MTS FSE MODULAR TRAINING

Rotary Actuators

November 17, 2015 Rev A

be certain.

Rotary Actuator

- The rotary actuator is available in several standard models
  - Model 215 for torques up to 11,300 N-m (100,000 lbf-in)
  - Model 216 for high torque applications
  - Model 217 for spinning applications (Model 217 not included in this module)

Model 215

Model 216

Rotary Actuator - Models

» These actuators are available in several torque ratings.

Model	Dynamic* Torque Rating	
	lbf-in.	N-m
215.32	2000	226
215.35	5000	565
215.41	10,000	1130
215.42	20,000	2260
215.45	50,000	5650
215.51	100,000	11,300
216.10	200,000	22,600
216.20	397,000	44,900
216.30	730,000	82,500

Rotation

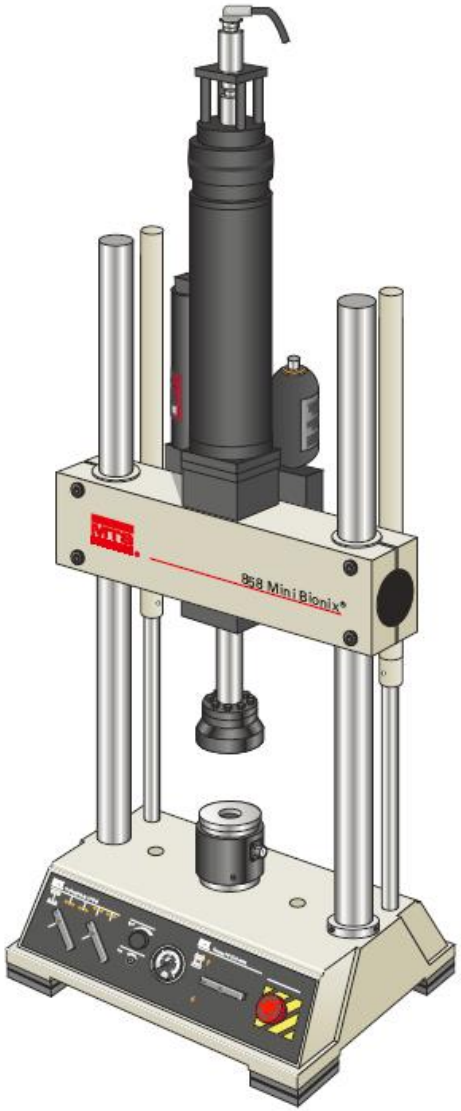
- Model 215 and 216 rotary actuators have a static rotation of 100 degrees (+/- 50 degrees) and a dynamic rotation of 90 degrees (+/- 45 degrees).
- These rotary actuators have a hydraulic cushion similar to a linear actuator. The cushion is located in the last 5 degrees of rotation.
- Dynamic testing cannot be performed in the are of the hydraulic cushion.

Rotary Actuator Models

- MTS uses a variety of purchased rotary actuators and hydraulic motors.
- These are often modified by MTS. Do not use a replacement direct from the manufacturer as they will not contain the appropriate modifications.
- These actuators and motors do not have a MTS model number.

Rotary Actuator Models

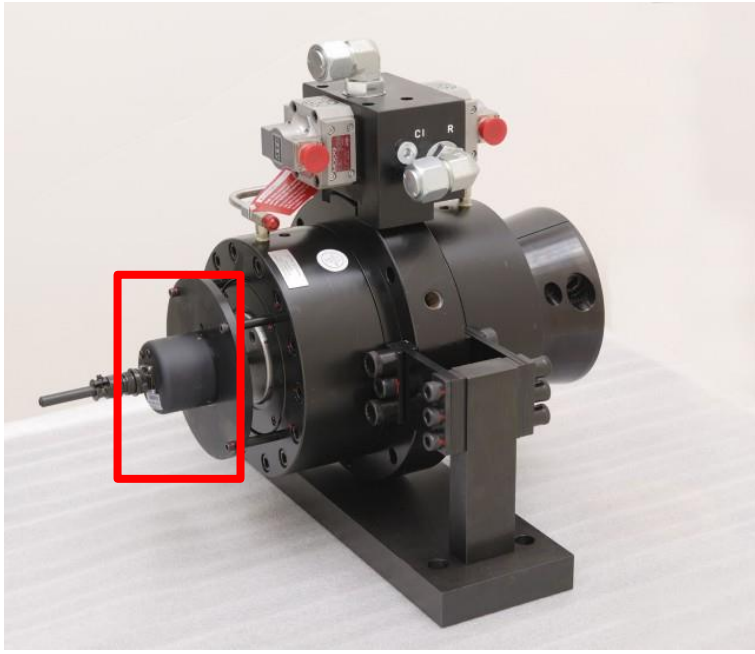
- The 358 / 359 Load Frames and Landmark 370.02 Axial Torsional load frames use a purchased rotary actuator.
  - Some versions have a hydraulic motor
- The hydraulic actuator in the Landmark load frame has a total rotation of 280 degrees.
  - These are calibrated to a full scale which is less than total available rotation.
  - P/N 575983-01
- These actuators are rated for 3000 PSI however MTS uses a pressure reducing valve to lower the input pressure to increase the life of the actuator.



