ENGINEERING DATA. 1

Quincy
ORTMAN CYLINDERS

Common Fluid Power Formulas

Property	Word Formula	Mathematic Equation
Fluid Pressure psi *(Pounds per Square Inch)*	$\text{Pressure} = \frac{\text{Force (lbs)}}{\text{Area (in}^2\text{)}}$	$P = \frac{F}{A}$
Cylinder Area Extend in^2 *(Square Inches)*	$\text{Area} = \pi/(4 \times \text{Bore Diameter}^2)$	$A = .7854\ D^2$
Cylinder Area Retract (w/rod) in^2 *(Square Inches)*	$\text{Area} = (\pi/4 \times \text{Bore Diameter}^2) - (\pi/4 \times \text{Rod Diameter}^2)$	$A = (.7854\ D_b^2) - (.7854\ D_r^2)$
Cylinder Force lbs. *(Pounds of Force)*	Force = Pressure (psi) x Net Area (in^2)	$F = PA$
Cylinder Velocity ft/s *(Feet per Second)*	$\text{Velocity} = \frac{231 \times \text{Flow Rate (GPM)}}{12 \times 60 \times \text{Net Area (in}^2\text{)}}$	$v = \frac{.3208\ Q}{A}$
Cylinder Volume G *(Gallons of Fluid)*	$\text{Volume} = \frac{\text{Net Area (in}^2\text{)} \times \text{Stroke (in)}}{231}$	$V = \frac{A\ L}{231}$
Cylinder Flow Rate GPM *(Gallons per Minute)*	$\text{Flow Rate} = \frac{12 \times 60 \times \text{Velocity (ft/s)} \times \text{Net Area (in}^2\text{)}}{231}$	$Q = 3.117\ v\ A$
Cylinder Power hp *(Horsepower)*	$\text{Horsepower} = \frac{\text{Pressure (psi)} \times \text{Flow Rate (GPM)}}{1714}$	$hp = \frac{P\ Q}{1714}$
Fluid Motor Torque lb-in *(Inch Pounds)*	$\text{Torque} = \frac{\text{Pressure (psi)} \times \text{F.M. Displacement (in}^3\text{/rev.)}}{2\pi}$	$T = \frac{P\ d}{2\pi}$
	$\text{Torque} = \frac{\text{Horsepower} \times 63025}{\text{RPM}}$	$T = \frac{63025\ hp}{n}$
	$\text{Torque} = \frac{\text{Flow Rate (GPM)} \times \text{Pressure (psi)} \times 36.77}{\text{RPM}}$	$T = \frac{36.77\ Q\ P}{N}$
Fluid Motor Speed RPM *(Revolutions per Minute)*	$\text{Speed} = \frac{231 \times \text{Flow Rate (GPM)}}{\text{F.M. Displacement (in}^3\text{/rev.)}}$	$n = \frac{231\ Q}{d}$
Fluid Motor Power hp *(Horsepower)*	$\text{Horsepower} = \frac{\text{Torque (lbs-in)} \times \text{RPM}}{63025}$	$hp = \frac{T\ n}{63025}$
Pump Outlet Flow GPM *(Gallons per Minute)*	$\text{Flow} = \frac{\text{RPM} \times \text{Pump Displacement (in}^3\text{/rev.)}}{231}$	$Q = \frac{n\ d}{231}$
Flow Rate Through Piping ft/s Velocity *(Feet per Second)*	$\text{Velocity} = \frac{.3208 \times \text{Flow Rate Through I.D. (GPM)}}{\text{Internal Area (in}^2\text{)}}$	$v = \frac{.3208\ Q}{A}$

Cylinder Selections and Forces

Product Overview

Quincy Ortman Cylinders offers a variety of cylinder models to meet various industry applications.

3TH Series
Heavy Duty Hydraulic Service
3000 psi Pressure Rating
1.50" – 20.00" Bore
NFPA
3TH series cylinders anticipate the ever increasing demands of industry for cylinders with higher pressure ratings, longer service life, and reduced maintenance. This robust cylinder offer 18 NFPA/JIC mounting styles and 7 rod end styles in bore sizes from 1.50" to 20.00". Though primarily designed for hydraulic service, the 3TH series cylinder may also be used for pneumatic service up to pressures of 750 psi.

3TH Pressure Ratings

Bore Size (in.)	Operating Pressures @ Estimated Safety Factors (based on yield) Shown			
	Recommended	4/1	2/1	Proof*
1.50	3000	2030	4060	5000
2.00	3000	2340	4680	5000
2.50	3000	2130	4260	5000
3.25	3000	2375	4750	5000
4.00	3000	1910	3820	5000
5.00	3000	2300	4600	5000
6.00	3000	2125	4250	5000
7.00	3000	1960	3920	5000
8.00	3000	1980	3960	5000
10.00	3000	2190	4380	5000
12.00	3000	2100	4200	5000
14.00	3000	2010	4020	5000
16.00	3000	1980	3965	5000
18.00	3000	2000	3995	5000
20.00	3000	1570	3140	5000

*Proof pressures may also be considered as maximum operating pressure under non-shock conditions. For applications where operating pressures exceed 3000 psi consult factory for recommendations, also see appropriate mounting styles for operating pressure limitations.

7L Series
Pressure Rated Hydraulic Service
Up to 1500 psi
1.50" – 14.00" Bore
NFPA
7L series cylinders are slightly smaller for hydraulic applications requiring less pressure to operate. 7L series cylinders range in bore size from 1.50" to 14.00". They offer 21 mounting and 7 rod end styles in accordance with NFPA/JIC guidelines.

7L Pressure Ratings

Bore Size (in.)	Operating Pressures @ Estimated Safety Factors (based on yield) Shown		
	4/1	3/1	2/1
1.50	2030	2710	
2.00	1045	1395	2090
2.50	1115	1485	2230
3.25	990	1320	1980
4.00	700	935	1400
5.00	680	910	1360
6.00	575	765	1150
8.00	510	680	1020
10.00	345	460	690
12.00	330	440	660
14.00	330	440	660

7K Series
Heavy Duty Pneumatic Service
250 psi Pressure Rating
1.50" – 20.00" Bore
NFPA
7K series cylinders are built rugged for industry's toughest pneumatic applications. 7K series cylinders incorporate hard chrome bore tubing for long lasting operation and are available in 21 NFPA/JIC mounting styles. They also offer 7 different rod end style and can be ordered in 1.50" to 20.00" bore sizes.

AS/ASH Series
Aluminum Air/Hydraulic Service
250 psi Air – 500 psi Hydraulic
1.50" – 8.00" Bore
NFPA
The AS series cylinder is a new innovative design from the creative team at Quincy Ortman Cylinders. This multi-service cylinder design utilizes precision extruded aluminum tubing unique to Quincy Ortman Cylinders. Channels in the extruded tubing make adding reed or hall effect switches simple. The all aluminum cylinder body is durable, lightweight, and corrosion resistant. The AS Series is available in bore sizes from 1.50" to 8.00", with options to choose from 16 NFPA/JIC mounting styles and 7 rod end styles.

AS Pressure Ratings

Bore Size	Pressure Ratings by Medium	
	Pneumatic	Hydraulic
1.50 – 4.00	250	500
5.00 – 8.00	200	400

101 Series
Roundline Air/Hydraulic Service
Up to 1500 psi
1.50" – 8.00" Bore
101 series is a unique roundline, space-saving design offered in light duty and heavy duty models. This 50 year old proven design has remained primarily unchanged and has served exceptionally in the toughest industrial environments. 101 series cylinders can be utilized in both pneumatic and hydraulic applications. They can be ordered in bores sizes from 1.50" to 8.00" with one of 8 mounting styles available.

101 Pressure Ratings

Bore Size	Light Duty		Heavy Duty	
	Air	Hyd.	Air	Hyd.
1.50 – 8.00	150	500	500	1500

FA Series
Knife Gate Pneumatic Valve Service
150 psi Pressure Rating
2.50" – 24.00" Bore
The FA series Pneumatic Knife Gate Cylinder offers a lightweight, compact tie rod cylinder capable of pressures up to 150 psi. This design is widely used throughout the valve industry and can be used in a variety of other applications requiring light duty pneumatic actuators.

7P Series
Air/Oil Booster
The 7P series air/oil booster provides an efficient answer to your clamping system or high-pressure hydraulic system needs. As a viable alternative to specialized power units, the 7P booster converts pneumatic pressure to hydraulic pressure in a cost-effective manner. Hydraulic output pressure is proportional to the pneumatic pressure relative to the piston and ram areas. Booster ratios range from 2:1 up to 36:1. Boosters are available in bore sizes from 3.25" to 14.00". Oil tanks can also be integrated into the booster design.

7R Series
Air/Oil Tanks
7R series air/oil tanks are an all steel design with a sight glass for gauging oil levels within the tank. 7R tanks can be pressurized to 250 psi to supply hydraulic fluid to low pressure hydraulic circuits. Tanks are available in bore sizes from 3.25" to 14.00".

Cylinder Sections and Forces

Cylinder Force

Cylinder force is the product of fluid pressure acting against the area of a cylinder piston. The formula for cylinder force; Force = Pressure (psi) x Area (in^2), can be used to calculate both cylinder extend and retract forces. It is important to remember, when calculating retract forces that the area displaced by the piston rod must be subtracted from the total area of the piston.

