

## Y20EBD Valve Linkage for M100 Motor Actuators

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# Introduction

## Application Details

The Y20EBD Valve Linkage converts the rotary motion of an M100 Series Motor Actuator to a linear movement in order to operate several types of valves.

A rack and pinion drive mechanism provides the linear movement. The rack assembly contains a spring that, when compressed by over travel, will maintain valve close off to rated values. The pinion gear may be reversed for manual operation with a 3/8 inch socket drive extension for service of controlled equipment.

**Table 1: Selection Table--Actuators and Linkages**

Linkage Number	Spring Return Actuator	Non-spring Return Actuator	Valve Seating Load, lb (n)
Y20EBD-1	M130	M120	75 (334) Green
Y20EBD-2	---	M140	150 (607) Yellow
Y20EBD-3	---	M150	270 (1201) Red
Y20EBD-5	M110	---	40 (178) Orange
Y20EBD-6	M130	M120	100 (449)

Note: The Y20EBD linkage kit can be used on Barber-Colman 1-1/2 to 2 inch valves. Use the grooved adapter bushing provided with the linkage kit for V-90 Series and the mid-bracket position. Larger Barber-Colman valves can mount onto the Y20EBD yoke directly; however, adding locally purchased large washers under the linkage bracket to prevent paint damage is recommended.

A selection of models are available to adapt M100 Motor Actuators to several types of valves.

A Y20EBD-4 linkage is available to enable an M150 Motor Actuator to operate S91 auxiliary switches for automatic heating/cooling changeover applications. The Y20EBD-4 allows additional over travel after valve close off for switch operation. See *Y20 Series Linkage Kits Product Bulletin* for a complete description.

Y20EBA valve linkage kits are available to adapt the M100 Series Actuators to valves made by other manufacturers. See *Y20 Series Linkage Kits Product Bulletin* for more information.

Refer to the technical bulletin provided with the motor actuator for information on wiring the motor actuator and related adjustments.

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**Glossary**

The following terminology is used in these instructions:

**CW**--Clockwise refers to the direction of rotation of the actuator shaft as seen from the load end.

**Zero Position**--The fully counterclockwise position of the actuator shaft--the de-energized position of a spring return actuator.

**Stem Up**--The initial position of the stem is up before operating the valve.

**Stem Down**--The initial position of the stem is down before operating the valve.

**Push/Drive Down to Open**--Pushing or driving the stem down opens the valve.

**Push/Drive Down to Close**--Pushing or driving the stem down closes the valve.

**Pull/Drive Up to Open**--Pulling or driving the stem up opens the valve.

**Pull/Drive Up to Close**--Pulling or driving the stem up closes the valve.

**Stem Up/Drive Down**--The stem is initially in the up position and the motor actuator through the linkage will drive the stem down.

**Stem Down/Drive Up**--The stem is initially in the down position and the motor actuator through the linkage will drive the stem up.

**Three Way Mixing Valve**--A valve with two inlets and one outlet. Valve seats on both stem up and stem down travel.

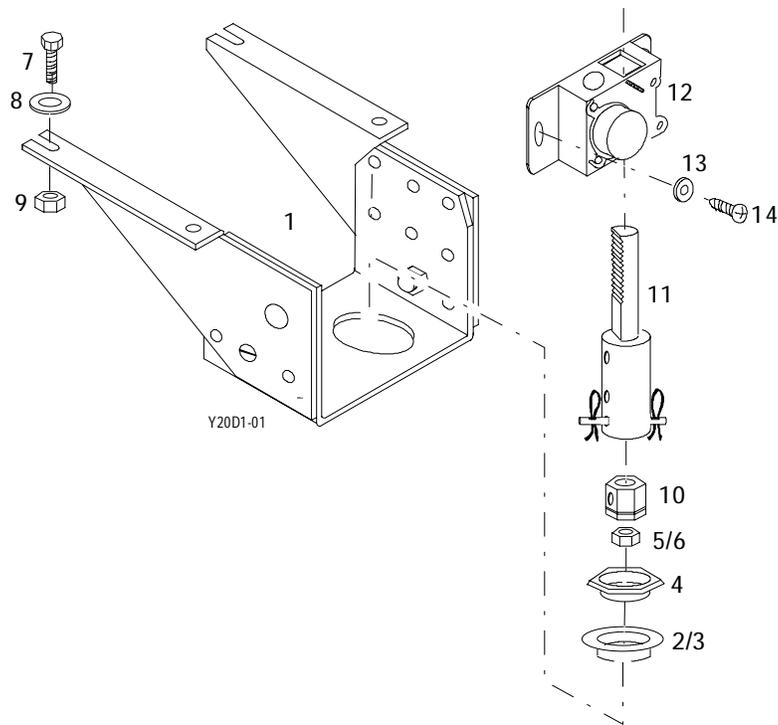
**Three Way Diverting Valve**--A valve with one inlet and two outlets. Valve seats on both stem up and stem down travel.

