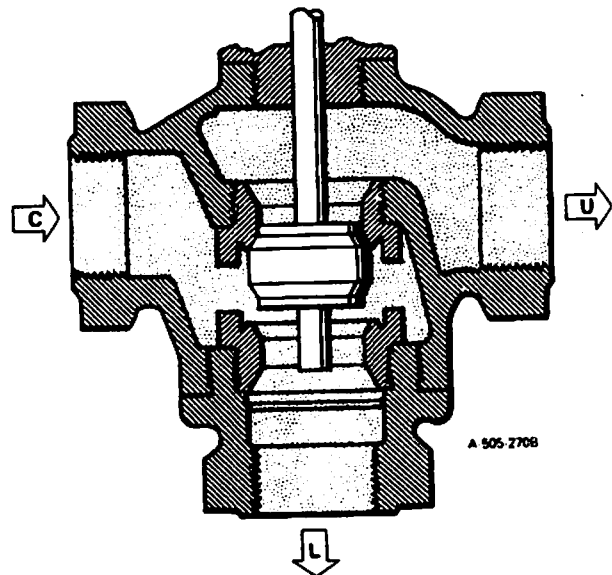


Figure 2. Three-Way Valve Body, Two Position Diverting Service

## INTRODUCTION

and "C" are connected. In intermediate positions, fluids from ports "L" and "U" are blended and exited at port "C".

Using the air-to-raise actuator, the appropriate closing of ports "U" and "L" are obtained.

**Two Position Diverting type, Figure 2** — In this type of application, ports "C" and "L" are normally connected. When the valve plug moves downward, ports "C" and "U" are connected. This movement allows the flow to be diverted to the "U" port.

### 1.1.3 Lin-E-Aire Actuator

There are two types of actuators, Air-to-Lower and Air-to-Raise. Selection depends upon the direction

of push rod motion required in case of air supply failure.

**Air-to-Lower type, Figure 3** — In this type of actuator, an increase in air pressure moves the push rod downward, compressing the spring. In the event of air failure, the push rod moves to its extreme upward position.

This actuator can also be supplied with a top mounted manual operator. The manual operator is often used as an adjustable travel stop. If it is used on a push-to-close valve, full opening can be restricted by manually setting the operator at a required position. If used on a push-to-open valve, full closing can be restricted.

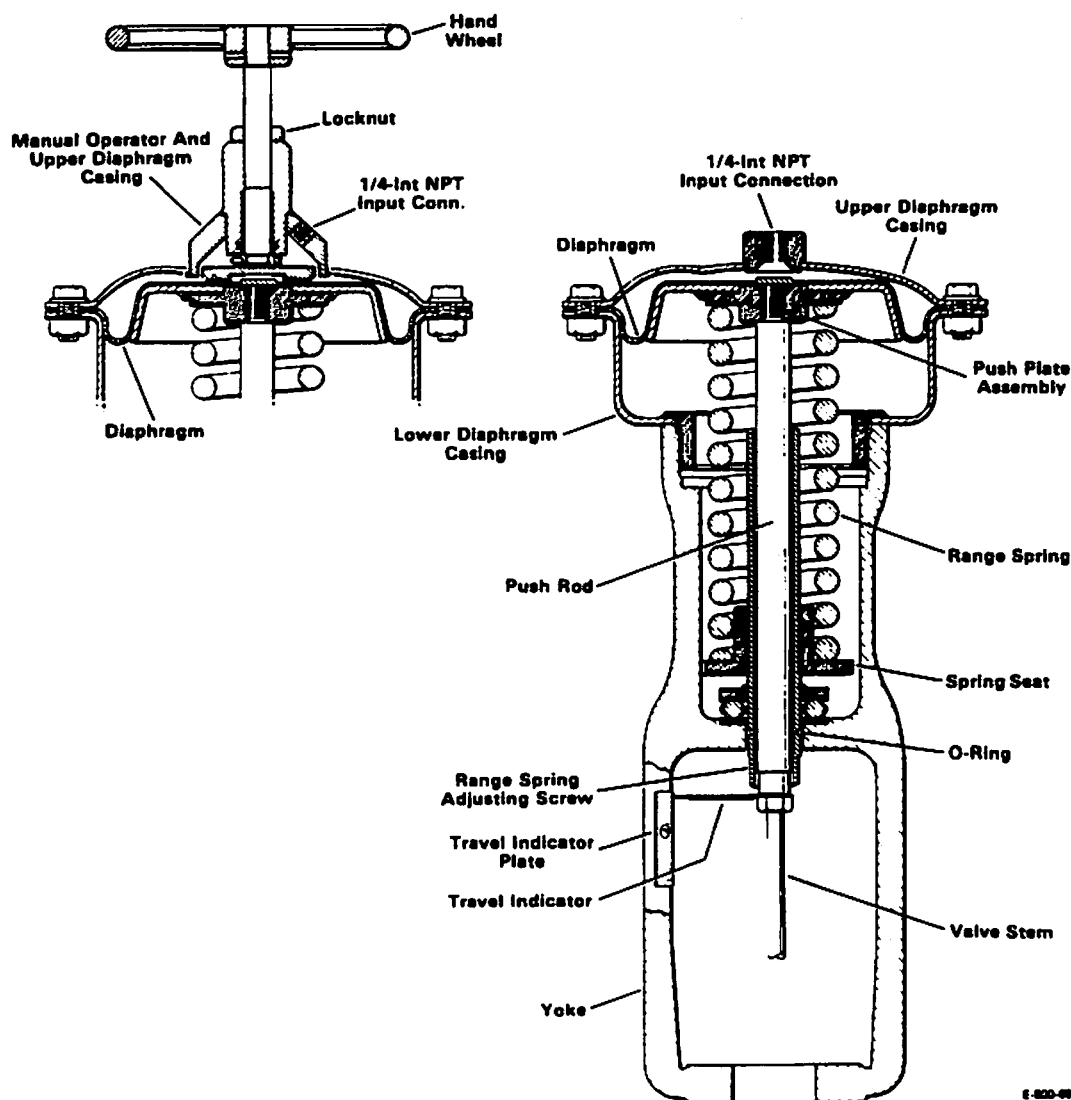
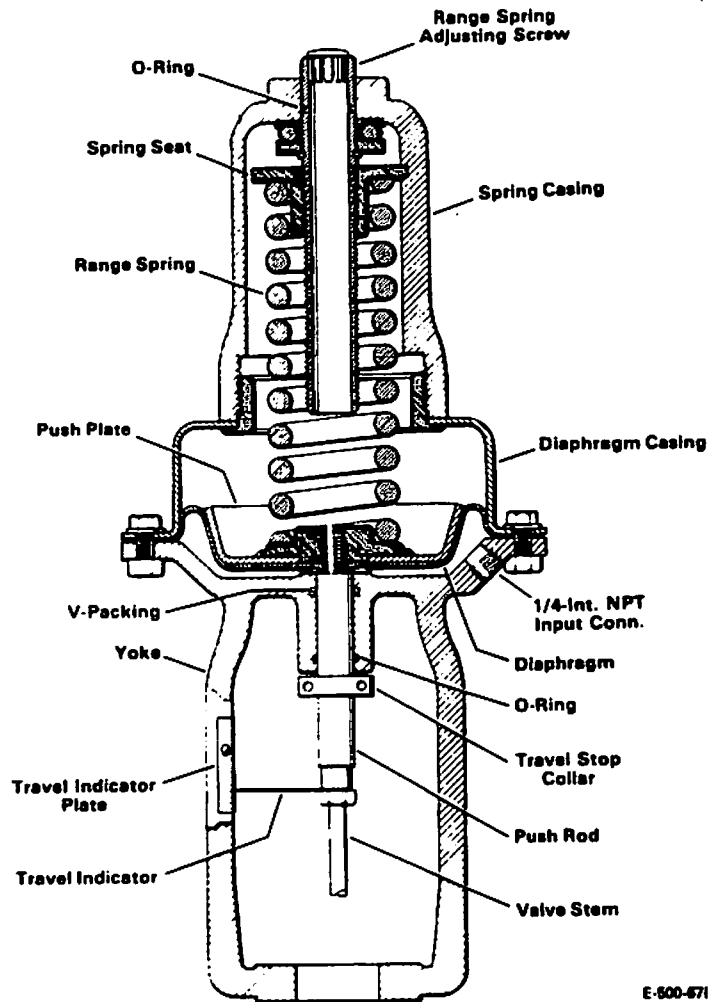


Figure 3. Air-to-Lower Actuator

## INTRODUCTION

**Air-to-Raise type, Figure 4** — In this type of actuator, an increase in air pressure moves the push rod upward, compressing the spring. In the event of air failure the push rod moves to its extreme downward position.

Thus, selection of actuator and valve depends upon customer application, piping arrangement and process control conditions required in case of air failure.



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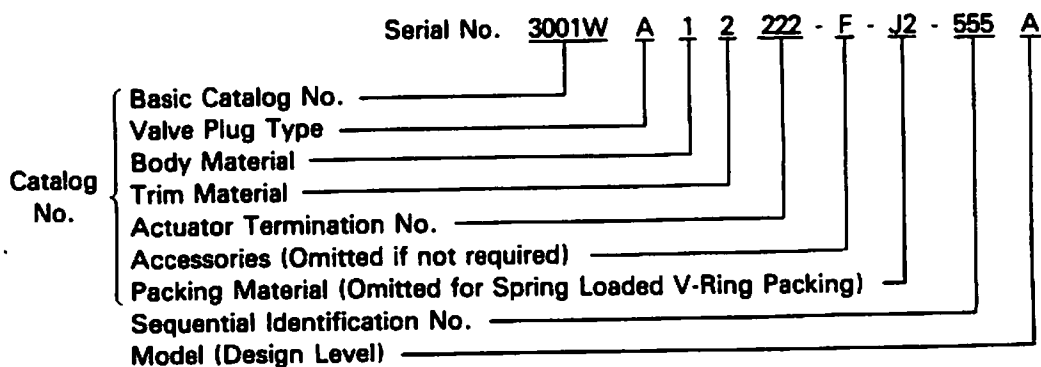
Figure 4. Air-to-Raise Actuator

## INTRODUCTION

### 1.2 SERIAL AND CATALOG NUMBERS

The serial number stamped on the data plate consists of catalog number and a sequential identification number. The catalog number describes the construction of the valve and actuator. The data plate is attached to the actuator.

An X before the serial number indicates that the instrument has been built to meet a customer's special requirements.



#### BASIC CATALOG NO.

- 3000W — Hi-Flow Valve, 1/2 inch, Three-Way
- 3001W — Hi-Flow Valve, 3/4 inch, Three-Way
- 3002W — Hi-Flow Valve, 1 inch, Three-Way
- 3003W — Hi-Flow Valve, 1-1/4 inch, Three-Way
- 3004W — Hi-Flow Valve, 1-1/2 inch, Three-Way
- 3005W — Hi-Flow Valve, 2 inch, Three-Way

#### VALVE PLUG TYPE

- A — Linear

#### BODY MATERIAL

- 1 — Ductile Iron
- 3 — Bronze
- 4 — Type 316 SST

#### TRIM MATERIAL

- 2 — Type 316 SST

#### ACTUATOR TERMINATION NO.

- 220 — Standard Air-to-Lower  
20 in<sup>2</sup> Effective Area
- 221 — Senior Air-to-Lower  
45 in<sup>2</sup> Effective Area
- 222 — Standard Air-to-Lower  
45 in<sup>2</sup> Effective Area
- 223 — Senior Air-to-Lower  
80 in<sup>2</sup> Effective Area
- 230 — Standard Air-to-Raise  
20 in<sup>2</sup> Effective Area
- 231 — Senior Air-to-Raise  
45 in<sup>2</sup> Effective Area
- 233 — Standard Air-to-Raise  
80 in<sup>2</sup> Effective Area

#### ACCESSORIES

- A — Valve Positioner
- C — Top Mounted Manual Operator
- F — Extension Bonnet
- M — Limit Switches
  - M1 — Dust Proof
  - M2 — Explosion Proof
  - M3 — Plug-in
- N — Air Set Mounting
  - N103 — 1004F Air Set
  - N103 — 1004F Air Set with Gauge
- P — Travel Limiter
- Z — Special Operating Range

#### OPTIONAL PACKING MATERIAL

- J2 — Spring Loaded Graphite Packing
- J3 — Lubricated Graphite Packing with Lubricator
- J7 — TFE V-Ring Packing for Vacuum Service
- J8 — Double TFE V-Ring Packing for Positive Pressure
- J9 — Double TFE V-Ring Packing for Negative Pressure
- J10 — Double TFE V-Ring Packing for Alternate Positive and Negative Pressures

#### EXAMPLE:

Serial No. 3001WA12220-F-J2-555A identifies a 3/4-inch three-way valve (3001W), with a linear valve plug (A). The body material is ductile iron (1), trim material is type 316 SST (2), and the actuator is air-to-lower (220). The valve has an extension bonnet (F), and spring loaded graphite packing (J2). The sequential identification number is 555 and the design level is Model A.