Extend Force
$F = P\ A_p$

Where:
F = Force (lbs.)
P = Pressure (psi)
A_p = Piston Area (in^2)

Retract Force
$F = P\ (A_p - A_r)$

Where:
F = Force (lbs.)
A_p = Piston Area (in^2)
A_r = Rod Area (in^2)

Use the Theoretical Cylinder Force tables on this page by tracking the cylinder bore and rod combination with respect to pressure to find force. Rows labeled EXTEND in the Rod column are for extend or push forces, no rod diameter considered in force calculation.

Bore	Rod	Effective Area	Theoretic Forces in Pounds (PSI)											
			60	80	100	150	200	250	500	1000	1500	2000	2500	3000
1.50	**EXTEND**	**1.77**	**106**	**141**	**177**	**265**	**353**	**442**	**884**	**1767**	**2651**	**3534**	**4418**	**5301**
	0.63	1.46	88	117	146	219	292	365	730	1460	2191	2921	3651	4381
	0.75	1.33	80	106	133	199	265	331	663	1325	1988	2651	3313	3976
	1.00	0.98	59	79	98	147	196	245	491	982	1473	1964	2454	2945
2.00	**EXTEND**	**3.14**	**188**	**251**	**314**	**471**	**628**	**785**	**1571**	**3142**	**4712**	**6283**	**7854**	**9425**
	0.63	2.83	170	227	283	425	567	709	1417	2835	4252	5670	7087	8504
	0.75	2.70	162	216	270	405	540	675	1350	2700	4050	5400	6750	8099
	1.00	2.36	141	188	236	353	471	589	1178	2356	3534	4712	5891	7069
	1.38	1.66	99	133	166	249	331	414	828	1657	2485	3313	4142	4970
2.50	**EXTEND**	**4.91**	**295**	**393**	**491**	**736**	**982**	**1227**	**2454**	**4909**	**7363**	**9818**	**12272**	**14726**
	0.63	4.60	276	368	460	690	920	1150	2301	4602	6903	9204	11505	13806
	1.00	4.12	247	330	412	619	825	1031	2062	4123	6185	8247	10308	12370
	1.38	3.42	205	274	342	514	685	856	1712	3424	5136	6848	8560	10272
	1.75	2.50	150	200	250	376	501	626	1252	2503	3755	5007	6259	7510
3.00	**EXTEND**	**7.07**	**424**	**565**	**707**	**1060**	**1414**	**1767**	**3534**	**7069**	**10603**	**14137**	**17672**	**21206**
	1.00	6.28	377	503	628	942	1257	1571	3142	6283	9425	12566	15708	18850
3.25	**EXTEND**	**8.30**	**498**	**664**	**830**	**1244**	**1659**	**2074**	**4148**	**8296**	**12444**	**16592**	**20739**	**24887**
	1.00	7.51	451	601	751	1127	1502	1878	3755	7510	11266	15021	18776	22531
	1.38	6.81	409	545	681	1022	1362	1703	3405	6811	10216	13622	17027	20433
	1.75	5.89	353	471	589	884	1178	1473	2945	5891	8836	11781	14726	17672
	2.00	5.15	309	412	515	773	1031	1289	2577	5154	7731	10308	12885	15463
3.50	**EXTEND**	**9.62**	**577**	**770**	**962**	**1443**	**1924**	**2405**	**4811**	**9621**	**14432**	**19242**	**24053**	**28863**
	1.25	8.39	504	672	839	1259	1679	2098	4197	8394	12591	16788	20985	25182
4.00	**EXTEND**	**12.57**	**754**	**1005**	**1257**	**1885**	**2513**	**3142**	**6283**	**12566**	**18850**	**25133**	**31416**	**37699**
	1.00	11.78	707	942	1178	1767	2356	2945	5891	11781	17672	23562	29453	35343
	1.25	11.34	680	907	1134	1701	2268	2835	5670	11339	17009	22678	28348	34018
	1.38	11.08	665	887	1108	1662	2216	2770	5541	11082	16622	22163	27704	33245
	1.75	10.16	610	813	1016	1524	2032	2540	5081	10161	15242	20322	25403	30483
	2.00	9.42	565	754	942	1414	1885	2356	4712	9425	14137	18850	23562	28274
	2.50	7.66	459	613	766	1149	1532	1914	3829	7658	11486	15315	19144	22973
5.00	**EXTEND**	**19.64**	**1178**	**1571**	**1964**	**2945**	**3927**	**4909**	**9818**	**19635**	**29453**	**39270**	**49088**	**58905**
	1.00	18.85	1131	1508	1885	2827	3770	4712	9425	18850	28274	37699	47124	56549
	1.38	18.15	1089	1452	1815	2723	3630	4538	9075	18150	27225	36300	45375	54450
	1.50	17.87	1072	1429	1787	2680	3574	4467	8934	17868	26802	35736	44670	53604
	1.75	17.23	1034	1378	1723	2584	3446	4307	8615	17230	25845	34459	43074	51689
	2.00	16.49	990	1319	1649	2474	3299	4123	8247	16493	24740	32987	41234	49480
	2.50	14.73	884	1178	1473	2209	2945	3682	7363	14726	22089	29453	36816	44179
	3.00	12.57	754	1005	1257	1885	2513	3142	6283	12566	18850	25133	31416	37699
6.00	**EXTEND**	**28.27**	**1696**	**2262**	**2827**	**4241**	**5655**	**7069**	**14137**	**28274**	**42412**	**56549**	**70686**	**84823**
	1.38	26.79	1607	2143	2679	4018	5358	6697	13395	26790	40184	53579	66974	80369
	1.75	25.87	1552	2070	2587	3880	5174	6467	12935	25869	38804	51738	64673	77607
	2.00	25.13	1508	2011	2513	3770	5027	6283	12566	25133	37699	50266	62832	75398
	2.50	23.37	1402	1869	2337	3505	4673	5841	11683	23366	35048	46731	58414	70097
	3.00	21.21	1272	1696	2121	3181	4241	5301	10603	21206	31809	42412	53015	63617
7.00	**EXTEND**	**38.48**	**2309**	**3079**	**3848**	**5773**	**7697**	**9621**	**19242**	**38485**	**57727**	**76969**	**96212**	**115454**
	3.00	31.42	1885	2513	3142	4712	6283	7854	15708	31416	47124	62832	78540	94248
	3.50	28.86	1732	2309	2886	4330	5773	7216	14432	28863	43295	57727	72159	86590
	4.00	25.92	1555	2073	2592	3888	5184	6480	12959	25918	38877	51836	64796	77755
	4.50	22.58	1355	1806	2258	3387	4516	5645	11290	22580	33870	45161	56451	67741
	5.00	18.85	1131	1508	1885	2827	3770	4712	9425	18850	28274	37699	47124	56549
8.00	**EXTEND**	**50.27**	**3016**	**4021**	**5027**	**7540**	**10053**	**12566**	**25133**	**50266**	**75398**	**100531**	**125664**	**150797**
	1.38	48.78	2927	3902	4878	7317	9756	12195	24390	48781	73171	97561	121952	146342
	1.75	47.86	2872	3829	4786	7179	9572	11965	23930	47860	71790	95721	119651	143581
	2.00	47.12	2827	3770	4712	7069	9425	11781	23562	47124	70686	94248	117810	141372
	2.50	45.36	2721	3629	4536	6804	9071	11339	22678	45357	68035	90714	113392	136071
	3.00	43.20	2592	3456	4320	6480	8639	10799	21599	43197	64796	86394	107993	129591
	3.50	40.64	2439	3252	4064	6097	8129	10161	20322	40644	60967	81289	101611	121933
	4.00	37.70	2262	3016	3770	5655	7540	9425	18850	37699	56549	75398	94248	113098
	4.50	34.36	2062	2749	3436	5154	6872	8590	17181	34361	51542	68723	85903	103084
	5.00	30.63	1838	2450	3063	4595	6126	7658	15315	30631	45946	61261	76577	91892
	5.50	26.51	1590	2121	2651	3976	5301	6627	13254	26507	39761	53015	66268	79522

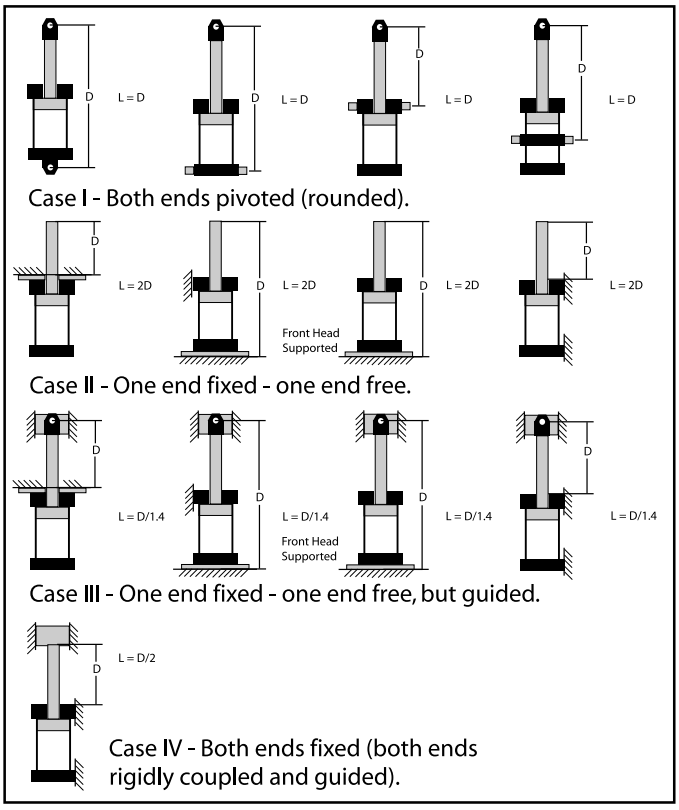
Rod Strength and Support

The Piston Rod in a cylinder acts as a column and, as such, is subjected not only to compressive stresses, but also buckling stresses which are a function of the moment of inertia for a constant modulus of elasticity. The "column strength" of a piston rod cannot be increased by using higher tensile strength or heat treated materials. For this reason, it is sometimes necessary to use an oversize piston rod strictly for the purpose of achieving the necessary "column strength."

