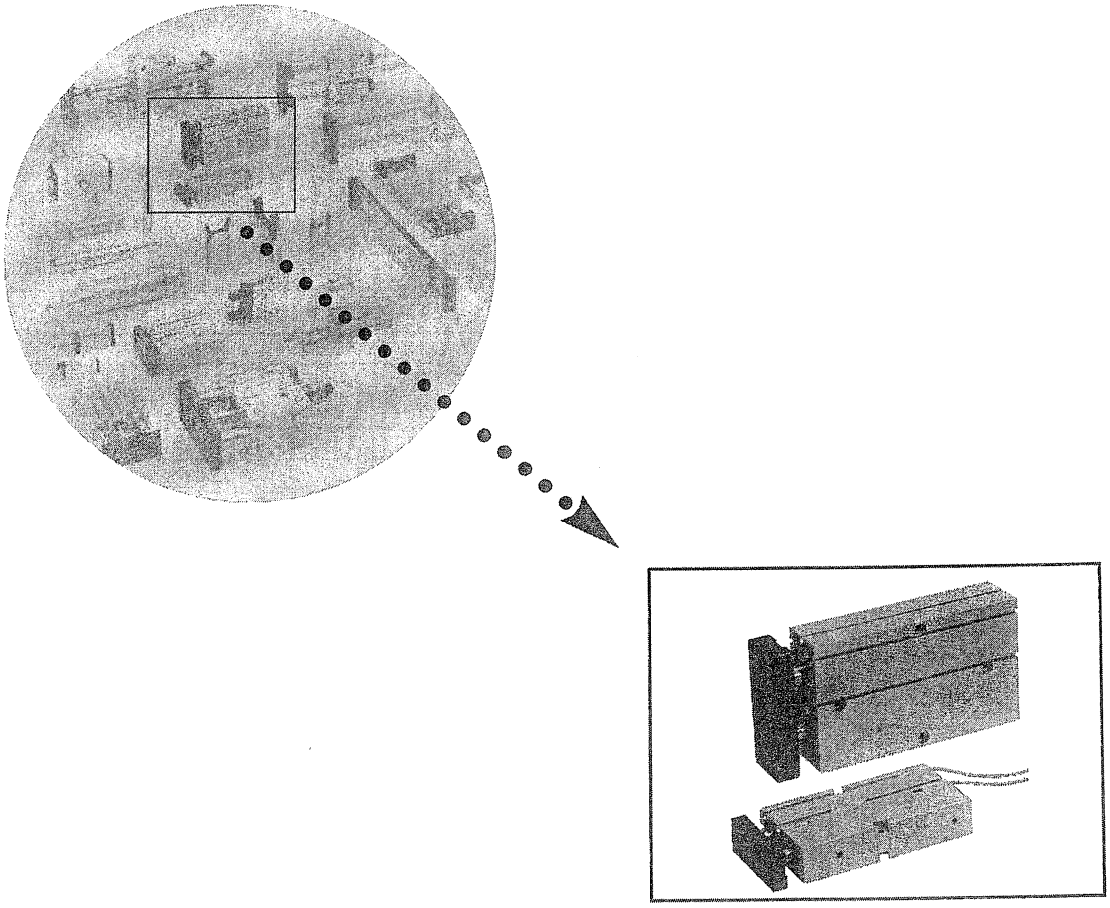
Twin Rod Cylinders



SELECTING A HUMPHREY TWIN ROD CYLINDER

THRUST FORCE

Thrust force (F) is determined by piston area (A) and air pressure (P). F = A x P.

Select an appropriate cylinder bore size based on the thrust force required in your application. Consider the load you have to move and the air pressure you have available to do the work (psig or kg/cm^2).

The table below shows calculated thrust forces of Twin Rod cylinders at various line pressures.

Use this formula to select the appropriate cylinder:

$$\text{Load rate} = \frac{\text{Load (weight)}}{\text{Calculated thrust force (from chart below)}}$$

Note: the load rate should be no greater than 70 percent for moderate cycle speeds, and no greater than 50 percent for high cycle speeds.

Example:

- Double acting cylinder, slow speed
- 70 psig operating pressure
- The application is to *push* a 30 pound load.

Calculate:

$.70\ (70\%) = \frac{30 \text{ pounds}}{\text{Calculated value}}$ or,

42.9 = Calculated value.

Select 5/8" (16mm) bore cylinder which can push 44.32 pounds at 71 psig.

Bore Size (I.D.) Inch (nom.) mm (actual)	Rod Size Inch (nom.) mm (actual)	Type		Pressure area Inch^2 (cm^2)	Air Pressure psig (kg/cm^2)						
					14 (1)	28 (2)	43 (3)	57 (4)	71 (5)	85 (6)	100 (7)
1/4 (6)	5/32 (4)	Double acting	Push	0.09 (0.56)	–	2.47 (1.12)	3.70 (1.68)	4.94 (2.24)	6.17 (2.80)	7.41 (3.36)	8.64 (3.92)
			Pull	0.05 (0.31)	–	1.37 (0.62)	2.05 (0.93)	2.73 (1.24)	3.42 (1.55)	4.10 (1.86)	4.79 (2.17)
3/8 (10)	1/4 (6)	Double acting	Push	0.24 (1.57)	–	6.92 (3.14)	10.36 (4.70)	13.85 (6.28)	17.29 (7.84)	20.77 (9.42)	24.21 (10.98)
			Pull	0.16 (1.00)	–	4.41 (2.00)	6.61 (3.00)	8.82 (4.00)	11.03 (5.00)	13.23 (6.00)	15.44 (7.00)
		Single acting	Push	0.24 (1.57)	–	–	1.01 (0.46)	4.50 (2.04)	7.94 (3.60)	11.42 (5.18)	14.86 (6.74)
5/8 (16)	5/16 (8)	Double acting	Push	0.62 (4.02)	8.86 (4.02)	17.73 (8.04)	26.59 (12.06)	35.46 (16.08)	44.32 (20.10)	53.19 (24.12)	62.05 (28.14)
			Pull	0.47 (3.01)	6.64 (3.01)	13.27 (6.02)	19.91 (9.03)	26.55 (12.04)	33.19 (15.05)	39.82 (18.06)	46.46 (21.07)
		Single acting	Push	0.62 (4.02)	–	8.49 (3.85)	17.35 (7.87)	26.22 (11.89)	35.08 (15.91)	43.95 (19.93)	52.81 (23.95)
3/4 (20)	3/8 (10)	Double acting	Push	0.97 (6.28)	13.85 (6.28)	27.70 (12.56)	41.54 (18.84)	55.39 (25.12)	69.24 (31.40)	83.08 (37.68)	96.93 (43.96)
			Pull	0.73 (4.71)	10.39 (4.71)	20.77 (9.42)	31.16 (14.13)	41.54 (18.84)	51.93 (23.55)	62.31 (28.26)	72.70 (32.97)
		Single acting	Push	0.97 (6.28)	–	17.05 (7.73)	30.89 (14.01)	44.74 (20.29)	58.54 (26.57)	72.43 (32.85)	86.28 (39.13)
1 (25)	15/32 (12)	Double acting	Push	1.52 (9.81)	21.63 (9.81)	43.26 (19.62)	64.89 (29.43)	86.52 (39.24)	108.16 (49.05)	129.79 (58.86)	151.42 (68.67)
			Pull	1.17 (7.55)	16.65 (7.55)	33.30 (15.10)	49.94 (22.65)	66.59 (30.20)	83.24 (37.75)	99.89 (45.30)	116.53 (52.85)
		Single acting	Push	1.52 (9.81)	–	25.18 (11.42)	46.81 (21.23)	68.44 (31.04)	90.07 (40.85)	111.71 (50.66)	133.34 (60.47)
1 1/4 (32)	5/8 (16)	Double acting	Push	2.49 (16.07)	35.43 (16.07)	70.87 (32.14)	106.30 (48.21)	141.74 (64.28)	177.17 (80.35)	212.61 (96.42)	248.04 (112.49)
			Pull	1.87 (12.05)	26.57 (12.05)	53.14 (24.10)	79.71 (36.15)	106.28 (48.20)	132.85 (60.25)	159.42 (72.30)	185.99 (84.35)

SPRING FORCES lbs. (kgf)

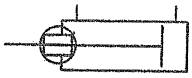
Bore in. (nom.) (mm) actual	Stroke inches (mm)	Zero stroke	End of stroke
3/8 (10)	1/2	3.46 (1.57)	4.63 (2.10)
	3/4	2.87 (1.30)	
	1	2.27 (1.03)	
	1 1/2	5.82 (2.64)	7.35 (4.24)
	2	4.65 (2.11)	
	2 1/2	3.46 (1.57)	
5/8 (16)	1/2	3.29 (1.47)	4.59 (2.08)
	3/4	2.56 (1.16)	
	1	1.90 (0.86)	
	1 1/2	5.20 (2.36)	9.24 (4.19)
	2	3.86 (1.75)	
	2 1/2	2.51 (1.14)	

Bore in. (nom.) (mm) actual	Stroke inches (mm)	Zero stroke	End of stroke
3/4 (20)	1/2	4.17 (1.89)	5.29 (2.40)
	3/4	3.62 (1.64)	
	1	3.09 (1.38)	
	1 1/2	7.30 (3.31)	10.65 (4.83)
	2	6.17 (2.80)	
	2 1/2	5.05 (2.29)	
1 (25)	1/2	6.99 (3.17)	8.89 (4.03)
	3/4	6.02 (2.73)	
	1	5.07 (2.30)	
	1 1/2	12.37 (5.61)	18.08 (8.20)
	2	10.45 (4.74)	
	2 1/2	8.56 (3.88)	

TWIN ROD CYLINDERS – DOUBLE ACTING

1/4-INCH BORE (NOMINAL) 6mm (ACTUAL)

SYMBOL



SPECIFICATIONS

Item	Bore size inch (nom.) / mm (actual)
	1/4 (6)
Type	Double acting
Medium	Air
Mounting	Side mount
Pressure range psig (kgf/cm²)	28~100 (2~7)
Proof pressure psig (kgf/cm²)	150 (10.5)
Temperature range °F (°C)	32~140 (0~60)
Piston speed range in./s (mm/s)	4~20 (100~500)
Cushion	None
Lubrication	None required
Allowable eccentricity	± 0.45°
Stroke adjustment range in. (mm)	–0.197 to 0 (–5 to 0) per specific stroke
Port size	#10-32

*If lubrication is used, apply a non-detergent 10W oil (ISO VG32), or equivalent.

BORE SIZE AND STROKE in. (mm)

Bore size inch (nom.) / mm (actual)	Standard stroke (in.)	Stroke adjustment range ("pull" side)
1/4 (6)	1/2, 3/4, 1, 1 1/2, 2	–0.197 to 0 (–5 to 0)

SEAL REPAIR KITS

SRK-HTBDA-[6]
Bore Size

ORDER EXAMPLE

Cylinders

HTDA **6 x 1/2**

- 6 x 1/2: Stroke; Bore size
- HTDA: Twin Rod Cylinders

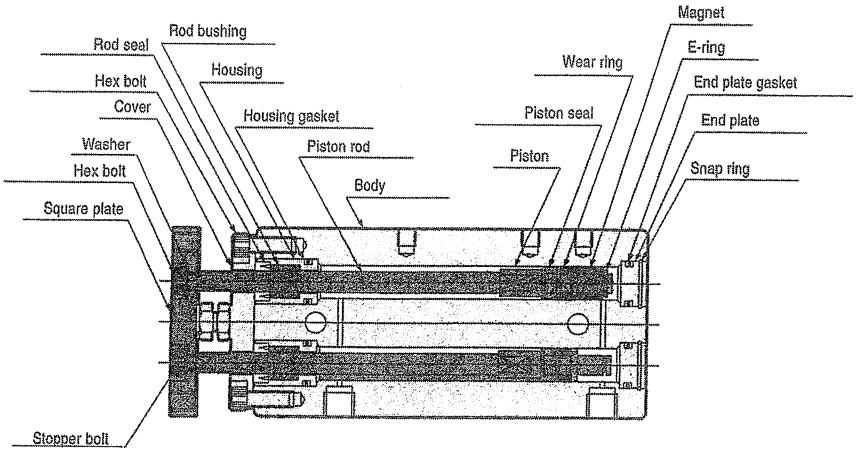
Sensor switches (order separately)

ZC153 **A** **HTDA6**

- HTDA6: Mounting bracket for 1/4 (6) bore Twin Rod Cylinders (specify).
- A: **Lead wire length:**
  A — 39 In. (nom.) 1000mm (actual)
  B — 108 In. (nom.) 3000mm (actual)
  C — 196 In. (nom.) 5000mm (actual)
- ZC153: **Sensor switch model**

ZC130	— Two wire type. Hall effect switch with LED.	10 – 28VDC
ZC153	— Three wire type. Hall effect switch with LED.	4.5 – 28VDC
CS5T	— Two wire type. Reed switch without LED.	5 – 28VDC 85 – 115VAC
CS11T	— Two wire type. Reed switch with LED.	10 – 28VDC

INNER CONSTRUCTION AND MAJOR PARTS



MAJOR PARTS AND MATERIALS OF CONSTRUCTION

Item	Material
Cylinder body	Anodized aluminum
Piston	Anodized aluminum
Cover	Anodized aluminum
Wear ring	Resin
Piston rod	Hard steel, hard chrome plated
Gasket	Buna
Housing	Anodized aluminum
End plate	Resin
Rod bushing	Oil permeated bronze
Seal	Buna
Snap ring	Hard steel, nickel plated
Magnet	Sintered magnet
E-ring	Stainless steel
Washer	Hard steel, black zinc plated
Head plate	Soft steel, black zinc plated
Stopper bolt	Soft steel, zinc plated

WEIGHT

oz. (gf)

Bore size Inch (nom.) / mm (actual)	Added weight		
	Zero stroke weight	Per ½-inch stroke	Weight of one sensor switch
			CS5T□*, CS11T□ ZC130□, ZC153□
¼ (6)	1.94 (55)	0.53 (15)	0.71 (20)

*Indicate desired length of lead wires:
A – 39 in. (nom.) 1000mm (actual)
B – 118 in. (nom.) 3000mm (actual)
C – 196 in. (nom.) 5000mm (actual)

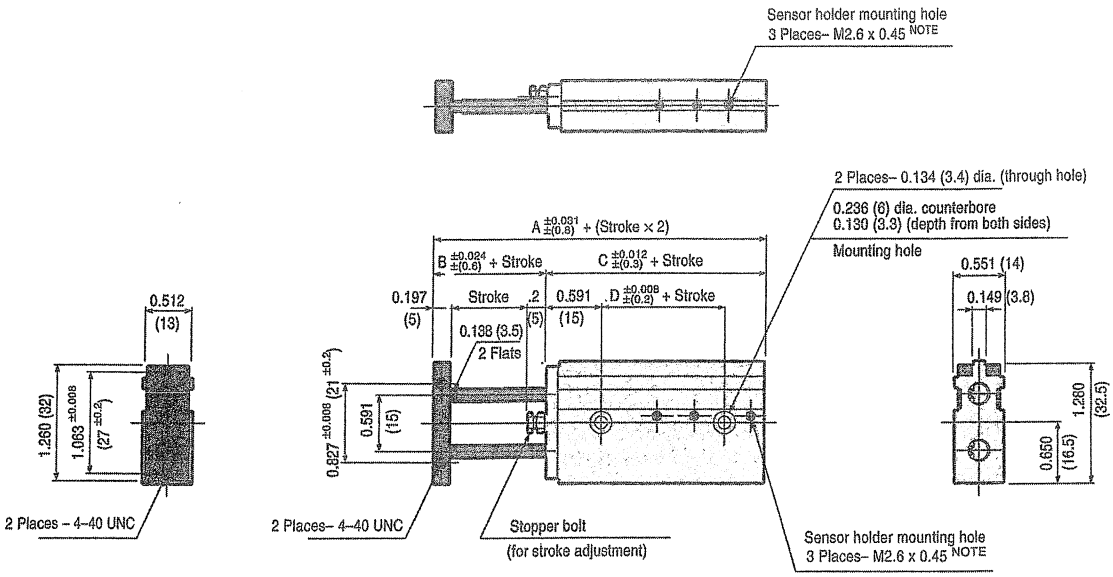
NOTE: Weight shown is for A-type lead length.

