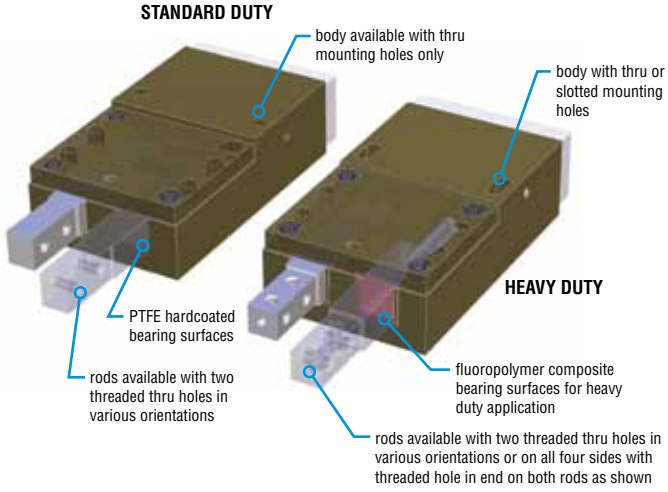
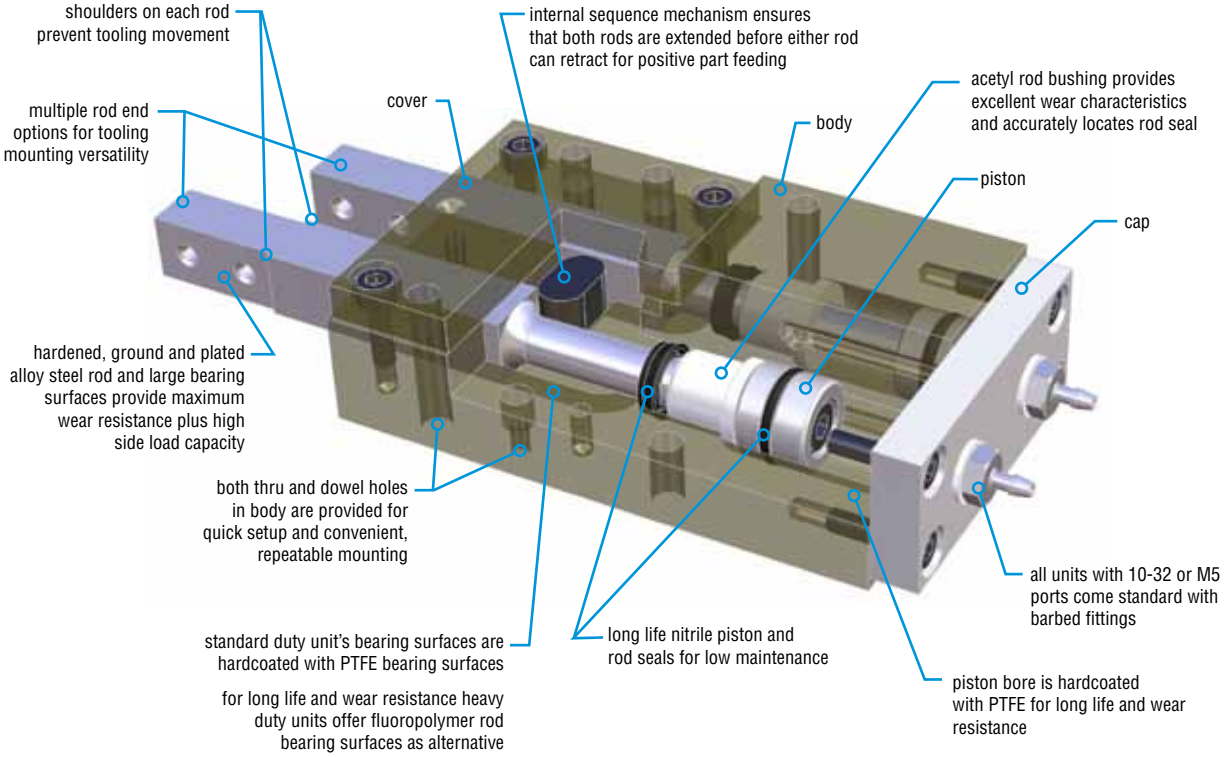
160

DOUBLE ROD PNEUMATIC ESCAPEMENT

Major Benefits

- Ideal for isolating and feeding individual parts from vibrating feeders, magazines, hoppers or conveyors
- Internally ported design requires only one 4-way valve for operation offered in standard and heavy duty
- Switch and flow control options
- Large rod bearing area ensures high side load capacity





ORDERING DATA: SERIES 160 DOUBLE ROD ESCAPEMENTS

STANDARD DUTY

TO ORDER SPECIFY:
Series, Model, Design No., Rod End Option, Cap Option, Switch Ready Option, and Seals.