The data shown in chart form is based on Euler's equation for a vertical column with both ends rounded (see Case I illustration). The values shown indicate our recommended maximum "column lengths" for the various piston rods under specified compressive loads and may be considered safe for most normal cylinder applications, both horizontal and vertical. The values of "L" shown in the chart are approximately one-half of the theoretical limit of "L" as determined by this equation. Factors such as vertical or horizontal mounting, shock or non-shock loading, frequency of operation, etc., should be taken into consideration in selecting a permissible value of "L". Deviations from these recommendations are, of course, a matter of engineering judgment based on a knowledge of the application. In some vertical applications, it may be possible to use values of "L" one-third greater than those on the chart shown. On the other hand, for a long stroke, horizontally mounted cylinder subjected to shock loading, it may be desirable to decrease the value of "L" by one-third.

To determine the proper piston rod diameter for your application, proceed as follows:

1. Determine the maximum thrust required in your application.
2. Identify your installation with one of those illustrated as Case I, II, III or IV.
3. Determine the recommended stop tube length, if one is required. (See "stop tubes" on next page.)
4. Determine the value of "L" for your installation with the piston rod in the fully extended position.
5. Now, referring to the chart, select the thrust figure that equals or exceeds your requirements.
6. Scan to the right on the chart until the value of "L" equals or exceeds the "L" dimension on your cylinder installation.
7. In some cases the recommended piston rod diameter may exceed that of the largest piston rod available for the cylinder under consideration. If this happens, it may be necessary to use a larger bore cylinder, operating at a reduced pressure, in order to obtain the required column strength.



VALUES OF "L" IN INCHES

	Piston Rod Diameters														
Thrust Load in Lbs.	**⅝**	**1**	**1⅜**	**1¾**	**2**	**2½**	**3**	**3½**	**4**	**4½**	**5**	**5½**	**7**	**8½**	**10**
700	28	72	137	221	288										
800	27	68	128	207	270										
900	25	64	120	195	254										
1,000	24	61	114	187	241										
1,200	22	55	104	169	220										
1,400	20	51	97	156	204										
1,600	19	48	90	146	191	298									
1,800	18	45	85	138	180	281									
2,000	17	43	81	131	171	267									
2,200	16	41	77	125	163	255									
2,600	15	38	71	115	150	234									
3,000	14	35	66	107	139	218									
4,000	12	30	57	93	121	189	271								
5,000	11	27	50	83	108	169	243	330							
6,000	10	25	47	76	99	154	222	302							
7,000	9	23	43	70	91	143	205	279	365						
8,000	8	22	41	66	85	133	192	261	341						
9,000		20	38	62	81	126	181	246	322	407					
10,000		19	36	59	76	119	172	234	305	386	477				
12,500		17	32	52	68	107	154	209	273	345	426				
15,000		16	30	48	63	98	140	191	249	315	389	471			
17,500		14	27	44	58	90	130	177	231	292	360	436			
20,000		13	26	42	54	84	121	165	216	273	337	408			
25,000		12	23	37	48	76	109	148	193	244	302	365			
30,000			21	34	44	69	99	136	176	223	275	333	530		
40,000			18	29	38	60	86	117	153	193	238	289	460		
50,000				26	34	54	77	105	137	173	213	258	429		
60,000				24	31	49	70	96	125	158	195	236	375		
80,000					27	42	61	83	108	137	169	204	322	537	
100,000					24	38	55	74	97	122	151	182	291	486	
120,000						35	50	68	88	112	138	167	266	443	
150,000								61	79	100	123	149	238	397	493
200,000										87	107	129	206	344	427
250,000										77	96	115	184	307	382
300,000												106	168	281	348
350,000												98	156	260	322
400,000												91	146	243	302
450,000												86	137	229	284
500,000													132	196	270
550,000													126	187	257
600,000													120	179	246
650,000													116	172	236
700,000													111	166	228
800,000														154	213
900,000														145	201
1,000,000														138	191

Rod Strength and Support

Internal Stops

A stop collar (Fig. 1) or stop tube is a tube or collar assembled between the head end cover and the cylinder piston. The function of a stop collar/tube is to act as a spacer to increase the distance between the piston and the rod bearing (located in the head end cover) when the piston rod is in fully extended position. This increase in spacing serves to reduce bearing loads and, at the same time, increases the structural rigidity of the assembly to prevent buckling and jack-knifing. Stop collars/tubes offer no additional bearing surface and no benefit during mid-stroke. Benefits are gained only at full extension.

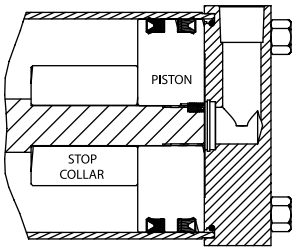


Fig.1

Dual piston stops (Fig. 2) are designed with two pistons on the piston rod separated by a spacer of calculated length. Dual pistons offer bearing separation at any position during operation. More importantly, in applications where side-loading may be present, dual pistons offer additionally bearing surface. Optional wearbands can be added to the pistons to alleviate metal to metal contact, a leading cause of malfunction in applications where side-loading occurs.

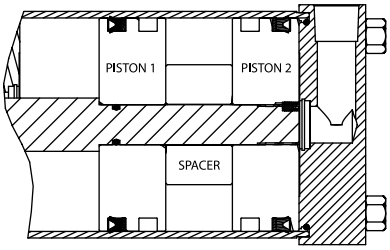


Fig. 2

The addition of an internal stop device to any cylinder will increase the net length of the cylinder body by the length of internal stop added. Thus, careful attention should be made with regard to cylinder mounts.

To determine if an internal stop is necessary, refer to the Mounting Cases and "L" Value charts on the previous page. An internal stop is recommended for cylinders mounted as shown in Cases I & II whenever "L" exceeds 40". Use one inch of additional stop for every ten inches over the basic 40" value of "L". In case of fractions, always round up to the next full inch. For example, if "L" = 83 inches, the internal stop required would be 5 inches. Cylinders mounted as those shown in Cases III and IV, typically do not require internal stops, but the decision should be based on the factors involved in the particular application under consideration.

Internal Stop Table

"L" Value (inches)	Internal Stop Length (inches)	"L" Value (inches)	Internal Stop Length (inches)
0-40	0	171-180	14
41-50	1	181-190	15
51-60	2	191-200	16
61-70	3	201-210	17
71-80	4	211-220	18
81-90	5	221-230	19
81-100	6	231-240	20
101-110	7	241-250	21
111-120	8	251-260	22
121-130	9	261-270	23
131-140	10	271-280	24
141-150	11	281-290	25
151-160	12	291-300	26
161-170	13	301-310	27

Rod Strength and Support

Supports

When considering long stroke, long bodied cylinders, it is recommended to use intermediate supports to resist cylinder sag and excessive vibration. Both may contribute to greatly reduce the life of cylinder seals and excessive wear of cylinder components. Depending upon bore size and mounting configuration, an intermediate mount or an intermediate tie rod support may be used.

Intermediate mounts (Fig. 3) should be considered when using fixed, non-centerline mounts such as side lugs (J-mount) or side tapped mount (H-mount). Fixed, centerline mounts such as flange mounts should also consider the use of an intermediate mount. The intermediate mount supports the cylinder body and prevents tie rods from twisting the cylinder body while under torque pressure.

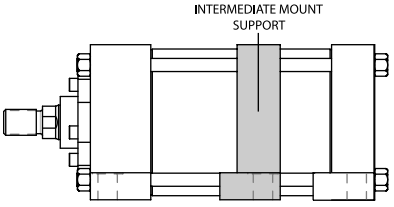


Fig. 3

Tie rod supports (Fig. 4) can be used for pivoting mounts such as clevis (G-mount), pivot (D-mount) and end cover trunnion mounts (ER/EB-mount) to support tie rods.

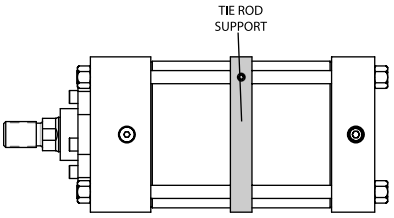


Fig. 4

The chart below may be used as a guide to determine whether supports are necessary for the application under consideration.