# Installation Procedures

## Tools Needed

- screwdriver, small blade
- screwdriver, medium blade
- pliers
- wrench, adjustable, medium
- socket wrench, 3/8 inch drive

## Kit Includes



Item	Description	Quantity	Item	Description	Quantity
1	Mounting Bracket Assembly	1	8	Washer (High Temp)	4
2	Valve Bushing, 3/4 in. Not Grooved	1	9	Hex Nut, 1/4-20	4
3	Valve Bushing, 1 in. Grooved	1	10	Valve Stem Connector	1
4	Yoke Nut	1	11	Rack Subassembly	1
5	Hex (Jam) Nut, 1/4-28	1	12	Gear Subassembly	1
6	Hex (Jam) Nut, 3/8-20	1	13	Washer, Black	2
7	Hex Cap Screw	4	14	Screw	2

Figure 1: Kit Components

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## **Installation Overview**

Upright mounting of the motor actuator is recommended.

When valve mounting, do not mount below the horizontal plane of the valve piping to prevent damage to the motor actuator if the valve leaks or develops condensation.

Do not install the motor actuator in atmospheres with explosive vapors or escaping gases, or where vapors having deteriorating properties might attack the actuator's metal parts.

Do not install where the ambient temperature of the surrounding area falls below -40°F (-40°C) for non-spring return motor actuators, or -35°F (-37°C) for spring return motor actuators. The maximum ambient temperature of the surrounding area of the motor actuator should not exceed 125°F (52°C).

Valve medium temperatures above 250°F (121°C) are permissible only if the maximum ambient temperature at the motor actuator is less than 105°F (41°C).

Use insulating washers furnished with the linkage kit for valve medium temperature applications over 250°F (121°C).

Locate the motor actuator where the shaft and wiring terminals are accessible.

The non-spring return M100 Actuator will hold its position if power is removed. The spring return actuator will return to its zero position if power is removed. Both types will hold their current position if the control signal is satisfied.

Note: The spring return is intended only as a safety feature to drive the actuator to its zero position in the event power is interrupted or turned off.

There are three sections to the installation of the Y20EBD valve linkage kit:

1. Configure and mount the yoke on the valve.
2. Mount the actuator and linkage assembly to the yoke and connect to the valve.
3. Adjust the travel limits to actuate the over travel spring and seat the valve.

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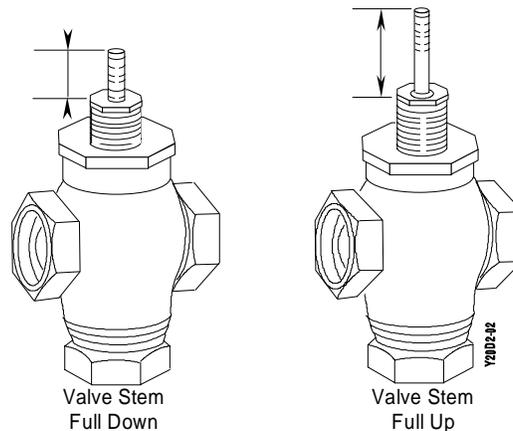
## Configuration and Mounting

### Valve Lift

The information obtained in the following steps will be used for the travel adjustments later. The reason that these measurements are here is that it is easier to take the measurements prior to installing the linkage and actuator than after.

For valves with various lift requirements, the actuator will require a change in travel by  $15^\circ$  for each additional 0.1 inch (2.54 mm) of lift required.

To determine the lift required:



**Figure 2: Stem Travel Measurement**

1. Measure the valve stem length in the full down position as shown in Figure 2.
2. Measure the valve stem length in the full up position as shown in Figure 2.
3. Subtract the full down position from the full up position, this will provide the valve lift.
4. Divide the valve lift by 0.1 inch.
5. Multiply the result by  $15^\circ$ .
6. Provide additional  $15^\circ$  rotation on 2-way valves and  $30^\circ$  additional rotation on 3-way valves for over travel seating.

Note: Maximum actuator rotation is  $270^\circ$ , which allows up to 1.7 inches lift on 2-way valves and 1.6 inches lift on 3-way valves.

Note: VT valves have only  $5/16$  inch lift which requires a reduction of actuator travel by  $25^\circ$  from factory setting.

Record the value for use with the travel adjustments.

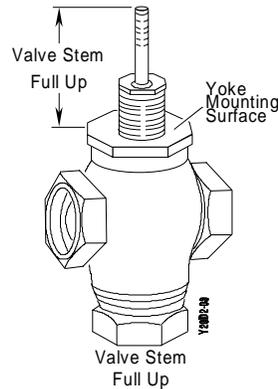
## Configuring Yoke

When configuring the yoke, two areas have to be considered:

- the distance the actuator will be from the valve (height)
- the direction of drive the actuator is going to provide to the valve