CAP OPTIONS
0 - Standard Cap
1 - Cap with flow controls and stroke adjustment
2 - Cap with stroke adjustment only
Cap with flow controls and/or stroke adjustments not available on Model 02 or 03.

SEALS
1 - Buna-N
2 - Fluoro-Elastomer

Options may affect unit length. See dimensional pages and option information details.

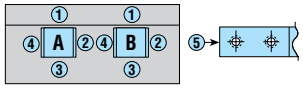
Refer to this product's online catalog in the product section for complete information including related dimensions and additional specifications. See link at bottom of this page.

SERIES	DESIGN NO.						
160	12	-	2	-	1	1	1	2

MODEL
IMPERIAL
02 - 3/8" Bore & Stroke
12 - 1/2" Bore & Stroke
22 - 3/4" Bore & Stroke
42 - 1-1/4" Bore & Stroke
METRIC
03 - 10 mm Bore & Stroke
13 - 12 mm Bore & Stroke
23 - 20 mm Bore & Stroke
43 - 32 mm Bore & Stroke

ROD END OPTIONS
1 - Flats and threaded holes on sides 1 and 3 on both rods
2 - Flats and threaded holes on sides 2 and 4 on both rods
3 - Flats and threaded holes on sides 1 and 3 of rod A, and on sides 2 and 4 of rod B
4 - Flats and threaded holes on sides 2 and 4 of rod A, and on sides 1 and 3 of rod B

ROD END POSITIONS



SWITCH READY OPTIONS
0 - None
1 - Series 5360 Hall Effect Switch Ready (Not available on 16002 & 16003 units.)
2*- 4 mm Round/6 mm Square Inductive Proximity Switch Ready (Available on 16002 & 16003 only.)
Switches and Mounting Kits (as applicable) must be ordered separately.

NOTE: *Customer to provide target for proximity switch sensing on -2 switch ready option.

HEAVY DUTY

TO ORDER SPECIFY:
Series, Model, Design No., Rod End Option, Cap Option, Switch Ready Option, and Seals.

CAP OPTIONS
0 - Standard Cap
1 - Cap with flow controls and stroke adjustment
2 - Cap with stroke adjustment only

SEALS
1 - Buna-N
2 - Fluoro-Elastomer

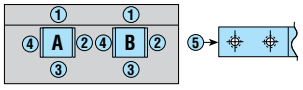
SERIES	DESIGN NO.						
160	10	-	2	-	0	1	1	1

MODEL
IMPERIAL
10 - 1/2" Bore & Stroke with slotted mounting hole
20 - 3/4" Bore & Stroke with slotted mounting hole
14 - 1/2" Bore & Stroke with standard mounting hole
24 - 3/4" Bore & Stroke with standard mounting hole
METRIC
11 - 12 mm Bore & Stroke with slotted mounting hole
21 - 20 mm Bore & Stroke with slotted mounting hole
15 - 12 mm Bore & Stroke with standard mounting hole
25 - 20 mm Bore & Stroke with standard mounting hole

ROD END OPTIONS
0 - Flats and threaded holes on all four sides with a threaded hole in the end on both rods
1 - Flats and threaded holes on sides 1 and 3 on both rods
2 - Flats and threaded holes on sides 2 and 4 on both rods
3 - Flats and threaded holes on sides 1 and 3 of rod A, and on sides 2 and 4 of rod B
4 - Flats and threaded holes on sides 2 and 4 of rod A, and on sides 1 and 3 of rod B

SWITCH READY OPTIONS
0 - None
1 - Series 5360 Hall Effect Switch Ready
Switches must be ordered separately.

