Series 244 Hydraulic Actuators

Series 244 Hydraulic Actuators (refer to figure 1) are heavy-duty, fatigue-resistant, force-generating actuators that operate under precision servovalve control in MTS closed-loop testing systems. Typical applications include static testing and cyclic tension-compression fatigue testing. The 244 Actuators can also be used in systems requiring reliable precision force generation or accurate control of piston rod displacement.

Features

- Wide range of force ratings: 1.1 kip (5kN) to 220 kip (1000 kN).
- Able to accept a wide range of servovalves from 1 gpm to 90 gpm (4 ℓ/m to 340 ℓ/m). Optional porting is available for flows greater than 90 gpm.
- Accessory displacement transducers are coaxially mounted within the hollow piston rod for simple construction, increased accuracy, and transducer protection.
- Non-metallic, direct-bonded bearings provide higher side load capabilities than metal bearings and eliminate bearing-to-rod galling failures.
- Accessory swivel head and swivel base can provide an adjustable bearing preload to minimize backlash.
- Wide variety of mounting accessories to adapt the actuators to a broad range of testing applications.
- Low-friction, long-life seal design.
- Large diameter, single-piece, chrome plated, hollow piston rods constructed to provide strength, large bearing areas, and extended seal and bearing life.
- Standard built-in hydraulic cushions protect the actuator from the effects of high velocity operation on all models up to 55 kip (250 kN).

006-866M

Figure 1. Model 244.22 Hydraulic Actuator (Shown with Accessories, Dual Servovalves, and Load Cell)

Description

Series 244 Actuators are designed for modular construction to accept a wide variety of options and accessories (discussed later in this Product Specification). When equipped with the appropriate options and accessories, the Series 244 Actuators can be configured for testing materials, structures, components, and products.

The Series 244 Actuators are designed for the severe requirements of servo controlled, closed loop testing applications without compromising long term reliability. Lab tested and field proven, the design features the latest technology in seal and bearing materials.

Design Characteristics

All MTS actuators are carefully manufactured to close tolerances. This attention to precision ensures reliability, performance, long life, and complete part interchangeability (within a given actuator model). The following characteristics are common to all 244 Actuators (refer to figure 2).

1. Piston Rod End (fixture attachment end): The piston rod has a hardened steel threaded insert that provides an internal thread for mounting load cells, grips, or swivel bearings. (Model 244.51 has no insert; internal threads are machined directly into the piston rod end.)

2. Porting: Large ports designed to accommodate servovalves with flow ratings up to 90 gpm (340 ℓ/m) for high piston rod velocity. The inner oil distributing channels are designed to minimize oil flow restrictions.

3. One Piece Piston Rod: Each Series 244 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 rod is machined from a single piece of heat-treated alloy steel, hard chrome plated, and ground to an 8 RMS finish to increase seal and bearing life. The hollow rod permits convenient installation and accurate axial alignment of displacement transducers.

4. Cushions: Hydraulic cushions protect Series 244 Actuators from effects of high-speed and high-mass loads. (Models 244.41 and 244.51 do not have hydraulic cushions.)

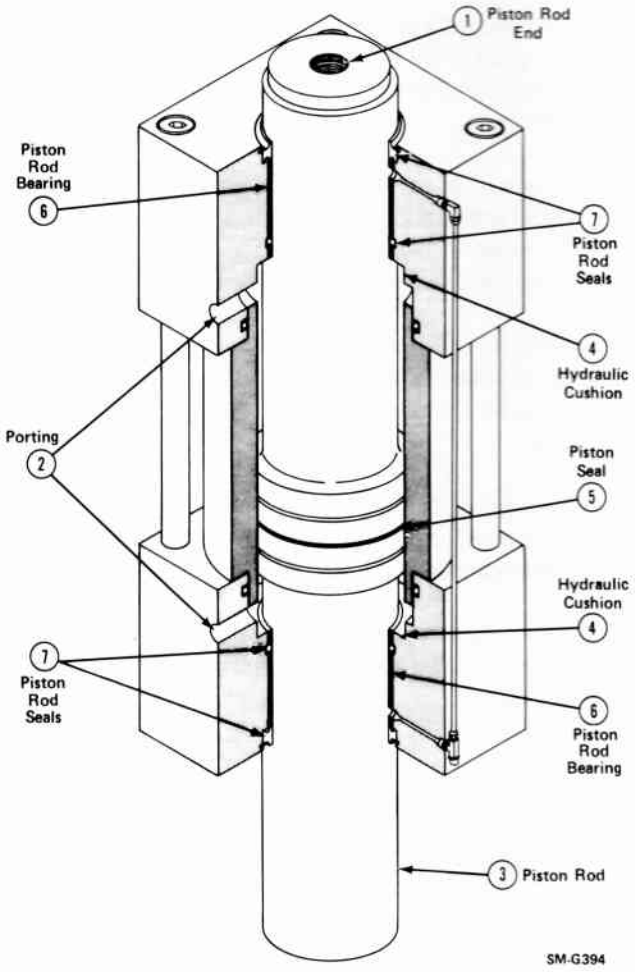


Figure 2. Cutaway View of Series 244 Actuator

5. Piston Seal: A reinforced Teflon seal configured to provide long life and low friction is normally provided on the piston. Grooves on the piston ensure adequate lubrication of piston surface during short-stroke, side-loaded tests.

   For high-speed cyclic testing applications, the piston seal can be omitted. The close tolerance fit provides an effective viscous seal.

6. Piston Rod Bearing: Series 244 Actuators are supplied with high capacity non-metallic bearings bonded directly to the end caps. The non-metallic bearings are standard with the 244 Actuators because of the inherent higher side load tolerance and resistance to failure from galling, seizure, etc.

7. Piston Rod Seals: The piston rod seals consist of a high-pressure seal and a low-pressure/wiper seal. (Series 244.1X and 244.2X Actuators used in load frame applications do not contain high pressure seals.) There are piston rod seals in both the front and rear end caps. The high-pressure seal is reinforced Teflon for long life and low friction. A small amount of hydraulic fluid is allowed to leak past the high-pressure seal for continuous bearing lubrication. Drainback ports return the hydraulic fluid passed by the high-pressure seal back to the system hydraulic power supply.

   The low-pressure/wiper seal provides two functions. The lower part of the low-pressure seal wipes hydraulic fluid (passed by the high-pressure seal) from the piston rod and guides the fluid into the drainback port. The upper part of the low-pressure seal functions as a scraper ring to minimize external contamination of the seals and bearings.

Options

The Series 244 Actuator consists of a basic cylinder assembly to which options can be incorporated. Options are changes to the basic cylinder assembly that can be ordered to adapt the Series 244 Actuator to a variety of testing requirements and configurations. The three available standard options are described below:

- Stroke length,
- Piston rod length, and
- special porting for flows greater than 90 gpm (340 ℓ/m).

Stroke Length

The standard stroke length for the Series 244 Actuator is 6 in. (152.4 mm). Optional stroke lengths are available.

Piston Rod Length

With the standard rod length, the top of the piston rod extends approximately 1 in. (25.4 mm) above the front end cap when the piston is fully retracted. Refer to the specifications tables I and II for exact rod lengths. Optional rod lengths allow the actuator to be mounted in a compatible MTS load frame. Separate options are available for either platen mounting or crosshead mounting.

Special Porting for Flows Greater than 90 gpm (340 ℓ/m)

The standard Series 244 Actuators can accept servovalves with flow ratings up to 90 gpm (340 ℓ/m). Optional porting can be provided to accommodate flow requirements greater than 90 gpm (340 ℓ/m). Consult MTS Systems Corporation for information on special flow requirements.

Accessories

Once the Series 244 Actuator is configured with the basic cylinder assembly and any necessary options, various accessories can be added for actuator or fixture mounting. Other accessories include displacement transducers to provide an indication of piston rod displacement. The seven available standard accessories are described below:

- special piston rod end inserts,
- displacement transducers,
- swivel base,
- pedestal base,
- swivel head,
- trunnion mounting, and
- gimbal mounting

Special Piston Rod End Inserts

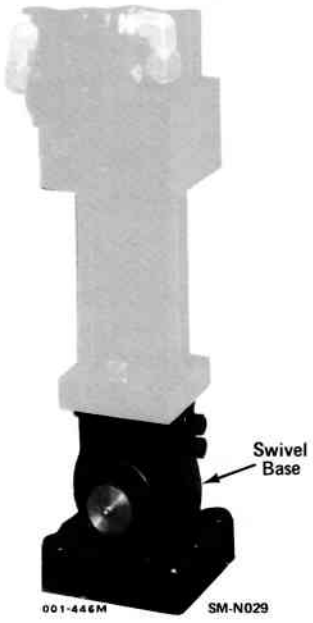
Special piston rod end inserts are available to provide compatible internal threads for connecting studs to mount load cells, swivel heads, interface fixtures, etc. Either U.S. customary or SI metric threads can be ordered.

Displacement Transducers

A linear variable differential transformer (LVDT) can be ordered to provide a stroke feedback signal to the system electronic control console. The LVDT can be configured with a open housing for load frame applications or a closed housing for attaching a swivel or pedestal base. The standard LVDT accessory (either open or closed housing) accommodates the standard Series 244 Actuator 6 in. (152.4 mm) stroke length. If the Series 244 Actuator is equipped with optional longer stroke length (see Options), additional length must also be added to the LVDT accessory to make it compatible with the actuator stroke length.

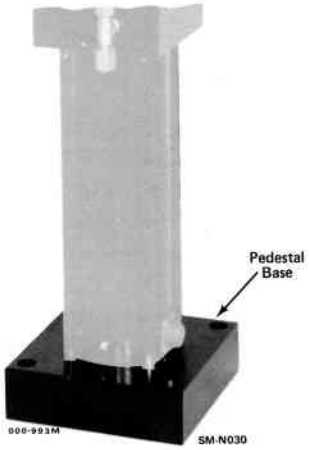
Swivel Base

The swivel base accessory allows the Series 244 Actuator to be mounted to a reaction mass, structural base, or bedplate for systems typically designed for structural fatigue testing. The swivel base is a semi-spherical swivel with a manually adjustable bearing preload to minimize backlash and still maintain swivel capabilities. Proper adjustment of the bearing preload reduces impact noise and improves the load zero crossing waveform during high-frequency, tension/compression testing. The swivel base is designed to attach to the closed housing LVDT accessory.