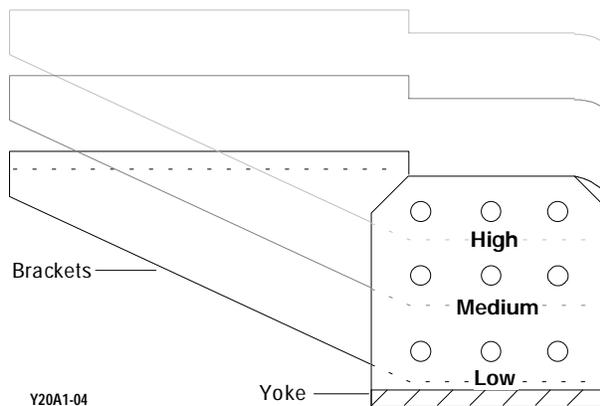
## Height

To determine the height:



**Figure 3: Height Measurement**

1. Raise the valve stem to its full up position.
2. Measure from the yoke mounting surface to the top of the stem.

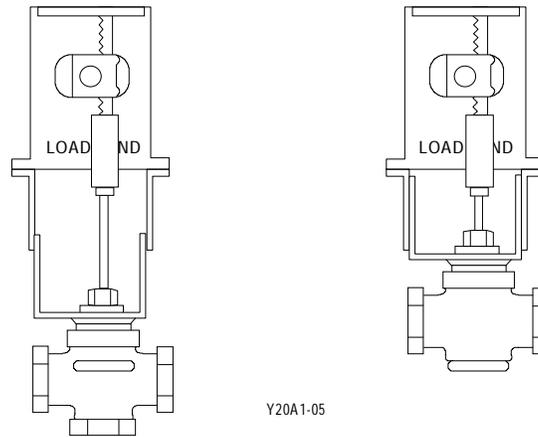


**Figure 4: Linkage Bracket Positions**

The linkage brackets can be mounted to the yoke in one of three positions: low, medium, or high.

- Low position for stem lengths from 2 inches up to 3 inches (50.8 to 76.2 mm) in full up position. Johnson brass valves up to 2 inch (50.8 mm) pipe size.
- Medium position for stem lengths from 3 inches to 4 inches (76.2 to 101.6 mm) in full up position. Johnson iron valves from 2-1/2 inches (63.5 mm) pipe size and larger. V90BA valves up to 2 inch (50.8 mm) and V90CA valves up to 3 inch (76.2 mm) pipe sizes.

- High position for stem lengths from 4 inches to 5-7/8 inches (101.6 to 147.2 mm) in full up position. V90CA valves from 4 inch through 6 inch (101.6 through 152.4 mm) pipe sizes.



**Figure 5: Long and Short Stem Valve Bodies**

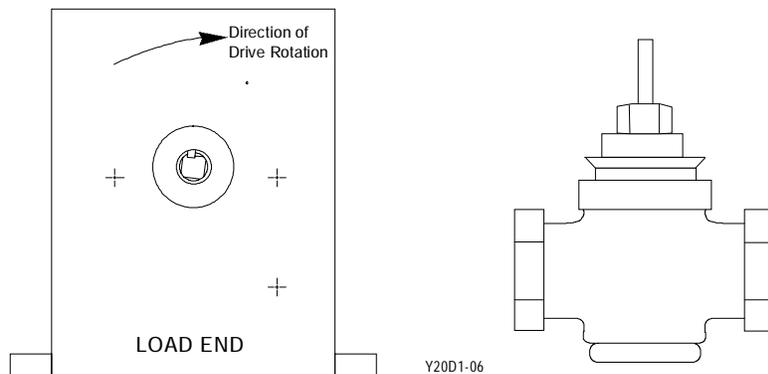
The left side of Figure 5 shows a Y20EBD Valve Linkage in the high position connecting a 3-way valve body with a long stem to a M100 Motor Actuator for stem up operation.

The right side of Figure 5 shows a Y20EBD Valve Linkage in the low position connecting a 2-way valve body with a short stem to a M100 Motor Actuator for stem up operation.

**Direction**

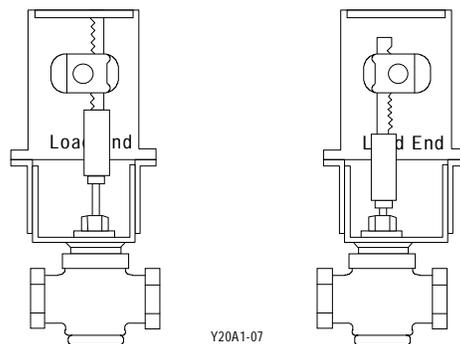
Except for M100C (reverse acting) and M100H models, with an increasing signal, the actuator always operates Clockwise (CW) from its zero mechanical position. This clockwise rotation can be used to drive the valve stem up or down, depending on the way the gear housing is attached to the actuator.

