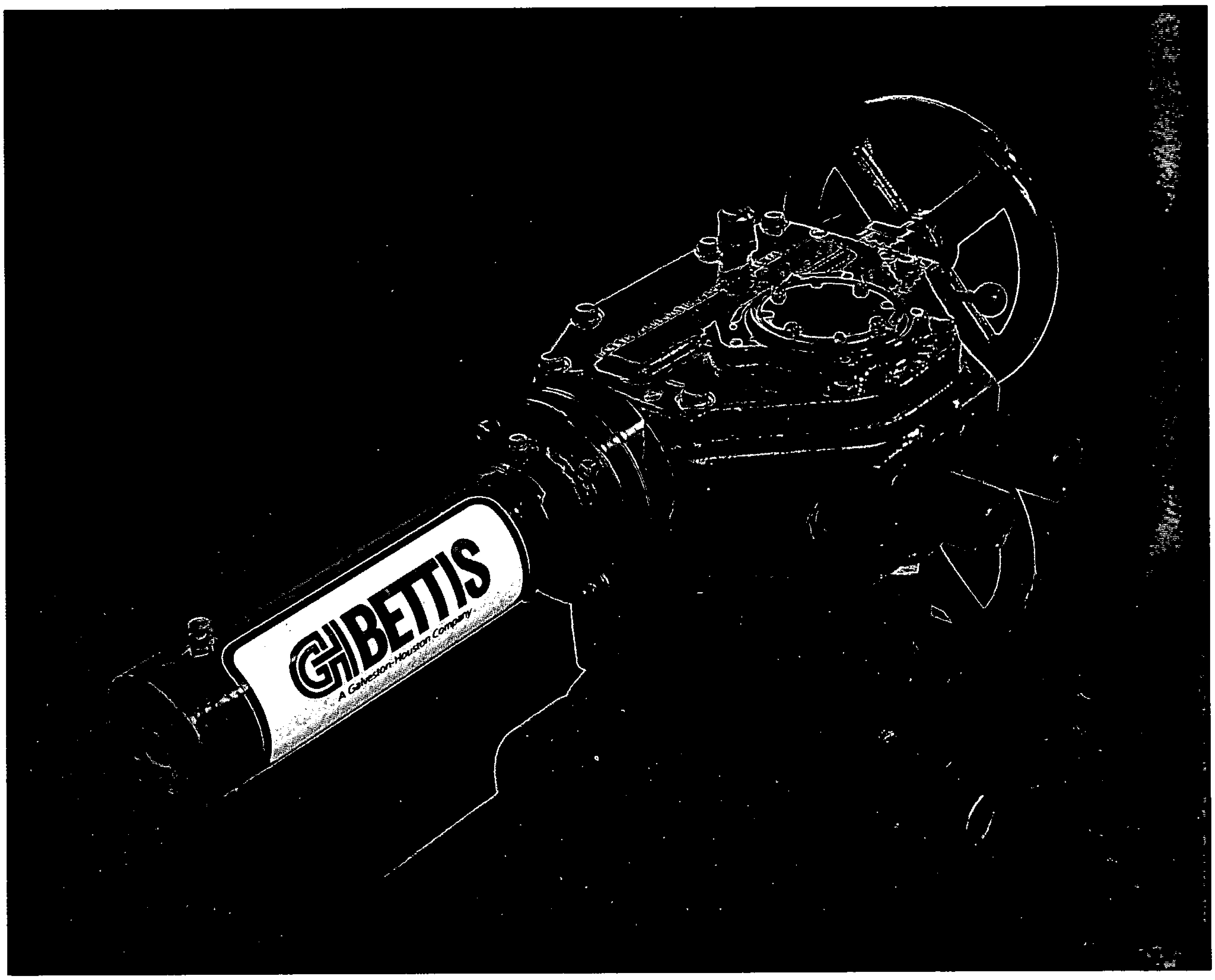
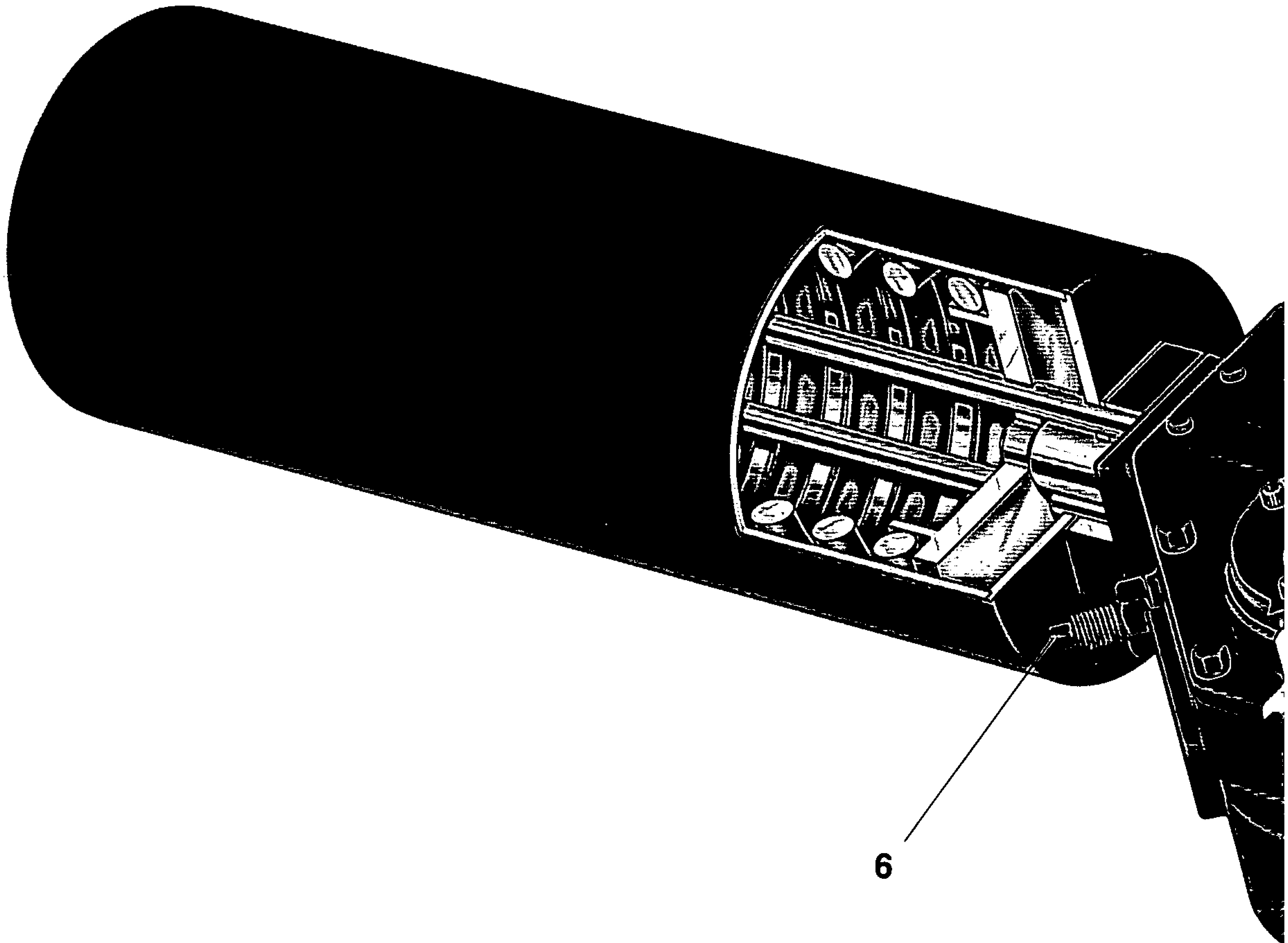
BETTIS
A Galveston-Houston Company

Heavy-Duty Product Series: Hydraulic Actuators



Design and Construction



Mechanical components

The GH-Bettis heavy duty product line of hydraulic actuators is ideal for operating Ball, Butterfly, Plug Valves and/or many other 90° degree rotating mechanisms. Available in the HD, T, TR and TRQ-Series, these rugged and uncomplicated actuators provide a practical and reliable method for opening and closing valves by remote control without the need for expensive and unnecessary gearing.

Double-Acting hydraulic actuators are available with guaranteed minimum torque outputs from 3,140 to over 2,000,000 pound inches. Failsafe spring-return models are available with torque outputs from 900 to 155,400 pound inches. Depending on application, the spring-return models can be assembled to open or close on the loss of operating pressure. The springs can be safely changed or replaced in the field without the use of special tools.

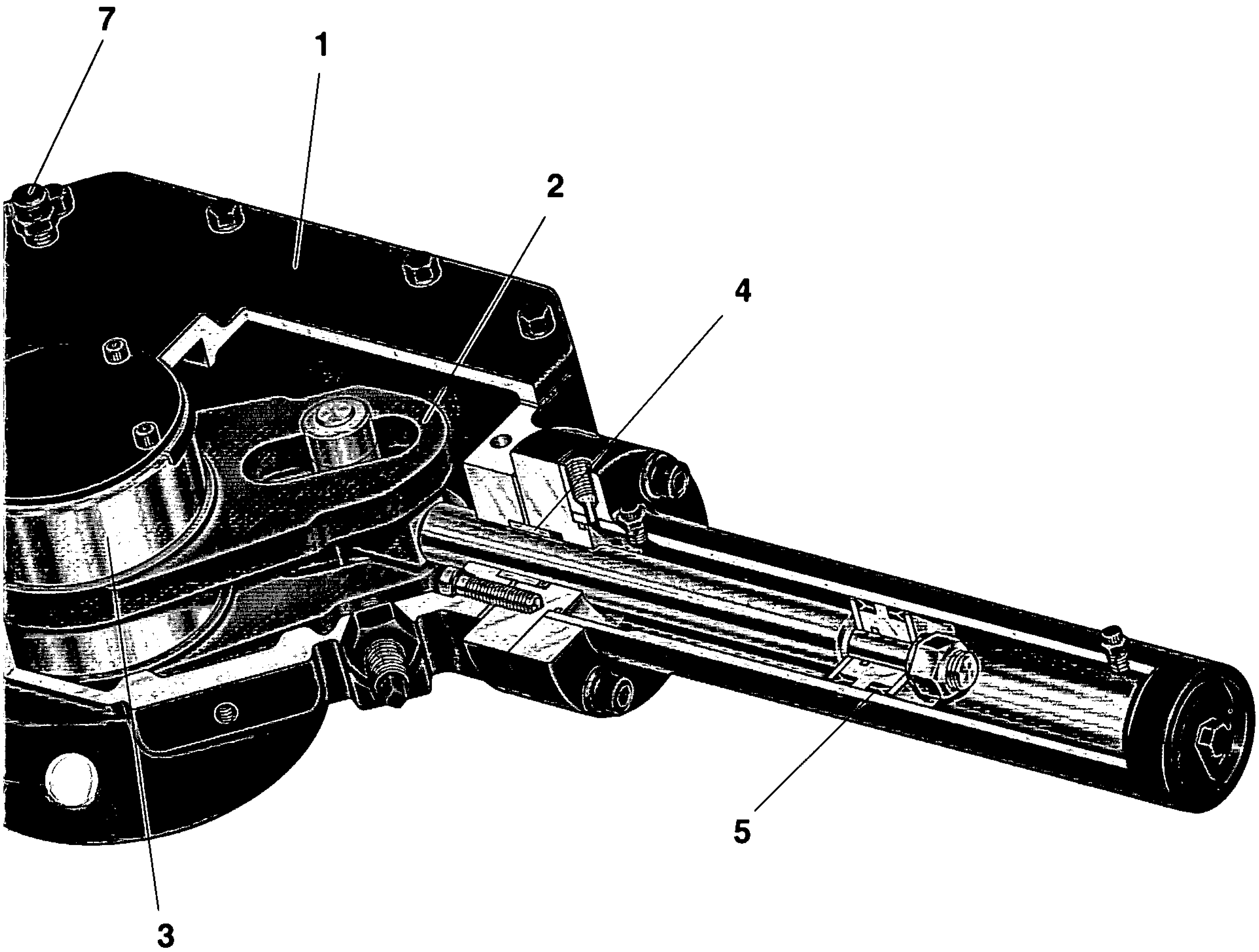
All heavy-duty hydraulic actuators are designed for operating temperatures of −20°F to +200°F; however, special seals are available for use in temperatures beyond these limits and where phosphate ester fire resistant fluids are used as an operating media.

A totally enclosed housing (1) protects all moving parts, minimizes the possibility of internal misalignment and reduces the chance of injury to operating personnel. The body is of a special design allowing use in hostile environments and is adaptable for submerged use.

A scotch yoke (2) mechanism transforms the linear movement of the piston into a 90 degree rotating movement. This provides optimum break torque and results in an actuator which is simple to maintain and service.

Oversized journal bearings (3) in the housing and cover assure proper alignment of the yoke and minimize side thrust on the valve stem. Bearing surfaces and cylinder bore are coated with a baked-on dry film lubricant and corrosion inhibitor for extended service life.

Bronze bushings (4) support and guide the piston rod. Because the piston is rigidly attached to the guided piston rod and does not come into contact with the cylinder walls, no wear can occur to the



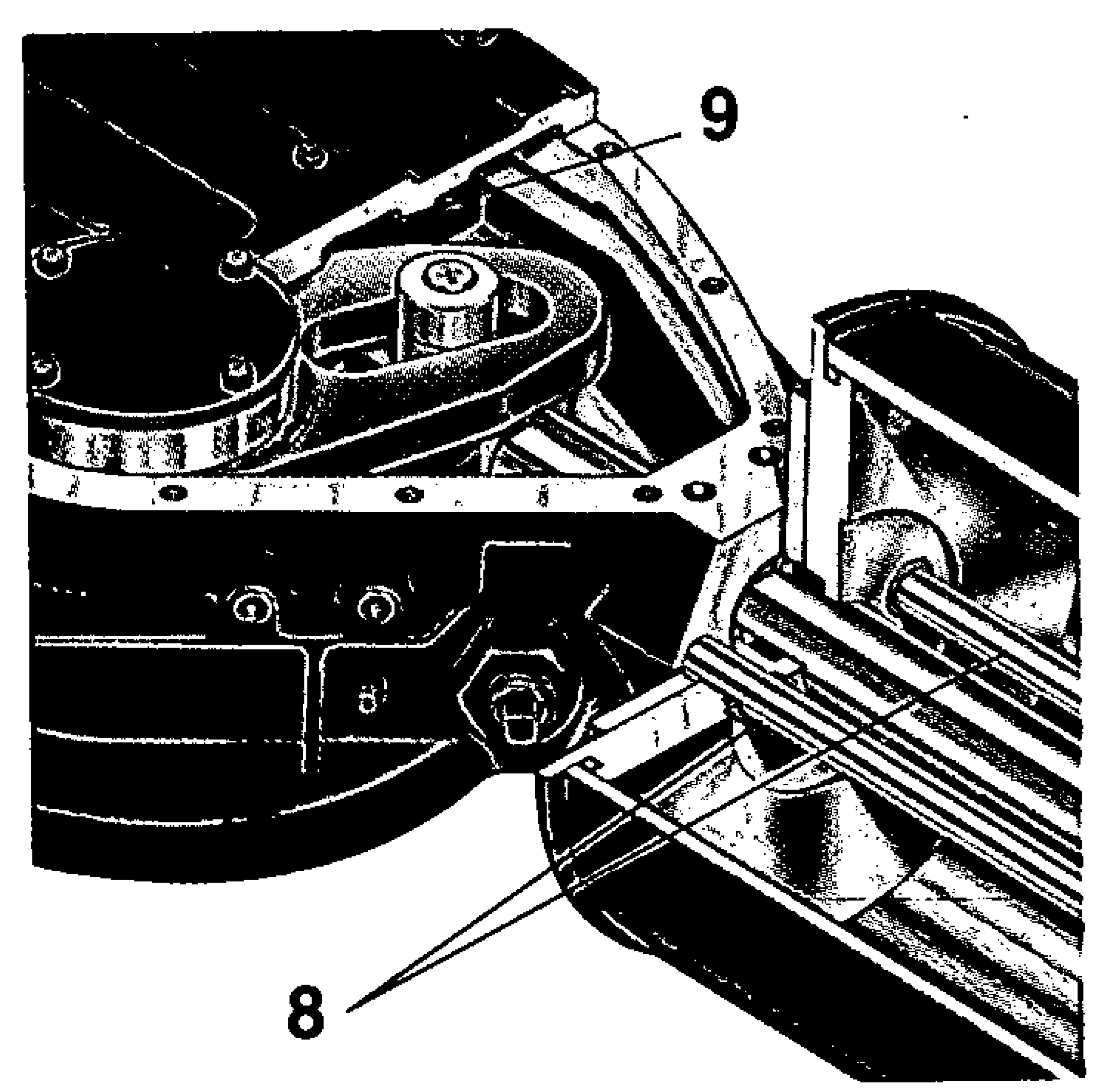
piston. Wear to the cylinder wall is also minimized because only the resilient seal (5) contacts the wall.