## INTRODUCTION

**1.3 TECHNICAL CHARACTERISTICS****VALVE BODY PRESSURE RATING**

Ductile Iron:	250 psig at 400°F (1725 kPa at 204°C)
Bronze:	250 psig at 400°F (1725 kPa at 204°C)
Type 316 SST:	300 psig at 400°F (2070 kPa at 204°C)

**AMBIENT TEMPERATURE LIMITS**

– 32°F min, 150°F max (– 36°C, 66°C)

**PROCESS TEMPERATURE LIMITS**

– 150°F (– 66°C) min (with Extension Bonnet),  
400°F (204°C) max

**MAXIMUM ACTUATOR AIR PRESSURE**

Refer to Table 1

**MAXIMUM STROKE**

Refer to Table 1

**ACTUATOR MATERIALS**

Frame:	Cast Iron, Baked Enamel Finish
Diaphragm Case:	Steel, Baked Enamel Finish
Diaphragm:	Buna-N-rubber, Nylon reinforced
Range Spring:	Plated spring steel
Range Spring	} Plated cold rolled steel
Seat:	
Adjusting Screw:	
Push Rod:	

**VALVE MATERIALS**

Body: }	} Refer to Paragraph 1.2
Trim: }	
Standard Packing:	Three spring loaded TFE V-Rings with wiper ring
Optional Packing:	Refer to Paragraph 1.2
Packing Bonnet:	Brass on ductile iron or bronze body; type 316 SST on 316 SST body

Table 1. Maximum Air Supply Pressure and Maximum Stroke

Actuator Termination Number		Actuator Part No.		Max. Air Supply Pressure		Max. Stroke	
		Without Hand Wheel	With Hand Wheel	psig	kPa	Inches	mm
Air to Lower	220	15S620	—	100	700	1	25.4
	221	15S621	15S721	50	350	1	25.4
	222	15S622	15S722	100	700	1-1/2	38.1
	223	15S623	15S723	50	350	1-1/2	38.1
Air to Raise	230	15S630	—	100	700	1	25.4
	231	15S631	—	50	350	1	25.4
	233	15S633	—	50	350	1-1/2	38.1

## INSTALLATION

## 2

## INSTALLATION

**2.1 MOUNTING**

Mount the control valve in a location where it will be accessible for servicing. The valve can be mounted in any position in the pipeline, but the preferred position is in a horizontal pipe run with the actuator perpendicular to the pipeline and above the pipe. The ambient temperature of the mounting location must be within the limits listed in 1.3 Technical Characteristics.

Clearance should be left above and below the control valve to permit removal of actuator and valve plug. Figure 5 shows removal clearance that is required. Mounting dimensions for these valves are shown in Figures 6, 7, 8 and 9.

Before mounting, inspect valve body ports. Make sure ports are clean and threaded connections have not been damaged.

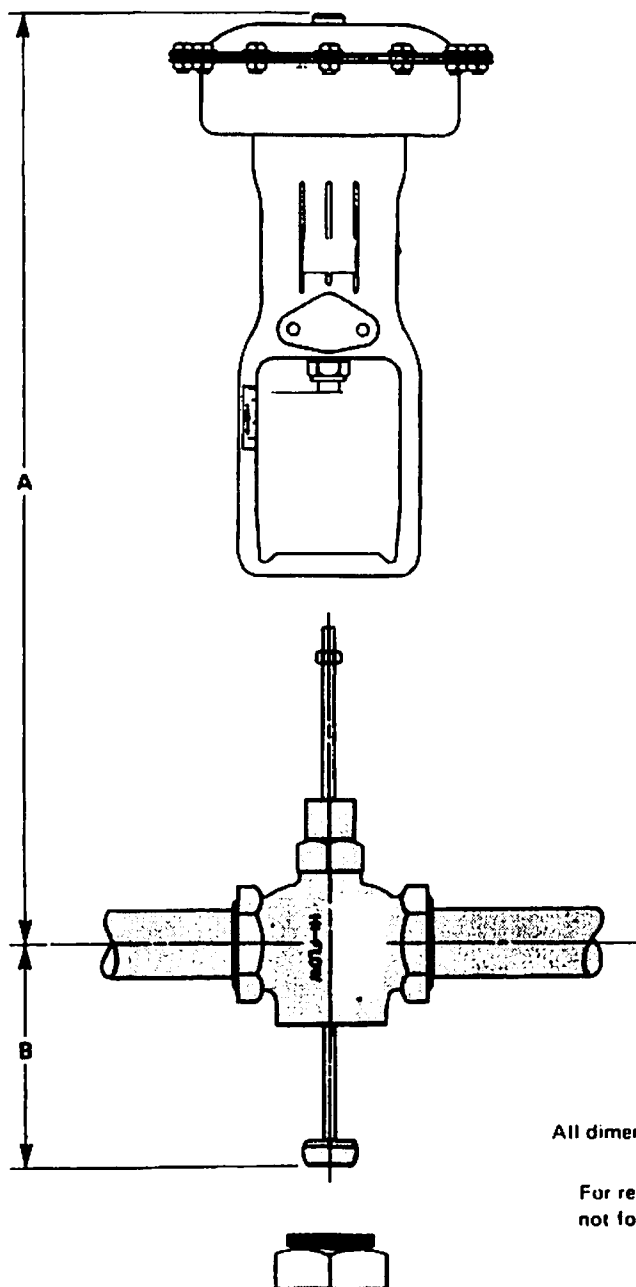
Mount the valve in the pipe line with flow(s) in the direction required for process application, Figures 1

and 2. Apply a suitable thread lubricant to the male pipe threads before putting the valve in the line.

**2.2 PNEUMATIC CONNECTIONS**

Connect the input pressure to the 1/4-inch Int NPT port on the top of an air-to-lower actuator or under the diaphragm casing on an air-to-raise actuator, Figure 6, 7 or 8. Either pipe or tubing may be used for the air line. The input pressure must not exceed the limits listed in 1.3 Technical Characteristics.

When there is a long distance between the actuator and the control device which produces the input pressure, or when a large actuator size is required, there may be excessive transmission lag in the control signal. A W.E Anderson valve positioner, Catalog Number 100N can be used to reduce the lag. If a valve positioner is furnished with the actuator, connections between the positioner and actuator are made at the factory. Refer to the valve positioner instructions for additional connection information.



All dimensions in inches

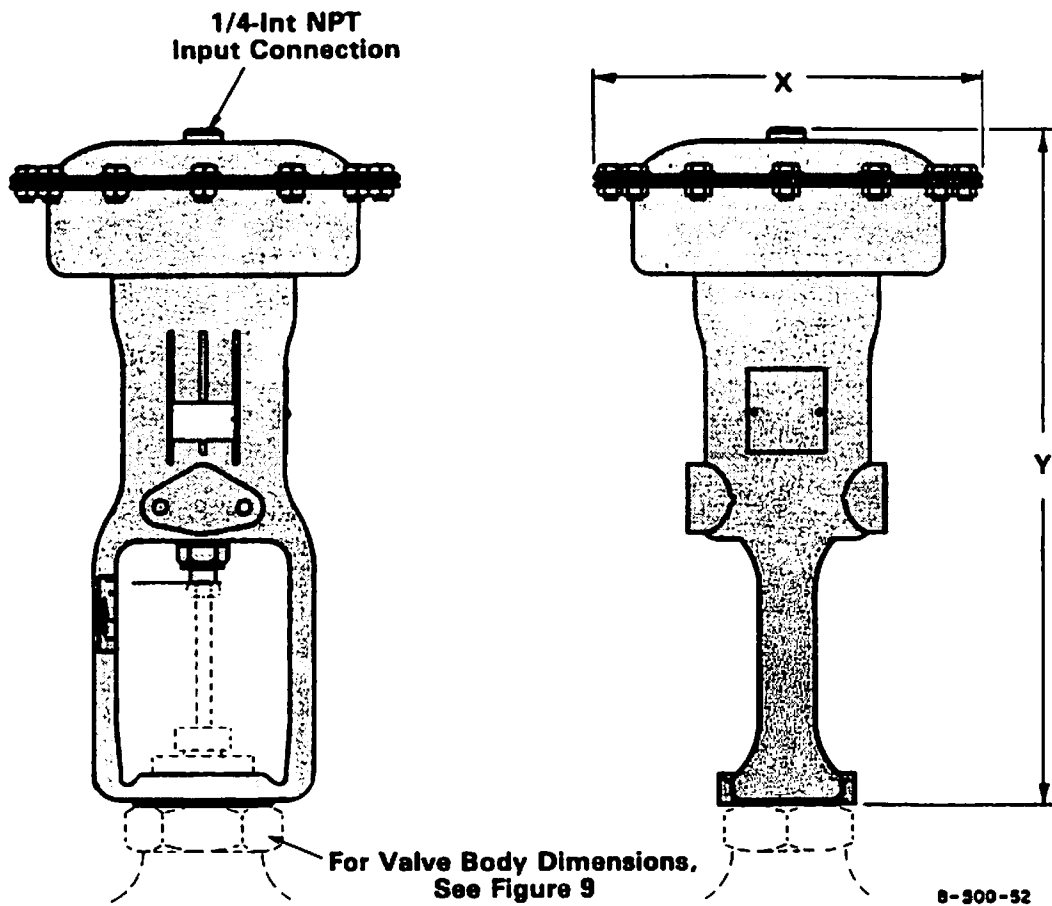
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VALVE SIZE	DIMENSION A									DIMENSION B	
	LIN-E-AIRE ACTUATOR										
	Push-to-Close Actuator			Push-to-Close Actuator with Handwheel			Push-to-Open Actuator				
	Term No.	Plain Bonnet	Ext. Bonnet	Term No.	Plain Bonnet	Ext. Bonnet	Term No.	Plain Bonnet	Ext. Bonnet	Plain Bonnet	Ext. Bonnet
1/2	220	24-1/2	29	--	--	--	230	24-3/4	29-1/4	9-7/8	14-3/8
	221	25-1/8	29-5/8	--	--	--	231	25-3/8	29-7/8		
	--	--	--	--	--	--	--	--	--		
3/4	220	24-1/2	29	--	--	--	230	24-3/4	29-1/4	9-7/8	14-3/8
	221	25-1/8	29-5/8	221(C)	30-7/8	35-3/8	231	25-3/8	29-7/8		
	222	27-1/4	31-3/4	--	--	--	--	--	--		
	--	--	--	--	--	--	233	29-7/8	34-3/8		
1	220	24-1/2	29	--	--	--	230	24-3/4	29-1/4	10-3/4	15-3/4
	221	25-1/8	29-5/8	221(C)	30-3/4	35-1/4	231	25-3/8	29-7/8		
	222	27-1/8	31-5/8	--	--	--	--	--	--		
	223	--	--	--	--	--	233	29-3/4	34-1/4		
		--	--	--	--	--	--	--	--		
1-1/4	220	24-5/8	29-1/8	--	--	--	230	24-7/8	29-3/8	10-7/8	15-7/8
	221	25-1/4	29-3/4	221(C)	30-7/8	35-3/8	231	25-3/4	30		
	222	27-1/8	31-5/8	222(C)	33-1/8	37-5/8	--	--	--		
	223	--	--	223(C)	35-3/4	40-1/4	233	29-7/8	34-3/8		
		--	--	--	--	--	--	--	--		
1-1/2	220	25	32	--	--	--	230	25-1/4	32-1/4	12-3/8	19-3/8
	221	25-5/8	32-5/8	221(C)	31-1/4	38-1/4	231	25-7/8	32-7/8		
	222	27-1/2	34-1/2	222(C)	33-1/2	40-1/2	--	--	--		
	223	--	--	223(C)	36-1/8	43-1/8	233	30-1/4	37-1/4		
		--	--	--	--	--	--	--	--		
2	220	25-1/4	32-1/4	--	--	--	230	25-1/2	32-1/2	12-1/2	19-1/2
	221	25-7/8	32-7/8	221(C)	31-1/2	38-1/2	231	26-1/8	33-1/8		
	222	27-3/4	34-3/4	222(C)	33-3/4	40-3/4	--	--	--		
	223	--	--	223(C)	36-3/8	43-3/8	233	30-1/2	37-1/2		
		--	--	--	--	--	--	--	--		