ROD END POSITIONS



4 mm SQUARE INDUCTIVE PROXIMITY SWITCHES

PART NO.	DESCRIPTION
18430-001-02	NPN (Sink) 2 meter cable
18430-002-02	PNP (Source) 2 meter cable

6 mm SQUARE INDUCTIVE PROXIMITY SWITCHES

PART NO.	DESCRIPTION
18431-001-02	NPN (Sink) 2 meter cable
18431-002-02	PNP (Source) 2 meter cable

INDUCTIVE SWITCH MOUNTING KITS

PROXIMITY SWITCH	KIT NUMBER
4 mm Round Inductive	57879
6 mm Square Inductive	57880

EACH PROXIMITY SWITCH MOUNTING KIT CONTAINS:
1 SWITCH BRACKET
1 BRACKET MOUNTING SCREW

SERIES 5360 HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
53603-1-02	NPN (Sink) 4.5-24 VDC, 2 meter cable
53604-1-02	PNP (Source) 4.5-24 VDC, 2 meter cable
53623-1	NPN (Sink) 4.5-24 VDC, Quick Connect
53624-1	PNP (Source) 4.5-24 VDC, Quick Connect

SPECIFICATIONS	SERIES 160
OPERATING PRESSURE	30 psi min to 150 psi [2 bar min to 10 bar max] air
OPERATING TEMPERATURE	-20° to +180°F [-28° to +82°C]
VELOCITY	20 in/sec [0.5 m/sec] typical min, zero load at 100 psi [7 bar]
LUBRICATION	5 million cycles
MAINTENANCE	Field repairable

UNIT	DESCRIPTION	BORE in	BORE mm	STROKE MIN	STROKE MAX	ROD DIRECTION	EFFECTIVE AREA in	EFFECTIVE AREA mm	WEIGHT lb	WEIGHT kg
16002/16003	STD DUTY, STD MTG	.375	10	.378	.404	EXTEND	.122	78.5	0.35	.16
						RETRACT	.094	60.5		
16010/16011	HEAVY DUTY, SLOTTED MTG	.500	12	.468	.494	EXTEND	.175	112.6	0.65	.29
16012/16013	STD DUTY, STD MTG					RETRACT	.126	81.1		
16014/16015	HEAVY DUTY, STD MTG									
16020/16021	HEAVY DUTY, SLOTTED MTG	.750	20	.735	.761	EXTEND	.487	313.4	1.56	.71
16022/16023	STD DUTY, STD MTG					RETRACT	.410	263.8		
16024/16025	HEAVY DUTY, STD MTG									
16042/16043	STD DUTY, STD MTG	1.250	32	1.245	1.271	EXTEND	1.247	802.4	6.25	2.8
						RETRACT	1.050	675.6		

CYLINDER THRUST CALCULATION

	IMPERIAL F = P x A	METRIC F = 0.1 x P x A
F = Cylinder Force	lb	N
P = Operating Pressure	psi	bar
A = Effective Area	in^2	mm^2

RESPONSE TIME

$$T = U - \frac{P}{S} + \frac{W}{X}$$

TOTAL CYCLE TIME = 2T + DWELL TIMES

P - Working pressure in psi [bar]
T - Time in seconds to extend one rod and retract the other
W - Total weight applied to rod in pounds [kg]

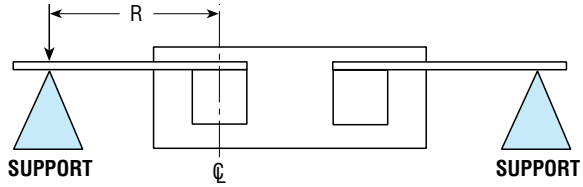
EQUATION	CONSTANT	STANDARD DUTY 1600x	STANDARD DUTY 1601x	STANDARD DUTY 1602x	STANDARD DUTY 1604x	HEAVY DUTY 1601x	HEAVY DUTY 1602x
RESPONSE TIME	U	0.125 [0.125]	0.200 [0.200]	0.250 [0.250]	0.350 [0.350]	0.200 [0.200]	0.250 [0.250]
	S	6500 [448]	1250 [86]	1000 [69]	1000 [69]	1250 [86]	1000 [69]
	X	1500 [580]	750 [340]	500 [227]	900 [408]	750 [340]	500 [227]

MAXIMUM ROD TORQUE

MODEL NO.	STANDARD DUTY in-lb	STANDARD DUTY [Nm]	HEAVY DUTY in-lb	HEAVY DUTY [Nm]
1600x	1.2	[0.14]	—	—
1601x	2.0	[0.25]	2.0	[0.25]
1602x	5.0	[0.6]	5.0	[0.6]
1604x	9.0	[1.1]	—	—

For applications which exceed the maximum allowable rod torque, the tooling should be supported as shown.
Calculation without the support:
Max. Rod Load Torque = (Load) x R