Calculation example: The weight of a ¼-inch bore cylinder with a 1½-inch stroke, together with two CS5TA sensor switches is:

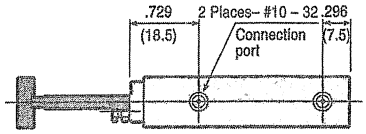
1.94 + (0.53 x 3) + (0.71 x 2) = 4.95 (140.33)

(3: ½-inch stroke x 3)

DIMENSIONS inch (mm)

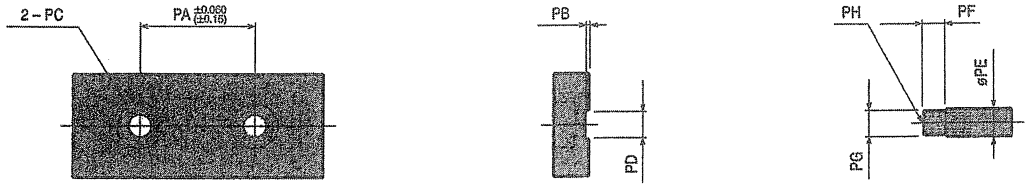


NOTE: ½ inch stroke models have two M2.6 × 0.45 holes.



Bore in. (nom.) (mm) (actual)	Letter			
	A	B	C	D
¼ (6)	1.929 (49)	0.394 (10)	1.535 (39)	0.512 (13)

ROD END DIMENSIONS

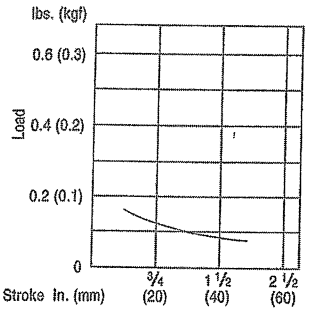


Bore in. (nom.) (mm) (actual)	Letter							
	PA	PB	PC thru hole x c'bore x depth	PD	PE	PF	PG	PH
¼ (6)	0.591 (15)	0.020 (0.5)	0.118 (3) x 0.236 (6) x 0.126 (3.2)	0.138 +0.060 +0.001 (3.5 +0.15 +0.15)	0.157 (4)	0.118 (3)	0.138 +0.059 −0.059 (3.5 −0 −0.15)	M2.6x0.45, 0.197 (5) deep

HANDLING AND CAUTIONS FOR 1/4-INCH BORE (6mm) DOUBLE ACTING CYLINDERS

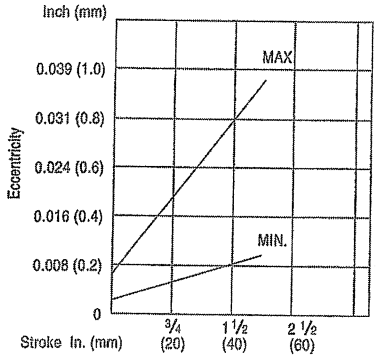
ALLOWABLE LATERAL LOAD

Lateral load on the rod bearing should be less than that indicated in the accompanying chart.



ALLOWABLE ECCENTRICITY

Eccentricity of the rod square plate, without load, is allowable within the following range.



MOUNTING

1. Mount cylinders in any direction; however, mounting surface must be flat. If bending or twisting of the cylinder occurs during mounting, cylinder cycle life may be diminished, the cylinder may leak, or improper operation may occur.

2. Do not damage the mounting surface, as this may affect surface flatness.

3. Washers are used with the hex bolts on the cylinder rod square plate. Make sure bolts are tight before using the cylinder.

STROKE ADJUSTMENT

The stroke of the piston rod can be adjusted within a range of –0.196 to 0 inches (–5 to 0mm). To adjust stroke, turn stopper bolt counterclockwise to obtain new stroke length. After adjustment has been made, re-tighten the locknut. Do not overtighten.

CYLINDER SPEED

Cylinders should not be operated faster than 20 inches per second (500mm/s). When operating cylinders rapidly, prevent direct shock by installing an external stroke limiting device.

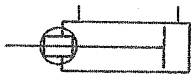
SENSOR SWITCH

1. Standard cylinders have magnets for operation of sensor switches.

2. If multiple cylinders with sensor switches are installed in close proximity, it is possible that the switches will operate sporadically. Consult factory.

TWIN ROD CYLINDERS – DOUBLE ACTING

3/8 (10) to 1 1/4 (32) bore



SPECIFICATIONS

Item	Bore size inch (nom.) / mm (actual)				
	3/8 (10)	5/8 (16)	3/4 (20)	1 (25)	1 1/4 (32)
Type	Double acting				
Medium	Air				
Mounting	Side mount				
Pressure range psig (kgf/cm²)	21~100 (1.5~7)	14~100 (1~7)			
Proof pressure psig (kgf/cm²)	143 (10.5)				
Temperature range °F (°C)	32~140 (0~60)				
Piston speed range in./s (mm/s)	4~20 (100~500)				
Bumper	None	Buna			
Lubrication	*None required				
Allowable eccentricity	± 0.4°	± 0.3°			
Stroke adjustment range in. (mm)	–0.197 to 0 (–5 to 0) per specific stroke				
Port size	#10-32				1/8

*If lubrication is used, apply a non-dtergent 10W oil (ISO VG32), or equivalent.

BORE SIZE AND STROKE

Bore size inch (nom.) / mm (actual	Standard stroke (in.)	Maximum stroke (in.)	Stroke adjustment range ("pull" side)
3/8 (10)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3	5	–0.197 to 0" (–5 to 0mm)
5/8 (16)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	6	
3/4 (20)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	7	
1 (25)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	7	
1 1/4 (32)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	7	

NOTE: 1. Consult factory when using two sensor switches on cylinders with 1/2" stroke.
2. Consult factory for non-standard strokes.

SEAL REPAIR KITS

SRK–HTBDA–10
Bore Size

ORDER EXAMPLE

Cylinders — Sensor Switches (order separately)

HTBDA | **16 X 1 1/2** | | | |

HTBDA
B Series
Twinrod Cylinders
Double acting type

16 X 1 1/2
Cylinder bore size
X
Stroke

Sensor Switch model

Lead wire length
A : 1000mm
B : 3000mm

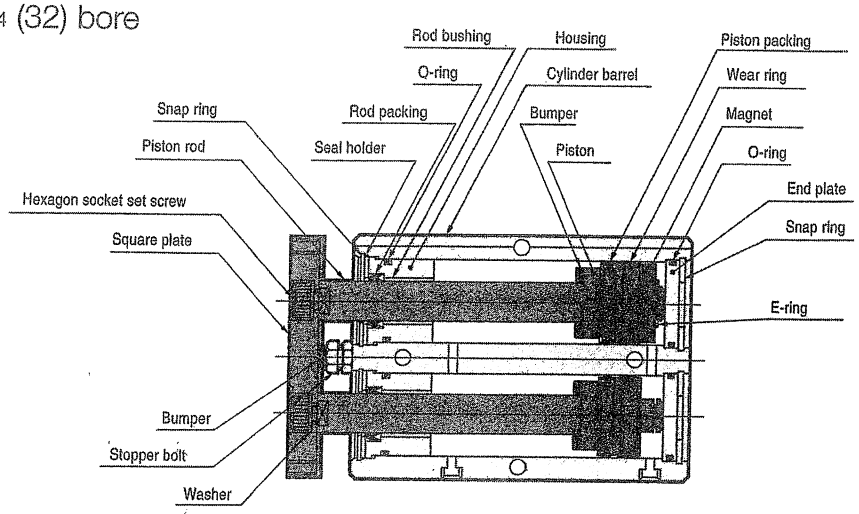
Number of sensor switch
1 : With one sensor switch
2 : With two sensor switches

ZE135 - Two lead wires, Hall effect type with indicator	DC10~28V	Horizontal lead wire type
ZE235 - Two lead wires, Hall effect type with indicator	DC10~28V	Vertical lead wire type
ZE155 - Three lead wires, Hall effect type with indicator	DC4.5~28V	Horizontal lead wire type
ZE255 - Three lead wires, Hall effect type with indicator	DC4.5~28V	Vertical lead wire type
ZE101 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Horizontal lead wire type
ZE201 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Vertical lead wire type
ZE102 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Horizontal lead wire type
ZE202 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Vertical lead wire type

Note: In the double acting long bushing type, the magnet for the sensor switch is built-in.

TWIN ROD CYLINDERS – DOUBLE ACTING

3/8 (10) to 1 1/4 (32) bore



MAJOR PARTS AND MATERIALS OF CONSTRUCTION

Item	Material
Cylinder barrel	Anodized aluminum
Piston	Anodized aluminum
Wear ring	Resin
Piston rod	Hard steel, hard chrome plated
O-ring	Buna
Seal holder	Mild steel, nickel plated
Housing	Anodized aluminum
End plate	Anodized aluminum
Rod bushing	Oil permeated bronze
Seal	Buna
Snap ring	Hard steel, nickel plated
Magnet	Resinous magnet
E-ring	Stainless steel
Washer	Hard steel, black galvanized
Square plate	Mild steel, black galvanized
Bumper*	Buna
Stopper bolt	Mild steel, galvanized

*10mm bore models are not equipped with a bumper.

WEIGHT

oz. (gf)

Bore size Inch (nom.)/mm (actual)	Additional weight			
	Zero stroke weight	Added weight per 1/2-inch stroke	Weight of sensor	
			ZE□□□A	ZE□□□B
3/8 (10)	3.53 (100)	0.81 (22.96)	0.53 (15)	1.23 (35)
5/8 (16)	7.27 (206)	1.21 (34.30)		
3/4 (20)	12.06 (342)	1.61 (45.63)		
1 (25)	18.34 (520)	2.29 (64.92)		
1 1/4 (32)	43.38 (1230)	3.94 (111.70)		

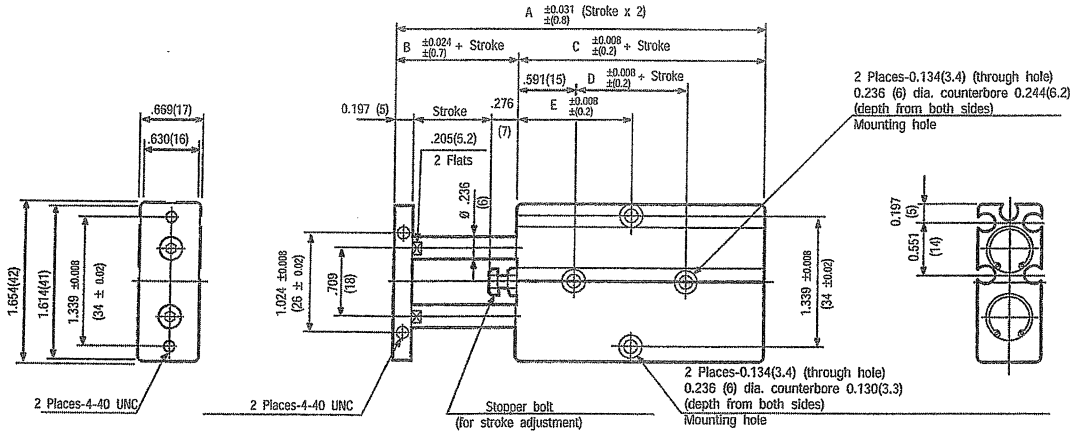
Calculation example: The weight of a 3/4-inch bore cylinder with a 1 1/2-inch storke, together with two CS3H sensor switches is:

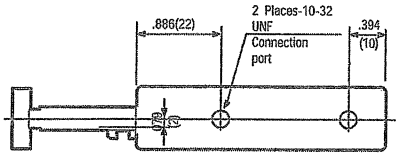
11.82 + (1.61 x 3) + (1.06 x 2) = 18.77 oz. (532.12) gf.

(1.61 x 3): 1/2-inch stroke x 3

DIMENSIONS/DOUBLE-ACTING TYPE inch (mm)

3/8 (10) bore

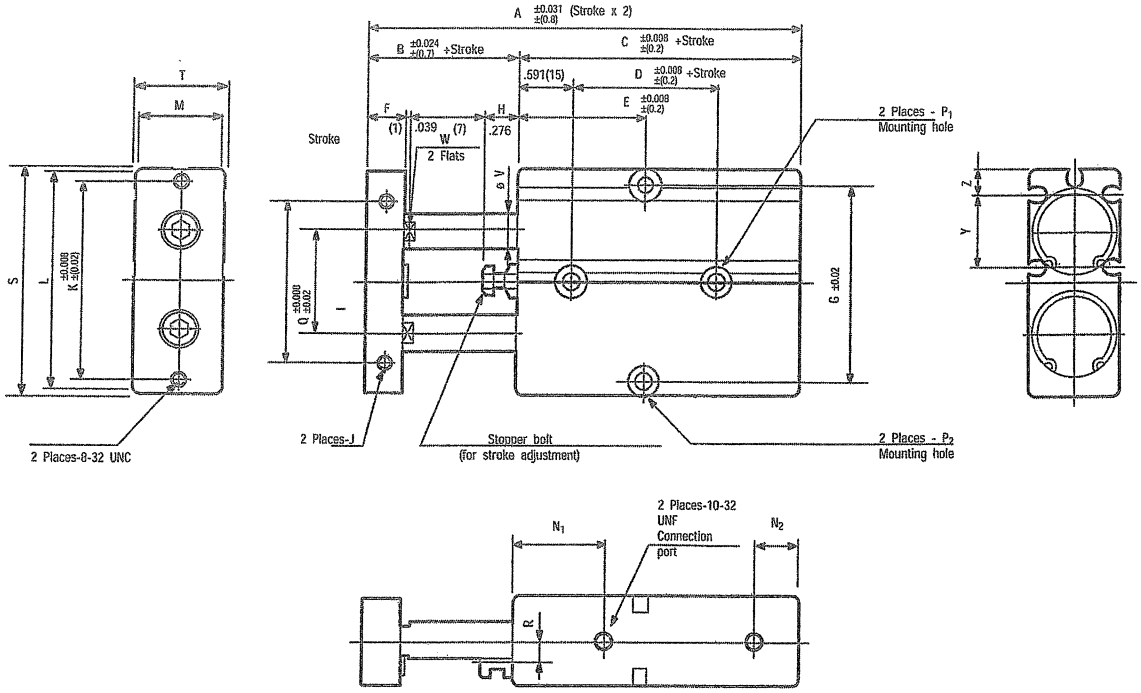




Bore in. (nom.) (mm) (actual)	Letter										
	A	B	C	D	E						
					Stroke						
					1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"
3/8 (10)	2.283 (58)	0.472 (12)	1.811 (46)	0.394 (10)	1.181 (30)	1.181 (30)	1.287 (32.70)	1.537 (39.05)	1.787 (45.40)	2.037 (51.75)	2.287 (58.10)

