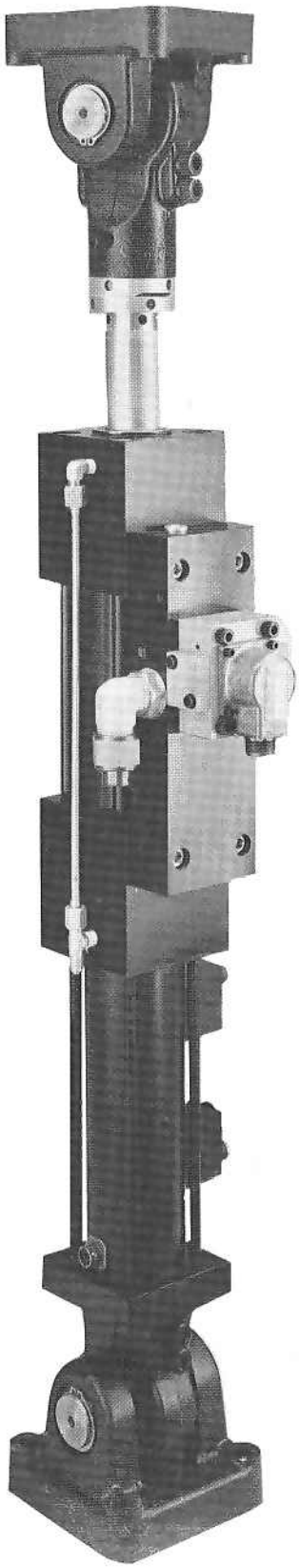
MTS®

Product Specification

SERIES 204 HYDRAULIC ACTUATORS



Series 204 Hydraulic Actuators are heavy-duty force-generating rams that operate under precision servovalve control in MTS closed-loop testing systems. Typical applications include static testing, cyclic tension-compression fatigue testing, high rate testing, systems having special long stroke requirements, or systems having reliable precision force generating or positioning requirements.

Series 204 Actuators are designed specifically for low and medium force (one-half metric ton-force to one hundred metric tons-force*) testing of structures, components, products, and materials. The Actuators are designed to achieve the lightest weight possible without compromising long term fatigue reliability. Their durability and dynamic side load tolerance makes them particularly effective in severe dynamic tests. Their special bearing and seal configurations also make them practical for low velocity or static requirements.

Any of the 204 Series Actuators can be installed in an MTS load frame for materials testing applications, (using a hole pattern in the upper end cap). A variety of mounting arrangements allows easy application of the Actuators to structures testing. Swivel bases and swivel heads provide a safe method of attachment to bending members, and special mounts, such as the gimbal-trunnion mount, can be used for bed-plate installations. The light-weight construction prevents performance degradation due to weight problems in articulated applications.

*One metric ton-force equals 2204.6 pounds or 9.8 kilonewtons.

Part Number 100-154-982

FEATURES

- Wide range of force ratings.
- Able to accept a wide range of servovalves from 1 gpm to 90 gpm (4 liters/min. to 340 liters/min.) except for Models 204.08 and 204.09 which have a maximum servovalve capacity of 15 gpm (56 liters/min.). Higher flows are available upon request.
- Built-in displacement transducers coaxially mounted within the hollow piston rod for simple construction and increased accuracy.
- Non-metallic bearings to withstand heavy side loads.
- Lightweight yet strong mechanical construction to produce minimum extraneous specimen loading.
- Zero backlash.
- Wide range of mounting options to adapt the Actuators to a broad range of testing applications.
- Low friction.
- Large diameter, single-piece, hollow piston rods constructed to provide strength, large bearing areas, and extended seal and bearing life.
- Standard built-in end cushions protect the Actuator from the effects of high velocity operation.

DESIGN CHARACTERISTICS

All MTS Actuators are carefully manufactured to close tolerances. This attention to precision ensures reliability, performance, long life, and complete part interchangeability. The following characteristics are common to all 204 Actuators. (Refer to Figure 1 for the locations.)

1. Upper Rod End: The upper piston rod is threaded for mounting load cells, grips, or swivel bearings. Internal threads are standard, but a combination of internal and external threads is optional. The threads are long to allow fatigue-resistant and backlash-free connections.