Field adjustable stops (6), an integral part of the actuator, ensure precise valve travel and protect the valve seat from excess torque.

A generous coating of suitable lubricant is applied during assembly, and a vented fill plug (7) is incorporated to allow for partially filling the housing with lubricating oil for extreme service conditions.

On many of the larger heavy-duty hydraulic actuators, (T, TR, and TRQ-Series) two internal cylinder tie bars (8) are incorporated into the unit. These internal tie bars guide the piston as it delivers thrust to the yoke. This guiding mechanism minimizes side thrust and any loss of efficiency due to internal deflection.

Another design feature of the larger units include a precision machined guiding track (9). The piston rod end is rigidly attached to the guided piston by the yoke nut as it moves along its axis. An axle, known as the yoke pin, has roller bearings which move within machined tracks and absorb all bending moments generated by the scotch-yoke mechanism. The minimized friction, due to the carefully guided piston and rod end, results in more torque with less operating pressure.



Product Series

Marine Service

The heavy duty product line of GH-Bettis hydraulic actuators are specially designed to satisfy the stringent requirements of the marine industry, both military and civilian. Many existing GH-Bettis actuator models have been approved for maritime and U.S. Department of Defense applications.

Coast Guard

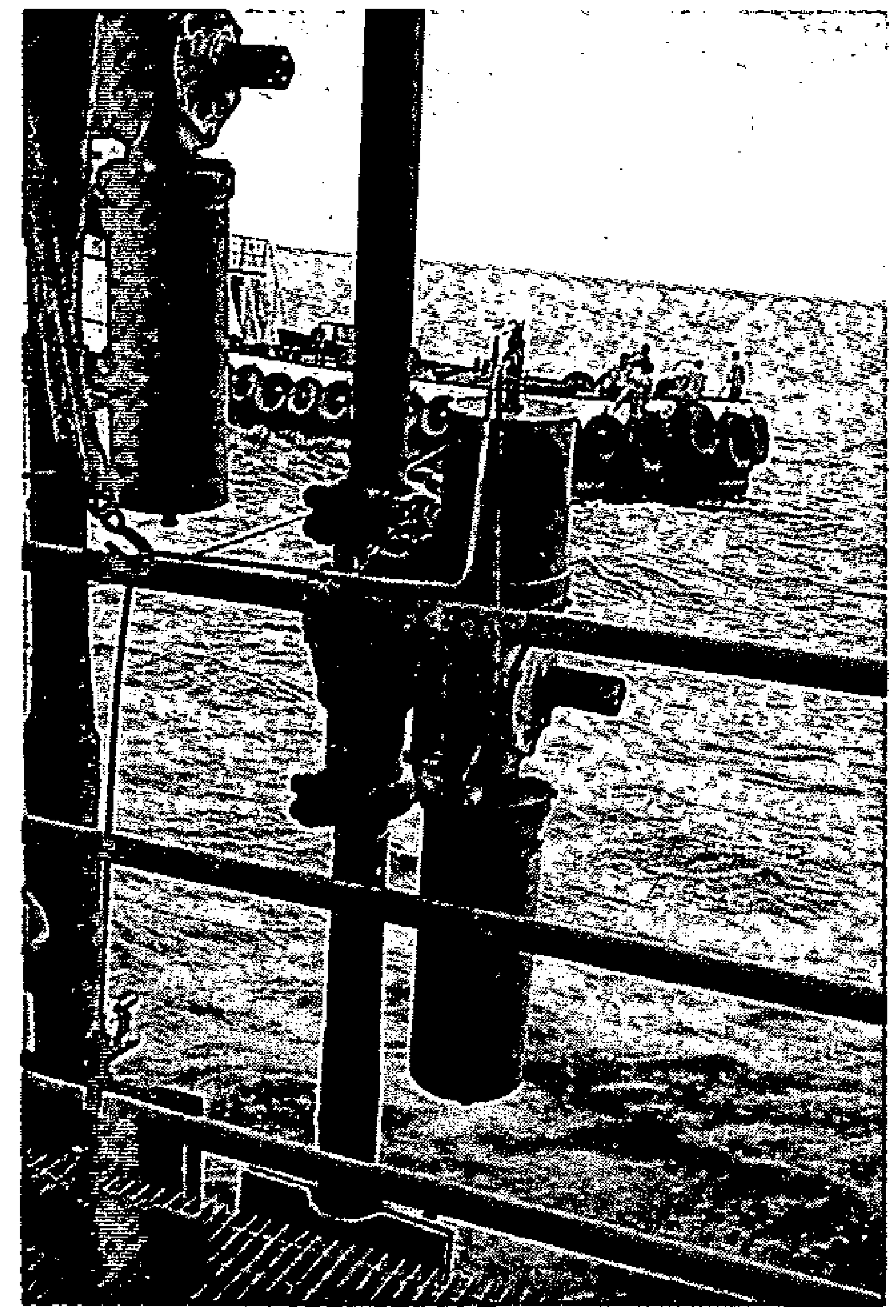
GH-Bettis has had numerous maritime and Coast Guard product approvals for various dock and ship-service applications. The GH-Bettis hydraulic actuator design provides dependable long life service required on crucial maritime environments.

U.S. Navy

The stringent requirements of APL and QPL documentation support for Department of Defense-Navy applications have been met by GH-Bettis on several existing productlines. Typical applications have included ballast tank controls, dry dock control and submerged service requirements.

Offshore

The offshore drilling industry has utilized GH-Bettis hydraulic actuators for many years, because of the unit's ability to resist salt spray environments. The GH-Bettis hydraulic actuator is a dependable, cost-effective means of controlling offshore fluids.

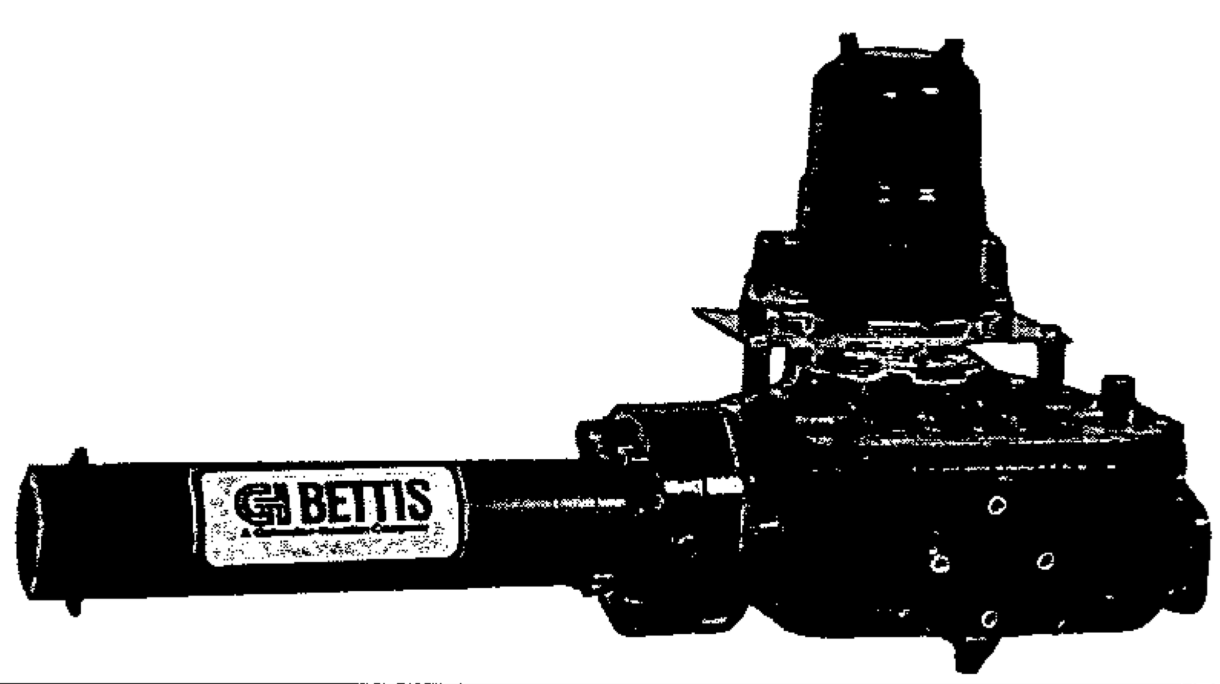


Submerged Service

GH-Bettis rugged submersible hydraulic actuators offer dependable long life service with guaranteed actuation. All units are specifically designed to satisfy requirements of the marine industry, both military and civilian, and can be used for any quarter-turn valve application. The GH-Bettis submerged actuator can also provide continuous underwater modulation when used in conjunction with the new GH-Bettis/PMV submersible positioner.

Typical marine applications requiring submersible hydraulic actuators include sub-sea fuel storage, transfer systems, marine vessel ballast and guaranteed short term/single cycle sink service. Specific actuator needs can be designed and supplied to meet individual application requirements for hydraulic and pneumatic service. All actuator torques are guaranteed minimum values thus providing dependable valve actuation. Submersible actuators are available in double acting or spring return designs, including the proven HD, T and TR-Series.

Reference Bulletin: No. 30.10-1

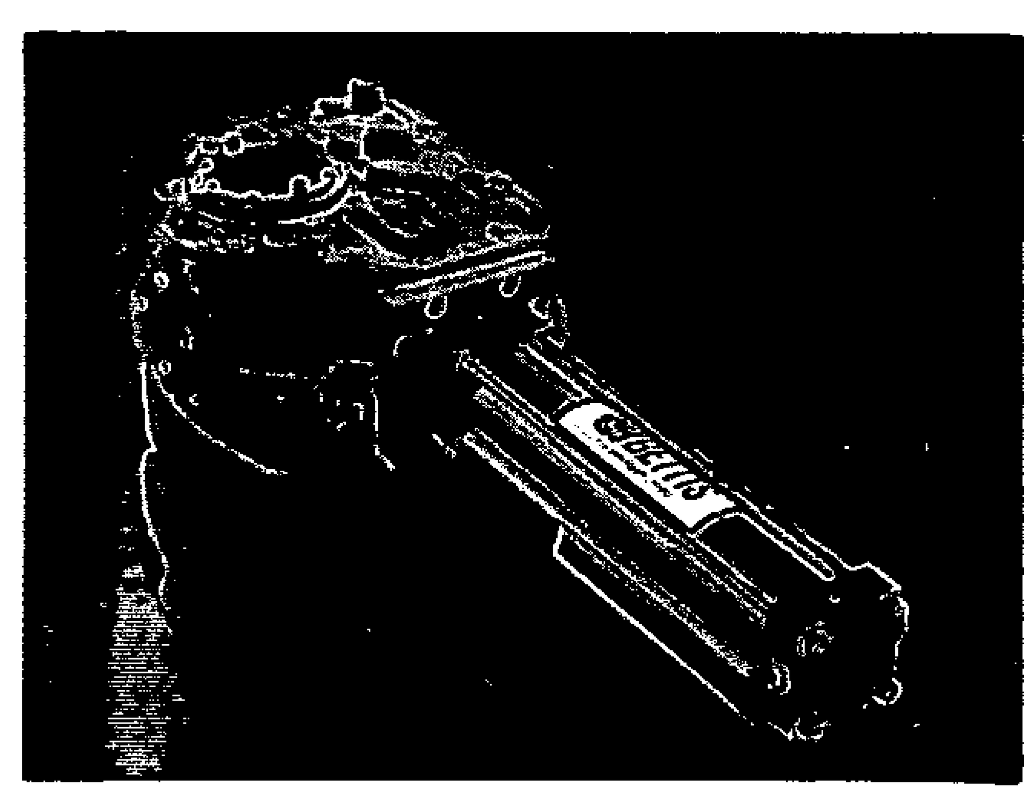


High-Pressure 5000 PSI

GH-Bettis offers a specially designed family of T-series actuators capable of operating at extreme high pressures up to 5000 psi.

These unique products incorporate all of the standard rugged design features and modular construction aspects found in all GH-Bettis actuators; plus, to meet the torque requirements of high-pressure Ball, Plug and Butterfly Valves, these double acting actuators can provide guaranteed minimum torque outputs in excess of 500,000 pound-inches, and a standard temperature range to +350°F.

Reference Bulletin: No. 90.40-1



Optional Features

Failsafe Operation

Every GH-Bettis actuator is capable of failsafe operation. This can be achieved by furnishing a reservoir system which stores the power energy required for emergency actuation, or a spring return for mechanical failsafe operation. In either case, the device can be assembled to either close or open a valve upon receiving a signal indicating a loss or delay of operating pressure.

With spring-return models, the spring is contained in a welded cartridge, where it safely remains in a compressed or preloaded condition when removed from the actuator housing. This unique safety feature makes it possible to dismantle and service the actuator in the field without risking injury to personnel.

Manual Overrides

GH-Bettis hydraulic actuators can be furnished with our patented self-contained hydraulic override system. These sophisticated but dependable overrides require no remote power source for activation in case of system failure. A bi-directional system with integral speed control (active during both power and manual operation) is available for double acting units and a uni-directional system with dual speed control is provided for spring return units.