INCHES	mm	INCHES	mm	INCHES	mm	INCHES	mm
9-7/8	250.83	25-1/2	647.70	30-1/2	774.70	34-3/4	882.65
10-3/4	273.05	25-5/8	650.88	30-3/4	781.05	35-1/4	895.35
10-7/8	276.23	25-3/4	654.05	30-7/8	784.23	35-3/8	898.53
12-3/8	314.33	25-7/8	657.23	31-1/4	793.25	35-3/4	908.05
12-1/2	317.50	26-1/8	663.58	31-1/2	800.10	36-1/8	917.58
14-3/8	365.13	27-1/8	688.98	31-5/8	803.28	36-3/8	923.93
15-3/4	400.05	27-1/4	692.15	31-3/4	806.45	37-1/4	946.15
15-7/8	403.23	27-1/2	698.50	32	812.80	37-1/2	952.50
19-3/8	492.13	27-3/4	704.85	32-1/4	819.15	37-5/8	955.68
19-1/2	495.30	29	736.60	32-1/2	825.50	38-1/4	971.55
24-1/2	622.30	29-1/8	739.78	32-5/8	828.68	38-1/2	977.90
24-5/8	625.48	29-1/4	742.95	32-7/8	835.03	40-1/4	1022.35
24-3/4	628.65	29-3/8	746.13	33-1/8	841.38	40-1/2	1028.70
24-7/8	631.83	29-5/8	752.48	33-1/2	850.90	40-3/4	1035.05
25	635.00	29-3/4	755.65	33-3/4	857.25	43-1/8	1095.38
25-1/8	638.18	29-7/8	758.83	34-1/4	869.95	43-3/8	1101.53
25-1/4	641.35	30	762.00	34-3/8	873.13		
25-3/8	644.53	30-1/4	768.35	34-1/2	876.30		

Figure 5. Removal Clearance Required

## INSTALLATION



Actuator		Part No.	X	Y	No. of Bolts	Yoke Boss Hole Diam.
Type	Term No.					
Standard	220	15S620	7-3/4	15-7/8	10	1-1/2
	222	15S622	10-5/8	18-5/8	12	1-15/16
Senior	221	15S621	10-5/8	16-9/16	12	1-1/2
	223	15S623	13-3/8	20	18	1-15/16

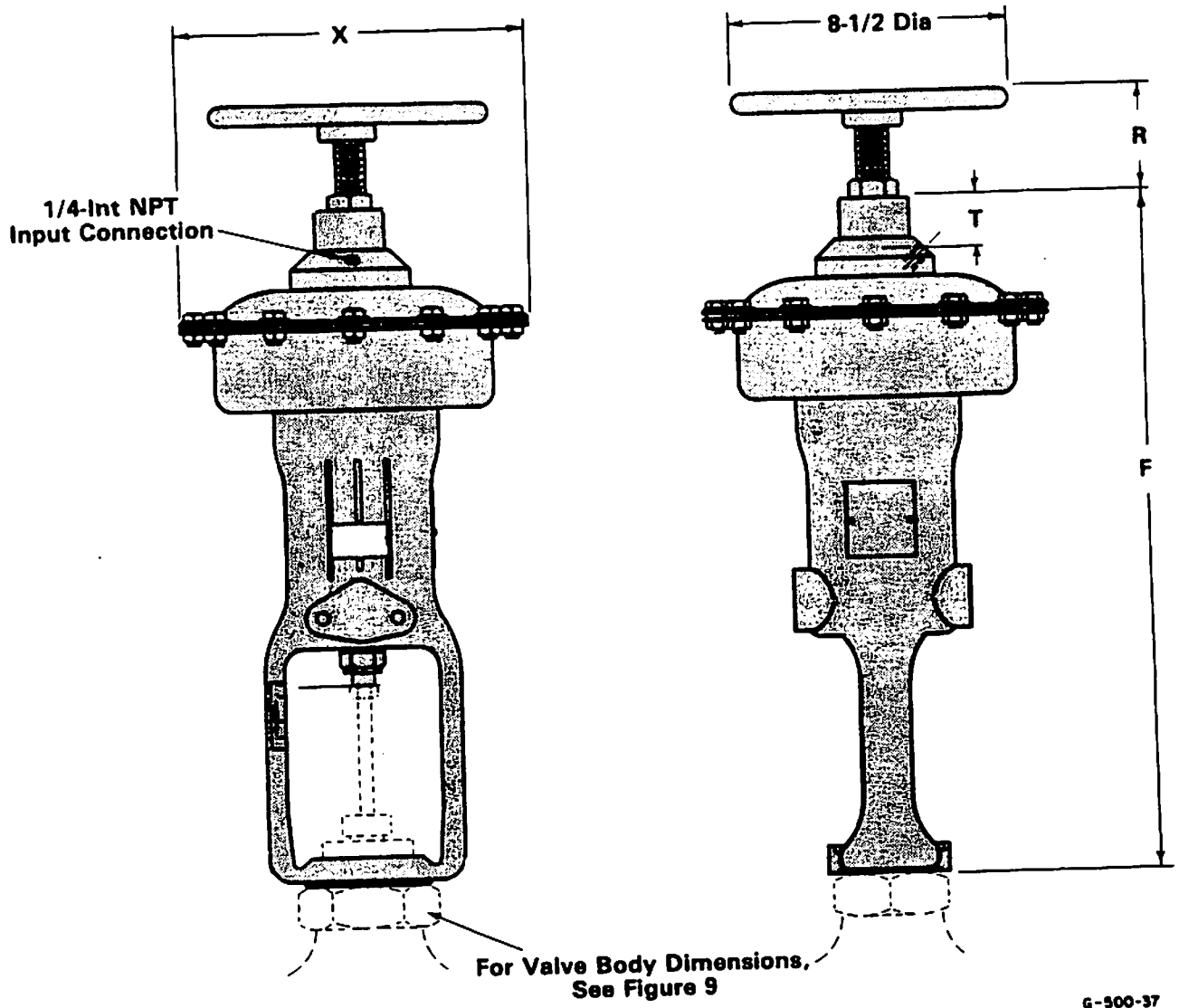
INCHES	mm
1-1/2	38.10
1-15/16	49.21
7-3/4	196.85
10-5/8	269.88
13-3/8	339.73
15-7/8	403.23
16-9/16	420.69
18-5/8	473.08
20	508.00

All dimensions in inches.

For reference only;  
not for construction

Figure 6. Mounting Dimensions for Air-to-Lower Actuator

## INSTALLATION



Actuator		Part No.	F	R (Max.)	T	X	No. of Bolts	Yoke Boss Hole Diam.
Type	Term. No.							
Standard	222	15S722	22-3/32	3-1/4	2-19/32	10-5/8	12	1-15/16
	221	15S721	20-1/32	3-1/4	2-19/32	10-5/8	12	1-1/2
Senior	223	15S723	24-1/8	4	3-9/32	13-3/8	18	1-15/16

All dimensions in inches.

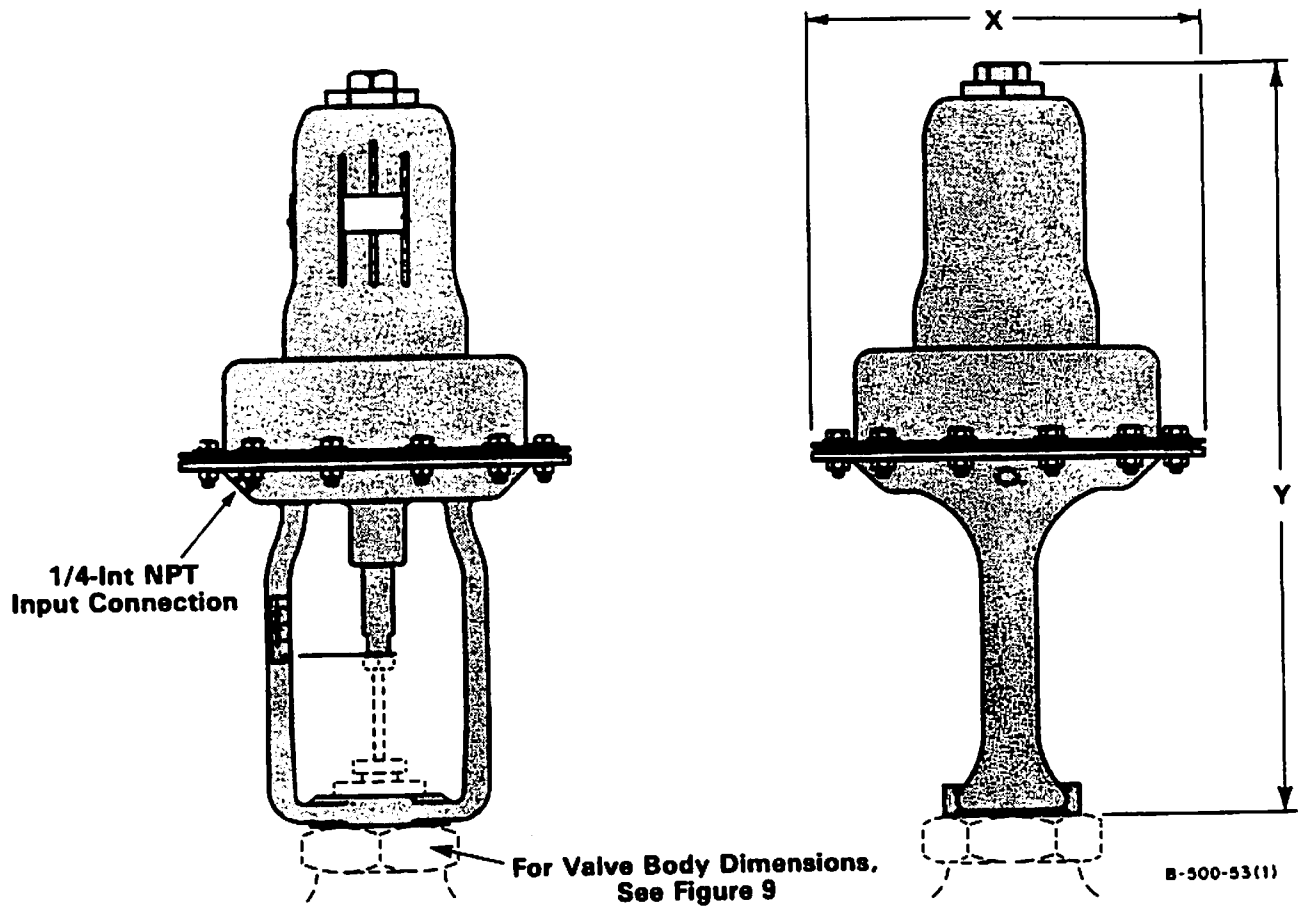
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INCHES	mm
8-1/2	215.90
10-5/8	269.88
13-3/8	339.73
20-1/32	508.79
22-3/32	561.18
24-1/8	612.78

INCHES	mm
1-1/2	38.10
1-15/16	49.21
2-19/32	65.88
3-1/4	82.55
3-9/32	83.34
4	101.60

Figure 7. Mounting Dimensions for Air-to-Lower Actuator with Manual Operator (Accessory C)

# INSTALLATION



Actuator		Part No.	X	Y	No. of Bolts	Yoke Boss Hole Diam.
Type	Term No.					
Standard	230	15S630	7-3/4	17-3/16	10	1-1/2
	231	15S631	10-5/8	17-13/16	12	1-1/2
Senior	233	15S633	13-3/8	22-9/32	18	1-1/2

INCHES	mm
1-1/2	38.10
7-3/4	196.85
10-5/8	269.88
13-3/8	339.73
17-3/16	438.56
17-13/16	452.44
22-9/32	566.94

All dimensions in inches.

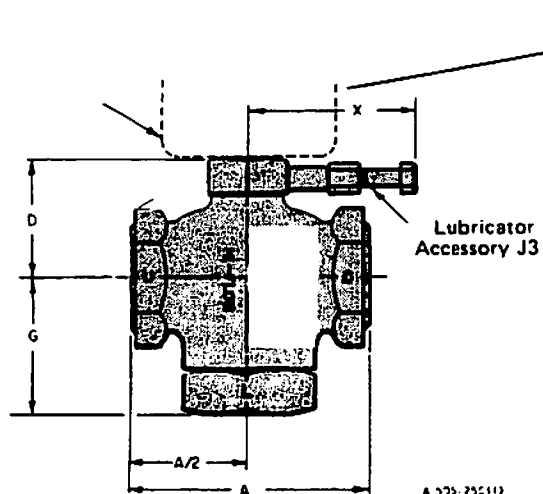
For reference only;  
not for construction

Figure 8. Mounting Dimensions for Air-to-Raise Actuator

## INSTALLATION

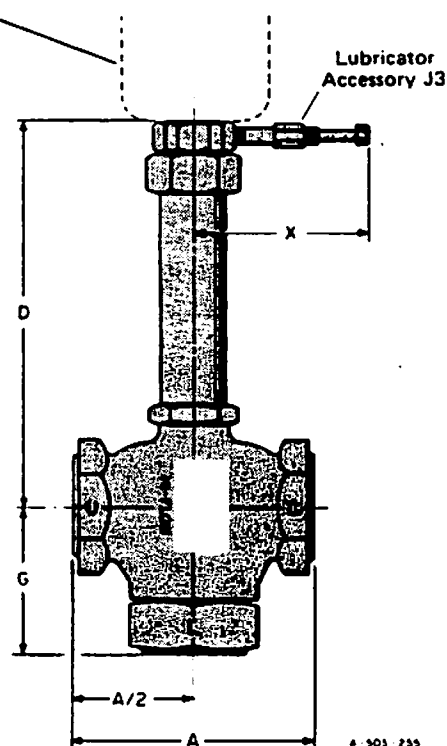
3000W thru 3005W \_\_\_\_\_  
Without Extension Bonnet

3000W thru 3005W \_\_\_\_\_-F  
With Extension Bonnet



All dimensions in inches.