2. Porting: Large ports allowing flows up to 90 gpm (340 liters/min.) for high piston rod velocity or high frequency work. The inner oil distributing channels are designed to minimize oil flow restrictions.

3. Servovalve Manifolds: Manifolds are available for all standard MTS servovalves. Plugs on the manifold ends allow convenient port access for special test setups. Dual servovalves can sometimes be used to double the flow in high-response applications. A load limiting valve, an anti-compression or anti-tension valve, a differential pressure transducer, or any combination of these can be added to any standard manifold.

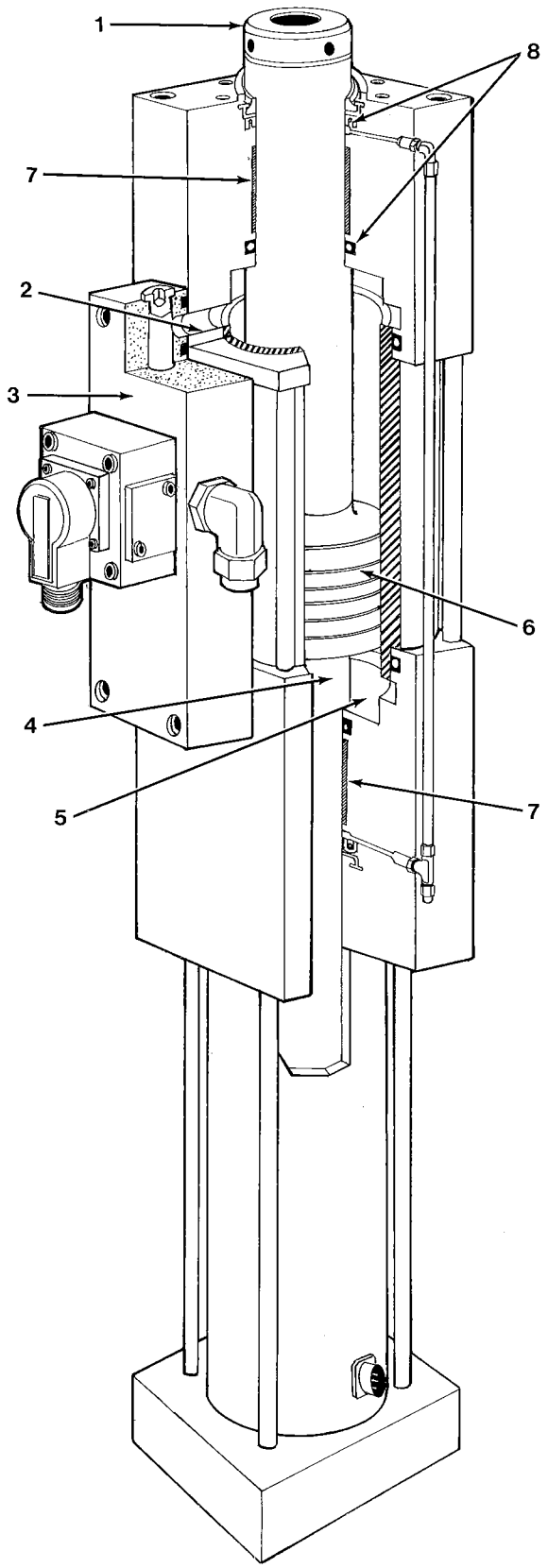


Figure 1 204 Design Characteristics

4. One Piece Piston Rod: Each 204-Series Actuator is double-ended, and has a large diameter piston rod. The double-ended piston has equal areas on both sides for balanced performance. The piston and rod are machined from a single piece of heat-treated alloy steel with large-radius fillets for reliable fatigue life. The rod is finished by a microhoning process which increases seal and bearing life. The hollow rod permits convenient installation and good axial alignment of displacement transducers.

5. Cushions: Hydraulic cushions protect Series 204 Actuators from effects of high-speed and high-mass loads. (204.8 and 204.9 models do not require cushions.)