DIMENSIONS/DOUBLE-ACTING TYPE inch (mm)

5/8 (16) ~1 (25) bore



Bore in. (nom.) (mm) (actual)	Letter									
	A	B	C	D	E					
					Stroke					
					1/2"	3/4"	1"	1 1/2"	2"	2 1/2"
5/8 (16)	2.677 (68)	0.591 (15)	2.087 (53)	0.788 (20)	1.234 (31.35)	1.359 (34.53)	1.484 (37.70)	1.734 (44.05)	1.984 (50.40)	2.234 (56.75)
3/4 (20)	3.070 (78)	0.788 (20)	2.283 (58)	0.788 (20)	1.378 (35)	1.378 (35)	1.484 (37.70)	1.734 (44.05)	1.984 (50.40)	2.234 (56.75)
1 (25)	3.189 (81)	0.748 (19)	2.441 (62)	1.181 (30)	1.575 (40)	1.575 (40)	1.681 (42.70)	1.931 (49.05)	2.181 (55.40)	2.431 (61.75)

Bore in. (nom.) (mm) (actual)	Letter									
	E		F	G	H	I	J	K	L	M
	Stroke									
	3"	3 1/2"	4"							
5/8 (16)	2.484 (63.10)	2.734 (69.45)	2.984 (75.80)	0.315 (8)	1.850 (47)	0.236 (6)	0.945 (24)	8-32 UNC x 0.197 deep	1.850 (47)	2.087 (53)	0.787 (20)
3/4 (20)	2.484 (63.10)	2.734 (69.45)	2.984 (75.80)	0.394 (10)	2.165 (55)	0.354 (9)	1.102 (28)	8-32 UNC x 0.197 deep	2.165 (55)	2.402 (61)	0.945 (24)
1 (25)	2.681 (68.10)	2.931 (74.45)	3.181 (80.80)	0.394 (10)	2.598 (66)	0.315 (8)	1.339 (34)	10-32 UNF x 0.236 deep	2.598 (66)	2.835 (72)	1.142 (29)

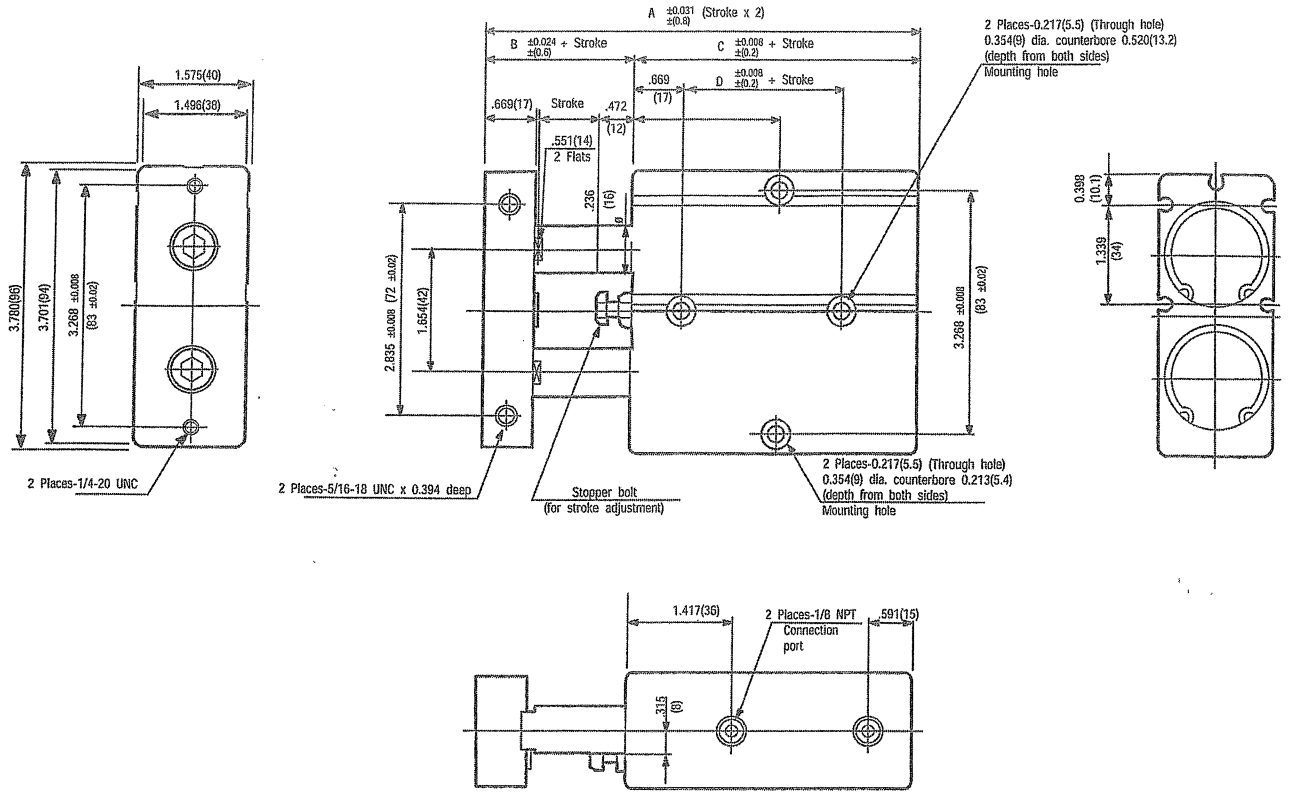
Bore in. (nom.) (mm) (actual)	Letter								
	N1	N2	P1 NOTE thru hole x c'bore x depth (from both sides)	P2 thru hole x c'bore x depth (from both sides)	Q	R	S	T	V	W
5/8 (16)	0.866 (22)	0.394 (10)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	1.340 (34)	0.157 (4)	2.130 (54)	0.830 (21)	0.315 (8)	0.244 (6.2)
3/4 (20)	0.984 (25)	0.472 (12)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	1.732 (44)	0.236 (6)	2.441 (62)	0.984 (25)	0.394 (10)	0.323 (8.2)
1 (25)	1.181 (30)	0.472 (12)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	2.205 (56)	0.276 (7)	2.874 (73)	1.181 (30)	0.472 (12)	0.402 (10.2)

NOTE: Counterbore is measured from outermost surface of cylinder.

Bore in (nom.) (mm) (actual)	Y	Z
5/8 (16)	0.728 (18.5)	0.224 (5.7)
3/4 (20)	0.788 (20)	.268 (6.8)
1 (25)	0.889 (22.5)	.327 (8.3)

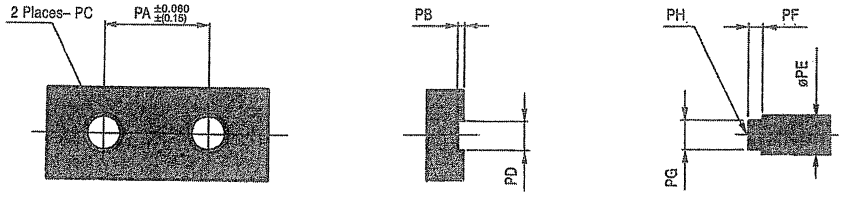
DIMENSIONS/DOUBLE-ACTING TYPE inch (mm)

1¼ (32) bore



Bore in. (nom.) (mm) (actual)	Letter										
	A	B	C	D	E						
					Stroke						
					½"	¾"	1"	1½"	2"	2½"	3"	3½"	4"
1¼ (32)	4.252 (108)	1.181 (30)	3.071 (78)	1.378 (35)	1.825 (46.35)	1.950 (49.53)	2.075 (52.70)	2.325 (59.05)	2.575 (65.40)	2.825 (71.75)	3.075 (78.10)	3.325 (84.45)	3.575 (90.80)

ROD END DIMENSIONS



Bore in. (nom.) (mm) (actual)	Letter							
	PA	PB	PC thru hole x c'bore x depth	PD	PE	PF	PG	PH
⅜ (10)	0.709 (18)	0.020 (0.5)	0.130 (3.3) x 0.244 (6.2) x 0.138 (3.5)	$0.205^{+0.004}_{0}$ ($5.2^{+0.1}_{0}$)	0.236 (6)	0.118 (3)	$0.205^{-0.002}_{-0.006}$ ($5.2^{-0.05}_{-0.15}$)	M3x0.5, 0.197 (5) deep
⅝ (16)	0.945 (24)	0.039 (1)	0.169 (4.3) x 0.307 (7.8) x 0.181 (4.6)	$0.244^{+0.004}_{0}$ ($6.2^{+0.1}_{0}$)	0.315 (8)	0.118 (3)	$0.244^{-0.002}_{-0.006}$ ($6.2^{-0.05}_{-0.15}$)	M4x0.7, 0.236 (6) deep
¾ (20)	1.102 (28)	0.039 (1)	0.256 (6.5) x 0.433 (11) x 0.268 (6.8)	$0.323^{+0.004}_{0}$ ($8.2^{+0.1}_{0}$)	0.394 (10)	0.118 (3)	$0.323^{-0.002}_{-0.006}$ ($8.2^{-0.05}_{-0.15}$)	M6x1, 0.315 (8) deep
1 (25)	1.339 (34)	0.039 (1)	0.256 (6.5) x 0.433 (11) x 0.268 (6.8)	$0.402^{+0.004}_{0}$ ($10.2^{+0.1}_{0}$)	0.472 (12)	0.118 (3)	$0.402^{-0.002}_{-0.006}$ ($10.2^{-0.05}_{-0.15}$)	M6x1, 0.315 (8) deep
1¼ (32)	1.654 (42)	0.079 (2)	0.417 (10.6) x 0.670 (17) x 0.472 (12)	$0.551^{+0.008}_{0}$ ($14^{+0.2}_{-0.03}$)	0.630 (16)	0.157 (4)	$0.551^{0}_{-0.008}$ ($14^{+0}_{-0.2}$)	M10x1.5, 0.551 (14) deep

TWIN ROD CYLINDERS
DOUBLE ACTING, LONG BUSHING TYPE

SYMBOL

- Has more than twice the bushing length of the standard double acting type (Model HTBDA).
- Provides additional rod support for extended cycle life.

SPECIFICATIONS

Item	Bore size inch (nom.) / mm (actual)				
	3/8 (10)	5/8 (16)	3/4 (20)	1 (25)	1 1/4 (32)
Type	Double acting				
Medium	Air				
Mounting	Side Mount				
Pressure range psig (kgf/cm²)	28~100 (2~7)	21~100 (1.5~7)			
Proof pressure psig (kgf/cm²)	143 (10.5)				
Temperature range °F (°C)	32~141 (0~60)				
Piston speed range in./s (mm/s)	4~20 (100~500)				
Bumper	None	Buna			
Lubrication	*None required				
Allowable eccentricity	± 0.4°	± 0.3°			
Stroke adjustment range in. (mm)	-0.197 to 0 (-5 to 0) per specific stroke				
Port size	#10-32				1/8

*If lubrication is used, apply a non-detergent 10W oil (ISO VG32), or equivalent.

BORE SIZE AND STROKE

Bore size inch (nom.) / mm (actual	Standard stroke (in.)	Maximum stroke (in.)	Stroke adjustment range ("pull" side)
3/8 (10)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3	5	-0.197 to 0" (-5 to 0mm)
5/8 (16)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	6	
3/4 (20)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	7	
1 (25)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	7	
1 1/4 (32)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4	7	

NOTE: 1. Consult factory when using two sensor switches on cylinders with 1/2" stroke.
2. Consult factory for non-standard strokes.

SEAL REPAIR KITS

SRK-HTBDA-10
Bore Size

ORDER EXAMPLE

Cylinders — Sensor Switches (order separately)

HTBDAM | **16 X 1 1/2** | | | |

B Series Twinrod Cylinders Double acting long bushing type

Cylinder bore size X Stroke

Sensor Switch model

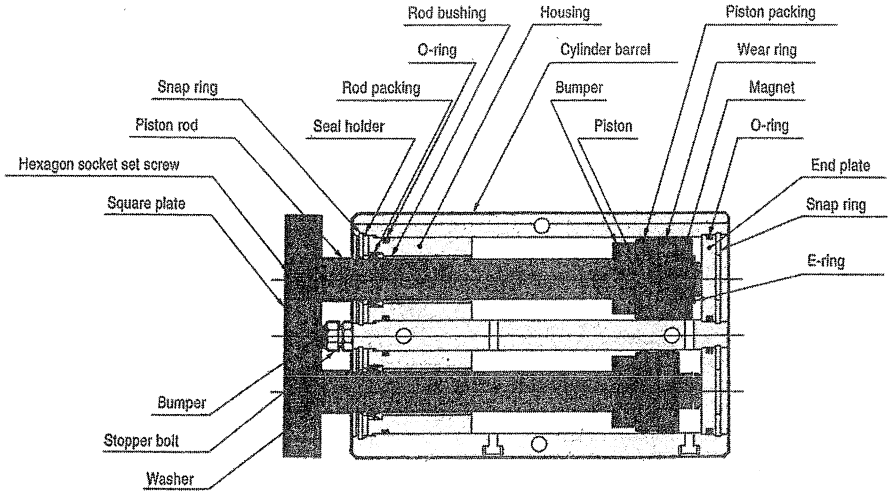
Lead wire length
A : 1000mm
B : 3000mm

Number of sensor switch
1 : With one sensor switch
2 : With two sensor switches

ZE135 - Two lead wires, Hall effect type with indicator (PNP, sourcing)	DC10~28V	Horizontal lead wire type
ZE235 - Two lead wires, Hall effect type with indicator (PNP, sourcing)	DC10~28V	Vertical lead wire type
ZE155 - Three lead wires, Hall effect type with indicator (NPN, sinking)	DC4.5~28V	Horizontal lead wire type
ZE255 - Three lead wires, Hall effect type with indicator (NPN, sinking)	DC4.5~28V	Vertical lead wire type
ZE101 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Horizontal lead wire type
ZE201 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Vertical lead wire type
ZE102 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Horizontal lead wire type
ZE202 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Vertical lead wire type

Note: In the double acting long bushing type, the magnet for the sensor switch is built-in.

INNER CONSTRUCTION AND MAJOR PARTS



MAJOR PARTS AND MATERIALS OF CONSTRUCTION

Item	Material
Cylinder barrel	Anodized aluminum
Piston	Anodized aluminum
Wear ring	Resin
Piston rod	Hard steel, hard chrome plated
O-ring	Buna
Seal holder	Mild steel, nickel plated
Housing	Anodized aluminum
End plate	Anodized aluminum
Rod bushing	Oil permeated bronze
Seal	Buna
Snap ring	Hard steel, nickel plated
Magnet	Resinous magnet
E-ring	Stainless steel
Washer	Hard steel, black galvanized
Square plate	Mild steel, black galvanized
Bumper*	Buna
Stopper bolt	Mild steel, galvanized

*10mm bore models are not equipped with a bumper.