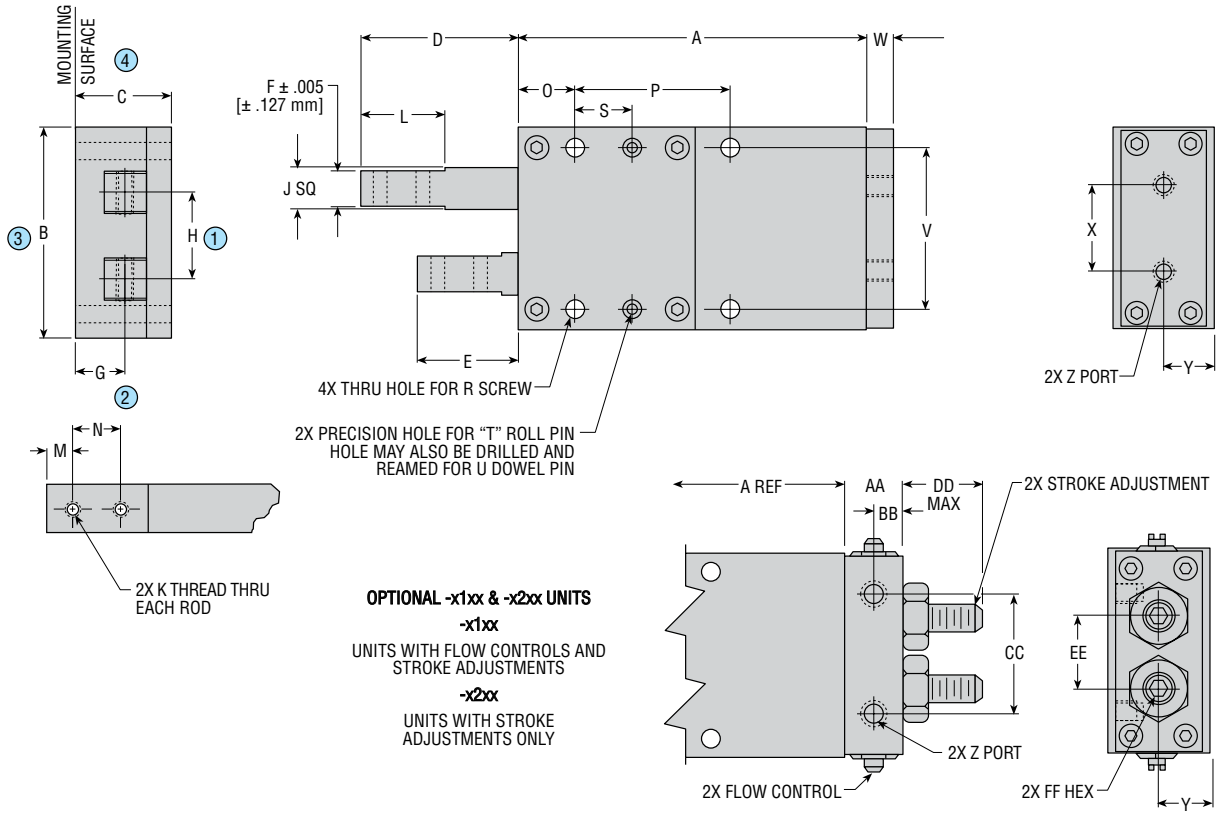
MAX. ROD LOAD TORQUE = (LOAD) x R



Sizing & Application Assistance

Use PHD's free online Product Sizing Application or view the Product Sizing Catalog at: www.phdinc.com/apps/sizing