6. Piston Seal: A reinforced Teflon seal configured to provide long life is normally provided on the piston. In addition, a low leakage viscous seal is provided through the use of labyrinth grooves on the piston and close tolerance fits. This seal is effective whenever the high pressure piston seal is omitted for high speed cyclic applications.

7. Rod Bearings: 204 Actuators may be supplied with conventional metal bearings or high capacity polyimide bearings. The polyimide bearings are standard with the 204 Actuators because of the extremely high side load tolerance inherent in the polyimide material. The metallic bearings are used in special low-friction applications where the high pressure rod seal is omitted. In place of the

rod seal, the bearing's labyrinth grooves and close tolerance fit provides an effective viscous seal. A comparison of the characteristics of the metallic and polyimide bearings is provided.

	Polyimide Bearing	Metallic Bearing
Capacity for Short Term Overloads	15,000 psi	15,000 psi
Continuous Side Load Capacity	1000-10,000 psi*	50-100 psi
Friction Coefficient	.1-.2	.1-.2
Wear Rate	$30 \times 10^{-10} \frac{in^3 min}{ft\text{-}lb\text{-}hr}$	$40,000 \times 10^{-10} \frac{in^3 min}{ft\text{-}lb\text{-}hr}$

*Limited by the temperature buildup that is directly related to the velocity of the Actuator rod.

8. Rod Seals: The rod bearing seal consists of three seals. The innermost seal is made from reinforced Teflon to provide a long-life high-pressure seal. A small amount of oil is allowed to leak past the Teflon seal to provide lubrication. A drain back port returns the oil passed by the high-pressure seal to the hydraulic power supply. A U-cup low-pressure seal scrapes the oil film from the rod to eliminate external leakage even at high frequencies and velocities. A scraper ring prevents external contamination of the seals and bearings.

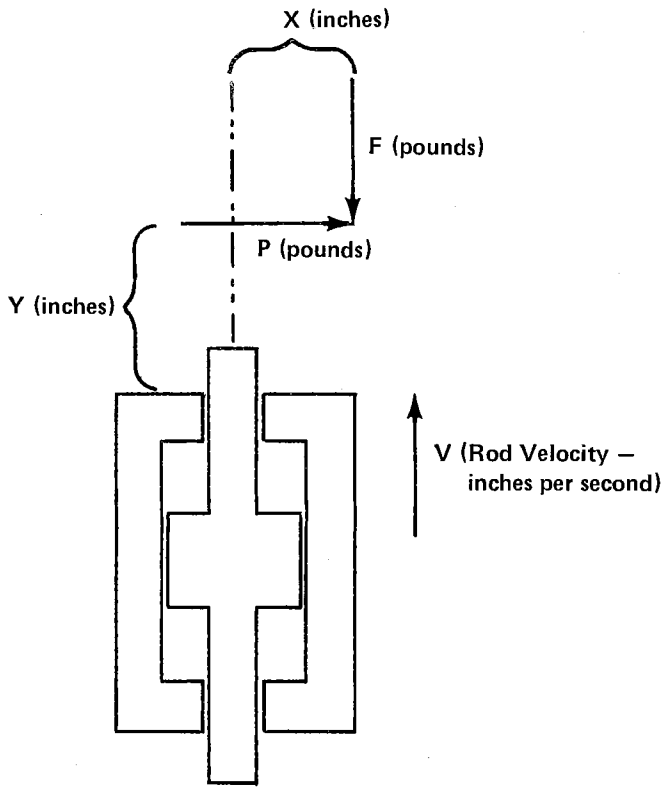
SERIES 204 APPLICATION

The suitability of Series 204 Actuators for continuous operation in applications having high non-axial loads can be determined by verifying that both of the following equations are satisfied using the values supplied in the table and the variables as indicated in the diagram.