WEIGHT

oz. (gf)

Bore size Inch (nom.)/mm (actual)	Additional weight			
			Weight of sensor	
	Zero stroke weight	Added weight per ½-inch stroke	ZE□□□A	ZE□□□B
⅜ (10)	4.41 (125)	0.81 (22.96)	.053 (15)	1.23 (35)
⅝ (16)	8.61 (244)	1.21 (34.30)		
¾ (20)	13.86 (393)	1.61 (45.64)		
1 (25)	20.99 (595)	2.29 (64.92)		
1¼ (32)	47.76 (1354)	3.94 (111.70)		

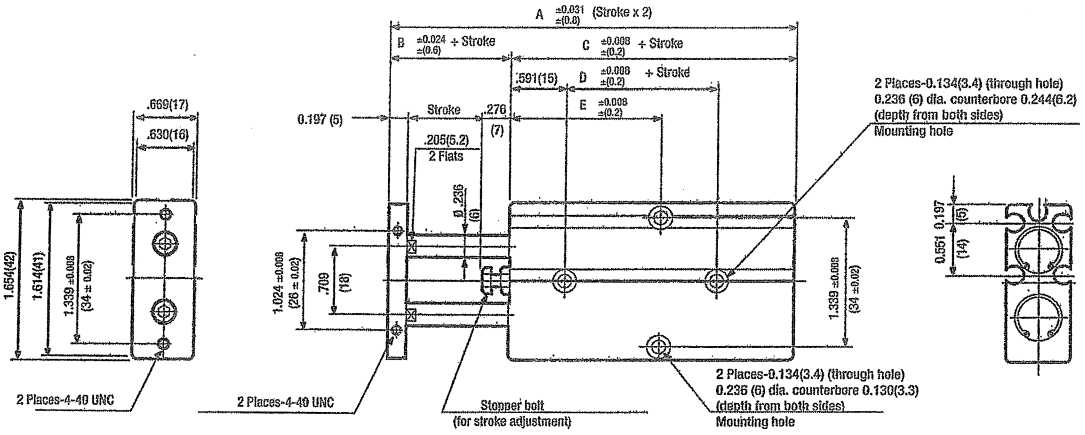
Calculation example: The weight of a ¾-inch bore cylinder with a 1½-inch stroke, together with two CS3H sensor switches is:

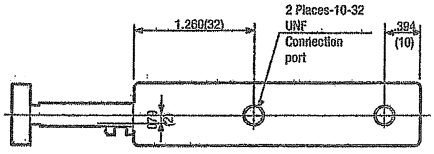
13.69 + (1.61 x 3) + (1.06 x 2) = 20.64 oz. (585.13) gf.

(3 = ½-inch stroke x 3)

DIMENSIONS/DOUBLE-ACTING LONG BUSHING TYPE inch (mm)

3/8 (10) bore

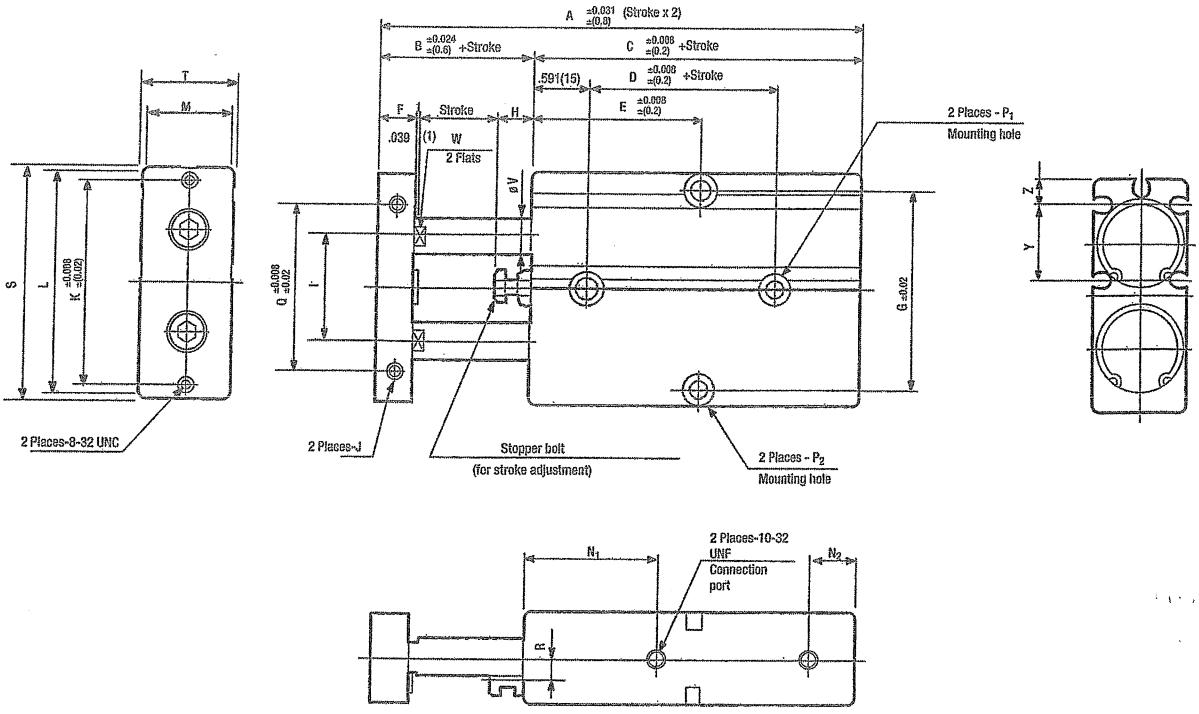




Bore in. (nom.) (mm) (actual)	Letter										
	A	B	C	C	E						
					Stroke						
					1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"
3/8 (10)	2.677 (68)	0.472 (12)	2.205 (56)	0.984 (25)	0.984 (25.00)	1.556 (39.53)	1.681 (42.70)	1.931 (49.05)	2.181 (55.40)	2.431 (61.75)	2.681 (68.10)

DIMENSIONS/DOUBLE-ACTING LONG BUSHING TYPE inch (mm)

5/8 (16) ~ 1 (25) bore



Bore in. (nom.) (mm) (actual)	Letter												
	A	B	C	D	E								
					Stroke								
					1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	3"	3 1/2"	4"
5/8 (16)	3.071 (78)	0.591 (15)	2.480 (63)	1.181 (30)	1.628 (41.35)	1.753 (44.53)	1.878 (47.70)	2.128 (54.05)	2.378 (60.40)	2.628 (66.75)	2.878 (73.10)	3.128 (79.45)	3.378 (85.80)
3/4 (20)	3.465 (88)	0.787 (20)	2.677 (68)	1.181 (30)	1.772 (45.00)	1.772 (45.00)	1.772 (45.00)	1.931 (49.05)	2.181 (55.40)	2.431 (61.75)	2.681 (68.10)	2.931 (74.45)	3.181 (80.80)
1 (25)	3.583 (91)	0.748 (19)	2.835 (72)	1.575 (40)	1.969 (50.00)	1.969 (50.00)	1.969 (50.00)	2.128 (54.05)	2.378 (60.40)	2.628 (66.75)	2.878 (73.10)	3.128 (79.45)	3.378 (85.80)

Bore in. (nom.) (mm) (actual)	Letter									
	F	G	H	I	J	K	L	M	N_1	N_2
5/8 (16)	0.315 (8)	1.850 (47)	0.236 (6)	0.945 (24)	8-32 UNC x 0.197 deep	1.850 (47)	2.087 (53)	0.787 (20)	1.260 (32)	0.394 (10)
3/4 (20)	0.394 (10)	2.165 (55)	0.354 (9)	1.102 (28)	8-32 UNC x 0.197 deep	2.165 (55)	2.402 (61)	0.945 (24)	1.378 (35)	0.472 (12)
1 (25)	0.394 (10)	2.598 (66)	0.315 (8)	1.339 (34)	10-32 UNF x 0.236 deep	2.598 (66)	2.835 (72)	1.142 (29)	1.575 (40)	0.472 (12)

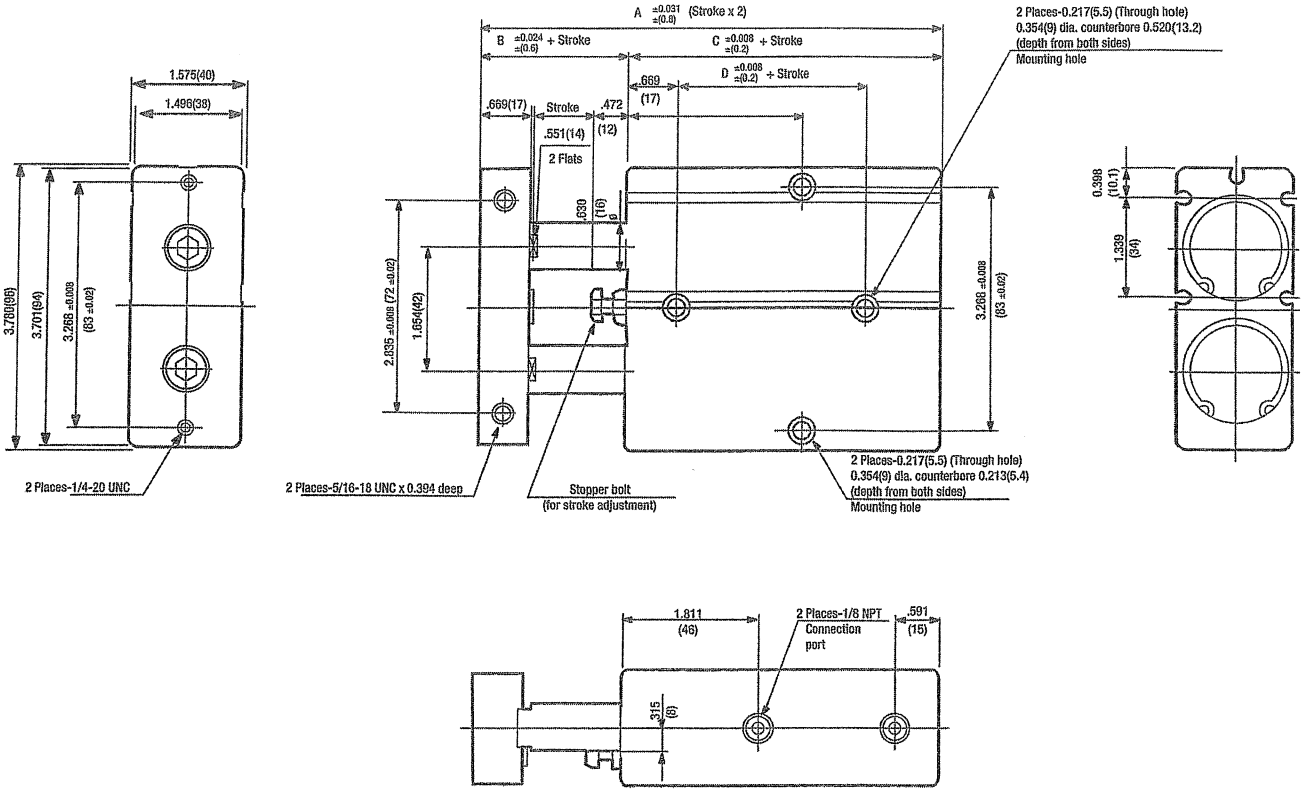
Bore in. (nom.) (mm) (actual)	Letter							
	P_1 NOTE thru hole x c'bore x depth (from both sides)	P_2 thru hole x c'bore x depth (from both sides)	Q	R	S	T	V	W
5/8 (16)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (7.2)	1.340 (34)	0.157 (4)	2.130 (54)	0.830 (21)	0.315 (8)	0.244 (6.2)
3/4 (20)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (7.2)	1.732 (44)	0.236 (6)	2.441 (62)	0.984 (25)	0.394 (10)	0.323 (8.2)
1 (25)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (7.2)	2.205 (56)	0.276 (7)	2.874 (73)	1.181 (30)	0.472 (12)	0.402 (10.2)

NOTE: Counterbore is measured from outermost surface of cylinder.

Bore in (nom.) (mm) (actual)	Y	Z
5/8 (16)	0.728 (18.5)	0.224 (5.7)
3/4 (20)	0.788 (20)	0.268 (6.8)
1 (25)	0.889 (22.5)	0.327 (8.3)

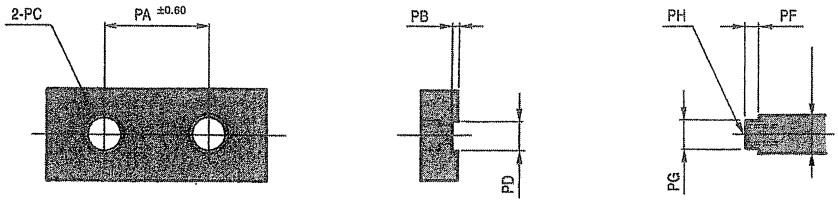
DIMENSIONS/DOUBLE-ACTING LONG BUSHING TYPE inch (mm)

1¼ (32) bore



Bore in. (nom.) (mm) (actual)	Letter									
	A	B	C	D	E					
					Stroke					
					½"	¾"	1"	1½"	2"	2½"	3"	3½"	4"
1¼ (32)	4.646 (118)	1.18 (30)	3.465 (88)	1.772 (45)	2.219 (56.35)	2.344 (59.53)	2.469 (62.70)	2.719 (69.05)	2.969 (75.40)	3.219 (81.75)	3.469 (88.10)	3.719 (94.45)	3.969 (100.8)

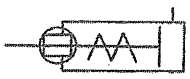
ROD END DIMENSIONS



Bore in. (nom.) (mm) (actual)	Letter							
	PA	PB	PC thru hole x c'bore x depth	PD	PE	PF	PG	PH
⅜ (10)	0.709 (18)	0.020 (0.5)	0.130 (3.3) x 0.244 (6.2) x 0.138 (3.5)	$0.205\ ^{+0.004}_{0}$ $(5.2\ ^{+0.1}_{0})$	0.236 (6)	0.118 (3)	$0.205\ ^{-0.002}_{-0.006}$ $(5.2\ ^{-0.05}_{-0.15})$	M3x0.5, 0.197 (5) deep
⅝ (16)	0.945 (24)	0.039 (1)	0.169 (4.3) x 0.307 (7.8) x 0.181 (4.6)	$0.244\ ^{+0.004}_{0}$ $(6.2\ ^{+0.1}_{0})$	0.315 (8)	0.118 (3)	$0.244\ ^{-0.002}_{-0.006}$ $(6.2\ ^{-0.05}_{-0.15})$	M4x0.7, 0.236 (6) deep
¾ (20)	1.102 (28)	0.039 (1)	0.256 (6.5) x 0.433 (11) x 0.268 (6.8)	$0.323\ ^{+0.004}_{0}$ $(8.2\ ^{+0.1}_{0})$	0.394 (10)	0.118 (3)	$0.323\ ^{-0.002}_{-0.006}$ $(8.2\ ^{-0.05}_{-0.15})$	M6x1, 0.315 (8) deep
1 (25)	1.339 (34)	0.039 (1)	0.256 (6.5) x 0.433 (11) x 0.268 (6.8)	$0.402\ ^{+0.004}_{0}$ $(10.2\ ^{+0.1}_{0})$	0.472 (12)	0.118 (3)	$0.402\ ^{-0.002}_{-0.006}$ $(10.2\ ^{-0.05}_{-0.15})$	M6x1, 0.315 (8) deep
1¼ (32)	1.654 (42)	0.079 (2)	0.417 (10.6) x 0.670 (17) x 0.472 (12)	$0.551\ ^{+0.008}_{0}$ $(14\ ^{+0.2}_{0.03})$	0.630 (16)	0.157 (4)	$0.551\ ^{0}_{-0.008}$ $(14\ ^{+0}_{-0.2})$	M10x1.5, 0.551 (14) deep

TWIN ROD CYLINDERS
SINGLE ACTING, PUSH TYPE

SYMBOL



SPECIFICATIONS

Item	Bore size inch (nom.) / mm (actual)			
	3/8 (10)	5/8 (16)	3/4 (20)	1 (25)
Type	Single acting, push type			
Medium	Air			
Mounting	Side Mount			
Pressure range psig (kgf/cm²)	35–100 (2.5~7)	28~100 (2~7)		
Proof pressure psig (kgf/cm²)	143 (10.5)			
Temperature range °F (°C)	32~141 (0~60)			
Piston speed range in./s (mm/s)	4~20 (100~500)			
Bumper	None	Buna		
Lubrication	*None required			
Allowable eccentricity	± 0.4°	± 0.3°		
Stroke adjustment range in. (mm)	–0.197 to 0 (–5 to 0) per specific stroke			
Port size	#10-32			

*If lubrication is used, apply a non-detergent 10W oil (ISO VG32), or equivalent.