Trim Options

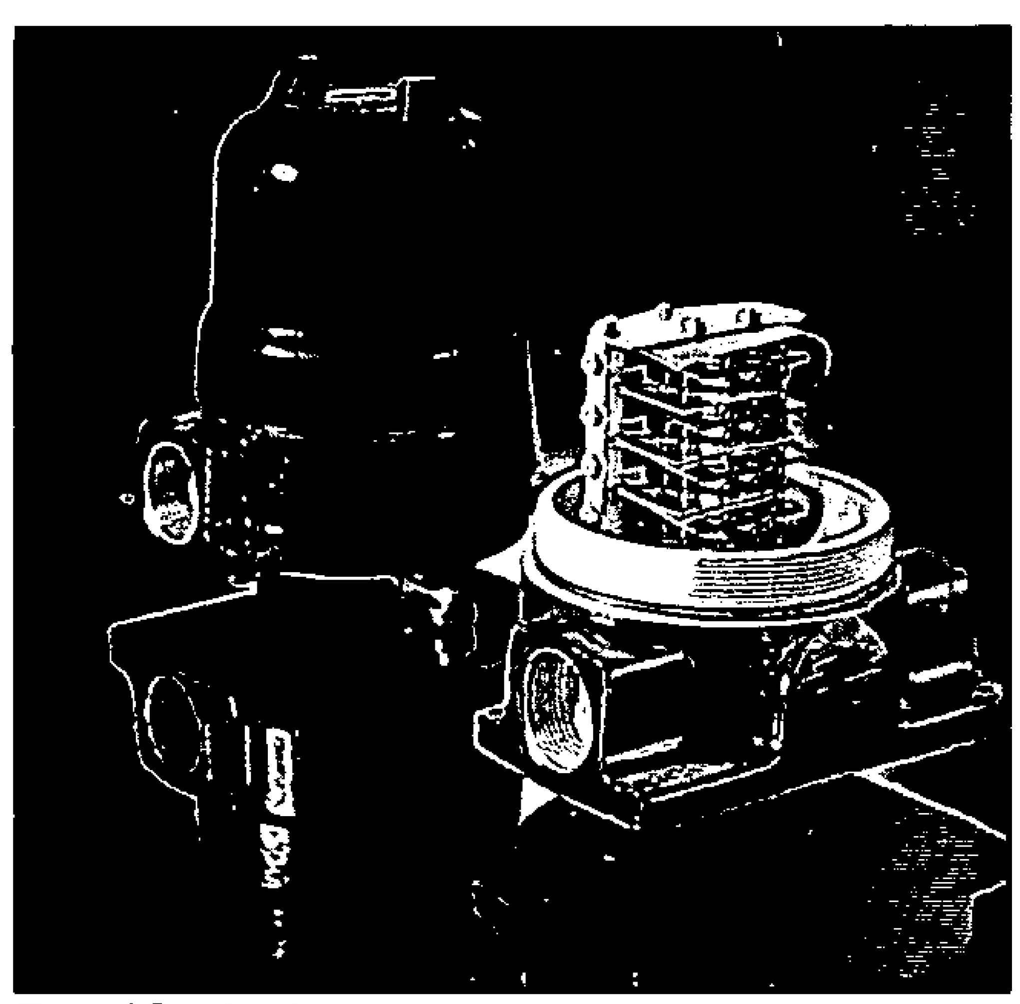
For special applications and/or extreme environments, GH-Bettis engineers have developed a wide variety of trim options for special design criteria. Today, many of these trims have become so common that their availability compares with that of standard stock items.

Some of these options include seals for high-temperature or synthetic fluid applications, stainless steel hardware and epoxy coatings for offshore usage, electroless nickel plating of internal components and controlled hardness metals for hydrogensulfide atmospheres. Also available are low-temperature, no-copper or yellow metals and the GH-Bettis N-Series which is specifically designed for nuclear power plant installations and meets the rigid design criteria required by the Nuclear Regulatory Commission.

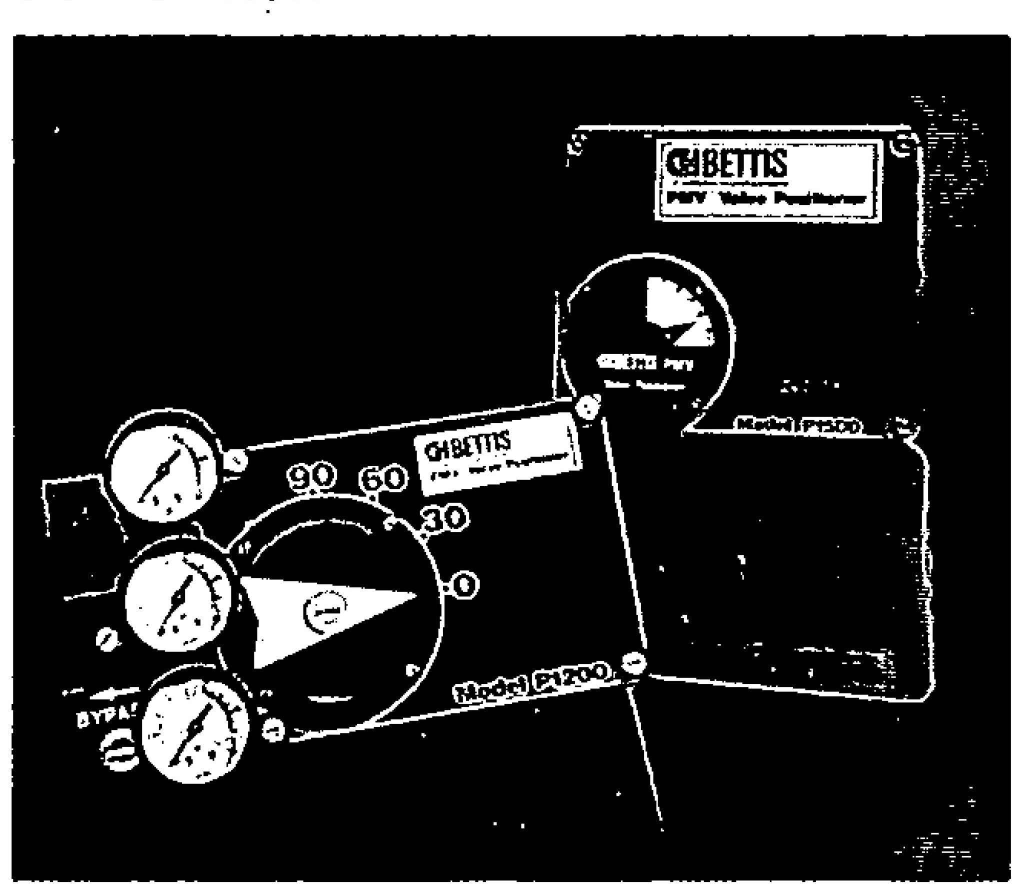
Accessories

Many GH-Bettis accessories can be provided in unique trims to ensure complete actuator control in harsh environments. The GH-Bettis/PMV Positioner is available in all stainless steel, marine bronze or unique combinations of various materials which will provide modulations service to valve and actuators in practically *any* environment.

Reference Bulletin: No. 90.60-1



BettiSwitch



PMV Positioner

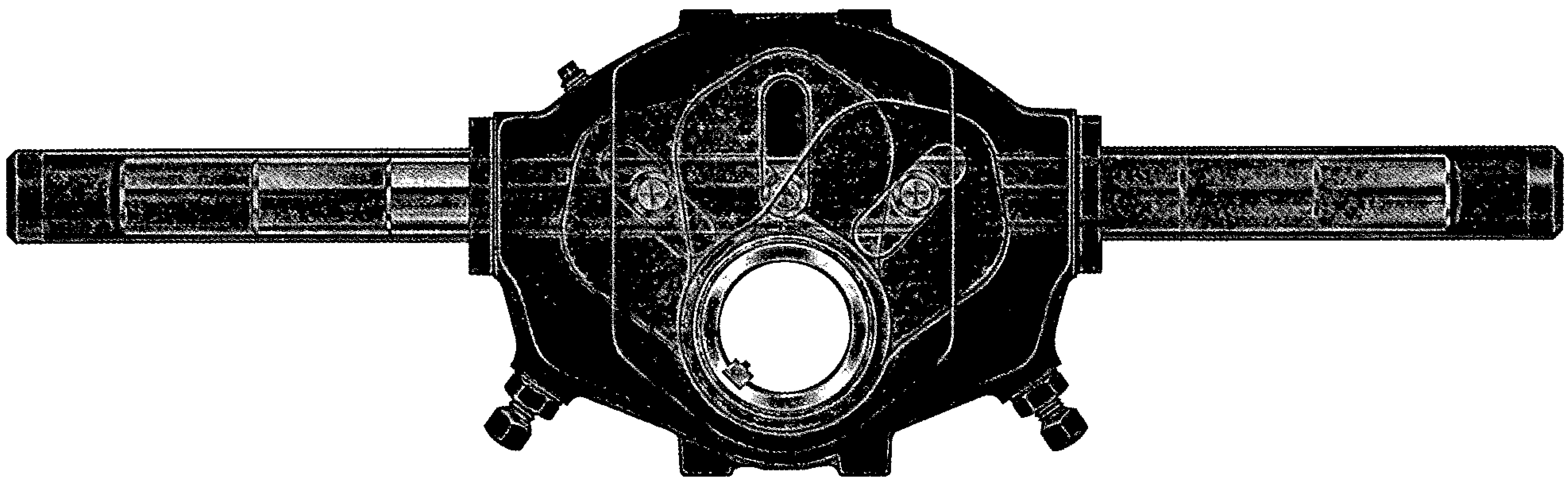
BettiSwitch

The BettiSwitch is a versatile position-indicating switch designed primarily for use with Bettis valve actuators. It is especially adaptable for sequence cycling of automated systems with a choice of operating mechanisms directly coupled to CB-Series actuators. It is listed by UL, CSA and BASEEFA and is designed to meet NEMA I, III, IV, VII, IX and XIII requirements.

Reference Bulletin: No. 90.10-1

Consult GH-Bettis, Waller, Texas for more information on specific trim requirements.

Engineering Data—Torque



Scotch-Yoke Mechanism

The Scotch-yoke mechanism produces a torque curve that most closely matches the requirements of valve actuation when converting linear to rotary motion. Unlike other methods, such as a crank arm that produces less torque at the beginning and the end of a stroke or a rack-and-pinion mechanism that produces a constant torque, the Scotch yoke produces greater torque at the beginning and the end of each stroke of the piston, precisely where it is required to operate most types of valves.

As the piston makes its stroke, the length of the moment arm is changing constantly. Because the moment arm is approximately 1½ times longer at the beginning and the end of the stroke than it is at the middle, and the force generated by pressure acting on the piston is amplified, the break torque (torque output at the beginning and the end of a stroke) approaches twice the magnitude of the run torque (torque output at the center of the stroke).

This efficiency of torque output allows the use of a smaller piston, shorter moment arm and lower operating pressures to achieve the same amount of break torque as produced by other types of mechanisms.

Over the years, GH-Bettis has refined and improved the basic Scotch-yoke design—particularly in minimizing the side thrust generated by the bearing surface. We also guarantee all published torque values as minimum values. If any Bettis actuator fails to meet its specified torque output under reasonable circumstances of time and use, we'll replace it. With GH-Bettis, you know what you are getting for your torque dollar.

Torque Selection

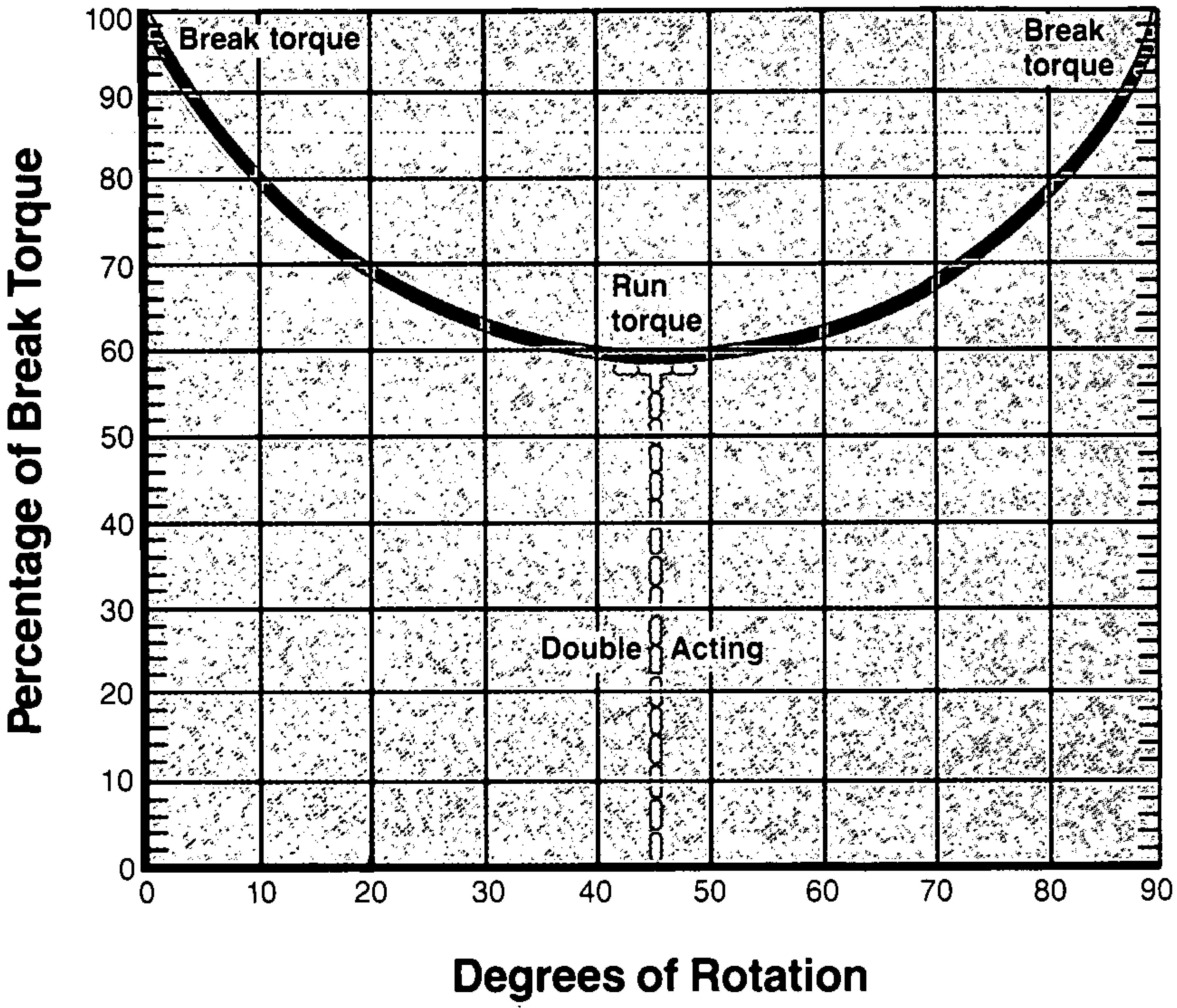
On the following graph, plot the percentage of torque against the desired degrees of rotation. Then multiply this percent torque value by either the break torque for double-acting actuators or the ending torque for spring-return actuators, using the guaranteed minimum torque values listed on pages 8 and 9.

Example: From page 8, you can determine that Model H-251.5 double-acting actuator has a break torque of 6,280 pound-inches at 1000 psig. What is the guaranteed minimum torque value at 70 degrees?

Solution: 68% x 7,000 lb-in = 4,270 lb-in.