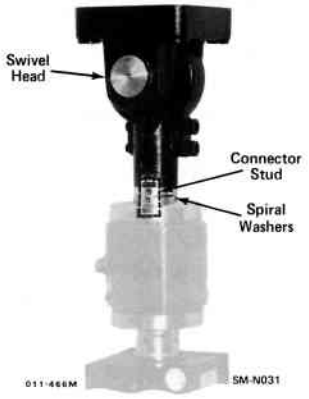
Pedestal Base

The pedestal base accessory allows the Series 244 Actuator to be rigidly mounted to a reaction mass for systems typically designed for vibration testing. The pedestal base is designed to attach to the closed housing LVDT accessory. Long stroke actuators or actuators with large attached masses may need external support braces.



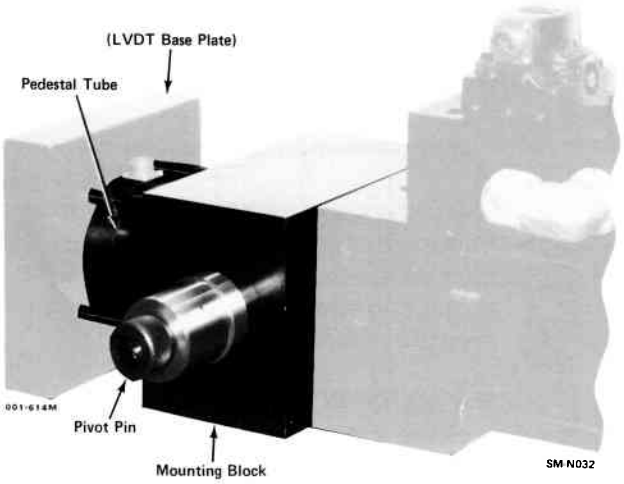
Swivel Head

The swivel head accessory provides the same features as the swivel base accessory. For structural testing applications, a Series 244 Actuator equipped with both a swivel head and swivel base provides pivotal freedom of the actuator at both ends. This combination reduces moment loads on the piston rod bearings and load cell. The swivel head accessory includes the swivel head, connector stud, and one set of spiral washers. (Note: spiral washers are not supplied on actuators of 11 kip/50 kN or less.) The connector stud is used to attach the swivel lead to the piston rod end. The spiral washers are used to preload the connector stud to provide fatigue resistant connections.



Trunnion Mounting

The trunnion mounting option allows the Series 244 Actuator to pivot on one plane. Trunnion mounting is only available for basic cylinders rated at 35 kip (150 kN) or less. The standard trunnion mounting consists of a block with pivot pins, a pedestal tube, and base plate that attaches to the rear end cap. In most configurations, the trunnion mounting accessory is ordered in conjunction with the closed housing LVDT accessory. In this case the trunnion mounting block with pivot pins, pedestal tube, and base plate replaces the LVDT closed housing pedestal tube. The trunnion mounting accessory is secured to the rear end cap by the tie rods supplied with the LVDT accessory.



Gimbal Mounting

The gimbal mounting accessory is basically a trunnion mounting accessory with the mounting fixture attached to an additional block with pivot pins that allows the Series 244 Actuator to pivot on two planes. Gimbal mounting is only available for basic cylinders rated at 35 kip (150 kN) or less. As mentioned in the description of the trunnion mounting, the gimbal mounting accessory is typically ordered with the closed housing LVDT accessory and replaces the LVDT pedestal tube.

Typical Actuator Configurations

The following paragraphs provide suggested combinations of options and accessories to configure the Series 244 Actuator basic cylinder for typical testing applications.

Load Frame Actuator

After the basic cylinder assembly has been determined, the following list of options and accessories will adapt the Series 244 Actuator for typical load frame testing applications.

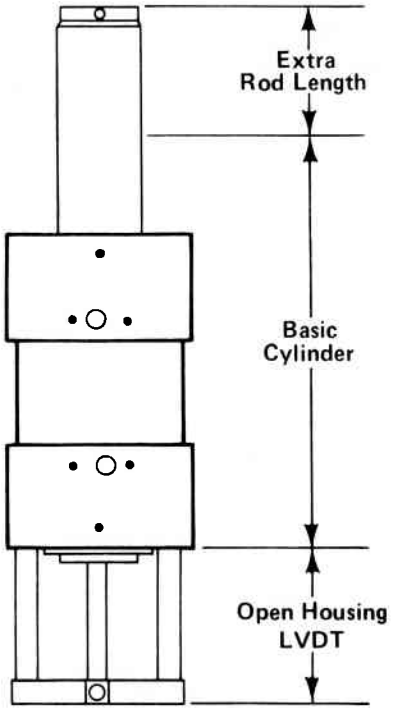
1. Extra rod length: specify for load frame platen or load frame crosshead mounting.

2. Open housing LVDT assembly to provide a stroke feedback signal for displacement control or displacement readout.

3. If applicable, specify extra stroke length.

4. Seals: the standard 244.1X and 2X load frame actuators contain low-pressure seals (no high-pressure seal). Actuators containing both low-pressure and high-pressure seals are optional.

   The 244.3X, 4X and 5X contain both low-pressure and high-pressure seals.



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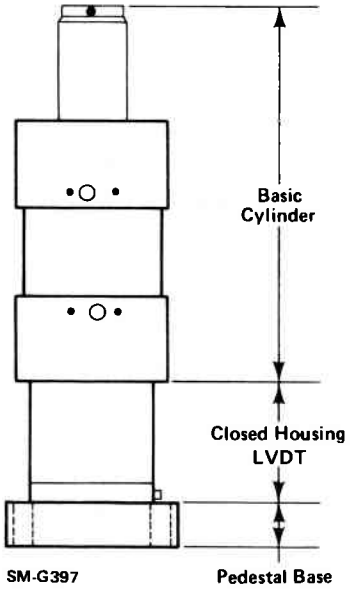
Pedestal Base Actuator

After the basic cylinder assembly has been determined, the following list of options and accessories will adapt the Series 244 Actuator for typical vibration testing applications.

1. Closed housing LVDT assembly to provide a stroke feedback signal for displacement control or displacement readout. The closed housing LVDT is also required to mount the pedestal base assembly.

2. Pedestal base assembly to enable mounting of the actuator to a reaction mass.

3. If applicable, specify extra stroke length.



Trunnion or Gimbal Mounting Actuator

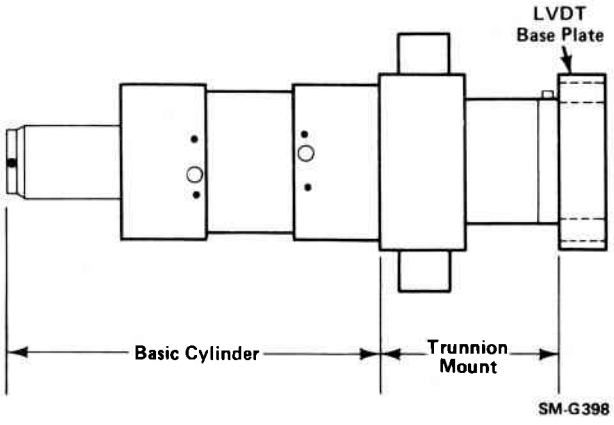
After the basic cylinder assembly has been determined, the following list of options and accessories will adapt the Series 244 Actuator for trunnion or gimbal mounting.

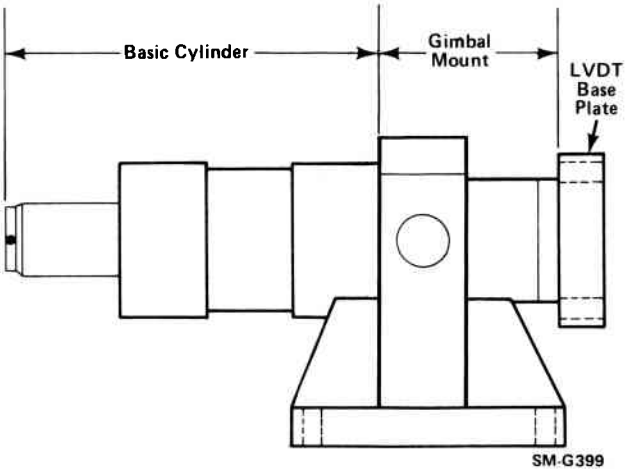
1. Closed housing LVDT assembly to provide a stroke feedback signal for displacement control or displacement readout.

2. Desired type of mounting; specify trunnion or gimbal configuration.

3. If applicable, specify extra stroke length.

4. If applicable, specify extra rod length.





Structural Actuator

After the basic cylinder assembly has been determined, the following list of options and accessories will adapt the Series 244 Actuator for typical structural testing applications.

1. Closed housing LVDT assembly to provide a stroke feedback signal for displacement control or displacement readout. The closed housing LVDT is also required to mount the swivel base assembly.

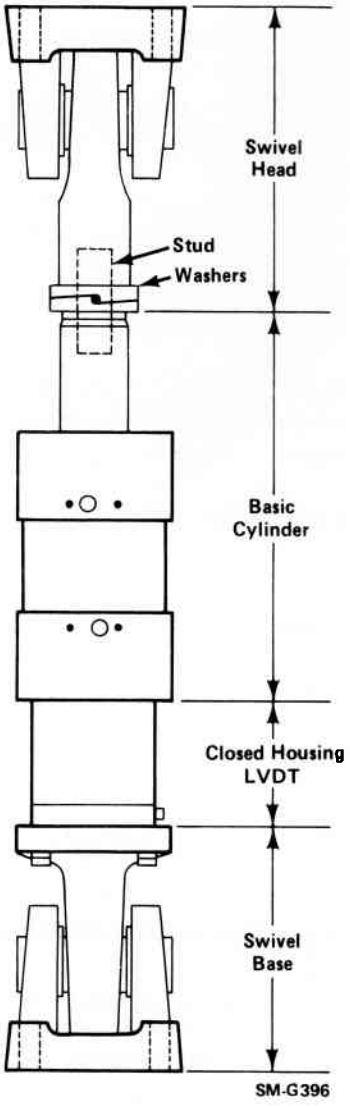
2. Swivel base assembly to enable mounting of the actuator to a reaction mass, structural base, or bedplate and also provide pivotal freedom.