BORE SIZE AND STROKE

Bore size inch (nom.) / mm (actual	Standard stroke (in.)	Maximum stroke (in.)	Stroke adjustment range ("pull" side)
3/8 (10)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2	2 1/2	–0.197 to 0" (–5 to 0mm)
5/8 (16)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2	2 1/2	
3/4 (20)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2	2 1/2	
1 (25)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2	2 1/2	

SEAL REPAIR KITS

SRK-HTBDA-10
Bore Size

ORDER EXAMPLE

Cylinders — Sensor Switches (order separately)

HTBSA | **16 X 1 1/2** | | | |

B Series
Twinrod Cylinders
Single acting push type

Cylinder bore size
X
Stroke

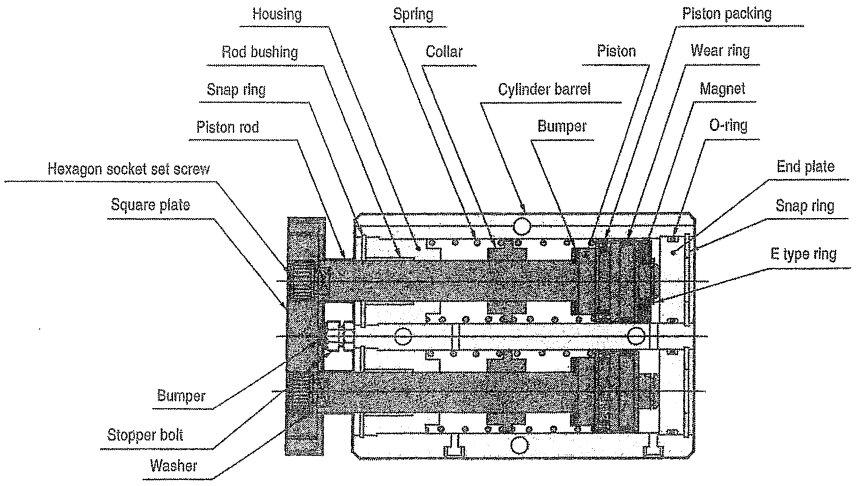
Lead wire length
A : 1000mm
B : 3000mm

Number of sensor switch
1 : With one sensor switch
2 : With two sensor switches

Sensor Switch model

ZE135 - Two lead wires, Hall effect type with indicator (PNP, sourcing)	DC10~28V	Horizontal lead wire type
ZE235 - Two lead wires, Hall effect type with indicator (PNP, sourcing)	DC10~28V	Vertical lead wire type
ZE155 - Three lead wires, Hall effect type with indicator (NPN, sinking)	DC4.5~28V	Horizontal lead wire type
ZE255 - Three lead wires, Hall effect type with indicator (NPN, sinking)	DC4.5~28V	Vertical lead wire type
ZE101 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Horizontal lead wire type
ZE201 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Vertical lead wire type
ZE102 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Horizontal lead wire type
ZE202 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Vertical lead wire type

INNER CONSTRUCTION AND MAJOR PARTS



MAJOR PARTS AND MATERIALS OF CONSTRUCTION

Item	Material
Cylinder barrel	Anodized aluminum
Piston	Anodized aluminum
Wear ring	Resin
Piston rod	Hard steel, hard chrome plated
O-ring	Buna
Seal holder	Mild steel, nickel plated
Housing	Anodized aluminum
End plate	Anodized aluminum
Rod bushing	Oil permeated bronze
Seal	Buna
Snap ring	Hard steel, nickel plated
Magnet	Resinous magnet
E-ring	Stainless steel
Washer	Hard steel, black galvanized
Square plate	Mild steel, black galvanized
Bumper*	Buna
Stopper bolt	Mild steel, galvanized

*10mm bore models are not equipped with a bumper.

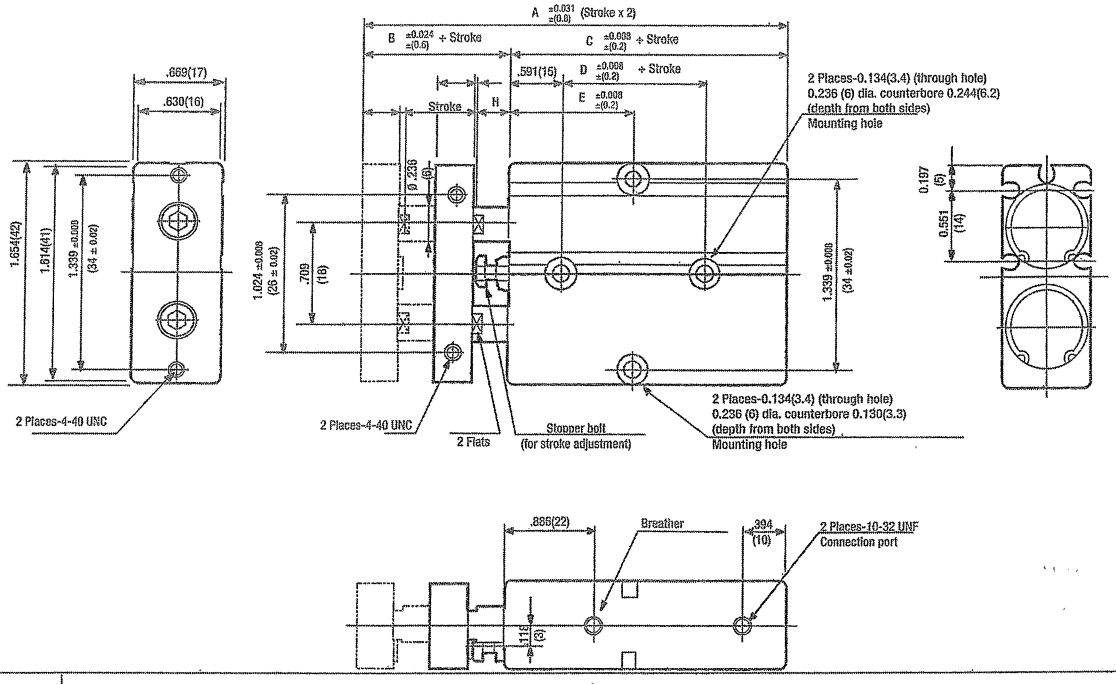
WEIGHT

oz. (gf)

Bore size In. (nom.) mm (actual)	Stroke (in.)							
	1/2	3/4	1	1 1/2	2	2 1/2	ZE□□□A	ZE□□□B
3/8 (10)	4.34 (123)	4.80 (136)	5.22 (148)	6.84 (194)	7.83 (222)	8.64 (245)	0.53 (15)	1.23 (35)
5/8 (16)	8.64 (245)	9.42 (267)	9.98 (283)	12.35 (350)	13.58 (385)	14.79 (419)		
3/4 (20)	13.72 (389)	14.57 (413)	15.34 (435)	18.87 (535)	20.49 (581)	22.08 (626)		
1 (25)	20.92 (593)	22.01 (624)	23.07 (654)	27.86 (654)	30.37 (861)	32.84 (931)		

DIMENSIONS/SINGLE-ACTING PUSH TYPE inch (mm)

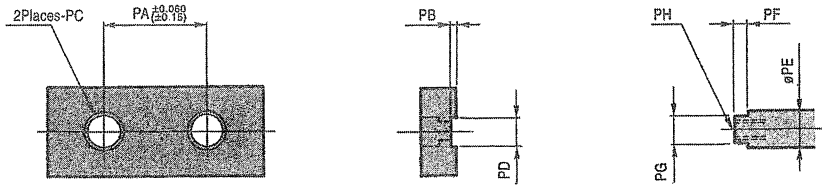
3/8 (10) bore



Bore in. (nom.) (mm) (actual)	Letter							
	A		B		C		D	
	Stroke							
	1/2" to 1"	1 1/2" to 2 1/2"	1/2" to 1"	1 1/2" to 2 1/2"	1/2" to 1"	1 1/2" to 2 1/2"	1/2" to 1"	1 1/2" to 2 1/2"
3/8 (10)	2.283 (58)	2.705 (68.7)	0.472 (12)	0.394 (10)	1.811 (46)	2.311 (58.7)	0.394 (10)	0.894 (22.7)

Bore in. (nom.) (mm) (actual)	Letter							
	E						H	
	Stroke							
	1/2"	3/4"	1"	1 1/2"	2"	2 1/2"	1/2" to 1"	1 1/2" to 2 1/2"
3/8 (10)	1.181 (30.00)	1.181 (30.00)	1.287 (32.70)	1.787 (45.40)	2.037 (51.75)	2.287 (58.10)	0.276 (7)	0.197 (5)

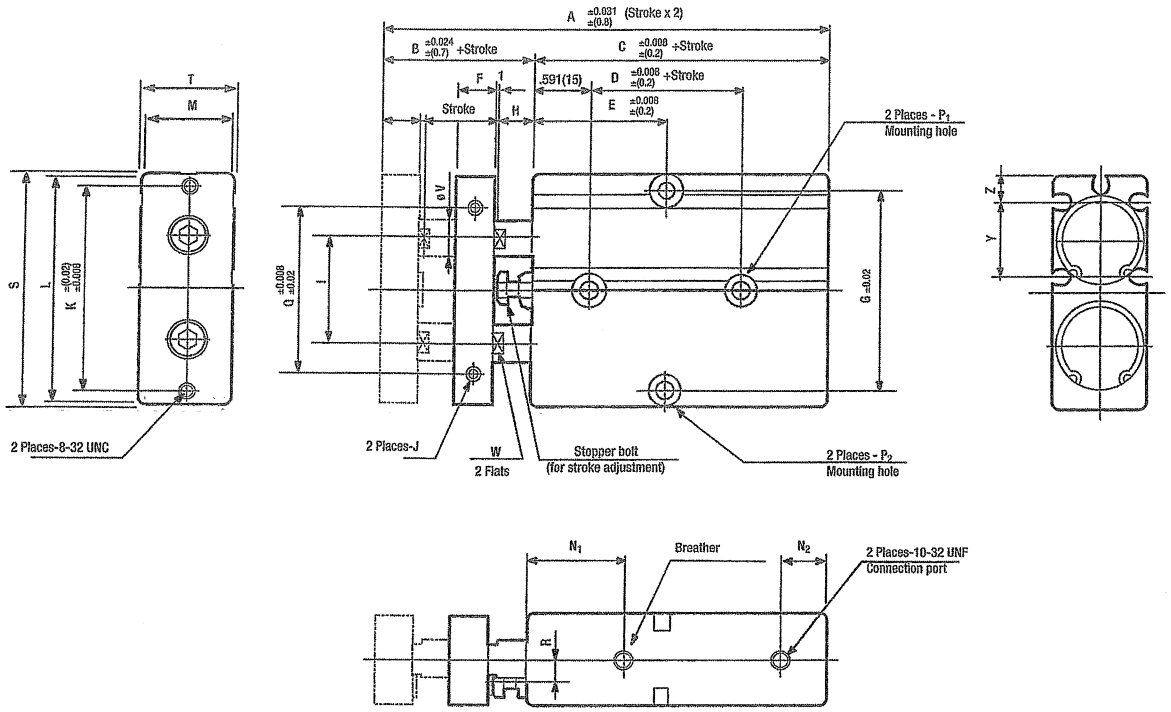
ROD END DIMENSIONS



Bore in. (nom.) (mm) (actual)	Letter							
	PA	PB	PC thru hole x c'bore x depth	PD	PE	PF	PG	PH
3/8 (10)	0.709 (18)	0.020 (0.5)	0.130 (3.3) x 0.244 (6.2) x 0.138 (3.5)	$0.205^{+0.004}_{0}$ $(5.2^{+0.1}_{0})$	0.236 (6)	0.118 (3)	$0.205^{-0.002}_{-0.006}$ $(5.2^{-0.05}_{-0.15})$	M3x0.5, 0.197 (5) deep
5/8 (16)	0.945 (24)	0.039 (1)	0.169 (4.3) x 0.307 (7.8) x 0.181 (4.6)	$0.244^{+0.004}_{0}$ $(6.2^{+0.1}_{0})$	0.315 (8)	0.118 (3)	$0.244^{-0.002}_{-0.006}$ $(6.2^{-0.05}_{-0.15})$	M4x0.7, 0.236 (6) deep
3/4 (20)	1.102 (28)	0.039 (1)	0.256 (6.5) x 0.433 (11) x 0.268 (6.8)	$0.323^{+0.004}_{0}$ $(8.2^{+0.1}_{0})$	0.394 (10)	0.118 (3)	$0.323^{-0.002}_{-0.006}$ $(8.2^{-0.05}_{-0.15})$	M6x1, 0.315 (8) deep
1 (25)	1.339 (34)	0.039 (1)	0.256 (6.5) x 0.433 (11) x 0.268 (6.8)	$0.402^{+0.004}_{0}$ $(10.2^{+0.1}_{0})$	0.472 (12)	0.118 (3)	$0.402^{-0.002}_{-0.006}$ $(10.2^{-0.05}_{-0.15})$	M6x1, 0.315 (8) deep

DIMENSIONS/SINGLE-ACTING PUSH TYPE inch (mm)

5/8 (16) ~ 1 (25) bore



Bore in. (nom.) (mm) (actual)	Letter												
	A		B	C		D		E					
	Stroke			Stroke				Stroke					
	½" to 1"	1½" to 2½"		½" to 1"	1½" to 2½"	½" to 1"	1½" to 2½"	½"	¾"	1"	1½"	2"	2½"
5/8 (16)	2.677 (68)	3.177 (80.7)	0.591 (15)	2.087 (53)	2.587 (65.7)	0.787 (20)	1.287 (32.7)	1.234 (31.35)	1.359 (34.53)	1.484 (37.70)	1.984 (50.40)	2.234 (56.75)	2.484 (63.10)
3/4 (20)	3.071 (78)	3.571 (90.7)	0.787 (20)	2.283 (58)	2.783 (70.7)	0.787 (20)	1.287 (32.7)	1.378 (35.00)	1.378 (35.00)	1.484 (37.70)	1.984 (50.40)	2.234 (56.75)	2.484 (63.10)
1 (25)	3.189 (81)	3.689 (93.7)	0.748 (19)	2.441 (62)	2.941 (74.7)	1.181 (30)	1.681 (42.7)	1.575 (40.00)	1.575 (40.00)	1.681 (42.70)	2.181 (55.40)	2.431 (61.75)	2.681 (68.10)

Bore in. (nom.) (mm) (actual)	Letter									
	F	G	H	I	J	K	L	M	N1	N2
5/8 (16)	0.315 (8)	1.850 (47)	0.236 (6)	0.945 (24)	8-32 UNC x 0.197 deep	1.850 (47)	2.087 (53)	0.787 (20)	0.866 (22)	0.394 (10)
3/4 (20)	0.394 (10)	2.165 (55)	0.354 (9)	1.102 (28)	8-32 UNC x 0.197 deep	2.165 (55)	2.402 (61)	0.945 (24)	0.984 (25)	0.472 (12)
1 (25)	0.394 (10)	2.598 (66)	0.315 (8)	1.339 (34)	10-32 UNF x 0.236 deep	2.598 (66)	2.853 (72)	1.142 (29)	1.181 (30)	0.472 (12)

Bore in. (nom.) (mm) (actual)	Letter						
	P1 NOTE thru hole x c'bore x depth (from both sides)	P2 thru hole x c'bore x depth (from both sides)	Q	R	S	T	V	W
5/8 (16)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (7.2)	1.340 (34)	0.157 (4)	2.130 (54)	0.830 (21)	0.315 (8)	0.244 (6.2)
3/4 (20)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (7.2)	1.732 (44)	0.236 (6)	2.441 (62)	0.984 (25)	0.394 (10)	0.323 (8.2)
1 (25)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (7.2)	2.205 (56)	0.276 (7)	2.874 (73)	1.181 (30)	0.472 (12)	0.402 (10.2)

NOTE: Counterbore is measured from outermost surface of cylinder.