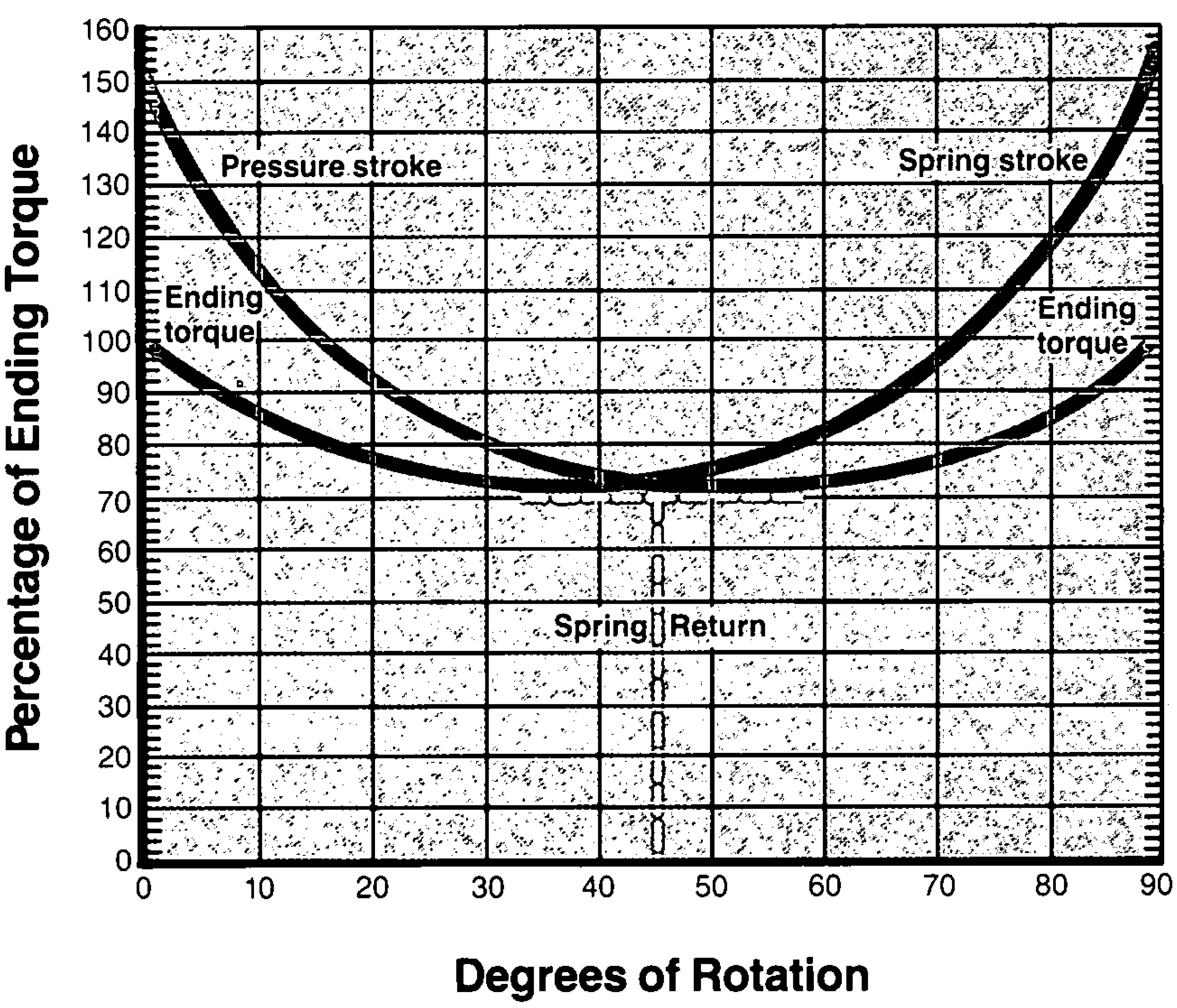
Torque Produced by Scotch-Yoke Mechanism

For listed torque values, see pages 8 and 9.



Double-Acting Actuators

The torque outputs (pressure to open, pressure to close) produced by double-acting actuators are expressed as break and run torques. The break torque is the torque produced at the beginning and the end of the Scotch-yoke rotation. The run torque is the torque produced at the mid-point (45 degrees) of the Scotch-yoke rotation.



Spring-Return Actuators

The torque output produced by spring-return actuators is expressed as ending torque and is that torque produced when the spring is in its extended position. The torque values indicated in orange in the graph follow the torque produced by the Scotch-yoke mechanism as the spring extends from the break position (spring compressed), providing continually changing force values. The torque values indicated in green follow the torque produced as pressure provides the force required to rotate the Scotch yoke from the end position, compressing the spring.

Torque Ratings
All Published Torques are Guaranteed Minimum Values.

Double-Acting Actuators
HD-Series

Actuator Model	Position of Stroke	Operating Pressure (psig)											
		500	750	1 000	1 200	1 300	1 400	1 500	1 600	1 800	2 000	2 500	3 000
H-251.5	Break	3 140	4 710	6 280	7 536	8 165	8 790	9 420	10 050	11 305	12 560	15 700	
	Run	1 750	2 625	3 500	4 200	4 550	4 900	5 250	5 600	6 300	7 000	8 750	
H-352.1	Break	8 500	12 750	17 000	20 400	22 100	23 800	25 500	27 200	30 600	34 000	42 500	51 000
	Run	4 725	7 090	9 450	11 340	12 285	13 230	14 175	15 120	17 010	18 900	23 625	28 350

T-Series

Actuator Model	Position of Stroke	Operating Pressure (psig)											
		500	750	1 000	1 200	1 300	1 400	1 500	1 600	1 800	2 000	2 500	3 000
T-201.5	Break	2 890	4 340	5 780	6 940	7 520	8 100	8 680	9 250	10 410	11 570	14 450	
	Run	1 610	2 410	3 210	3 860	4 180	4 500	4 820	5 140	5 780	6 430	8 050	
T-202.0	Break	5 350	8 020	10 690	12 830	13 900	14 970	16 040	17 110				
	Run	2 970	4 460	5 940	7 130	7 720	8 320	8 910	9 500				
T-302.7	Break	10 000	150 000	20 000	24 000	26 000	28 000	30 000	32 000	36 000	40 000	49 900	
	Run	5 550	8 315	11 090	13 300	14 415	15 525	16 630	17 740	19 960	22 175	27 725	
T-303.5	Break	18 225	27 340	36 450	43 750	47 400	51 000	54 700	58 325				
	Run	10 125	15 200	20 250	24 300	26 325	28 350	30 375	32 400				
T-304.0	Break	24 800	37 210	49 615	59 540								
	Run	13 835	20 750	27 670	33 205								
T-402.7	Break	14 200	21 300	28 375	34 050	36 900	39 750	42 575	45 405	51 100	56 775	70 975	85 150
	Run	7 885	11 825	15 775	18 925	20 500	22 075	23 650	25 225	28 375	31 550	39 425	47 300
T-403.5	Break	25 925	38 875	51 850	62 225	67 400	75 575	77 775	82 950	93 325	103 700		
	Run	14 400	21 600	28 800	34 575	37 450	40 325	43 200	46 075	57 850	57 600		
T-404.0	Break	35 300	52 450	70 600	84 750	91 800	98 850	105 900	113 000				
	Run	19 615	29 425	39 225	47 075	51 000	54 925	58 850	62 775				
T-505	Break	66 000	99 000	132 000	158 000	171 000	184 000	198 000	211 000				
	Run	36 700	50 000	73 400	88 000	95 340	102 000	110 000	117 500				
T-507	Break	145 000											
	Run	80 700											
T-805	Break	103 000	156 000	208 000	250 000	270 400	291 000	312 000	332 000	374 000	416 000		
	Run	57 700	85 830	115 500	138 000	148 770	161 000	171 660	185 000	208 000	231 000		
T-807	Break	228 000	342 000										
	Run	127 100	190 000										

TR-Series

Actuator Model	Position of Stroke	Operating Pressure (psig)											
		500	750	1 000	1 200	1 300	1 400	1 500	1 600	1 800	2 000	2 500	3 000
TR-1007	Break	250 150	378 230	504 305	605 165	655 600	706 025	756 455	806 890	907 750			
	Run	147 090	220 625	294 165	353 000	382 415	411 830	441 250	470 660	529 500			
TR-1010	Break	614 520	921 780										
	Run	358 455	537 680										
TR-10207	Break	536 092	804 138										
	Run	312 710	469 060										
TRQ-10207	Break	536 090	804 140	1 072 185	1 286 620	1 393 840	1 501 060	1 608 275	1 715 500	1 929 930			
	Run	312 710	469 060	625 415	750 495	813 040	875 580	938 160	1 000 660	1 125 745			
TRQ-10210	Break	1 260 840	1 891 260										
	Run	735 460	1 103 190										
TRQ-10407	Break	1 072 185	1 608 275										
	Run	625 415	938 120										

Torque Ratings **All Published Torques are Guaranteed Minimum Values.**

Spring Return Actuators

HD-Series

Actuator Model	Position of Stroke	Operating Pressure (psig)												
		500	600	700	800	900	1 000	1 200	1 400	1 600	1 800	2 000	2 500	3 000
H-251.5-SR	End	540 920	560 1 300	560 1 400	580 1 810	580 1 810	5 100 2 265	5 125 2 450	5 125 2 820	5 150 3 435	780 3 790	7 100 4 180	7 125 5 045	7 150 6 550
H-352.1-SR	End				740 3 380	740 4 530	740 4 530	740 4 530	760 6 810	780 7 410	780 9 055	7 100 9 250	7 125 11 670	7 125 14 150

T-Series

Actuator Model	Position of Stroke	Operating Pressure (psig)												
		500	600	700	800	900	1 000	1 200	1 400	1 600	1 800	2 000	2 500	3 000
T-302.7-SR	End				5 4 230	5 5 510	5 5 510	4 9 570	4 9 570	3 13 400	2 13 910	2 19 240	2 20 200	1 27 370
T-303.5-SR	End	5 4 490	5 5 510	4 8 140	4 9 570	3 10 800	3 13 400	2 17 720	2 20 200	2 20 200	1 25 130	1 28 100		
T-402.7-SR	End								5 13 300	5 13 300	4 19 900	4 19 900	3 29 400	3 29 400
T-403.5-SR	End				5 9 610	5 13 300	5 13 300	4 19 900	3 29 400	3 29 400	3 29 400	2 35 855		
T-404.0-SR	End		5 8 590	5 13 300	4 16 500	4 19 900	3 25 470	3 29 400	3 29 400	2 41 300	2 41,300			
T-505-SR	End			4 39 900	3 46 000	3 48 000	3 48 000	3 48 000	2 80 100	2 81 500				
T-507-SR	End	3 48 000	2 53 600	2 81 500	2 81 500	1 93 400	1 111 000	1 111 000						
T-805-SR	End								3 101 800	3 129 000				
T-807-SR	End	5 63 300	4 95 600	3 109 100	3 129 000	3 129 000	2 159 500	2 177 000						

NOTE: Numbers above torque output are spring sizes and must be specified; for example, H-251.5-SR580

GH-Bettis certifies that the published torque output values represent true, tested and measured torque capabilities. All are guaranteed minimum values. A properly applied and maintained GH-Bettis actuator will produce the published torque throughout a long service life.
For torque requirements greater than shown, please consult your GH-Bettis representative.

Sizing Information

The following information is designed to aid in sizing Bettis heavy-duty hydraulic actuators to specific valve requirements.

An accurate maximum torque requirement must be obtained. Most valve manufacturers publish normal valve stem torque requirements and torque correction factors for unusual applications or extreme operating conditions. Normal stem torque for a properly applied and maintained valve is generally defined as the maximum torque required to rotate the valve element (ball, disc, plug, etc.) from its fully closed position when the element is against the full valve-rated differential pressure. Because the features of each valve make and model are unique, torque correction factors must be provided by the manufacturer. Adjustments are usually made relative to differential pressure, extreme temperatures, unusual loadings and operating speed requirements. For accurate torque requirements, all information pertinent to the valve application, including size, model, figure number and nominal pressure rating, must be furnished to the valve manufacturer.

When an accurate maximum torque requirement is obtained, further consideration must be given to the valve type, design and application to determine whether the requirement is valid only at the beginning and/or end of each stroke or at an intermediate position.

GH-Bettis double-acting Scotch-yoke actuators can then be appropriately selected from torque output charts in accordance with their guaranteed minimum break or run (mid-stroke) output torque.

Bettis spring-return Scotch-yoke actuators may be selected using the published, guaranteed minimum, ending torque output values except when the maximum requirement is at an intermediate position of the piston stroke. In these cases, select an actuator having an ending torque at least 25 percent greater than the torque requirement for the intermediate position. Note: The 25 percent adjustment is not to be considered a "safety factor". This ending torque adjustment, applied to the spring-return, Scotch-yoke-type actuator, assures an intermediate position torque output equal to or greater than the requirement.

Performance Data

Double-Acting Actuators HD-Series, T-Series, TR-Series

Actuator Model	Displ. Per Stroke (in³) CW	Displ. Per Stroke (in³) CCW	Max. Operating Pressure* (psig)	Max. Allowable Operating Pressure** (psig)	Appx. Weight (lbs.) Standard	Appx. Weight (lbs.) W/Manual Override
H251.5	9	9	3 000	3 000	66	—
H352.1	24	24	3 000	4 000	133	—
T-201.5	9	7	3 300	3 300	56	62
T-202.0			1 550	2 000	54	60
T-302.7	24	33	2 775	2 775	139	253
T-303.5	46	54	1 615	1 750	151	265
T-304.0	63	71	1 200	1 400	154	268
T-402.7	34	46	3 750	3 750	192	307
T-403.5	65	77	2 200	2 600	203	320
T-404.0	89	101	1 620	2 000	211	326
T-505	173	199	1 700	1 800	368	557
T-507	380	407	725	850	404	592
T-805	251	290	2 075	2 075	473	683
T-807	553	591	920	1 200	508	718
TR-1007	647	707	1 800	2 200	1 659	1 998
TR-1010	1 576	1 637	740	940	1 699	2 038
TR-10207	1 354	1 354	850	1 200	1 837	2 187
TR-10210	3 233	3 233	360	530	1 917	2 267
TRQ-10207	1 354	1 354	1 600	2 200	2 358	2 987
TRQ-10210	3 233	3 233	680	940	2 438	3 067
TRQ-10407	2 706	2 706	800	1 280	2 714	3 387
TRQ-10410	6 465	6 465	340	545	2 874	3 225

Spring Return Actuators HD-Series

Actuator Model	Displ. per Stroke in³	Actuator Spring Size 40	60	80	100	125	150	Max. Allowable Operating Pressure** (psig)	Appx. Weight (lbs.) Standard	Appx. Weight (lbs.) Manual Override
		Max. Operating Pressure* (psig)								
H-251.5-SR	9								96	—
H-352.1-SR	24								220	—

T-Series

Actuator Model	Displ. per Stroke in³	Actuator Spring Size SR5	SR4	SR3	SR2	SR1	Max. Allowable Operating Pressure** (psig)	Actuator Spring Size SR5	SR4	SR3	SR2	SR1	Appx. Weight Manual Override
		Max. Operating Pressure* (psig)						Max. Operating Pressure* (psig)					
T-302.7-SR		2 700	2 700	2 700	3 000	3 100	3 000†	414	334	264	271	274	—
T-303.5-SR		1 500	1 600	1 700	1 800	2 000	1 700†	426	346	276	283	286	—
T-402.7-SR		2 800	2 800	3 000	—	—	3 100	462	468	389	314	317	—
T-403.5-SR		2 300	2 300	2 400	2 500	—	2 500	474	481	401	326	329	—
T-404.0-SR		1 800	1 900	2 000	2 200	—	1 975†	481	488	408	333	335	—
T-505-SR		—	2 075	2 075	2 075	2 075	2 075	1 209	979	820	831	—	100
T-507-SR		—	900	920	1 100	1 250	1 100†	1 244	1 013	854	865	—	100
T-805-SR		2 100	2 100	2 100	2 100	—	2 100	—	1 313	1 075	1 094	935	115
T-808-SR		1 100	1 225	1 225	1 225	—	1 225	—	1 353	1 116	1 134	976	115