Intermediate Support Table

Bore Sizes by Series		Minimum Stroke Lengths for Support
3TH	7L–7K	
	1.50	50
	2.00	60
	2.50	60
1.50	3.25	75
	4.00	75
2.00	5.00	90
2.50	6.00	90
3.25	8.00	90
4.00		90
	10.00	160
	12.00	160
5.00 or larger	14.00 or larger	220

Cylinder Piston Speed

Hydraulic Cylinder Speed

Hydraulic cylinder speed is given in inches per minute and can be theoretically determined by dividing the flow rate delivered to the cylinder by the net piston area then converting to in/s. The simplified calculation for cylinder speed is:

$$v = \frac{231\ Q}{A}$$

Where: 231 = converts GPM to in^3
Q = Flow rate (GPM)
A = Net piston area (in^2)

The chart below and on the following page, reflects hydraulic piston speeds at given flow rates per bore and rod size combinations.

Bore	Rod	Effective Area	Theoretic Hydraulic Piston Speeds in Inches Per Minute (IN/M)									
			1 GPM	5 GPM	10 GPM	15 GPM	20 GPM	25 GPM	30 GPM	40 GPM	50 GPM	75 GPM
1.50	**EXTEND**	**1.77**	**131**	**653**								
	0.63	1.46	159	792								
	0.75	1.33	174									
	1.00	0.98	236									
2.00	**EXTEND**	**3.14**	**74**	**368**	**736**							
	0.63	2.83	82	409	817							
	0.75	2.70	86	428	856							
	1.00	2.36	98	490								
	1.38	1.66	140	696								
2.50	**EXTEND**	**4.91**	**48**	**236**	**471**	**706**	**941**					
	0.63	4.60	51	252	503	754						
	1.00	4.12	57	281	561	842						
	1.38	3.42	68	338	676							
	1.75	2.50	93	462	924							
3.00	**EXTEND**	**7.07**	**33**	**164**	**327**	**491**	**654**	**817**	**981**			
	1.00	6.28	37	184	368	552	736	920				
3.25	**EXTEND**	**8.30**	**28**	**140**	**279**	**418**	**557**	**696**	**835**			
	1.00	7.51	31	154	308	462	616	769	923			
	1.38	6.81	34	170	340	509	679	849				
	1.75	5.89	40	197	393	589	785	981				
	2.00	5.15	45	225	449	673	898	1122				
3.50	**EXTEND**	**9.62**	**25**	**121**	**241**	**361**	**481**	**601**	**721**	**961**		
	1.25	8.39	28	138	276	413	551	689	826			
4.00	**EXTEND**	**12.57**	**19**	**92**	**184**	**276**	**368**	**460**	**552**	**736**	**919**	
	1.00	11.78	20	99	197	295	393	491	589	785	981	
	1.25	11.34	21	102	204	306	408	510	612	815		
	1.38	11.08	21	105	209	313	417	522	626	834		
	1.75	10.16	23	114	228	342	455	569	683	910		
	2.00	9.42	25	123	246	368	491	614	736	981		
	2.50	7.66	31	151	302	453	604	754	905			
5.00	**EXTEND**	**19.64**	**12**	**59**	**118**	**177**	**236**	**295**	**353**	**471**	**589**	**883**
	1.00	18.85	13	62	123	184	246	307	368	491	613	920
	1.38	18.15	13	64	128	191	255	319	382	510	637	955
	1.50	17.87	13	65	130	194	259	324	388	518	647	970
	1.75	17.23	14	68	135	202	269	336	403	537	671	
	2.00	16.49	15	71	141	211	281	351	421	561	701	
	2.50	14.73	16	79	157	236	314	393	471	628	785	
	3.00	12.57	19	92	184	276	368	460	552	736	919	
6.00	**EXTEND**	**28.27**	**9**	**41**	**82**	**123**	**164**	**205**	**246**	**327**	**409**	**613**
	1.38	26.79	9	44	87	130	173	216	259	345	432	647
	1.75	25.87	9	45	90	134	179	224	268	358	447	670
	2.00	25.13	10	46	92	138	184	230	276	368	460	690
	2.50	23.37	10	50	99	149	198	248	297	396	495	742
	3.00	21.21	11	55	109	164	218	273	327	436	545	817
7.00	**EXTEND**	**38.48**	**7**	**31**	**61**	**91**	**121**	**151**	**181**	**241**	**301**	**451**
	3.00	31.42	8	37	74	111	148	184	221	295	368	552
	3.50	28.86	9	41	81	121	161	201	241	321	401	601
	4.00	25.92	9	45	90	134	179	223	268	357	446	669
	4.50	22.58	11	52	103	154	205	256	307	410	512	768
	5.00	18.85	13	62	123	184	246	307	368	491	613	920
8.00	**EXTEND**	**50.27**	**5**	**23**	**46**	**69**	**92**	**115**	**138**	**184**	**230**	**345**
	1.38	48.78	5	24	48	72	95	119	143	190	237	356
	1.75	47.86	5	25	49	73	97	121	145	194	242	362
	2.00	47.12	5	25	50	74	99	123	148	197	246	368
	2.50	45.36	6	26	51	77	102	128	153	204	255	382
	3.00	43.20	6	27	54	81	107	134	161	214	268	402
	3.50	40.64	6	29	57	86	114	143	171	228	285	427
	4.00	37.70	7	31	62	92	123	154	184	246	307	460
	4.50	34.36	7	34	68	101	135	169	202	269	337	505
	5.00	30.63	8	38	76	114	151	189	227	302	378	566
	5.50	26.51	9	44	88	131	175	218	262	349	436	654

Flow and Porting

Hydraulic Flow Rates

A major factor in determining the speed of a hydraulic cylinder piston is the flow through the connecting lines, generally expressed in gallons per minute (GPM), and measured as the input/exhaust flow through the cylinder cap end cover port. Due to fluid displacement of the piston rod, flow through the head end cover port will be less than the cap end cover port. Fluid velocity or line velocity, should be limited to 15 feet per second (ft/s) to minimize fluid turbulence, pressure drop, and hydraulic shock.

Hydraulic flow velocity is determined by dividing the flow in GPM required by application speed, by the effective area of the port or supply line.

$$\text{VELOCITY} = \frac{\text{FLOW (GPM)}}{\text{PORT}} \text{ or } v = \frac{Q}{A}$$

The Hydraulic Flow Rate Chart in conjunction with the Hydraulic Piston Speed Chart can be used as a guide in determining whether standard cylinder ports are adequate for the application. The Hydraulic Flow Rate Chart returns flow rates in feet per second (ft/s), by flow in GPM and port size in inches, with connecting lines using Schedule 80 pipe.

If piston speed results in fluid flow in excess of 15 ft/s for port sizes listed, consider the use of larger lines with oversized welded half coupling ports, or utilize two ports per end cover connected to provide the fluid flow required.

"This information should be used as a guide for your consideration, investigation, and verification. This information does not constitute a warranty or representation and we assume no legal responsibility or obligation with respect thereto, and the use to which such information may be put."

Port Size	Effective Area	Theoretic Hydraulic Flow Velocity in Feet Per Second (ft/s)										
		1 GPM	5 GPM	10 GPM	15 GPM	20 GPM	25 GPM	30 GPM	40 GPM	50 GPM	75 GPM	100 GPM
0.38	0.141	2.3	11.4									
0.50	0.234	1.4	6.9	13.7								
0.75	0.432		3.7	7.4	11.1	14.9						
1.00	0.719		2.2	4.5	6.7	8.9	11.2	13.4				
1.25	1.282		1.3	2.5	3.8	5.0	6.3	7.5	10.0	12.5		
1.50	1.766			1.8	2.7	3.6	4.5	5.5	7.3	9.1	13.6	
2.00	2.951			1.1	1.6	2.2	2.7	3.3	4.3	5.4	8.2	10.9
2.50	4.236				1.1	1.5	1.9	2.3	3.0	3.8	5.7	7.6
3.00	6.600					1.0	1.2	1.5	1.9	2.4	3.6	4.9

Port Sizes and Options

Quincy Ortman Cylinders designates cylinder port positions by numbering the positions 1 through 4 clockwise around the head end view of the cylinder. Position 5 is used to call out the axial center position of the cap end cover face. Cylinders can be ordered with ports in any position to facilitate installation. In most instances, port position can be obtained by rotating the head or cap end cover during assembly, other times the port is machine into an alternate position to maintain the correct orientation to the mounting style. Cylinder ports can be ordered in any position, based on the mounting configuration. Additional ports may also be supplied.

Quincy Ortman designates position #1 as the standard port location. Other than standard port locations must be specified on customer orders. NPTF dryseal cylinder ports are supplied as standard and will be supplied unless otherwise noted on customer orders. SAE, BSPP, and BSPT ports are available as an option as well as oversized ports. Oversized ports are often accomplished by welding a half coupling boss the cylinder end cover, allowing raised material to be threaded without disturbing captured tube seals within the end covers. Additionally, Quincy Ortman can prepare cylinders to accept manifold and SAE Code 61 and 62, 4-bolt flange ports for 3TH hydraulic applications.

NOTE: Alternate port positions, especially position numbers 2 and 4 may cause interference between fittings and mounts or mounting bolts. Oversized and/or additional ports carry additional fluid quantity into the cylinder that may develop excessive fluid velocities. Quincy Ortman recommends a maximum fluid velocity of 15 ft/s.