To determine the direction of actuator drive:



**Figure 6: Motor Actuator and Valve**

1. With the motor actuator next to the valve, view the motor actuator from the load end.
2. Determine the type of valve being used and the direction that will be required to drive the stem from its initial position.
  - Stem Up Two Way Valve--Drive Down to Close
  - Stem Up Two Way Valve--Drive Down to Open
  - Stem Down Two Way Valve--Drive Up to Open
  - Stem Down Two Way Valve--Drive Up to Close
  - Stem Up Three Way Valve
  - Stem Down Three Way Valve



**Figure 7: Stem Up/Drive Down and Stem Down/Drive Up**

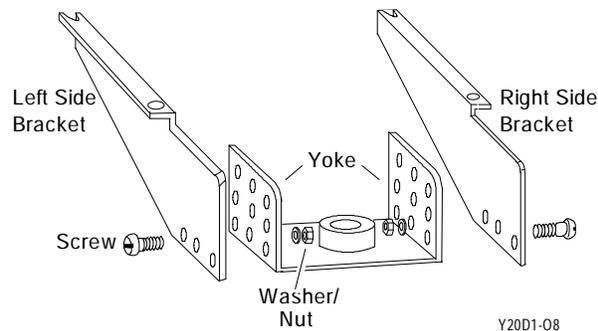
3. For valves with the stem in the initial up position, the hole in the yoke will be to the right of center when facing the load end as shown in the left illustration of Figure 7.

For valves with the stem in the initial down position, the hole in the yoke will be to the left of center when facing the load end as shown in the right illustration of Figure 7.

The brackets are assembled at the factory in the low position and for stem up/drive down valve application with the hole in the yoke to the right of center as shown in the left illustration of Figure 7.

### Changing Yoke

For any other application, the yoke and brackets must be disassembled and reassembled for the specific application as described below.



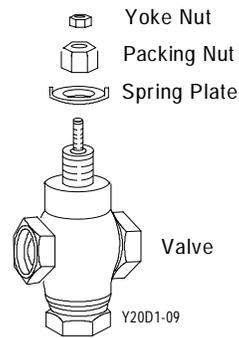
**Figure 8: Bracket Components**

1. Remove the screw, washer, and nut securing the left and right side brackets to the base bracket.
2. Position the yoke, left side, and right side brackets as determined previously. The pins on the side brackets will fit into the holes in the yoke until the screw is inserted.
3. Install the screw, washer, and nut to secure the side brackets to the yoke and tighten.

## Mounting Yoke

Note: The Y20EBD Linkage Kit can be used on Barber-Colman 1-1/2 to 2 inch valves. Use the grooved adapter bushing provided with the linkage kit for V-90 Series and the mid-bracket position. Larger Barber-Colman valves can mount onto the Y20EBD yoke directly; however, adding locally purchased large washers under the linkage bracket to prevent paint damage is recommended.

To mount the yoke on the valve:

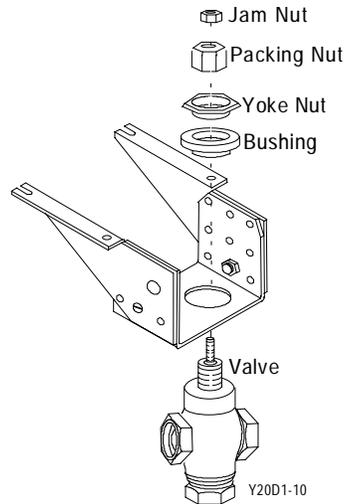


**Figure 9: Preparing Valve**

1. Remove the yoke nut (if present), packing nut (if necessary), and spring plate (if present) from the valve as shown in Figure 9.

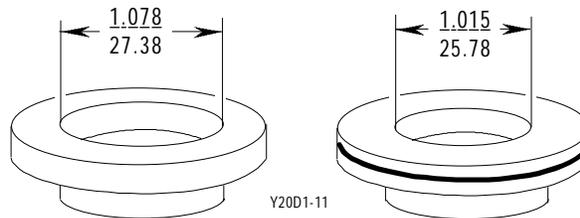
Note: Valves with 1/4 inch stems use the furnished yoke nut having a 3/4 inch thread to install the bushing and secure the bracket.

Larger valves have a one inch packing box thread on the yoke which fits the smaller hole bushing and requires a separate yoke nut that is usually furnished with the valve.



**Figure 10: Mounting Yoke**

2. Place the yoke on the valve over the stem and bonnet.
3. Select the proper bushing and slide it over the bonnet and into the yoke hole.



**Figure 11: Bushings**

Note: Two bushings are provided:

- large hole--1.078 in. (27.38 mm) inside diameter which is identified by a smooth outer edge
- small hole--1.015 inch (25.78 mm) inside diameter which is identified by a groove on its outer edge

In general, valves up to two inch pipe size have 1/4 inch stems and use the large hole (no groove) bushing; valves larger than two inch pipe size have 3/8 inch stems and use the small hole bushing (with groove).

4. Install the yoke nut. For valve bodies 2-1/2 inch and larger, use the yoke nut furnished with the valve. Fasten the yoke in place securely by tightening the yoke nut with a wrench 1/8 turn past finger tight.
5. If the packing nut was removed, reinstall and tighten it. For valves with U-Cup packing, tighten the nut 1/8 turn past “finger tight.” For all other valves, tighten finger tight.