3. Swivel head assembly to enable mounting of the actuator to a shake table, structure, etc, and provide pivotal freedom. Swivel head assemblies are supplied with a connector stud (for mounting to the piston rod) and spiral washers (to provide a fatigue resistant connection).

4. If applicable, specify extra stroke length.

5. Seals: the standard 244.1X and 2X structural actuators contain both low-pressure and high-pressure seals. Actuators with the low-pressure seal only are optional.

   The 244.3X, 4X and 5X actuators contain both low-pressure and high-pressure seals.



Specifications

The Series 244 Actuator models are listed according to force ratings. Table I lists the specifications for the basic cylinder assembly shown in figure 3. Tables II through VI list the specifications for options and accessories illustrated in figures 4 through 9. Refer to Footnote 1 on the tables for figure/table correlation.

Ordering Information

When ordering a Series 244 Actuator, first specify the desired basic cylinder assembly and U.S. customary or SI metric piston rod end connection. The basic cylinder assembly is ordered by the model number corresponding to the desired force rating; e.g., 244.21 corresponds to an 11 kip (50 kN) actuator. Refer to the specifications section for model number and force rating information. Then, specify the desired options and accessories.

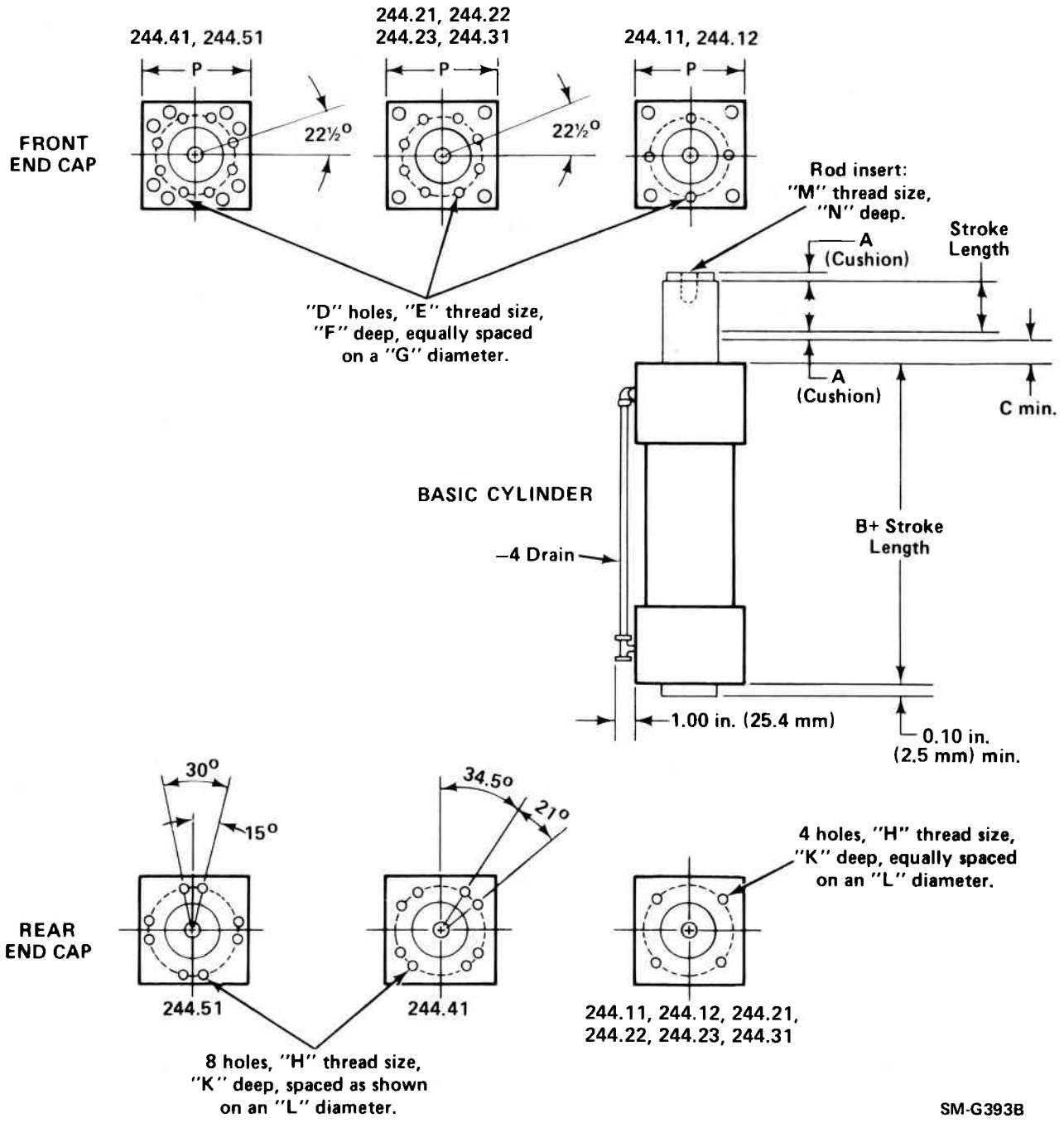


Figure 3. Series 244 Actuator Basic Cylinder Dimensional Drawing

Table I. Specifications for Basic Cylinder Assembly[1]

Model	Force Rating[2]		Standard Stroke Length[3]		Rod Diameter		Effective Piston Area		Cushions (A)		B		C[4]		
	kip	kN	in.	mm	in.	mm	$in.^2$	cm^2	in.	mm	in.	mm	in.	mm	
244.11	3.3	15	6	152.4	1.751	44.45	1.17	7.50	0.60	15.24	9.38	238.25	1.00	25.4	
244.12	5.5	25	6	152.4	1.751	44.45	2.10	13.50	0.60	15.24	9.38	238.25	1.00	25.4	
244.21	11	50	6	152.4	2.7515	69.85	3.90	25.16	0.40	10.16	9.7	246.38	1.00	25.4	
244.22	22	100	6	152.4	2.7515	69.85	7.57	48.84	0.30	7.62	9.2	233.68	1.00	25.4	
244.23	35	150	6	152.4	2.75	69.85	12.73	82.13	0.25	6.35	9.2	233.68	1.00	25.4	
244.31	55	250	6	152.4	3.75	95.25	19.63	126.65	0.20	5.08	10.10	256.54	1.00	25.4	
244.41	110	500	6	152.4	5.25	133.35	38.48	248.28	None	None	12.27	316.58	1.12	28.4	
244.51	220	1000	6	152.4	6.00	152.40	75.60	487.70	None	None	13.49	342.6	1.50	38.1	

Model	D	E	F		G		H	K		L		M		N[5]		P	
			in.	mm	in.	mm		in.	mm	in.	mm	U.S. Cust.	SI Metric	in.	mm	in.	mm
244.11	4	3/8 - 16	0.75	19.05	3.20	81.28	3/8 - 16	0.75	19.05	3.50	89.9	1/2 - 20	M12 x 1.25 mm	1.75	44.45	4.00	101.60
244.12	4	3/8 - 16	0.75	19.05	3.20	81.28	3/8 - 16	0.75	19.05	3.50	89.9	1/2 - 20	M12 x 1.25 mm	1.75	44.45	4.00	101.60
244.21	8	1/2 - 13	0.75	19.05	4.10	104.14	5/8 - 11	1.00	25.4	5.00	127.0	1 - 14	M27 x 2 mm	2.25	57.15	5.00	127.00
244.22	8	1/2 - 13	0.75	19.05	4.10	104.14	5/8 - 11	1.00	25.4	5.00	127.0	1 - 14	M27 x 2 mm	2.25	57.15	6.00	152.40
244.23	8	1/2 - 13	0.75	19.05	4.10	104.14	5/8 - 11	1.00	25.4	5.00	127.0	1 - 14	M27 x 2 mm	2.25	57.15	6.50	165.10
244.31	8	5/8 - 11	1.00	25.4	5.50	139.7	7/8 - 9	1.50	38.1	7.53	191.26	1 1/2 - 12	M36 x 2 mm	2.75	69.85	8.50	215.90
244.41	8	1 - 8	1.75	44.45	10.37	263.40	7/8 - 9	1.50	38.1	10.00	254.00	2 - 12	M52 x 2 mm	2.75	69.85	11.75	298.45
244.51	8	1 - 8	1.75	44.45	10.37	263.40	1 - 8	1.75	44.45	11.06	280.92	3 - 12	M76 x 2 mm	4.50[6]	114.3[6]	15.25	387.35

1 Specifications in this table refer to figure 3.
2 Nominal force achieved with 21.0 MPa (3000 psi) hydraulic pressure.
3 Stroke length does not include actuator cushions (specification A).
4 This specification applies to standard length piston rod fully retracted.
5 Dimension is from end of piston rod to bottom of internal threads.
6 The 244.51 does not use a threaded rod insert.

Specifications are subject to change without notice.