	NPTF*			SAE			BSPP			BSPT			SAE Code 61	SAE Code 62
Bore	3TH	7K,7L,AS	101	3TH	7K,7L,AS	101	3TH	7K,7L,AS	101	3TH	7K,7L,AS	101	3TH	3TH
1.50	1/2	3/8	1/4	8	6	4	1/2	3/8	1/4	1/2	3/8	1/4		
2.00	1/2	3/8	3/8	8	6	6	1/2	3/8	3/8	1/2	3/8	3/8		
2.50	1/2	3/8	3/8	8	6	6	1/2	3/8	3/8	1/2	3/8	3/8	1/2	1/2
3.00			3/8			6			3/8			3/8		
3.25	3/4	1/2		12	10		3/4	1/2		3/4	1/2		3/4	3/4
3.50			1/2			10			1/2			1/2		
4.00	3/4	1/2	1/2	12	10	10	3/4	1/2	1/2	3/4	1/2	1/2	3/4	3/4
5.00	3/4	1/2	3/4	12	10	12	3/4	1/2	3/4	3/4	1/2	3/4	3/4	3/4
6.00	1	3/4	3/4	16	12	12	1	3/4	3/4	1	3/4	3/4	1	1
7.00	1 1/4			20			1 1/4			1 1/4			1 1/4	1 1/4
8.00	1 1/2	3/4	3/4	24	12	12	1 1/2	3/4	3/4	1 1/2	3/4	3/4	1 1/2	1 1/2
10.00	2	1		24	16		2	1		2	1		2	2
12.00	2 1/2	1		24	16		2 1/2	1		2 1/2	1		2 1/2	2 1/2
14.00	2 1/2	1 1/4		24	20		2 1/2	1 1/4		2 1/2	1 1/4		2 1/2	2 1/2
16.00	3	1 1/4					3	1 1/4		3	1 1/4		3	3
18.00	3	1 1/2					3	1 1/2		3	1 1/2		3	3
20.00	3	2					3	2		3	2		3	3

*Standard port issued if no port type is specified

Temperature and Fluid Compatibility

Temperature

Quincy Ortman standard cylinders are capable of being operated at temperatures between –20°F and +200°F. Please consult the nearest authorized distributor or the factory for applications with temperatures greater than 200°F. It is noteworthy that most sealing compounds exhibit reduced life as they are operated at temperatures near their stated limits. When selecting seals, it is a good idea to select a compound that exceeds temperature requirements within the application being considered.

Fluids

Quincy Ortman standard sealing compounds are Polyurethane and Buna-N. Both compounds are well suited for use with any quality grade petroleum based hydraulic oil. Oil used within Quincy Ortman cylinders should be maintained at 18/16/13 per ISO 4406:1999 or equivalent for cleanliness. This can be accomplished using a 10 micron filtration system. Below is a seal compatibility chart for referencing fluid types and temperature ranges. Whenever a fluid other than petroleum based hydraulic oil is used, it is best to contact the nearest authorized distributor or the factory for consultation.

Fluid Compatibility Reference

Fluid Type	Trade Name	Buna-N –30°F to 250°F	Polyurethane –40°F to 180°F	Viton® –15°F to 400°F	Teflon® –300°F to 400°F	Ethylene-Propylene –70°F to 250°F
Brake Fluid		3	4	4	1	1
Gasoline		1	3	1	1	4
Transmission Fluid (ATF)		1	1	1	1	4
Petroleum Base Oil	Preservative Oil	1	1	1	1	1
Petroleum Base Oil	Aircraft Hydraulic Fluid	1	1	1	1	1
HWBF (95-5)		1	4	1	1	1
Water Glycol	Houghto-Safe 600	1	4	2	1	1
	Houghto-Safe 500	1	4	4	1	1
	Houghto-Safe 271	1	4	2	1	1
	Unicon Hydrolube J4	1	4	1	1	1
	Celluguard	1	4	1	1	1
Water/Oil Emulsions	Houghto-Safe 5000	1	4	1	1	4
	Gulf FR	1	1	1	1	4
	Pyrogard C & D	1	1	4	1	4
Phosphate-Ester	Houghto-Safe 1000	4	4	1	1	1
	Houghto-Safe 1120	4	4	1	1	2
	Fryquell (Cellulube)	4	4	4	1	4
	Pyrogard 42,43,53,55,190,600	4	4	1	1	1
	Skydrol 500 Type 2	4	4	4	1	1
	Skydrol 7000 Type 2	4	4	2	1	1
	Pydraul 312C,230C,540C	4	4	1	1	4
	Pydraul 10E	4	4	4	1	1
	Pydraul 29ELT,30E,50E,65E	4	4	1	1	1
Silicate Ester	OS-45 Type 3 & 4	2	4	1	1	4
	Oronite 8200	2	1	1	1	4
	Oronite 8515	2	1	1	1	4
	Brayco 846	2	3	4	1	1

1 = Satisfactory
2 = Fair
3 = Doubtful
4 = Not Recommended

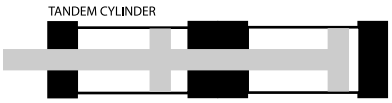
Cylinder Options

Cylinder Construction

Quincy Ortman Cylinders offers a number of variations in cylinder construction. Descriptions of the more common variation are described below, however Quincy Ortman's engineering staff is capable of designing many more special applications at your request.

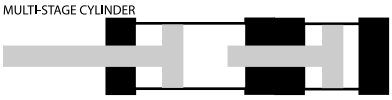
Tandem Cylinders

Tandem cylinders are a combination of two cylinders of the same stroke length used in tandem to double cylinder force output. The pistons between the two cylinders are connected with a common rod. For proper results cylinders in the tandem arrangement should be energized simultaneously.



Multi-stage Cylinders

Multi-stage cylinders combine multiple cylinders at different stroke lengths. Piston rods between the cylinders are not connected. This allows each cylinder to be energized independently in sequence to produce multiple stroke levels out of the foremost cylinder.

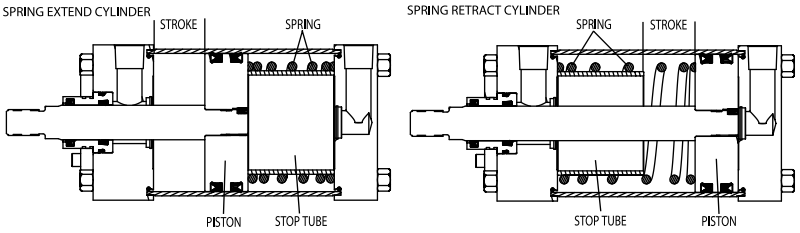


Duplex Cylinders

Duplex Cylinders are two independent cylinders combined together back-to-back. Duplex cylinder share common tie rods.

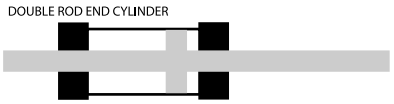
Spring-Loaded Cylinders

Spring-loaded cylinders are offered in spring extend or spring retract orientations. Spring extend cylinders position the spring behind the piston to force the piston and rod out of the cylinder to full extension. In spring retract cylinders the spring is captured between the head end cover and the piston to maintain the rod in a fully retracted state. Spring-loaded cylinders are single acting, generally used in failsafe applications or auto return operations. When requesting spring-loaded cylinders, it is important to specify the force required to overcome the load in the application.



Double Rod End Cylinders

Double rod end cylinders have two rods exiting at either end of the cylinder attached to a single piston. The advantage of double rod end cylinders is that they produce equal force and equal speed in either direction, while performing two operations with one stroke.



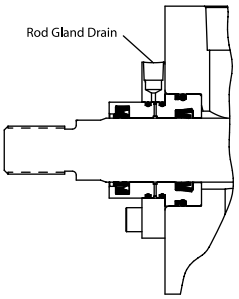
Rod Gland Options

Metallic Rod Scrapers

Metallic rod scrapers should be used in place of synthetic wiper seals in applications where contaminants may cling or stick to the extended piston rod. Metallic rod scrapers are available upon request.

Rod Gland Drains

In applications where external weapage from the piston rod in hydraulic cylinder cannot be tolerated, rod gland drains offer a path for trapped fluid, between the rod seal and the rod wiper, to be drained back to tank. Monitoring the amount of fluid being drained can help help gauge the wear of rod seals to determine if replacement is necessary.



Other Options and Add-ons

Stainless Steel Piston Rods

In applications where the piston rod may be subjected to water, special wash-downs, or weather, stainless steel piston rods should be considered. Quincy Ortman stocks, but is not limited to, 303 and 17-4 ph stainless steel rod stock. Other commonly used stainless materials, such as 304 and 316, are available upon request.

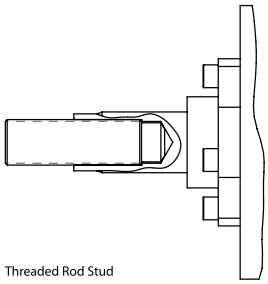
(Cylinder Options continued on page 18)

Cylinder Options

(Continued from page 17)

Studded Rod Ends

Quincy Ortman offers studded rod ends for applications held in high tension where it may be possible to break or shear standard machined rod ends. For rod sizes 5/8" to 2 1/2", a rolled thread stud can be threaded into a standard female rod end. Studded rod ends offer higher resistance to thread shear and are more economical to replace in case of fracture.