For reference only;  
not for construction.



Catalog No.	Valve Size	A		D		G	X
		Ductile Iron or Bronze Body	Type 316 SST Body	Without Extension	With Extension		
3000W	1/2"	3-3/4	4-3/16	2-3/16	6-11/16	2-9/16	4-7/8
3001W	3/4"	3-7/8	4-1/4	2-3/16	6-11/16	2-9/16	4-7/8
3002W	1"	4-3/4	5-1/4	2-7/16	6-15/16	3	4-7/8
3003W	1-1/4"	5	5-3/4	2-1/2	7	3-3/16	5-1/16
3004W	1-1/2"	5-1/2	6-1/8	2-3/4	9-3/4	3-3/4	5-1/16
3005W	2"	6-1/2	6-7/8	3-3/16	10-3/16	3-15/16	5-1/16

INCHES	mm	INCHES	mm	INCHES	mm
2-3/16	55.56	3-15/16	100.01	5-3/4	146.05
2-7/16	61.91	4-3/16	106.36	6-1/8	155.58
2-1/2	63.50	4-1/4	107.95	6-1/2	165.10
2-9/16	65.09	4-3/4	120.65	6-11/16	169.06
2-3/4	69.85	4-7/8	123.83	6-7/8	174.63
3	76.20	5	127.00	6-15/16	178.21
3-3/16	80.96	5-1/16	128.59	7	177.80
3-3/4	95.25	5-1/4	133.35	9-3/4	247.65
3-7/8	98.43	5-1/2	139.70	10-3/16	258.76

Figure 9. Mounting Dimensions for 3000W thru 3005W Hi-Flow Valves

## OPERATION

## 3

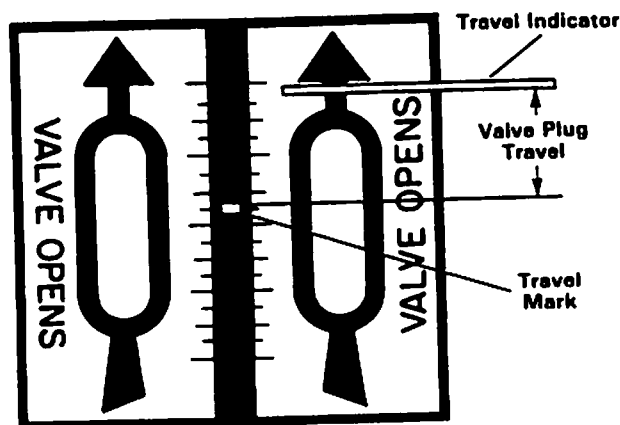
## OPERATION

## 3.1 CHECKING VALVE TRAVEL

The actuator spring has been selected to meet the requirements of the application and has been adjusted at the factory to the pressure range stamped on the data plate. The spring has a constant rate of compression, and spring adjustments shift the pressure span up or down to make stem travel coincide with this pressure range. When in service, the actuator should yield the required travel when pressure range stamped on data plate is applied. This diaphragm pressure range is generally 3 to 15 psi (20 to 100 kPa), but other ranges may be used.

When the actuator is completely installed and connected to the control device, it should be checked with normal working line pressure conditions for correct travel. Apply the pressure range listed on the data plate to the actuator. Note that travel indicator should have moved the distance marked on indicator plate, Figure 10.

The pressure drop across the valve body ports has a direct effect on the actual operating pressure range. In some instances, the valve operating range may be different from the indicated range. This is because the pressure conditions in the valve body are different from those originally specified and for which the control valve has been set at the factory.



A-505-356A

Figure 10. Travel Indicator Plate Showing Valve Plug Travel

## 3.2 ADJUSTING ACTUATOR RANGE

## NOTE

When using this procedure, be sure that the value is operating under normal line pressure conditions. Refer to 4.6 Adjusting Actuator Range-Shop Procedure if valve is not in pipe line. If necessary, make test hookup as shown in Figure 24.

## 3.2.1 Air-to-Lower Actuator

1. Slowly increase input pressure until stem just begins to move. Stem motion can be easily detected by feeling stem or push rod as pressure is applied.

## WARNING

*If valve is used for steam service or where line process is hot, use visual means of detecting movement to avoid injury.*

2. Note input pressure at which stem moves.
3. If input pressure is not the same as lower range value on data plate, spring adjusting screw must be adjusted.

If pressure is high, turn adjusting screw, Figure 11, counterclockwise as viewed from the valve top.

If pressure is low, turn adjusting screw clockwise as viewed from the valve top.

4. Release input pressure and repeat Steps 1, 2 and 3 until valve stem moves at the lower range value.

## 3.2.2 Air-to-Lower Actuator with Manual Operator

1. Loosen locknut under hand wheel, Figure 3 and turn hand wheel counterclockwise to relieve all force on diaphragm.
2. Slowly increase input pressure until stem just begins to move. Stem motion can be easily



## OPERATION

detected by feeling stem or push rod as pressure is applied.

**WARNING**

*If valve is used for steam service or where line process is hot, use visual means of detecting movement to avoid injury.*

3. Note input pressure at which stem moves.
4. If input pressure is not the same as lower range value on data plate, spring adjusting screw must be adjusted.

If pressure is high, turn adjusting screw, Figure 11, counterclockwise as viewed from the valve top.

If pressure is low, turn adjusting screw clockwise as viewed from the valve top.

5. Release input pressure and repeat Steps 2, 3 and 4 until valve stem moves at the lower range value.
6. Turn hand wheel clockwise to required setting and tighten locknut under hand wheel.

**3.2.3 Air-to-Raise Actuator**

1. Loosen the four set screws on travel stop collar, Figure 11, collar should move freely on push rod.

2. Slowly increase input pressure until stem just begins to move. Stem motion can be easily detected by feeling stem or push rod as pressure is applied.

**WARNING**

*If valve is used for steam service or where line process is hot, use visual means of detecting movement to avoid injury.*

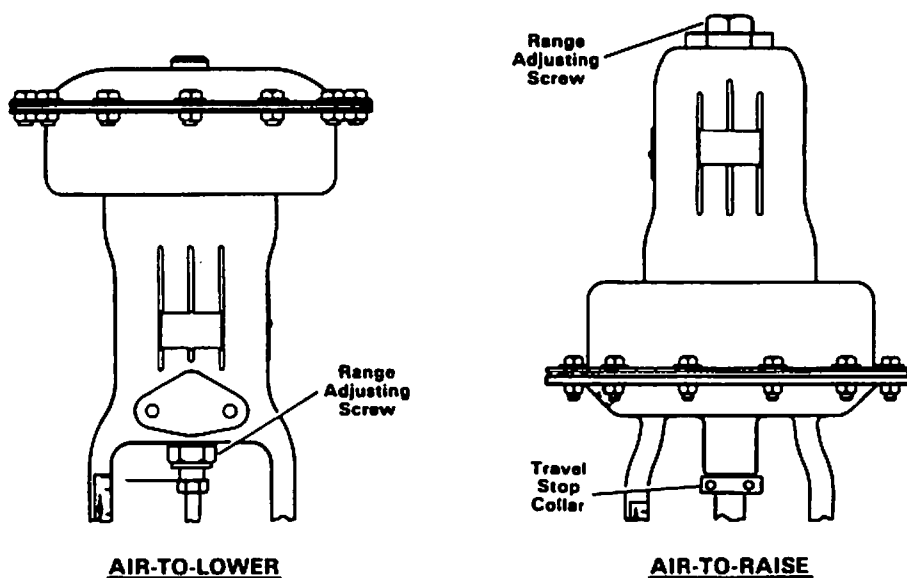
3. Note input pressure at which stem moves.
4. If input pressure is not the same as lower range value on data plate, spring adjusting screw must be adjusted.

If pressure is high, turn adjusting screw clockwise as viewed from the valve top.

If pressure is low, turn adjusting screw counterclockwise as viewed from the valve top.

5. Release input pressure and repeat Steps 2, 3 and 4 until valve stem moves at lower range value.

6. Apply the upper range value input pressure stamped on data plate. Slide travel stop collar up on push rod right to yoke and tighten the four set screws.



E 500 76

Figure 11. Adjusting Actuator Range

## MAINTENANCE

## 4

## MAINTENANCE

## 4.1 TEST EQUIPMENT AND TOOLS REQUIRED

The only test equipment required for valve and actuator maintenance is an air supply source, gage and regulator. The tools required are shown in Table 2.

## 4.2 DISASSEMBLING VALVE

The control valve has only three parts which normally require maintenance. They are the packing, valve plug and stem assembly, and seat ring. Use this procedure to disassemble the valve and check these components for wear or damage. It is recommended that the packing always be replaced following disassembly of the valve.

**WARNING**

*Before attempting any maintenance on control valve, make sure valve has been relieved of all pressure.*

1. Loosen stem locknut, Figure 12.
2. Loosen valve mounting nut.
3. Shutoff pressure to actuator and disconnect air line.

Table 2. Tools Required

Valve Size	Tool	Size	Use
All	Screwdriver	3/16-inch	Travel Indicator Plate
		1/4-inch	
	Open End Wrenches	1/2-inch 9/16-inch 5/8-inch	Diaphragm Casing Mounting Screw and Nut
		7/8-inch 1-1/4-inch	Range Spring Adjusting Screw
		9/16-inch 11/16-inch	Actuator Push Rod
		1/2-inch	Valve Stem Locknut
		31/32-inch	Valve Packing Nut
		1-3/4-inch 2-1/4-inch	Bonnet
		2-3/8-inch 2-5/8-inch 2-7/8-inch 3-1/8-inch 3-5/8-inch	Adapter Union
All	Hammer	—	Valve Mounting
	Drive Pin	—	
	Seat Ring Tool Part Number 153S22 (Figure 13)	—	Valve Seat Ring
	Valve Packing Tool Part Number 153P9 (Figure 14)	—	TFE V-Ring Valve Packing