Axial-Torsional

Rotation Feedback - RVDT / ADT

- Rotary actuators use a RVDT or ADT for rotation feedback.
  - See transducers module for additional details
- These are analog transducers.
- The RVDT and ADT use different electrical connectors.
  - The RVDT uses a 6 pin connector
  - The ADT uses a 5 pin connector

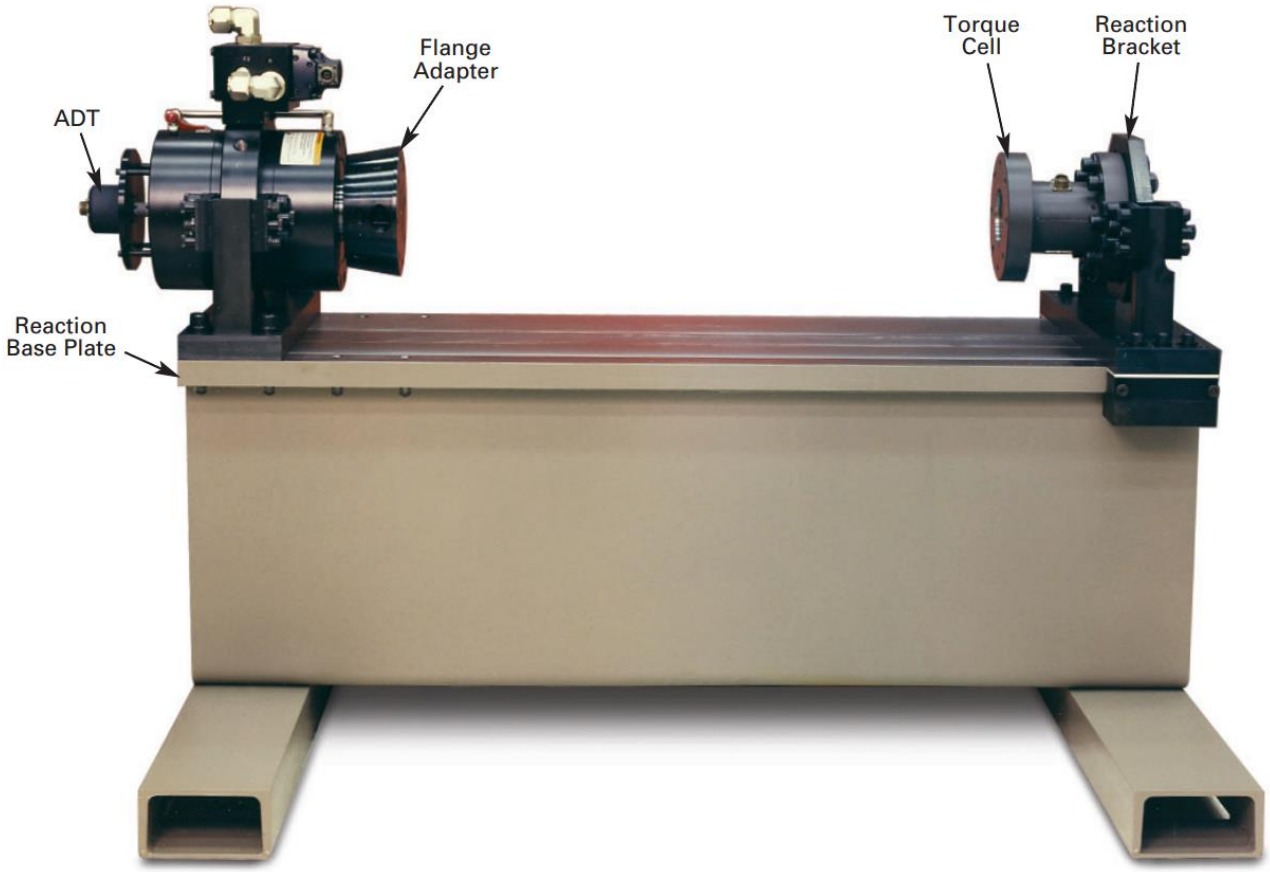


Rotation Feedback - Encoder

- Some rotary actuator are now using an Encoder for rotation feedback.
  - See transducers module for additional details
- These are digital transducers.
- This is connected to an appropriate digital card in the controller.