Threaded Rod Stud

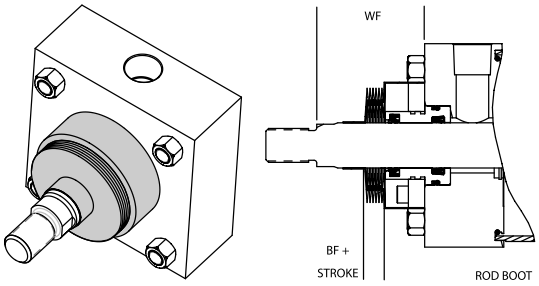
Rod Boots

For applications where the piston rod may be exposed to contaminants with air hardening properties, such as tar, a rod boot or bellows may be suggested. Rod boots are a collapsible cover over the piston rod. The addition of a rod boot will increase rod extension lengths to accommodate the collapsed boot length. To calculate WF with a rod boot, use the table below to determine the collapsed boot length by multiplying the cylinder stroke by the "Boot Factor" (BF), add 1 1/8" and then add C.

WF = (BF x stroke) + C + 1 1/8'

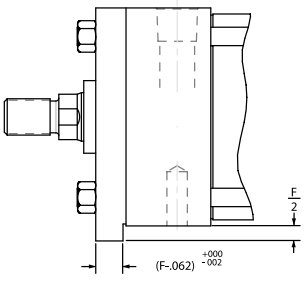
Rod Boot Factor Table

Rod Diameter	5/8	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2	4
BF	.10	.10	.10	.10	.10	.10	.09	.09	.09
OD	2 1/4	2 5/8	3	3 3/8	3 7/8	4 3/8	5 1/8	5 5/8	6 1/4
C	3/8	1/2	5/8	3/4	7/8	1	1	1	1



Extended Key Retainer Plates

Extended key retainer plates are extended, full-faced rod bearing retainer plates with a mill cut to form a key. The key should be fitted to a milled slot in the mounting surface of the application. Used with side and foot mounted cylinders, extended key retainer plates assure the cylinder will not shift while in operation.



Extended Key Retainer Plate

Air Bleeds

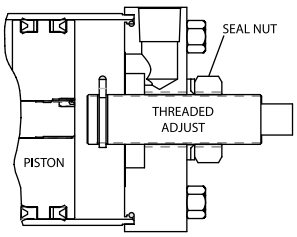
Air bleeds are used for bleeding air out of a hydraulic cylinder. Quincy Ortman places air bleeds in the tube at the highest point. Air is bled from the cylinder by backing out the threaded plug to allow air to pass by the threads and applying slight pressure to the opposite side of the cylinder. Air bleeds can be ordered at either end or both ends of a cylinder.

Plated Finishes and Coatings

Quincy Ortman Cylinders are also available in a number of plated finishes, such as NiCoTef®, Electroless Nickel, Flash Chrome, and Cad plating. Additionally we are prepared to handle most primer, paint and epoxy coating requirements. Contact the sales staff or an authorized distributor near you for details.

Stroke Adjusts

Stroke adjusts can be used for applications where the stroke or travel may need to vary. Stroke adjustment is accomplished by threading a post through the end cover of the cylinder and locking it in place with a seal nut. Threading the post in or backing the post out will vary the piston travel.



Approximate Cylinder Weights

3TH Series Cylinders

Bore Size	Rod Size	Basic Weight	3TH Series with Mount (Lbs.)											Per in. Stroke
			A	B	E	G	J,K	L	M,N	AA	BB	CC	EB,ER	
1.50	.63	7.1	8.1	7.5	9.4	7.5	7.6	7.3	7.2	8.9	8.5	8.4	7.5	.5
	1.00	7.5	8.5	7.8	9.8	7.8	7.9	7.7	7.6	9.2	8.8	8.8	7.9	.6
2.00	1.00	11.5	13.9	12.6	16.3	12.7	12.8	12.1	11.8	15.6	14.7	13.4	12.7	1.0
	1.38	12.2	14.6	13.6	17.0	13.4	13.5	12.8	12.5	16.3	15.4	14.1	13.4	1.4
2.50	1.00	16.2	19.4	17.2	22.2	17.4	19.3	16.7	16.5	20.8	19.3	18.3	17.3	1.3
	1.38	16.7	19.9	17.7	22.7	17.9	19.8	17.2	17.0	21.3	19.8	18.8	17.8	1.8
	1.75	18.0	21.2	19.0	24.0	19.2	21.1	18.5	18.3	22.6	21.1	20.1	19.1	2.3
3.25	1.38	32.8	38.9	35.0	41.8	36.1	35.9	33.7	33.3	42.5	39.6	37.1	35.2	2.3
	1.75	33.6	39.7	35.8	42.6	36.9	36.7	34.5	34.1	43.3	40.4	37.9	36.0	2.9
	2.00	34.3	40.4	36.5	43.3	37.6	37.4	35.2	34.8	44.0	41.1	38.6	36.7	3.2
4.00	1.75	44.1	52.6	47.1	53.6	49.9	50.3	45.1	44.6	57.1	53.2	48.5	46.4	3.1
	2.00	45.0	53.5	48.0	54.5	50.8	51.2	46.0	45.5	58.0	54.1	49.4	47.3	3.4
	2.50	46.5	55.0	49.5	56.0	52.3	52.7	47.5	47.0	59.5	55.6	50.9	48.8	4.4
5.00	2.00	78.8	93.0	83.3	93.3	86.7	84.9	81.9	80.3	100	92.3	88.3	81.1	4.8
	2.50	81.0	95.2	85.5	95.5	88.9	87.1	84.1	82.5	102	94.5	90.5	83.3	5.2
	3.00	84.4	98.6	88.9	98.9	92.3	90.5	87.5	85.9	105	97.9	93.9	86.7	7.0
	3.50	85.4	99.6	89.9	100	93.3	91.5	88.5	86.9	106	98.9	94.9	87.7	8.4
6.00	2.50	124	145	131	143	137	136	128	126	152	145	138	127	6.5
	3.00	126	147	133	145	139	138	130	128	158	147	140	129	7.8
	3.50	128	149	135	147	141	140	132	130	160	149	142	131	9.2
	4.00	132	153	139	151	145	144	136	134	164	151	146	135	10.9
7.00	3.00	186	214	195	218	209	206	193	190	227	213	205	193	8.9
	3.50	187	215	196	219	210	207	194	191	228	214	206	194	10.3
	4.00	192	220	201	224	215	212	199	196	233	219	211	199	12.0
	4.50	195	223	204	227	218	215	202	199	236	222	214	202	13.9
	5.00	200	228	209	232	223	220	207	204	241	227	219	207	16.0
8.00	3.50	255	289	265	287	280	276	264	259	304	284	279	262	11.7
	4.00	260	294	270	292	285	281	269	264	309	289	284	267	13.3
	4.50	264	298	274	296	289	285	273	268	313	293	288	271	14.4
	5.00	268	302	278	300	293	289	277	272	317	297	292	275	17.5
	5.50	275	309	285	307	300	296	284	279	324	304	299	282	19.7
10.00	4.50	533	647	583	667	614	562	—	—	706	682	-	552	20.2
	5.00	540	655	628	674	621	569	—	—	713	686	-	559	22.3
	5.50	551	665	635	695	632	580	—	—	724	694	-	570	24.6
	7.00	588	703	690	722	669	618	—	—	761	718	-	607	33.0
12.00	5.50	882	1061	1026	1105	984	967	—	—	1137	1102	-	910	28.5
	7.00	921	1100	1051	1144	1024	1006	—	—	1176	1127	-	950	37.4
	8.50	981	1160	1090	1204	1083	1066	—	—	1236	1166	-	1009	47.2
14.00	7.00	1391	1681	1620	1748	1637	1561	—	—	1816	1755	-	1446	45.0
	8.50	1453	1743	1658	1811	1700	1623	—	—	1878	1793	-	1509	55.2
	10.00	1525	1815	1708	1882	1771	1695	—	—	1950	1843	-	1580	67.6

To Calculate Approximate Cylinder Weight:

Find the "Base Weight" with mount.

Multiply the inches of stroke by "Per Inch Stroke" weight.

Add the Base and Per Inch Stroke weights together.

To Calculate for Double Rod End Cylinders:

Multiply the "Base Weight" by 1.16.

Multiply the inches of stroke by "Per Inch Stroke" weight.

Add the Base and Per Inch Stroke weights together.

To estimate for Packaging Weight:

Add 10% of the total cylinder weight.

Cylinder weight is difficult to accurately estimate due to variations in stroke, cylinder construction, and modifications. Our weight charts provide a good estimate of basic cylinder weights. Quincy Ortman cannot be held responsible for differences in freight charges based upon estimated weight. Accurate weight and dimension can be made available from Quincy Ortman sales on the day of shipment.