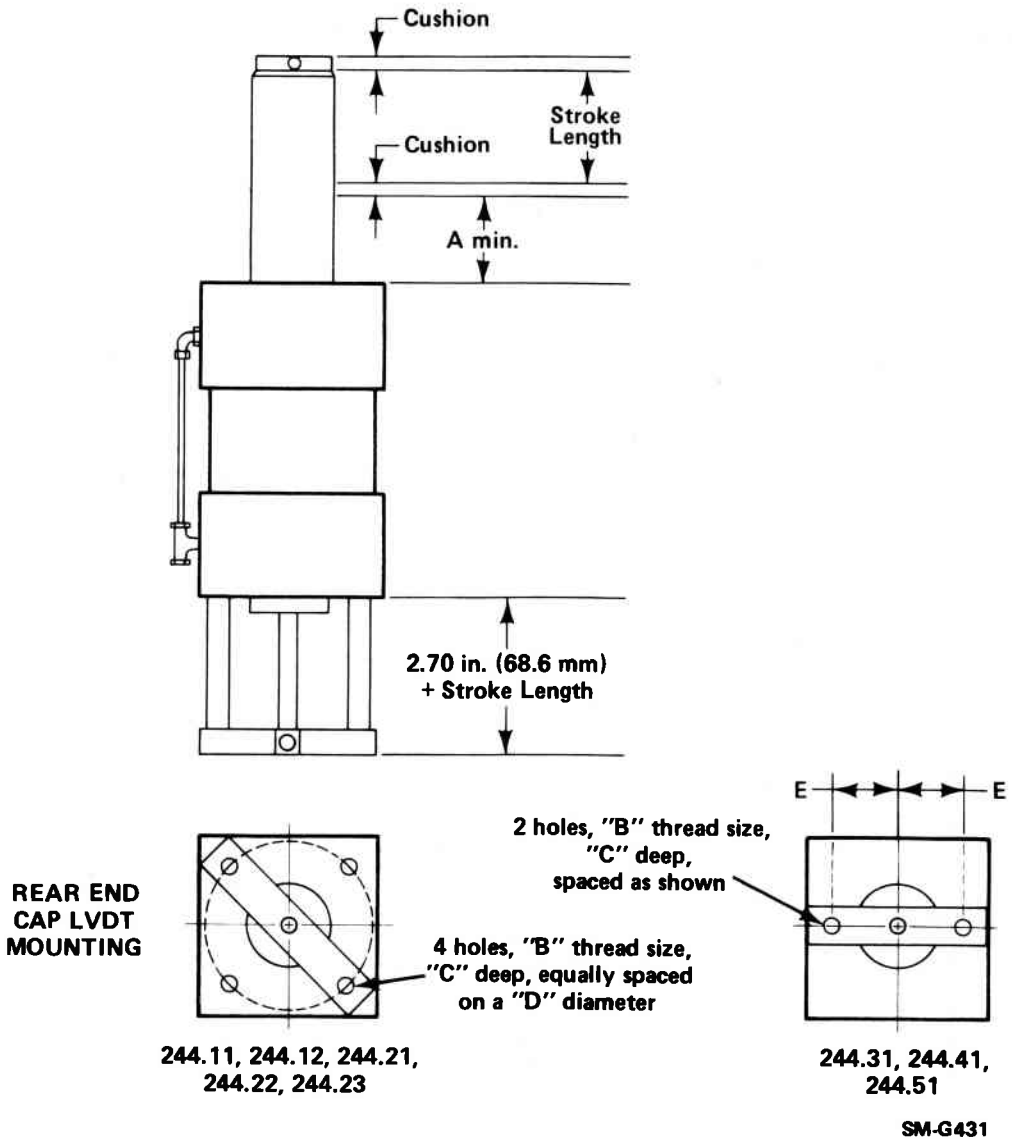


Figure 4. Series 244 Actuator with Extra Piston Rod Length for Load Frame Applications and Open Housing LVDT

Table II. Specifications for Extra Piston Rod Length for Load Frame Applications and Open Housing LVDT[1]

Model	A[2]		B	C		D		E		Weight[3]	
	in.	mm		in.	mm	in.	mm	in.	mm	lb	kg
244.11	5.90	149.9	3/8-16	0.75	19.05	3.50	89.9	N/A[4]	N/A	39	18
244.12	5.90	149.9	3/8-16	0.75	19.05	3.50	89.9	N/A	N/A	41	19
244.21	7.07	179.6	3/8-16[5]	1.00	25.40	5.00	127.0	N/A	N/A	122	56
244.22	7.07	179.6	3/8-16[5]	1.00	25.40	5.00	127.0	N/A	N/A	133	61
244.23	7.07	179.6	3/8-16[5]	1.00	25.40	5.00	127.0	N/A	N/A	151	69
244.31	8.85	224.8	3/8-16	0.60	15.24	N/A	N/A	3.06	77.72	282	128
244.41	9.25	234.9	3/8-16	0.60	15.24	N/A	N/A	3.96	100.58	645	293
244.51	9.82	249.4	3/8-16	0.60	15.24	N/A	N/A	3.96	100.58	1135	516

1 Specifications in this table refer to figure 4. Specifications not listed in this table can be found in table I.

2 This specification applies to standard extra length piston rod fully retracted.

3 Includes basic load frame cylinder assembly and open housing LVDT.

4 Not applicable (N/A).

5 Requires 5/8-11 to 3/8-16 insert thread (supplied on open housing LVDT assembly).

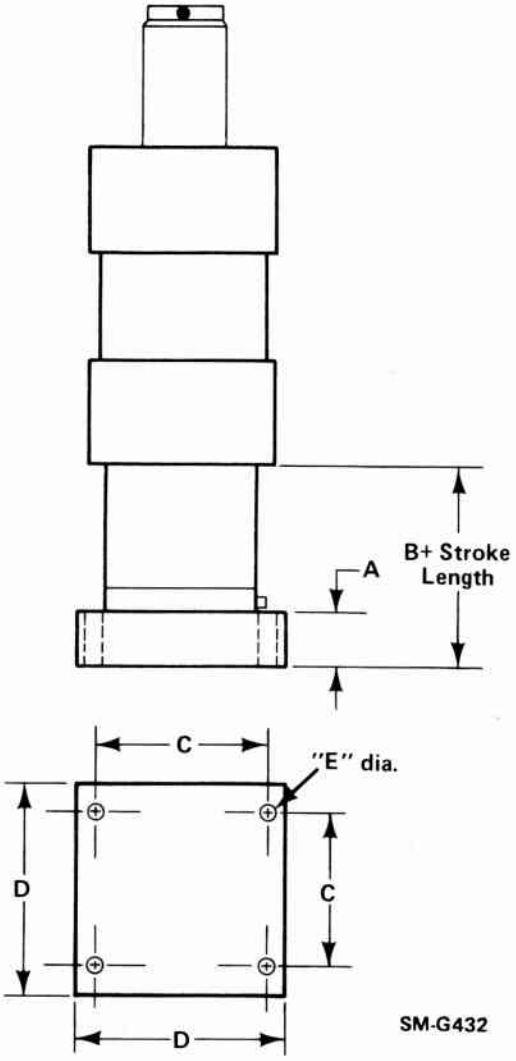


Figure 5. Series 244 Actuator with Pedestal Base and Closed Housing LVDT

Table III. Specifications for Pedestal Base and Closed Housing LVDT[1]

Model	A		B		C		D		E		Weight[2]	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lb	kg
244.11	1.50	38.1	4.68	118.9	4.50	114.3	5.50	139.7	0.56	14.2	56	25.5
244.12	1.50	38.1	4.68	118.9	4.50	114.3	5.50	139.7	0.56	14.2	58	26.4
244.21	1.75	44.4	4.51	114.6	5.75	146.0	7.38	187.4	0.68	17.3	151	68.6
244.22	1.75	44.4	4.51	114.6	5.75	146.0	7.38	187.4	0.68	17.3	162	73.6
244.23	1.75	44.4	4.51	114.6	5.75	146.0	7.38	187.4	0.68	17.3	180	81.8
244.31	2.50	63.5	4.86	123.4	7.25	184.2	9.00	228.6	0.94	23.9	353	160.5
244.41	2.50	63.5	4.46	113.3	11.00	279.4	13.88	352.6	1.31	33.3	849	385.9
244.51	3.00	76.2	3.38	85.8	11.00	279.4	14.00	355.6	1.56	39.6	1472	669.1

[1] Specifications in this table refer to figure 5. Specifications not listed in this table can be found in table I.

[2] Includes basic cylinder assembly, pedestal base, and closed housing LVDT assembly.

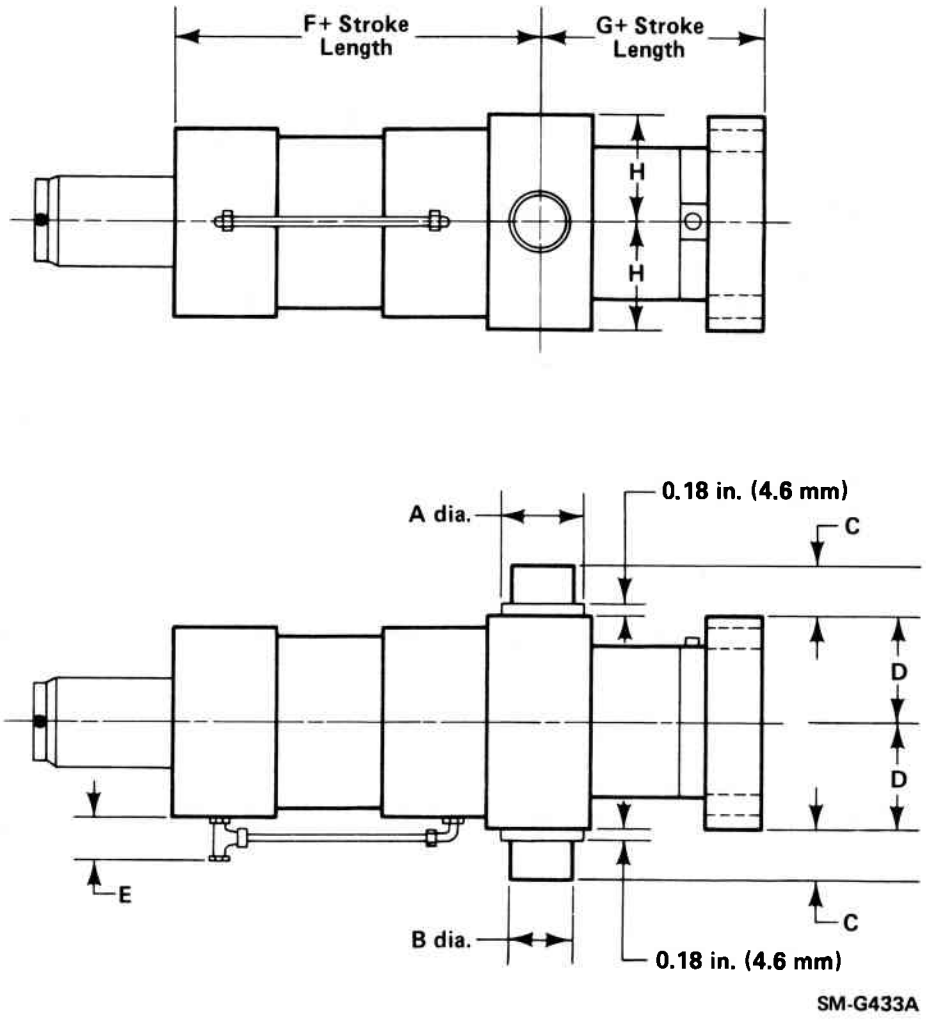


Figure 6. Series 244 Actuator with Trunnion Accessory

Table IV. Specifications for Trunnion Accessory[1]