DIMENSIONS: SERIES 160 DOUBLE ROD ESCAPEMENTS STANDARD DUTY



OPTIONAL -x1xx & -x2xx UNITS

-x1xx

UNITS WITH FLOW CONTROLS AND STROKE ADJUSTMENTS

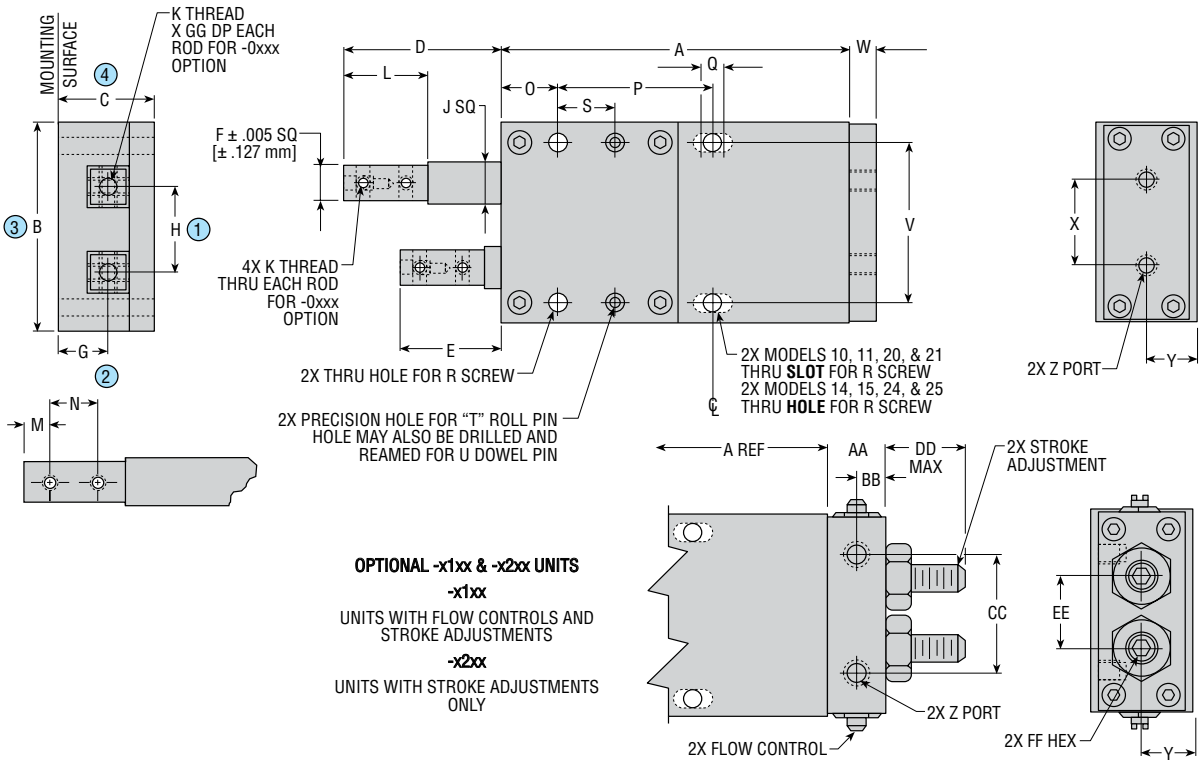
-x2xx

UNITS WITH STROKE ADJUSTMENTS ONLY

LETTER DIM.	IMPERIAL MODEL NO.				METRIC MODEL NO.			
	16002-2	16012-2	16022-2	16042-2	16003-2	16013-2	16023-2	16043-2
A	2.510	3.000	3.880	6.140	63.8	76.2	98.6	156.0
B	1.500	1.781	2.539	3.740	38.1	45.2	64.5	95.0
C	.750	.875	1.188	1.969	19.1	22.2	30.2	50.0
D	.986	1.358	1.885	3.385	25.0	34.5	47.9	86.0
E	.593	.875	1.135	2.125	15.1	22.2	28.8	54.0
F	.259	.310	.435	.768	6.6	7.9	11.0	19.5
G	.374	.438	.593	.983	9.5	11.1	15.1	25.0
H	.551	.748	1.123	1.752	14.0	19.0	28.5	44.5
J	.300	.364	.490	.860	7.6	9.2	12.4	21.8
K	4-40 UNC	6-32 UNC	10-32 UNF	5/16-18 UNC	M3 x 0.5	M3 x 0.5	M5 x 0.8	M8 x 1.25
L	.500	.750	1.000	2.000	12.7	19.1	25.4	50.8
M	.125	.187	.250	.500	3.2	4.7	6.4	12.7
N	.250	.375	.500	.875	6.4	9.5	12.7	22.2
O	.431	.500	.687	1.004	10.9	12.7	17.4	25.5
P	1.095	1.344	1.709	2.875	27.8	34.1	43.4	73.0
R	#6	#6	#10	5/16	M3	M3	M5	M8
S	.408	.500	.750	1.250	10.4	12.7	19.1	31.8
T	3/32	3/32	5/32	3/16	3/32	3/32	5/32	3/16
U	1/8	1/8	3/16	1/4	3.0	3.0	5.0	6.0
V	1.166	1.468	2.125	3.147	29.6	37.3	54.0	79.9
W	.250	.250	.380	.380	6.4	6.4	9.7	9.7
X	.551	.750	1.125	1.752	14.0	19.1	28.6	44.5
Y	.374	.438	.593	.983	9.5	11.1	15.1	25.0
Z	10-32 UNF	10-32 UNF	1/8 NPT	1/8 NPT	M5 x 0.8	M5 x 0.8	1/8 BSP	1/8 BSP
AA	—	.500	.625	.625	—	12.7	15.9	15.9
BB	—	.250	.312	.312	—	6.4	7.9	7.9
CC	—	1.032	1.406	2.276	—	26.2	35.7	57.8
DD	—	.817	1.010	2.020	—	20.8	25.7	51.3
EE	—	.625	.876	1.421	—	15.9	22.3	36.1
FF	—	1/8	3/16	8 mm	—	1/8	3/16	8 mm

