

Приводы гидравлические модульные серии 98Н

Технические характеристики



Архангельск (8182)63-90-72
Астана (7172)727-132
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06

Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Липецк (4742)52-20-81
Киргизия (996)312-96-26-47

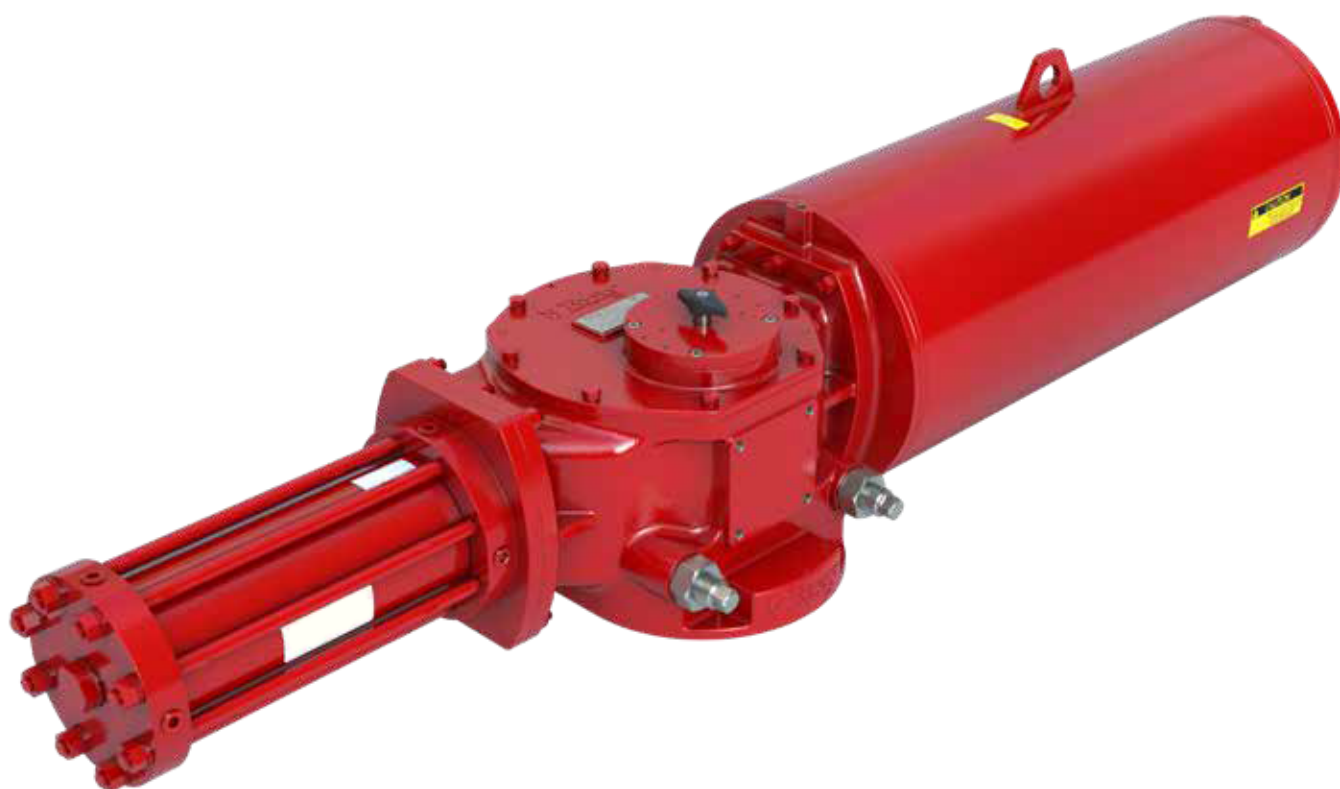
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Казахстан (772)734-952-31

Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Таджикистан (992)427-82-92-69

Сургут (3462)77-98-35
Тверь (4822)63-31-35
Томск (3822)98-41-53
Тула (4872)74-02-29
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Ярославль (4852)69-52-93

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Приводы гидравлические модульные серии 98Н



Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

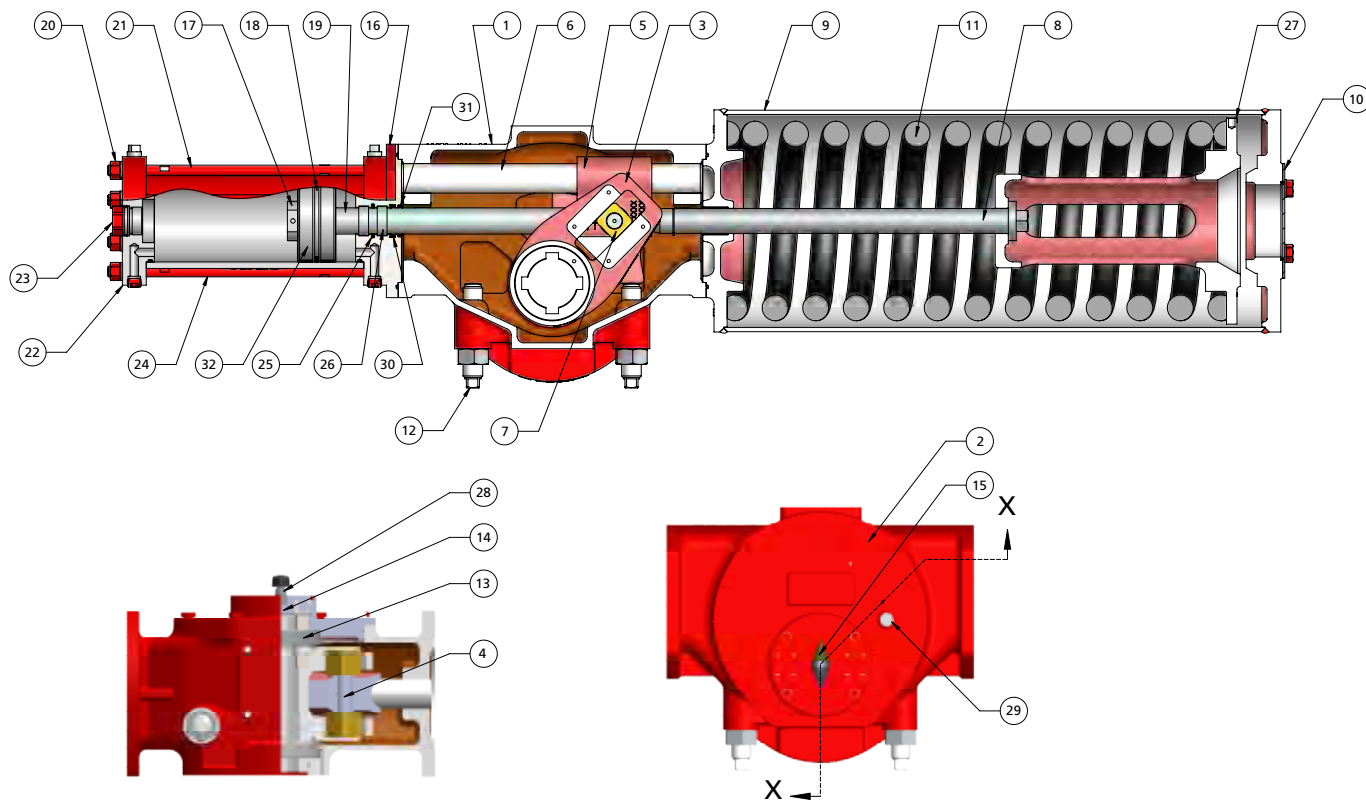
General Specifications and Features

GENERAL SPECIFICATIONS												
RANGE												
Model	ISO Base	Rated Torque		Spring End Torque Nm		Spring End Torque Lb-in		Maximum Stem Acceptance Diameter		Maximum Stem Height	Over Travel	
		Nm	Lb-in	Min	Max	Min	Max	mm	inch	mm	± degrees	
12 E2	F07/F12	1,200	10,621	310	660	2,744	5,842	22 A/F	0.87 A/F	130	5	
18 E2	F12	1,800	15,932	530	1,035	4,691	9,161	35.0	1.38	163	5	
45 E2	F12/F16	4,500	39,830	1,070	2,675	9,471	23,676	50.0	1.97	183	5	
73 E2	F12/F16	7,300	64,612	2,130	4,280	18,853	37,882	63.5	2.50	216	5	
14 E3	F16/F25	14,000	123,914	3,485	7,845	30,846	69,436	76.2	3.00	240	5	
24 E3	F25/F30	24,000	212,424	6,555	15,150	58,018	134,093	114.3	4.50	295	3	
45 E3	F30/F35	45,000	398,295	11,950	25,595	105,769	226,541	152.4	6.00	318	3	
10 E4	F35/F40	100,000	885,100	25,226	50,306	223,275	445,261	177.8	7.00	402	3	
CONFIGURATIONS												
DA	Double Acting- Single Cylinder											
DD	Double Acting- Dual Cylinders											
SR-CW	Spring Return- Fail CW											
SR-CCW	Spring Return- Fail CCW											
OPERATING CONDITIONS												
Pressure Range	500 to 3000 psig											
Media	Hydraulic Fluid (Standard Trim) - ISO VG 32/46, ISO-L-HV, flash point>157°C											
Temperature Range - Standard Options	Standard : -20°F to 212°F (-29°C to 100°C)								Non-PED			
	Low Temp : Down to -50°F (-46°C)											
	Standard : -20°F to 176°F (-29°C to 80°C)								PED			
COMPLIANCES												
Torque Base	Mounting dimensions per ISO 5211											
Accessories	Shaft Driven Accessories Mounting as per NAMUR-VDE											
Testing	In accordance with EN 15714-4:2009											
Ingress Protection	IP67M & IP68											
Safety	ATEX, SIL 3, PED											

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Materials of Construction - Standard Actuators



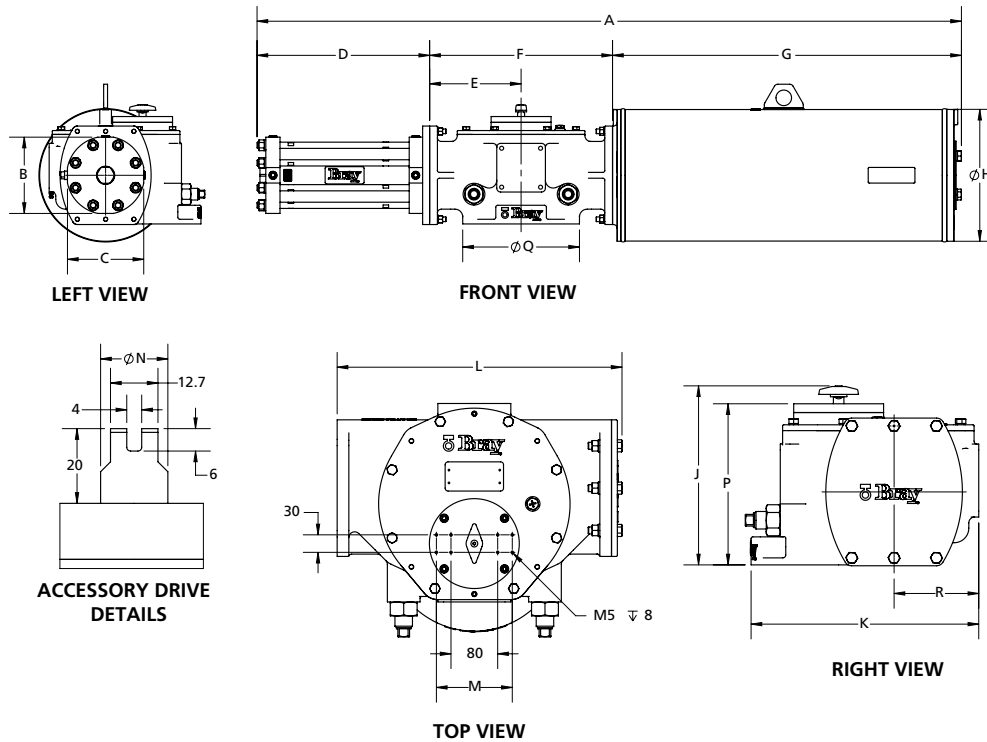
ITEM NO.	DESCRIPTION	MATERIAL
1	HOUSING	DUCTILE IRON
2	HOUSING COVER	DUCTILE IRON
3	YOKE	DUCTILE IRON
4	YOKE PIN	ALLOY STEEL
5	GUIDE BLOCK	CARBON STEEL
6	GUIDE ROD	ALLOY STEEL
7	SLIDER BLOCK	BRONZE
8	SPRING ROD	ALLOY STEEL
9	PIPE	CARBON STEEL
10	END COVER	CARBON STEEL
11	SPRING	ALLOY STEEL
12	STOP BOLT	STEEL
13	YOKE BUSHING	PTFE BRONZE
14	FLANGED BUSHING	PTFE BRONZE
15	POSITION INDICATOR	PLASTIC
16	ADAPTOR PLATE	CARBON STEEL

ITEM NO.	DESCRIPTION	MATERIAL
17	PISTON	CARBON STEEL
18	PISTON SEAL	PTFE + NITRILE
19	PISTON ROD	ALLOY STEEL
20	TIE ROD NUT	CARBON STEEL
21	TIE ROD	ALLOY STEEL
22	END CAP PRESSURE MODULE	CARBON STEEL
23	PIPE PLUG	CARBON STEEL
24	BARREL	CARBON STEEL
25	ROD SEAL	PTFE + NITRILE
26	PISTON ROD BUSHING	PHENOLIC RESIN
27	SPRING GUIDE	CARBON STEEL
28	ACCESSORY DRIVE SHAFT	STAINLESS STEEL
29	BREATHER	STAINLESS STEEL
30	SEAL U-CUP	POLYURETHANE
31	WIPER	POLYURETHANE
32	GUIDE RING	PHENOLIC RESIN

Notes: All fasteners on standard actuators are Zinc plated with Blue trivalent coating.
 Actuator standard coating is epoxy base coat (75-150 microns) with polyurethane top coat (50-75 microns).

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Nominal Maximum Dimensions



Series 98H Max Dimensions, inch

Model	ISO Base	A	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R
12E2	F12/F07	36.9	4.5	4.5	11.9	4.6	9.3	15.7	7.1	7.3	6.8	9.8	--	0.6	6.1	4.4	3.0
18E2	F12	43.7	4.5	4.5	13.5	5.5	11.1	19.1	8.1	8.7	8.7	11.7	--	0.6	7.4	4.4	4.0
45E2	F16/F12	54.0	5.5	5.5	15.3	6.3	12.5	26.2	9.4	9.7	9.4	13.1	--	0.7	8.5	7.7	3.8
73E2	F16/F12	60.6	7.7	7.7	16.3	7.9	15.8	28.5	12.8	11.8	11.3	16.5	--	0.7	9.8	7.8	5.1
14E3	F25/16	72.6	9.6	9.6	18.8	9.3	18.5	35.3	13.5	12.1	15.4	19.6	5.1	0.7	10.9	11.8	5.7
24E3	F30/25	90.4	10.8	10.8	22.3	11.5	22.9	45.2	15.6	14.3	19.3	23.8	5.1	1.0	13.1	13.8	7.3
45E3	F35/30	113	12.2	12.2	25.6	14.3	28.6	58.9	18.7	15.3	22.8	29.5	5.1	1.0	14.1	16.3	8.3
10E4	F40/F35	136.3	14.6	14.6	30.9	17.8	35.5	69.8	21.9	18.9	28.3	37.6	5.1	1.0	17.8	18.7	11.3

Series 98H Max Dimensions, mm

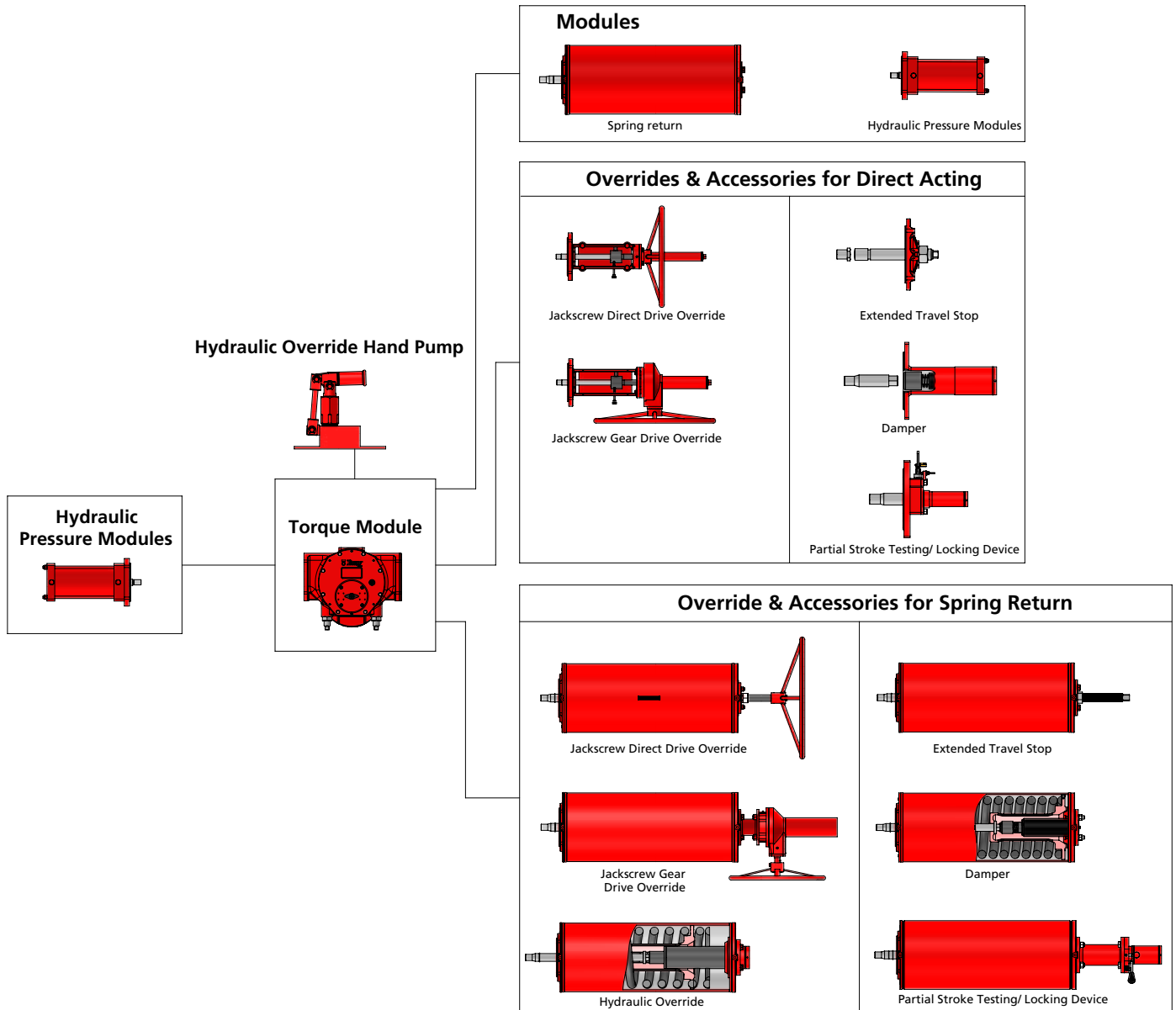
Model	ISO Base	A	B	C	D	E	F	G	H	J	K	L	M	N	P	T	U
12E2	F12/F07	937	115	115	301	118	236	400	180	185	173	248	--	15	155	113	76
18E2	F12	1110	115	115	342.5	140.5	281	486	205	222	220	296	--	15	189	113	102
45E2	F16/F12	1371	140	140	388	159	318	664	240	246	240	333	--	18	216	195	96
73E2	F16/F12	1540	196	196	415	201	402	723.45	326	300	288	420	--	18	249	197	129
14E3	F25/16	1845	244	244	478	235	470	896	342	307	390	498	130	18	276	300	145
24E3	F30/25	2296	275	275	566	291	582	1148	397	364	491	605	130	25	334	350	186
45E3	F35/30	2871	310	310	650	363	726	1495	476	388	580	750	130	25	357	415	212
10E4	F40/F35	3461	372	372	786	451	902	1773	556	481	720	955	130	25	451	475	286

Note: Refer ES drawings for dimensions of specific models

HYDRAULIC CYLINDER PORT SIZE			
Cylinder Size	32-50mm	63-140mm	160-250mm
Ports, NPT	1/4"	1/2"	3/4"

Note: 3 NPT ports, 90 degrees apart provided on the end cap and adaptor.