Model[2]	A		B		C		D		E		F		G[3]		H		Weight[4]	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	lb	kg
244.11	1.87	47.5	1.7507	44.468	1.74	44.2	3.88	98.6	1.75	44.4	11.82	300.2	2.24	56.9	2.50	63.5	108	49.1
244.12	1.87	47.5	1.7507	44.468	1.74	44.2	3.88	98.6	1.75	44.4	11.82	300.2	2.24	56.9	2.50	63.5	110	50.0
244.21	1.87	47.5	1.7507	44.468	1.74	44.2	3.88	98.6	1.75	44.4	12.14	308.4	2.07	52.6	2.50	63.5	209	95.0
244.22	2.37	60.2	2.2509	57.173	2.14	54.4	4.38	111.2	1.75	44.4	11.64	295.6	2.07	52.6	3.00	76.2	220	100.0
244.23	2.37	60.2	2.2509	57.173	2.14	54.4	4.38	111.2	1.75	44.4	11.64	295.6	2.07	52.6	3.00	76.2	238	108.2

1 Specifications in this table refer to figure 6. Refer to table I for basic cylinder specifications. Refer to table III for pedestal base specifications.

2 Trunnion mount not available for 244.31, 244.41, and 244.51 actuators.

3 Not applicable for 244.11, 244.12, 244.21, 244.22, and 244.23 actuators with 1 in. to 4 in. (25.4 mm to 101.6 mm) stroke length.

4 Includes basic cylinder assembly, closed housing LVDT, and trunnion.

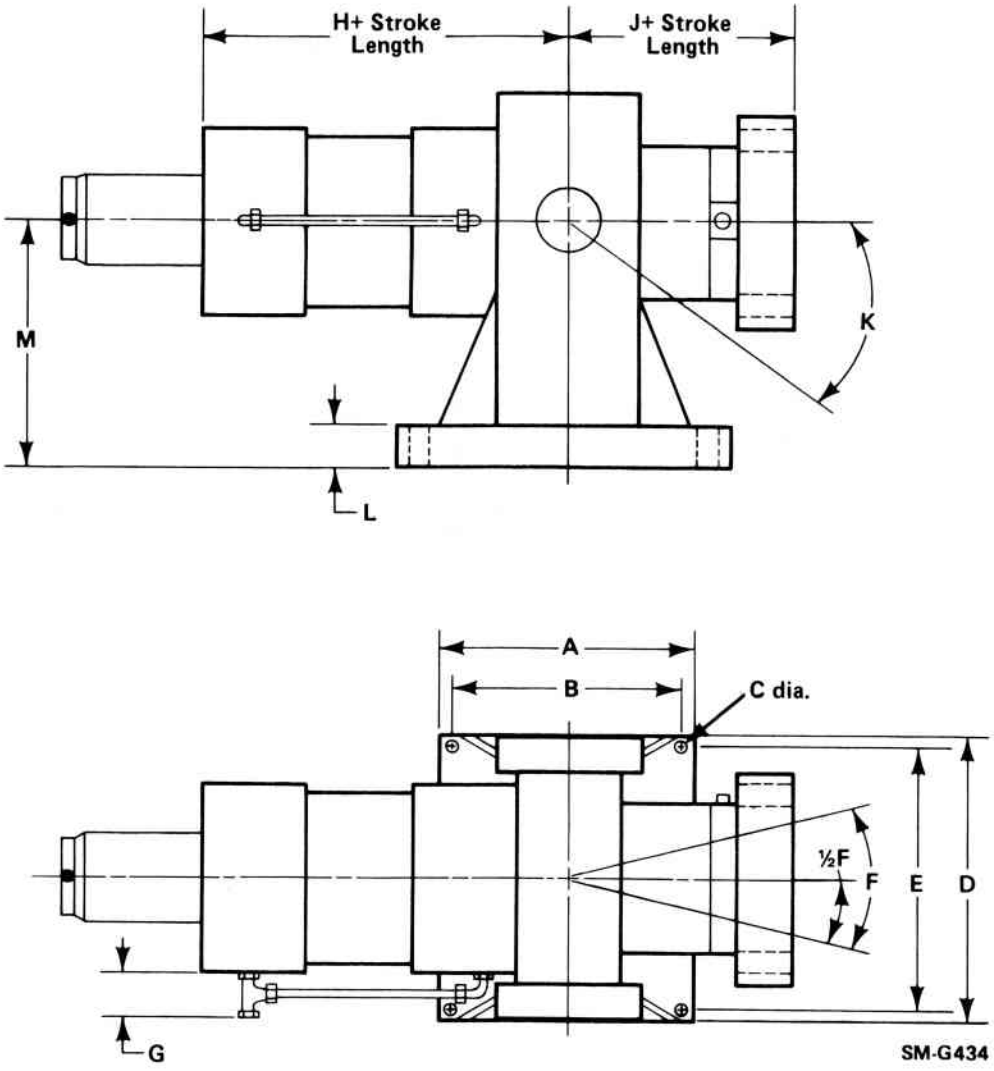


Figure 7. Series 244 Actuator with Gimbal Accessory

Table V. Specifications for Gimbal Accessory[1]

Model[2]	A		B		C		D		E		F[3]
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	
244.11	13.76	349.5	12.00	304.8	0.812	20.6	15.76	400.3	12.00	304.8	66°
244.12	13.76	349.5	12.00	304.8	0.812	20.6	15.76	400.3	12.00	304.8	66°
244.21	13.76	349.5	12.00	304.8	0.812	20.6	15.76	400.3	12.00	304.8	52°
244.22	15.76	400.3	13.76	349.5	1.06	26.9	20.00	508.0	14.00	355.6	50°
244.23	15.76	400.3	13.76	349.5	1.06	26.9	20.00	508.0	14.00	355.6	50°

Model[2]	G		H		J		K[3]	L		M		Weight[4]	
	in.	mm	in.	mm	in.	mm		in.	mm	in.	mm	lb	kg
244.11	1.75	44.4	11.82	300.2	2.24	56.9	32°	1.50	38.1	8.25	209.6	345	156.8
244.12	1.75	44.4	11.82	300.2	2.24	56.9	32°	1.50	38.1	8.25	209.6	347	157.7
244.21	1.75	44.4	12.14	308.4	2.07	52.6	25°	1.50	38.1	8.25	209.6	423	192.3
244.22	1.75	44.4	11.64	295.6	2.07	52.6	35°	2.00	50.8	9.87	250.7	484	220.0
244.23	1.75	44.4	11.64	295.6	2.07	52.6	35°	2.00	50.8	9.87	250.7	500	227.3

[1] Specifications in this table refer to figure 7. Refer to table I for basic cylinder specifications. Refer to table III for pedestal base specifications.

[2] Gimbal mount not available for 244.31, 244.41, and 244.51 actuators.

[3] Applies to 244.11, 244.12, 244.21, 244.22, and 244.23 actuators with 6 in. (152.4 mm stroke).

[4] Includes basic cylinder assembly, closed housing LVDT, pedestal base, and gimbal.

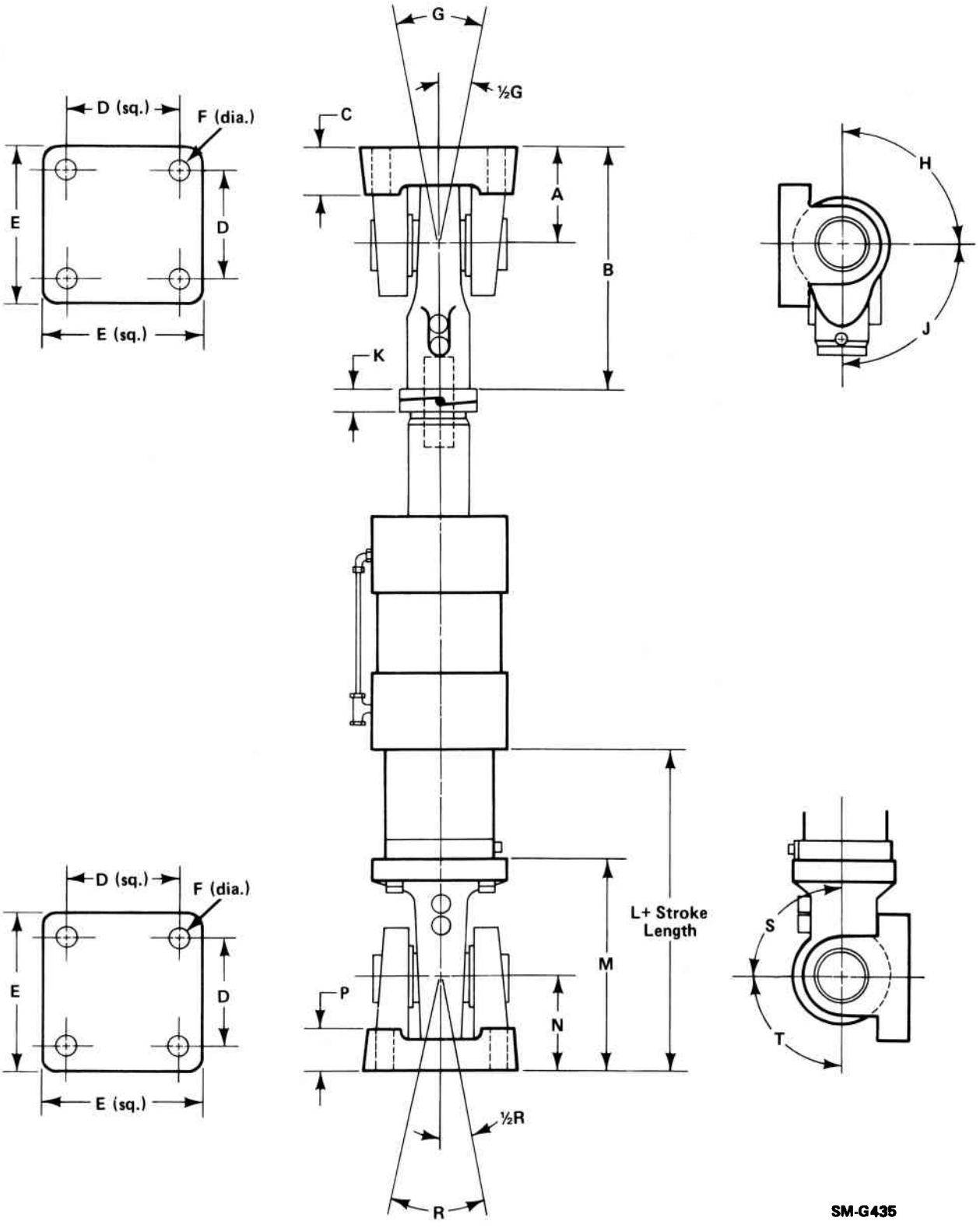


Figure 8. Series 244 Actuator with Swivel Base and Swivel Head (All Models except 244.51)