				Polyimide Bearing		Metallic Bearing	
	A	B	C	D	E	D	E
204.0X	1,400	.8	6.4	4,000	1,300	920	40
204.5X	2,100	1.5	6	10,000	2,000	2,000	100
204.6X	15,000	1.7	6	16,000	5,000	3,300	160
204.7X	46,000	1.9	6	27,000	8,000	5,400	270
204.8X	140,000	2.5	6.5	65,000	19,000	13,000	650
204.9X	210,000	2.7	8	82,000	24,000	16,500	820

$$P(B + Y) + Fx < A$$

$$P + \frac{Fx}{(C + \text{stroke})} < E < \frac{D}{V}$$



OPTIONS

Series 204 Hydraulic Actuators may be modified by adding the desired options to adapt the Actuator to a variety of applications.

Full-stroke or short-stroke displacement transducers (LVDT) are available for structures, vibration, and load frame applications. (Refer to Figure 2.) The displacement transducers are easily mounted inside the hollow rod. The LVDT core is chrome-plated for long life, and the assembly includes a unique, easy-to-adjust core mount, the connector wiring, and a mating oil-tight connector. Each Actuator comes with a long hex wrench for positioning the core for stroke midpoint during setup. Velocity transducers can also be used in some applications. Consult MTS for specific applications.

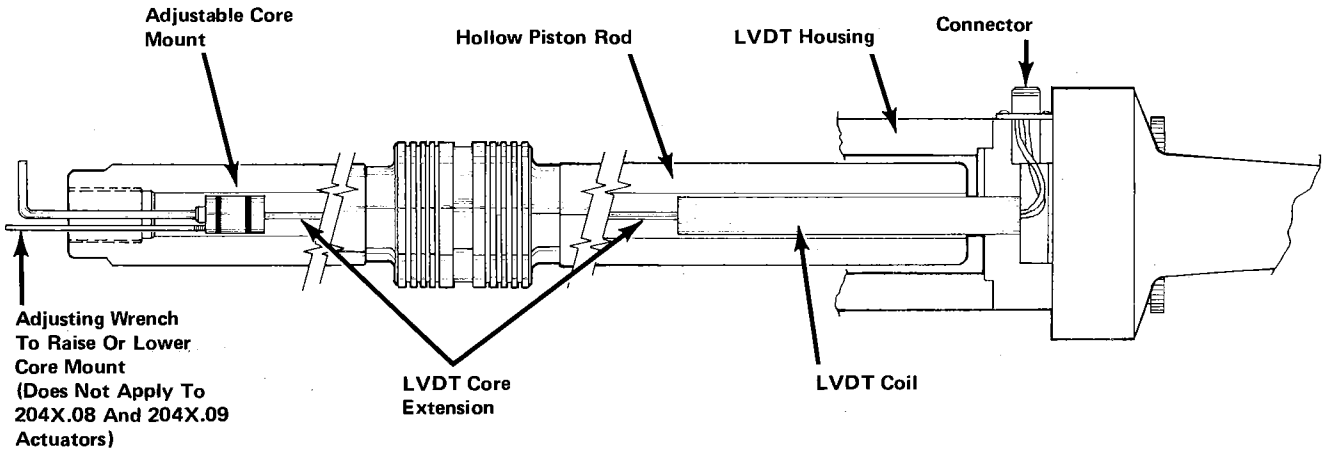


Figure 2 Piston Rod And LVDT

A rigid and fatigue resistant force train attachment method is available with the use of Spiral Washers (refer to Figure 3). A threaded stud is preloaded between the piston rod and the fixture or load cell. Spiral Washers between the fixture and rod are then tightened under the tension load to provide an extremely rigid connection. The use of Spiral Washers also provides the shortest overall height for the fixture connection. (Spiral Washers are not normally used with actuators rated under 10 tons.)