Manual Overrides and Accessories



Manual Overrides																																	
Series 9H Actuator Model	12 E2			18 E2			45 E2				73 E2				14 E3					24 E3					45 E3					10 E4			
Spring #	1	2	3	1	2	3	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4
Jack Screw - Direct Drive - DA		o				o				o																							
Jack Screw - Direct Drive - SR	o	o	o	o	o	o	o	o																									
Jack Screw - Bevel Gear Drive - DA										o				o					o					o									
Jack Screw - Bevel Gear Drive - SR							o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o											
Hydraulic Override - DA		o				o				o				o					o					o									
Hydraulic Override - SR	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
Sandwich Gear Box - DA		o				o				o				o					o					o									
Sandwich Gear Box - SR	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o											

o = Available

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Module Weights

MODULE WEIGHTS (APPROX), Lbs																			
Model	Rated Torq, Nm	Torque Module	Hydraulic Pressure Modules, mm												Spring Modules				
			32	40	50	63	80	100	125	140	160	180	200	220	250	1	2	3	4
12 E2	1200	33	13	14	18	25	39								53	53	60		
18 E2	1800	55		19	22	31	46								82	86	90		
45 E2	4500	84			23	32	49	68							134	146	152	172	
73 E2	7300	146			32	42	61	80	111						214	216	238	293	
14 E3	14000	236				53	74	90	122	149	188				362	384	403	430	452
24 E3	24000	428					100	104	157	188	220	282			575	593	619	677	679
45 E3	45000	666						174	177	239	276	335	406		1065	1116	1259	1369	1431
10 E4	100000	1312							249	278	365	433	521	648	802.5	2061	2205	2502	2701

MODULE WEIGHTS (APPROX), Kg																			
Model	Rated Torq, Nm	Torque Module	Hydraulic Pressure Modules, mm												Spring Modules				
			32	40	50	63	80	100	125	140	160	180	200	220	250	1	2	3	4
12 E2	1200	15	6.0	6.5	8.0	11.5	17.5								24	24	27		
18 E2	1800	25		8.5	10.0	14.0	21.0								37	39	41		
45 E2	4500	38			10.5	14.5	22.0	31.0							61	66	69	78	
73 E2	7300	66			14.5	19.0	27.5	36.5	50.5						97	98	108	133	
14 E3	14000	107				24.0	33.5	41.0	55.5	67.5	85.5				164	174	183	195	205
24 E3	24000	194					45.5	47.0	71.0	85.5	100.0	128.0			261	269	281	307	308
45 E3	45000	302						79.0	80.5	108.5	125.0	152.0	184.0		483	506	571	621	649
10 E4	100000	595							113.0	126.0	165.5	196.5	236.5	294.0	364.0	935	1000	1135	1225

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Technical Data - Double Acting Actuators

Model	Maximum Operating Pressure				Volume				Actuator Weight		Assembly Weight (approx)				
	Symmetrical		Canted		cu.in		Lts		Lbs	Kg	w/Jackscrew Override		w/Hydraulic Override		
	psi	bar	psi	bar	Rod End	Cap End	Rod End	Cap End			Lbs	Kg	Lbs	Kg	
DA	12E2-32	3000	206.7	2620	180.5	3.0	5.5	0.05	0.10	49	22	77	35		
	12E2-40	2036	140.3	1677	115.5	5.5	8.5	0.10	0.15	50	23	78	35.5		
	12E2-50	1303	89.8	1073	74.0	10.5	13.5	0.20	0.25	53	24	82	37		
	12E2-63	841	57.9	692	47.7	19.0	21.5	0.35	0.35	61	28	89	41		
DD	12E2-32	2083	143.5	1716	118.2	8.5	8.5	0.15	0.15	60	27				
	12E2-40	1199	82.6	1012	69.7	14.0	14.0	0.25	0.25	62	28				
	12E2-50	739	50.9	608	41.9	24.0	24.0	0.39	0.39	68	31				
DA	18E2-40	2443	168.3	2012	138.7	6.5	10.0	0.10	0.20	78	36	122	56		
	18E2-50	1564	107.7	1288	88.7	12.0	16.0	0.20	0.30	82	37	126	57		
	18E2-63	1009	69.5	831	57.2	22.0	25.5	0.40	0.45	90	41	134	61		
	18E2-80	626	43.1	515	35.5	33.0	41.5	0.55	0.70	106	48	150	68		
DD	18E2-40	1518	104.6	1250	86.2	16.5	16.5	0.30	0.30	93	42				
	18E2-50	915	63.0	754	51.9	28.0	28.0	0.46	0.46	99	45				
	18E2-63	547	37.7			47.5	47.5	0.80	0.80	117	53				
DA	45E2-50	3000	206.7	2477	170.7	14.5	20.5	0.25	0.35	111	51	175	79.5		
	45E2-63	1894	130.5	1560	107.5	27.0	31.5	0.45	0.50	120	55	184	83.5		
	45E2-80	1175	80.9	991	68.3	41.5	52.0	0.70	0.85	137	62	201	91		
	45E2-100	770	53.1	634	43.7	67.0	82.5	1.10	1.35	157	71	220	100		
DD	45E2-50	1718	118.4	1415	97.5	35.0	35.0	0.60	0.60	130	59				
	45E2-63	1028	70.8	867	59.7	58.5	58.5	1.00	1.00	148	67				
	45E2-80	632	43.6	521	35.9	93.5	93.5	1.55	1.55	181	82				
DA	73E2-50	3000	206.7	3000	206.7	13.5	26.5	0.25	0.45	186	85	272	123.5	301	136.5
	73E2-63	2497	172.0	2056	141.7	28.0	38.0	0.50	0.65	196	89	282	128	311	141
	73E2-80	1548	106.7	1275	87.9	51.0	61.5	0.85	1.05	215	98	301	136.5	330	149.5
	73E2-100	1015	69.9	836	57.6	79.0	99.0	1.35	1.65	235	107	321	145.5	349	158.5
	73E2-125	649	44.7	535	36.9	127.5	142.0	2.10	2.35	266	121	352	160	380	172.5
DD	73E2-50	2492	171.7	2053	141.4	40.0	40.0	0.70	0.70	209	95				
	73E2-63	1433	98.7	1180	81.3	66.0	66.0	1.15	1.15	229	104				
	73E2-80	862	59.4	710	48.9	112.5	112.5	1.90	1.90	267	121				
DA	14E3-63	3000	206.7	3000	206.7	26.5	46.0	0.45	0.75	304	138	452	205	476	216
	14E3-80	2500	172.3	2060	141.9	52.0	71.5	0.85	1.20	325	148	473	214.5	497	225.5
	14E3-100	1600	110.3	1318	90.8	89.0	114.0	1.50	1.90	342	155	489	222	514	233
	14E3-125	1024	70.6	864	59.5	148.0	167.5	2.45	2.75	374	170	521	236.5	546	247.5
	14E3-140	836	57.6	689	47.5	190.0	217.0	3.15	3.60	400	182	548	248.5	572	259.5
DD	14E3-63	2525	174.0	2080	143.3	72.5	72.5	1.20	1.20	342	155				
	14E3-80	1429	98.4	1177	81.1	123.5	123.5	2.05	2.05	384	174				
	14E3-100	891	61.4	734	50.5	203.0	203.0	3.40	3.40	417	189				
	14E3-125	553	38.1			315.5	315.5	5.20	5.20	481	218				

For Dual Cylinder Models, Total Swept volume is Rod End plus Cap End volume

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Technical Data - Double Acting Actuators (Cont.)

Model		Maximum Operating Pressure				Volume				ActuatorWeight		Assembly Weight (approx)			
		Symmetrical		Canted		cu.in		Lts		Lbs	Kg	w/Jackscrew Override		w/Hydraulic Override	
		psi	bar	psi	bar	Rod End	Cap End	Rod End	Cap End			Lbs	Kg	Lbs	Kg
DA	24E3-80	3000	206.7	2642	182.0	62.0	91.5	1.05	1.50	554	252	771	350	808	366.5
	24E3-100	2053	141.5	1691	116.5	116.5	145.0	1.95	2.40	558	253	774	351	811	368
	24E3-125	1314	90.5	1082	74.6	186.0	216.5	3.05	3.55	611	277	827	375	864	392
	24E3-140	1047	72.2	884	60.9	240.0	278.0	3.95	4.60	643	292	859	390	896	406.5
	24E3-160	822	56.6	677	46.6	322.5	365.5	5.30	6.00	675	306	891	404	928	421
DD	24E3-80	1905	131.3	1569	108.1	153.5	153.5	2.55	2.55	628	285				
	24E3-100	1142	78.7	964	66.4	261.5	261.5	4.35	4.35	635	288				
	24E3-125	720	49.6	592.9	40.9	402.5	402.5	6.60	6.60	741	336				
	24E3-140	566	39.0			518.0	518.0	8.55	8.55	805	365				
DA	45E3-100	3000	206.7	2576	177.5	122.0	171.50	2.00	2.85	877	398			1230	558
	45E3-125	2002	138.0	1649	113.6	212.5	267.5	3.50	4.40	881	400			1233	560
	45E3-140	1596	110.0	1314	90.6	276.5	336.5	4.55	5.55	942	428			1295	588
	45E3-160	1222	84.2	1031	71.0	382.5	437.0	6.30	7.20	979	444			1332	604
	45E3-180	989	68.1	815	56.2	498.0	558.0	8.20	9.15	1038	471			1391	631
DD	45E3-100	1855	127.8	1528	105.3	293.5	293.5	4.85	4.85	1014	460				
	45E3-125	1112	76.7	939	64.7	480.0	480.0	7.90	7.90	1021	463				
	45E3-140	889	61.2	732	50.4	613.0	613.0	10.10	10.10	1144	519				
	45E3-160	667	45.9	549.2	37.8	819.5	819.5	13.50	13.50	1217	552				
DA	10E4-125	3000	206.7	3000	206.7	235.0	342.0	3.85	5.60	1640	744			2246	1019
	10E4-140	2910	200.5	2397	165.1	309.5	412.0	5.10	6.75	1669	757			2275	1032
	10E4-160	2228	153.5	1835	126.4	431.50	548.00	7.10	9.00	1756	797			2362	1071.5
	10E4-180	1760	121.3	1450	99.9	575.50	697.50	9.40	11.45	1824	828			2431	1102.5
	10E4-200	1426	98.2	1174	80.9	731.00	862.00	12.00	14.15	1912	868			2519	1142.5
	10E4-220	1178	81.2	994	68.5	916.0	1032.0	15.05	16.95	2039	925			2646	1200
	10E4-250	935	64.4	770	53.1	1212.5	1334.0	19.90	21.90	2194	995			2800	1270
DD	10E4-125	2164	149.1	1783	122.8	577.0	577.0	9.45	9.45	1810	821				
	10E4-140	1663	114.6	1369	94.4	721.5	721.5	11.85	11.85	1867	847				
	10E4-160	1232	84.9	1015	69.9	979.5	979.5	16.1	16.1	2041	926				
	10E4-180	976	67.2	804	55.4	1273.0	1273.0	20.9	20.9	2178	988				
	10E4-200	778	53.6	641.0	44.2	1593.0	1593.0	26.2	26.2	2355	1068				

Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Technical Data - Spring Return Actuators

Model	Spring #	Maximum Operating Pressure				Volume		Actuator Weight		Assembly Weight (approx)			
		Symmetrical		Canted		Rod end		Lbs	Kg	w/Jackscrew Override		w/Hydraulic Override	
		psi	bar	psi	bar	cu.in	Lts			Lbs	Kg	Lbs	Kg
12E2-40	1	3000	206.7	3000	206.7	5.5	0.10	100	45.5	114	51.5		
12E2-50		2134	147.0	1831	126.2	10.5	0.20	104	47	117	53		
12E2-63		1234	85.1	1059	73.0	19.0	0.35	111	51	125	57		
12E2-80		727	50.1	624	43.0	28.0	0.50	125	57	138	63		
12E2-40	2	3000	206.7	3000	206.7	5.5	0.10	100	45.5	114	51.5		
12E2-50		2238	154.2	1936	133.4	10.5	0.20	104	47	117	53		
12E2-63		1295	89.2	1120	77.1	19.0	0.35	111	51	125	56.5		
12E2-80		763	52.6	660	45.4	28.0	0.50	125	57	138	62.5		
12E2-40	3	3000	206.7	3000	206.7	5.5	0.10	107	48.5	120	54.5		
12E2-50		2449	168.7	2146	147.9	10.5	0.20	110	50	123	56		
12E2-63		1417	97.6	1241	85.5	19.0	0.35	118	54	131	59.5		
12E2-80		834	57.5	731	50.4	28.0	0.50	131	60	144	65.5		
18E2-50	1	2702	186.1	2334	160.8	12.0	0.20	159	72	172	78		
18E2-63		1515	104.4	1309	90.2	22.0	0.40	168	76	181	82		
18E2-80		893	61.6	771	53.1	33.0	0.55	183	83	196	89		
18E2-50	2	2800	192.9	2432	167.6	12.0	0.20	163	74	176	80		
18E2-63		1570	108.2	1364	94.0	22.0	0.40	172	78	185	84		
18E2-80		925	63.8	803	55.3	33.0	0.55	187	85	201	91		
18E2-50	3	3000	206.7	2706	186.5	12.0	0.20	168	76	181	82		
18E2-63		1723	118.7	1517	104.5	22.0	0.40	176	80	190	86		
18E2-80		1014	69.9	892	61.5	33.0	0.55	192	87	205	93		
45E2-63	1	2784	191.8	2388	164.5	27.0	0.45	250	114	277	125.5		
45E2-80		1612	111.1	1382	95.3	41.5	0.70	267	121	293	133		
45E2-100		1012	69.7	868	59.8	67.0	1.10	287	130	313	142		
45E2-63	2	2973	204.9	2577	177.6	27.0	0.45	261	119	288	130.5		
45E2-80		1722	118.6	1492	102.8	41.5	0.70	278	126	304	138		
45E2-100		1061	73.1	935	64.4	67.0	1.10	298	135	324	147		
45E2-63	3	3000	206.7	2835	195.3	27.0	0.45	268	122	325	147.5		
45E2-80		1871	128.9	1642	113.1	41.5	0.70	284	129	342	155		
45E2-100		1153	79.4	1027	70.8	67.0	1.10	304	138	362	164		
45E2-63	4	3000	206.7	2952	203.4	27.0	0.45	288	131	347	157.5		
45E2-80		1939	133.6	1710	117.8	41.5	0.70	304	138	364	165		
45E2-100		1194	82.3	1069	73.7	67.0	1.10	324	147	384	174		
73E2-63	1	3000	206.7	3000	206.7	28.0	0.50	401	182	463	210	478	217
73E2-80		2381	164.0	2056	141.6	51.0	0.85	420	191	482	218.5	497	225.5
73E2-100		1426	98.2	1231	84.8	79.0	1.35	440	200	502	227.5	517	234.5
73E2-125		893	61.5	770	53.1	127.5	2.10	471	214	532	241.5	548	248.5
73E2-63	2	3000	206.7	3000	206.7	28.0	0.50	403	183	467	212	481	218
73E2-80		2455	169.2	2130	146.8	51.0	0.85	422	192	486	220.5	499	226.5
73E2-100		1471	101.3	1276	87.9	79.0	1.35	442	201	506	229.5	519	235.5
73E2-125		920	63.4	798	55.0	127.5	2.10	473	215	537	243.5	550	249.5
73E2-63	3	3000	206.7	3000	206.7	28.0	0.50	425	193	492	223	503	228
73E2-80		2600	179.1	2275	156.7	51.0	0.85	444	202	510	231.5	521	236.5
73E2-100		1557	107.3	1362	93.9	79.0	1.35	464	211	530	240.5	541	245.5
73E2-125		974	67.1	851	58.6	127.5	2.10	495	225	561	254.5	572	259.5
73E2-63	4	3000	206.7	3000	206.7	28.0	0.50	481	218	547	248	558	253
73E2-80		2733	188.3	2408	165.9	51.0	0.85	499	227	565	256.5	577	261.5
73E2-100		1637	112.8	1442	99.4	79.0	1.35	519	236	585	265.5	596	270.5
73E2-125		1023	70.5	900	62.0	127.5	2.10	550	250	616	279.5	627	284.5

Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Technical Data - Spring Return Actuators (cont.)

Model	Spring #	Maximum Operating Pressure				Volume		Actuator Weight		Assembly Weight (approx)			
		Symmetrical		Canted		Rod end		Lbs	Kg	w/Jackscrew Override		w/Hydraulic Override	
		psi	bar	psi	bar	cu.in	Lts			Lbs	Kg	Lbs	Kg
14E3-80	1	3000	206.7	3000	206.7	52.0	0.85	671	305	766	347.5	779	353.5
14E3-100		2379	163.9	2043	140.8	89.0	1.50	688	312	783	355	796	361
14E3-125		1425	98.2	1224	84.3	148.0	2.45	720	327	815	370	828	375.5
14E3-140		1110	76.5	971	66.9	190.0	3.15	746	339	841	382	854	387.5
14E3-160		849	58.5	728	50.2	253.5	4.15	786	357	881	400	894	405.5
14E3-80	2	3000	206.7	3000	206.7	52.0	0.85	693	315	793	359.5	801	363.5
14E3-100		2448	168.7	2112	145.5	89.0	1.50	710	322	809	367	818	371
14E3-125		1466	101.0	1265	87.2	148.0	2.45	742	337	841	382	850	385.5
14E3-140		1143	78.7	1003	69.1	190.0	3.15	768	349	868	394	876	397.5
14E3-160		873	60.1	753	51.9	253.5	4.15	808	367	907	412	916	415.5
14E3-80	3	3000	206.7	3000	206.7	52.0	0.85	713	324	812	368.5	821	372.5
14E3-100		2538	174.9	2202	151.7	89.0	1.50	730	331	829	376	838	380
14E3-125		1520	104.7	1319	90.9	148.0	2.45	762	346	861	391	870	394.5
14E3-140		1184	81.6	1028	70.8	190.0	3.15	788	358	887	403	896	406.5
14E3-160		904	62.3	784	54.0	253.5	4.15	828	376	927	421	936	424.5
14E3-80	4	3000	206.7	3000	206.7	52.0	0.85	740	336	854	387.5	848	384.5
14E3-100		2685	185.0	2349	161.8	89.0	1.50	756	343	871	395	864	392
14E3-125		1608	110.8	1407	96.9	148.0	2.45	788	358	903	410	896	406.5
14E3-140		1253	86.3	1096	75.5	190.0	3.15	815	370	929	422	923	418.5
14E3-160		956	65.8	835	57.5	253.5	4.15	854	388	969	440	962	436.5
14E3-80	5	3000	206.7	3000	206.7	52.0	0.85	762	346	876	397.5	870	394.5
14E3-100		2784	191.8	2449	168.7	89.0	1.50	778	353	893	405	886	402
14E3-125		1668	114.9	1467	101.0	148.0	2.45	810	368	925	420	918	416.5
14E3-140		1299	89.5	1143	78.7	190.0	3.15	837	380	951	432	945	428.5
14E3-160		991	68.3	870	60.0	253.5	4.15	876	398	991	450	984	446.5
24E3-100	1	3000	206.7	2824	194.5	116.5	1.95	1107	502	1261	572	1263	573
24E3-125		1922	132.4	1656	114.1	186.0	3.05	1160	526	1314	596	1316	597
24E3-140		1487	102.5	1281	88.3	240.0	3.95	1192	541	1346	611	1348	612
24E3-160		1109	76.4	973	67.0	322.5	5.30	1224	555	1378	625	1380	626
24E3-180		877	60.4	755	52.0	422.5	459.50	1285	583	1440	653	1442	654
24E3-100	2	3000	206.7	2963	204.2	116.5	1.95	1124	510	1281	581	1281	581
24E3-125		2004	138.1	1738	119.7	186.0	3.05	1177	534	1334	605	1334	605
24E3-140		1551	106.8	1345	92.6	240.0	3.95	1209	549	1366	620	1366	620
24E3-160		1156	79.6	1020	70.3	322.5	5.30	1241	563	1398	634	1398	634
24E3-180		914	63.0	792	54.5	422.5	459.50	1285	583	1442	654	1442	654
24E3-100	3	3000	206.7	3000	206.7	116.5	1.95	1151	522	1343	609	1307	593
24E3-125		2120	146.1	1854	127.7	186.0	3.05	1204	546	1396	633	1360	617
24E3-140		1641	113.0	1435	98.9	240.0	3.95	1236	561	1427	648	1392	632
24E3-160		1223	84.3	1070	73.7	322.5	5.30	1268	575	1459	662	1424	646
24E3-180		966	66.6	844	58.1	422.5	459.50	1329	603	1521	690	1486	674
24E3-100	4	3000	206.7	3000	206.7	116.5	1.95	1208	548	1402	636	1365	619
24E3-125		2202	151.7	1935	133.3	186.0	3.05	1261	572	1455	660	1418	643
24E3-140		1704	117.4	1498	103.2	240.0	3.95	1293	587	1487	675	1450	658
24E3-160		1270	87.5	1116	76.9	322.5	5.30	1325	601	1519	689	1481	672
24E3-180		1002	69.1	880	60.7	422.5	459.50	1387	629	1581	717	1543	700
24E3-100	5	3000	206.7	3000	206.7	116.5	1.95	1210	549	1407	638	1367	620
24E3-125		2294	158.1	2028	139.7	186.0	3.05	1263	573	1459	662	1420	644
24E3-140		1775	122.3	1570	108.1	240.0	3.95	1295	588	1491	677	1452	659
24E3-160		1324	91.2	1170	80.6	322.5	5.30	1327	602	1523	691	1484	673
24E3-180		1044	71.9	922	63.5	422.5	459.50	1389	630	1585	719	1545	701

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Technical Data - Spring Return Actuators (cont.)