NOTES:
1) METRIC DIMENSIONS ARE IN MILLIMETERS
2) ROD STROKES MAY BE LIMITED TO .125" [3.17 mm] BY USE OF OPTIONAL STROKE ADJUSTMENT SCREWS
3) FULLY EXTENDED ROD MAY RETRACT UP TO 0.025" [0.64 mm] UPON PRESSURIZATION OF RETRACTED ROD
4) ROD SHOWN WITH -2xxx OPTION

All dimensions are reference only unless specifically toleranced.



OPTIONAL -x1xx & -x2xx UNITS

-x1xx

UNITS WITH FLOW CONTROLS AND STROKE ADJUSTMENTS

-x2xx

UNITS WITH STROKE ADJUSTMENTS ONLY

LETTER DIM.	IMPERIAL MODEL NO.		METRIC MODEL NO.	
	16010 & 16014	16020 & 16024	16011 & 16015	16021 & 16025
A	3.000	3.880	76.2	98.6
B	1.781	2.539	45.2	64.5
C	.875	1.188	22.2	30.2
D	1.358	1.885	34.5	47.9
E	.875	1.135	22.2	28.8
F	.310	.435	7.9	11.0
G	.471	.594	12.0	15.1
H	.746	1.121	18.9	28.5
J	.364	.490	9.2	12.4
K	6-32 UNC	10-32 UNF	M3 x 0.5	M5 x 0.8
L	.750	1.000	19.1	25.4
M	.187	.250	4.8	6.4
N	.375	.500	9.5	12.7
O	.500	.687	12.7	17.4
P	1.344	1.709	34.1	43.4
Q	.189	.170	4.8	4.3
R	#6	#10	M3	M5
S	.500	.750	12.7	19.1
T	3/32	5/32	3/32	5/32
U	1/8	3/16	3.0	5.0
V	1.468	2.125	37.3	54.0
W	.250	.380	6.4	9.7
X	.750	1.125	19.1	28.6
Y	.437	.594	11.1	15.1
Z	10-32 UNF	1/8 NPT	M5 x 0.8	1/8 BSP
AA	.500	.625	12.7	15.9
BB	.250	.312	6.4	7.9
CC	1.032	1.406	26.2	35.7
DD	.817	1.010	20.8	25.7
EE	.625	.876	15.9	22.3
FF	1/8	3/16	1/8	3/16
GG	.312	.437	8.0	11.0

NOTES:

1) METRIC DIMENSIONS ARE IN MILLIMETERS
2) ROD STROKES MAY BE LIMITED TO .125" [3.17 mm] BY USE OF OPTIONAL STROKE ADJUSTMENT SCREWS
3) FULLY EXTENDED ROD MAY RETRACT UP TO 0.025" [0.64 mm] UPON PRESSURIZATION OF RETRACTED ROD
4) ROD SHOWN WITH -0xxx OPTION (SEE PAGE 3-6 FOR EXAMPLE OF -2xxx OPTION. K THREAD - 1 ON END OF EACH ROD)

All dimensions are reference only unless specifically toleranced.

HEAVY DUTY VS. STANDARD DUTY

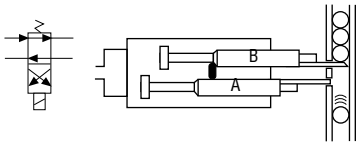
PHD Escapements are available in heavy and standard duty models. The heavy duty model is offered in two sizes and uses fluoropolymer composite rod bearings which allow higher static and impact loads on the stroke rods. The standard duty model is offered in four sizes. It utilizes PTFE impregnated hardcoat rod bearings for applications requiring moderate static and impact loads on the stroke rods.

TYPICAL OPERATION

WORKING PRINCIPLE

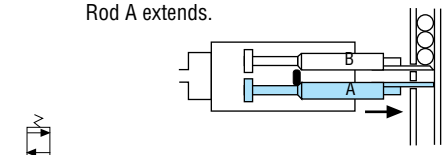
PHD Escapements are internally ported allowing both double acting stroke rods to be operated by a single 4 port, 2 position valve. The sequence of rod motions allows parts being fed continuously from a magazine or feeder to be separated or grouped for subsequent processing.