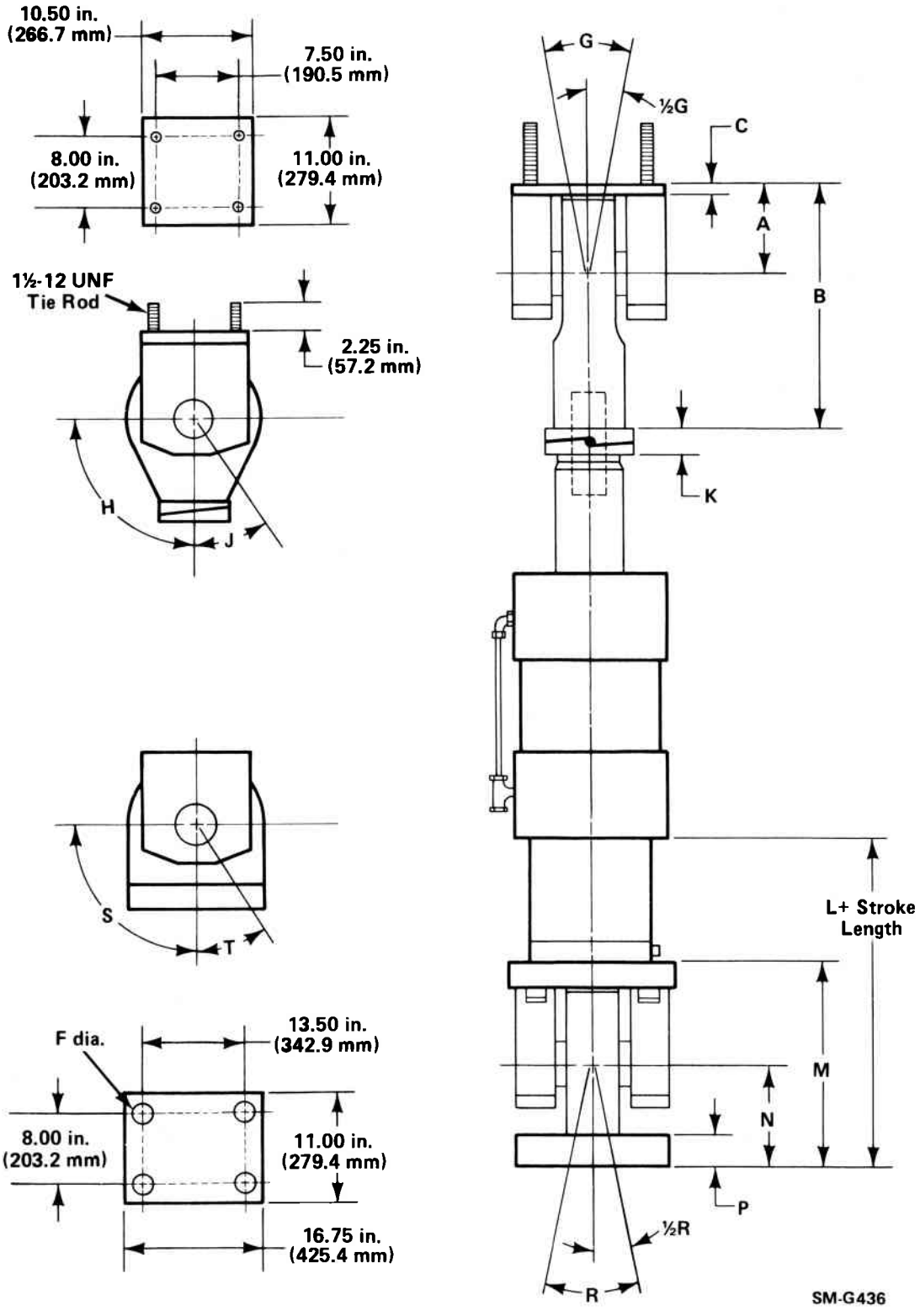


Figure 9. Model 244.51 Actuator with Swivel Head and Swivel Base

Table VI. Specifications for Swivel Base and Swivel Head Accessories[1]

Model	A		B		C		D		E		F		G	H[2]	J[2]	
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm				
244.11	3.00	76.2	7.80	198.1	1.50	38.1	4.50	114.3	5.62	142.7	0.53	13.5	10°	69°	90°	
244.12	3.00	76.2	7.80	198.1	1.50	38.1	4.50	114.3	5.62	142.7	0.53	13.5	10°	69°	90°	
244.21	3.00	76.2	7.80	198.1	1.50	38.1	4.50	114.3	5.62	142.7	0.53	13.5	10°	69°	90°	
244.22	4.00	101.6	10.38	263.6	2.12	53.8	5.75	146.0	7.38	187.4	0.69	17.5	10°	90°	90°	
244.23	4.00	101.6	10.38	263.6	2.12	53.8	5.75	146.0	7.38	187.4	0.69	17.5	10°	90°	90°	
244.31	5.50	139.7	14.00	355.6	2.62	66.5	7.25	184.2	9.00	228.6	0.81	20.6	10°	65°	90°	
244.41	7.50	190.5	18.00	457.2	3.62	91.9	11.00	279.4	14.00	355.6	1.31	33.3	10°	70°	90°	
244.51	9.12	231.6	20.74	526.8	0.50	12.7	——[3]	——[3]	——[3]	——[3]	1.56	39.6	9°	90°	18°	

Model	K		L		M		N		P		R	S[2]	T[2]	Weight				Actuator Assy. Weight[5]: Swivel Base		Actuator Assy. Weight[5]: Swivel Base and Swivel Head	
														Swivel Base		Swivel Head					
	in.	mm	in.	mm	in.	mm	in.	mm	in.	mm				lb	kg	lb	kg	lb	kg	lb	kg
244.11	——[4]	——[4]	10.30	261.6	7.12	180.8	3.00	76.2	1.50	38.1	10°	90°	77°	26	11.8	24	10.9	69	31.4	93	42.2
244.12	——[4]	——[4]	10.30	261.6	7.12	180.8	3.00	76.2	1.50	38.1	10°	90°	77°	26	11.8	24	10.9	71	32.3	94	42.7
244.21	——[4]	——[4]	9.88	251.0	7.12	180.8	3.00	76.2	1.50	38.1	10°	90°	77°	28	12.7	26	11.8	152	69.1	178	80.7
244.22	1.04	26.4	12.14	308.4	9.38	238.3	4.00	101.6	2.12	53.8	10°	78°	62°	64	29	55	25	199	90.5	254	115.2
244.23	1.04	26.4	12.14	308.4	9.38	238.3	4.00	101.6	2.12	53.8	10°	78°	62°	64	29	55	25	217	98.6	272	123.4
244.31	1.30	33.0	14.86	377.4	12.50	317.5	5.50	139.7	2.62	66.5	10°	85°	62°	154	69.9	128	58	449	204.1	577	261.7
244.41	1.30	33.0	19.96	507.0	18.00	457.2	7.50	190.5	3.62	91.9	10°	87°	64°	465	211	410	186	1177	535.0	1587	719.8
244.51	1.80	45.7	23.00	584.2	19.12	485.6	10.50	266.7	3.50[6]	88.9[6]	9°	90°	18°	545[7]	251[7]	595	270	2017	916.8	2612	1184.8

1 Specifications in this table refer to figures 8 and 9. Refer to table I for basic cylinder specifications.

2 If the actuator is mounted such that the applied load is not perpendicular to the swivel mounting base, slippage can occur and additional retaining stops with larger securing bolts might be necessary. Refer to figure 10 for additional information.

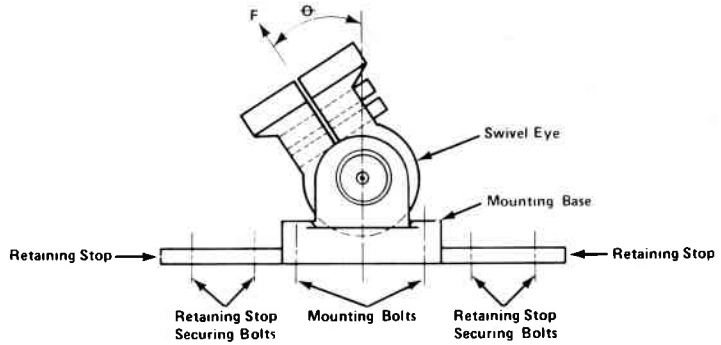
3 Swivel head and swivel mounting hole dimensions. Refer to figure 9.

4 Spiral washers not required on 244.11, 244.12, and 244.21 actuators.

5 Includes basic cylinder assembly, closed housing LVDT, swivel base and swivel head (as noted), and spiral washers (when applicable).