Model	Spring #	Maximum Operating Pressure				Volume		Actuator Weight		Assembly Weight (approx)			
		Symmetrical		Canted		Rod end		Lbs	Kg	w/Jackscrew Override		w/Hydraulic Override	
		psi	bar	psi	bar	cu.in	Lts			Lbs	Kg	Lbs	Kg
45E3-125	1	3000	206.7	2728	187.9	212.5	3.50	1908	866			2157	979
45E3-140		2404	165.6	2069	142.6	276.5	4.55	1970	894			2219	1006.5
45E3-160		1762	121.4	1517	104.5	382.5	6.3	2006	910			2255	1023
45E3-180		1353	93.2	1164	80.2	498.0	8.2	2066	937			2315	1050
45E3-200		1074	74.0	941	64.9	618.5	10.15	2136	969			2385	1082
45E3-125	2	3000	206.7	2823	194.5	212.5	3.50	1959	889			2208	1002
45E3-140		2477	170.6	2142	147.6	276.5	4.55	2021	917			2270	1029.5
45E3-160		1815	125.1	1570	108.2	382.5	6.30	2057	933			2306	1046
45E3-180		1393	96.0	1205	83.0	498.0	8.20	2116	960			2366	1073
45E3-200		1106	76.2	974	67.1	618.5	10.15	2187	992			2436	1105
45E3-125	3	3000	206.7	3000	206.7	212.5	3.50	2102	954			2351	1067
45E3-140		2616	180.2	2281	157.2	276.5	4.55	2164	982			2413	1094.5
45E3-160		1917	132.1	1672	115.2	382.5	6.30	2200	998			2449	1111
45E3-180		1472	101.4	1283	88.4	498.0	8.20	2260	1025			2509	1138
45E3-200		1168	80.5	1019	70.2	618.5	10.15	2330	1057			2579	1170
45E3-125	4	3000	206.7	3000	206.7	212.5	3.50	2212	1004			2461	1117
45E3-140		2693	185.5	2358	162.5	276.5	4.55	2274	1032			2523	1144.5
45E3-160		1974	136.0	1728	119.1	382.5	6.30	2310	1048			2560	1161
45E3-180		1515	104.4	1327	91.4	498.0	8.20	2370	1075			2619	1188
45E3-200		1203	82.9	1053	72.6	618.5	10.15	2440	1107			2690	1220
45E3-125	5	3000	206.7	3000	206.7	212.5	3.50	2274	1032			2523	1145
45E3-140		2790	192.2	2455	169.1	276.5	4.55	2336	1060			2585	1172.5
45E3-160		2045	140.9	1799	124.0	382.5	6.30	2372	1076			2621	1189
45E3-180		1569	108.1	1381	95.2	498.0	8.20	2432	1103			2681	1216
45E3-200		1246	85.8	1096	75.5	618.5	10.15	2502	1135			2751	1248
10E4-160	1	3000	206.7	2964	204.2	431.5	7.10	3738	1696			4013	1820.5
10E4-180		2597	178.9	2231	153.7	575.5	9.40	3806	1727			4082	1851.5
10E4-200		2035	140.2	1748	120.4	731.0	12.00	3894	1767			4170	1891.5
10E4-220		1642	113.1	1411	97.2	916.0	15.05	4021	1824			4297	1949
10E4-250		1240	85.4	1065	73.4	1212.5	19.90	4176	1894			4451	2019
10E4-160	2	3000	206.7	3000	206.7	431.5	7.10	3881	1761			4157	1885.5
10E4-180		2669	183.9	2303	158.7	575.5	9.40	3950	1792			4225	1916.5
10E4-200		2091	144.1	1804	124.3	731.0	12.00	4038	1832			4313	1956.5
10E4-220		1687	116.2	1456	100.3	916.0	15.05	4164	1889			4440	2014
10E4-250		1274	87.8	1100	75.8	1212.5	19.90	4319	1959			4594	2084
10E4-160	3	3000	206.7	3000	206.7	431.5	7.10	4179	1896			4454	2020.5
10E4-180		2832	195.1	2466	169.9	575.5	9.40	4247	1927			4523	2051.5
10E4-200		2219	152.9	1932	133.1	731.0	12.00	4335	1967			4611	2091.5
10E4-220		1790	123.4	1559	107.4	916.0	15.05	4462	2024			4738	2149
10E4-250		1352	93.2	1178	81.1	1212.5	19.90	4616	2094			4892	2219
10E4-160	4	3000	206.7	3000	206.7	431.5	7.10	4377	1986			4653	2110.5
10E4-180		2933	202.1	2567	176.9	575.5	9.40	4446	2017			4721	2141.5
10E4-200		2298	158.3	2011	138.6	731.0	12.00	4534	2057			4809	2181.5
10E4-220		1854	127.8	1623	111.8	916.0	15.05	4661	2114			4936	2239
10E4-250		1400	96.5	1226	84.5	1212.5	19.90	4815	2184			5090	2309

Sizing a Series 98H Hydraulic Actuator

1.0 Introduction

Valves in services such as,

- > Frequent and/or fast operation
- > Hazardous areas
- > Remote locations
- > Emergency Shutdown or Venting applications
- > Process control
- > Reliable and consistent operation

are almost always automated, besides the ones that require very high thrust/torque to operate which would be very tedious or not practical, manually.

Valve actuators are required to move the valve's closure element (ball/disc/plug) to end positions of open or close with adequate torque/thrust to seat or unseat, or to move and positively hold the closure element at a desired intermediate position for process control requirements. They also need to accomplish the fail-safe function for an application, to drive the valve to close or open position, on loss of motive power.

2.0 Common Terminology

Some of the most used terms in the quarter turn actuator sizing for valves:

- > DA or Double Acting: The actuation is by compressed media on either side of the piston.
 - > SR or Spring Return: Actuation by compressed media on one side and by the compressed spring in other direction.
 - > Fail Safe: Actuator's response to loss of motive energy to mitigate unsafe consequence of a system's failure.
 - > Fail Close: The actuator turns the valve stem (normally clockwise) to close the valve, in event of loss of motive power or signal.
 - > Fail Open: The actuator turns the valve stem (normally counterclockwise) to open the valve, in event of loss of motive power or signal.
 - > Fail Last: Also referred to as Fail in Place and Fail Freeze, holds the last position on failure of power or signal.
 - > BTO: Also called as Break to Open Torque, Unseating Torque, Pneumatic / Hydraulic Break or Start Torque is the Actuator's maximum output torque at the start of the power stroke to unseat or open a valve, usually at the Zero degrees position of the quarter turn travel.
 - > RTO: Run to Open Torque is the torque output of actuator at the mid position of travel or the minimum torque output along the torque curve.
 - > ETO: End to Open Torque, Pneumatic/Hydraulic End, Air/Hydraulic End Torque is the torque output of the actuator at the end of the quarter turn travel or at the valve's full open or 90-degree position of the travel.
 - > BTC: Break to Close, Spring Break Torque or Spring Start (for SR actuators) is the actuator's output torque at the start of the return stroke or valve closing stroke, either by the fluid power on DA actuators or by the compressed spring in SR actuators.
 - > RTC: Run to Close Torque is the torque output of the actuator at mid position of travel or the minimum torque along the torque curve.
 - > ETC: End to Close, Seating Torque, Spring End Torque, Pneumatic/Hydraulic End Torque is the maximum output torque of actuator at the end of the return power stroke or valve closing/ seating position either by fluid power on DA actuator or by the expanded spring in SR actuators, at the zero degree position of travel.
 - > MAST: The Maximum Allowable Stem Torque of the valve.
 - > FOS: A factor equal or greater than 1 multiplied by the valve's torque requirement, used for sizing an actuator for the valve.
 - > MOR: Manual Override
 - > Stroke: A 90-degree operation in either clockwise (CW) or counterclockwise (CCW) direction. A Power Stroke is by compressed Air or hydraulic pressure and the Spring Stroke is the return stroke by the stored energy in a spring, compressed by the power stroke.
 - > Cycle: Sequential operation of two strokes of actuator, opening or counterclockwise stroke and closing or clockwise stroke.
 - > Sizing: Pressure: Minimum operating pressure available, at which the actuator is to be sized for the valve.
 - > MOP: The Maximum Operating Pressure of the actuator that outputs the rated torque/thrust of the actuator.
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3.0 Series 98H Actuators

- 3.1 S98H are Hydraulic Scotch Yoke Actuators with an operating pressure range of 500 to 3000psig hydraulic pressure. The actuators range from 1200 Nm to 100,000Nm rated torque in 8 sizes, with multiple pressure and spring modules to choose from and optimize the selection. Refer to General Specifications and the Configurations sections for more details.
- 3.2 These hydraulic actuators use mineral oil as the media which gives them of a higher degree of corrosion protection compared to Air or gas operation and makes them suitable for corrosive environments in offshore and in gas-over-oil applications. However, the hydraulic system is closed operation system in the sense that all fluid must return to the hydraulic reservoir unlike the pneumatic actuators, where the media is exhausted to atmosphere. As the hydraulic fluid is incompressible, the operation is with a finer control. As with the Pneumatic S98, all the optional modules and build configurations are available here too.

4.0 Sizing S98H for a Valve

- 4.1 Establish the Valve's torque requirements for the application and service that it would be put in, from the valve manufacturer's technical documentation.
- The differential pressure across the valve closure element (Ball/Disc/Plug) bears on this torque value.
- 4.2 The maximum torque position during the dynamic operation and direction of rotation in which this is encountered shall also be determined. The maximum torque would normally be the unseating torque of the valve in the selected operating conditions, for most cases.
- 4.3 The FOS or the factor of safety in the sizing an actuator for this valve shall be determined, as recommended by the valve manufacturer or by the application engineering.
- 4.4 Multiply the FOS factor with each of the 3 (BTO, RTO & ETC), or the 6 (BTO, RTO, ETO, BTC, RTC & ETC) torque values provided by the valve manufacturer, to determine the max. and min. torque requirements of the actuator.
- 4.5 Note the MAST or the maximum allowable stem torque value of the valve.
- 4.6 Next, determine if the application requires Double Acting or a Spring Return actuator.
- 4.7 Note the Sizing Pressure value for selecting the actuator that will output required torques at this pressure.
- 4.8 Selecting a DA actuator (for clockwise to close operation)
- Look up the torque charts for the required configuration of the actuator, i.e., DA, under the sizing pressure column. Scroll down to locate the Starting and Mid torques that are same or higher than the required.
- 4.9 Note the S98H actuator model corresponding to these values.
- 4.10 Selecting a SR actuator (fail close or Fail clockwise)
- Look up the torque charts for SR actuators for the Spring End Torque that meets or exceeds the ETC torque determined in step 4. Scroll along to the right to the sizing pressure column to check if the Hydraulic Start torque meets or exceeds the BTO value determined in step 4. The Hydraulic End torque also must meet or exceed the ETO value.
- If the hydraulic torques meet the requirement, note the actuator model and the spring number.
- If the hydraulic torques fall short, then move down along the sizing pressure column to the next pressure module size with the same spring number as previous one and verify if the hydraulic torque values satisfy. Note the actuator model and the spring #.
- 4.11 Check the MOP for the selected model of the actuator to confirm that the maximum supply pressure does not exceed the MOP. If it does, then the supply pressure must be restricted to selected actuator's MOP or select another actuator with higher MOP.
- Contact Bray Sales or Distributor for any assistance required with optimizing the sizing.
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Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig											Limiting MOP, psi
				500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	
				Hydraulic Torque, Lb-in											
12E2-40	1	Start	4166					2555	3410	4266	5122	5978	6834	7689	3000
		Mid	1930					1060	1541	2023	2504	2986	3467	3948	
		End	2741					1214	2070	2926	3782	4637	5493	6349	
12E2-40	2	Start	5381						2765	3621	4477	5333	6189	7044	3000
		Mid	2461						1038	1520	2001	2482	2964	3445	
		End	3427						926	1782	2638	3493	4349	5205	
12E2-40	3	Start	6880									4030	4886	5742	3000
		Mid	3267									1719	2201	2682	
		End	4811									2082	2938	3794	
12E2-50	1	Start	4166		2058	3604	5150	6696	8242	9788					2134
		Mid	1930		780	1650	2520	3389	4259	5128					
		End	2741		717	2263	3809	5355	6901	8447					
12E2-50	2	Start	5381			2959	4505	6051	7597	9143	10688			2238	
		Mid	2461			1147	2017	2886	3756	4625	5495				
		End	3427			1119	2665	4211	5757	7303	8849				
12E2-50	3	Start	6880				3202	4748	6294	7840	9386			2449	
		Mid	3267				1253	2123	2993	3862	4732				
		End	4811				1254	2800	4346	5892	7438				
12E2-63	1	Start	4166	2765	5437	8110	10782							1234	
		Mid	1930	1178	2681	4185	5688								
		End	2741	1424	4097	6769	9442								
12E2-63	2	Start	5381		4792	7465	10137							1295	
		Mid	2461		2178	3682	5185								
		End	3427		2953	5625	8298								
12E2-63	3	Start	6880		3490	6162	8834							1417	
		Mid	3267		1415	2918	4422								
		End	4811		1542	4214	6887								
12E2-80	1	Start	4166	6493										727	
		Mid	1930	3275											
		End	2741	5153											
12E2-80	2	Start	5381	5848	10385									763	
		Mid	2461	2772	5324										
		End	3427	4009	8545										
12E2-80	3	Start	6880	4545	9082									834	
		Mid	3267	2009	4561										
		End	4811	2598	7134										

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig											Limiting MOP, psi
				500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	
				Hydraulic Torque, Lb-in											
18E2-50	1	Start	6124			2858	4836	6746	8656	10565	12475	14384			2702
		Mid	3028			1215	2308	3375	4442	5510	6577	7644			
		End	4712			1479	3424	5334	7243	9153	11063	12972			
18E2-50	2	Start	7483				4087	5996	7906	9816	11725	13635	15544		2800
		Mid	3617				1719	2786	3853	4920	5988	7055	8122		
		End	5461				2065	3975	5885	7794	9704	11614	13523		
18E2-50	3	Start	11940						5811	7721	9630	11540	13450	15359	3000
		Mid	5448						2022	3090	4157	5224	6291	7358	
		End	7556						1427	3337	5247	7156	9066	10975	
18E2-63	1	Start	6124		5376	8702	12317	15723							1515
		Mid	3028		2626	4489	6488	8392							
		End	4712		3997	7323	10905	14311							
18E2-63	2	Start	7483		4644	7970	11567	14973							1570
		Mid	3617		2049	3912	5899	7803							
		End	5461		2670	5996	9546	12952							
18E2-63	3	Start	11940			5924	9472	12878							1723
		Mid	5448			2120	4069	5972							
		End	7556			1643	5089	8494							
18E2-80	1	Start	6124	6886	12629										893
		Mid	3028	3471	6689										
		End	4712	5507	11250										
18E2-80	2	Start	7483	6154	11897										925
		Mid	3617	2895	6112										
		End	5461	4180	9923										
18E2-80	3	Start	11940		9851	15595									1014
		Mid	5448		4320	7538									
		End	7556		5571	11314									

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Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
45E2-63	1	Start	13003			8024	12645	17072	21500	25927	30355	34782	39210		2784
		Mid	6286			3535	6085	8559	11034	13508	15982	18456	20930		
		End	9493			4596	9134	13562	17989	22417	26844	31272	35699		
45E2-63	2	Start	17219					13714	18141	22569	26996	31424	35851	40279	2973
		Mid	8402					6443	8917	11392	13866	16340	18814	21288	
		End	12851					9346	13774	18201	22629	27056	31483	35911	
45E2-63	3	Start	24910						13573	18001	22428	26856	31283	35711	3000
		Mid	11827						5492	7966	10440	12915	15389	17863	
		End	17419						6082	10510	14937	19365	23792	28219	
45E2-63	4	Start	32171								20349	24776	29204	33631	3000
		Mid	14437								7831	10305	12779	15253	
		End	19498								7676	12104	16531	20959	
45E2-80	1	Start	13003	5663	13130	20596	28738	36384							1612
		Mid	6286	2213	6395	10578	15079	19351							
		End	9493	2235	9701	17168	25227	32874							
45E2-80	2	Start	17219		9850	17316	25380	33026							1722
		Mid	8402		4324	8507	12962	17235							
		End	12851		5585	13051	21012	28658							
45E2-80	3	Start	24910			12856	20812	28458	36104						1871
		Mid	11827			5153	9537	13810	18083						
		End	17419			5541	13320	20967	28613						
45E2-80	4	Start	32171					26378	34025						1939
		Mid	14437					11200	15473						
		End	19498					13706	21352						
45E2-100	1	Start	13003	14972	27092	39213									1012
		Mid	6286	7428	14218	21008									
		End	9493	11544	23664	35785									
45E2-100	2	Start	17219	11692	23813	35933									1061
		Mid	8402	5356	12146	18937									
		End	12851	7427	19548	31668									
45E2-100	3	Start	24910		19352	31473									1153
		Mid	11827		8793	15583									
		End	17419		12037	24158									
45E2-100	4	Start	32171		17322	29442									1194
		Mid	14437		6238	13028									
		End	19498		4947	17068									

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke																	
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi			
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000		
				Hydraulic Torque, Lb-in													
73E2-63	1	Start	25819							14746	19545	24344	29143	33942	38741	3000	
		Mid	12480							6292	8974	11656	14338	17020	19702		
		End	18847							7775	12574	17373	22172	26971	31770		
73E2-63	2	Start	31339								16927	21726	26525	31324	36123	3000	
		Mid	14754								6700	9382	12064	14746	17428		
		End	21466								7053	11852	16651	21450	26249		
73E2-63	3	Start	41373										21470	26269	31068	3000	
		Mid	18970										7848	10530	13212		
		End	26520										6617	11416	16215		
73E2-63	4	Start	45865												26389	3000	
		Mid	21533												10649		
		End	31200														11723
73E2-80	1	Start	25819			15814	24955	33716	42476	51236	59997					2381	
		Mid	12480			6953	11998	16893	21789	26684	31580						
		End	18847			9006	17984	26744	35505	44265	53026						
73E2-80	2	Start	31339					31097	39858	48618	57379					2455	
		Mid	14754					14619	19515	24410	29306						
		End	21466					21224	29984	38745	47505						
73E2-80	3	Start	41373					26043	34803	43564	52324	61085				2600	
		Mid	18970					10403	15299	20194	25090	29985					
		End	26520					11190	19950	28711	37471	46232					
73E2-80	4	Start	45865					21363	30124	38884	47644	56405	65165			2733	
		Mid	21533					7840	12736	17632	22527	27423	32318				
		End	31200					6698	15458	24218	32979	41739	50500				
73E2-100	1	Start	25819		24444	38727	54287									1426	
		Mid	12480		11788	19790	28389										
		End	18847		17637	31920	47316										
73E2-100	2	Start	31339		21888	36170	51669									1471	
		Mid	14754		9562	17563	26115										
		End	21466		12247	26529	41795										
73E2-100	3	Start	41373			31235	46614	61241								1557	
		Mid	18970			13436	21899	30073									
		End	26520			16731	31761	46388									
73E2-100	4	Start	45865			26665	41935	56561								1637	
		Mid	21533			10927	19336	27510									
		End	31200			12345	27269	41896									
73E2-125	1	Start	25819	28063	51296											893	
		Mid	12480	13815	26831												
		End	18847	21255	44489												
73E2-125	2	Start	31339	25506	48739											920	
		Mid	14754	11589	24605												
		End	21466	15865	39098												
73E2-125	3	Start	41373	20570	43804											974	
		Mid	18970	7462	20478												
		End	26520	6067	29300												
73E2-125	4	Start	45865		39234	62467										1023	
		Mid	21533		17969	30985											
		End	31200		24914	48147											

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Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
14E3-80	1	Start	42556					24893	34181	43470	52758	62047	71335	80624	3000
		Mid	20507					10637	15827	21018	26208	31399	36590	41780	
		End	30838					13175	22463	31752	41040	50328	59617	68905	
14E3-80	2	Start	48762						29686	38975	48263	57551	66840	76128	3000
		Mid	23497						12837	18028	23218	28409	33600	38790	
		End	35333						16257	25546	34834	44123	53411	62700	
14E3-80	3	Start	56805							33144	42432	51721	61009	70298	3000
		Mid	27373							14151	19342	24532	29723	34914	
		End	41163							17503	26791	36080	45368	54656	
14E3-80	4	Start	74023									42184	51472	60760	3000
		Mid	34849									17057	22247	27438	
		End	50701									18861	28150	37438	
14E3-80	5	Start	91521											54262	3000
		Mid	41554											20733	
		End	57199											19940	
14E3-100	1	Start	42556		17505	33377	50436	66691	82946	99200	115455				2379
		Mid	20507		6602	15494	24911	33994	43078	52161	61245				
		End	30838		6062	21935	38718	54973	71227	87482	103737				
14E3-100	2	Start	48762			28988	45941	62196	78450	94705	110960				2448
		Mid	23497			12567	21921	31004	40088	49171	58255				
		End	35333			15875	32512	48767	65022	81277	97531				
14E3-100	3	Start	56805					56365	72620	88875	105129	121384			2538
		Mid	27373						27128	36211	45295	54378	63462		
		End	41163						40724	56979	73233	89488	105743		
14E3-100	4	Start	74023						46828	63082	79337	95592	111847		2685
		Mid	34849						19652	28736	37819	46903	55986		
		End	50701						23506	39760	56015	72270	88525		
14E3-100	5	Start	91521						56584	72839	89094	105349	121603		2784
		Mid	41554						22031	31114	40198	49281	58365		
		End	57199						22262	38517	54772	71027	87281		
14E3-125	1	Start	42556	22890	49391	75892	104861								1425
		Mid	20507	9619	24466	39313	55324								
		End	30838	11448	37949	64450	93142								
14E3-125	2	Start	48762		45002	71503	100365								1466
		Mid	23497		21539	36386	52334								
		End	35333		31889	58390	86937								
14E3-125	3	Start	56805		39308	65809	94535	121674							1520
		Mid	27373		17744	32591	48458	63624							
		End	41163		24035	50536	78893	106033							
14E3-125	4	Start	74023			56496	84997	112137							1608
		Mid	34849			25272	40982	56148							
		End	50701			33723	61675	88815							
14E3-125	5	Start	91521			50151	78499	105639							1668
		Mid	41554			18709	34277	49444							
		End	57199			16637	44177	71317							