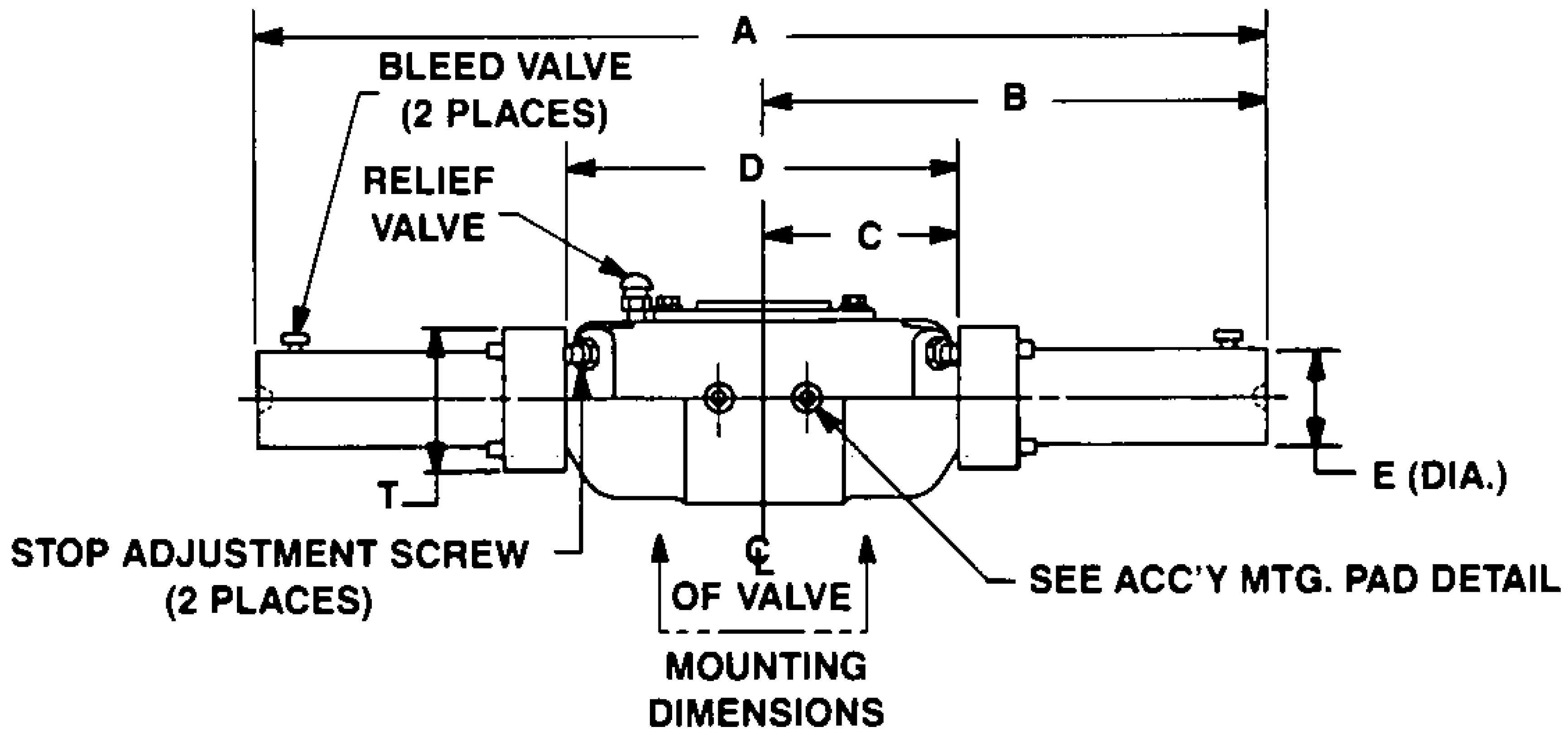
*Maximum operating pressure is the pressure required to produce the maximum rated torque of the actuator.

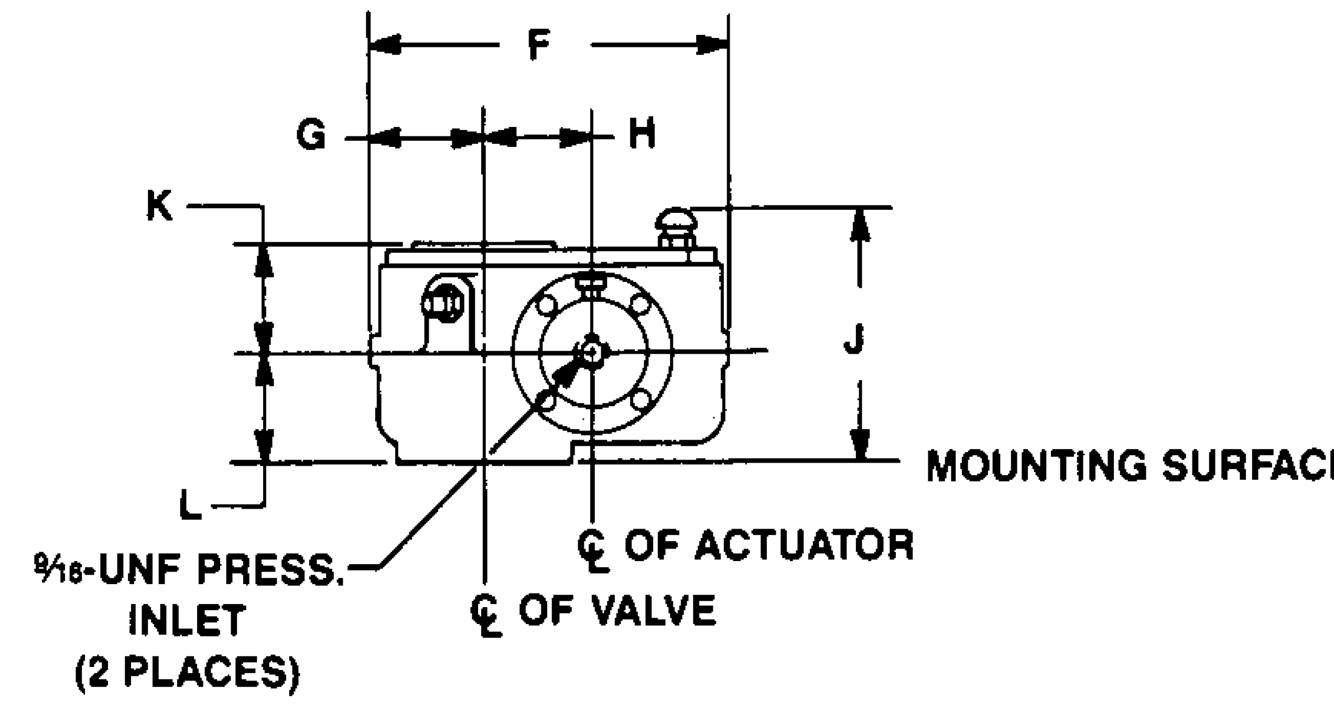
**Maximum allowable operating pressure is the maximum static pressure that may be applied to a fully stroked actuator against the travel stops. Pressures applied to only one end of the cylinder in excess of the maximum allowable operating pressure may result in permanent deformation of the torque-producing mechanism of the actuator. Maximum pneumatic test pressure is 1.25 times the maximum allowable operating pressure when applied to both sides of the cylinder simultaneously.

†Except when maximum operating pressure is higher.

Dimensions — HD Series

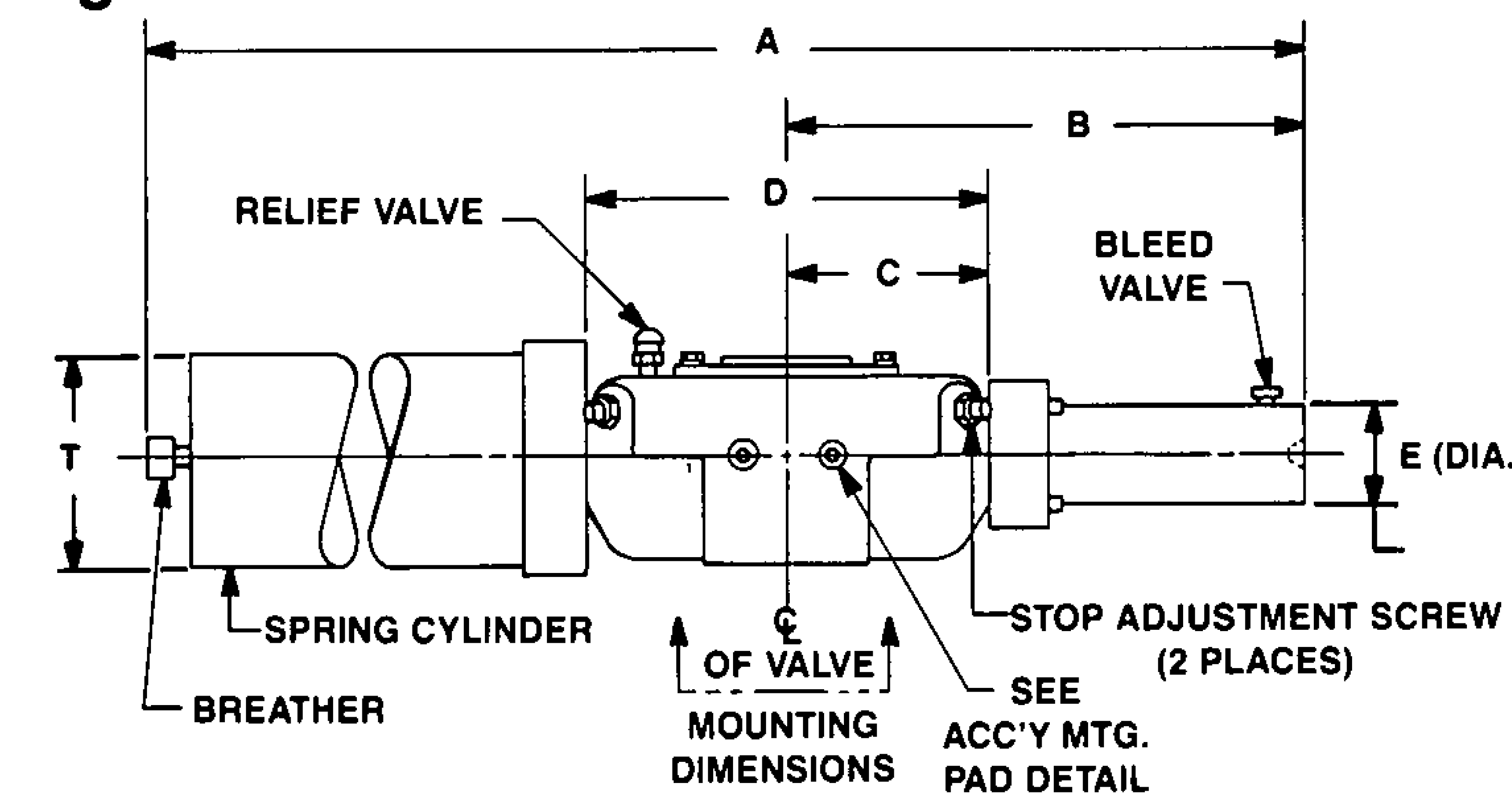
Double Acting

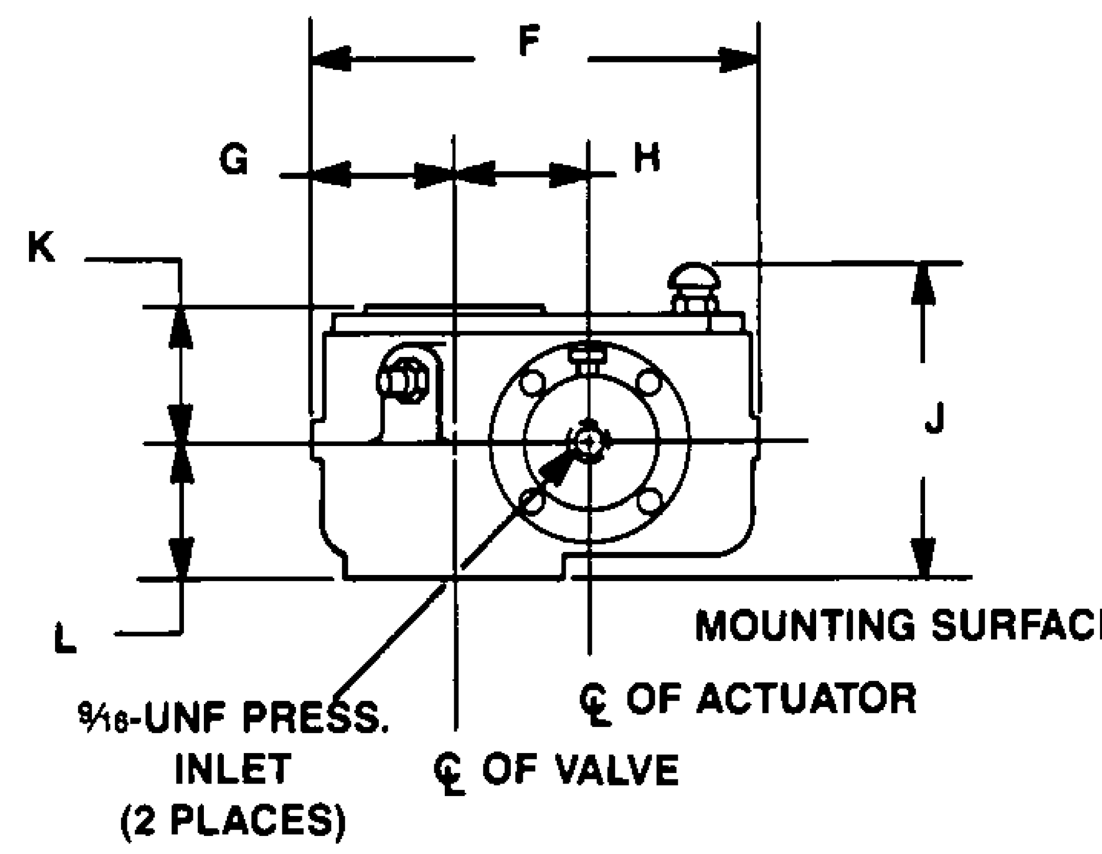




Acuator Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P (±.002)	Q	R	S	T
H251.5	31 1/2	15 3/4	5 9/16	11 1/8	2	8 29/32	2 7/8	2 1/2	7 5/8	2 13/16	2 13/16	3 3/16	1 19/32	2.504	5 5/8	1/2-13 UNC	3/4	3 3/4
H352.1	36 7/8	18 7/16	6 13/16	13 5/8	2 13/16	11 13/16	3 5/8	3 3/8	8 3/8	3 3/4	3 9/16	4 1/16	2 1/32	3.254	7 1/4	3/4-10 UNC	1	5

Spring Return





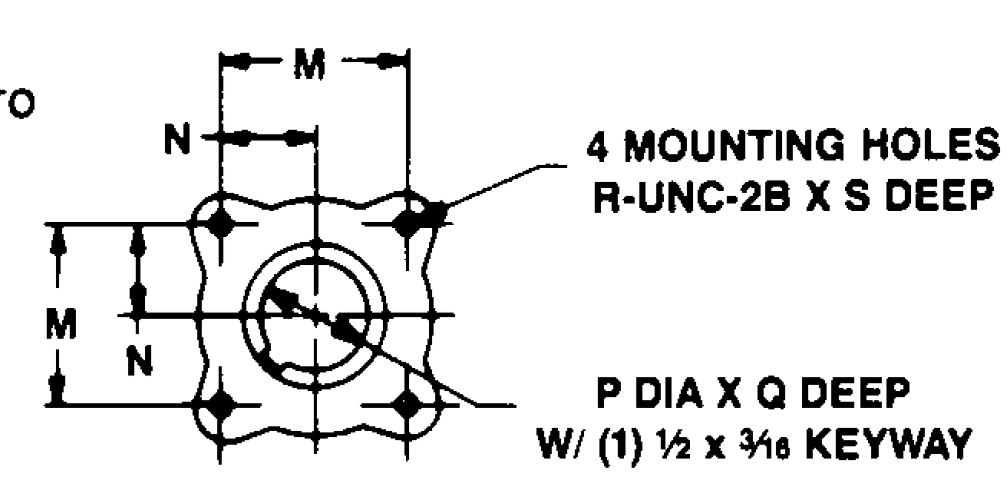
Actuator Model	Spring Size										B	C	D
	540	560	580	5 100	5 125	5 150	780	7 100	7 125	7 150			
	Dimension A												
H251.5-SR	45	45	45	50 25/32	50 25/32	50 25/32	46 1/8	46 1/8	50 13/16	50 13/16	15 3/4	5 9/16	11 1/8