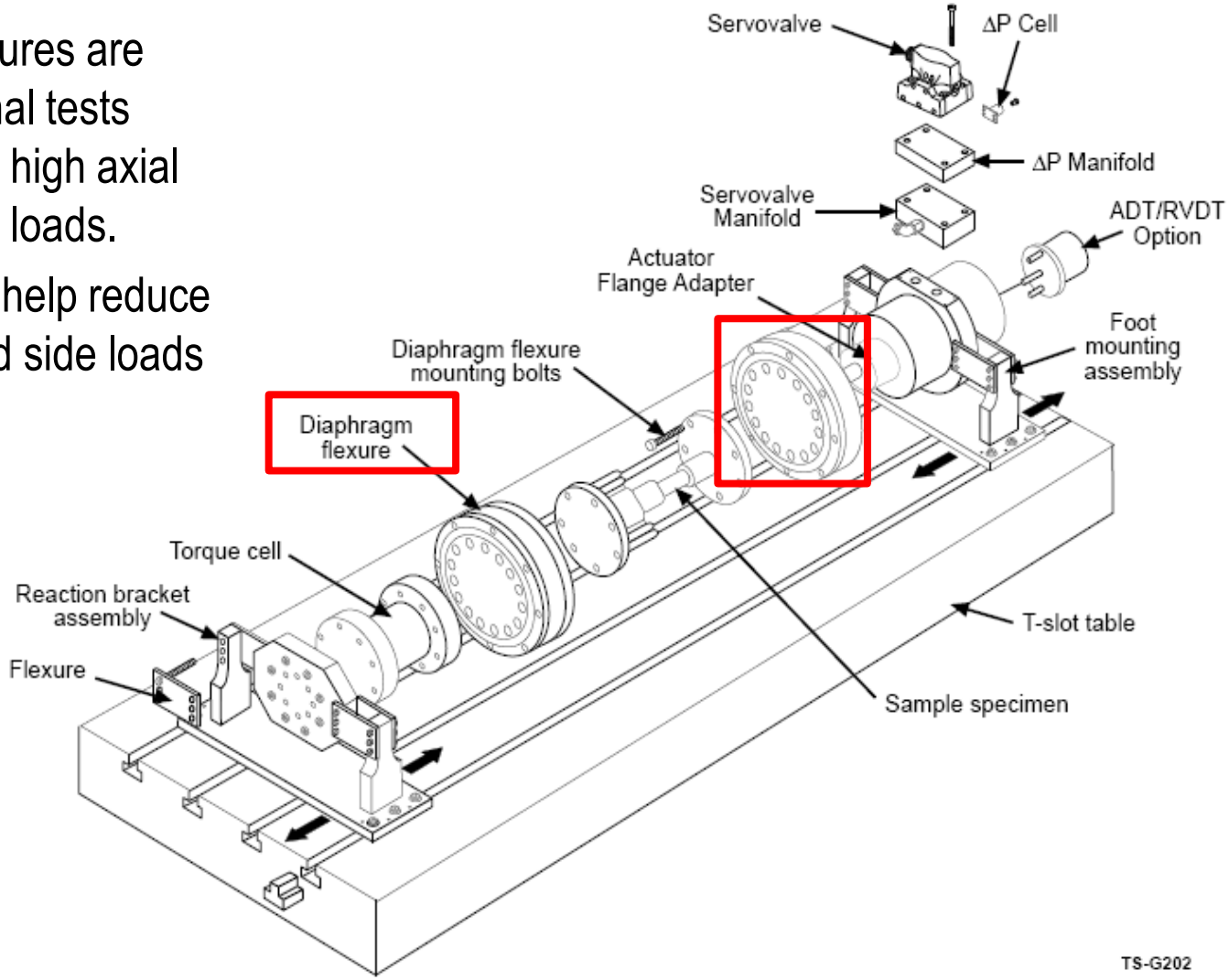
Torque Feedback

» Torque is measured using a torque cell



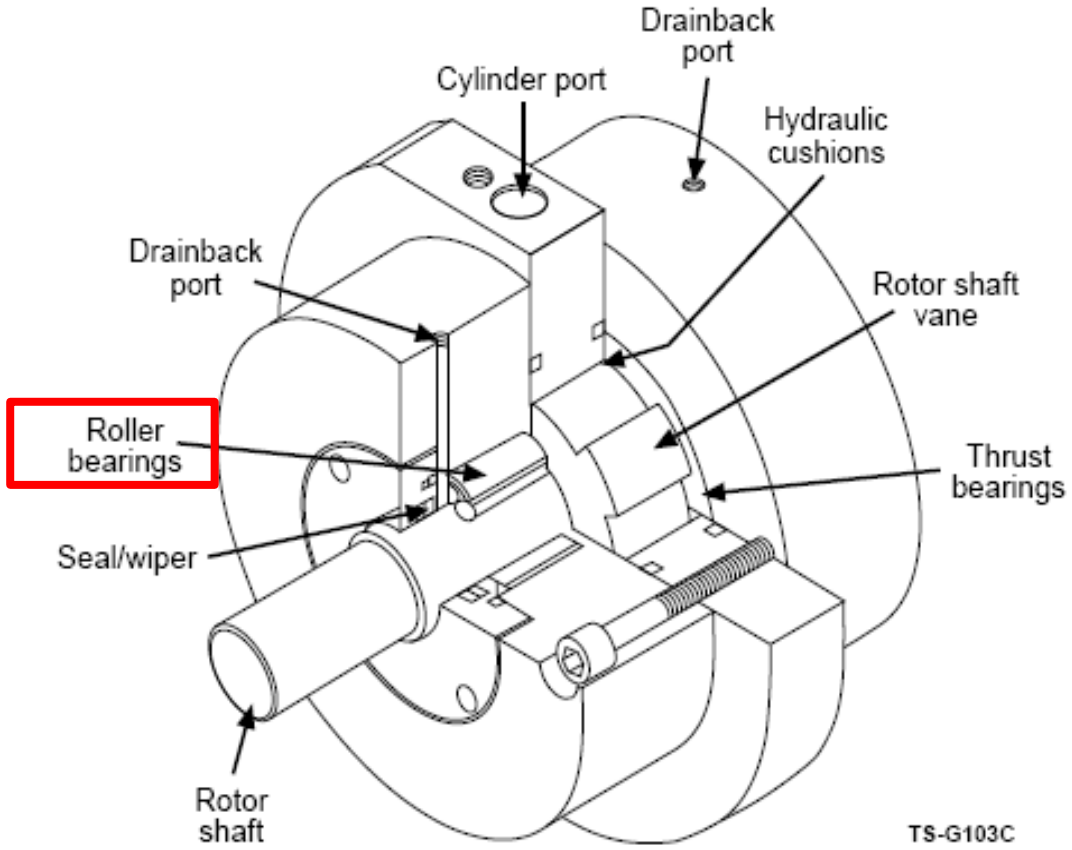
Diaphragm Flexures

- Diaphragm flexures are used for torsional tests which generate high axial forces and side loads.
- These flexures help reduce thrust loads and side loads at the actuator