Bore in (nom.) (mm) (actual)	Y	Z
5/8 (16)	0.728 (18.5)	0.224 (5.7)
3/4 (20)	0.788 (20)	0.268 (6.8)
1 (25)	0.889 (22.5)	0.327 (8.3)

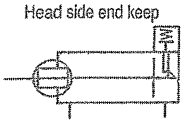
TWIN ROD END KEEP CYLINDERS

DOUBLE ACTING

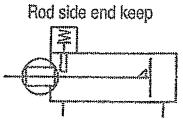
- End Keep Cylinders lock piston rods in the event of pressure loss or failure.
- "HL" models keep the piston rods in the fully retracted position.
- "RL" models keep the piston rods in the fully extended position.
- Piston rods remain locked until pressure is restored or until manual override is applied. This special feature prevents unintended actuation, helps prevent injury to personnel and damage to the cylinder and to adjacent equipment.

NOTE: End Keep function does not operate when cylinders are in mid-position.

Head side end keep



Rod side end keep



SPECIFICATIONS

Item	Bore size inch (nom.) / mm (actual)		
	5/8 (16)	3/4 (20)	1 (25)
Type	Double acting		
Medium	Air		
Mounting	Side mount		
Pressure range psig (kgf/cm²)	21~100 (1.5~7)		
Temperature range °F (°C)	32~140 (0~60)		
Piston speed range in./s (mm/s)	20 (500)		
Bumper	Buna		
Lubrication	*None required		
Allowable eccentricity	±0.3°		
Stroke adjustment range in. (mm)	-HL fixed stopper bolt -RL 0.197 to 0 (-5 to 0)		
Max. retaining force (at end keep) lb. (kgf)	5/8 (16) 21.6 (9.8)	3/4 (20) 33.0 (15.4)	1 (25) 52.9 (24)
Backlash (at end keep) in. (mm)	0.039 (1) max.		
Port size	#10-32 UNF		

*If lubrication is used, apply Class 1 turbine oil (ISO VG32), or equivalent.

BORE SIZE AND STROKE

Bore size inch (nom.) / mm (actual)	Standard stroke (in.)	Pull side stroke adjustment	
		-HL	-RL
5/8 (16)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3	–	-0.197 to 0" (-5 to 0mm)
3/4 (20)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3		
1 (25)	1/2, 3/4, 1, 1 1/2, 2, 2 1/2, 3		

NOTE: Consult factory when using two sensor switches on cylinders with 1/2" stroke.

SEAL REPAIR KITS

SRK-HTBDA-16
Bore Size

ORDER EXAMPLE

Cylinders — Sensor Switches (order separately)

HTBDAK | 16 X 1 1/2 | HL | | | |

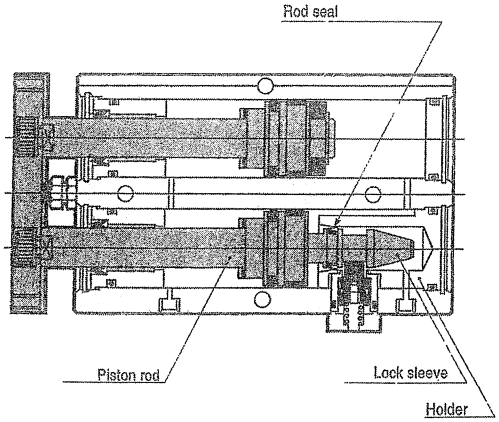
- HTBDAK: B Series End Keep Twin Rod Cylinders
- 16 X 1 1/2: Cylinder bore size X Stroke
- HL: End keep position — HL : Head side end keep; RL : Rod side end keep
- Sensor Switch model
- Lead wire length — A : 1000mm; B : 3000mm
- Number of sensor switch — 1 : With one sensor switch; 2 : With two sensor switches

Sensor Switch model		
ZE135 - Two lead wires, Hall effect type with indicator (PNP, sourcing)	DC10~28V	Horizontal lead wire type
ZE235 - Two lead wires, Hall effect type with indicator (PNP, sourcing)	DC10~28V	Vertical lead wire type
ZE155 - Three lead wires, Hall effect type with indicator (NPN, sinking)	DC4.5~28V	Horizontal lead wire type
ZE255 - Three lead wires, Hall effect type with indicator (NPN, sinking)	DC4.5~28V	Vertical lead wire type
ZE101 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Horizontal lead wire type
ZE201 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Vertical lead wire type
ZE102 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Horizontal lead wire type
ZE202 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Vertical lead wire type

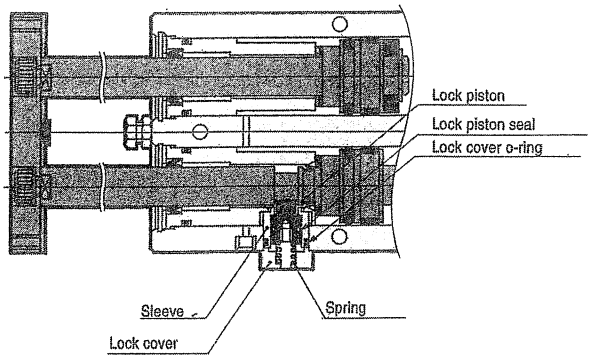
Note: In the end keep cylinder, the magnet for the sensor switch is built-in.

TWIN ROD LOCKING CYLINDERS

-HL – Locks in retracted position



-RL – Locks in extended position



MAJOR PARTS AND MATERIALS OF CONSTRUCTION

Item		Material
Piston rod	-HL	Hard steel (chrome plated)
	-RL	Hard steel (heat treated chrome plate)
Lock sleeve (-HL only)		Hard steel (heat treated)
Holder (-HL only)		Anodized aluminum
Lock piston		Hard steel (heat treated)
Sleeve		Anodized aluminum
Spring		Stainless steel
Lock cover		Anodized aluminum
Lock piston seal		Buna
Rod seal		Buna
Lock cover O-ring		Buna

WEIGHT

oz. (gf)

Bore size inch (nom.) / mm (actual)		Additional weight			
		Zero stroke weight	Added weight per 1/2-inch stroke	Weight of sensor ZE□□□A	Weight of sensor ZE□□□B
5/8 (16)	-HL	8.22 (233)	1.57 (44.51)	0.53 (15)	1.23 (35)
	-RL	9.10 (258)	1.48 (41.96)		
3/4 (20)	-HL	12.87 (365)	2.24 (63.50)		
	-RL	13.54 (3.84)	2.19 (62.09)		
1 (25)	-HL	22.33 (633)	2.33 (66.05)		
	-RL	23.32 (661)	2.29 (64.92)		

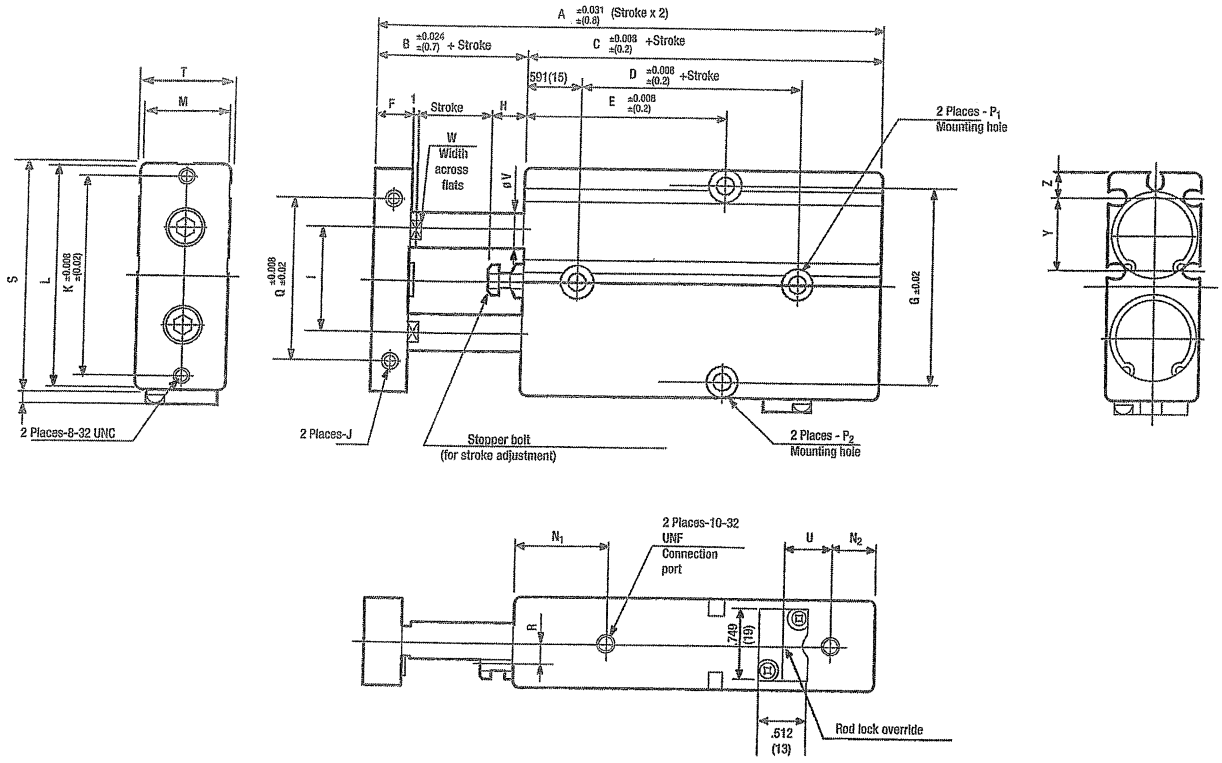
Calculation example: The weight of a 3/4-inch bore "-HL" type cylinder with a 1 1/2-inch stroke, together with two CS3H sensor switches is:

11.11+ (2.24 x 3) + (1.06 x 2) = 19.95 oz. (565.57) gf.

3 = 1/2-inch stroke x 3

DIMENSIONS/-HL – LOCKS IN RETRACTED POSITION inch (mm)

5/8 (16) ~ 1 (25) bore



Bore in. (nom.) (mm) (actual)	Letter									
	A	B	C	D	E					
					Stroke					
					1/2"	1"	1 1/2"	2"	2 1/2"	3"
5/8 (16)	3.677 (93.4)	0.591 (15)	3.087 (78.4)	1.787 (45.4)	1.734 (44.05)	1.984 (50.4)	2.234 (56.75)	2.484 (63.10)	2.734 (69.45)	2.984 (75.80)
3/4 (20)	4.071 (103.4)	0.787 (20)	3.283 (83.4)	1.787 (45.4)	1.734 (44.05)	1.984 (50.4)	2.234 (56.75)	2.484 (63.10)	2.734 (69.45)	2.984 (75.80)
1 (25)	4.189 (106.4)	0.748 (19)	3.441 (87.4)	2.181 (55.4)	1.931 (49.05)	2.181 (55.4)	2.431 (61.75)	2.681 (68.10)	2.931 (74.45)	3.181 (80.80)

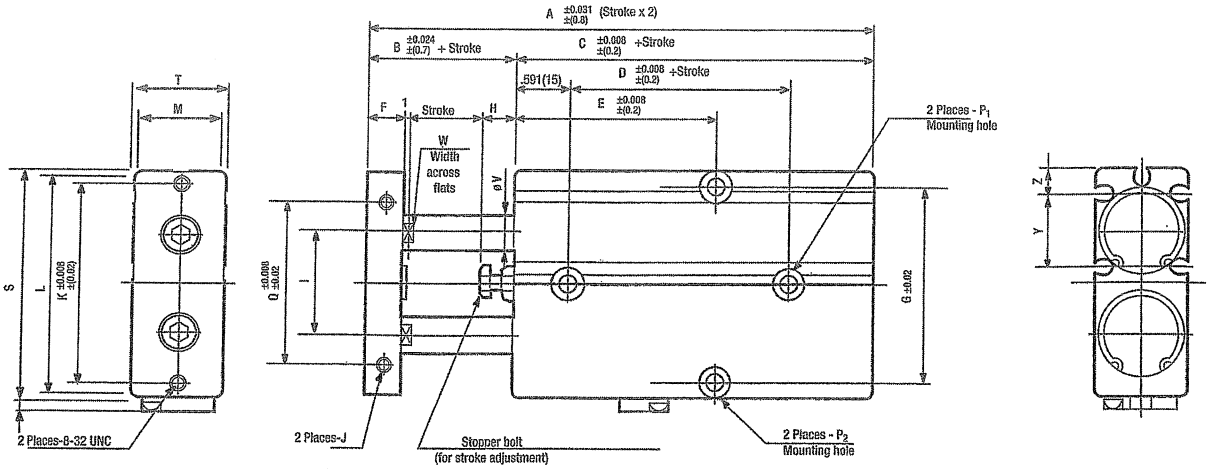
Bore in. (nom.) (mm) (actual)	Letter									
	F	G	H	I	J	K	L	M	N_1	N_2
5/8 (16)	0.315 (8)	1.850 (47)	0.236 (6)	0.945 (24)	8-32 UNC x 0.197 deep	1.850 (47)	2.087 (53)	0.787 (20)	0.866 (22)	0.394 (10)
3/4 (20)	0.394 (10)	2.165 (55)	0.354 (9)	1.102 (28)	8-32 UNC x 0.197 deep	2.165 (55)	2.402 (61)	0.945 (24)	0.984 (25)	0.472 (12)
1 (25)	0.394 (10)	2.598 (66)	0.315 (8)	1.339 (34)	10-32 UNF x 0.236 deep	2.598 (66)	2.835 (72)	1.142 (29)	1.181 (30)	0.472 (12)

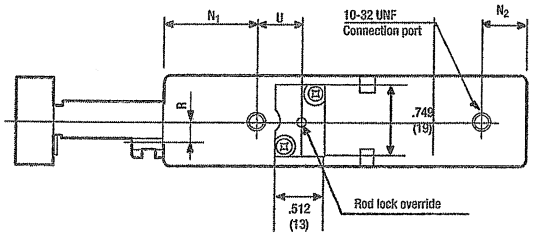
Bore in. (nom.) (mm) (actual)	Letter							
	P_1 NOTE thru hole x c'bore x depth (from both sides)	P_2 thru hole x c'bore x depth (from both sides)	Q	R	S	T	V	W
5/8 (16)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	1.340 (34)	0.157 (4)	2.130 (54)	0.830 (21)	0.315 (8)	0.244 (6.2)
3/4 (20)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	1.732 (44)	0.236 (6)	2.441 (62)	0.984 (25)	0.394 (10)	0.323 (8.2)
1 (25)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	2.205 (56)	0.276 (7)	2.874 (73)	1.181 (30)	0.472 (12)	0.402 (10.2)

NOTE: Counterbore is measured from outermost surface of cylinder.