Actuator Model	Spring Size										B	C	D
	740	760	780	7 100	7 125	7 150							
	Dimension A												
H352.1-SR	58 1/8	58 1/8	63 1/2	63 1/2	67 5/8						18 7/16	6 13/16	13 5/8

Actuator Model	E	F	G	H	J	K	L	M	N	P (DIA.)	Q	R	S	T
H251.5-SR	2	8 29/32	2 7/8	2 1/2	7 5/8	2 13/16	2 13/16	3 3/16	1 19/32	2.504	5 5/8	1/2-13 UNC	3/4	5 3/8
H352.1-SR	2 13/16	11 13/16	3 5/8	3 3/8	8 3/8	3 3/4	3 9/16	4 1/16	2 1/32	3.254	7 1/4	3/4-10 UNC	1	7 1/2

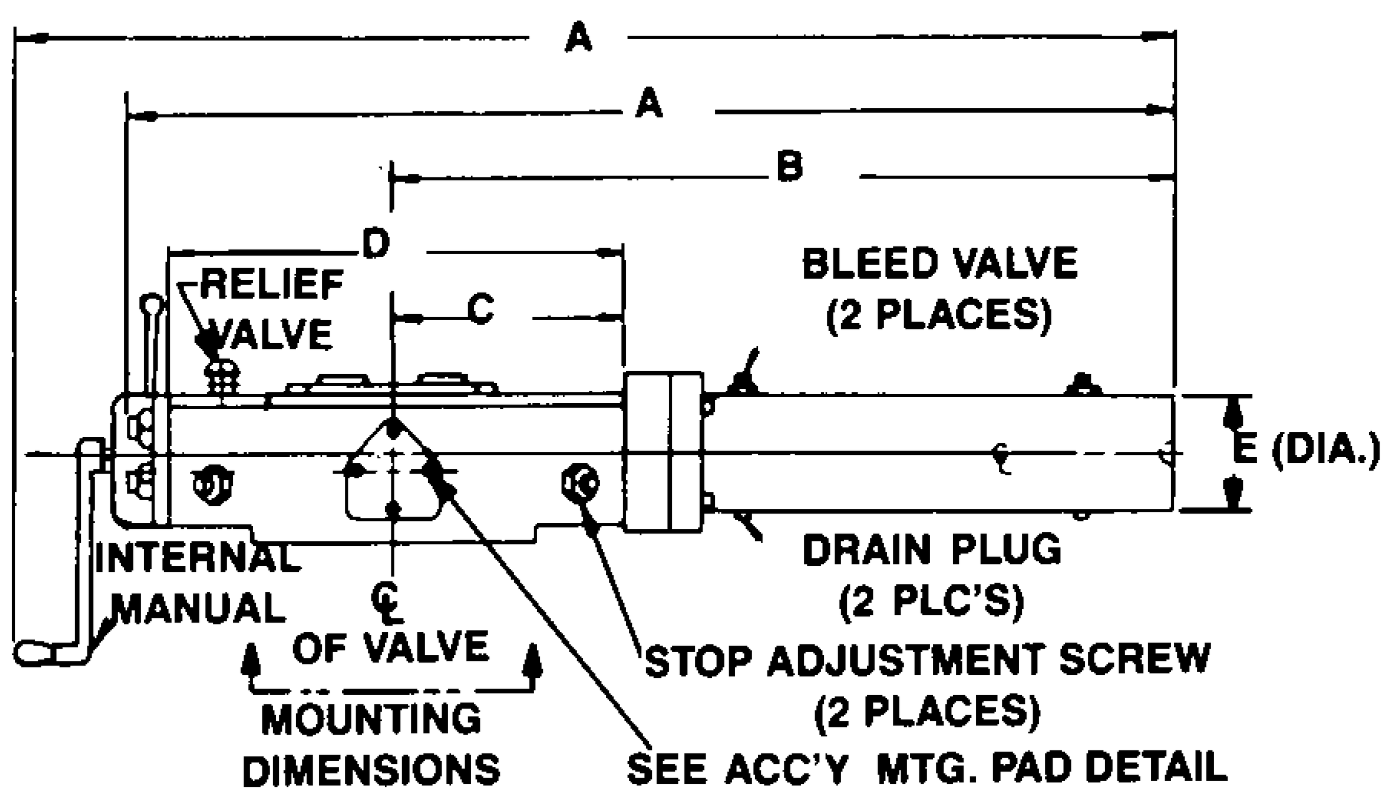
Mounting Dimensions (View A-A) For All HD-Series Actuators

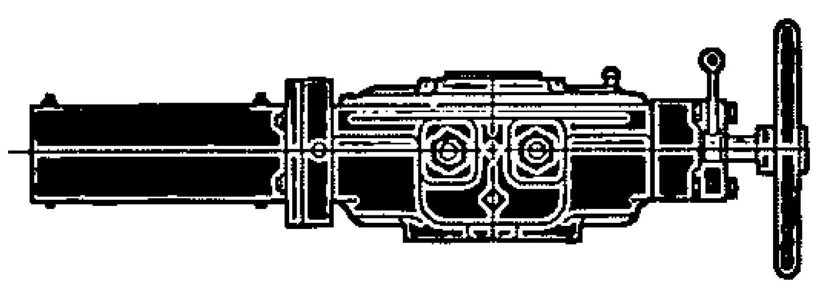
NOTE: ACTUATOR SHOWN ROTATED TO THE FULL CLOCKWISE POSITION.



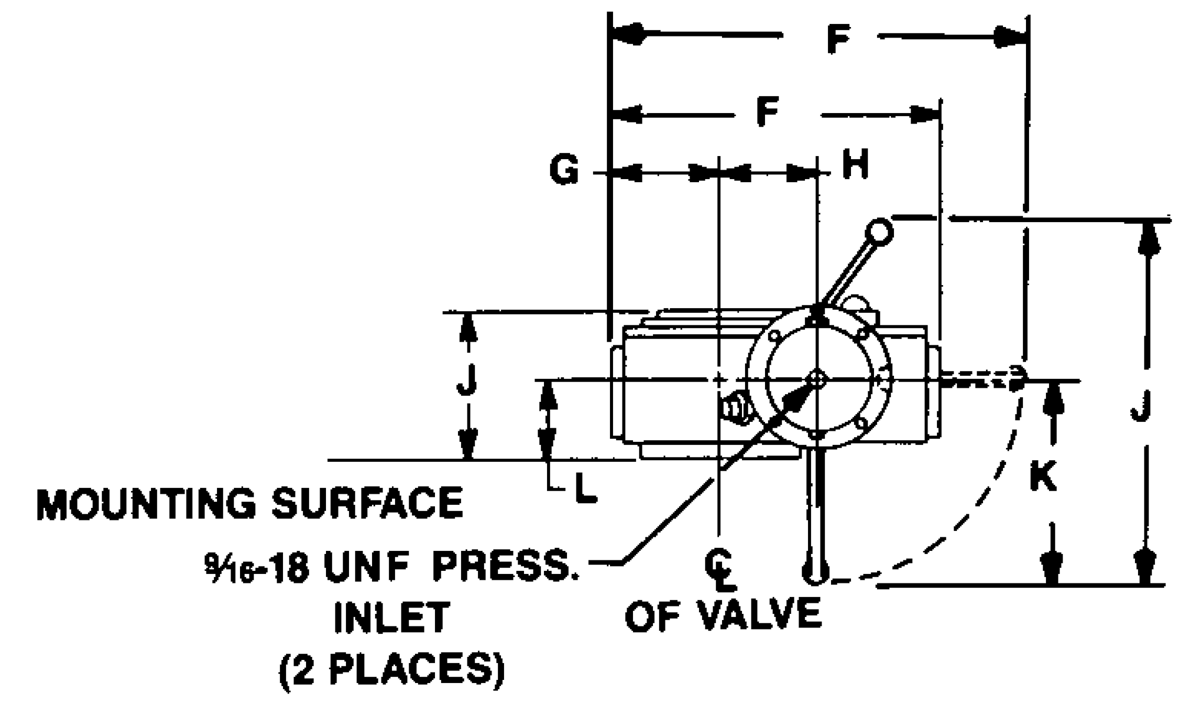
Certified dimensional drawings available on request. Contact factory with correct model designation and serial number.

Dimensions — T Series

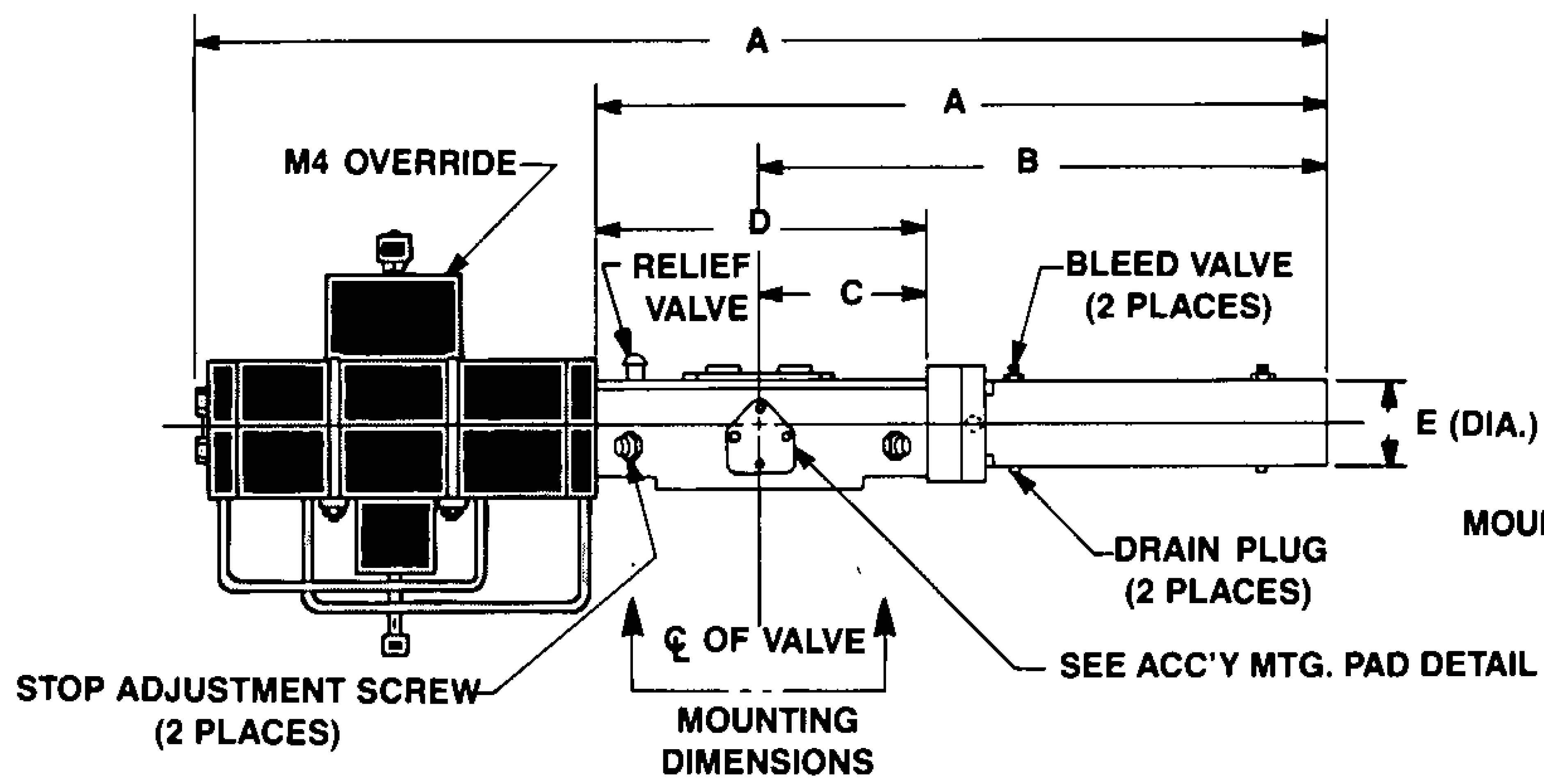


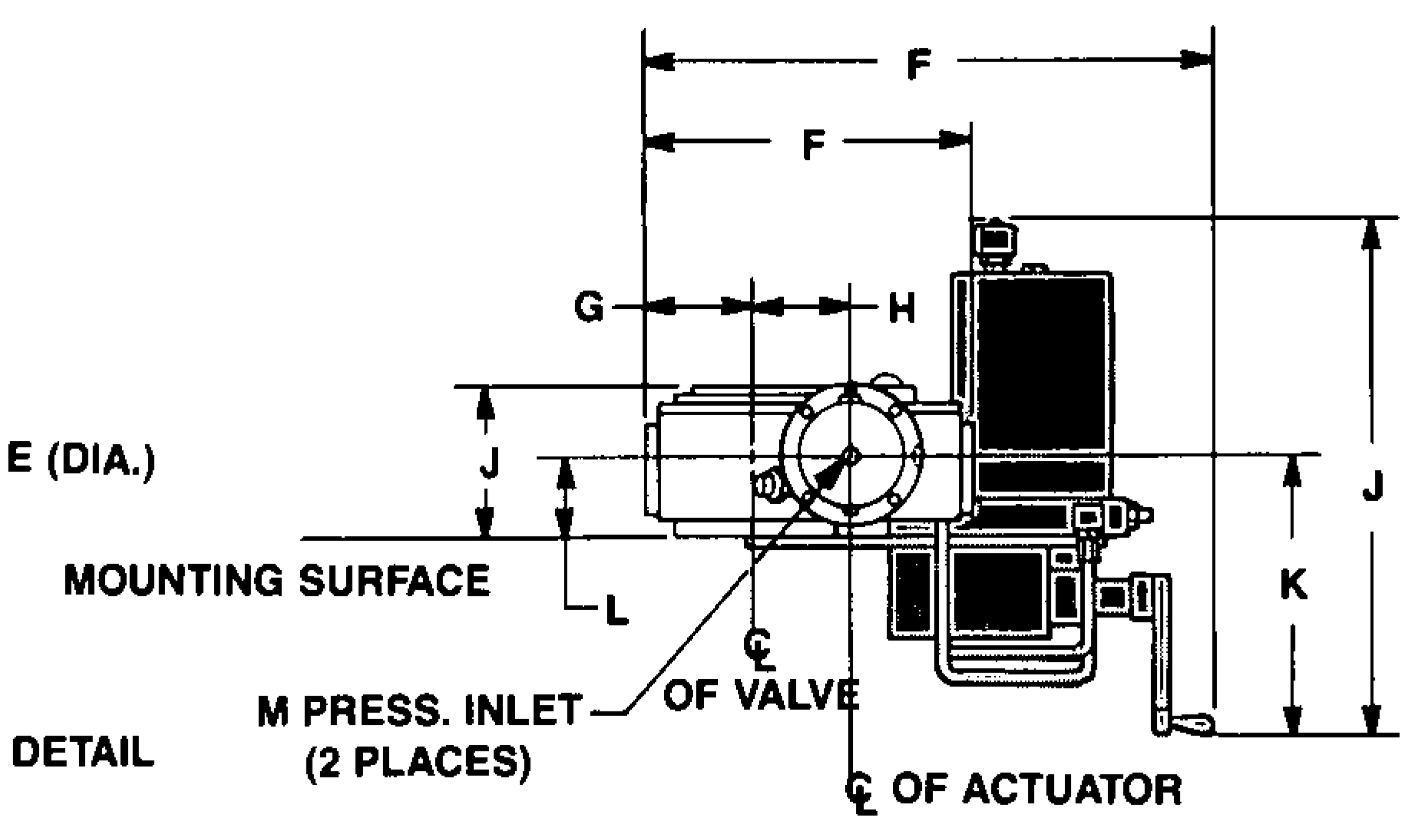


T-2 CYLINDER ORIENTATION



Actuator Model	A (shaded)	A	B	C	D	E	F (shaded)	F	G	H	J (shaded)	J	K (shaded)	L
T-201.5M	25 15/16	20 5/8	16 11/16	4 15/16	9 7/8	2 1/2	11 9/16	9 3/16	3 5/8	2 1/2	8	5 1/8	4	2 9/16
T-202.0M														
T-302.7M	38 1/2	31 5/16	24 11/16	6 5/16	12 5/8	3 1/2	13 15/16	11 3/8	3 5/8	2 13/16	14 5/8	7 7/8	7 1/2	3 15/16
T-303.0M	38	30 13/16	24 3/16			4 1/4								
T-304.0M						4 11/32								