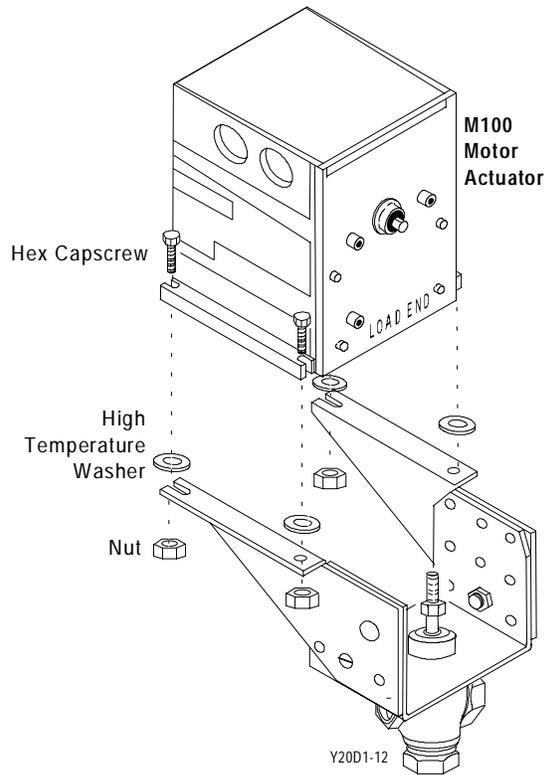
Note: JCI valves have U-Cup packing.

6. Install the proper size jam nut onto the valve stem as far as it will go.  
Do not tighten.

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## Actuator and Linkage

### Mounting Actuator



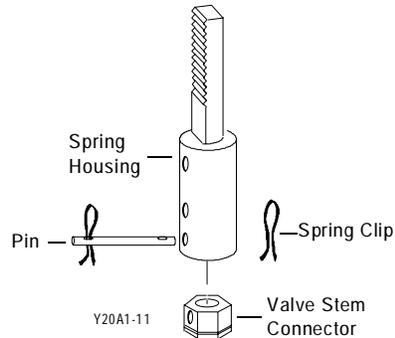
**Figure 12: Mounting Motor Actuator**

1. Locate the load end over the yoke.
2. Mount the actuator onto the brackets using the four bolts and nuts, but do not tighten.

Note: If the temperature of the valve or its media is high enough to raise the actuator temperature above its limit of 125°F (52°C), insert the four white insulating washers (provided with the linkage kit) between the actuator and the brackets. For lower temperature applications, omit the insulating washers.

## Valve Stem Connector

As received, the valve stem connector (mounted in the spring housing of the rack subassembly) accommodates a 1/4 inch stem valve. If the valve has a 3/8 inch stem, replace the connector with the 3/8 inch connector furnished separately. To change the valve stem connector:



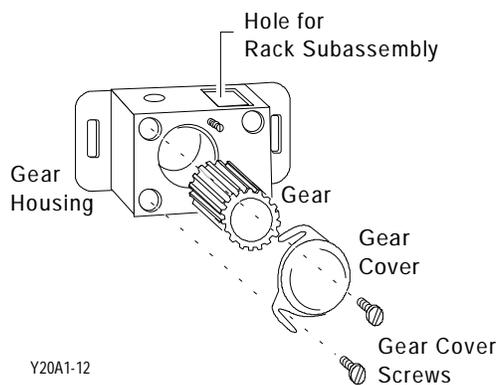
**Figure 13: Valve Stem Connector**

1. Remove the spring clip and pin from the spring housing as shown in Figure 13.
2. Insert the connector nut so that the holes line up with the holes in the spring housing.
3. Replace the pin and spring clip.

Note: It is a good idea to verify which valve stem connector is inserted prior to installation.

## Mounting Linkage

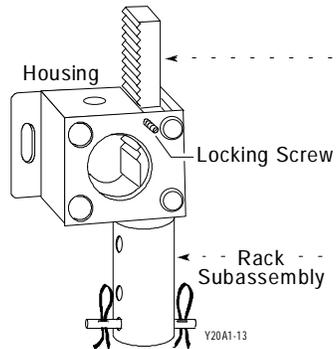
To mount the gear housing and rack assembly to the motor actuator and valve, proceed as follows:



**Figure 14: Gear Housing Assembly**

1. Loosen the two gear cover screws and remove the gear cover and gear from the gear housing as shown in Figure 14.

2. Determine the required position of the gear housing on the load end of the actuator so that the opening for the rack assembly is located as follows:
  - stem up position, drive down operation--rack to the right
  - stem down position, drive up operation--rack to the left