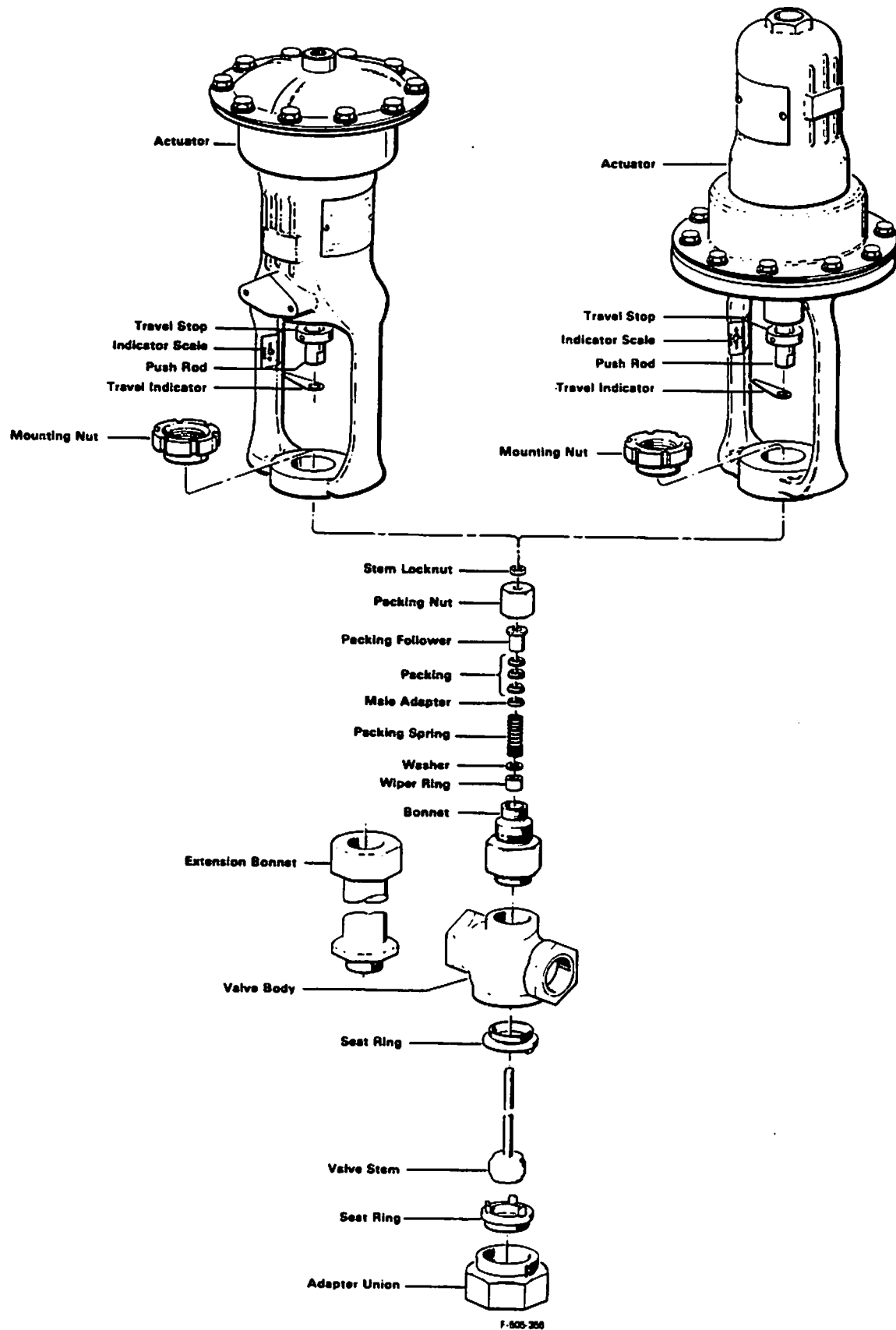


Figure 12. Exploded View of Control Valve

## MAINTENANCE

### WARNING

*Make sure all pressure has been relieved from actuator.*

4. Unscrew mounting nut.
5. Unscrew valve stem and plug assembly from push rod by rotating actuator. It may be necessary to use pliers to hold valve stem. If necessary, grip stem near threads to avoid scoring lower portion of stem.
6. Lift actuator off valve body.
7. Remove stem locknut.
8. Unscrew packing nut and remove packing follower from bonnet.
9. Remove adapter union and pull valve plug and stem assembly from bottom of valve body. Draw stem threads carefully thru valve stem packing to avoid damaging the V-rings. If packing is damaged, it should be replaced. Unscrew bonnet from valve body.

### NOTE

Check valve plug and stem assembly as well as seat rings for damage. If valve plug or seat ring is badly scratched or wire drawn, replacement must be made when valve is reassembled. Refer to 4.3 Assembling Valve.

### CAUTION

*When performing Step 10, be careful not to scratch the surface that guides the valve stem.*

10. Form a wire hook and pull packing from bonnet, or push a rod through to force the parts out of upper part of bonnet.
11. The spring and washer can be removed by turning bonnet upside down and tapping or shaking it.
12. If seat rings need to be replaced, remove them using tool, part number 153S22, Figure 13.
13. Thoroughly clean bonnet after removing internal parts.

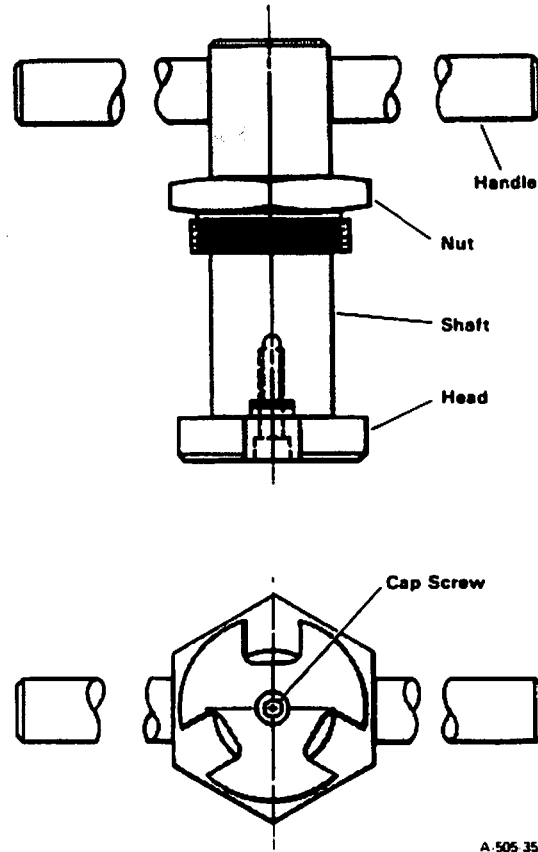


Figure 13. W.E Anderson Seat Ring Removal Tool, Part No. 153S22

### 4.3 ASSEMBLING VALVE

After disassembling the valve and checking for worn or damaged parts in 4.1 Test Equipment and Tools Required, use this procedure to install the required new parts and assemble the valve.

1. If new seat ring, Figure 12, is to be installed, proceed as follows:
  - a. Apply a coating of Plastic Lead Seal, Part Number 325M36 (John Crane Insoluble Number 2), to threads of new seat ring.
  - b. Using seat ring tool, Figure 13, screw seat ring into valve body. Tighten seat ring to torque specifications listed in Table 3.

### NOTE

When installing valve plug and stem assembly in bonnet it is recommended that packing be replaced.

Table 3. Torque Values for Assembling Valve

VALVE PART	VALVE SIZE	TORQUE	
		Foot-lbs	Newton-Metre
Seat Ring	1/2, 3/4, 1 & 1-1/4 1-1/2 & 2	100-125	135.6-169.5
		125-150	169.5-203.4
Bonnet	ALL	100-125	135.6-169.5
Adapter Union	1/2 & 3/4 1 & 1-1/4 1-1/2 & 2	100-125	135.6-169.5
		125-150	169.5-203.4
		200-250	271.2-339

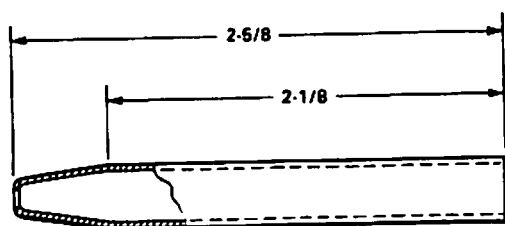
2. Install new valve plug and stem assembly, Figure 12, in bonnet by inserting stem through bottom of valve. Apply coating of Plastic Lead Seal to threads of adapter union and assemble to bottom of valve. Apply coating of Plastic Lead Seal to threads of bonnet, slide bonnet over valve stem and screw into valve body. Tighten cap and bonnet to torque specifications listed in Table 3.

3. Install new packing as follows:

- a. **TFE Packing** - Use packing tool, part number 153P9, Figure 14, to prevent damaging packing. Slide tool over valve stem threads. Lightly coat TFE packing with silicone grease, W.E Anderson part number 353M27 (Dow Corning Number 17 compound). Slide packing over stem in the order shown in figure 15 or 18 through 21, choosing the view that applies to the packing being replaced.

**CAUTION**

*Never pound TFE packing to force it into bonnet.*



A 505 354

Figure 14. W.E. Anderson Valve Packing Tool, Part No. 153P9

- b. **Graphite Pacing** — Install packing in the order shown in Figure 16 or 17, choosing the view that applies to the packing being replaced. Be careful not to damage packing on valve stem threads.

4. Install packing nut on valve stem as follows:

- a. **TFE packing** — Tighten packing nut as far as it will go.
- b. **Graphite packing** — Tighten packing nut finger tight. Make further adjustments to stop leakage after flow has been established.

5. Install stem locknut and travel indicator on valve stem.

6. Mount actuator on valve body, install valve mounting nut over stem assembly as stem passes thru boss.

**CAUTION**

*When performing Step 7, be careful not to rotate valve plug on seat ring.*

7. Screw valve plug and stem assembly into push rod by turning actuator on body until valve plug is against upper seat. Grip valve stem with pliers to keep valve plug from turning on seat and turn actuator two more complete turns. Then tighten valve mounting nut.
8. Align travel indicator with scale and tighten stem locknut.

MAINTENANCE

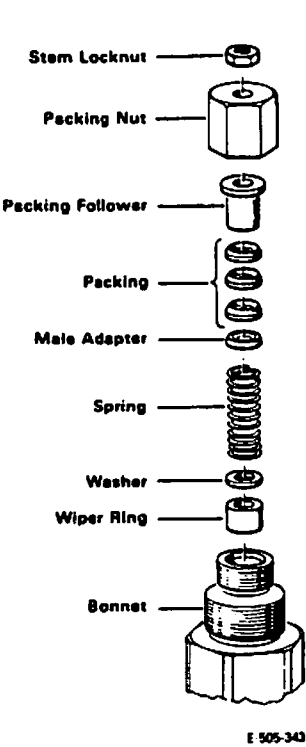


Figure 15. Standard Packing Spring Loaded TFE V-Ring

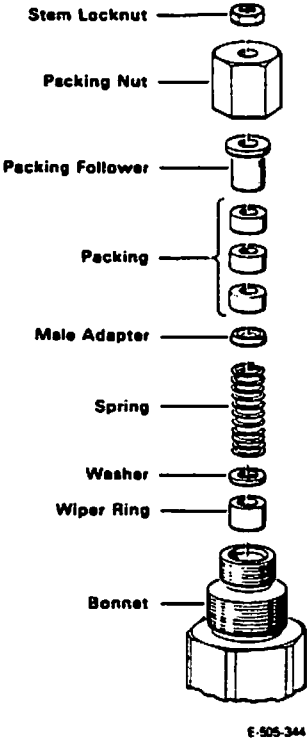


Figure 16. Optional Packing Catalog No. Code J2 Spring Loaded Graphite

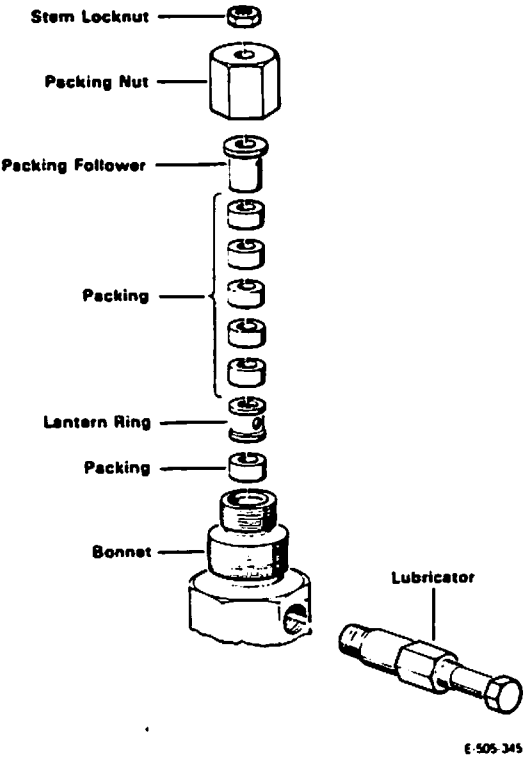


Figure 17. Optional Packing Catalog No. Code J3 Lubricated Graphite with Lubricator

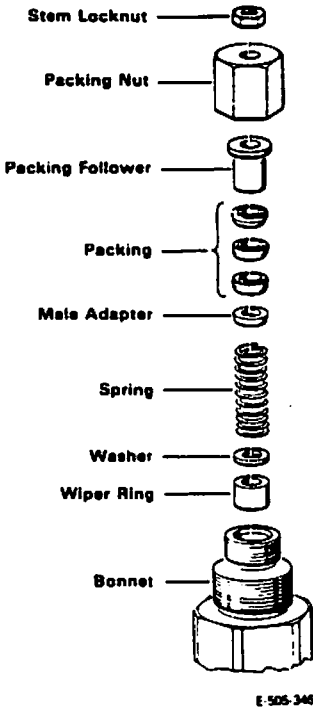


Figure 18. Optional Packing Catalog No. Code J7 TFE V-Ring for Vacuum Service

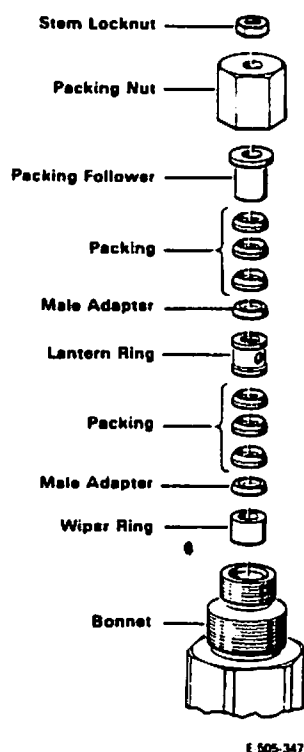


Figure 19. Optional Packing Catalog No. Code J8  
Double TFE V-Ring for Positive Pressure

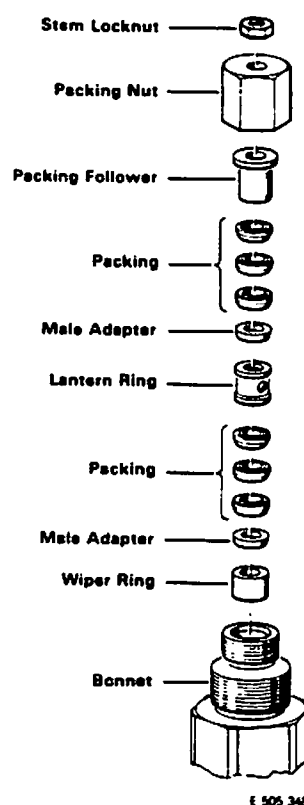


Figure 20. Optional Packing Catalog No. Code J9  
Double TFE V-Ring for Negative Pressure

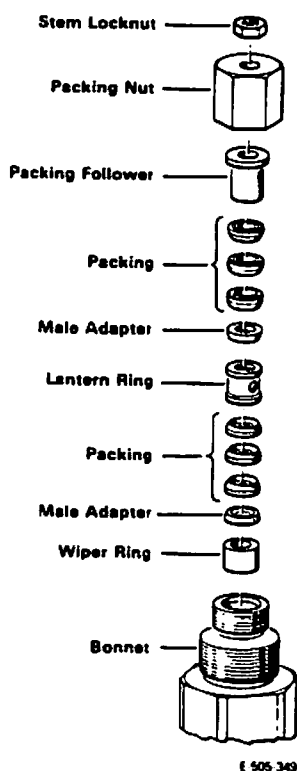


Figure 21. Optional Packing Catalog No. Code J10  
Double TFE V-Ring for Alternate  
Positive and Negative

## 4.4 REPLACING ACTUATOR DIAPHRAGM

### 4.4.1 Air-to-Lower Actuator

1. Isolate or bypass the control valve in pipe line.
2. Shut off pressure to actuator and disconnect air line.
3. Turn range spring adjusting screw counterclockwise as viewed from the valve top, to relieve all spring compression.