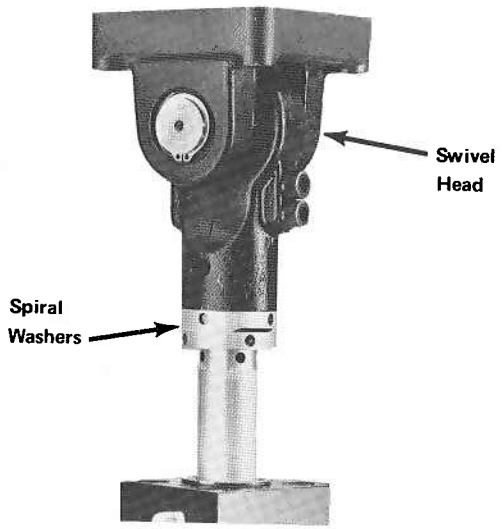


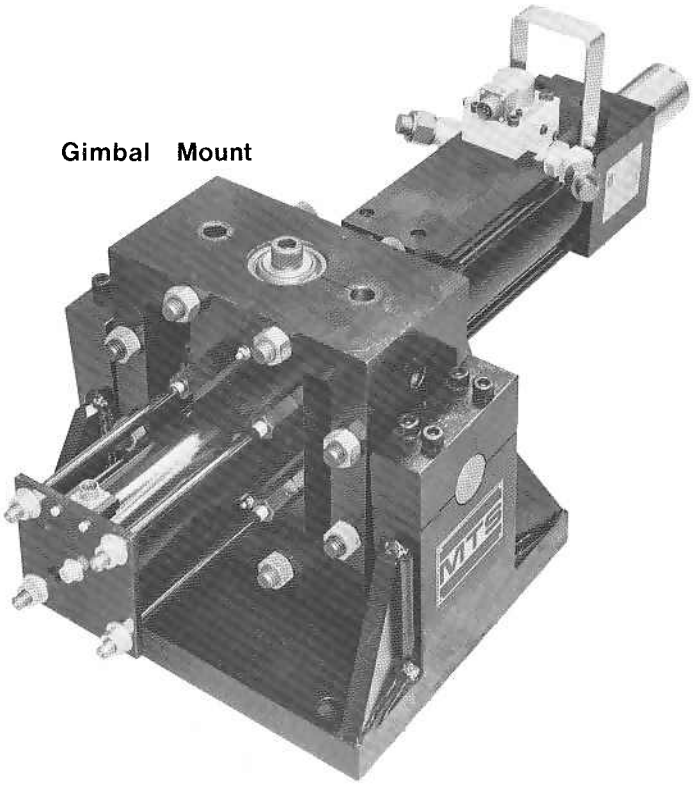
Figure 3 Actuator Rod With Swivel Head

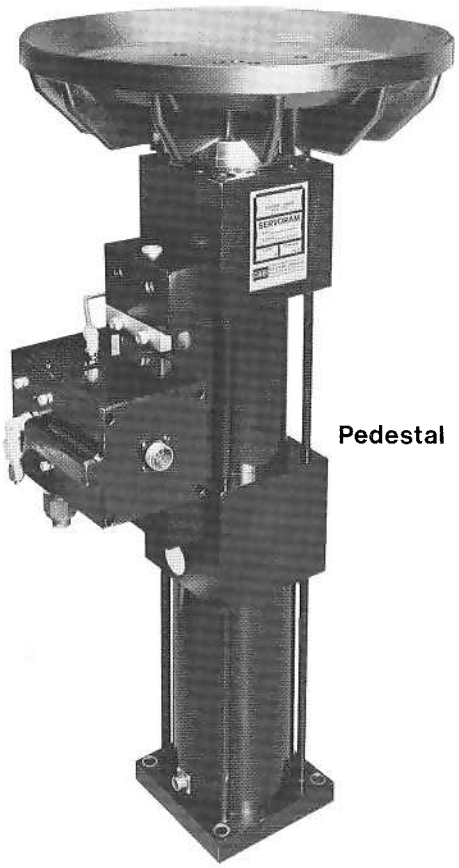
Non-standard strokes may be requested. Consult MTS for details.

Extra long piston rods are available. The extra rod length is provided for load frame applications.

External Stroke limit switches are available for attachment to the actuator. An electronic stroke limit is available on all units with LVDT stroke transducers. Stroke limit switches are not available on the 204.0 low force series actuators.