Approximate Cylinder Weights
7K & 7L Series Cylinders

Bore Size	Rod Size	Basic Weight	7K & 7L Series with Mount (Lbs.)											Per in. Stroke
			A	B	E	G	J,K	L	M,N	AA	BB	CC	EB,ER	
1.50	.63	4.1	4.9	4.5	5.8	4.4	4.6	4.2	4.2	5.4	5.1	4.5	4.5	.4
	1.00	4.3	5.1	4.6	6.1	4.6	4.8	4.4	4.4	5.6	5.2	4.7	4.7	.5
2.00	.63	6.5	7.6	6.9	9.0	6.8	7.0	6.7	6.6	8.1	7.5	7.3	6.9	.5
	1.38	7.0	8.1	7.4	9.6	7.3	7.6	7.2	7.1	8.7	8.0	7.9	7.4	.9
2.50	.63	9.5	10.9	10.0	12.7	9.8	10.1	9.7	9.6	11.6	10.7	10.9	9.9	.6
	1.75	10.7	12.1	11.1	13.8	11.0	11.2	10.9	10.8	12.7	11.6	12.1	11.1	1.5
3.25	1.00	17.9	21.5	18.1	23.0	19.0	19.4	18.3	18.1	22.8	19.5	19.9	18.3	.9
	2.00	18.6	22.2	19.7	23.6	19.6	20.1	19.0	18.8	23.5	21.1	20.5	19.0	1.6
4.00	1.00	25.8	30.3	27.7	34.3	26.9	27.3	26.2	26.0	31.7	29.2	28.9	26.2	1.0
	1.75	27.2	31.7	29.1	35.7	28.3	28.7	27.6	27.4	33.1	30.6	30.3	27.6	1.8
	2.50	29.3	33.8	30.2	37.8	30.3	30.8	29.7	29.5	35.2	32.7	32.4	29.7	2.6
5.00	1.00	40.7	47.7	42.3	55.8	41.6	44.2	41.5	41.1	50.0	44.8	45.5	41.1	1.2
	1.75	42.0	49.0	43.6	57.1	42.9	45.5	42.8	42.4	51.3	46.1	46.8	42.4	1.6
	2.50	44.1	51.1	45.7	59.2	45.0	47.6	44.9	44.5	53.4	48.2	48.9	44.5	2.4
	3.50	48.0	55.0	49.6	62.8	48.9	51.5	48.8	48.4	57.3	52.1	52.8	48.4	3.7
6.00	1.38	63.9	74.9	65.9	90.2	66.2	67.4	64.7	64.3	78.3	69.4	70.5	65.1	2.4
	2.00	65.5	76.5	67.5	91.8	67.8	69.0	66.3	65.9	79.9	71.0	72.1	66.7	2.8
	3.00	69.4	80.4	71.4	95.7	71.7	72.9	70.2	69.8	83.8	74.9	76.0	70.6	4.0
	4.00	74.9	85.9	76.9	101.2	77.1	78.4	75.7	75.3	89.2	80.4	81.3	76.1	5.4
8.00	1.38	100.2	—	—	146.4	102.6	103.7	101.8	101.0	99.7	99.5	112.8	101.4	3.0
	2.50	105.2	—	—	151.4	107.6	108.7	106.8	106.0	104.7	104.5	117.8	106.4	4.0
	3.50	112.1	—	—	158.3	114.5	115.6	113.7	112.9	111.6	111.4	124.7	113.3	5.3
	4.50	121.4	—	—	167.6	123.8	124.9	123.0	122.2	120.9	120.7	134.0	122.6	7.1
	5.00	126.8	—	—	173.0	129.2	130.3	128.4	127.6	126.3	126.1	139.4	128.0	8.2
	5.50	132.8	—	—	179.1	135.3	136.4	134.5	133.7	132.4	132.2	145.4	134.1	9.3
10.00	1.75	189	—	—	266	195	196	191	190	188	187	212	191	4.3
	2.50	193	—	—	270	199	200	195	194	192	191	216	195	5.0
	3.50	200	—	—	277	206	207	202	201	199	198	223	202	6.4
	4.50	209	—	—	286	215	216	211	210	208	207	232	211	8.2
	5.00	215	—	—	292	221	222	217	216	214	213	238	217	9.2
	5.50	221	—	—	298	227	228	223	222	220	220	244	224	10.4
12.00	2.00	289	—	—	406	299	296	291	290	288	287	323	291	7.7
	3.50	299	—	—	416	309	306	301	300	298	297	333	301	9.6
	4.50	308	—	—	425	318	315	310	309	307	306	342	310	11.4
	5.00	314	—	—	431	324	321	316	315	313	312	348	316	12.4
	5.50	320	—	—	437	330	327	322	321	319	319	355	322	13.6
14.00	2.50	454	—	—	625	467	467	458	456	453	452	509	457	6.5
	3.50	461	—	—	632	474	474	465	463	460	459	516	464	8.3
	4.50	471	—	—	642	484	484	475	473	470	469	526	474	10.0
	5.00	477	—	—	648	490	490	481	479	476	475	532	480	11.1
	5.50	484	—	—	655	496	497	488	486	482	482	538	487	12.3

To Calculate Approximate Cylinder Weight:

Find the "Base Weight" with mount.

Multiply the inches of stroke by "Per Inch Stroke" weight.

Add the Base and Per Inch Stroke weights together.

To Calculate for Double Rod End Cylinders:

Multiply the "Base Weight" by 1.16.

Multiply the inches of stroke by "Per Inch Stroke" weight.

Add the Base and Per Inch Stroke weights together.

To estimate for Packaging Weight:

Add 10% of the total cylinder weight.

Cylinder weight is difficult to accurately estimate due to variations in stroke, cylinder construction, and modifications. Our weight charts provide a good estimate of basic cylinder weights. Quincy Ortman cannot be held responsible for differences in freight charges based upon estimated weight. Accurate weight and dimension can be made available from Quincy Ortman sales on the day of shipment.

Approximate Cylinder Weights
101 Series Cylinders

Bore Size	Rod Size	101 Series Light Duty with Mount (Lbs.)						Per Inch Stroke
		A,B	C	D	E	F	G	
1.50	.75	5.1	4.5	4.1	4.1	3.6	4.3	.4
2.00	.75	6.2	5.6	5.2	5.5	4.7	5.4	.5
2.50	1.00	10.5	10.1	11.4	9.2	8.2	9.6	.7
3.00	1.00	12.3	11.8	11.4	11.2	10.0	11.3	.8
3.50	1.25	20.0	18.4	18.4	18.6	15.8	18.4	1.0
4.00	1.25	26.9	25.3	25.3	26.1	22.5	25.3	1.1
5.00	1.50	43.6	42.2	39.2	40.4	35.3	39.4	1.7
6.00	1.75	64.4	61.4	59.2	63.6	53.2	62.3	2.1
8.00	2.25	120.2	120.2	115.6	123.6	101.6	115.4	3.0

Bore Size	Rod Size	101 Series Light Duty with Mount (Lbs.)						Per Inch Stroke
		AH,BH	CH	DH	EH	FH	GH	
1.50	.75	5.4	4.8	4.4	4.4	3.9	4.5	.5
2.00	.75	6.6	6.0	5.6	5.8	5.1	5.8	.6
2.50	1.00	11.0	10.6	11.9	9.7	8.7	10.1	.8
3.00	1.00	12.8	12.3	11.9	11.7	10.5	11.9	.9
3.50	1.25	20.7	19.1	19.1	19.3	16.3	19.0	1.2
4.00	1.25	26.7	26.1	26.1	26.8	23.3	26.1	1.3
5.00	1.50	45.6	44.2	41.2	42.4	37.3	41.4	2.3
6.00	1.75	67.1	64.1	61.8	66.3	55.8	65.0	2.8
8.00	2.25	128.1	127.9	123.5	131.5	109.5	123.2	4.9

Approximate Cylinder Weights
AS Series Cylinders

Bore Size	Basic Weight	AS Series with Mount				Per Inch Stroke
		A,B	J,CC	G	D	
1.50	1.8	3.4	2.1	2.2	2.1	.2
2.00	2.3	3.3	2.7	2.8	2.7	.3
2.50	3.0	4.3	4.6	4.6	4.5	.3
3.25	5.6	8.9	6.7	7.1	6.9	.5
4.00	7.5	12.1	9.3	9.4	9.2	.5

To Calculate Approximate Cylinder Weight:

Find the "Base Weight" with mount.

Multiply the inches of stroke by "Per Inch Stroke" weight.

Add the Base and Per Inch Stroke weights together.

To Calculate for Double Rod End Cylinders:

Multiply the "Base Weight" by 1.16.

Multiply the inches of stroke by "Per Inch Stroke" weight.

Add the Base and Per Inch Stroke weights together.

To estimate for Packaging Weight:

Add 10% of the total cylinder weight.

Cylinder weight is difficult to accurately estimate due to variations in stroke, cylinder construction, and modifications. Our weight charts provide a good estimate of basic cylinder weights. Quincy Ortman cannot be held responsible for differences in freight charges based upon estimated weight. Accurate weight and dimension can be made available from Quincy Ortman sales on the day of shipment.

Repair Kits

3TH Series Repair Kits

Bore Size	Rod Size	Tube Seal Kit Standard	Rod Seal Kit Standard	Rod Gland Kit Standard
1.50	.63	TS523511000	RS003540010	RG003530010
	1.00		RS003540020	RG003500020
2.00	1.00	TS533511000	RS003540020	RG003530020
	1.38		RS003540030	RG003530030
2.50	1.00	TS543511000	RS003540020	RG003530020
	1.38		RS003540030	RG003530030
	1.75		RS003540040	RG003530040
3.25	1.38	TS563511000	RS003540030	RG003530030
	1.75		RS003540040	RG003530040
	2.00		RS003540050	RG003530050
4.00	1.75	TS583511000	RS003540040	RG003530040
	2.00		RS003540050	RG003530050
	2.50		RS003540060	RG003530060
5.00	2.00	TS593511000	RS003540050	RG003530050
	2.50		RS003540060	RG003530060
	3.00		RS003540070	RG003530070
	3.50		RS003540080	RG003530080
6.00	2.50	TS603511000	RS003540060	RG003530060
	3.00		RS003540070	RG003530070
	3.50		RS003540080	RG003530080
	4.00		RS003540090	RG003530090
7.00	3.00	TS613511000	RS003540070	RG003530070
	3.50		RS003540080	RG003530080
	4.00		RS003540090	RG003530090
	4.50		RS003540100	RG003530100
	5.00		RS003540110	RG003530110
8.00	3.50	TS623511000	RS003540080	RG003530080
	4.00		RS003540090	RG003530090
	4.50		RS003540100	RG003530100
	5.00		RS003540110	RG003530110
	5.50		RS003540120	RG003530120

NOTE: To specify Viton® seals in any kit, change the last digit of the kit number from 0 to 1.