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Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
24E3-100	1	Start	86173					65698	86319	106940	127561	148182	168803	189425	3000
		Mid	40682					29491	41044	52596	64149	75702	87255	98808	
		End	58028					39581	60202	80823	101444	122066	142687	163308	
24E3-100	2	Start	101825					54195	74816	95437	116058	136679	157300	177921	3000
		Mid	48347					21987	33540	45093	56645	68198	79751	91304	
		End	69532					24297	44918	65539	86160	106781	127402	148023	
24E3-100	3	Start	132017							79031	99652	120273	140894	161515	3000
		Mid	61478							32239	43791	55344	66897	78450	
		End	85938							36058	56679	77300	97921	118542	
24E3-100	4	Start	154552									108846	129467	150088	3000
		Mid	71044									45979	57532	69085	
		End	97365									55295	75916	96537	
24E3-100	5	Start	178697									95770	116391	137012	3000
		Mid	81532									35712	47265	58818	
		End	110440									31718	52339	72961	
24E3-125	1	Start	86173		46325	80643	117800	152966	188132						1922
		Mid	40682		18864	38141	58681	78382	98083						
		End	58028		20838	55156	91683	126849	162015						
24E3-125	2	Start	101825			69417	106297	141462	176628	211794					2004
		Mid	48347			30799	51177	70878	90579	110281					
		End	69532			40240	76399	111565	146730	181896					
24E3-125	3	Start	132017					125056	160222	195388					2120
		Mid	61478					58024	77725	97427					
		End	85938					82083	117249	152415					
24E3-125	4	Start	154552					113629	148795	183961					2202
		Mid	71044					48659	68360	88062					
		End	97365					60079	95244	130410					
24E3-125	5	Start	178697					100554	135719	170885	206051				2294
		Mid	81532					38392	58093	77795	97496				
		End	110440					36502	71668	106833	141999				
24E3-140	1	Start	86173		76417	120766	169191	214635							1487
		Mid	40682		35767	60679	87472	112932							
		End	58028		50929	95278	143074	188518							
24E3-140	2	Start	101825		65190	109539	157688	203132							1551
		Mid	48347		28424	53336	79968	105428							
		End	69532		36013	80362	127790	173234							
24E3-140	3	Start	132017			93529	141282	186726							1641
		Mid	61478			40759	67114	92574							
		End	85938			51591	98309	143753							
24E3-140	4	Start	154552			82377	129855	175298							1704
		Mid	71044			31595	57749	83209							
		End	97365			30116	76304	121748							
24E3-140	5	Start	178697					162223	207667						1775
		Mid	81532					72942	98401						
		End	110440					98171	143615						

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Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
45E3-125	1	Start	158124				92967	132712	172457	212202	251948	291693	331438	371183	3000
		Mid	74444				38458	60724	82991	105258	127525	149792	172059	194326	
		End	105759				44322	84068	123813	163558	203303	243048	282793	322539	
45E3-125	2	Start	193270					117498	157243	196988	236733	276478	316224	355969	3000
		Mid	88618					46849	69116	91383	113650	135917	158184	180450	
		End	120973					49749	89494	129239	168984	208729	248475	288220	
45E3-125	3	Start	210693						128048	167793	207538	247283	287028	326774	3000
		Mid	101840						56172	78439	100706	122973	145240	167507	
		End	150169						72481	112226	151971	191716	231462	271207	
45E3-125	4	Start	246931							151669	191414	231159	270904	310649	3000
		Mid	116579							64010	86277	108544	130811	153078	
		End	166293								76841	116586	156331	196076	
45E3-125	5	Start	292379									210852	250597	290342	3000
		Mid	135089									90424	112691	134958	
		End	186600										111953	151698	
45E3-140	1	Start	158124			101320	156217	208613	261008	313403	365799				2404
		Mid	74444			43581	73893	103247	132601	161955	191309				
		End	105759			53848	107573	159968	212363	264759	317154				
45E3-140	2	Start	193270				141003	193398	245793	298189	350584	402979			2477
		Mid	88618				60018	89372	118726	148080	177434	206788			
		End	120973				73254	125649	178045	230440	282835	335230			
45E3-140	3	Start	210693					164203	216598	268994	321389	373784			2616
		Mid	101840					76428	105782	135136	164490	193844			
		End	150169					108636	161032	213427	265822	318217			
45E3-140	4	Start	246931					148079	200474	252869	305265	357660			2693
		Mid	116579					61999	91353	120707	150061	179415			
		End	166293					73251	125646	178041	230437	282832			
45E3-140	5	Start	292379						180167	232563	284958	337353	389748		2790
		Mid	135089						73233	102587	131941	161295	190649		
		End	186600						81268	133663	186058	238454	290849		
45E3-160	1	Start	158124		106091	175858	251690	323180	394669						1762
		Mid	74444		46261	85451	127381	167432	207484						
		End	105759		58618	128386	203045	274535	346025						
45E3-160	2	Start	193270			161010	236475	307965	379455						1815
		Mid	88618			71874	113505	153557	193608						
		End	120973			94894	168726	240216	311706						
45E3-160	3	Start	210693				132518	207280	278770	350260					1917
		Mid	101840				59209	100561	140613	180664					
		End	150169				78291	151713	223203	294693					
45E3-160	4	Start	246931					262646	334136	405625					1974
		Mid	116579					126184	166236	206287					
		End	166293					187818	259308	330797					
45E3-160	5	Start	292379					242339	313829	385318					2045
		Mid	135089					108064	148116	188167					
		End	186600					143440	214929	286419					

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
45E3-180	1	Start	158124	78562	169448	260334	359892								1353
		Mid	74444	30797	81850	132904	188000								
		End	105759	31089	121975	212861	311247								
45E3-180	2	Start	193270		154600	245486	344677								1393
		Mid	88618		68273	119327	174125								
		End	120973		88483	179369	276929								
45E3-180	3	Start	210693		126108	216994	315482								1472
		Mid	101840		55608	106661	161181								
		End	150169		71880	162766	259916								
45E3-180	4	Start	246931			201259	299358	392488							1515
		Mid	116579			92543	146752	198927							
		End	166293			128234	224530	317660							
45E3-180	5	Start	292379			181441	279051	372181							1569
		Mid	135089			74813	128632	180808							
		End	186600			84925	180152	273282							
45E3-200	1	Start	158124	125769	240258	354748									1074
		Mid	74444	57315	121627	185939									
		End	105759	78296	192786	307276									
45E3-200	2	Start	193270	110921	225410	339900									1106
		Mid	88618	43738	108050	172362									
		End	120973	44804	159294	273784									
45E3-200	3	Start	210693		196919	311409									1168
		Mid	101840		95384	159696									
		End	150169		142691	257181									
45E3-200	4	Start	246931		181183	295673									1203
		Mid	116579		81266	145578									
		End	166293		108158	222648									
45E3-200	5	Start	292379		161366	275855	399983								1246
		Mid	135089		63536	127848	196383								
		End	186600		64849	179339	301084								

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
10E4-160	1	Start	311558				178155	258442	338728	419014	499301	579587	659873	740160	3000
		Mid	150942				77134	122114	167093	212073	257053	302033	347012	391992	
		End	223277				97205	177491	257778	338064	418350	498637	578923	659209	
10E4-160	2	Start	395372					227779	308066	388352	468638	548925	629211	709498	3000
		Mid	183135					90599	135578	180558	225538	270518	315497	360477	
		End	253939					95649	175935	256221	336508	416794	497080	577367	
10E4-160	3	Start	463500						238356	318642	398928	479215	559501	639787	3000
		Mid	222118						97416	142396	187376	232356	277335	322315	
		End	323649						109411	189697	269983	350270	430556	510843	
10E4-160	4	Start	583231									436114	516400	596687	3000
		Mid	267905									187532	232512	277492	
		End	366750									233356	313642	393928	
10E4-180	1	Start	311558			198466	310027	416687	523348	630008	736669	843330			2597
		Mid	150942			89296	151014	210769	270525	330281	390036	449792			
		End	223277			119466	229076	335737	442397	549058	655719	762379			
10E4-180	2	Start	395372				279364	386025	492686	599346	706007	812667			2669
		Mid	183135				119499	179254	239010	298766	358521	418277			
		End	253939				147234	253894	360555	467215	573876	680537			
10E4-180	3	Start	463500					316315	422975	529636	636297	742957	849618		2832
		Mid	222118					141092	200848	260604	320359	380115	439871		
		End	323649					187370	294031	400691	507352	614013	720673		
10E4-180	4	Start	583231						379875	486535	593196	699857	806517		2933
		Mid	267905						156025	215780	275536	335292	395047		
		End	366750						177116	283777	390438	497098	603759		
10E4-200	1	Start	311558		180676	313533	457412	593550	729688	865825					2035
		Mid	150942		79302	153932	233585	309855	386125	462395					
		End	223277		101676	234533	376462	512599	648737	784875					
10E4-200	2	Start	395372			283609	426750	562888	699025	835163					2091
		Mid	183135			123095	202070	278340	354610	430880					
		End	253939			154663	294619	430757	566895	703032					
10E4-200	3	Start	463500			215579	357040	493177	629315	765453	901591				2219
		Mid	222118			85754	163908	240178	316448	392718	468988				
		End	323649			89741	228095	364233	500370	636508	772646				
10E4-200	4	Start	583231					450077	586215	722352	858490				2298
		Mid	267905					195355	271625	347895	424165				
		End	366750					247318	383456	519594	655732				

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
10E4-220	1	Start	311558		276060	440713	620312	789030							1642
		Mid	150942		132883	225373	324848	419371							
		End	223277		197060	361713	539362	708079							
10E4-220	2	Start	395372		246137	410789	589650	758367							1687
		Mid	183135		102046	194535	293333	387856							
		End	253939		117190	281842	457519	626237							
10E4-220	3	Start	463500			342759	519940	688657	857375						1790
		Mid	222118			157194	255171	349694	444217						
		End	323649			216921	390995	559713	728430						
10E4-220	4	Start	583231			300697	476839	645557	814274						1854
		Mid	267905			113335	210348	304871	399393						
		End	366750			102824	274081	442798	611516						
10E4-250	1	Start	311558	218148	436170	654193	893751								1240
		Mid	150942	100352	222821	345290	478040								
		End	223277	139148	357171	575193	812801								
10E4-250	2	Start	395372	188225	406247	624269	863089								1274
		Mid	183135	69515	191984	314453	446525								
		End	253939	59278	277300	495322	730958								
10E4-250	3	Start	463500		338217	556239	793379								1352
		Mid	222118		154643	277112	408363								
		End	323649		212379	430401	664434								
10E4-250	4	Start	583231		296155	514177	750278								1400
		Mid	267905		110783	233252	363540								
		End	366750		98282	316304	547520								

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig											Limiting MOP, psi
				500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	
				Hydraulic Torque, Lb-in											
12E2-40	1	Start	3541					3102	4141	5180	6219	7258	8297	9336	3000
		Mid	1930					1060	1541	2023	2504	2986	3467	3948	
		End	3328					1032	1760	2487	3215	3942	4670	5397	
12E2-40	2	Start	4574							4396	5435	6474	7513	8552	3000
		Mid	2461							1520	2001	2482	2964	3445	
		End	4160							1515	2242	2970	3697	4425	
12E2-40	3	Start	5849									4893	5932	6971	3000
		Mid	3267									1719	2201	2682	
		End	5841									1770	2498	3225	
12E2-50	1	Start	3541			4375	6252	8129	10006						1831
		Mid	1930			1650	2520	3389	4259						
		End	3328			1924	3238	4552	5867						
12E2-50	2	Start	4574			3592	5469	7346	9223						1936
		Mid	2461			1147	2017	2886	3756						
		End	4160			952	2266	3580	4894						
12E2-50	3	Start	5849					5764	7641	9518					2146
		Mid	3267					2123	2993	3862					
		End	5841					2380	3695	5009					
12E2-63	1	Start	3541	3357	6601	9846									1059
		Mid	1930	1178	2681	4185									
		End	3328	1211	3483	5755									
12E2-63	2	Start	4574		5818	9063									1120
		Mid	2461		2178	3682									
		End	4160		2510	4782									
12E2-63	3	Start	5849		4237	7481	10726								1241
		Mid	3267		1415	2918	4422								
		End	5841		1311	3583	5854								
12E2-80	1	Start	3541	7883											624
		Mid	1930	3275											
		End	3328	4380											
12E2-80	2	Start	4574	7100											660
		Mid	2461	2772											
		End	4160	3408											
12E2-80	3	Start	5849	5519											731
		Mid	3267	2009											
		End	5841	2208											

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, psig											Limiting MOP, psi
				500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	
				Hydraulic Torque, Lb-in											
18E2-50	1	Start	5206				5872	8190	10509	12827	15145				2334
		Mid	3028				2308	3375	4442	5510	6577				
		End	5720				2911	4534	6158	7781	9404				
18E2-50	2	Start	6361				4962	7280	9598	11917	14235				2432
		Mid	3617				1719	2786	3853	4920	5988				
		End	6631				1756	3379	5003	6626	8249				
18E2-50	3	Start	10150							9374	11692	14010			2706
		Mid	5448							3090	4157	5224			
		End	9174							2837	4460	6083			
18E2-63	1	Start	5206		6527	10564	14954								1309
		Mid	3028		2626	4489	6488								
		End	5720		3398	6225	9270								
18E2-63	2	Start	6361		5638	9676	14044								1364
		Mid	3617		2049	3912	5899								
		End	6631		2270	5097	8115								
18E2-63	3	Start	10150				11500	15635							1517
		Mid	5448				4069	5972							
		End	9174				4326	7221							
18E2-80	1	Start	5206	8360	15332										771
		Mid	3028	3471	6689										
		End	5720	4681	9564										
18E2-80	2	Start	6361	7471	14444										803
		Mid	3617	2895	6112										
		End	6631	3553	8436										
18E2-80	3	Start	10150		11960										892
		Mid	5448		4320										
		End	9174		4736										

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Bray Series 98H Hydraulic Scotch Yoke Actuator
Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
45E2-63	1	Start	11054			9742	15352	20727	26102	31478	36853				2388
		Mid	6286			3535	6085	8559	11034	13508	15982				
		End	11525			3907	7765	11529	15293	19056	22820				
45E2-63	2	Start	14638				11274	16650	22025	27400	32776	38151			2577
		Mid	8402				3969	6443	8917	11392	13866	16340			
		End	15602				4181	7945	11709	15473	19237	23000			
45E2-63	3	Start	21176						16479	21854	27230	32605	37980		2835
		Mid	11827						5492	7966	10440	12915	15389		
		End	21148						5170	8934	12698	16462	20226		
45E2-63	4	Start	27349								24705	30080	35456		2952
		Mid	14437								7831	10305	12779		
		End	23673								6526	10289	14053		
45E2-80	1	Start	11054		15940	25005	34890								1382
		Mid	6286		6395	10578	15079								
		End	11525		8247	14594	21446								
45E2-80	2	Start	14638		11959	21023	30813	40096							1492
		Mid	8402		4324	8507	12962	17235							
		End	15602		4748	11095	17862	24362							
45E2-80	3	Start	21176			15608	25267	34550							1642
		Mid	11827			5153	9537	13810							
		End	21148			4710	11324	17824							
45E2-80	4	Start	27349					32025							1710
		Mid	14437					11200							
		End	23673					11651							
45E2-100	1	Start	11054	18177	32892										868
		Mid	6286	7428	14218										
		End	11525	9813	20117										
45E2-100	2	Start	14638	14195	28911										935
		Mid	8402	5356	12146										
		End	15602	6314	16618										
45E2-100	3	Start	21176		23495	38211									1027
		Mid	11827		8793	15583									
		End	21148		10233	20537									
45E2-100	4	Start	27349			35745									1069
		Mid	14437			13028									
		End	23673			14509									

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig											Limiting MOP, psi
				500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	
				Hydraulic Torque, Lb-in											
73E2-63	1	Start	21948						17903	23729	29555	35382	41208	47034	3000
		Mid	12480						6292	8974	11656	14338	17020	19702	
		End	22882						6609	10689	14769	18848	22928	27008	
73E2-63	2	Start	26641							20550	26377	32203	38029	43856	3000
		Mid	14754							6700	9382	12064	14746	17428	
		End	26061							5996	10076	14155	18235	22315	
73E2-63	3	Start	35171									26066	31893	37719	3000
		Mid	18970									7848	10530	13212	
		End	32197									5625	9705	13785	
73E2-63	4	Start	38990											32038	3000
		Mid	21533											10649	
		End	37879											9966	
73E2-80	1	Start	21948			19199	30297	40933	51569	62205				2056	
		Mid	12480			6953	11998	16893	21789	26684					
		End	22882			7656	15288	22735	30183	37630					
73E2-80	2	Start	26641				27119	37754	48390	59026				2130	
		Mid	14754				9724	14619	19515	24410					
		End	26061				10595	18042	25490	32937					
73E2-80	3	Start	35171					31618	42254	52890	63525			2275	
		Mid	18970					10403	15299	20194	25090				
		End	32197					9513	16960	24407	31854				
73E2-80	4	Start	38990						36572	47208	57844			2408	
		Mid	21533						12736	17632	22527				
		End	37879						13141	20588	28036				
73E2-100	1	Start	21948			29677	47017							1231	
		Mid	12480			11788	19790								
		End	22882			14993	27135								
73E2-100	2	Start	26641			26573	43913	62730						1276	
		Mid	14754			9562	17563	26115							
		End	26061			10411	22553	35530							
73E2-100	3	Start	35171				37921	56593						1362	
		Mid	18970				13436	21899							
		End	32197				14223	27000							
73E2-100	4	Start	38990				32373	50912						1442	
		Mid	21533				10927	19336							
		End	37879				10494	23181							
73E2-125	1	Start	21948	34070	62277									770	
		Mid	12480	13815	26831										
		End	22882	18069	37820										
73E2-125	2	Start	26641	30966	59173									798	
		Mid	14754	11589	24605										
		End	26061	13487	33237										
73E2-125	3	Start	35171		53181									851	
		Mid	18970		20478										
		End	32197		24908										
73E2-125	4	Start	38990		47633									900	
		Mid	21533		17969										
		End	37879		21179										

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Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
14E3-80	1	Start	36177					30222	41499	52776	64052	75329	86606	97883	3000
		Mid	20507					10637	15827	21018	26208	31399	36590	41780	
		End	37439					11200	19096	26992	34888	42784	50681	58577	
14E3-80	2	Start	41452						36041	47318	58595	69872	81149	92425	3000
		Mid	23497						12837	18028	23218	28409	33600	38790	
		End	42897						13821	21717	29613	37509	45405	53301	
14E3-80	3	Start	48290							40239	51516	62793	74070	85347	3000
		Mid	27373							14151	19342	24532	29723	34914	
		End	49975							14879	22775	30671	38568	46464	
14E3-80	4	Start	62927									51214	62491	73768	3000
		Mid	34849									17057	22247	27438	
		End	61555									16034	23930	31826	
14E3-80	5	Start	77802											65878	3000
		Mid	41554											20733	
		End	69444											16951	
14E3-100	1	Start	36177			40522	61233	80968	100702	120437					2043
		Mid	20507			15494	24911	33994	43078	52161					
		End	37439			18647	32914	46732	60551	74369					
14E3-100	2	Start	41452			35193	55776	75510	95245	114979					2112
		Mid	23497			12567	21921	31004	40088	49171					
		End	42897			13495	27639	41457	55275	69093					
14E3-100	3	Start	48290					68431	88166	107900					2202
		Mid	27373					27128	36211	45295					
		End	49975					34619	48438	62256					
14E3-100	4	Start	62927					56852	76587	96321	116056				2349
		Mid	34849					19652	28736	37819	46903				
		End	61555					19982	33800	47619	61437				
14E3-100	5	Start	77802						68698	88432	108167				2449
		Mid	41554						22031	31114	40198				
		End	69444						18925	32744	46562				
14E3-125	1	Start	36177	27790	59965	92139	124313								1224
		Mid	20507	9619	24466	39313	54160								
		End	37439	9732	32260	54789	77318								
14E3-125	2	Start	41452			54635	86810	121851							1265
		Mid	23497			21539	36386	52334							
		End	42897			27109	49638	73905							
14E3-125	3	Start	48290			47723	79897	114772							1319
		Mid	27373			17744	32591	48458							
		End	49975			20432	42961	67068							
14E3-125	4	Start	62927				68591	103193							1407
		Mid	34849				25272	40982							
		End	61555				28668	52430							
14E3-125	5	Start	77802				60887	95304							1467
		Mid	41554				18709	34277							
		End	69444				14143	37555							

Canted

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig											Limiting MOP, psi
				500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	
				Hydraulic Torque, Lb-in											
24E3-100	1	Start	73256					79762	104798	129833	154869	179904	204940		2824
		Mid	40682					29491	41044	52596	64149	75702	87255		
		End	70450					33648	51178	68708	86238	103768	121298		
24E3-100	2	Start	86562						90832	115867	140903	165938	190974	216009	2963
		Mid	48347						33540	45093	56645	68198	79751	91304	
		End	84417						38185	55715	73245	90775	108305	125835	
24E3-100	3	Start	112228							95949	120985	146020	171056	196091	3000
		Mid	61478							32239	43791	55344	66897	78450	
		End	104335							30653	48183	65713	83243	100773	
24E3-100	4	Start	131385									132147	157182	182218	3000
		Mid	71044									45979	57532	69085	
		End	118208									47006	64537	82067	
24E3-100	5	Start	151911										141308	166343	3000
		Mid	81532										47265	58818	
		End	134083										44494	62024	
24E3-125	1	Start	73256		56242	97907	143018	185712							1656
		Mid	40682		18864	38141	58681	78382							
		End	70450		17714	46888	77940	107835							
24E3-125	2	Start	86562			84277	129052	171746	214439						1738
		Mid	48347			30799	51177	70878	90579						
		End	84417			34208	64947	94842	124736						
24E3-125	3	Start	112228				109134	151828	194522						1854
		Mid	61478				38323	58024	77725						
		End	104335				39885	69779	99674						
24E3-125	4	Start	131385					137954	180648						1935
		Mid	71044					48659	68360						
		End	118208					51073	80967						
24E3-125	5	Start	151911						164773	207467					2028
		Mid	81532						58093	77795					
		End	134083						60925	90819					
24E3-140	1	Start	73256		92776	146618	205411								1281
		Mid	40682		35767	60679	87472								
		End	70450		43295	80996	121628								
24E3-140	2	Start	86562		79146	132989	191445								1345
		Mid	48347		28424	53336	79968								
		End	84417		30615	68316	108635								
24E3-140	3	Start	112228			113551	171527								1435
		Mid	61478			40759	67114								
		End	104335			43858	83573								
24E3-140	4	Start	131385			100011	157653	212825							1498
		Mid	71044			31595	57749	83209							
		End	118208			25602	64866	103498							
24E3-140	5	Start	151911				141779	196951							1570
		Mid	81532				47482	72942							
		End	134083				44824	83456							