The swivel bearing base (option) is designed for structural testing applications. The bearing preload can be manually adjusted during operation to reduce the backlash close to zero and yet provide freedom to swivel. It can also be tightened to obtain a rigid base mounting for some applications when desirable. A swivel bearing head similar to the swivel base (refer to Figure 3) is available for mating the piston rod to a load cell or fixture. The combination swivel head and swivel base is often recommended for structures testing applications. By providing pivotal freedom of the Actuator at both ends, the swivel bearings reduce moment loads on the rod bearing and load cell. A non-adjustable swivel bearing, preloaded to zero backlash, is available for use with the 204.0 group. Pedestal base, trunnion mount, or gimbal mount options (Figure 4) are available as alternatives to the swivel base.





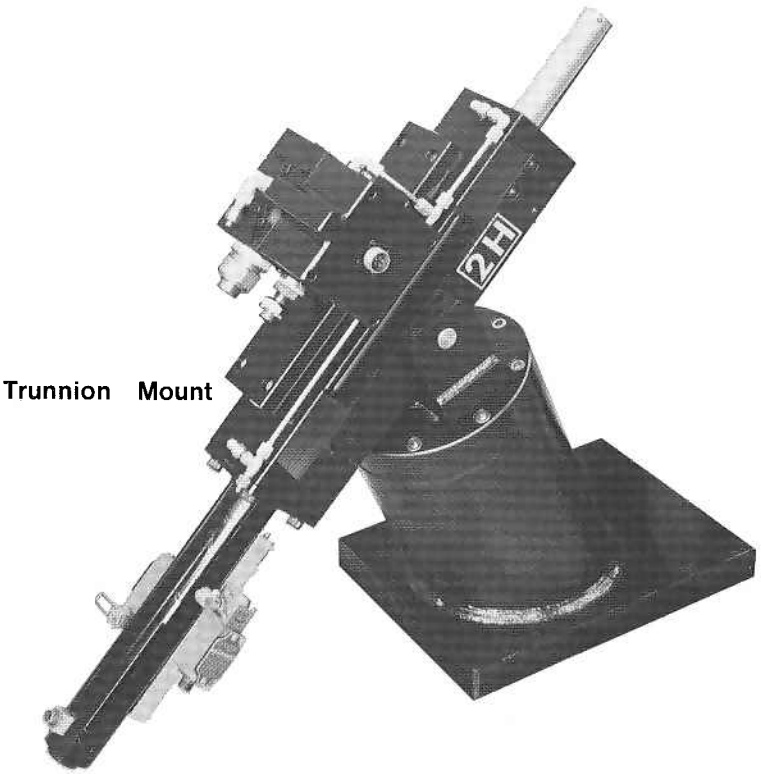


Figure 4 Actuator Mounting Options

SPECIFICATIONS

Series 204 Actuators are divided into six groups according to standard piston rod diameters: 204.0X, 204.5X, 204.6X, 204.7X, 204.8X, and 204.9X. Thirteen standard actuators within these six groups provide a range of force ratings from 1100 pounds (0,5 metric tons) to 220,000 pounds (100 metric tons). Stroke lengths are standard at 4" for 204.0X models and at 6" for the other five model groups. Stroke lengths of up to 20" are available on all models except the 204.0X model group. (Refer to Figure 5 when referencing the specifications.)