Bore in (nom.) (mm) (actual)	Y	Z
5/8 (16)	0.728 (18.5)	0.224 (5.7)
3/4 (20)	0.788 (20)	0.268 (6.8)
1 (25)	0.889 (22.5)	0.327 (8.3)

DIMENSIONS/-HL – LOCKS IN EXTENDED POSITION inch (mm)





Bore in. (nom.) (mm) (actual)	Letter									
	A	B	C	D	E					
					Stroke					
					½"	1"	1½"	2"	2½"	3"
⅝ (16)	3.677 (93.4)	0.591 (15)	3.087 (78.4)	3.756 (95.4)	1.984 (50.4)	1.984 (50.4)	2.234 (56.75)	2.484 (63.10)	2.734 (69.45)	2.984 (75.80)
¾ (20)	4.071 (103.4)	0.787 (20)	3.283 (83.4)	1.787 (45.4)	2.047 (52.0)	2.047 (52.0)	2.234 (56.75)	2.484 (63.10)	2.734 (69.45)	2.984 (75.80)
1 (25)	4.189 (106.4)	0.748 (19)	3.441 (87.4)	2.181 (55.4)	2.181 (55.4)	2.181 (55.4)	2.431 (61.75)	2.681 (68.10)	2.931 (74.45)	3.181 (80.80)

Bore in. (nom.) (mm) (actual)	Letter									
	F	G	H	I	J	K	L	M	N_1	N_2
⅝ (16)	0.315 (8)	1.850 (47)	0.236 (6)	0.945 (24)	8-32 UNC x 0.197 deep	1.850 (47)	2.087 (53)	0.787 (20)	0.866 (22)	0.394 (10)
¾ (20)	0.394 (10)	2.165 (55)	0.354 (9)	1.102 (28)	8-32 UNC x 0.197 deep	2.165 (55)	2.402 (61)	0.945 (24)	0.984 (25)	0.472 (12)
1 (25)	0.394 (10)	2.598 (66)	0.315 (8)	1.339 (34)	10-32 UNF x 0.236 deep	2.598 (66)	2.835 (72)	1.142 (29)	1.181 (30)	0.472 (12)

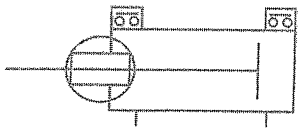
Bore in. (nom.) (mm) (actual)	Letter							
	P_1 NOTE thru hole x c'bore x depth (from both sides)	P_2 thru hole x c'bore x depth (from both sides)	Q	R	S	T	V	W
⅝ (16)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	1.340 (34)	0.157 (4)	2.130 (54)	0.830 (21)	0.315 (8)	0.244 (6.2)
¾ (20)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	1.732 (44)	0.236 (6)	2.441 (62)	0.984 (25)	0.394 (10)	0.323 (8.2)
1 (25)	0.177 (4.5) x 0.295 (7.5) x 0.283 (7.2)	0.177 (4.5) x 0.315 (8) x 0.173 (4.4)	2.205 (56)	0.276 (7)	2.874 (73)	1.181 (30)	0.472 (12)	0.402 (10.2)

NOTE: Counterbore is measured from outermost surface of cylinder.

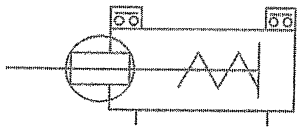
Bore in (nom.) (mm) (actual)	Y	Z
⅝ (16)	0.728 (18.5)	0.224 (5.7)
¾ (20)	0.788 (20)	0.268 (6.8)
1 (25)	0.889 (22.5)	0.327 (8.3)

Symbol

●Double acting type



●Single acting push type



Specifications

●Solid state type

Item \ Model	ZE135	ZE155	ZE235	ZE255
Sensor type	DC 2-wire type	DC 3-wire type	DC 2-wire type	DC 3-wire type
Lead wire direction	Horizontal		Vertical	
Power supply voltage	—	DC4.5~28V	—	DC4.5~28V
Load voltage	DC10~28V	DC4.5~28V	DC10~28V	DC4.5~28V
Load current	4~20mA(at 25°C, 10mA at 60°C)	50mA MAX.	4~20mA(at 25°C, 10mA at 60°C)	50mA MAX.
ON current consumpsion	—	10mA MAX. (DC24V)	—	10mA MAX. (DC24V)
Internal voltage drop note 1	4.5V MAX.	0.5V MAX.(Less than 10V at 20mA)	4.5V MAX.	0.5V MAX.(Less than 10V at 20mA)
Leakage current	1mA MAX. (DC24V、25°C)	50 μA MAX. (DC24V)	1mA MAX. (DC24V、25°C)	50 μA MAX. (DC24V)
Delay time	1ms MAX.			
Insulation resistance	100MΩ MIN. (At DC500V Megger between case and lead wire)			
Dielectric strength	AC500V (50/60Hz) 1min. (between case and lead wire)			
Shock resistance note 2	294m/s² {30.0G} (Non repeated shock)			
Vibration resistance note 2	88.3m/s²(9.0G) Total amplitude 1.5mm, 10~55Hz			
Environmental protection	IP67 IEC standard (JIS C0920)			
Indicator lamp	ON : Red LED			
Lead wire	PCCV insulated cable (2X0.15SQ) Brown/BlueX ℓ note 3	PCCV insulated cable (3X0.15SQ) Brown/Blue/BlackX ℓ note 3	PCCV insulated cable (2X0.15SQ) Brown/BlueX ℓ note 3	PCCV insulated cable (3X0.15SQ) Brown/Blue/BlackX ℓ note 3
Temperature range	32~140°F (0~60°C)			
Storage temperature	14~158°F (-10~70°C)			
Weight	15g (For lead wire length A : 1000mm)、35g (For lead wire length B : 3000mm)			

Note1 : Internal voltage drop depends on load current.
2 : Test procedures are our internal standards.
3 : Lead wire length A : 1000mm B : 3000mm

●Reed switch type

Item \ Model	ZE101		ZE102		ZE201		ZE202	
Sensor type	DC 2-wire type							
Lead wire direction	Horizontal				Vertical			
Load voltage	DC5~28V	AC85~115V (r.m.s)	DC10~28V	AC85~115V (r.m.s)	DC5~28V	AC85~115V (r.m.s)	DC10~28V	AC85~115V (r.m.s)
Load current	40mA MAX.	20mA MAX.	5~40mA	5~20mA	40mA MAX.	20mA MAX.	5~40mA	5~20mA
Internal voltage drop note 1	10mV MAX. (at load current DC40mA)		3.0V MAX.		10mV MAX. (at load current DC40mA)		3.0V MAX.	
Leakage current	0mA							
Delay time	1ms MAX.							
Insulation resistance	100MΩ MIN. (At DC500V Megger between case and lead wire)							
Dielectric strength	AC500V (50/60Hz) 1min. (between case and lead wire)							
Shock resistance note 2	294m/s² {30.0G} (Non repeated shock)							
Vibration resistance note 2	88.3m/s²(9.0G) Total amplitude 1.5mm, 10~55Hz, Resonance frequency 2750±250Hz							
Environmental protection	IP67 IEC standard (JIS C0920)							
Indicator lamp	None		ON : Red LED		None		ON : Red LED	
Lead wire	PCCV insulated cable (2X0.15SQ) Brown/BlueX ℓ note 3							
Temperature range	32~140°F (0~60°C)							
Storage temperature	14~158°F (-10~70°C)							
Sensor switch protection	Required (For more details, refer to page ⑲)							
Weight	15g (For lead wire length A : 1000mm)、35g (For lead wire length B : 3000mm)							

Note1 : Internal voltage drop depends on load current.
2 : Test procedures are our internal standards.
3 : Lead wire length A : 1000mm B : 3000mm

Order Code

ZE135 | A | - HP

Lead wire length
A : 1000mm
B : 3000mm

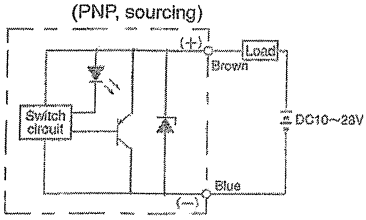
Sensor Switch model

ZE135 - Two lead wires, Hall effect type with indicator	DC10~28V	Horizontal lead wire type	ZE155 - Three lead wires, Hall effect type with indicator	DC4.5~28V	Horizontal lead wire type
ZE235 - Two lead wires, Hall effect type with indicator	DC10~28V	Vertical lead wire type	ZE255 - Three lead wires, Hall effect type with indicator	DC4.5~28V	Vertical lead wire type
ZE101 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Horizontal lead wire type	ZE102 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Horizontal lead wire type
ZE201 - Two lead wires, Reed switch type w/o indicator	DC5~28V AC85~115V	Vertical lead wire type	ZE202 - Two lead wires, Reed switch type with indicator	DC10~28V AC85~115V	Vertical lead wire type

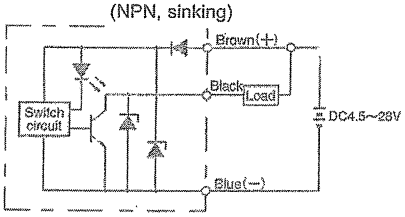
Circuitry

Hall effect type

2-wire type
(PNP, sourcing)



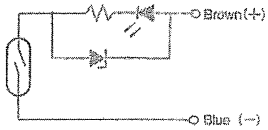
3-wire type
(NPN, sinking)



Reed switch type

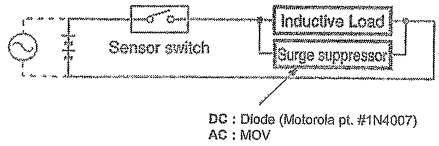
Without indicator

With indicator



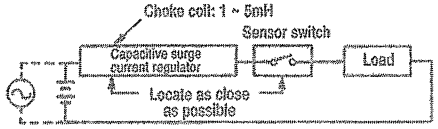
Recommended Protection for Reed Switch Sensors

Use with inductive loads (magnetic relays, etc.)



DC : Diode (Motorola pt. #1N4007)
AC : MOV

Use with long lead wires (>32'/10m) between sensor switch and load

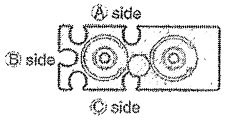


Sensor Switch Operating Range - Response Differential - Maximum Sensing Locations

Operating range : ℓ
The distance the piston (magnet) travels in one direction while the switch is in the ON position.

Response differential : C
The distance between the point where the piston (magnet) turns the switch ON in one direction, and the point where the switch turns OFF as the piston (magnet) travels in the opposite direction.

Mounting surface of the sensor switches



Solid state type

in (mm)

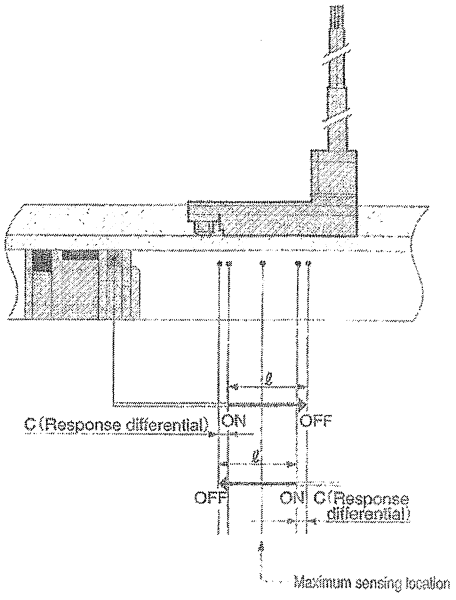
Item	Mounting surface \ Bore size	3/8 (10)	5/8 (16)	3/4 (20)	1 (25)	1 1/4 (32)
Operating range : ℓ	A side, C side	0.098~0.236(2.5~6)			.098~.236(2.5~6.5)	0.197~.472(5~12)
	B side	.098~.157(2.5~4)	0.078~.177(2~4.5)		.098~.217(2.5~5.5)	0.157~0.354(4~9)
Response differential : C	—	Less than .039(1.0)	Less than .047(1.2)		Less than .059(1.5)	Less than .079(2.0)
Maximum sensing location[*1]	—	0.236(6)				

Note : The chart indicates refernce value.

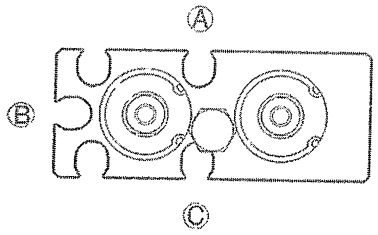
Reed switch type

in (mm)

Mounting surface \ Bore size	3/8 (10)	5/8 (16)	3/4 (20)	1 (25)	1 1/4 (32)
Operating range : ℓ	0.236~0.335(6~8.5)		0.236~0.315(6~8)	0.276~0.374(7~9.5)	0.472~0.650(12~16.5)
Response differential : C	Less than .059(1.5)				Less than .098(2.5)
Maximum sensing location[*1]	0.394(10)				



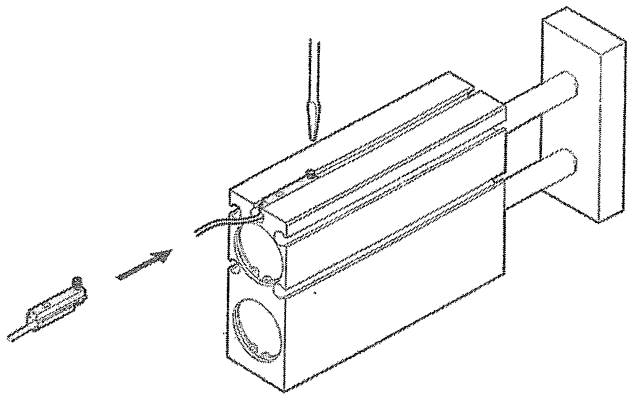
Sensor Switch Mounting Surfaces



Rod side and head side stroke end can be detected when mounting sensor switchs on one or two of the A, B or C sides. Drawing is showing the view from rod side.