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig										Limiting MOP, psi	
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000
				Hydraulic Torque, Lb-in											
45E3-125	1	Start	134422				112869	161122	209376	257629	305883	354137	402390	2728	
		Mid	74444				38458	60724	82991	105258	127525	149792	172059		
		End	128399				37679	71466	105254	139041	172829	206616	240404		
45E3-125	2	Start	164299						190904	239158	287412	335665	383919	2823	
		Mid	88618						69116	91383	113650	135917	158184		
		End	146871						76079	109867	143654	177442	211229		
45E3-125	3	Start	179111						155459	203713	251967	300220	348474	396727	3000
		Mid	101840						56172	78439	100706	122973	145240	167507	
		End	182316						61616	95404	129191	162979	196766	230554	
45E3-125	4	Start	209917							184137	232391	280644	328898	377151	3000
		Mid	116579							64010	86277	108544	130811	153078	
		End	201892							65322	99110	132898	166685	200473	
45E3-125	5	Start	248552									255990	304244	352497	3000
		Mid	135089									90424	112691	134958	
		End	226546									95171	128959	162746	
45E3-140	1	Start	134422			123010	189659	253271	316883	380495					2069
		Mid	74444			43581	73893	103247	132601	161955					
		End	128399			45776	91448	135990	180531	225072					
45E3-140	2	Start	164299				171188	234800	298411	362023					2142
		Mid	88618				60018	89372	118726	148080					
		End	146871				62274	106815	151356	195898					
45E3-140	3	Start	179111					199355	262966	326578	390190				2281
		Mid	101840					76428	105782	135136	164490				
		End	182316					92352	136894	181435	225976				
45E3-140	4	Start	209917					179779	243390	307002	370614				2358
		Mid	116579					61999	91353	120707	150061				
		End	201892					62271	106812	151354	195895				
45E3-140	5	Start	248552						218736	282348	345960				2455
		Mid	135089						73233	102587	131941				
		End	226546						69086	113628	158169				
45E3-160	1	Start	134422		128802	213505	305570	392364						1517	
		Mid	74444		46261	85451	127381	167432							
		End	128399		49832	109141	172610	233383							
45E3-160	2	Start	164299			195478	287099	373892						1570	
		Mid	88618			71874	113505	153557							
		End	146871			80669	143435	204209							
45E3-160	3	Start	179111			160887	251654	338447						1672	
		Mid	101840			59209	100561	140613							
		End	182316			66555	128972	189746							
45E3-160	4	Start	209917				232078	318871	405665					1728	
		Mid	116579				86133	126184	166236						
		End	201892				98891	159665	220438						
45E3-160	5	Start	248552				207424	294217	381011					1799	
		Mid	135089				68013	108064	148116						
		End	226546				61165	121938	182712						

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Lb-in	Operating Pressure, psig											Limiting MOP, psi
				500	750	1000	1250	1500	1750	2000	2250	2500	2750	3000	
				Hydraulic Torque, Lb-in											
10E4-160	1	Start	264856				216294	313767	411241	508714	606188	703662	801135	898609	2964
		Mid	150942				77134	122114	167093	212073	257053	302033	347012	391992	
		End	271074				82634	150886	219138	287389	355641	423893	492145	560396	
10E4-160	2	Start	336108						374015	471488	568962	666435	763909	861383	3000
		Mid	183135						135578	180558	225538	270518	315497	360477	
		End	308301						149563	217815	286066	354318	422570	490822	
10E4-160	3	Start	394023							386855	484328	581802	679276	776749	3000
		Mid	222118							142396	187376	232356	277335	322315	
		End	392934							161262	229514	297766	366017	434269	
10E4-160	4	Start	495807								432001	529475	626948	724422	3000
		Mid	267905								142552	187532	232512	277492	
		End	445261								130125	198376	266628	334880	
Canted															
10E4-180	1	Start	264856			240952	376395	505889	635383	764877	894371				2231
		Mid	150942			89296	151014	210769	270525	330281	390036				
		End	271074			101558	194738	285411	376084	466756	557429				
10E4-180	2	Start	336108				339169	468663	598157	727651	857145			2303	
		Mid	183135				119499	179254	239010	298766	358521				
		End	308301				125164	215836	306509	397182	487854				
10E4-180	3	Start	394023					384030	513523	643017	772511	902005		2466	
		Mid	222118					141092	200848	260604	320359	380115			
		End	392934					159284	249957	340629	431302	521974			
10E4-180	4	Start	495807						461196	590690	720184	849678		2567	
		Mid	267905						156025	215780	275536	335292			
		End	445261						150567	241240	331912	422585			
Canted															
10E4-200	1	Start	264856		219354	380652	555332	720614	885895						1748
		Mid	150942		79302	153932	233585	309855	386125						
		End	271074		86435	199377	320032	435763	551494						
10E4-200	2	Start	336108			344323	518106	683387	848669					1804	
		Mid	183135			123095	202070	278340	354610						
		End	308301			131479	250457	366188	481919						
10E4-200	3	Start	394023				433473	598754	764035					1932	
		Mid	222118				163908	240178	316448						
		End	392934				193904	309636	425367						
10E4-200	4	Start	495807					546427	711708	876989				2011	
		Mid	267905					195355	271625	347895					
		End	445261					210246	325977	441709					
Canted															
10E4-220	1	Start	264856		335158	535058	753105							1411	
		Mid	150942		132883	225373	324848								
		End	271074		167522	307493	458513								
10E4-220	2	Start	336108		298828	498728	715878							1456	
		Mid	183135		102046	194535	293333								
		End	308301		99624	239595	388939								
10E4-220	3	Start	394023			416134	631245	836081						1559	
		Mid	222118			157194	255171	349694							
		End	392934			184405	332386	475814							
10E4-220	4	Start	495807				578918	783754						1623	
		Mid	267905				210348	304871							
		End	445261				232997	376424							

Bray Series 98H Hydraulic Scotch Yoke Actuator
Technical Manual

Output Torque – Imperial – Lb-in

SR - CANTED YOKE

Spring Return Canted Yoke																
Actuator	Spring #	Position	Spring Torque	Operating Pressure, psig										Limiting MOP, psi		
				500	750	1000	1250	1500	1750	2000	2250	2500	2750		3000	
				Hydraulic Torque, Lb-in												
			Lb-in											Canted		
10E4-250	1	Start	264856	264848	529543	794238										1065
		Mid	150942	100352	222821	345290										
		End	271074	118290	303632	488974										
10E4-250	2	Start	336108	228519	493214	757909										1100
		Mid	183135	69515	191984	314453										
		End	308301	50392	235734	421075										
10E4-250	3	Start	394023		410620	675315										1178
		Mid	222118		154643	277112										
		End	392934		180544	365886										
10E4-250	4	Start	495807		359554	624249									1226	
		Mid	267905		110783	233252										
		End	445261		83550	268891										

Note: Select Canted Yoke only for Fail CW.

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															Symmetric	Limiting MOP, bar
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar												
				35	50	70	85	100	125	140	160	175	190	207		
				Hydraulic Torque, Nm												
12E2-40	1	Start	471					269	410	494	606	690	774	870	207	
		Mid	218					109	188	235	298	346	393	447		
		End	310					118	258	342	455	539	623	718		
12E2-40	2	Start	608						337	421	533	617	701	797	207	
		Mid	278						131	178	241	289	336	390		
		End	387						129	213	325	409	494	589		
12E2-40	3	Start	777									470	554	650	207	
		Mid	369									203	250	304		
		End	544									250	334	430		
12E2-50	1	Start	471		215	418	570	722	975	1127					147	
		Mid	218		78	192	278	363	506	591						
		End	310		64	266	418	570	824	976						
12E2-50	2	Start	608			345	497	649	902	1054					154	
		Mid	278			136	221	307	449	535						
		End	387			137	289	441	694	846						
12E2-50	3	Start	777				350	502	755	907	1110			169		
		Mid	369				135	220	363	448	562					
		End	544				130	282	535	687	890					
12E2-63	1	Start	471	322	584	935	1197							85		
		Mid	218	138	286	483	631									
		End	310	170	433	783	1046									
12E2-63	2	Start	608		511	862	1125							89		
		Mid	278		229	426	574									
		End	387		304	654	917									
12E2-63	3	Start	777		364	715	977							98		
		Mid	369		143	340	488									
		End	544		144	495	757									
12E2-80	1	Start	471	749	1195									50		
		Mid	218	379	630											
		End	310	598	1044											
12E2-80	2	Start	608	676	1122									53		
		Mid	278	322	573											
		End	387	469	915											
12E2-80	3	Start	777	529	975									58		
		Mid	369	236	487											
		End	544	309	755											

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar										Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190		207
				Hydraulic Torque, Nm											
18E2-50	1	Start	692			336	532	719	1032	1220	1470	1658			186
		Mid	342			144	252	357	532	637	777	882			
		End	532			180	372	560	873	1060	1311	1499			
18E2-50	2	Start	845				447	635	948	1135	1386	1573	1761		193
		Mid	409				186	291	466	571	711	815	920		
		End	617				219	406	719	907	1157	1345	1533		
18E2-50	3	Start	1349						711	899	1149	1337	1525	1737	207
		Mid	615						259	364	504	609	714	832	
		End	854							216	403	654	841	1029	
18E2-63	1	Start	692		570	1006	1365	1700							104
		Mid	342		276	520	718	905							
		End	532		414	850	1206	1540							
18E2-63	2	Start	845		487	923	1280	1615							108
		Mid	409		211	455	652	839							
		End	617		264	700	1052	1387							
18E2-63	3	Start	1349			692	1044	1379							119
		Mid	615			252	445	632							
		End	854			209	548	883							
18E2-80	1	Start	692	798	1362										62
		Mid	342	403	720										
		End	532	642	1207										
18E2-80	2	Start	845	715	1280										64
		Mid	409	338	655										
		End	617	492	1057										
18E2-80	3	Start	1349		1049	1802									70
		Mid	615		452	874									
		End	854		565	1318									

Symmetric

Bray Series 98H Hydraulic Scotch Yoke Actuator

Technical Manual

Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar											Limiting MOP, bar
				35	50	70	85	100	125	140	160	175	190	207	
				Hydraulic Torque, Nm											
73E2-63	1	Start	2917						1803	2274	2904	3375	3847	4382	207
		Mid	1410						787	1051	1403	1666	1930	2229	
		End	2129						1015	1487	2116	2588	3060	3594	
73E2-63	2	Start	3541							1979	2608	3080	3552	4086	207
		Mid	1667							794	1146	1409	1673	1972	
		End	2425							863	1492	1964	2436	2971	
73E2-63	3	Start	4675									2509	2980	3515	207
		Mid	2143									933	1197	1495	
		End	2996										830	1302	
73E2-63	4	Start	5182											2986	207
		Mid	2433											1206	
		End	3525												
73E2-80	1	Start	2917			1846	2752	3613	5048	5910	7058				164
		Mid	1410			819	1318	1799	2601	3082	3724				
		End	2129			1077	1964	2825	4261	5122	6271				
73E2-80	2	Start	3541					3317	4753	5614	6762				169
		Mid	1667					1542	2344	2826	3467				
		End	2425					2202	3637	4498	5647				
73E2-80	3	Start	4675					2746	4182	5043	6191	7053			179
		Mid	2143					1066	1868	2349	2991	3472			
		End	2996					1068	2503	3365	4513	5375			
73E2-80	4	Start	5182					2217	3653	4514	5663	6524	7385		188
		Mid	2433					776	1578	2060	2701	3183	3664		
		End	3525					560	1996	2857	4006	4867	5728		
73E2-100	1	Start	2917		2602	4474	6020								98
		Mid	1410		1242	2291	3144								
		End	2129		1833	3705	5232								
73E2-100	2	Start	3541		2313	4185	5724	7162							101
		Mid	1667		991	2040	2887	3691							
		End	2425		1224	3096	4609	6047							
73E2-100	3	Start	4675			3628	5153	6591							107
		Mid	2143			1573	2411	3214							
		End	2996			1989	3475	4913							
73E2-100	4	Start	5182			3111	4624	6063							113
		Mid	2433			1290	2121	2925							
		End	3525			1493	2967	4406							
73E2-125	1	Start	2917	3251	5535										62
		Mid	1410	1606	2886										
		End	2129	2482	4766										
73E2-125	2	Start	3541	2962	5246										63
		Mid	1667	1354	2634										
		End	2425	1873	4157										
73E2-125	3	Start	4675	2404	4689										67
		Mid	2143	888	2168										
		End	2996	766	3050										
73E2-125	4	Start	5182		4172	7218									71
		Mid	2433		1884	3591									
		End	3525		2554	5600									

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke																Limiting MOP, bar
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar												
				35	50	70	85	100	125	140	160	175	190			
			Nm	Hydraulic Torque, Nm												
14E3-80	1	Start	4808					2604	4126	5040	6257	7171	8084	9119	207	
		Mid	2317					1085	1732	2189	2798	3254	3711	4228		
		End	3484					1280	2802	3716	4933	5847	6760	7795		
14E3-80	2	Start	5509						3618	4532	5749	6663	7576	8611	207	
		Mid	2655						1598	2108	2789	3299	3810	4388		
		End	3992						2101	3014	4232	5145	6059	7094		
14E3-80	3	Start	6418							3873	5091	6004	6917	7952	207	
		Mid	3093							1670	2351	2861	3372	3950		
		End	4651							2106	3323	4237	5150	6185		
14E3-80	4	Start	8363									4926	5840	6875	207	
		Mid	3937									2017	2527	3105		
		End	5728									2291	3204	4240		
14E3-80	5	Start	10340											6140	207	
		Mid	4695											2348		
		End	6463											2263		
14E3-100	1	Start	4808		1800	3881	5572	7171	9834	11432	13563				164	
		Mid	2317		646	1812	2744	3637	5126	6019	7210					
		End	3484		507	2588	4248	5847	8510	10108	12239					
14E3-100	2	Start	5509			3385	5064	6663	9326	10925	13055				169	
		Mid	2655			1481	2406	3299	4788	5681	6872					
		End	3992			1903	3547	5145	7809	9407	11538					
14E3-100	3	Start	6418					6004	8668	10266	12397	13995			175	
		Mid	3093					2861	4350	5243	6434	7327				
		End	4651					4237	6900	8499	10629	12228				
14E3-100	4	Start	8363					4926	7590	9188	11319	12917			185	
		Mid	3937					2017	3505	4398	5589	6482				
		End	5728					2291	4955	6553	8684	10282				
14E3-100	5	Start	10340						6856	8454	10585	12183	13781		192	
		Mid	4695						2748	3641	4832	5725	6618			
		End	6463						2978	4576	6707	8305	9903			
14E3-125	1	Start	4808	2678	5283	8757	11637								98	
		Mid	2317	1138	2598	4544	6133									
		End	3484	1385	3990	7465	10313									
14E3-125	2	Start	5509		4787	8262	11129	13797							101	
		Mid	2655		2267	4213	5795	7286								
		End	3992		3306	6780	9612	12280								
14E3-125	3	Start	6418		4144	7618	10470	13139							105	
		Mid	3093		1838	3785	5357	6848								
		End	4651		2418	5893	8703	11371								
14E3-125	4	Start	8363			6566	9393	12061							111	
		Mid	3937			2958	4513	6004								
		End	5728			3993	6758	9426								
14E3-125	5	Start	10340			5849	8659	11327							115	
		Mid	4695			2216	3755	5246								
		End	6463			2063	4781	7449								

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Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar										Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190		207
			Nm	Hydraulic Torque, Nm											
14E3-140	1	Start	4808	4401	7745	12204									77
		Mid	2317	2103	3977	6475									
		End	3484	3108	6452	10911									
14E3-140	2	Start	5509	3905	7249	11708								79	
		Mid	2655	1773	3646	6144									
		End	3992	2423	5767	10226									
14E3-140	3	Start	6418	3262	6606	11065								82	
		Mid	3093	1344	3217	5715									
		End	4651	1536	4880	9339									
14E3-140	4	Start	8363		5554	10012	13678							86	
		Mid	3937		2391	4889	6908								
		End	5728		2980	7439	11043								
14E3-140	5	Start	10340		4837	9295	12944							90	
		Mid	4695		1649	4147	6150								
		End	6463		1050	5509	9066								
14E3-160	1	Start	4808	7002	11461									59	
		Mid	2317	3561	6059										
		End	3484	5709	10168										
14E3-160	2	Start	5509	6506	10965									60	
		Mid	2655	3230	5728										
		End	3992	5024	9483										
14E3-160	3	Start	6418	5863	10321									62	
		Mid	3093	2801	5299										
		End	4651	4137	8596										
14E3-160	4	Start	8363	4810	9269									66	
		Mid	3937	1974	4472										
		End	5728	2237	6696										
14E3-160	5	Start	10340		8552									68	
		Mid	4695		3731										
		End	6463		4766										

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															Limiting MOP, bar
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar										Symmetric	
				35	50	70	85	100	125	140	160	175	190		
Hydraulic Torque, Nm															
24E3-100	1	Start	9736					6960	10340	12367	15070	17098	19125	21423	207
		Mid	4596					3073	4966	6102	7617	8752	9888	11176	
		End	6556					4010	7389	9416	12120	14147	16175	18473	
24E3-100	2	Start	11505					5661	9040	11067	13771	15798	17826	20124	207
		Mid	5463					2225	4118	5254	6769	7905	9040	10328	
		End	7856					2283	5662	7689	10393	12420	14448	16746	
24E3-100	3	Start	14916							9214	11917	13945	15972	18270	207
		Mid	6946							3802	5316	6452	7588	8876	
		End	9710							4358	7062	9089	11117	13415	
24E3-100	4	Start	17462									12654	14681	16979	207
		Mid	8027									5394	6530	7817	
		End	11001									6603	8631	10928	
24E3-100	5	Start	20190									11176	13204	15502	207
		Mid	9212									4234	5370	6657	
		End	12478									3939	5967	8265	
24E3-125	1	Start	9736		4849	9348	13037	16494	22257						133
		Mid	4596		1915	4442	6477	8414	11643						
		End	6556		1970	6469	10086	13543	19306						
24E3-125	2	Start	11505			8080	11737	15194	20957	24415					138
		Mid	5463			3613	5629	7566	10795	12732					
		End	7856			4783	8359	11816	17579	21037					
24E3-125	3	Start	14916					13341	19103	22561					146
		Mid	6946					6114	9342	11280					
		End	9710					8486	14248	17706					
24E3-125	4	Start	17462					12050	17812	21270					152
		Mid	8027					5056	8284	10221					
		End	11001					5999	11762	15220					
24E3-125	5	Start	20190					10572	16335	19793	24403				158
		Mid	9212					3896	7124	9061	11644				
		End	12478					3336	9098	12556	17166				
24E3-140	1	Start	9736		8137	13951	18763	23231							103
		Mid	4596		3762	7028	9685	12189							
		End	6556		5257	11071	15812	20281							
24E3-140	2	Start	11505		6868	12682	17463	21932							107
		Mid	5463		2932	6198	8838	11341							
		End	7856		3572	9386	14085	18554							
24E3-140	3	Start	14916			10873	15610	20078							113
		Mid	6946			4777	7385	9888							
		End	9710			6135	10755	15223							
24E3-140	4	Start	17462			9613	14319	18787							117
		Mid	8027			3742	6327	8830							
		End	11001			3709	8268	12736							
24E3-140	5	Start	20190					17310							122
		Mid	9212					7670							
		End	12478					10073							

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Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar										Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190		207
			Nm	Hydraulic Torque, Nm											
24E3-160	1	Start	9736	7250	13099	20898									76
		Mid	4596	3264	6549	10930									
		End	6556	4370	10219	18018									
24E3-160	2	Start	11505	5981	11830	19629								80	
		Mid	5463	2434	5720	10100									
		End	7856	2685	8534	16333									
24E3-160	3	Start	14916		10021	17820	24254							84	
		Mid	6946		4298	8679	12228								
		End	9710		5283	13082	19398								
24E3-160	4	Start	17462		8761	16560	22963							88	
		Mid	8027		3263	7644	11170								
		End	11001		2857	10656	16912								
24E3-160	5	Start	20190			15119	21485							91	
		Mid	9212			6509	10010								
		End	12478			8056	14248								
24E3-180	1	Start	9736	11186	18723									60	
		Mid	4596	5475	9708										
		End	6556	8307	15843										
24E3-180	2	Start	11505	9918	17454									63	
		Mid	5463	4645	8879										
		End	7856	6621	14158										
24E3-180	3	Start	14916	8109	15645									67	
		Mid	6946	3224	7458										
		End	9710	3371	10907										
24E3-180	4	Start	17462		14385	24434								69	
		Mid	8027		6422	12067									
		End	11001		8481	18529									
24E3-180	5	Start	20190		12943	22992								72	
		Mid	9212		5287	10932									
		End	12478		5881	15929									