#### **WARNING**

*If all spring compression is not relieved, serious injury can occur when removing upper diaphragm casing.*

4. Loosen and remove all diaphragm casing mounting screws, nuts and washers, Figure 22.
5. Lift off upper diaphragm casing from actuator assembly.

MAINTENANCE

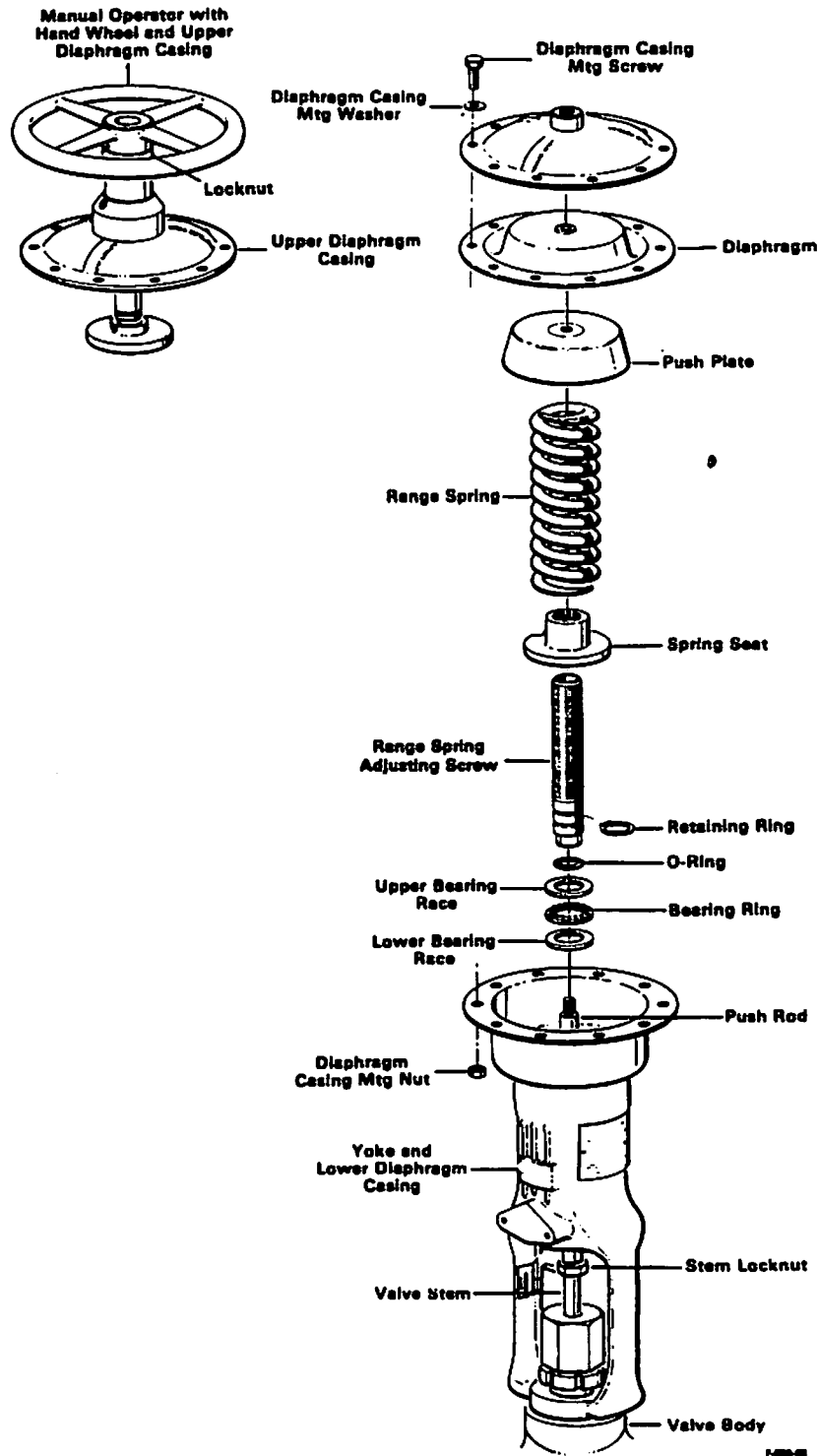


Figure 22. Exploded View of Air-to-Lower Actuator



6. Remove old diaphragm and discard.
7. Install upper diaphragm casing with new diaphragm on actuator assembly. Fasten with bolts, nuts and washers removed in Step 4.
8. Reconnect pipe or tubing to pressure connection in upper diaphragm casing.
9. Readjust actuator travel, refer to 3.2 Adjusting Actuator Range.

#### 4.4.2 Air-to-Lower Actuator with Manual Operator

1. Isolate or bypass the control valve in pipe line.
2. Shutoff pressure to actuator and disconnect air line.
3. Turn manual operator hand wheel counterclockwise to relieve all pressure on diaphragm.
4. Turn range spring adjusting screw counterclockwise as viewed from the valve top, to relieve all spring compression.

##### WARNING

*If all spring compression is not relieved, serious injury can occur when removing manual operator and upper diaphragm casing.*

5. Loosen and remove all diaphragm casing mounting screws, nuts and washers, Figure 22.
6. Lift off manual operator and diaphragm casing from actuator assembly.
7. Remove old diaphragm and discard.
8. Install manual operator and diaphragm casing with new diaphragm on actuator assembly. Fasten with bolts, nuts and washers removed in Step 5.
9. Reconnect pipe or tubing to pressure connection in manual operator housing.
10. Readjust actuator travel, refer to 3.2 Adjusting Actuator Range.

#### 4.4.3 Air-to-Raise Actuator

1. Isolate or bypass the control valve in pipe line.
2. Shutoff pressure to actuator and disconnect air line.
3. Turn range spring adjusting screw clockwise as viewed from the valve top, to relieve all spring compression.

##### WARNING

*If all spring compression is not relieved, serious injury can occur when removing spring and diaphragm casing.*

4. Loosen and remove all diaphragm casing mounting screws, nuts and washers, Figure 23.
5. Lift off spring and diaphragm casing from actuator assembly.
6. Loosen and remove locking nut, washer and push plate from push rod.
7. Remove old diaphragm and discard.
8. Install new diaphragm and line up bolt holes in diaphragm with bolt holes in yoke.
9. Assemble push plate on push rod and fasten with locking nut and washer removed in Step 6.
10. Install spring, range spring adjusting screw and diaphragm casing on actuator assembly. Fasten with bolts, nuts and washers removed in Step 4.
11. Reconnect pipe or tubing to pressure connection in yoke.
12. Readjust actuator travel, refer to 3.2 Adjusting Actuator Range.

#### 4.5 CHANGING ACTUATOR RANGE SPRING

##### 4.5.1 Air-to-Lower Actuator

1. Isolate or bypass the control valve in pipe line.
2. Shutoff pressure to actuator and disconnect air line.

# MAINTENANCE

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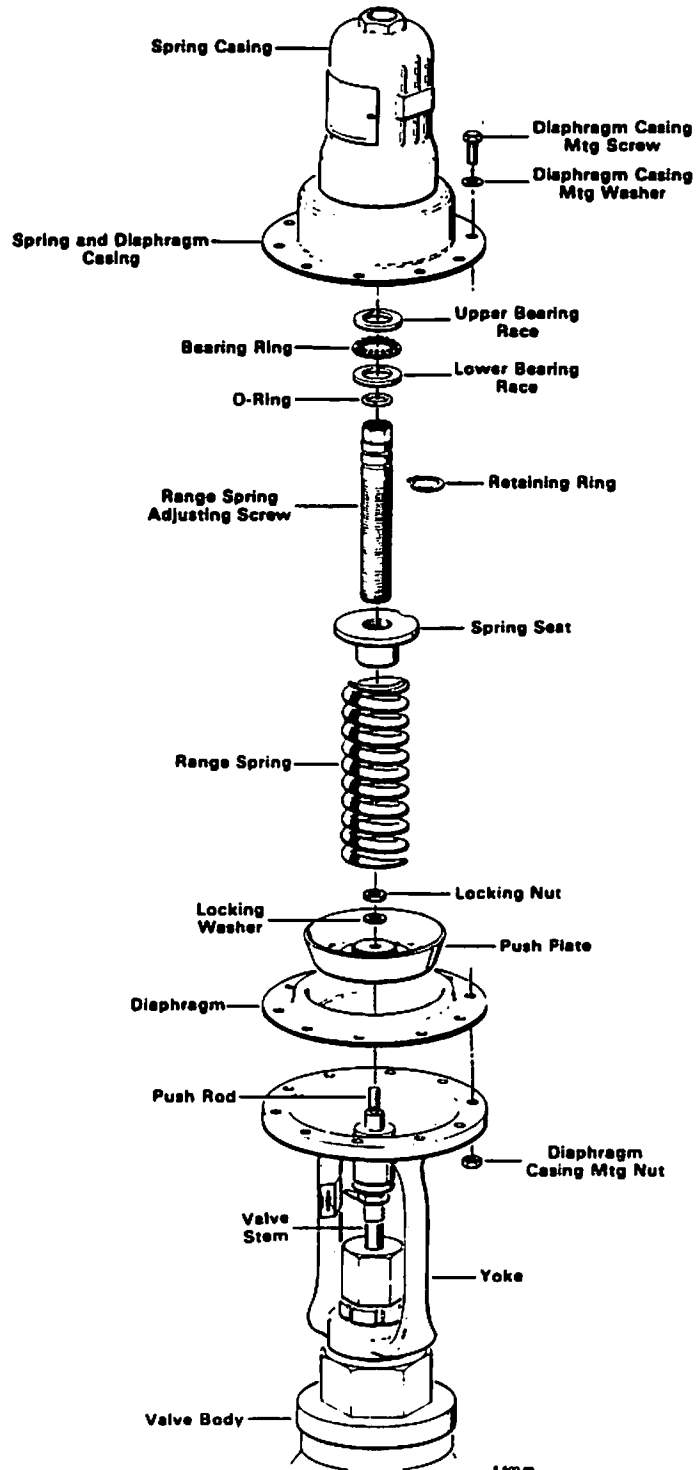


Figure 23. Exploded View of Air-to-Raise Actuator

## MAINTENANCE

3. Turn range spring adjusting screw counterclockwise as viewed from the valve top, to relieve all spring compression.

**WARNING**

*If all spring compression is not relieved, serious injury can occur when removing upper diaphragm casing.*

4. Loosen and remove all diaphragm casing mounting screws, nuts and washer, Figure 22.
5. Lift off upper diaphragm casing and diaphragm from actuator assembly.
6. Loosen valve stem locknut just enough to unscrew push rod with push plate from valve stem.

**CAUTION**

*Do not rotate valve plug on seat ring. It may be necessary to use pliers to hold valve stem. If necessary grip stem near threads to avoid scoring stem.*

7. Remove push rod and push plate with range spring from actuator assembly.
8. Install new range spring with push rod and push plate in actuator assembly.
9. Screw push rod on to valve stem to top of stem locknut and tighten locknut.
10. Install diaphragm casing with diaphragm on actuator assembly. Fasten with the bolts, nuts and washers removed in Step 4.
11. Reconnect pipe or tubing to pressure connection in upper diaphragm casing.
12. Readjust actuator travel, refer to 3.2 Adjusting Actuator Range.