Example: TS523511001

7K & 7L Series Repair Kits

Bore Size	Rod Size	Tube Seal Kit Standard	Rod Seal Kit Standard	Rod Gland Kit Standard
1.50	.63	TS777512000	RS003540010	RG003540010
	1.00		RS007540020	RG007540020
2.00	.63	TS787512000	RS003540010	RG003540010
	1.00		RS003540020	RG003540020
	1.38		RS007540030	RG007540030
2.50	.63	TS797512000	RS003540010	RG003540010
	1.00		RS003540020	RG003540020
	1.38		RS003540030	RG003540030
	1.75		RS007540040	RG007540040
3.25	1.00	TS817512000	RS003540020	RG003540020
	1.38		RS003540030	RG003540030
	1.75		RS003540040	RG003540040
	2.00		RS003540050	RG003540050
4.00	1.00	TS837512000	RS003540020	RG003540020
	1.38		RS003540030	RG003540030
	1.75		RS003540040	RG003540040
	2.00		RS003540050	RG003540050
	2.50		RS003540060	RG003540060
5.00	1.00	TS847512000	RS003540020	RG003540020
	1.38		RS003540030	RG003540030
	1.75		RS003540040	RG003540040
	2.00		RS003540050	RG003540050
	2.50		RS003540060	RG003540060
	3.00		RS003540070	RG003540070
	3.50		RS003540080	RG003540080
6.00	1.38	TS857512000	RS003540030	RG003540030
	1.75		RS003540040	RG003540040
	2.00		RS003540050	RG003540050
	2.50		RS003540060	RG003540060
	3.00		RS003540070	RG003540070
	3.50		RS003540080	RG003540080
	4.00		RS003540090	RG003540090
8.00	1.38	TS877512000	RS003540030	RG003540030
	1.75		RS003540040	RG003540040
	2.00		RS003540050	RG003540050
	2.50		RS003540060	RG003540060
	3.00		RS003540070	RG003540070
	3.50		RS003540080	RG003540080
	4.00		RS003540090	RG003540090
	4.50		RS003540100	RG003540100
	5.00		RS003540110	RG003540110
	5.50		RS003540120	RG003540120

Repair Kits

101 Series Repair Kits

Bore Size	Rod Size	Tub Seal Kit			Rod Seal Kit Standard	Rod Gland Kit Standard
		Heavy Duty Air/Hyd. Standard	Light Duty Air Standard	Light Duty Hyd. Standard		
1.50	.75	TS2715120H0	TS2715120K0	TS2715120L0	RS001540160	RG001530160
2.00	.75	TS2815120H0	TS2815120K0	TS2815120L0	RS001540160	RG001530160
2.50	1.00	TS2915120H0	TS2915120K0	TS2915120L0	RS001540020	RG001530020
3.00	1.00	TS3015120H0	TS3015120K0	TS3015120L0	RS001540020	RG001530020
3.50	1.25	TS3215120H0	TS3215120K0	TS3215120L0	RS001540170	RG001530170
4.00	1.25	TS3315120H0	TS3315120K0	TS3315120L0	RS001540170	RG001530170
5.00	1.50	TS3415120H0	TS3415120K0	TS3415120L0	RS001540180	RG001530180
6.00	1.75	TS3515120H0	TS3515120K0	TS3515120L0	RS001540040	RG001530040
8.00	2.25	TS3715120H0	TS3715120K0	TS3715120L0	RS001540190	RG001530190

AS Series Repair Kits

Bore Size	Rod Size	Tube Seal Kit Standard	Rod Seal Kit Standard	Rod Gland Kit Standard
1.50	.63	TS77AS1200	RS00AS40310	RG00AS30310
2.00	.63	TS78AS1200	RS00AS41310	RG00AS31310
	1.00		RS00AS41320	RG00AS31320
2.50	.63	TS79AS1200	RS00AS40310	RG00AS31310
	1.00		RS00AS41320	RG00AS31320
3.25	1.00	TS81AS1200	RS00AS42320	RG00AS32320
	1.38		RS00AS42330	RG00AS32330
4.00	1.00	TS83AS1200	RS00AS42320	RG00AS32320
	1.38		RS00AS42330	RG00AS32330
5.00	1.00	TS84AS1200	RS00AS42320	RG00AS32320
	1.38		RS00AS42330	RG00AS32330
6.00	1.38	TS85AS1200	RS00AS43330	RG00AS33330
	1.75		RS00AS43340	RG00AS33340
8.00	1.38	TS87AS1200	RS00AS43330	RG00AS33330
	1.75		RS00AS43340	RG00AS33340

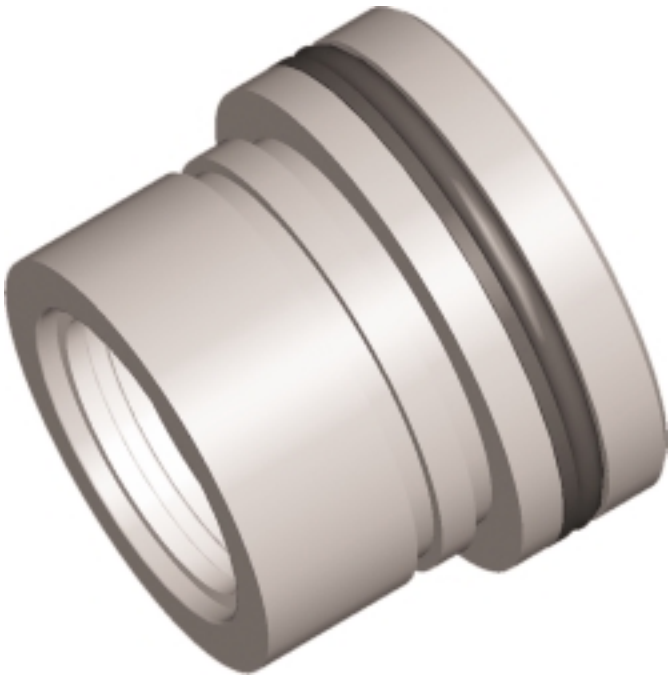
FA Series Repair Kits

Bore Size	Rod Size	Complete Kit Standard
2.50	1.00	KFA0250BUNA
3.25	1.00	KFA0325BUNA
4.00	1.00	KFA0400BUNA
5.00	1.00	KFA0500BUNA
6.00	1.00	KFA0600BUNA
7.00	1.00	KFA0700BUNA
8.00	1.00	KFA0800BUNA
10.00	1.00	KFA1000BUNA-A
12.00	1.38	KFA1200BUNA-A
14.00	1.38	KFA1400BUNA-A
16.00	1.75	KFA1600BUNA-A
18.00	2.00	KFA1800BUNA-A
20.00	2.00	KFA2000BUNA
22.00	3.00	KFA2200BUNA
24.00	3.50	KFA2400BUNA

NOTE: To specify Viton® seals in any kit, change the last digit of the kit number from 0 to 1.

Example: TS523511001

Two Year Cylinder and Uni-Cartridge Assembly Warranty



Uni-Cartridge Rod Bearing

The exclusive Quincy Ortman Uni-Cartridge rod bearing is standard on every 3TH, 7K or 7L series cylinder to help eliminate most causes of cylinder failure. Uni-Cartridge provides the ultimate in sealing plus greater bearing area and resistance to side load stress.

Uni-Cartridge features include the most advanced rod seal and wiper configuration in the industry. Uni-Cartridge's one-piece construction with bolted retainer permits fast removal and replacement without disassembly of the cylinder for reduced downtime and convenience.

WARRANTY

Seller warrants that any product of its manufacture, which upon examination is found by a Seller's representative to be defective in either workmanship or material under normal use and service, will, at Seller's option, be repaired or replaced free of charge including lowest transportation charges but not cost of installation or removal or have the purchased price refunded, provided that SELLER receives written claim specifying the defect within two (2) years or 4,000 hours of use in normal service applications, whichever arrives first after the Seller ships the product. Modified or special products shall be subject to special written warranty depending on application of products. In no event shall Seller be liable for any claims, whether arising from breach of contract or warranty or claims of negligence or negligent manufacture, in excess of the purchase price. ALL OTHER WARRANTIES EXPRESSED AND IMPLIED INCLUDING ANY WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR USE ARE HEREBY DISCLAIMED. The foregoing expresses all of Seller's obligations and liabilities with respect to the quality of items furnished by it and it shall under no circumstances be liable for consequential, collateral or special losses or damages.

DISASSEMBLY OF THIS PRODUCT WILL VOID WARRANTY.

As product improvement is a continuous process, specifications are subject to change without notice.