INITIAL VALVE POSITION

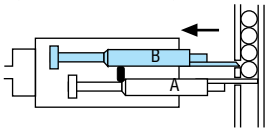


ACTIVATED VALVE POSITION

Rod A extends.

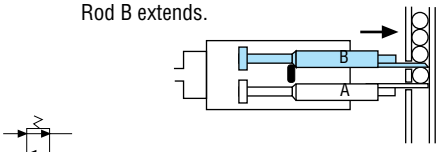


Internal sequence mechanism allows rod B to retract only after rod A is fully extended.

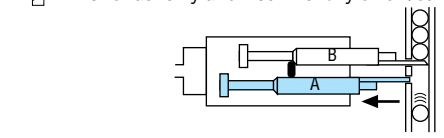


RETURN TO INITIAL VALVE POSITION

Rod B extends.



Internal sequence mechanism allows rod A to retract only after rod B is fully extended.



OPTIONS: SERIES 160 DOUBLE ROD ESCAPEMENTS

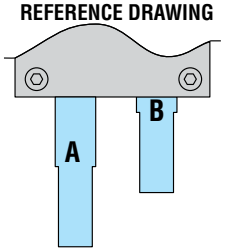
-Xxxx ROD END OPTIONS

PHD Escapements can be specified with a number of rod end options. The dimensioned drawing on page 3-7 shows rod option -0 specifying flats and threaded holes on four sides with an additional threaded hole in the end of the rod.

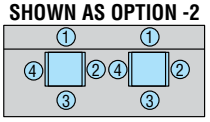
The most cost effective rod end options are -1, -2, -3, and -4. These options provide mounting holes and flats on two sides only of each rod.

0 - Flats and threaded holes on all four sides with a threaded hole in the end on both rods (heavy duty option only)
1 - Flats and threaded holes on sides 1 and 3 on both rods
2 - Flats and threaded holes on sides 2 and 4 on both rods
3 - Flats and threaded holes on sides 1 and 3 of rod A and on sides 2 and 4 of rod B
4 - Flats and threaded holes on sides 2 and 4 of rod A and on sides 1 and 3 of rod B

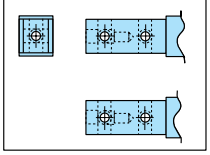
OPTIONS -1 THROUGH -4 REFERENCE DRAWING



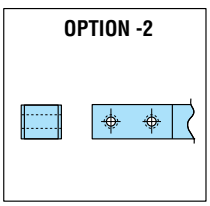
SHOWN AS OPTION -2



OPTION -0



OPTION -2



1 HALL EFFECT SWITCH READY -xx1x

This option equips the escapement with magnets on both rods for use with PHD Series 5360 Hall Effect Switches. These switches mount easily to the escapement using “T” slots in the body. Not available on 16002 and 16003 units. Switches must be ordered separately.

Options may affect unit length. See dimensional pages and option information details.

Refer to this product’s online catalog in the product section for complete information including related dimensions and additional specifications. See link at bottom of this page.

2 SWITCH READY -xx2x 16002 AND 16003 UNITS ONLY

This option equips the escapement with mounting holes for use with either 4 mm round or 6 mm square metal sensing proximity switches on the Series 16002 and 16003 Escapements. Proximity switches and mounting kits must be ordered separately. See Switches and Sensors section for complete switch specifications.

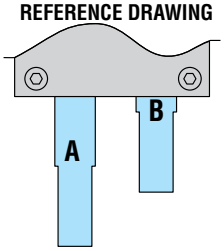
-Xxxx ROD END OPTIONS

PHD Escapements can be specified with a number of rod end options. The dimensioned drawing on page 3-7 shows rod option -0 specifying flats and threaded holes on four sides with an additional threaded hole in the end of the rod.

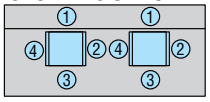
The most cost effective rod end options are -1, -2, -3, and -4. These options provide mounting holes and flats on two sides only of each rod.