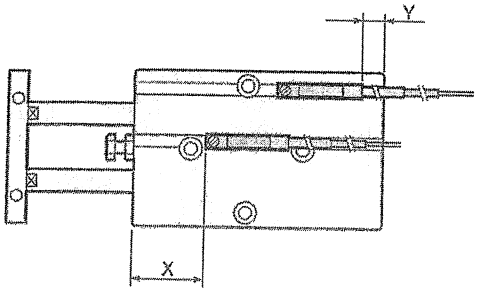
Sensor Switch Mounting

- Loose screw. Slide sensor switch along groove on cylinder body.
- Orient switch to desired location and tighten screw. Maximur torque for tightening screw is 0.1N·m~0.2N·m{1kgf·cm~2kgf·c

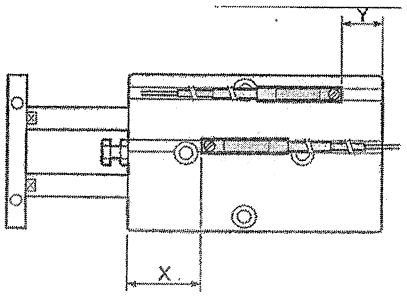


Double acting type

- Direction of the lead wire is toward the head side

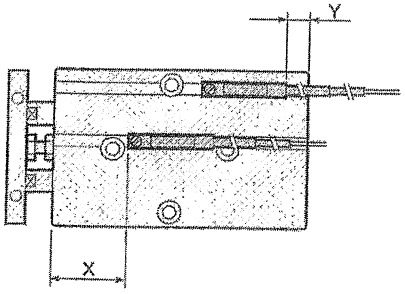


- Direction of the head side switch lead wire only is toward the rod side

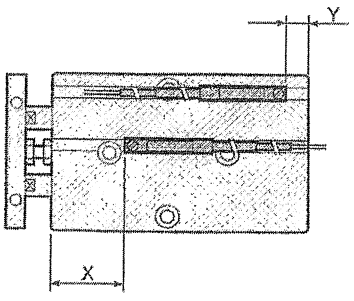


Single acting push type

- Direction of the lead wire is toward the head side

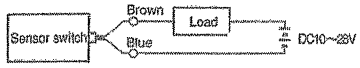


- Direction of the head side switch lead wire only is toward the rod side

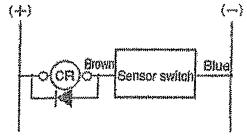


2-wire type

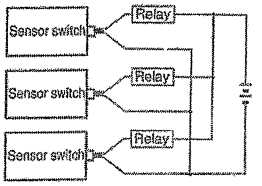
Basic connection

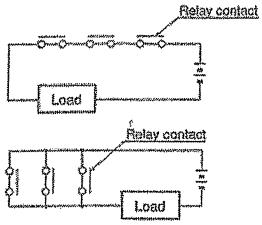


Connection to relay

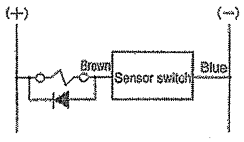


AND connection, OR connection

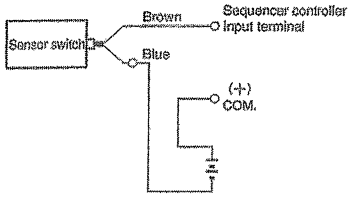




Connection to solenoid

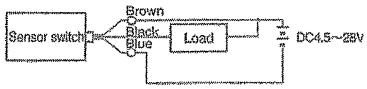


Connection to sequencer

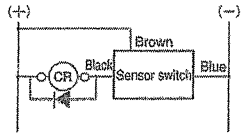


3-wire type

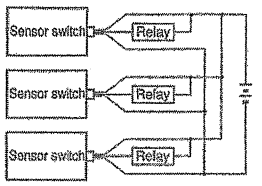
Basic connection

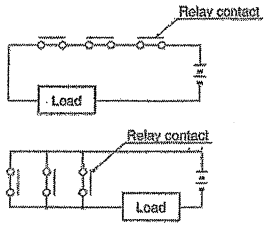


Connection to relay

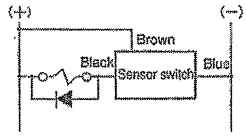


AND connection, OR connection

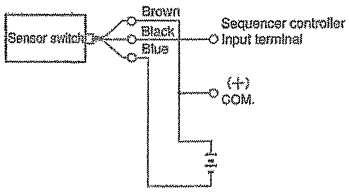




Connection to solenoid

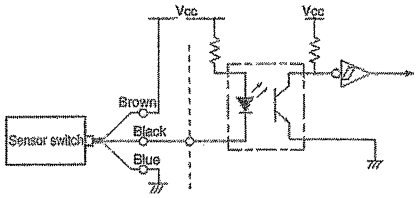


Connection to sequencer

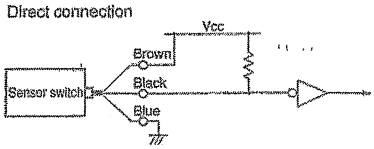


Connection to TTL

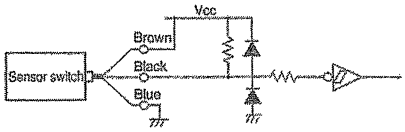
Separate connection



Direct connection



C-MOS connection



Note 1.Follow wire color code for proper connection;other wise switch will malfunction or may be damaged.

2.Solid state 2-wire type sensor switches should not be connected to TTL or C-MOS.

3.Use of a surge protection diode is recommended for inductive loads such as relays.

4.For OR Connection,it is possible to directly connect outputs of sensor switches (for example,two brown wires).But the amount of leakage current will increase proportionally by the number of sensor switches.Therefore,be cautious against load return failure.

5.Avoid using sensor switches in places where other strong magnetic forces are present or near large current such as power lines(switches are actuated by magnetism).

6.Use care with lead wires. Do not pull or bend lead wires excessively.

7.Do not use sensor switches in areas where chemically active agents or gas are present.

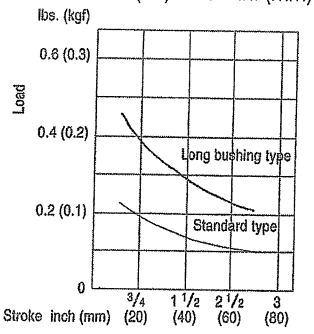
8.Consult us before using sensor switches in oily or wet surroundings.

INSTALLATION

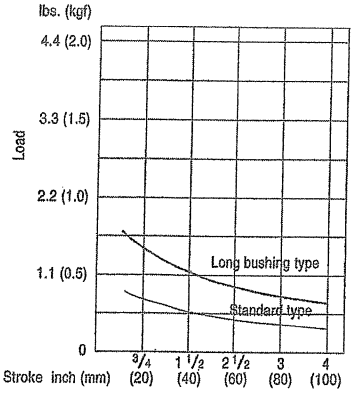
ALLOWABLE LATERAL LOAD

The lateral load for the rod square plate should be below the following curves.

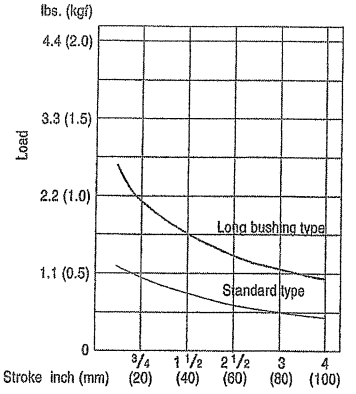
3/8 (10) bore – in. (mm)



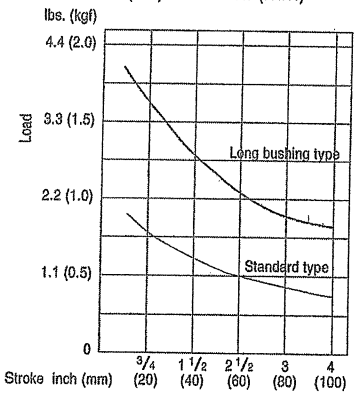
5/8 (16) bore – in. (mm)



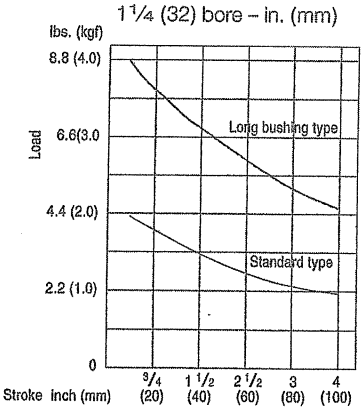
3/4 (20) bore – in. (mm)



1 (25) bore – in. (mm)



1 1/4 (32) bore – in. (mm)

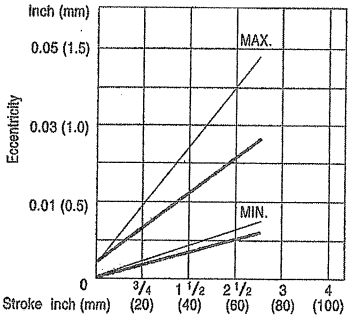


ALLOWABLE ECCENTRICITY

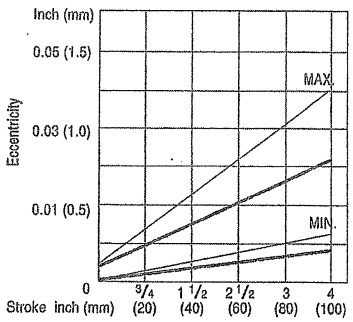
Eccentricity of the rod square plate, without load, is allowable within the following range.

——— Standard type
═══ Long bushing type

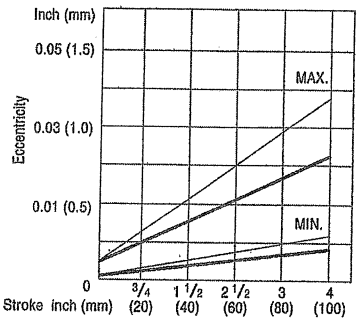
3/8 (10) bore – in. (mm)



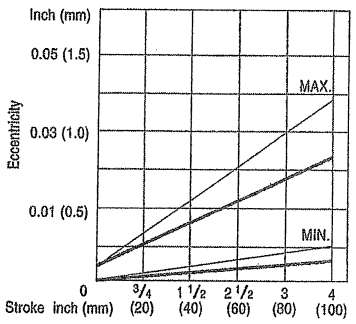
5/8 (16) bore – in. (mm)



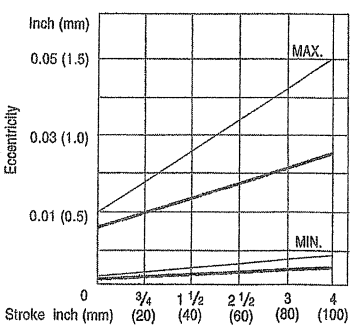
3/4 (20) bore – in. (mm)



1 (25) bore – in. (mm)



1 1/4 (32) bore – in. (mm)



TECHNICAL TIPS & PRECAUTIONS

INSTALLATION AND ADJUSTMENT

INSTALLATION

1. Mount cylinders in any direction; however, the mounting surface must be flat. If there is bending or twisting of the cylinder during mounting, cycle life may be diminished, the cylinder may leak, or it may not operate properly.

2. Ensure that no damage occurs to the mounting surface, as this may adversely affect surface flatness.

3. Cylinder rod square plate hex bolts must be secure before using cylinder.

ADJUSTING CYLINDER STROKE

The stroke of Humphrey Twin Rod Cylinders can be adjusted within a range of –0.197 to 0 inches (–5 to 0mm), except for HTDAK suffix "-HL" models (adjusting the stroke on these cylinders renders the End Keep inoperable).

To adjust stroke, loosen locknut and turn stopper bolt counterclockwise to obtain new stroke length. After adjustment has been made, re-tighten the locknut. Do not overtighten.

TIPS FOR END KEEP CYLINDERS

1. Use of a 2-position, 4- or 5-port valve is recommended. Do not use 3-position valves in which the center position has delivery ports open to exhaust.

2. For controlling cylinder speed, use a meter-out type flow control. The cylinder's locking mechanism may not release if a meter-in type flow control is used.

3. Supply pressure must be at least 22 psig (1.5 kgf/cm^2).

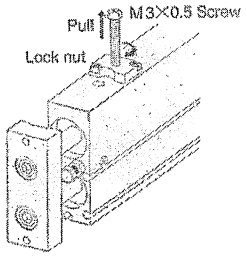
CAUTIONS

1. Do not admit compressed air to the supply port adjacent to the locking mechanism if the opposite supply port has been previously exhausted. This may cause unintended actuation; the piston rod may suddenly extend or retract. This could lead to personal injury, and/or damage the cylinder or adjacent equipment.

2. Before commencing operation of the cylinder after it has been completely exhausted (such as prior to start up, or after an emergency stop), first pressurize the supply port opposite the one nearest the locking mechanism.

MANUAL OPERATION OF LOCKING MECHANISM

1. For manual operation, insert a 4-40 UNC threaded screw into the lock piston opening in the mechanism. Thread the screw into the lock piston about three turns. Pull on the screw to disengage the lock piston. To maintain the manual override, shoulder a 4-40 locknut against the cylinder. This maintains release of the lock piston, and frees-up hands.



CAUTIONS

1. Do not release locking mechanism when a load is present on the piston rods. This may cause unintended operation which could result in injury to personnel, or damage to equipment. When releasing the locking mechanism, be sure that air is supplied to the port opposite the port adjacent to the locking mechanism, then release mechanism.

2. If difficulty is experienced releasing the locking mechanism manually, the cause may be interference between the lock piston and the piston rods. In this case, supply air to the port opposite the one located adjacent to the locking mechanism, and release the lock as described above.

3. If contaminants (water, oil, dirt or other debris) enter the manual override opening, the locking mechanism may not pull out sufficiently to disengage the piston rod. Provide adequate protection to avoid this condition.

Mounting and Stroke Adjustment

Mounting

1. Cylinders can be mounted in any direction; however, mounting surface must be flat. If bending or twisting of the cylinder occurs during mounting, cylinder performance may be interfered with, the cylinder may leak, or improper operation may occur.
2. Do not damage the mounting surface with scratches or dents, as this may affect surface flatness.
3. Washers are used with the hex bolts on the cylinder rod front plate. Make sure bolts are tight before using the cylinder.

Stroke adjustment

The stroke of the twinrod cylinders can be easily adjusted within a range of -5 to 0mm. To adjust stroke, turn stopper bolt counterclockwise to obtain shorter stroke length. After adjustments have been made, re-tighten the lock nut. Do not over tighten past the standard location. It is impossible to adjust stroke past the standard location.

Cylinder speed

Cylinders should not be operated faster than 500mm per second. (It can be adjusted using speed controller.) When operating cylinders rapidly (more than 500mm/s), prevent direct shock by installing an external stroke limiting device such as an external stopper. If an external stopper can not be installed, please contact us.

Sensor Switches

1. Standard cylinders have built-in magnets for the operation of sensor switches. When sensor switches are mounted on cylinders, they become sensor cylinders.
2. Mount the sensor switch in the mounting grooves on the cylinder body by locating the sensor switch screw toward the cylinder piping ports.

General Cautions

Fluid

1. Use compressed air as fluid. Consult us if using any other fluid.
2. Air should be clean, dry, uncontaminated and contain no oil particles. An air filter (filtration ratio of less than 40 microns) should be installed near the cylinder and valves. Periodically remove, drain, clean or replace filter element.
   If dust is present in the cylinder, it may result in malfunction.

Lubrication

No lubrication is required. However, if lubrication is used, apply Class 1 turbine oil (ISO VG32) or equivalent. Do not use spindle oil or machine oil.

Atmosphere

1. When operating in ambient conditions such as excessive dust or exposure to water or oil particles, install appropriate protective devices such as a cover.
2. When media or the atmosphere contains the following substances, it should not be used: organic solvents, phosphoric acid ester-type machine oil, sulfurous acid gas, chlorine gas, or acids.