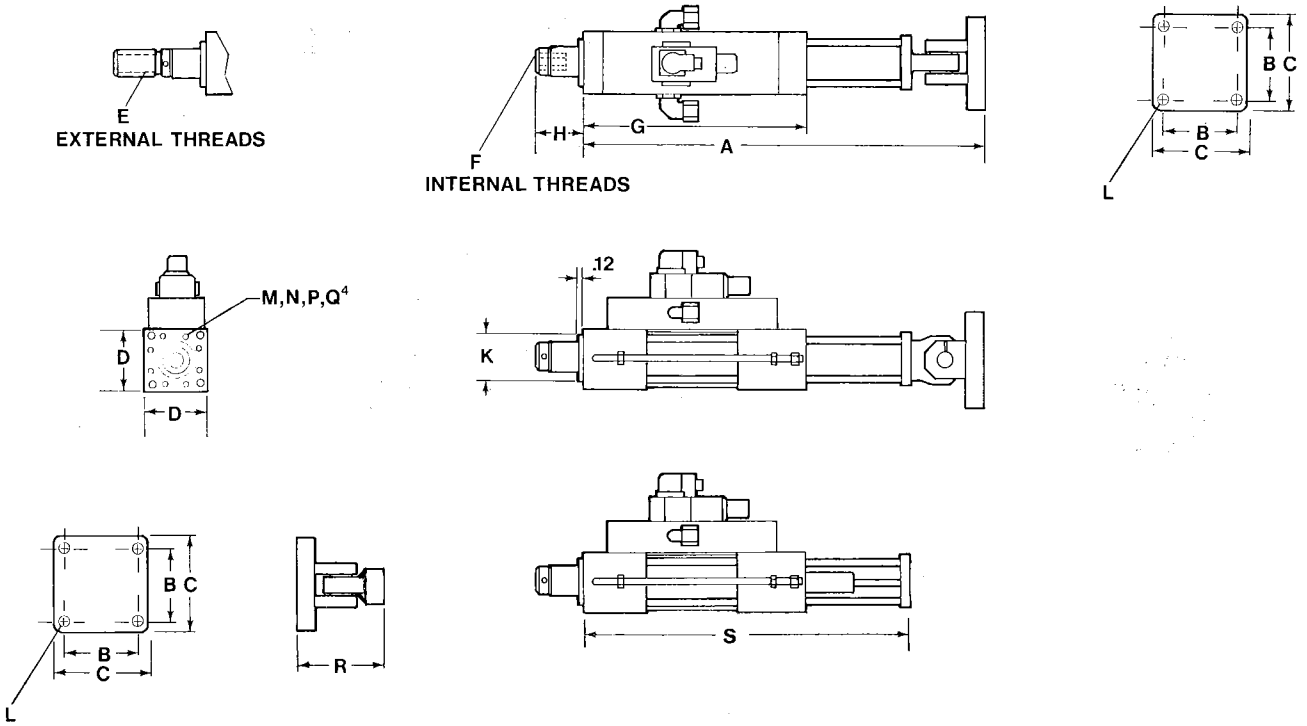


Figure 5 Actuator Dimensions

Notes:

1. 204.08 and 204.09 dimensions based on 4-inch strokes. All others are based on a 6-inch stroke.
2. 204.91 swivel base is rectangular (11.00 x 16.75 inches) with four bolt holes in an 8.00 x 13.50 inch rectangular pattern.
3. Dimensions given in inches.
4. M is the thread size, N is the hole depth, P is the bolt circle, and Q is the number of holes.
5. This dimension with rod fully retracted. For actuators used in load frames , extra rod length is provided.
6. 1 metric ton = 1000 kg = 2204.6 lbs = 9.8 kilonewtons. Maximum 3000 psi ΔP force can be calculated from the given piston area and is typically 2 to 12% greater than the nominal rating. All 204 Actuator assemblies are structurally fatigue rated for infinite life at ±full nominal force rating.
7. Less cushions.
8. With standard stroke, swivel base, and Model 252 servovalve.
9. External threads are standard on 204.0X Actuators and optional on all others.