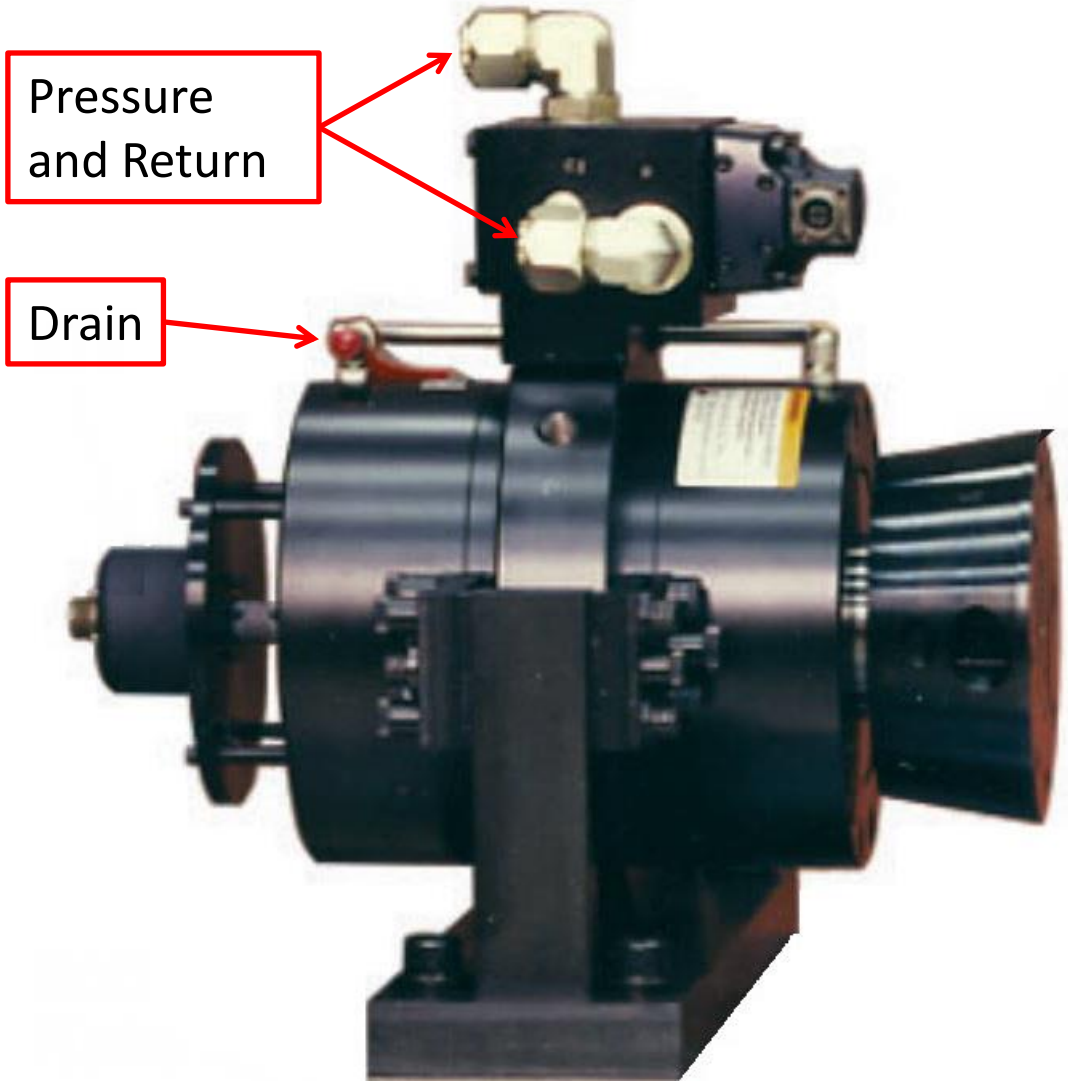
Rotary Actuator Bearings

- The model 215 rotary actuator uses roller bearings between the rotor shaft and end cap.
- The bearings are lubricated by oil flow from the cylinder to the drain.
- These bearings are not field replaceable.