#### 4.5.2 Air-to-Lower Actuator with Manual Operator

1. Isolate or bypass the control valve in pipe line.
2. Shutoff pressure to actuator and disconnect air line.
3. Turn manual operator hand wheel counterclockwise to relieve all pressure on diaphragm.

4. Turn range spring adjusting screw counterclockwise as viewed from the valve top, to relieve all spring compression.

**WARNING**

*If all spring compression is not relieved, serious injury can occur when removing manual operator and upper diaphragm casing.*

5. Loosen and remove all diaphragm casing mounting screws, nuts and washers, Figure 22.
6. Liftoff manual operator and diaphragm casing with diaphragm from actuator assembly.
7. Loosen valve stem locknut just enough to unscrew push rod with push plate from valve stem.

**CAUTION**

*Do not rotate valve plug on seat ring. It may be necessary to use pliers to hold valve stem. If necessary grip stem near threads to avoid scoring stem.*

8. Remove push rod and push plate with range spring from actuator assembly.
9. Install new range spring with push rod and push plate in actuator assembly.
10. Screw push rod on to valve stem to top of stem locknut and tighten locknut.
11. Install manual operator and diaphragm casing with diaphragm on actuator assembly. Fasten with bolts, nuts and washers removed in Step 5.
12. Reconnect pipe or tubing to pressure connection in manual operator housing.
13. Readjust actuator travel, refer to 3.2 Adjusting Actuator Range.

#### 4.5.3 Air-to-Raise Actuator

1. Isolate or bypass the control valve in pipe line.
2. Shutoff pressure to actuator and disconnect air line.

## MAINTENANCE

- Turn range spring adjusting screw clockwise as viewed from the valve top, to relieve all spring compression.

### WARNING

*If all spring compression is not relieved, serious injury can occur when removing spring casing.*

- Unscrew spring casing with adjusting screw from diaphragm casing, Figure 23.
- Remove old range spring and install new spring.
- Screw spring casing with adjusting screw onto diaphragm casing.
- Reconnect pipe or tubing to pressure connection in yoke.
- Readjust actuator travel, refer to 3.2 Adjusting Actuator Range.

## 4.6 ADJUSTING ACTUATOR RANGE-SHOP PROCEDURE

### NOTE

Make test hookup as shown in Figure 24. When using this procedure the valve should be out of the pipe line or there should be no pressure in the line. Pipe line

pressure will cause inaccurate spring adjustments.

### 4.6.1 Actuator with Throttling-Mixing Valve, Figure 25.

### NOTE

For valves with manual operator, refer to 4.6.3 Air-to-Lower Actuator with Hand Wheel.

- To establish actuator input pressure at which valve stem should begin to move from Figures 27a, 27b or 27c, select the figure which covers the actuator termination number on data plate under serial number. Determine value of maximum differential pressure using the following equation.

$$\Delta P = (U - C) + (L - C) \quad (1)$$

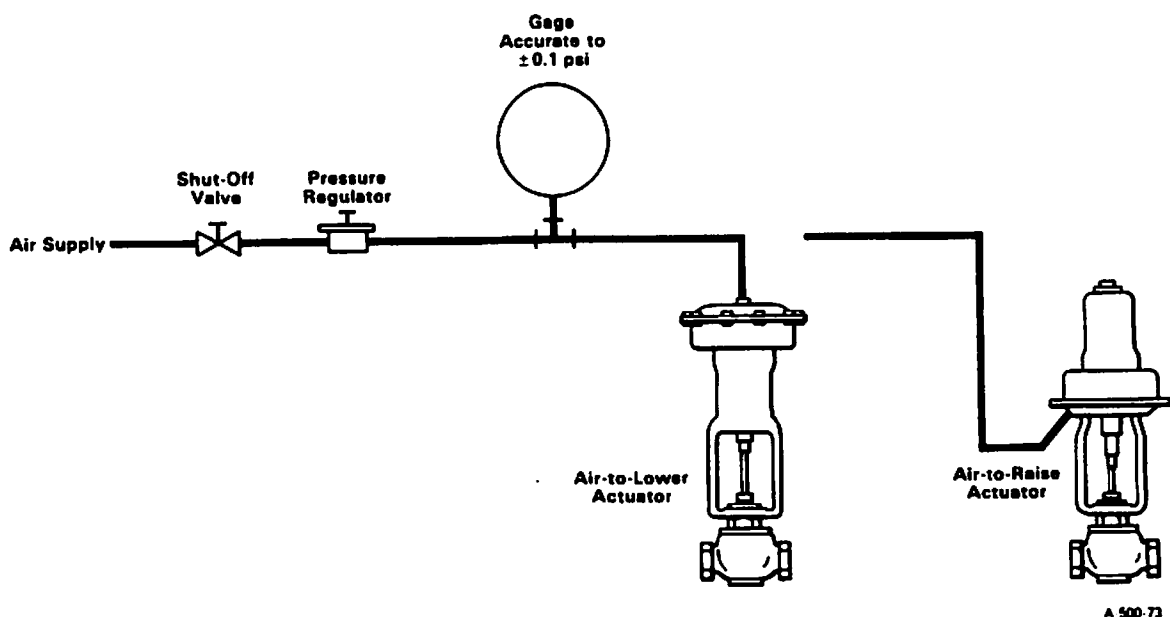
where  $\Delta P$  = Maximum differential pressure, psi

U and L = Valve input pressure, psig

C = Valve output pressure, psig

Example:

Serial number on data plate reads 3002WA12221, which is a 1" size valve with actuator termination number 221, and the valve is being used for throttling-mixing service. Calculate maximum differential pressure using equation (1).



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Figure 24. Test Hookup

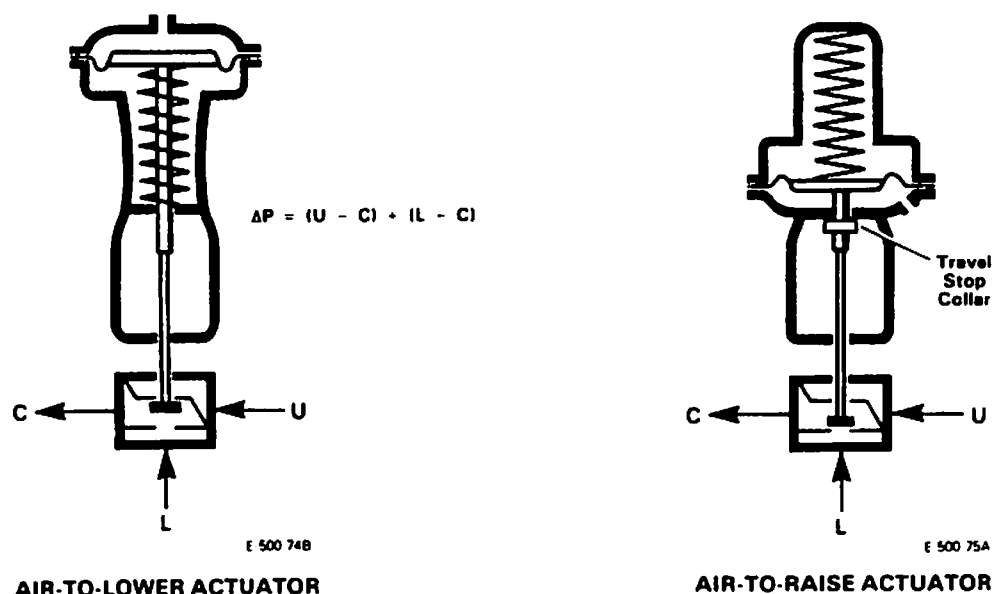


Figure 25. Throttling-Mixing Valve

assume  $U = 120$  psig (827 kPa),  
 $C = 60$  psig (414 kPa),  
 $L = 100$  psig (690 kPa)

$$\Delta P = (120 - 60) + (100 - 60) = 100 \text{ psig (690 kPa)}$$

Using Figure 27b, we can determine that valve stem movement should begin when actuator input reaches 5 psig (34 kPa)  $\pm$  0.2 psig (1.4 kPa).

2. If actuator has a travel stop collar, Figure 11, loosen four set screws on travel stop collar, collar should move freely on push rod.
3. Slowly increase input pressure until stem just begins to move. Stem motion can be accurately detected by feeling stem or push rod as pressure is applied.
4. Note input pressure at which stem moves.
5. If input pressure is not as found in Step 1, spring adjusting screw must be adjusted.

#### Air-to-Lower Actuator

If pressure is high, turn adjusting screw counter-clockwise as viewed from the valve top.

If pressure is low, turn adjusting screw clockwise as viewed from the valve top.

#### Air-to-Raise Actuator

If pressure is high, turn adjusting screw clockwise as viewed from the valve top.

If pressure is low, turn adjusting screw counter-clockwise as viewed from the valve top.

6. Release input pressure and repeat Steps 3, 4 and 5 until valve stem just begins to move at the pressure found in Step 1.
7. If actuator has a travel stop collar, determine span from range stamped on data plate. Add span to the value determined in Step 1 and apply this input pressure to actuator. Slide travel stop collar up on push rod tight against yoke and tighten the four set screws.

#### 4.6.2 Actuator with Two Position Diverting Valve, Figure 26.

##### NOTE

For valves with manual operator, refer to 4.6.3 Air-to-Lower Actuator with Hand Wheel.

1. To establish actuator input pressure at which valve stem should begin to move from Figures 27a, 27b or 27c, select the figure which covers the actuator termination number on data plate

## MAINTENANCE

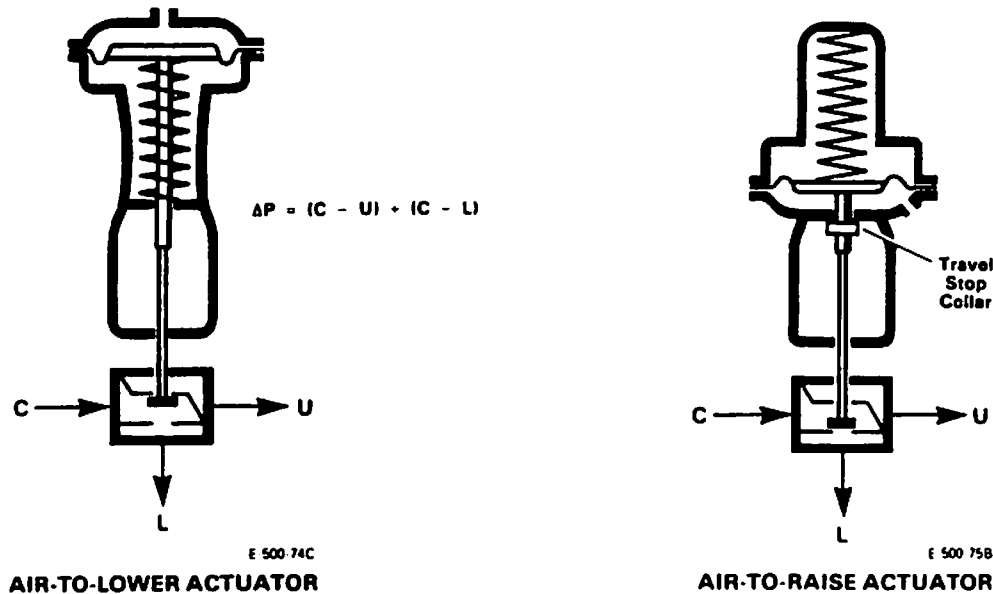


Figure 26. Two Position Diverting Valve

under serial number. Determine value of maximum differential pressure using the following equation.

$$\Delta P = (C-U) + (C-L) \quad (2)$$

where  $\Delta P$  = Maximum differential pressure, psi  
 U and L = Valve output pressure, psig  
 C = Valve input pressure, psig

**Example:**

Serial number on data plate reads 3002WA12221, which is a 1" size valve with actuator termination number 221, and the valve is being used for two position diverting service. Calculate maximum differential pressure using equation (2).

assume C = 100 psig (690 kPa),  
 U = 40 psig (276 kPa),  
 L = 60 psig (414 kPa)

$$\Delta P = (100-40) + (100-60) = 100 \text{ psig (690 kPa)}$$

Using Figure 27b, we can determine that valve stem movement should begin when actuator input reaches 5 psig (34 kPa)  $\pm$  0.2 psig (1.4 kPa).

- If actuator has a travel stop collar, Figure 11, loosen four set screws on travel stop collar, collar should move freely on push rod.

- Slowly increase input pressure until stem just begins to move. Stem motion can be accurately detected by feeling stem or push rod as pressure is applied.
- Note input pressure at which stem just begins to move.
- If input pressure is not as found in Step 1, spring adjusting screw must be adjusted.

**Air-to-Lower Actuator**

If pressure is high, turn adjusting screw counter-clockwise as viewed from the valve top.