6 Swivel base mounting plate is optional.

7 Weight with swivel base mounting plate is 710 lb. (322 kg).



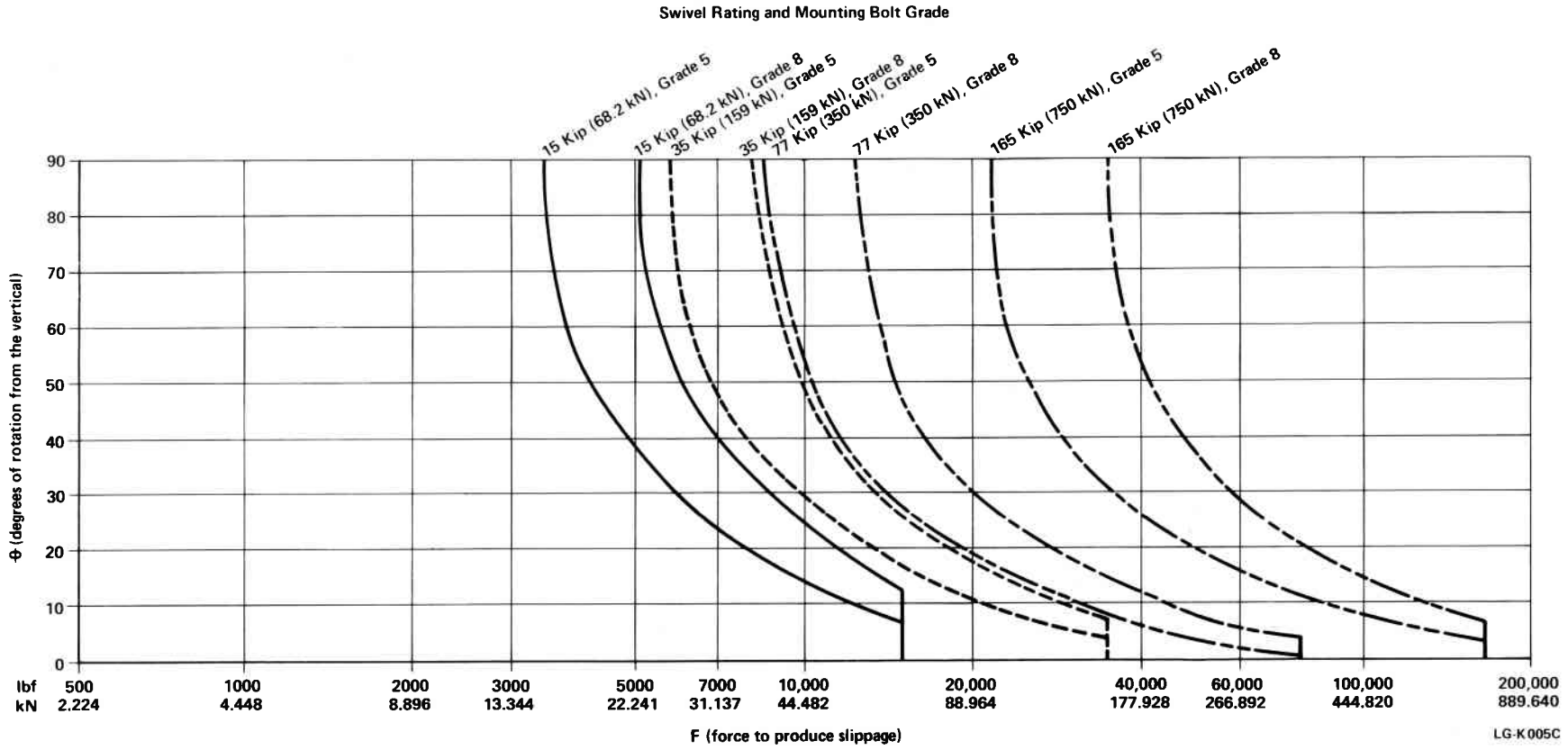


Figure 10. Maximum Load at Slippage Vs Angle of Load Application

Operating Considerations for Tests Requiring Nonaxial Loading

Nonaxial loading can occur from sideload forces applied directly to the piston rod (refer to P in figure 11) and/or moments resulting from off center loading (refer to F in figure 11). There are four basic things that must be considered to determine the suitability of an actuator for nonaxial loaded tests: 1) the total sideload force that will be applied during the test, 2) whether the total sideload will be continuous or cyclic, 3) if the total sideload is continuous, the average piston rod velocity during the test, and 4) if the total sideload is cyclic, the frequency of the applied sideload. The following procedure provides the user with information to determine the suitability of a particular actuator model for tests requiring nonaxial loading.

1. Determine the magnitude of nonaxial loads F and P (refer to figure 11) and the point of application of these loads (B and C respectively). These parameters are determined by the user and are dependent on the test setup configuration. If any parameter is variable during the test, maximum values should be used. F and P should be in pounds force; B and C should be in inches.

2. Calculate the moment force applied to the front bearing using the following formula:

$$M = (F)(B) + P(C + A)$$

where M = the resultant sideload of the moment force applied to the bearing in in.-lbf

F and P = nonaxial forces in lbf (determined in step 1)

B and C = position of applied forces in in. (determined in step 1)

A = a constant associated with the particular actuator model (refer to figure 11 for this value

3. Determine the resultant sideload (S_M) due to the moment force using the appropriate graph in figure 11. If the vertical line from the moment force applied at the front bearing does not intersect the appropriate actuator line, the actuator is not suitable for the test and a larger actuator should be ordered.

NOTE

The graphs in figure 11 provide sideload criteria for 6 and 10 inch stroke actuators. For other stroke lengths, consult MTS Systems Corporation for sideload tolerance information.

4. Next, calculate the total sideload using the following formula:

$$S_T = P + S_M$$

where S_T = total sideload in lbf

P = directly applied sideload determined by the user in step 1

S_M = resultant sideload of the moment force determined in step 3

NOTE

Once the total sideload is determined, the next criteria for actuator suitability is if the sideload is continuous or cyclic. If the sideload is continuous (a continuous sideload may vary in force), the suitability of the actuator depends on the average velocity of the actuator piston rod during the test. If the sideload is cyclic (i.e., total sideload force varies equally through zero), the suitability of the actuator depends on the cyclic frequency of the sideload.

For continuous total sideload, refer to step 5.

For cyclic total sideload, refer to step 6.

5. In continuous sideloaded testing applications (most common application), the main consideration for actuator suitability (once the total sideload has been determined acceptable) is the average velocity of the actuator piston rod during the test. Refer to figure 12 to determine the maximum allowable average velocity of the actuator piston rod with the predetermined total sideload. If the test requires higher velocities, a larger force rated actuator should be considered.

6. In cyclic sideloaded testing applications, the main consideration for actuator suitability (once the total sideload has been determined acceptable) is the frequency of the applied sideload during the test. Refer to figure 13 to determine the minimum allowable sideload cyclic frequency with the predetermined total sideload. If the test requires lower cyclic sideload frequencies, consult MTS Systems Corporation for special actuator design considerations.

Following is an example using the preceding procedure to determine the suitability of a Model 244.31 Actuator with a 6 in. stroke for a specific test. The numbered steps of this example correspond to the numbered steps of the preceding procedure.

1. Test conditions determined by the user based on setup configuration and test parameters:

   $F = 3000$ lbf
   $P = 500$ lbf
   $B = 3.00$ in.
   $C = 3.50$ in.

2. From the center graph in figure 11, the constant $A = 2.14$. With the above conditions, the moment force at the front bearing is:

   $$M = (F)(B) + P(C + A)$$
   $$= (3000)(3.00) = 500(3.50 + 2.14)$$
   $$= 11{,}820 \text{ in.-lbf}$$
   $$= 11.820 \times 10^3 \text{ in.-lbf}$$

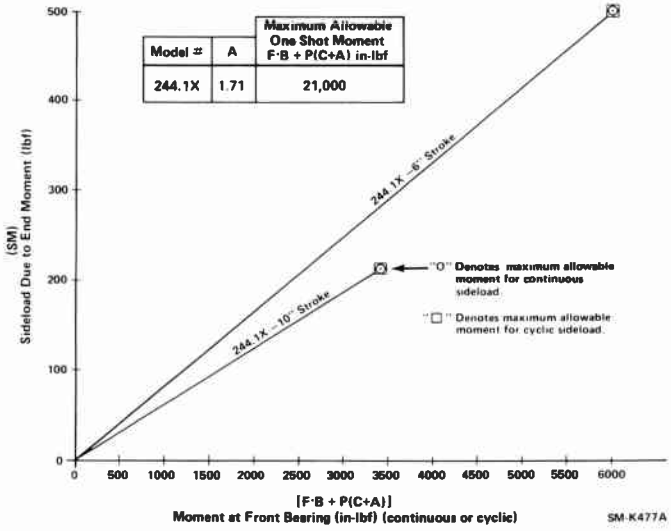
3. Using the appropriate graph in figure 11, the sideload due to the moment force (of step 2) is approximately 900 lbf.

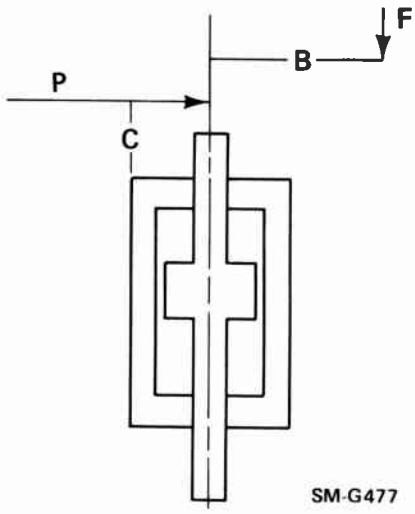
4. The total sideload is:

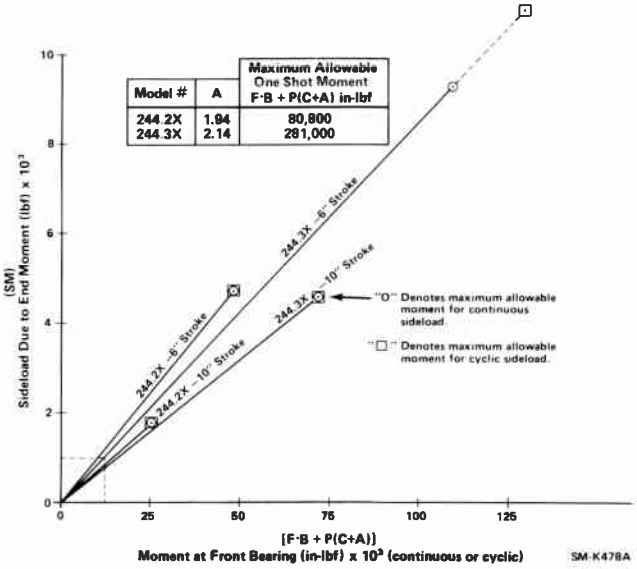
   $$ST = S_M + P$$
   $$= 900 + 500$$
   $$= 1400$$
   $$= 1.4 \times 10^3 \text{ lbf}$$

5. For continuous sideload applications, the maximum average piston rod velocity from the graph in figure 12 is 35 in./s.