Actuator Hose Connections

- Rotary actuators have the normal pressure, return, and drain connections.
  - P and R stamped in manifold to identify each hose location
- Do not use a drain hose smaller than the actuator drain fitting.
- Rotary actuators with a 3 stage valve will also have pilot pressure, pilot return, and valve drain hose connections.

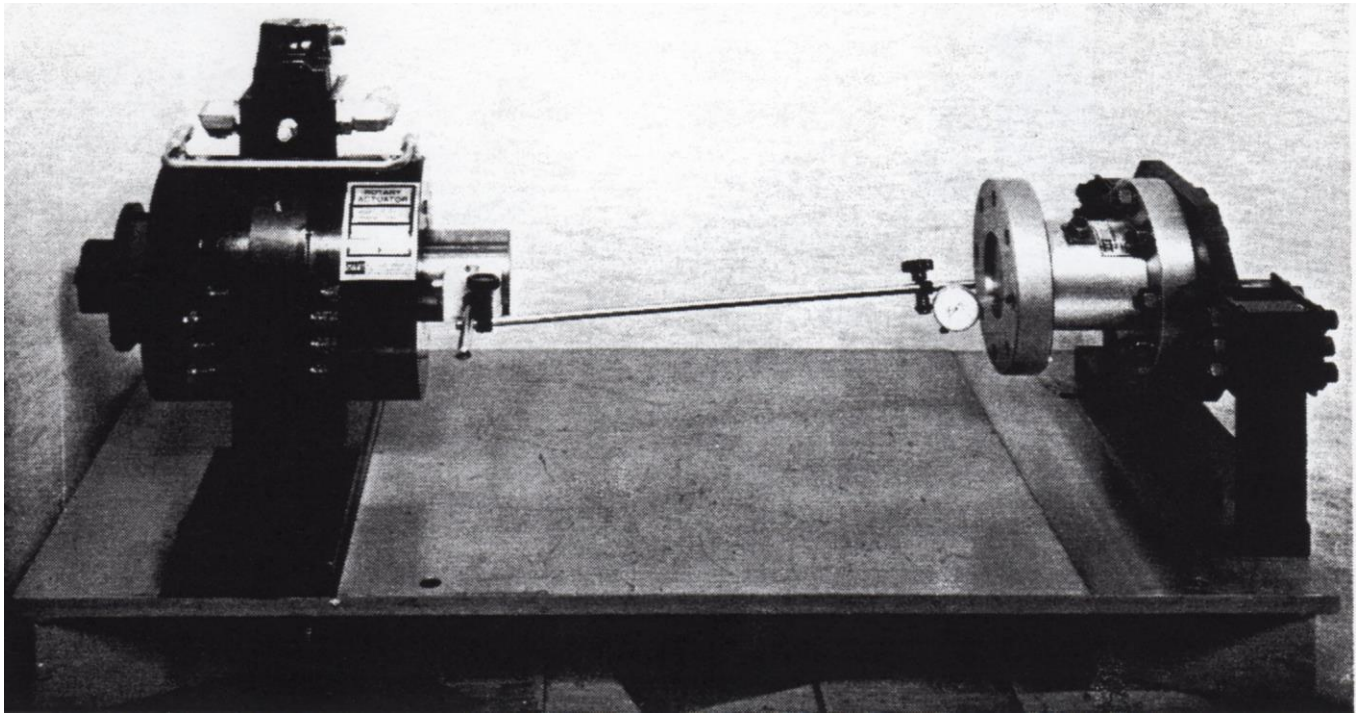


Installation - Mechanical

- The rotary actuator and torque cell / reaction fixture must be on the same centerline.
  - There should not be any parallel or angular misalignment
- Actuators on a MTS supplied base have been aligned.
- Refer to appropriate product manual for procedure and tolerances.