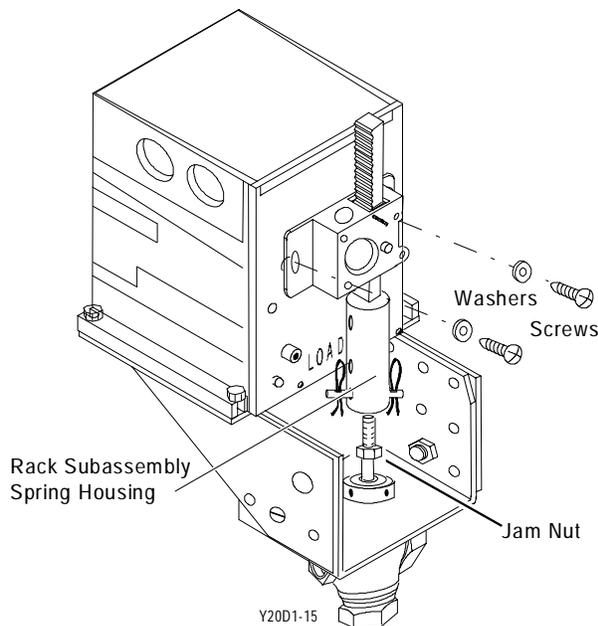


**Figure 15: Inserting Rack Subassembly**

3. Insert the rack subassembly into the gear housing by sliding it from the bottom through the hole in the gear housing as shown in Figure 15.

Note: If the rack subassembly has difficulty being inserted, check the locking screw to make sure that it is not interfering with movement of the rack. If it is, back it out until there is no interference.

4. When the rack subassembly is completely in the housing, tighten the locking screw to secure the rack subassembly in position.



**Figure 16: Mounting Gear Housing**

5. Position the gear housing and rack subassembly over the valve stem and align the gear housing with the M100 drive shaft.
6. Attach the gear housing to the motor actuator with the washers and gear housing screws. Do not tighten the screws at this time.
7. Loosen the locking screw and lower the rack subassembly to the valve stem. Thread the rack subassembly spring housing completely onto the valve stem.
8. Tighten the jam nut (shown in Figure 16) against the stem connector.
9. Align the actuator with the valve body to avoid binding of the linkage and tighten the four mounting bolts.
10. Tighten the screws securing the gear housing to 25 in·lb (2.83 N·m) maximum.

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### ***Travel Limits***



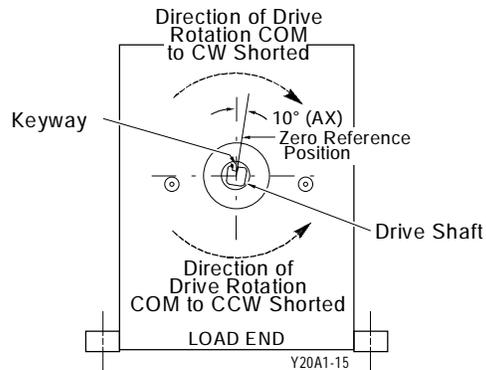
**CAUTION:** Do not perform the following operations if the valve is under pressure. Shut off pump power, including standby power, before attempting manual operation.

The procedure for adjusting the travel limits is different for the different configurations of valves:

- Stem Up Two Way Valve--Drive Down to Close Drive down to close, spring return open is the most common configuration for heating.
- Stem Up Two Way Valve--Drive Down to Open
- Stem Down Two Way Valve--Drive Up to Open
- Stem Down Two Way Valve--Drive Up to Close
- Stem Up Three Way Valve
- Stem Down Three Way Valve



**CAUTION:** Travel adjustments are made with power connected to the actuator. On M100A Actuators, always disconnect power from the actuator before adjusting the slide stop to increase travel.



**Figure 17: Actuator Zero Position**

The actuators are factory set at zero position which is 10° clockwise from square and for 90° clockwise travel as shown in Figure 17. Each 15° of actuator rotation results in 0.1 inch (2.54 mm) of linear movement of the rack assembly. The 90° actuator rotation provides 1/2 inch (12.7 mm) of valve stem lift plus 0.1 inch (2.54 mm) of over travel.

Disconnect all control wires to the actuator. Refer to the technical bulletin provided with the motor actuator for information on wiring the motor actuator and related adjustments.

Connect only 24 VAC to terminals T1-T2. Be sure that power is off while connections are made or changed. For quick reference, Table 2 provides the connections for individual actuators.

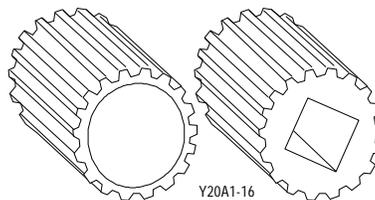
Note: The M100C requires a Y199 tester to drive the motor actuator.

### Stem Up Two Way Valve

For stem up valves, make certain that the rack is assembled to the right of the gear housing center.

#### ***Drive Down to Close Valves***

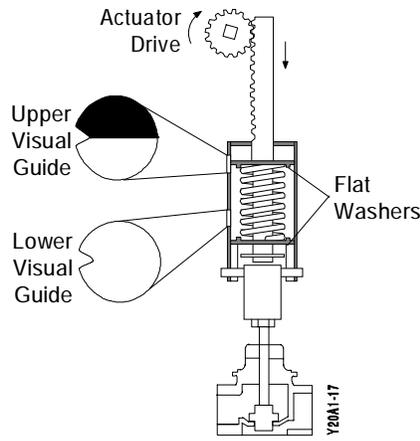
1. Manually move the rack and spring housing assembly, connected to the valve stem, to the full up position.