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Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															Limiting MOP, bar
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar										Symmetric	
				35	50	70	85	100	125	140	160	175	190		
Hydraulic Torque, Nm															
45E3-125	1	Start	17866				10195	14103	20616	24524	29734	33642	37550	41979	207
		Mid	8411				4172	6362	10010	12200	15119	17308	19498	21979	
		End	11949				4699	8607	15120	19028	24238	28146	32054	36483	
45E3-125	2	Start	21837					12384	18897	22805	28015	31923	35831	40260	207
		Mid	10012					4794	8443	10632	13551	15741	17930	20411	
		End	13668					4729	11243	15150	20361	24269	28177	32605	
45E3-125	3	Start	23805						15599	19506	24717	28625	32533	36961	207
		Mid	11506						6980	9170	12089	14278	16467	18949	
		End	16967						9320	13228	18439	22346	26254	30683	
45E3-125	4	Start	27899							17685	22895	26803	30711	35140	207
		Mid	13172							7539	10458	12648	14837	17318	
		End	18789							9230	14441	18348	22256	26685	
45E3-125	5	Start	33034									24509	28416	32845	207
		Mid	15263									10601	12790	15271	
		End	21083									13334	17242	21671	
45E3-140	1	Start	17866			11800	17243	22395	30981	36133	43002				166
		Mid	8411			5122	8121	11007	15817	18703	22552				
		End	11949			6437	11747	16899	25485	30637	37505				
45E3-140	2	Start	21837				15524	20676	29262	34414	41283				171
		Mid	10012				6553	9439	14250	17136	20984				
		End	13668				7870	13021	21607	26759	33628				
45E3-140	3	Start	23805					17377	25963	31115	37984	43136			180
		Mid	11506					7977	12787	15673	19521	22408			
		End	16967					11099	19685	24837	31706	36857			
45E3-140	4	Start	27899					15556	24142	29293	36162	41314			186
		Mid	13172					6347	11157	14043	17891	20777			
		End	18789					7101	15687	20839	27708	32859			
45E3-140	5	Start	33034						21847	26999	33868	39019	44171		192
		Mid	15263						9110	11996	15844	18730	21616		
		End	21083						10673	15825	22694	27845	32997		
45E3-160	1	Start	17866			11204	20351	27882	34911						121
		Mid	8411			4787	9925	14081	18019						
		End	11949			5841	14987	22386	29415						
45E3-160	2	Start	21837				18673	26163	33192	44907					125
		Mid	10012				8391	12513	16451	23015					
		End	13668				11203	18508	25538	37253					
45E3-160	3	Start	23805				15454	22864	29894	41609					132
		Mid	11506				6960	11051	14989	21552					
		End	16967				9327	16586	23615	35330					
45E3-160	4	Start	27899						28072	39787					136
		Mid	13172						13359	19922					
		End	18789						19617	31332					
45E3-160	5	Start	33034						25777	37492	44521				141
		Mid	15263						11311	17875	21813				
		End	21083						14603	26318	33347				

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Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar											Limiting MOP, bar
				35	50	70	85	100	125	140	160	175	190	207	
				Hydraulic Torque, Nm											
45E3-180	1	Start	17866	9190	18126	30041	39939								93
		Mid	8411	3656	8675	15368	20836								
		End	11949	3826	12762	24677	34443								
45E3-180	2	Start	21837		16448	28363	38220								96
		Mid	10012		7141	13834	19268								
		End	13668		8978	20893	30566								
45E3-180	3	Start	23805		13229	25144	34922	44078							101
		Mid	11506		5710	12403	17806	22936							
		End	16967		7102	19017	28643	37800							
45E3-180	4	Start	27899			23366	33100	42257							104
		Mid	13172			10808	16176	21306							
		End	18789			15115	24645	33802							
45E3-180	5	Start	33034			21127	30805	39962							108
		Mid	15263			8805	14128	19258							
		End	21083			10222	19631	28788							
Symmetric															
45E3-200	1	Start	17866	14605	25862	40871									74
		Mid	8411	6697	13021	21452									
		End	11949	9241	20498	35507									
45E3-200	2	Start	21837	12927	24184	39193									76
		Mid	10012	5164	11487	19918									
		End	13668	5457	16714	31723									
45E3-200	3	Start	23805		20965	35974									81
		Mid	11506		10056	18487									
		End	16967		14838	29847									
45E3-200	4	Start	27899		19187	34196	45453								83
		Mid	13172		8461	16892	23215								
		End	18789		10936	25946	37202								
45E3-200	5	Start	33034		16948	31957	44281								86
		Mid	15263		6457	14888	21678								
		End	21083		6043	21052	33107								

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Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															Limiting MOP, bar
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar										Symmetric	
				35	50	70	85	100	125	140	160	175	190		
Hydraulic Torque, Nm															
10E4-160	1	Start	35201				19505	27399	40556	48450	58975	66869	74763		83710
		Mid	17054				8366	12788	20159	24582	30478	34901	39323	44335	
		End	25227				10359	18253	31410	39304	49829	57723	65617	74563	
10E4-160	2	Start	44671					23935	37092	44986	55511	63405	71299	80245	207
		Mid	20691					9228	16598	21021	26918	31340	35763	40775	
		End	28691					9006	22163	30057	40582	48476	56370	65316	
10E4-160	3	Start	52368					29215	37109	47635	55529	63423	72369	207	
		Mid	25096					12287	16709	22606	27028	31451	36463		
		End	36567					14647	22541	33066	40960	48854	57800		
10E4-160	4	Start	65896								50659	58553	67499	207	
		Mid	30269								21964	26387	31399		
		End	41437								27750	35644	44591		
10E4-180	1	Start	35201			23142	34200	44687	62166	72653	86636	97123		179	
		Mid	17054			10492	16598	22474	32266	38141	45975	51850			
		End	25227			14216	25054	35541	53020	63507	77490	87977			
10E4-180	2	Start	44671				30736	41223	58701	69189	83171	93659		184	
		Mid	20691				13038	18913	28705	34580	42414	48289			
		End	28691				15807	26294	43773	54260	68243	78730			
10E4-180	3	Start	52368				33347	50825	61312	75295	85782	96269		195	
		Mid	25096				14601	24393	30269	38102	43978	49853			
		End	36567				18778	36256	46744	60726	71214	81701			
10E4-180	4	Start	65896					45956	56443	70425	80913	91400		202	
		Mid	30269					19329	25204	33038	38913	44789			
		End	41437					23047	33534	47517	58004	68491			
10E4-200	1	Start	35201			18924	36341	50624	64009	86318	99703			140	
		Mid	17054			8123	17907	25799	33298	45797	53296				
		End	25227			9998	27415	41477	54863	77172	90557				
10E4-200	2	Start	44671				32960	47159	60545	82854	96239			144	
		Mid	20691				14423	22239	29738	42236	49735				
		End	28691				18391	32230	45616	67925	81310				
10E4-200	3	Start	52368				25274	39283	52668	74977	88363			153	
		Mid	25096				10204	17927	25426	37924	45423				
		End	36567				11056	24714	38100	60409	73794				
10E4-200	4	Start	65896					47799	70108	83493	101340			158	
		Mid	30269					20362	32860	40359	50358				
		End	41437					24890	47199	60584	78432				

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Output Torque – Metric – Nm

SR - SYMMETRIC YOKE

Spring Return Symmetrical Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar										Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190		207
			Nm	Hydraulic Torque, Nm											
10E4-220	1	Start	35201		29344	50930	68776	85365							113
		Mid	17054		13977	26102	35969	45263							
		End	25227		20419	42004	59630	76218							
10E4-220	2	Start	44671		25963	47549	65312	81900							116
		Mid	20691		10492	22618	32408	41702							
		End	28691		11394	32980	50383	66971							
10E4-220	3	Start	52368			39862	57435	74024	101672						123
		Mid	25096			18399	28097	37390	52880						
		End	36567			25645	42867	59455	87103						
10E4-220	4	Start	65896			35110	52566	69154	96802						128
		Mid	30269			13443	23032	32326	47815						
		End	41437			12753	29657	46246	73894						
10E4-250	1	Start	35201	25399	46836	75418	99246								85
		Mid	17054	11761	23802	39857	53039								
		End	25227	16474	37910	66492	90100								
10E4-250	2	Start	44671	22019	43455	72037	95781								88
		Mid	20691	8277	20318	36373	49479								
		End	28691	7449	28886	57468	80853								
10E4-250	3	Start	52368		35769	64351	87905								93
		Mid	25096		16099	32154	45167								
		End	36567		21551	50133	73336								
10E4-250	4	Start	65896		31016	59598	83035								97
		Mid	30269		11144	27199	40103								
		End	41437		8660	37242	60127								

Symmetric

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar											Limiting MOP, bar
				35	50	70	85	100	125	140	160	175	190	207	
				Hydraulic Torque, Nm											
18E2-50	1	Start	588				645	873	1253	1481	1785				161
		Mid	342				252	357	532	637	777				
		End	646				316	476	742	902	1114				
18E2-50	2	Start	719				543	771	1150	1378	1682				168
		Mid	409				186	291	466	571	711				
		End	749				186	345	611	771	984				
18E2-50	3	Start	1147							1091	1395	1623			187
		Mid	615							364	504	609			
		End	1037							343	556	715			
18E2-63	1	Start	588		692	1221	1657								90
		Mid	342		276	520	718								
		End	646		352	723	1025								
18E2-63	2	Start	719		592	1121	1555								94
		Mid	409		211	455	652								
		End	749		225	595	894								
18E2-63	3	Start	1147				1267	1674							105
		Mid	615				445	632							
		End	1037				466	751							
18E2-80	1	Start	588	969	1654										53
		Mid	342	403	720										
		End	646	546	1026										
18E2-80	2	Start	719	868	1554										55
		Mid	409	338	655										
		End	749	418	898										
18E2-80	3	Start	1147		1273										62
		Mid	615		452										
		End	1037		480										

Canted

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar											Limiting MOP, bar
				35	50	70	85	100	125	140	160	175	190	207	
				Hydraulic Torque, Nm											
73E2-63	1	Start	2480						2189	2761	3525	4098	4671	5320	207
		Mid	1410						787	1051	1403	1666	1930	2229	
		End	2585						863	1264	1799	2200	2601	3056	
73E2-63	2	Start	3010							2402	3166	3739	4312	4961	207
		Mid	1667							794	1146	1409	1673	1972	
		End	2944							734	1269	1670	2071	2525	
73E2-63	3	Start	3974									3046	3618	4268	207
		Mid	2143									933	1197	1495	
		End	3638									706	1107	1562	
73E2-63	4	Start	4405											3626	207
		Mid	2433											1206	
		End	4280											1130	
73E2-80	1	Start	2480			2241	3341	4386	6129	7175					142
		Mid	1410			819	1318	1799	2601	3082					
		End	2585			915	1669	2402	3622	4354					
73E2-80	2	Start	3010				2981	4027	5770	6816					147
		Mid	1667				1061	1542	2344	2826					
		End	2944				1139	1872	3092	3824					
73E2-80	3	Start	3974					3334	5077	6122					157
		Mid	2143					1066	1868	2349					
		End	3638					908	2128	2860					
73E2-80	4	Start	4405						4435	5481	6875				166
		Mid	2433						1578	2060	2701				
		End	4280						1697	2429	3405				
73E2-100	1	Start	2480			3159	5432	7137							85
		Mid	1410			1242	2291	3078							
		End	2585			1558	3150	4343							
73E2-100	2	Start	3010			2808	5081	6950							88
		Mid	1667			991	2040	2887							
		End	2944			1040	2632	3918							
73E2-100	3	Start	3974				4404	6256							94
		Mid	2143				1573	2411							
		End	3638				1691	2954							
73E2-100	4	Start	4405				3777	5614	7360						99
		Mid	2433				1290	2121	2925						
		End	4280				1269	2523	3745						
73E2-125	1	Start	2480			3947	6720								53
		Mid	1410			1606	2886								
		End	2585			2110	4052								
73E2-125	2	Start	3010			3596	6369								55
		Mid	1667			1354	2634								
		End	2944			1592	3534								
73E2-125	3	Start	3974				5692								59
		Mid	2143				2168								
		End	3638				2593								
73E2-125	4	Start	4405				5066								62
		Mid	2433				1884								
		End	4280				2171								

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar										Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190		207
				Hydraulic Torque, Nm											
14E3-80	1	Start	4087					3162	5010	6118	7597	8706	9814	11071	207
		Mid	2317					1085	1936	2446	3127	3637	4147	4726	
		End	4230					1088	2382	3159	4194	4970	5747	6626	
14E3-80	2	Start	4683						4393	5502	6980	8089	9198	10454	207
		Mid	2655						1598	2108	2789	3299	3810	4388	
		End	4847						1786	2563	3598	4374	5150	6030	
14E3-80	3	Start	5456							4702	6180	7289	8398	9655	207
		Mid	3093							1670	2351	2861	3372	3950	
		End	5646							1790	2825	3602	4378	5258	
14E3-80	4	Start	7110									5981	7090	8346	207
		Mid	3937									2017	2527	3105	
		End	6955									1948	2724	3604	
14E3-80	5	Start	8790											7455	207
		Mid	4695											2348	
		End	7846											1923	
14E3-100	1	Start	4087			4711	6765	8706	11939	13880					141
		Mid	2317			1812	2744	3637	5126	6019					
		End	4230			2200	3612	4970	7235	8593					
14E3-100	2	Start	4683			4109	6149	8089	11323	13263					146
		Mid	2655			1481	2406	3299	4788	5681					
		End	4847			1618	3015	4374	6639	7997					
14E3-100	3	Start	5456					7289	10523	12463					152
		Mid	3093					2861	4350	5243					
		End	5646					3602	5866	7225					
14E3-100	4	Start	7110					5981	9215	11155	13742				162
		Mid	3937					2017	3505	4398	5589				
		End	6955					1948	4212	5571	7382				
14E3-100	5	Start	8790						8323	10264	12851				169
		Mid	4695						2748	3641	4832				
		End	7846						2532	3890	5702				
14E3-125	1	Start	4087	3251	6414	10632	13796								84
		Mid	2317	1138	2598	4544	6004								
		End	4230	1177	3392	6346	8561								
14E3-125	2	Start	4683		5812	10030	13511								87
		Mid	2655		2267	4213	5795								
		End	4847		2810	5764	8171								
14E3-125	3	Start	5456		5031	9249	12712								91
		Mid	3093		1838	3785	5357								
		End	5646		2056	5009	7398								
14E3-125	4	Start	7110			7972	11403								97
		Mid	3937			2958	4513								
		End	6955			3394	5745								
14E3-125	5	Start	8790			7101	10512	13752							101
		Mid	4695			2216	3755	5246							
		End	7846			1753	4064	6332							

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - CANTED YOKE

Spring Return Canted Yoke																
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar											Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190	207		
			Nm	Hydraulic Torque, Nm												
14E3-140	1	Start	4087	5343	9403											67
		Mid	2317	2103	3977											
		End	4230	2642	5485											
14E3-140	2	Start	4683	4741	8801	14214										69
		Mid	2655	1773	3646	6144										
		End	4847	2060	4903	8693										
14E3-140	3	Start	5456	3960	8020	13433										71
		Mid	3093	1344	3217	5715										
		End	5646	1306	4149	7939										
14E3-140	4	Start	7110		6742	12156										76
		Mid	3937		2391	4889										
		End	6955		2534	6324										
14E3-140	5	Start	8790			11285										79
		Mid	4695			4147										
		End	7846			4683										
14E3-160	1	Start	4087	8501	13914											50
		Mid	2317	3561	6059											
		End	4230	4853	8644											
14E3-160	2	Start	4683	7899	13312											52
		Mid	2655	3230	5728											
		End	4847	4271	8062											
14E3-160	3	Start	5456	7118	12531											54
		Mid	3093	2801	5299											
		End	5646	3517	7307											
14E3-160	4	Start	7110	5840	11254											58
		Mid	3937	1974	4472											
		End	6955	1902	5692											
14E3-160	5	Start	8790		10383											60
		Mid	4695		3731											
		End	7846		4051											

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - CANTED YOKE

Spring Return Canted Yoke															
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar										Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190		207
				Hydraulic Torque, Nm											
24E3-100	1	Start	8277					8450	12553	15015	18297	20758	23220		195
		Mid	4596					3073	4966	6102	7617	8752	9888		
		End	7960					3409	6281	8005	10303	12027	13750		
24E3-100	2	Start	9780						10975	13437	16719	19180	21642	24432	204
		Mid	5463						4118	5254	6769	7905	9040	10328	
		End	9538						4813	6537	8835	10559	12282	14236	
24E3-100	3	Start	12680							11186	14468	16930	19391	22181	207
		Mid	6946							3802	5316	6452	7588	8876	
		End	11788							3705	6003	7727	9450	11404	
24E3-100	4	Start	14845									15362	17824	20614	207
		Mid	8027									5394	6530	7817	
		End	13356									5613	7337	9290	
24E3-100	5	Start	17164										16030	18820	207
		Mid	9212										5370	6657	
		End	15149										5072	7026	
24E3-125	1	Start	8277		5887	11349	15827	20025							114
		Mid	4596		1915	4442	6477	8414							
		End	7960		1674	5499	8574	11513							
24E3-125	2	Start	9780			9809	14249	18447							120
		Mid	5463			3613	5629	7566							
		End	9538			4066	7106	10045							
24E3-125	3	Start	12680				11999	16197	23193						128
		Mid	6946				4177	6114	9342						
		End	11788				4274	7214	12112						
24E3-125	4	Start	14845					14629	21626						133
		Mid	8027					5056	8284						
		End	13356					5100	9999						
24E3-125	5	Start	17164						19832	24030					140
		Mid	9212						7124	9061					
		End	15149						7734	10674					
24E3-140	1	Start	8277		9878	16937	22780								88
		Mid	4596		3762	7028	9685								
		End	7960		4469	9411	13442								
24E3-140	2	Start	9780			8339	15397	21202							93
		Mid	5463			2932	6198	8838							
		End	9538			3036	7979	11974							
24E3-140	3	Start	12680				13201	18952	24376						99
		Mid	6946				4777	7385	9888						
		End	11788				5215	9142	12941						
24E3-140	4	Start	14845				11671	17384	22809						103
		Mid	8027				3742	6327	8830						
		End	13356				3153	7029	10827						
24E3-140	5	Start	17164					15590	21015						108
		Mid	9212					5167	7670						
		End	15149					4764	8563						

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - CANTED YOKE

Spring Return Canted Yoke															Limiting MOP, bar
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar											
				35	50	70	85	100	125	140	160	175	190		
				Hydraulic Torque, Nm											
45E3-125	1	Start	15188				12378	17122	25030	29774	36100	40844	45589		188
		Mid	8411				4172	6362	10010	12200	15119	17308	19498		
		End	14507				3995	7317	12854	16176	20605	23927	27249		
45E3-125	2	Start	18563						22943	27687	34013	38757	43502		195
		Mid	10012						8443	10632	13551	15741	17930		
		End	16594						9557	12879	17309	20631	23953		
45E3-125	3	Start	20237						18938	23682	30008	34752	39497	44874	207
		Mid	11506						6980	9170	12089	14278	16467	18949	
		End	20599						7923	11245	15675	18997	22319	26084	
45E3-125	4	Start	23717							21470	27796	32541	37285	42662	207
		Mid	13172							7539	10458	12648	14837	17318	
		End	22811							7847	12276	15598	18920	22685	
45E3-125	5	Start	28083									29755	34500	39877	207
		Mid	15263									10601	12790	15271	
		End	25596										11336	14658	
45E3-140	1	Start	15188			14327	20935	27189	37613	43868					143
		Mid	8411			5122	8121	11007	15817	18703					
		End	14507			5472	9986	14366	21665	26044					
45E3-140	2	Start	18563				18848	25102	35526	41781					148
		Mid	10012				6553	9439	14250	17136					
		End	16594				6690	11070	18369	22748					
45E3-140	3	Start	20237					21097	31522	37776					157
		Mid	11506					7977	12787	15673					
		End	20599					9435	16734	21114					
45E3-140	4	Start	23717					18886	29310	35564	43903				163
		Mid	13172					6347	11157	14043	17891				
		End	22811					6037	13336	17715	23554				
45E3-140	5	Start	28083						26524	32779	41118				169
		Mid	15263						9110	11996	15844				
		End	25596						9073	13453	19292				
45E3-160	1	Start	15188		13603	24707	33851	42385							105
		Mid	8411		4787	9925	14081	18019							
		End	14507		4965	12740	19030	25006							
45E3-160	2	Start	18563			22670	31764	40298							108
		Mid	10012			8391	12513	16451							
		End	16594			9524	15734	21710							
45E3-160	3	Start	20237			18762	27759	36293							115
		Mid	11506			6960	11051	14989							
		End	20599			7929	14100	20075							
45E3-160	4	Start	23717				25547	34081							119
		Mid	13172				9421	13359							
		End	22811				10701	16677							
45E3-160	5	Start	28083				22762	31296	45519						124
		Mid	15263				7373	11311	17875						
		End	25596				6439	12414	22373						

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Output Torque – Metric – Nm

SR - CANTED YOKE

Spring Return Canted Yoke															Limiting MOP, bar
Actuator	Spring #	Position	Spring Torque Nm	Operating Pressure, bar											
				35	50	70	85	100	125	140	160	175	190		
				Hydraulic Torque, Nm											
10E4-160	1	Start	29925				23681	33265	49238	58822	71600	81184	90768	101630	204
		Mid	17054				8366	12788	20159	24582	30478	34901	39323	44335	
		End	30627				8806	15517	26702	33412	42360	49071	55781	63387	
10E4-160	2	Start	37975						45032	54616	67394	76978	86562	97424	207
		Mid	20691						16598	21021	26918	31340	35763	40775	
		End	34833						18841	25551	34499	41210	47920	55526	
10E4-160	3	Start	44519							45054	57832	67416	77000	87861	207
		Mid	25096							16709	22606	27028	31451	36463	
		End	44396							19162	28109	34820	41531	49136	
10E4-160	4	Start	56019								51920	61504	71087	81949	207
		Mid	30269								17541	21964	26387	31399	
		End	50308								16880	23591	30301	37907	
10E4-180	1	Start	29925			28096	41522	54254	75474	88206					154
		Mid	17054			10492	16598	22474	32266	38141					
		End	30627			12085	21298	30214	45072	53987					
10E4-180	2	Start	37975				37316	50048	71268	84000	100976			159	
		Mid	20691				13038	18913	28705	34580	42414				
		End	34833				13438	22353	37211	46126	58013				
10E4-180	3	Start	44519				40485	61706	74438	91414				170	
		Mid	25096				14601	24393	30269	38102					
		End	44396				15963	30822	39737	51624					
10E4-180	4	Start	56019						55793	68526	85502	98234		177	
		Mid	30269						19329	25204	33038	38913			
		End	50308						19592	28507	40394	49309			
10E4-200	1	Start	29925			22975	44121	61461	77712					121	
		Mid	17054			8123	17907	25799	33298						
		End	30627			8499	23306	35260	46639						
10E4-200	2	Start	37975				40016	57255	73506	100590				124	
		Mid	20691				14423	22239	29738	42236					
		End	34833				15634	27399	38778	57743					
10E4-200	3	Start	44519				47693	63943	91028					133	
		Mid	25096				17927	25426	37924						
		End	44396				21010	32389	51354						
10E4-200	4	Start	56019					58031	85116	101367				139	
		Mid	30269					20362	32860	40359					
		End	50308					21159	40124	51503					

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Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

SR - CANTED YOKE

Spring Return Canted Yoke																
Actuator	Spring #	Position	Spring Torque	Operating Pressure, bar											Limiting MOP, bar	
				35	50	70	85	100	125	140	160	175	190	207		
			Nm	Hydraulic Torque, Nm												
10E4-220	1	Start	29925		35626	61832	83499									97
		Mid	17054		13977	26102	35969									
		End	30627		17358	35708	50691									
10E4-220	2	Start	37975		31522	57728	79293	99433								100
		Mid	20691		10492	22618	32408	41702								
		End	34833		9686	28036	42831	56933								
10E4-220	3	Start	44519			48396	69731	89871								108
		Mid	25096			18399	28097	37390								
		End	44396			21801	36441	50543								
10E4-220	4	Start	56019				63819	83958								112
		Mid	30269				23032	32326								
		End	50308				25212	39314								
Canted																
10E4-250	1	Start	29925	30837	56862	91563										73
		Mid	17054	11761	23802	39857										
		End	30627	14004	32228	56525										
10E4-250	2	Start	37975	26732	52758	87458										76
		Mid	20691	8277	20318	36373										
		End	34833	6333	24556	48854										
10E4-250	3	Start	44519		43426	78126										81
		Mid	25096		16099	32154										
		End	44396		18320	42618										
10E4-250	4	Start	56019		37656	72357	98382									85
		Mid	30269		11144	27199	39240									
		End	50308		7362	31659	49882									

Note: Select Canted Yoke only for Fail CW.