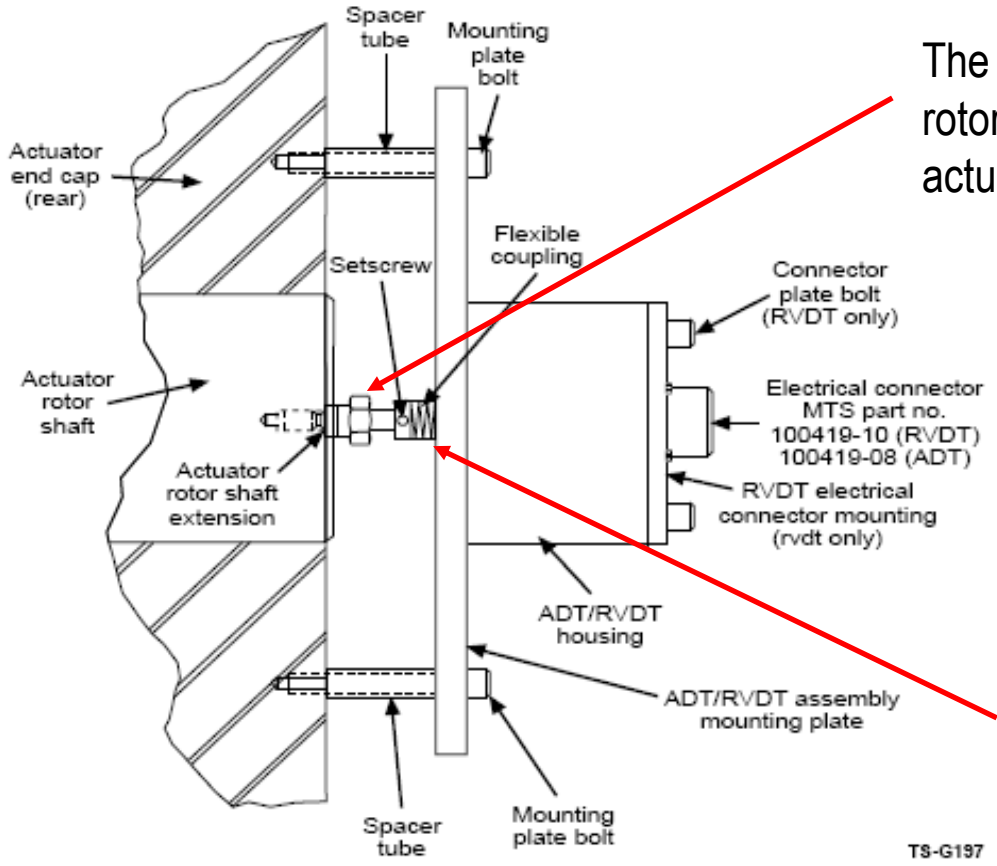
Installation - Mechanical

- Alignment can be verified using a dial indicator on a magnetic base attached to the actuator shaft or flange and measuring at the torque cell
  - The face of the torque cell can be used for angular alignment.
  - The inside pilot diameter of the torque cell can be used for concentricity.



RVDT / ADT

- The rotation feedback is from a RVDT or ADT
- The transducer is connected to the rotary actuator using a flexible shaft



The flexible coupling is connected to the rotor shaft extension and rotates with the actuator as it rotates.

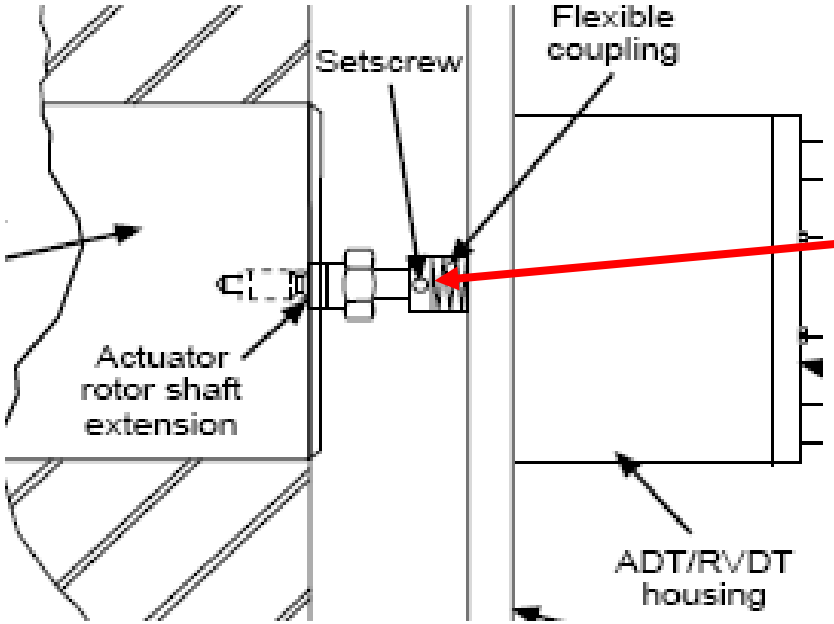
The flexible coupling connects the RVDT/ADT to the actuator.

RVDT / ADT Replacement

- After replacing the rotation feedback transducer it must be centered.
- It is best to put the system into torque control and using the manual command, rotate the actuator to one end of its travel, record the output of the transducer.
- Rotate the actuator to the other end of its travel, and then record the output.
- If the transducer is mounted in the center of its travel, then the output will be the same, if the are not then the device is not centered and requires adjustment.

RVDT / ADT Centering Adjustment

- Rotate the actuator to one end and turn off the hydraulic pressure. Loosen the set screw on the actuator side of the flex coupling. Rotate the flexible coupling and the transducer shaft so that the output value will be the same at both ends of travel. Turn hydraulic pressure back on and rotate to the other end cap and verify that the output is the same. Repeat as necessary to get equal output from the transducer.