**Figure 18: Pinion Gear Ends**

2. Insert the pinion gear into the gear housing with the square hole end (Figure 18) over the actuator shaft.
3. Replace the gear cover and tighten the gear cover screws. See Figure 14.

4. Refer to the technical bulletin provided with the motor actuator and adjust the actuator travel to drive the stem down and compress the spring in the housing (turn power off when adjusting M100A slide stops).

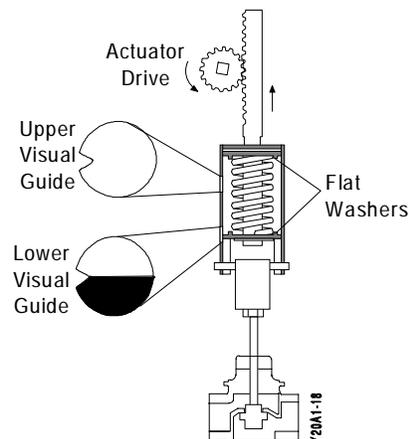


**Figure 19: Upper Visual Guide Indicating Full Down Travel**

5. As shown in Figure 19, when the edge of the upper flat washer is opposite the notch in the upper visual guide, the travel is properly adjusted. This represents 0.1 inch (2.54 mm) compression of the spring with the valve seated.

#### ***Drive Down to Open Valves***

1. Power the actuator to position the actuator 15° from zero. This is equivalent to 0.1 inch (2.54 mm) of stem travel.
2. Manually move the rack and spring housing assembly, connected to the valve stem, to the full up position.
3. Insert the pinion gear into the gear housing with the square hole over the actuator shaft.
4. Replace the gear cover and tighten the gear cover screws.
5. Allow the actuator to return to zero position.



**Figure 20: Lower Visual Guide Indicating Full Up Travel**

6. As shown in Figure 20, the edge of the lower flat washer should appear opposite the notch in the lower visual indicator to indicate compression of the spring with the valve seated.
7. Refer to the technical bulletin provided with the motor actuator and adjust the actuator travel for the full lift as described in the *Valve Lift* section.

**Stem Down Two Way Valves**

For stem down valves, make certain that the rack is assembled to the left of the gear housing.

***Drive Up to Close Valves***

1. Manually move the rack and spring housing assembly, connected to the valve stem, to the full down position.
2. Insert the pinion gear into the gear housing with the square hole over the actuator shaft.
3. Replace the gear cover and tighten the gear cover screws.
4. Refer to the technical bulletin provided with the motor actuator and adjust the actuator travel to drive the stem up and compress the spring in the housing (turn power off when adjusting the M100A slide stop).
5. When the edge of the lower flat washer is opposite the notch in the lower visual guide, the travel is properly adjusted. This represents 0.1 inch (2.54 mm) compression of the spring with the valve seated.

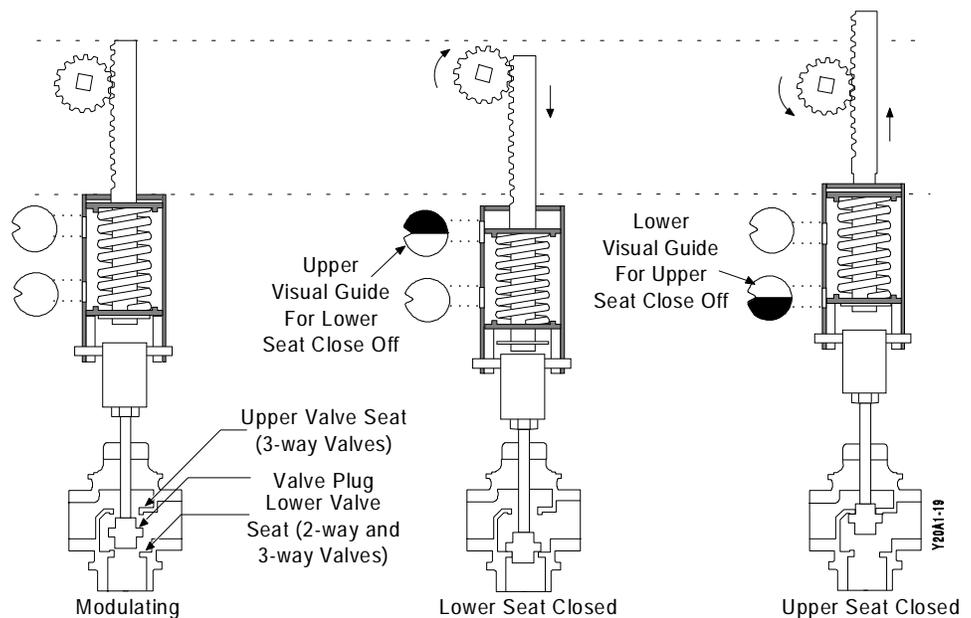
***Drive Up to Open Valves***

1. Power the actuator to position the actuator 15° from zero. This is equivalent to 0.1 inch (2.54 mm) of stem travel.
2. Hold the rack in its full down position.
3. Insert the pinion gear into the gear housing with the square hole over the actuator shaft.
4. Replace the gear cover and tighten the gear cover screws.
5. Allow the actuator to return to zero position. The edge of the upper flat washer should appear opposite the notch in the upper visual indicator to indicate compression of the spring with the valve seated.
6. Refer to the technical bulletin provided with the motor actuator and adjust the actuator travel for full lift as described in the *Valve Lift* section.