6. For cyclic sideload applications, the minimum cyclic sideload frequency from the graph in figure 13 is 0.9 Hz.







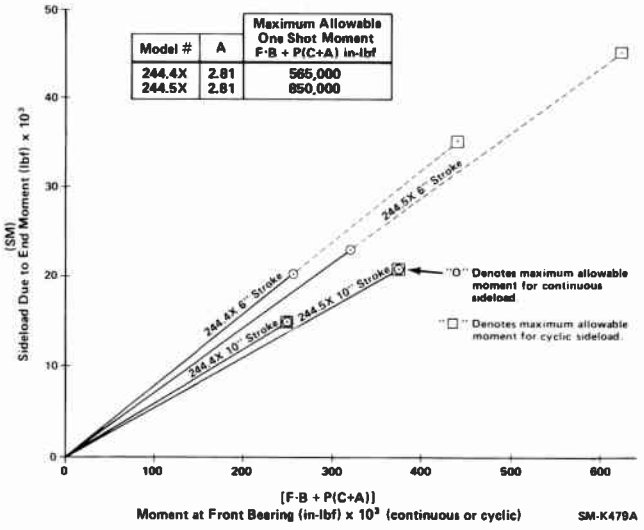


Figure 11. Sideload Due to End Moment Vs Moment at Front Bearing

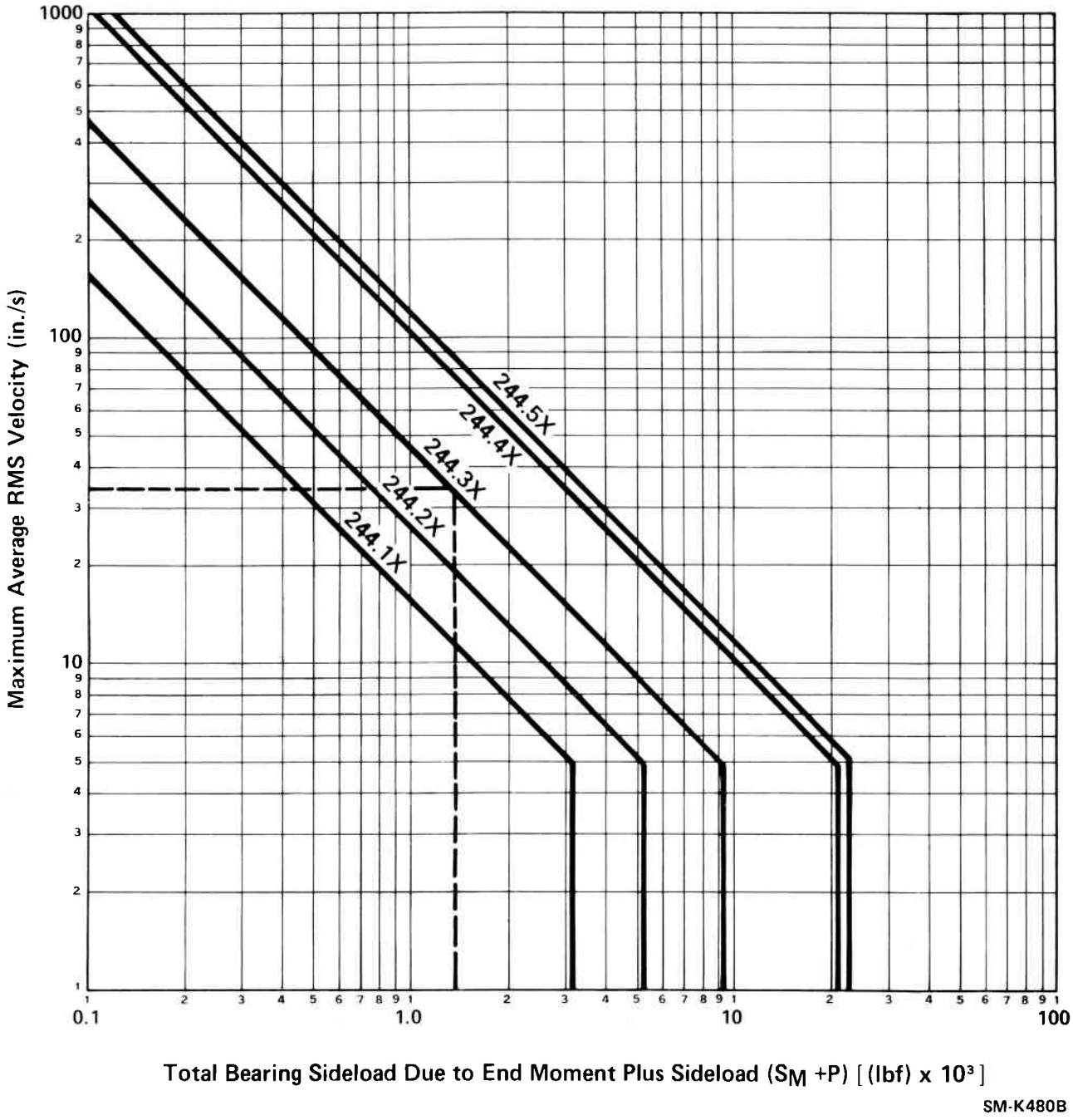


Figure 12. Average Maximum Velocity Vs Total Bearing Sideload

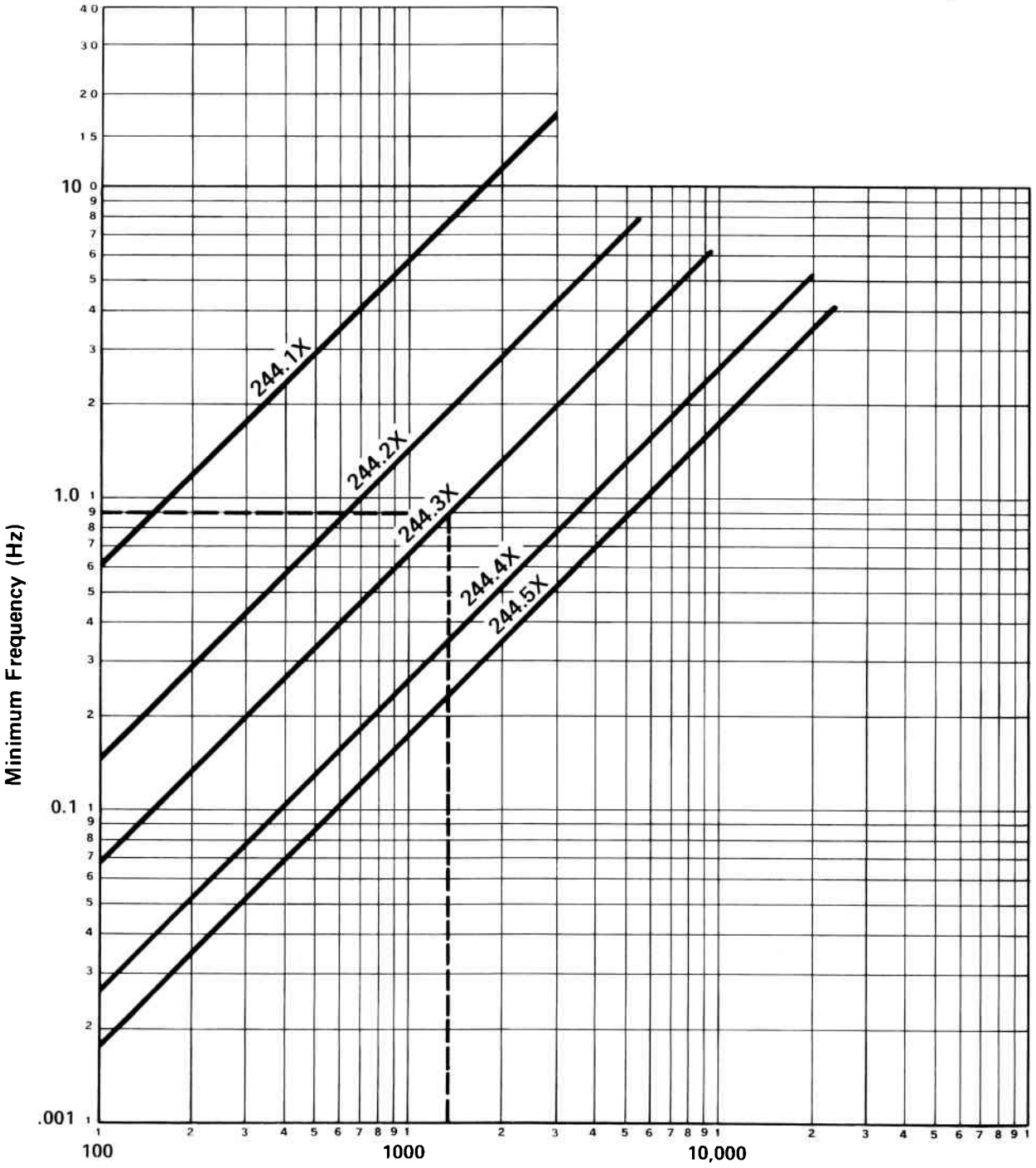


Figure 13. Minimum Frequency Vs Total Bearing Sideload

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