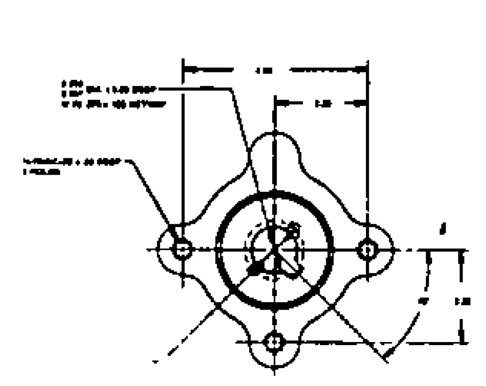




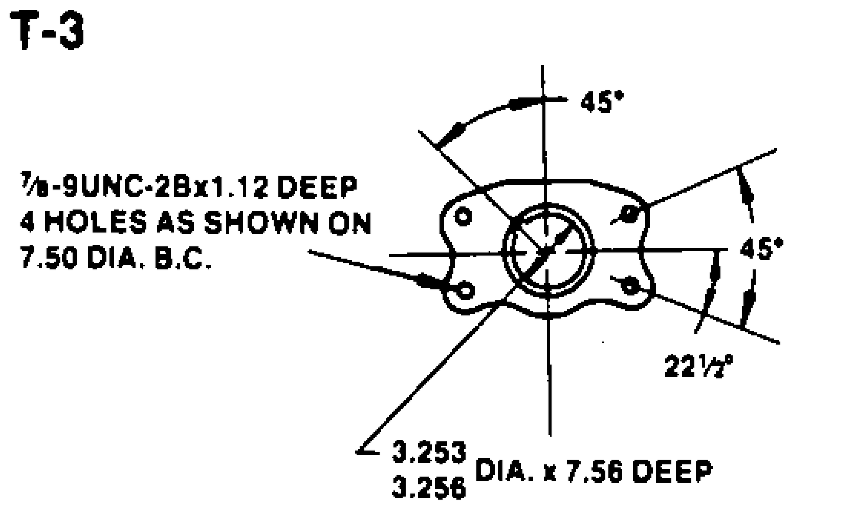
Actuator Model	A (shaded)	A	B	C	D	E	F (shaded)	F	G	H	J (shaded)	J	K (shaded)	L	M
T-302.7	48	31 5/16	24 11/16	6 5/16	12 5/8	3 1/2	23 3/16	11 3/8	3 5/8	2 13/16	20 9/16	7 7/8	12 1/8	3 15/16	9/16-18 UNF
T-303.5	47	30 13/16	24 3/16			4 1/4									
T-304.0						4 11/32									
T-402.7	52 3/8	36 9/16	26 7/8	8 1/2	17	3 1/2	24 7/16	14 3/16	4 5/8	4	20 9/16	8 1/2	12 1/8	4 3/16	9/16-18 UNF
T-403.5	51 7/8	36 1/16	26 3/8			4 1/4									
T-404.0						4 11/32									
T-505	69 3/8	48	34 13/16	12	24	5 7/8	30 3/4	19 7/8	7 13/16	5 1/2	20 9/16	8 11/16	13 1/8	4 13/16	3/8 NPT
T-507						8									
T-805	86 9/16	60 3/4	43 11/16	15	30	5 7/8	33 1/4	23 9/16	7 13/16	8	20 9/16	8 3/8	13 1/8	4 3/16	3/8 NPT
T-807						8									

Mounting Dimensions (View A-A)

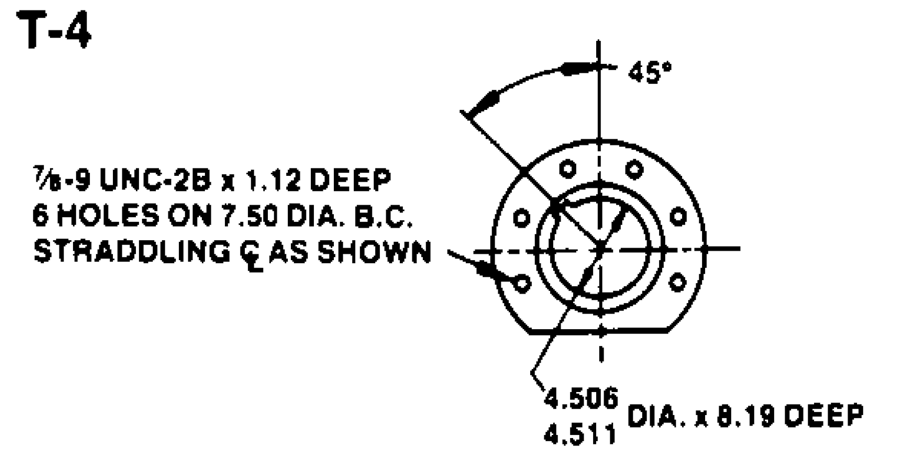
T-2



T-3

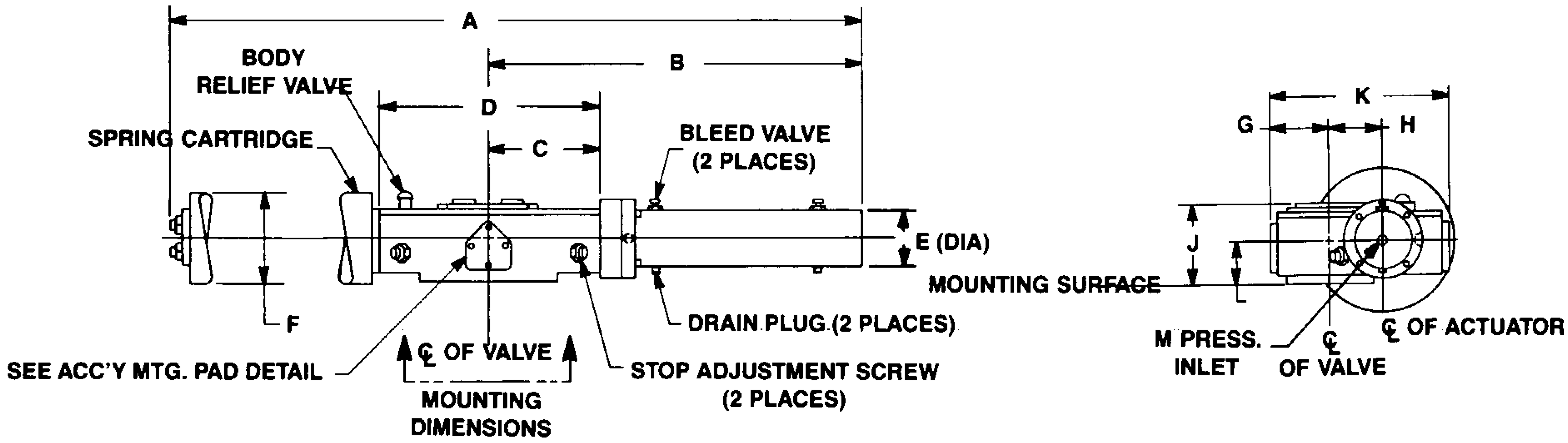


T-4

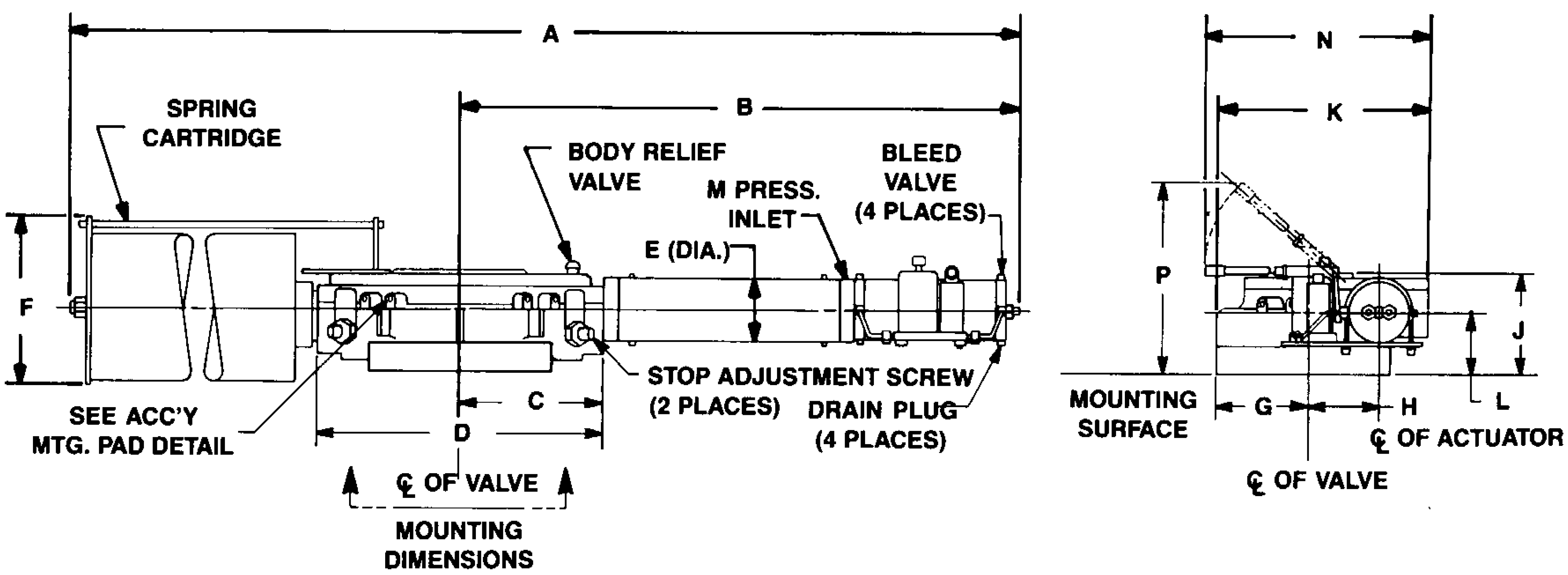


NOTE: ACTUATOR SHOWN ROTATED TO THE FULL CLOCKWISE POSITION.

Dimensions — T Series (Cont.)

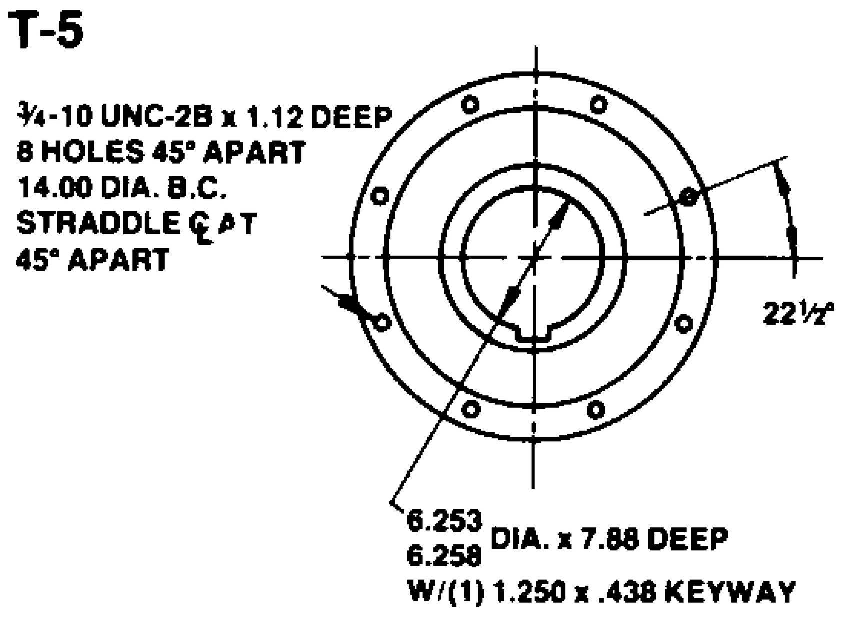


Actuator Model	Spring Size SR1	SR2	SR3	SR4	SR5	B	C	D	E	Spring Size SR1	SR2	SR3	SR4	SR5	G	H	J	K	L	M
	Dimension A									Dimension F										
T-302.7-SR	70 3/8	61 1/2	63	63	66 3/8	24 11/16	6 5/16	12 5/8	3 1/2	11 3/8	10 3/4	7	7	7	3 5/8	2 13/16	7 3/4	11 7/16	3 15/16	9/16-18 UNF
T-303.5-SR	69 7/8	61	62 1/2	62 1/2	65 7/8	24 3/16			4 1/2											
T-402.7-SR	70 11/16	74 25/32	65 5/8	67 29/32	70 11/16	26 7/8	8 1/2	17	3 1/2	11 3/8	10 3/4	7	7	7	4 5/8	4	8 1/2	14 3/16	4 3/16	9/16-18 UNF
T-403.5-SR	70 3/16	74 9/32	65 1/8	65 13/32	68 3/16	26 3/8			4 1/4											
T-404.0-SR									4 11/32											
T-505-SR	121 3/16	110 3/4	96 3/8	103	—	34 13/16	12	24	5 7/8	13 9/16	13 3/16	12 13/16	12 13/16	—	7 13/16	5 1/2	8 11/16	19 7/8	4 13/16	3/8-NPT
T-507-SR									8											
T-805-SR	—	113 7/16	122 3/4	131 15/16	115 3/16	43 11/16	15	30	5 7/8	—	13 9/16	13 3/16	13 3/16	12 13/16	7 13/16	8	8 3/8	23 9/16	4 3/16	3/8-NPT
T-807-SR									8											