Model	A[1]	B	C	D	E	F	G[1]	H[5]	K	L	M	N
204.08	18.73	1.37	2.00	2-1/2 x 3	1-14 UNS	1/2-20 UNF	9.275	1.72	N.A.	.28	1/4-20 UNC	.50
204.09	18.73	1.37	2.00	2-1/2 x 3	1-14 UNS	1/2-20 UNF	9.275	1.72	N.A.	.28	1/4-20 UNC	.50
204.51	31.78	4.50	5.62	4.00	1-1/2-12 UNF	1-14 UNS	15.48	.97	2.375	.53	3/8-16 UNC	.75
204.52	31.78	4.50	5.62	4.00	1-1/2-12 UNF	1-14 UNS	15.48	.97	2.375	.53	3/8-16 UNC	.75
204.61	31.26	4.50	5.62	5.00	2-1/2-12 UN	1-14 UNS	15.38	.93	3.500	.53	1/2-13 UNC	.75
204.62	31.26	4.50	5.62	5.50	2-1/2-12 UN	1-14 UNS	15.38	.93	3.500	.53	1/2-13 UNC	.75
204.63	33.32	5.75	7.38	6.00	2-1/2-12 UN	1-14 UNS	15.18	.93	3.500	.69	1/2-13 UNC	.75
204.64	33.22	5.75	7.38	6.50	2-1/2-12 UN	1-14 UNS	15.08	.93	3.500	.69	1/2-13 UNC	.75
204.71	36.50	7.25	9.00	8.00	3-1/2-12 UN	2-12 UN	15.64	.98	4.625	.81	5/8-11 UNC	1.00
204.72	36.50	7.25	9.00	8.50	3-1/2-12 UN	2-12 UN	15.64	.98	4.625	.81	5/8-11 UNC	1.00
204.81	44.60	11.00	14.00	11.50	5-8 UN	2-12 UN	18.64	1.57	6.500	1.31	1-8 UNC	1.75
204.82	44.60	11.00	14.00	13.00	5-8 UN	2-12 UN	18.64	1.57	6.500	1.31	1-8 UNC	1.75
204.91	48.50	Note 2	Note 2	15.25	5-7/8-8 UN	3-12 UN	19.50	1.37	N.A.	1.56	1-8 UNC	1.75

Model	P	Q	R	S	Nominal Force Rating[6]		Piston Area in.[2]	Std. Stroke[7] Inches	Cushions Inches	Rod Dia. Inches	Approx. Weight Lbs.[8]
					Metric Tons	Kips					
204.08	2.00	4	2.48	16.25	0,5	1.1	.40	4	.25	1-1/8	16
204.09	2.00	4	2.48	16.25	1,0	2.2	.78	4	.25	1-1/8	16
204.51	3.20	4	7.80	24.18	1,5	3.3	1.17	6	.60	1-5/8	80
204.52	3.20	4	7.80	24.18	2,5	5.5	1.91	6	.60	1-5/8	85
204.61	4.10	8	7.80	24.08	5	11	3.73	6	.40	2-5/8	170
204.62	4.10	8	7.80	24.08	7	15	5.23	6	.40	2-5/8	190
204.63	4.10	8	10.38	23.88	10	22	7.54	6	.30	2-5/8	270
204.64	4.10	8	10.38	23.78	16	35	12.54	6	.25	2-5/8	290
204.71	5.50	8	14.00	24.34	25	55	18.53	6	.20	3-5/8	560
204.72	5.50	8	14.00	24.34	35	77	26.00	6	.20	3-5/8	610
204.81	10.37	8	18.00	27.34	50	110	38.51	6	...	5-1/4	1150
204.82	10.37	8	18.00	27.34	75	165	56.91	6	...	5-1/4	1300
204.91	10.37	8	20.74	28.20	100	220	75.62	6	...	6	1800

ORDERING INFORMATION

Series 204 Actuators are described (less the servovalve and manifold assembly) by the basic size number (from the specification table) plus the bearing type letter, the configuration letter and stroke dash number. Follow the example when ordering Series 204 Hydraulic Actuators.

Basic Actuator Size From Table

204A. 62D - 05

Bearing Type

A - Standard Bearing
B - Metallic Bearing

Configuration

A	–	Basic actuator assembly with no accessories
B	–	Version A with extra rod lengths for MTS Load Frames
C	–	Version B plus transducer assembly with LVDT for load frames
D	–	Basic actuator with swivel base and LVDT
E	–	Version D plus swivel head
F	–	Basic actuator with pedestal base and LVDT for free standing applications
G	–	Basic actuator with trunnion mount and LVDT
H	–	Basic actuator with gimbal mount and LVDT

Stroke Dash Numbers *

.01	1" Double Amplitude
.02	2" Double Amplitude
.03	3" Double Amplitude
.04	4" Double Amplitude
.05	6" Double Amplitude
.06	8" Double Amplitude
.07	10" Double Amplitude
.08	12" Double Amplitude
.09	16" Double Amplitude
.10	20" Double Amplitude

*Only 2" and 4" strokes are available with the 204X.0X model group. For stroke requirements greater than 4" on 204X.0X models and strokes greater than 20" on other models, consult MTS.

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