If pressure is low, turn adjusting screw clockwise as viewed from the valve top.

**Air-to-Raise Actuator**

If pressure is high, turn adjusting screw clockwise as viewed from the valve top.

If pressure is low, turn adjusting screw counter-clockwise as viewed from the valve top.

- Release input pressure and repeat Steps 3, 4 and 5 until valve stem just begins to move at the pressure found in Step 1.
- If actuator has a travel stop collar, determine span from range stamped on data plate. Add

span to the value determined in Step 1 and apply this input pressure to actuator. Slide travel stop collar up on push rod tight against yoke and tighten the four set screws.

#### 4.6.3 Air-to-Lower Actuator with Hand Wheel

1. Loosen manual operator locknut, Figure 3, and turn hand wheel counterclockwise to relieve all force on diaphragm.

2. Perform Steps 4.6.1 for Actuator with Throttling-Mixing Valve.

Perform Steps 4.6.2 for Actuator with Two Position Diverting Valve.

3. At end of adjustment procedure, turn hand wheel clockwise to required setting and tighten locknut under hand wheel.

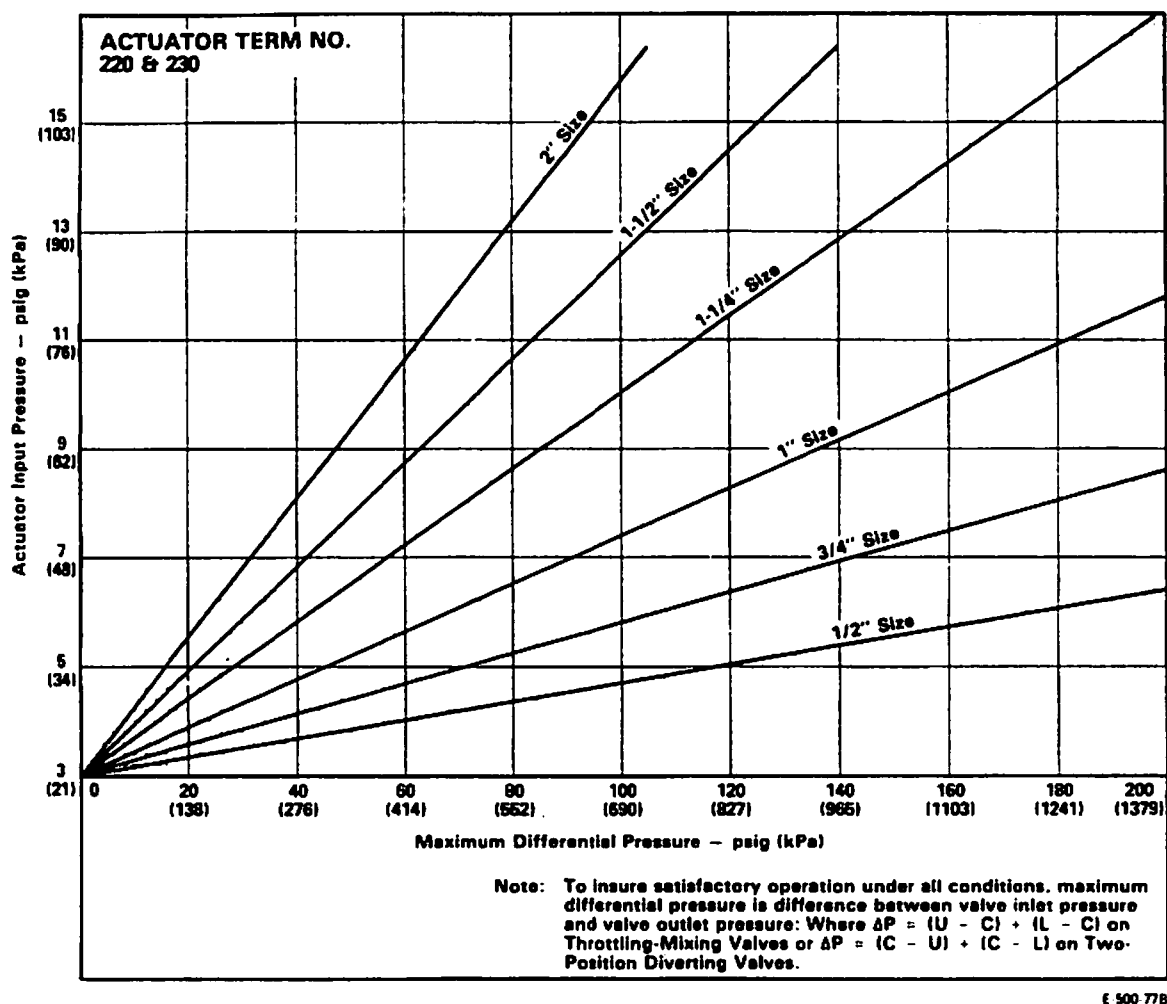
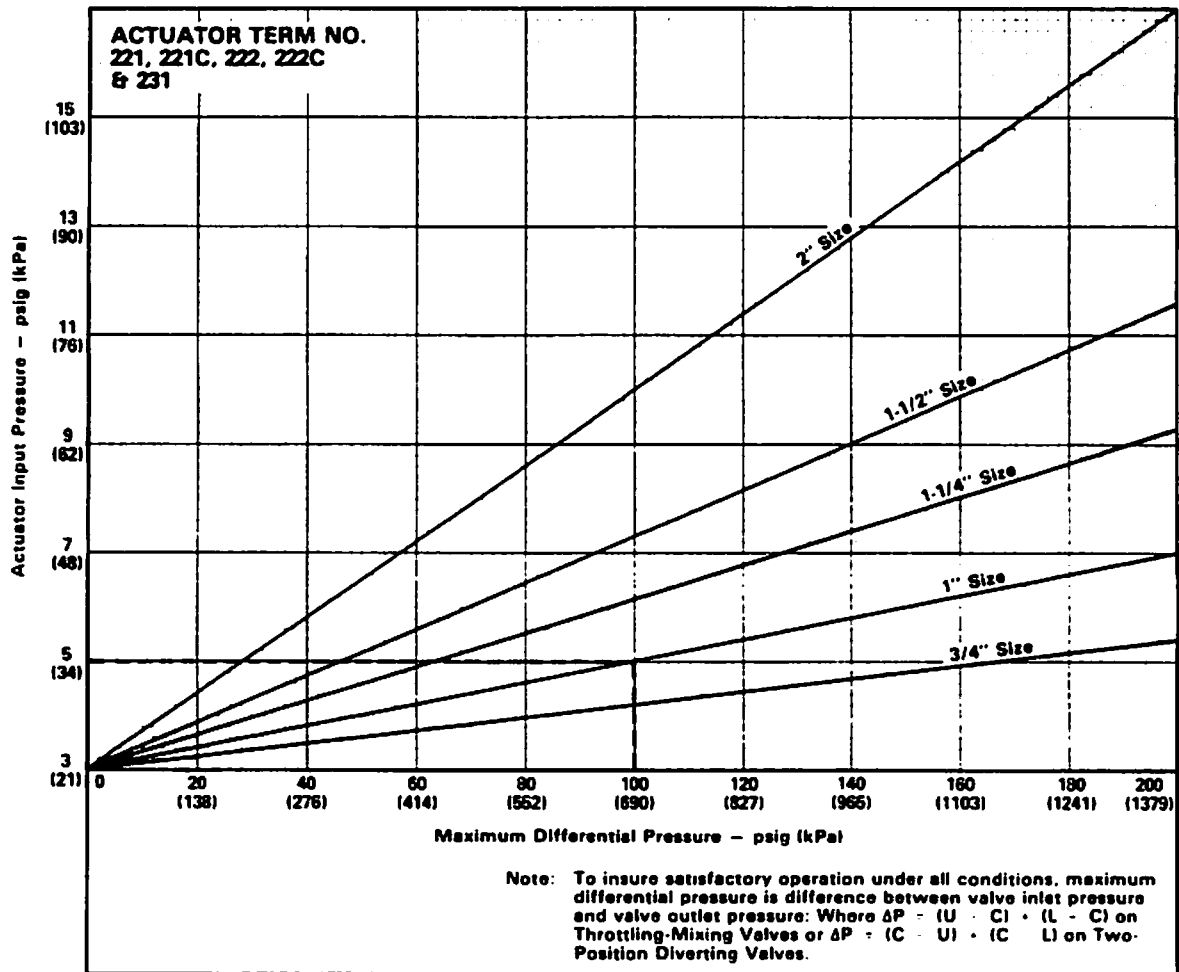


Figure 27a. Actuator Input Pressure Versus Maximum Differential Pressure for Termination Nos. 220, 230 (20 Sq. In. Std)

## MAINTENANCE



E 500 788

Figure 27b. Actuator Input Pressure Versus Maximum Differential Pressure for Termination Nos. 221, 221C, 231 (45 Sq. In. Senior), 222, 222C (45 Sq. In. Std)



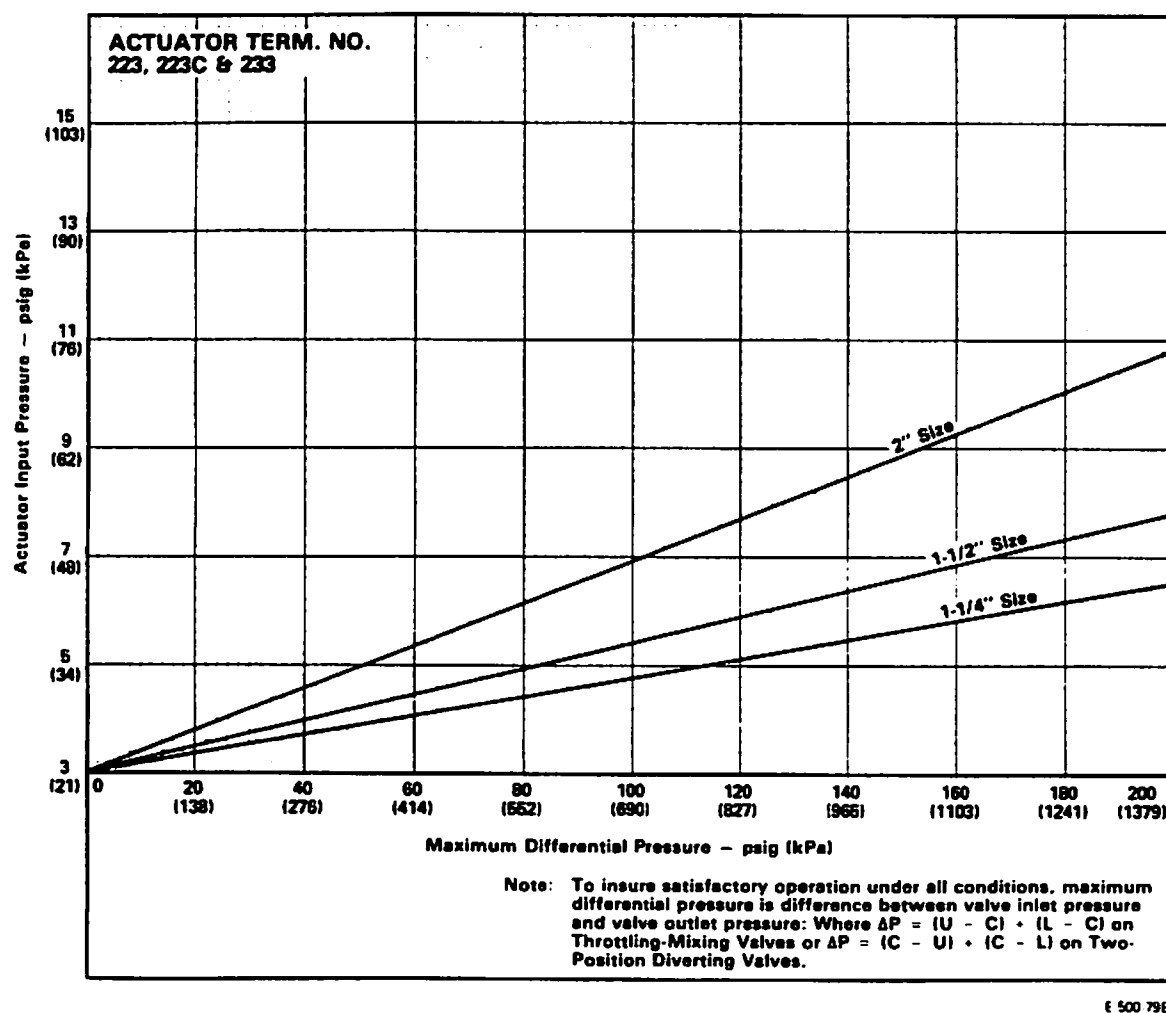


Figure 27c. Actuator Input Pressure Versus Maximum Differential Pressure for Termination Nos. 223, 233C, 233 (80 Sq. In. Senior)