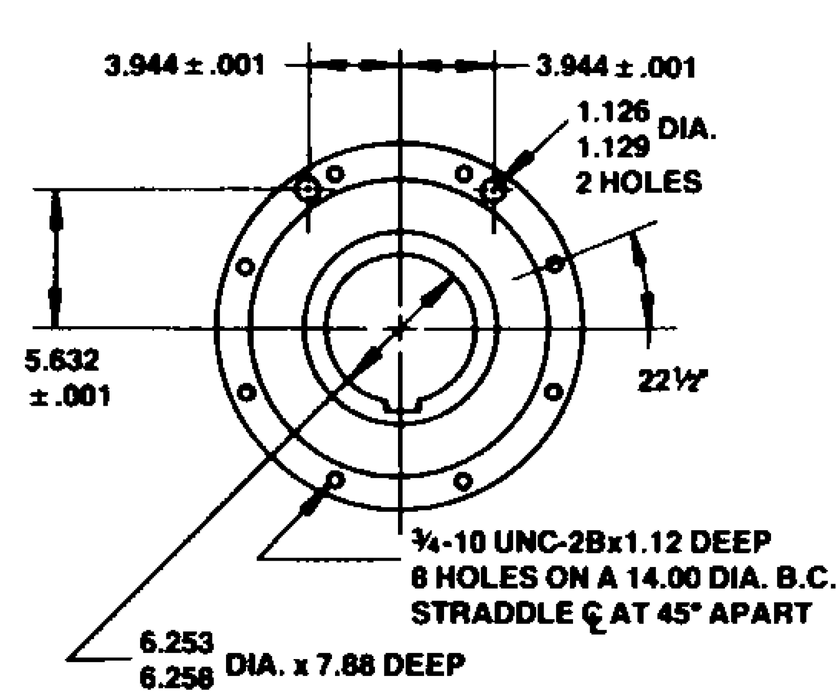


Actuator Model	Spring Size SR1	SR2	SR3	SR4	SR5	B	C	D	E	Spring Size SR1	SR2	SR3	SR4	SR5	G	H	J	K	L	M	N	P
	Dimension A									Dimension F												
T-505-SR-M7	142 3/4	132	117 5/8	124 1/4	—	55 3/8	12	24	5 7/8	13 9/16	13 9/16	12 13/16	12 13/16	—	7 13/16	5 1/2	8 11/16	19 7/8	4 13/16	3/8-NPT	37 7/8	34 13/16
T-507-SR-M7									8													
T-805-SR-M7	—	161 1/8	150 3/8	159 3/8	142 5/8	70 3/4	15	30	5 7/8	—	13 9/16	13 3/16	13 3/16	12 13/16	7 13/16	8	8 3/8	23 9/16	4 3/16	3/8-NPT	39 1/16	34 3/16
T807-SR-M7									8													

T-5



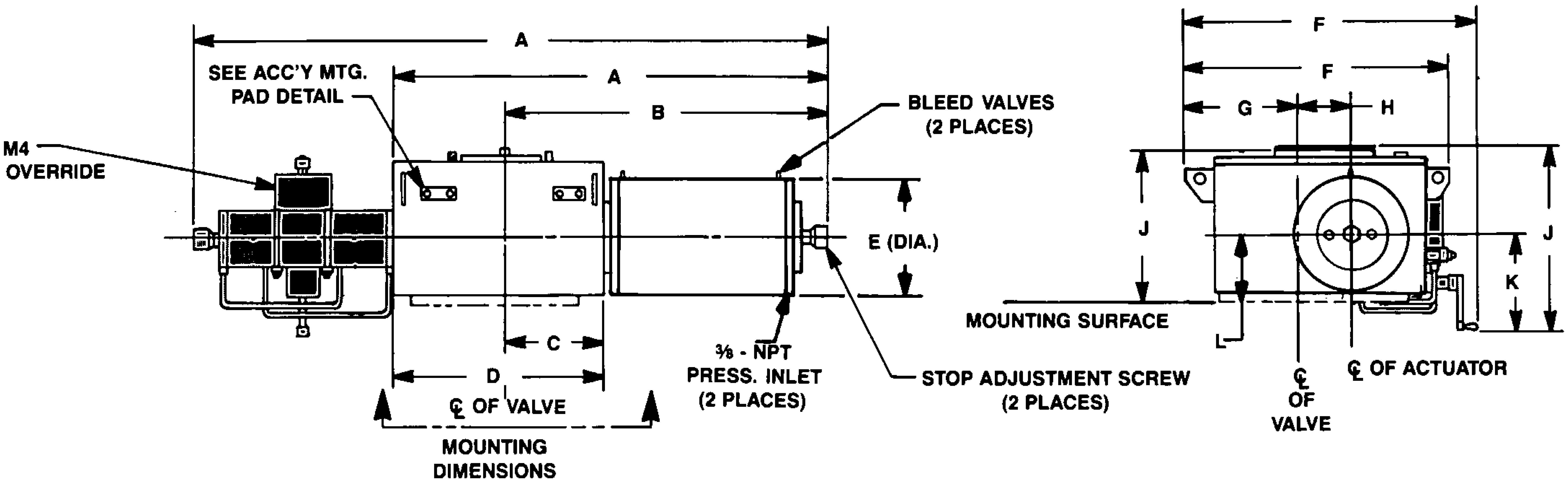
T-8



Certified dimensional drawings available on request. Contact factory with correct model designation and serial number.

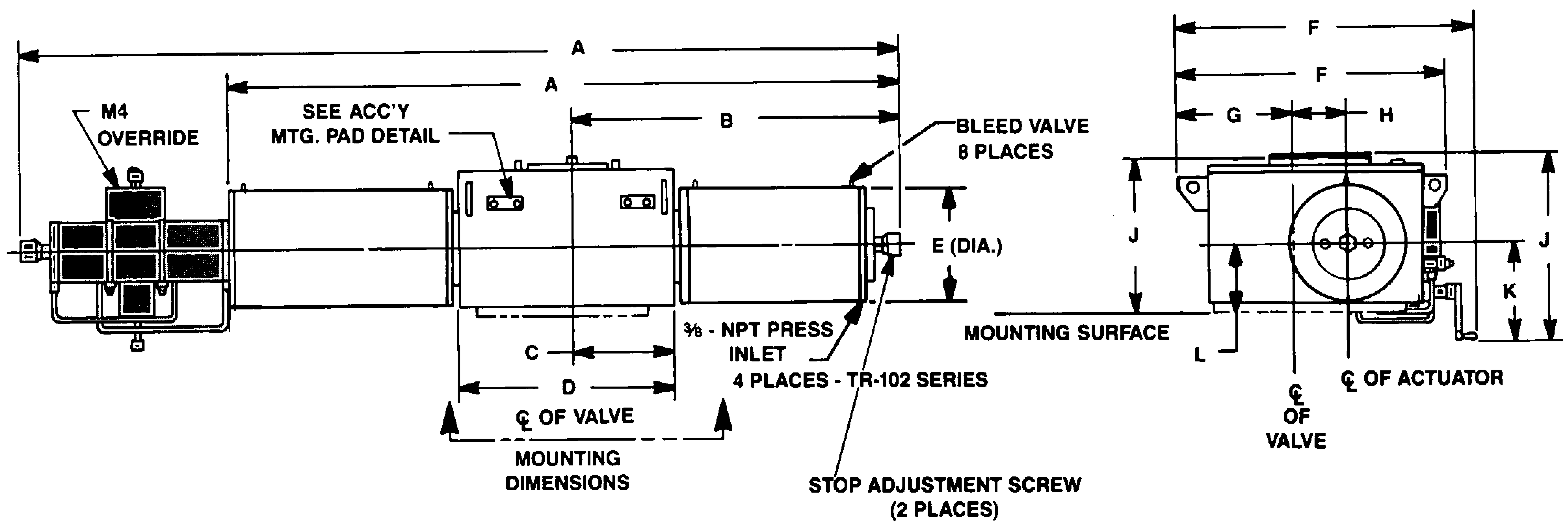
Dimensions — TR Series

Double-Acting with M4 Hydraulic Override



ACTUATOR MODEL	A	A	B	C	D	E	F	F	G	H	J	J	K	L
TR-1007 TR-1007-M4	112 3/8	62 15/16	56 3/16	19 1/2	39	8	43 7/8	38 1/4	14 1/2	10 1/4	20 1/4	13 7/8	14 5/8	8 1/4
TR-1010 TR-1010-M4						11								

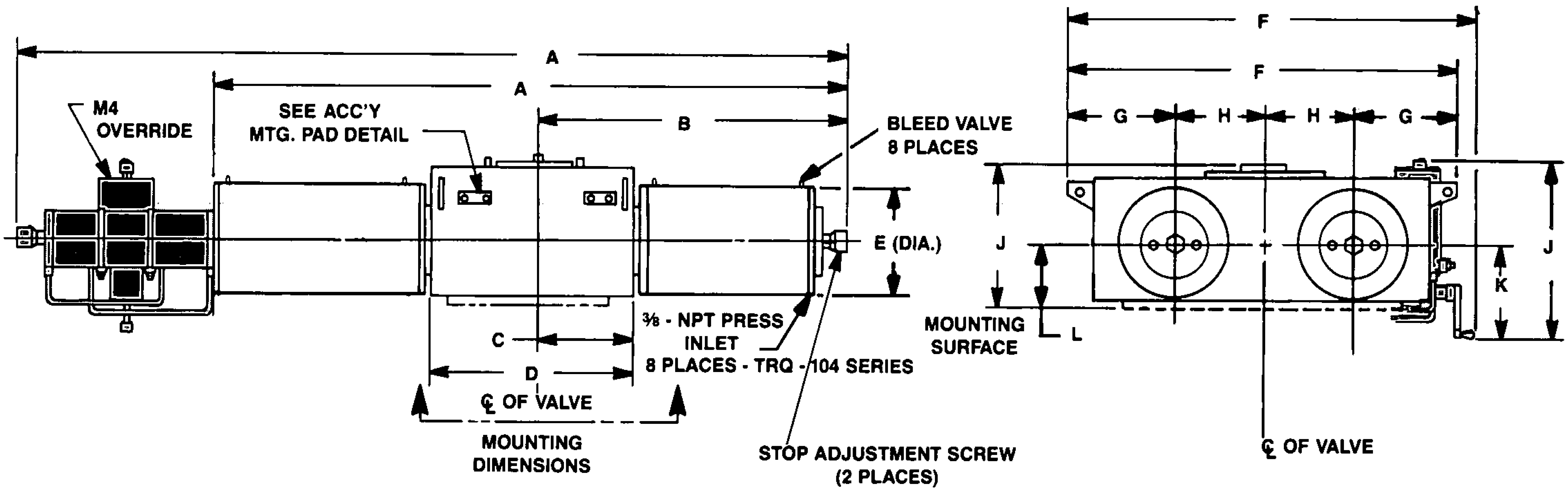
Double-Acting with M4 Hydraulic Override



ACTUATOR MODEL	A	A	B	C	D	E	F	F	G	H	J	J	K	L
TR-10207 TR-10207-M4	143 13/16	112 3/8	56 3/16	19 1/2	39	8	43 7/8	38 1/4	14 1/2	10 1/4	20 1/4	13 7/8	14 5/8	8 1/4
TR-10210 TR-10210-M4						11								

Dimensions — TRQ Series

Double-Acting with M4 Hydraulic Override



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<tr><th>ACTUATOR MODEL</th><th>A</th><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>F</th><th>G</th><th>H</th><th>J</th><th>J</th><th>K</th><th>L</th></tr>
<tr><td>TRQ-10407
TRQ-10407-M4</td><td rowspan="2">143 13/16</td><td rowspan="2">112⅜</td><td rowspan="2">56 3/16</td><td rowspan="2">19½</td><td rowspan="2">39</td><td>8</td><td rowspan="2">53⅛</td><td rowspan="2">47½</td><td rowspan="2">13½</td><td rowspan="2">10¼</td><td rowspan="2">20¼</td><td rowspan="2">13⅞</td><td rowspan="2">14⅝</td><td rowspan="2">8¼</td></tr>
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TRQ-10410-M4</td><td>11</td></tr>
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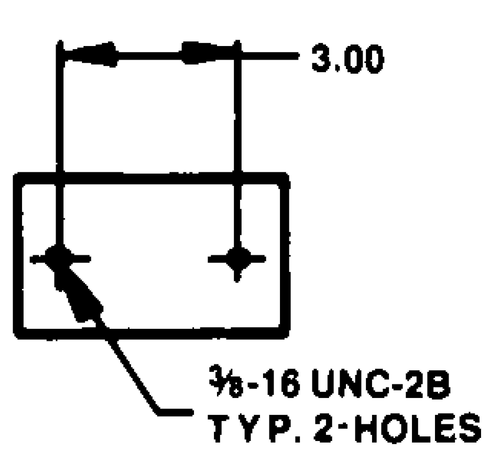
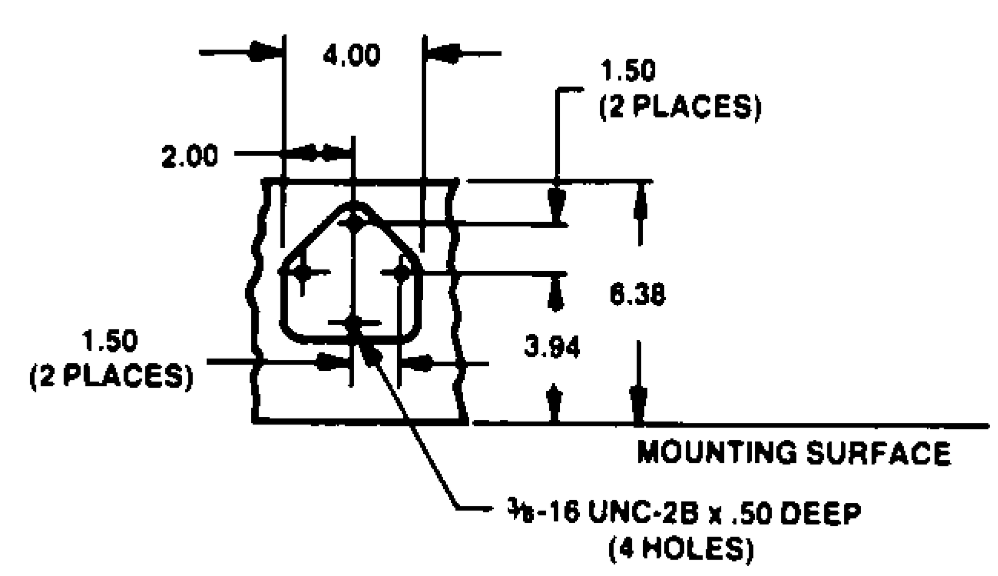
Accessory Mounting Pad Detail

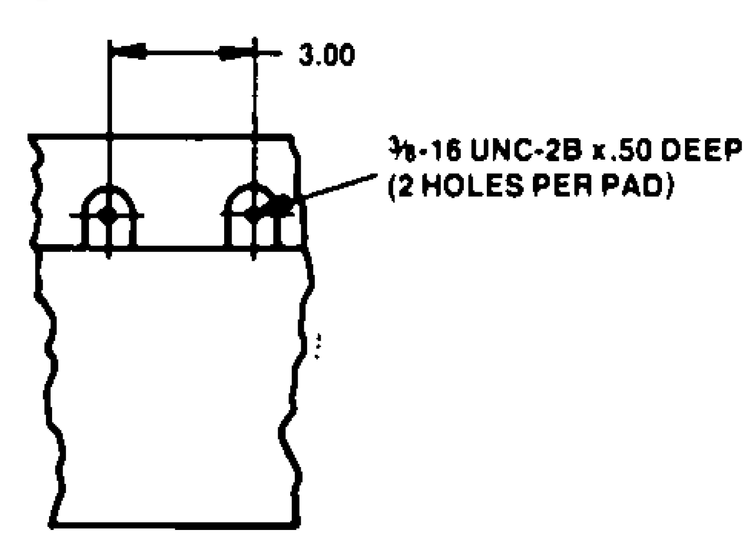
T-2



T-3, T-4, T-8



T-5



Certified dimensional drawings available on request. Contact factory with correct model designation and serial number.