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Sample Part Number

98H F 1 F 4 - 213 C 2 1 G 00 0 S 0

Series	Size Code						Base Number		
98H	Actuator Size	Bore Size			Cylinder Size*	Spring Size		Base Code	Action
98H	F	1			F	4	-	213	C
	A	X	Refer to Table Below			A	32mm	0	None (DA)
	B	12 E2				B	40mm	1	Spring 1
	C	18 E2				C	50mm	2	Spring 2
	D	45 E2				D	63mm	3	Spring 3
	E	73 E2				E	80mm	4	Spring 4
	F	14 E3				F	100mm	5	Spring 5
	G	24 E3				G	125mm		
	H	45 E3				H	140mm		
	J	10 E4				J	160mm		
						K	180mm		
						L	200mm		
						M	220mm		
						N	250mm		

Actuator Bore Selection Table				
Actuator Size	X			
	1*	2	3	4
12 E2	1.181"			
18 E2	1.378"	1.181"		
45 E2	1.969"	1.378"	1.75"	
73 E2	2.5"	1.969"	2.362"	
14 E3	3"	2.5"	2.362"	
24 E3	4.5"	4.0"	3.5"	3.149"
45 E3	6.0"	5.0"	4.724"	
10 E4	7.0"	6.0"		

Select code that matches bore to valve stem.
 *Select 1 for lower valve stems and pick a suitable mounting kit.

*Cylinder size is the Pressure Module Bore Size

Base Number					Trim Code		
Mounting/Yoke	Ports	Standard Options		Design Code	MOC	Temp Trim	Coating
2	1	G		00	0	S	0
1 ISO / Symmetrical	1 NPT	N	None	00 Standard	0 Standard (DI/CS)	S Standard	0 Standard
2 ISO / Canted	2 Custom*	H	Hydraulic Override ¹	01 PED		L Low Temp	
		K	Hand Pump Override ²				
		J	Jackscrew Direct drive		XXX-Special Requirements		
		G	Jackscrew Gear drive				
		E	Extended Stopper 45 deg				
		F	Extended Stopper 90 deg				
		D	Damper - Hydraulic				
		P	PST & Locking Device				

*With NPT-Custom thread adaptors

*See pg. 7 for Manual Override
¹ Using secondary cylinder
² Using primary cylinder

NOTE: 1. See "Standard Combinations" for valid cylinder and spring combinations.
 2. Refer to ES-00233, to determine actuator orientations.

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Actuator Mounting Kits Selection

Actuator Model			Valve Mounting Code		Mounting Kit	
Model	Mtg Flange	Bore (in)	Mounting Code	Stem Dia (In)	Part Number	Contents
12E2	F12/F07	1.181 (0.87" A/F)	D	0.866 (0.63" A/F)	98-B00D-22650-536	(2)
12E2	F12/F07	1.181 (0.87" A/F)	E	1.181 (0.87" A/F)	98-B00E-22652-536 *	(3)
12E2	F12/F07	1.181 (0.87" A/F)	E	1.181 (0.87" A/F)	98-0F12-22650-536	(1)
12E2	F12/07	1.181 (0.87" A/F)	E	1.181 (0.87" A/F)	98-B00E-22650-536	(3)
12E2	F12/F07	1.181 (0.87" A/F)	F	1.378	98-B00F-22650-536	(3)
12E2	F12/F07	1.181 (0.87" A/F)	G	1.969	98-B00G-22650-536	(3)
18E2	F12	1.378	D	0.866 (0.63" A/F)	98-C00D-22650-536	(2)
18E2	F12	1.181 (0.87" A/F)	E	1.181 (0.87" A/F)	98-0F12-22650-536	(1)
18E2	F12	1.378	F	1.378	98-0F12-22650-536	(1)
18E2	F12	1.378	F	1.378	98-C00F-22650-536	(3)
18E2	F12	1.378	F25-1	2.5	98-C251-22650-536	(3)
18E2	F12	1.378	G	1.969	98-C00G-22650-536	(3)
18E2	F12	1.378	H	2.5	98-C00H-22650-536	(3)
45E2	F12/F16	1.969	E	1.181	98-D00E-22650-536	(2)
45E2	F12/F16	1.378	F	1.378	98-0F12-22650-536	(1)
45E2	F12/F16	1.378	F16-1	1.378	98-0F16-22650-536	(1)
45 E2	F12/F16	1.969	F16-1	1.378	98-D161-22650-536	(3)
45E2	F12/F16	1.969	F25-1	2.5	98-D251-22650-536	(3)
45E2	F12/F16	1.969	F25-2	3.0	98-D252-22650-536	(3)
45 E2	F12/F16	1.969	F30-1	3.0	98-D301-22650-536	(3)
45E2	F12/F16	1.969	G	1.969	98-0F16-22650-536	(1)
45E2	F12/F16	1.969	H	2.5	98-D00H-22650-536	(3)
73E2	F12/F16	2.5	F	1.378	98-E00F-22650-536	(2)
73E2	F12/F16	2.5	F16-1	1.378	98-E161-22650-536	(2)
73E2	F12/F16	2.5	F25-1	2.5	98-E251-22650-536	(3)
73E2	F12/F16	2.5	F25-2	3.0	98-E252-22650-536	(3)
73E2	F12/F16	2.5	F30-1	3.0	98-E301-22650-536	(3)
73E2	F12/F16	2.5	F30-2	3.5	98-E302-22650-536	(3)
73 E2	F12/F16	2.5	F30-3	4.0	98-E303-22650-536	(3)
73 E2	F12/F16	2.5	F35-1	4.0	98-E351-22650-536	(3)
73 E2	F12/F16	2.5	F35-2	6.0	98-E352-22650-536	(3)
73E2	F12/F16	1.969	G	1.969	98-0F16-22650-536	(1)
73E2	F12/F16	2.5	H	2.5	98-0F16-22650-536	(1)
14E3	F25/F16	3.0	F16-1	1.378	98-F161-22650-536	(2)
14E3	F25/F16	2.5	F25-1	2.5	98-0F25-22650-536	(1)
14E3	F25/F16	3.0	F25-2	3.0	98-0F25-22650-536	(1)
14E3	F25/F16	3.0	F30-1	3.0	98-F301-22650-536	(3)
14E3	F25/F16	3.0	F30-2	3.5	98-F302-22650-536	(3)
14E3	F25/F16	3.0	F30-3	4.0	98-F303-22650-536	(3)
14E3	F25/F16	3.0	F30-5	4.5	98-F305-22650-536	(3)
14E3	F25/F16	3.0	F35-1	4.0	98-F351-22650-536	(3)
14E3	F25/F16	3.0	F35-4	5.0	98-F354-22650-536	(3)
14E3	F25/F16	3.0	G	1.969	98-F00G-22650-536	(2)
14E3	F25/F16	2.5	H	2.5	98-0F16-22650-536	(1)

(1) Stud Mounting Kit (SMK) for mounting actuators directly to valves (actuator flange and bore match the valve top plate and stem). Includes only mounting studs.

(2) Adaptor Mounting Kit (AMK) for mounting actuators to valves using a sleeve/shaft adaptor only (no bracket). Includes mounting studs and adaptor.

(3) Direct Mounting Kit (DMK) for mounting actuators to valves when actuator flange and bore do not match the valve top plate and stem. Includes bracket, mounting studs and adaptor/shaft coupler.

*Perpendicular to pipe line

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

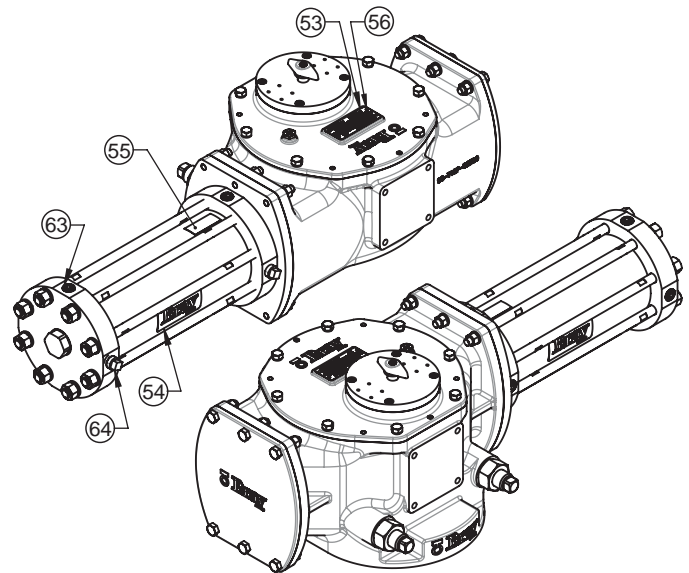
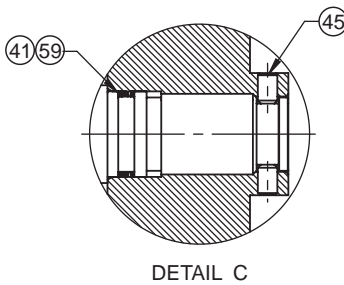
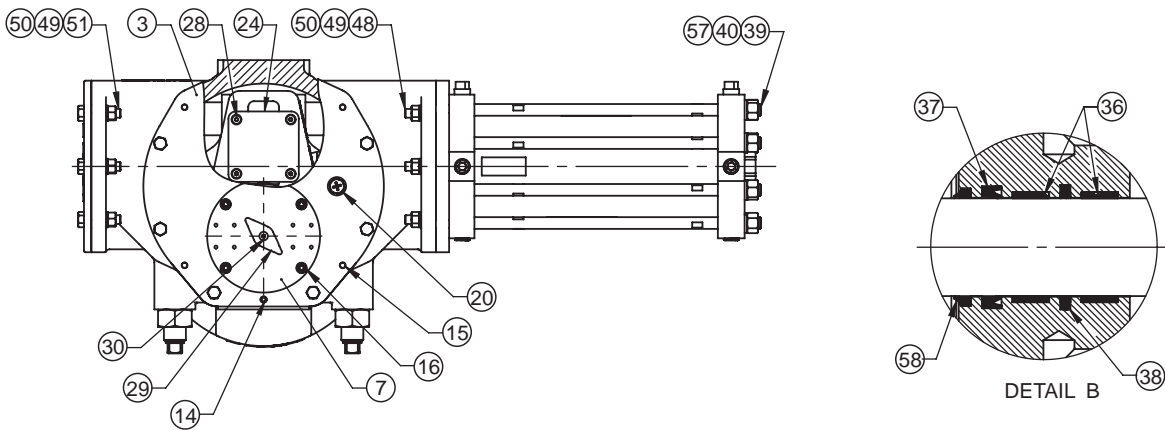
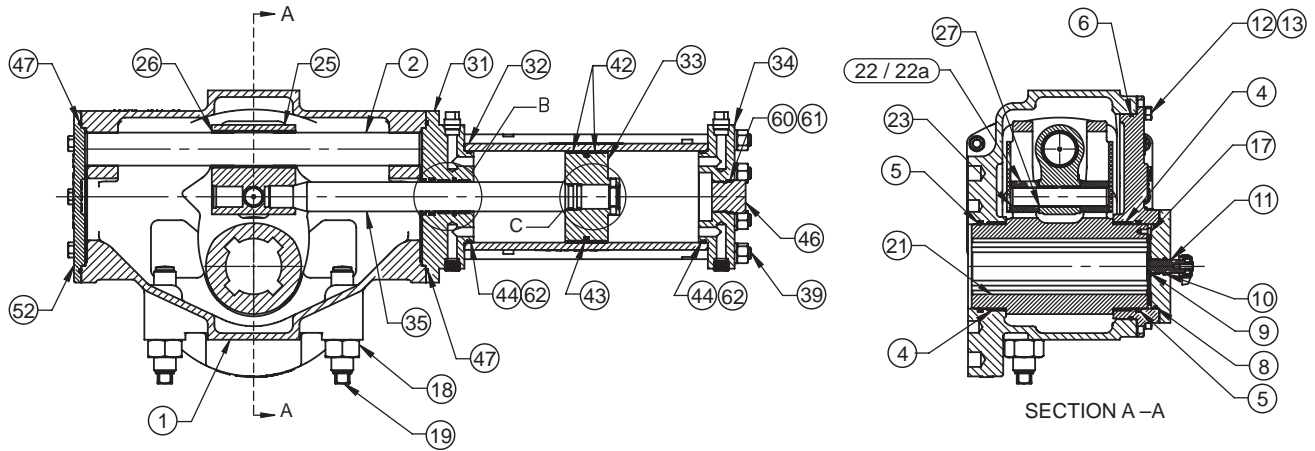
Actuator Mounting Kits Selection - cont.

Actuator Model			Valve Mounting Code		Mounting Kit	
Model	Mtg Flange	Bore (in)	Mounting Code	Stem Dia (In)	Part Number	Contents
24E3	F25/F30	4.5	F25-1	2.5	98-G251-22650-536	(2)
24E3	F25/F30	4.5	F25-2	3.0	98-G252-22650-536	(2)
24E3	F25/F30	4.5	F30-1	3.0	98-G301-22650-536	(2)
24E3	F25/F30	3.5	F30-2	3.5	98-0F30-22650-536	(1)
24E3	F25/F30	4.0	F30-3	4.0	98-0F30-22650-536	(1)
24E3	F25/F30	4.5	F30-4	5.0	98-G304-22650-536	(3)
24E3	F25/F30	4.5	F30-5	4.5	98-0F30-22650-536	(1)
24E3	F25/F30	4.5	F35-1	4.0	98-G351-22650-536	(3)
24E3	F25/F30	4.5	F35-2	6.0	98-G352-22650-536	(3)
24E3	F25/F30	4.5	F35-3	4.5	98-G353-22650-536	(3)
24E3	F25/F30	4.5	F35-4	5.0	98-G354-22650-536	(3)
45E3	F30/F35	6.0	F30-2	3.5	98-H302-22650-536	(2)
45E3	F30/F35	6.0	F30-3	4.0	98-H303-22650-536	(2)
45E3	F30/F35	6.0	F30-5	4.5	98-H305-22650-536	(2)
45E3	F30/F35	6.0	F35-1	4.0	98-H351-22650-536	(2)
45E3	F30/F35	6.0	F35-2	6.0	98-0F35-22650-536	(1)
45E3	F30/F35	6.0	F35-3	4.5	98-H353-22650-536	(2)
45E3	F30/F35	5.0	F35-4	5.0	98-0F35-22650-536	(1)
45E3	F30/F35	6.0	F40-1	7.0	98-H401-22650-536	(3)
45E3	F30/F35	6.0	F40-3	6.0	98-H403-22650-536	(3)
45E3	F30/F35	6.0	F40-4	5.0	98-H404-22650-536	(3)
45E3	F30/F35	6.0	F48-2	7.0	98-H482-22650-536	(3)
10E4	F40	7.0	F30-2	3.5	98-J302-22650-536	(3)
10E4	F40	7.0	F30-3	4.0	98-J303-22650-536	(3)
10E4	F40	7.0	F30-5	4.5	98-J305-22650-536	(3)
10E4	F35	6.0	F35-2	6.0	98-0F35-22650-536	(1)
10E4	F40	7.0	F35-3	4.5	98-J353-22650-536	(2)
10E4	F40	7.0	F35-4	5.0	98-J354-22650-536	(3)
10E4	F40	7.0	F40-1	7.0	98-0F40-22650-536	(1)
10E4	F40	7.0	F40-2	7.5	98-J402-22650-536	(3)
10E4	F40	7.0	F40-3	6.0	98-0F40-22650-536	(1)
10E4	F40	7.0	F48-2	7.0	98-J482-22650-536	(3)

- (1) Stud Mounting Kit (SMK) for mounting actuators directly to valves (actuator flange and bore match the valve top plate and stem). Includes only mounting studs.
- (2) Adaptor Mounting Kit (AMK) for mounting actuators to valves using a sleeve/shaft adaptor only (no bracket). Includes mounting studs and adaptor.
- (3) Direct Mounting Kit (DMK) for mounting actuators to valves when actuator flange and bore do not match the valve top plate and stem. Includes bracket, mounting studs and adaptor/shaft coupler.

Cylinder Size,MM					Purge Valve Kit Part Number		
					DA	SR	DD
32	40	50			98H-0250-25800-580	98H-0250-25801-580	98H-0250-25802-580
63	80	100	125	140	98H-0500-25800-580	98H-0500-25801-580	98H-0500-25802-580
160	180	200	220	250	98H-0750-25800-580	98H-0750-25801-580	98H-0750-25802-580

Hydraulic Actuator - Double Acting, Single Cylinder Assembly



For reference only. Please refer to ES-00688 drawing for current information.