## Three Way Valves

Three way valves, mixing or diverting, can be assembled so that the upper seat is initially closed (stem up) or so that the lower seat is initially closed (stem down). Stem up or stem down operation is determined by the yoke configuration and position of the rack and gear housing. Travel adjustments are similar for either case and require both upper and lower limits to be set. Both mixing and diverting 3-way valves are adjusted the same way.

1. Power the actuator to position the drive shaft  $15^\circ$  from zero. This is equivalent to 0.1 inch of stem travel.
2. Manually position the rack to the full stem up or stem down position as required.
3. Insert the pinion gear into the gear housing with the square hole over the actuator shaft.
4. Replace the gear cover and screws.



**Figure 21: Linkage Adjustment Stem Up 3-Way Valve**

5. Allow the actuator to return to the zero position. The flat washer should align with the notch at the bottom of the spring case for stem up valves or with the upper notch for stem down valves. This indicates valve seating at the zero position.
6. Refer to the technical bulletin provided with the motor actuator and adjust the travel to fully stroke the valve and compress the over travel spring at full lift. The washer should be aligned with the notch opposite the starting point.
7. Figure 21 illustrates the over travel indication for seating stem up 3-way valves.

## Manual Operation



**CAUTION:** Do not perform this operation if the valve is under pressure. Shut off pump power, including standby power, before attempting manual operation.

The valve can be manually operated without electrical power when necessary for maintenance or emergency operation. To operate the valve manually:

1. Remove the gear cover.
2. Remove the pinion gear from the gear housing and insert the gear with the square hole facing out.
3. A 3/8 inch socket wrench drive will fit in the square hole and enable manual positioning of the valve.
4. The spring can be compressed and then held in position by turning the locking screw (located on the gear housing) in to hold the rack in position.

**IMPORTANT:** To return to automatic operation, return the actuator to the zero position and reinstall the gear with the square hole engaging the actuator shaft. Repeat the travel limit adjustments as necessary.

# Checkout Procedure

After Installation and adjustment, run the system through several complete open/close cycles to be sure that all components are functioning correctly. Check to be sure that the actuator responds to the controller and operates the valve properly. Check for proper voltage. Check for operation of the linkage without binding.



**CAUTION:** The actuator should not be stalled by the valve. The actuator may be damaged if it is not free to complete its full stroke.

**Table 2: Actuator Connections for Travel Limit Adjustment**

Model	Jumper Terminals	
	Clockwise (CW)	Counterclockwise (CCW)
M100A	1 and 2	1 and 3
M100C	COM to CW	COM to CCW
M100E	S1 to S2*	Disconnect S1, S2, A, C
M100F	8 and 9	8 and 10
M100G or M100H	8 to T1	8 to 10
M100J	8 and 9	8 and 10
M100Q	8 to T1	8 to 10
M100M	R to B	Disconnect R from B

\* Apply 24 VAC to relay terminals A and C for clockwise rotation.

Note: On all models, remove controller wires and apply 24 VAC to terminals T1 and T2 while making adjustments. Spring return models will go full CCW when power to T1 and T2 is removed.

# Replacement Parts

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Table 3 shows replacement parts that may be ordered from your nearest Johnson Controls branch or distributor.

**Table 3: Y20 Linkage Repair Parts**

Description	Code Number	Remarks
<b>Gear Assembly</b>	GER18A-600	Includes CVR115-1 and GER28-1
<b>Gear Only</b>	GER28-1	
<b>Gear Cover</b>	CVR115-1	Includes Mounting Screws
<b>Spring Housing and Rack Assembly *</b>	RCK12A--620 RCK12A--621 RCK12A--622 RCK12A--623 RCK12A--624 RCK12A--626	270 lb (1201 N) -- used with Y20EBD-3 179 lb (796 N) -- used with Y20EBD-4 150 lb (667 N) -- used with Y20EBD-2 75 lb (334 N) -- used with Y20EBD-1 40 lb (178 N) -- used with Y20EBD-5 100 lb (445 N) -- used with Y20EBD-6

\* Rack and Spring Housing are an assembly with spring and standard connector (1/4-28) installed.

Specify Spring Load for application when ordering.

**Table 4: Accessories**

Description	Part Number
<b>5/16 inch Stem Connector</b>	Y20EBE-1
<b>VT Adapter Kit</b>	Y20EBE-2

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# Notes



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