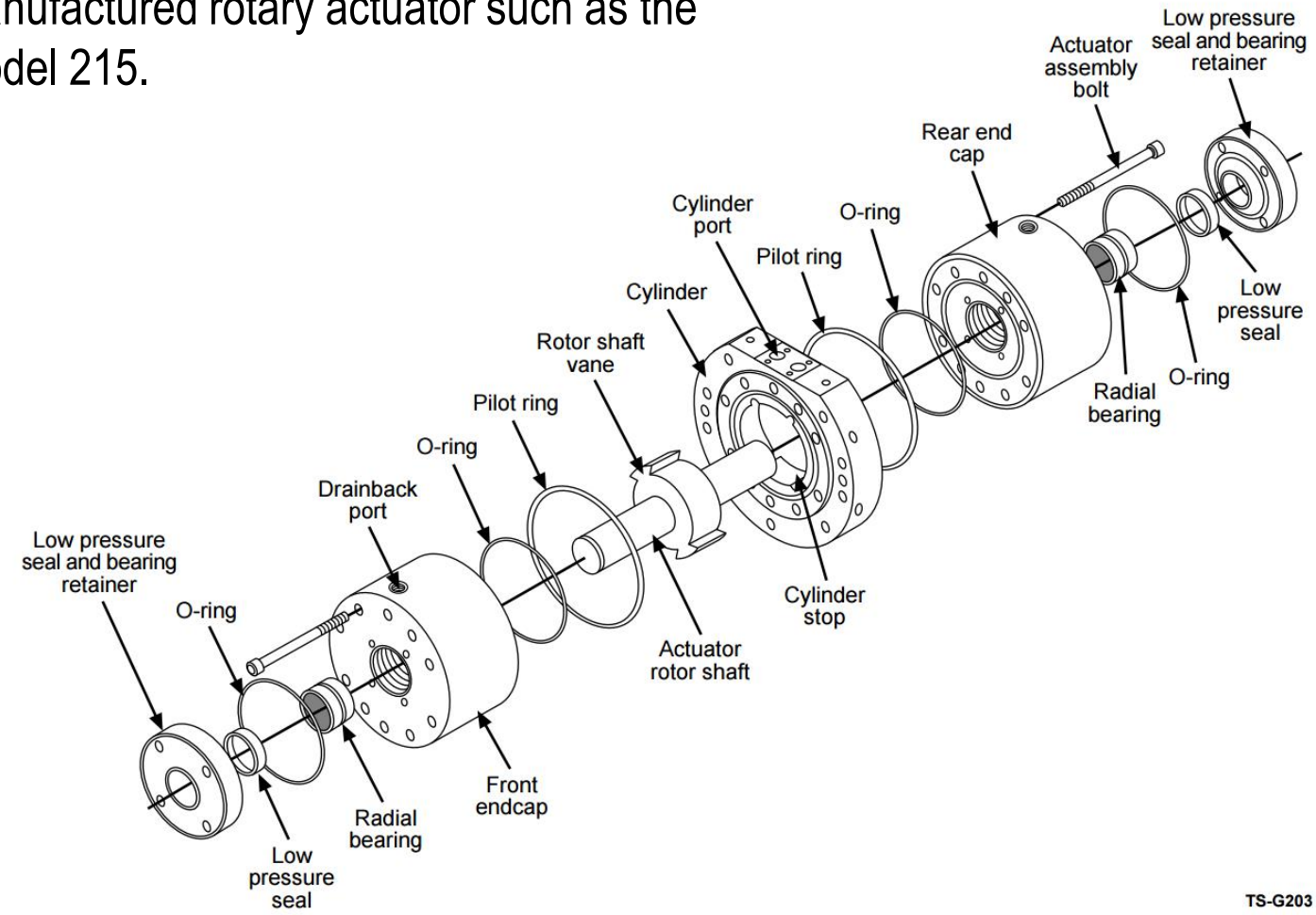
Loosen the set screw on the actuator side of the coupling for centering adjustment.

RVDT / ADT Centering Adjustment

- The transducer will require calibration following replacement.
- Do not be alarmed if the actual indicated rotation during the centering adjustment is incorrect since the transducer is not calibrated yet.
- The full scale travel will be adjusted during calibrations
- It is only important during the centering process to achieve equal indicated travel at each end stop of the rotary actuator.

Rotary Actuator Seals – MTS actuators

» There are no high pressure seals in a MTS manufactured rotary actuator such as the model 215.



Rotary Actuator Seals

- Excess flow is minimized by close tolerance machining between the cylinder and rotor vane.

- There are two symptoms likely when the rotary actuator wears.
  - The rotary actuator may not be able to achieve full torque.
  - The flow across the rotor vane will increase.

- You may be able to hear the oil flow increase when the actuator is hard over in the end cap. This sounds like running water and will diminish when the actuator is moved out of the end cap.

- This type of wear is not field repairable and the actuator must be returned to the factory for remanufacturing.

Excess Flow

» The maximum expected flow across the vane is shown in the table below.

» Flow should be checked with the actuator hard over into each end cap.
- Measure return line flow to check for wear.

Measured cross vane flow values should not exceed:

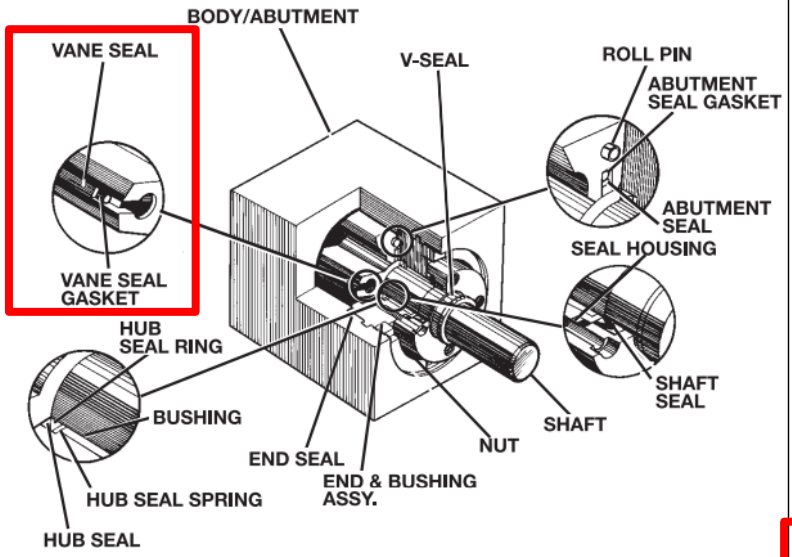
- 1 gpm for 215.32/35 actuators
- 2 gpm for 215.41/42 actuators
- 3 gpm for 215.45/51 actuators

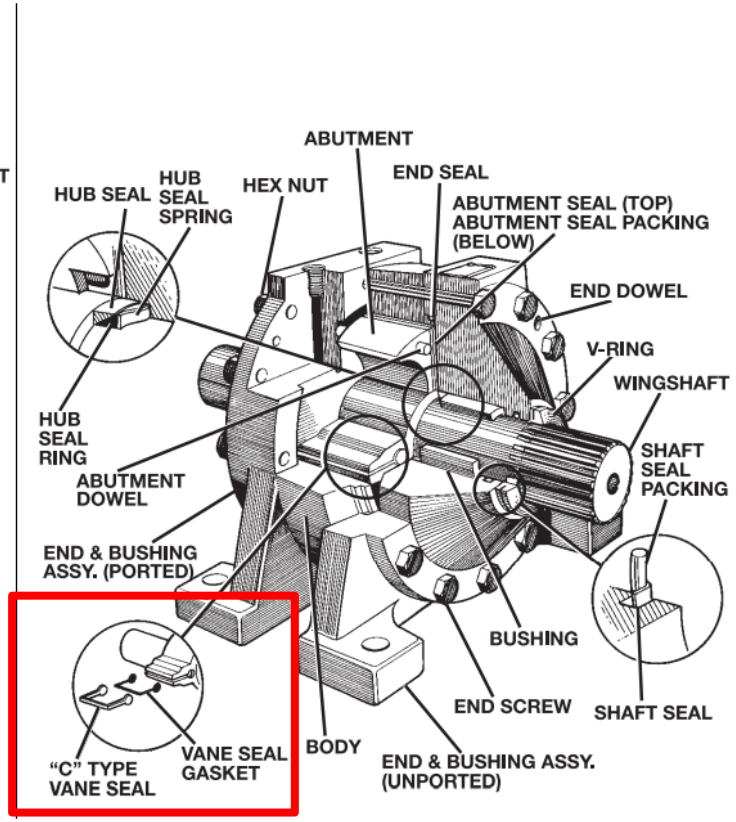
Drain Flow

- The typical drain flow is less than 1.9 LPM (0.5 GPM).
  - This oil is used to lubricate the roller bearings.
- The drain flow should be checked at regular intervals.
- An increase in the drain flow indicates internal wear.

Rotary Actuator Seals – Purchased Actuators

» Many purchased actuators have high pressure seals. The cutaway shown below is the rotary actuator used on the Landmark axial torsional load frames. Note the use of a high pressure seal on the vane. When this wears it will cause the actuator to not be able to achieve rated capacity. Seal kits may be available from the manufacturer. Also note these use a bushing on the shaft and not roller bearings.

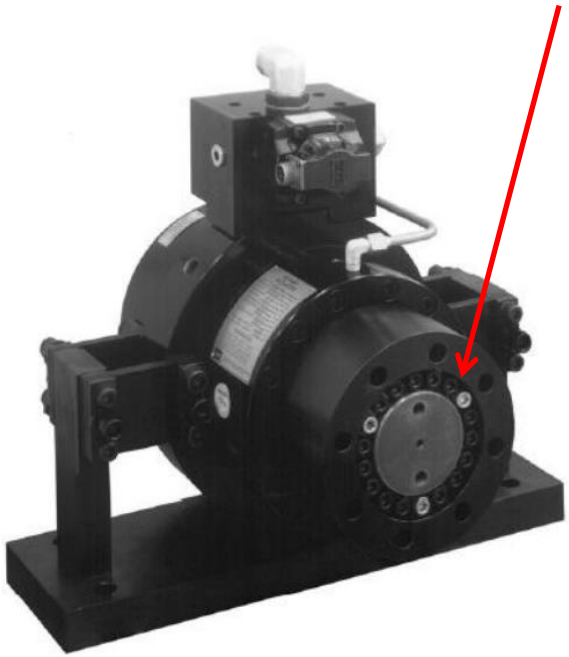




Flange Attachment

» The flange is attached to the rotor shaft using one of two methods.
- A ringfeder brand keyless clamp
- A split flange with clamping bolts

Ringfeder keyless clamp



Split Flange with clamp bolts

Flange Attachment

- Do not loosen or tighten the bolts on the Ringfeder clamp assembly. This is assembled using a specific tightening sequence to properly install the clamp.

- For assembly instructions search DOD for drawing 31788801