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

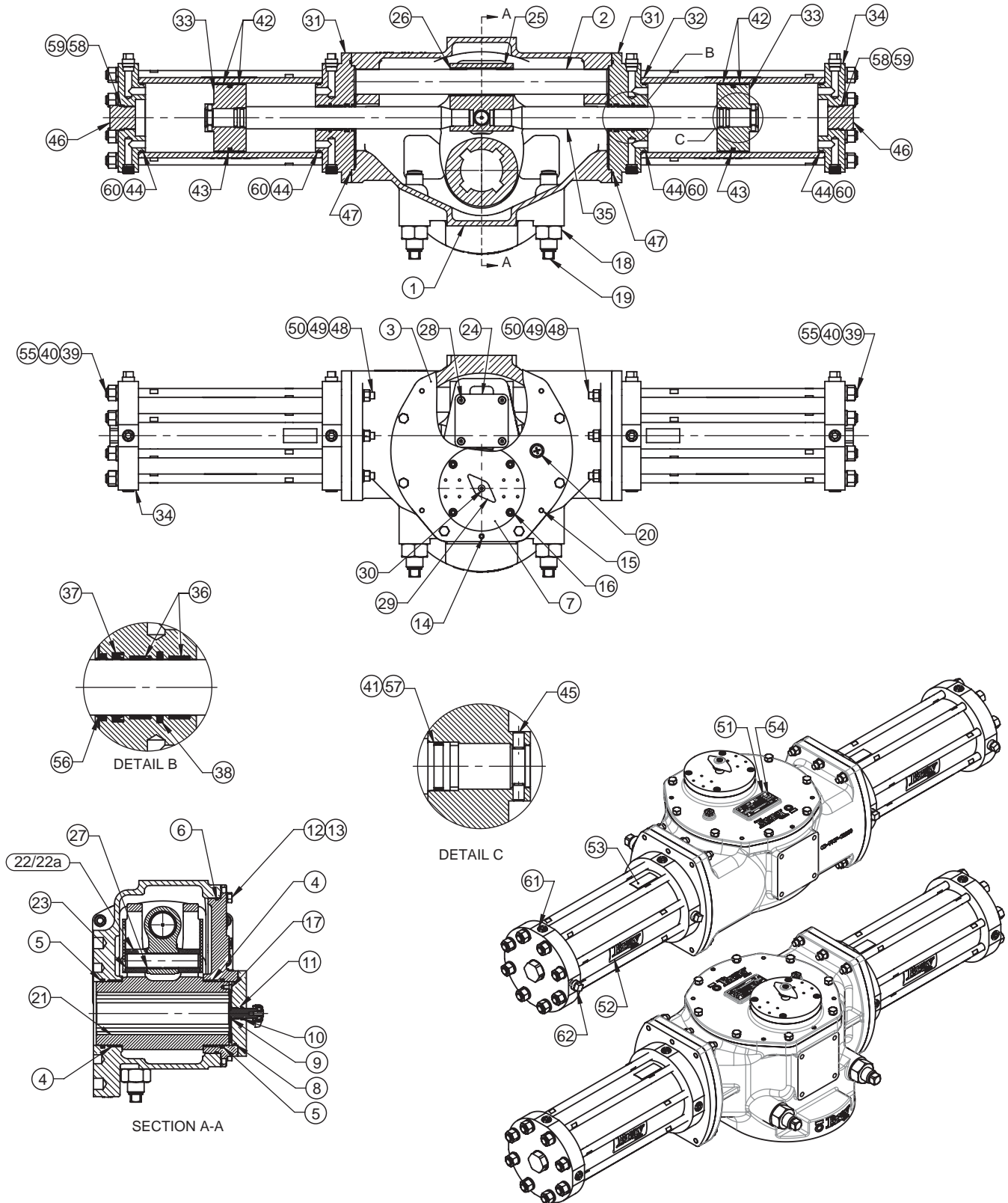
Item		Description	Material	Qty.
1		Yoke Housing	Ductile Iron	1
2		Guide Rod	Alloy Steel	1
3		Housing Cover	Ductile Iron	1
4	**	Bushing (Yoke)	PTFE Bronze	2
5	*	O-Ring (Yoke)	Buna-N	2
6	*	O-Ring (Cover)	Buna-N	1
7		Top Cover	Ductile Iron	1
8	*	O-Ring (Top Cover)	Buna-N	1
9	**	Flanged Bushing	PTFE Bronze	1
10	*	O-Ring (Accessory Drive)	Buna-N	1
11		Accessory Drive	Stainless Steel	1
12		Hex Bolt	Steel	8
13		Spring Washer	Spring Steel	8
14		Set Screw, Socket Head	Steel	2
15		Dowel Pin	Hardened Steel	4
16		Socket Head Caps Screw,	Steel	4
17		Socket Head Caps Screw, Low Head	Steel	1
18		Seal Nut	Steel	2
19		Stop Bolt	Steel	2
20		Breather Vents	Carbon Steel	1
21		Yoke	Ductile Iron	1
22	**	Slider Block	Bronze	2
22a	**	Roller	Steel	2
23		Yoke Pin	Alloy Steel	1
24		Retainer Plate	Plastic	2
25		Guide Block	Carbon Steel	1
26	**	Bushing (Guide Rod)	PTFE Bronze	2
27	**	Bushing (Yoke Pin)	PTFE Bronze	2
28		Cap Screw, Flat Head, Hex Socket	Steel	8
29		Position Indicator	Plastic	1
30		Cap Screw, Flat Head, Hex Socket	Steel	1
31		Adaptor, Pressure Module	Carbon Steel	1
32		Barrel	Carbon Steel	1

Item		Description	Material	Qty.
33		Piston	Alloy Steel	1
34		End Cap, Pressure Module	Carbon Steel	1
35		Piston Rod	Alloy Steel	1
36	*	Guide Ring, Piston Rod	Phenolic Resin	2
37	*	Lip Seal	Polyurethane	1
38	*	Sealing Set, Piston Rod	PTFE & Buna-N	1
39		Tie Rod	Alloy Steel	8
40		Nut, Tie Rod	Steel	8
41	*	O-Ring (Piston Rod)	Buna-N	1
42	*	Guide Ring, Piston	Phenolic Resin	2
43	*	Sealing Set, Piston	PTFE & Buna-N	1
44	*	O-Ring (Barrel)	Buna-N	2
45		Set Screw, Piston Lock	Steel	2
46		End Plug	Steel	1
47	*	O-Ring (Module)	Buna-N	2
48		Stud / Bolt (Module)	Steel	6
49		Spring Washer (Module)	Spring Steel	12
50		Nut (Module)	Steel	12
51		Hex Bolt	Steel	6
52		End Cover, DA	Ductile Iron	1
53		Name Plate	Stainless Steel	1
54		Label, Logo	Metallized Polyester	2
55		Label, Configuration	Metallized Polyester	1
56		Rivets	Stainless Steel	4
57		Spring Washer, Tie Rod	Spring Steel	8
58	*	Wiper	Polyurethane	1
59	*	Backup Ring (Piston Rod)	PTFE	2
60	*	O-Ring (End Plug)	Buna-N	1
61	*	Backup Ring (End Plug)	PTFE	1
62	*	Backup Ring (Barrel)	PTFE	2
63		Pipe Plug	Carbon Steel	4
64		Protective Plug	Plastic	2

*	Parts in Seal Kits
* & **	Parts in Repair Kits

For reference only. Please refer to ES-00688 drawing for current information.

Hydraulic Actuator - Double Acting, Dual Cylinder Assembly



For reference only. Please refer to ES-00689 drawing for current information.

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

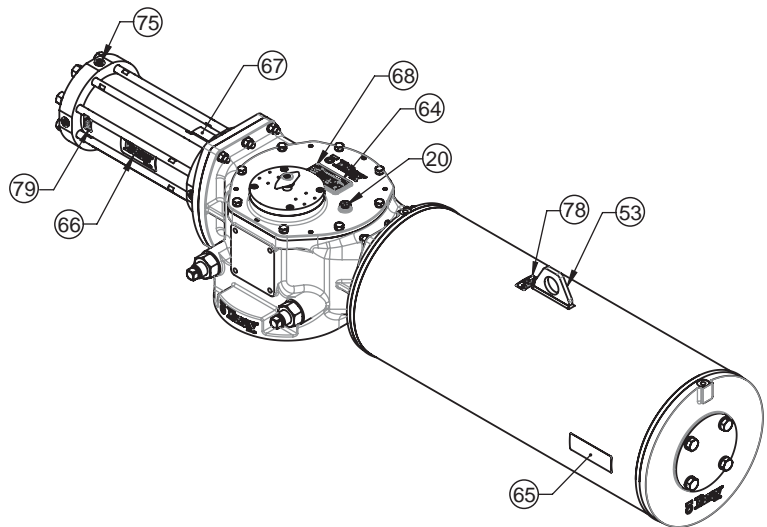
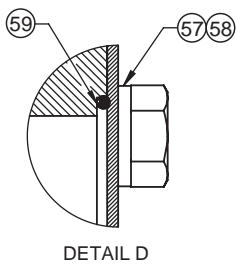
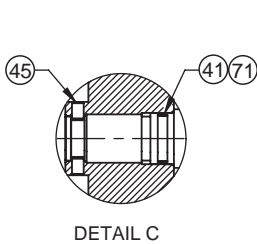
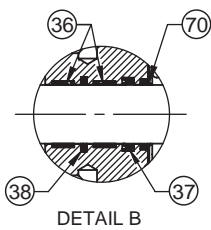
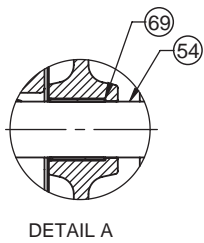
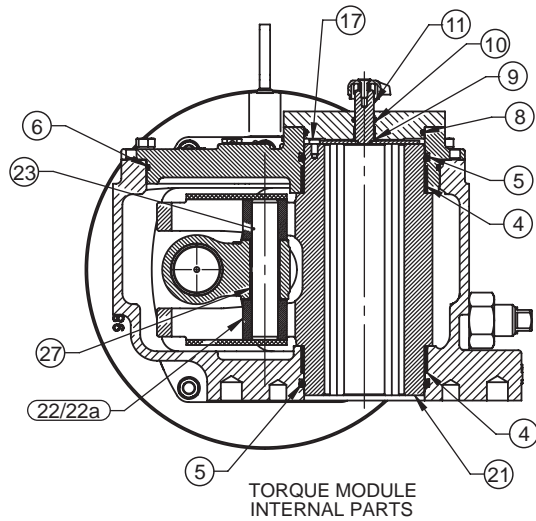
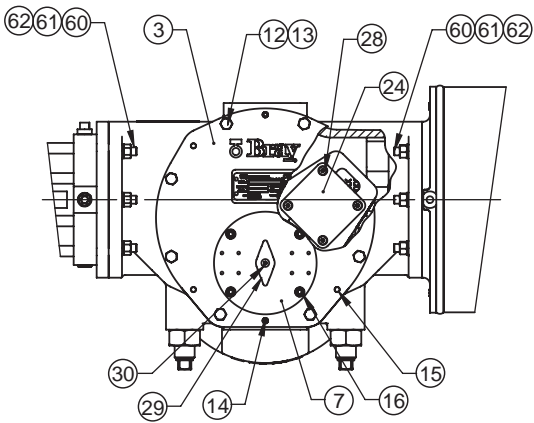
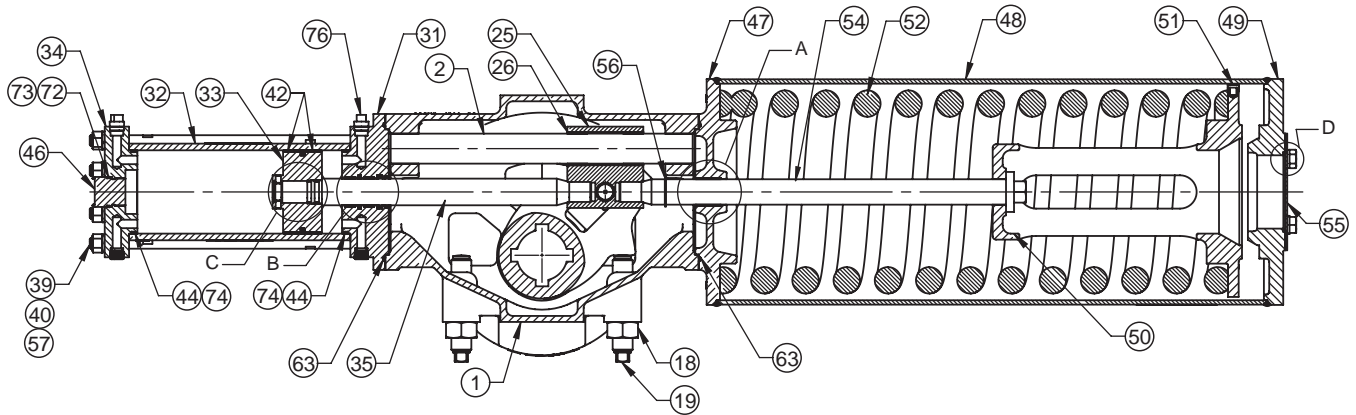
Item		Description	Material	Qty.
1		Yoke Housing	Ductile Iron	1
2		Guide Rod	Alloy Steel	1
3		Housing Cover	Ductile Iron	1
4	**	Bushing (Yoke)	PTFE Bronze	2
5	*	O-Ring (Yoke)	Buna-N	2
6	*	O-Ring (Cover)	Buna-N	1
7		Top Cover	Ductile Iron	1
8	*	O-Ring (Top Cover)	Buna-N	1
9	**	Flanged Bushing	PTFE Bronze	1
10	*	O-Ring (Accessory Drive)	Buna-N	1
11		Accessory Drive	Stainless Steel	1
12		Hex Bolt	Steel	8
13		Spring Washer	Spring Steel	8
14		Set Screw, Socket Head	Steel	2
15		Dowel Pin	Hardened Steel	4
16		Socket Head Caps Screw,	Steel	4
17		Socket Head Caps Screw, Low Head	Steel	1
18		Seal Nut	Steel	2
19		Stop Bolt	Steel	2
20		Breather Vents	Carbon Steel	1
21		Yoke	Ductile Iron	1
22	**	Slider Block	Bronze	2
22a	**	Roller	Steel	2
23		Yoke Pin	Alloy Steel	1
24		Retainer Plate	Plastic	2
25		Guide Block	Carbon Steel	1
26	**	Bushing (Guide Rod)	PTFE Bronze	2
27	**	Bushing (Yoke Pin)	PTFE Bronze	2
28		Cap Screw, Flat Head, Hex Socket	Steel	8
29		Position Indicator	Plastic	1
30		Cap Screw, Flat Head, Hex Socket	Steel	1
31		Adaptor, Pressure Module	Carbon Steel	2

Item		Description	Material	Qty.
32		Barrel	Carbon Steel	2
33		Piston	Alloy Steel	2
34		End Cap, Pressure Module	Carbon Steel	2
35		Piston Rod	Alloy Steel	2
36	*	Guide Ring, Piston Rod	Phenolic Resin	4
37	*	Lip Seal	Polyurethane	2
38	*	Sealing Set, Piston Rod	PTFE & Buna-N	2
39		Tie Rod	Steel	16
40		Nut, Tie Rod	Steel	16
41	*	O-Ring (Piston Rod)	Buna-N	2
42	*	Guide Ring, Piston	Phenolic Resin	4
43	*	Sealing Set, Piston	PTFE & Buna-N	2
44	*	O-Ring (Barrel)	Buna-N	4
45		Set Screw, Piston Lock	Steel	4
46		End Plug	Steel	2
47	*	O-Ring (Module)	Buna-N	2
48		Stud / Hex Bolt (Module)	Steel	12
49		Spring Washer (Module)	Spring Steel	12
50		Nut (Module)	Steel	12
51		Name Plate	Stainless Steel	1
52		Label, Logo	Metallized Polyester	4
53		Label, Configuration	Metallized Polyester	2
54		Rivets	Stainless Steel	4
55		Spring Washer, Tie Rod	Spring Steel	16
56	*	Wiper	Polyurethane	2
57	*	Backup Ring (Piston Rod)	PTFE	4
58	*	O-Ring (End Plug)	Buna-N	2
59	*	Backup Ring (End Plug)	PTFE	2
60	*	Backup Ring (Barrel)	PTFE	4
61		Pipe Plug	Carbon Steel	8
62		Protective Plug	Plastic	4

*	Parts in Seal Kits
* & **	Parts in Repair Kits

For reference only. Please refer to ES-00689 drawing for current information.

Spring Return Hydraulic Actuator Assembly



For reference only. Please refer to ES-00690 drawing for current information.

Bray Series 98H Hydraulic Scotch Yoke Actuator Technical Manual

Item		Description	Material	Qty.
1		Yoke Housing	Ductile Iron	1
2		Guide Rod	Alloy Steel	1
3		Housing Cover	Ductile Iron	1
4	**	Bushing (Yoke)	PTFE Bronze	2
5	*	O-Ring (Yoke)	Buna-N	2
6	*	O-Ring (Cover)	Buna-N	1
7		Top Cover	Ductile Iron	1
8	*	O-Ring (Top Cover)	Buna-N	1
9	**	Flanged Bushing	PTFE Bronze	1
10	*	O-Ring (Accessory Drive)	Buna-N	1
11		Accessory Drive	Stainless Steel	1
12		Hex Bolt	Steel	8
13		Spring Washer	Spring Steel	8
14		Set Screw, Socket Head	Steel	2
15		Dowel Pin	Hardened Steel	4
16		Socket Head Caps Screw	Steel	4
17		Socket Head Caps Screw, Low Head	Steel	1
18		Seal Nut	Steel	2
19		Stop Bolt	Steel	2
20		Breather Vents	Carbon Steel	1
21		Yoke	Ductile Iron	1
22	**	Slider Block	Bronze	2
22a	**	Roller	Steel	2
23		Yoke Pin	Alloy Steel	1
24		Retainer Plate	Plastic	2
25		Guide Block	Carbon Steel	1
26	**	Bushing (Guide Rod)	PTFE Bronze	2
27	**	Bushing (Yoke Pin)	PTFE Bronze	2
28		Cap Screw, Flat Head, Hex Socket	Steel	8
29		Position Indicator	Plastic	1
30		Cap Screw, Flat Head, Hex Socket	Steel	1
31		Adaptor, Pressure Module	Carbon Steel	1
32		Barrel	Carbon Steel	1
33		Piston	Alloy Steel	1
34		End Cap, Pressure Module	Carbon Steel	1
35		Piston Rod	Alloy Steel	1
36	*	Guide Ring, Piston Rod	Phenolic Resin	2
37	*	Lip Seal	Polyurethane	1
38	*	Sealing Set, Piston Rod	PTFE & Buna-N	1
39		Tie Rod	Alloy Steel	8

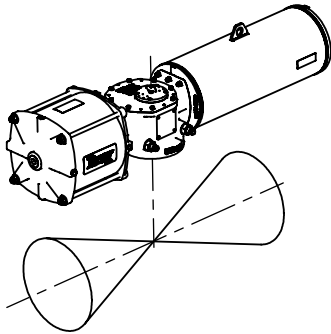
Item		Description	Material	Qty.
40		Nut, Tie Rod	Steel	8
41	*	O-Ring (Piston Rod)	Buna-N	1
42	*	Guide Ring, Piston	Phenolic Resin	2
43	*	Sealing Set, Piston	PTFE & Buna-N	1
44	*	O-Ring (Barrel)	Buna-N	2
45		Set Screw, Piston Lock	Steel	2
46		End Plug	Steel	1
47		Adaptor, Spring Module	Carbon Steel	1
48		Pipe	Carbon Steel	1
49		End Cap, Spring Module	Carbon Steel	1
50		Spring Guide	Carbon Steel	1
51		Button	Plastic	9
52		Spring, Compression	Alloy Steel	1
53		Lifting Lug	Carbon Steel	1
54		Spring Rod	Alloy Steel	1
55		End Cover	Carbon Steel	1
56		Retainer Ring	Stainless Steel	1
57		Spring Washer	Spring Steel	12
58		Hex Bolt	Steel	4
59	*	O-Ring (End Cover)	Buna-N	1
60		Stud / Hex Bolt (Module)	Steel	12
61		Nut (Module)	Steel	12
62		Spring Washer (Module)	Spring Steel	12
63	*	O-Ring (Module)	Buna-N	2
64		Name Plate	Stainless Steel	1
65		Label, Caution	Metallized Polyester	1
66		Label, Logo	Metallized Polyester	2
67		Label, Configuration	Metallized Polyester	1
68		Rivets	Stainless Steel	4
69	**	Bushing (Adaptor)	PTFE Bronze	1
70	*	Wiper	Polyurethane	1
71	*	Backup Ring (Piston Rod)	PTFE	2
72	*	O-Ring (End Plug)	Buna-N	1
73	*	Backup Ring (End Plug)	PTFE	1
74	*	Backup Ring (Barrel)	PTFE	2
75		Pipe Plug	Carbon Steel	4
76		Protective Plug	Plastic	2
78		Label, Lifting	Metallized Polyester	1
79		Label, Venting	Metallized Polyester	1

*	Parts in Seal Kits
* & **	Parts in Repair Kits

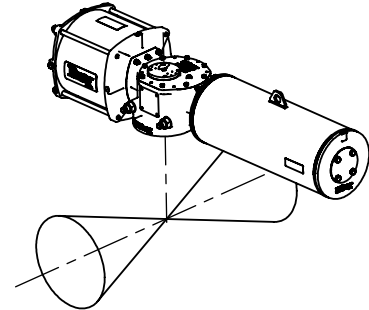
For reference only. Please refer to ES-00690 drawing for current information.

Actuator Orientations - Where "1H1" is the Standard Actuator Orientation

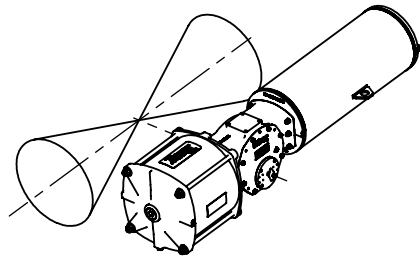
1H1



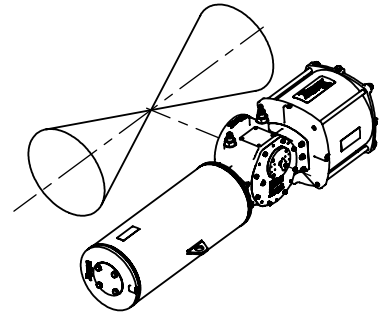
1H2



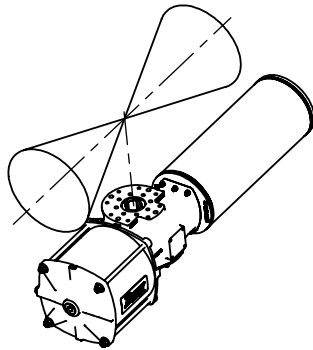
2H1



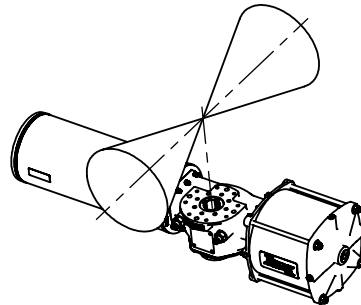
2H2



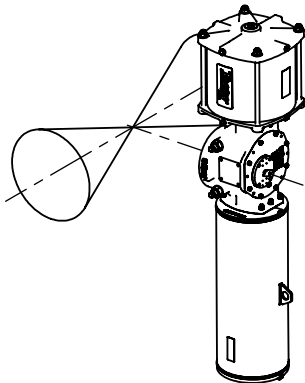
3H1



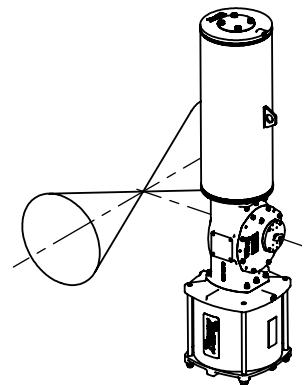
3H2



4V1



4V2



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