0 - Flats and threaded holes on all four sides with a threaded hole in the end on both rods (heavy duty option only)
1 - Flats and threaded holes on sides 1 and 3 on both rods
2 - Flats and threaded holes on sides 2 and 4 on both rods
3 - Flats and threaded holes on sides 1 and 3 of rod A and on sides 2 and 4 of rod B
4 - Flats and threaded holes on sides 2 and 4 of rod A and on sides 1 and 3 of rod B

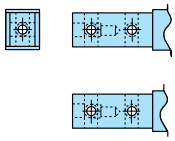
OPTIONS -1 THROUGH -4 REFERENCE DRAWING



SHOWN AS OPTION -2



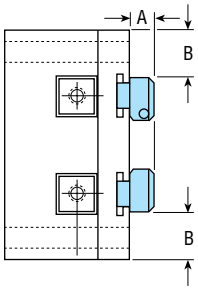
OPTION -0



OPTION -2

1 HALL EFFECT SWITCH READY -xx1x

This option equips the escapement with magnets on both rods for use with PHD Series 5360 Hall Effect Switches. These switches mount easily to the escapement using "T" slots in the body. Not available on 16002 and 16003 units. Switches must be ordered separately. **See Switches and Sensors section for complete specifications.**



	STANDARD DUTY		HEAVY DUTY	
MODEL	DIM. A	DIM. B	DIM. A	DIM. B
1601x	.317 [8.1]	.275 [7.0]	.317 [8.1]	.275 [7.0]
1602x	.234 [6.0]	.475 [12.1]	.234 [6.0]	.475 [12.1]
1604x	.200 [5.1]	.752 [19.1]	—	—

Numbers shown in [ ] are mm.

SERIES 5360 MINIATURE HALL EFFECT SWITCHES

PART NO.	DESCRIPTION
53603-1-02	NPN (Sink) 4.5-24 VDC, 2 meter Cable
53604-1-02	PNP (Source) 4.5-24 VDC, 2 meter Cable
53623-1	NPN (Sink) 4.5-24 VDC, Quick Connect
53624-1	PNP (Source) 4.5-24 VDC, Quick Connect

2 SWITCH READY -xx2x 16002 AND 16003 UNITS ONLY

This option equips the escapement with mounting holes for use with either 4 mm round or 6 mm square metal sensing proximity switches on the Series 16002 and 16003 Escapements. Proximity switches and mounting kits must be ordered separately. **See Switches and Sensors section for complete switch specifications.**

NOTE: Switch targets must be supplied by the end user (see below).

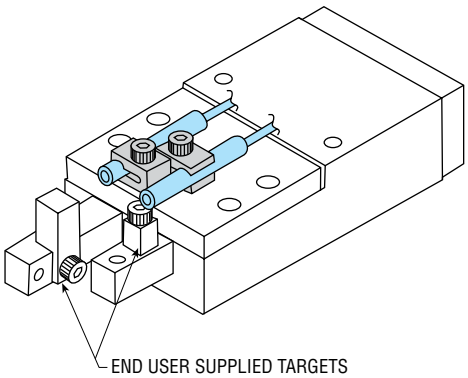
PROXIMITY SWITCH MOUNTING KITS

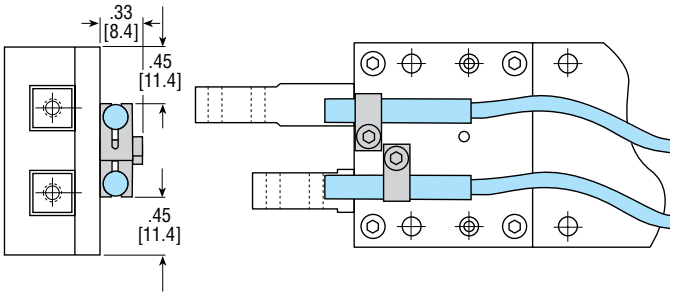
PROXIMITY SWITCH	KIT NUMBER
4 mm Round Inductive	57879
6 mm Square Inductive	57880

EACH PROXIMITY SWITCH MOUNTING KIT CONTAINS:
1 SWITCH BRACKET
1 BRACKET MOUNTING SCREW

4 mm ROUND

Illustrated below is a suggested method of installing switch targets for use with a 4 mm inductive proximity switch. Suggested maximum gap between target and switch is .032 inch [0.8 mm].



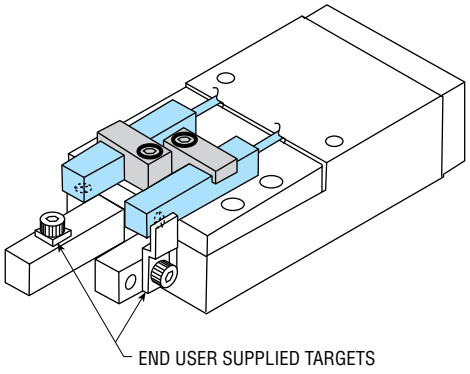


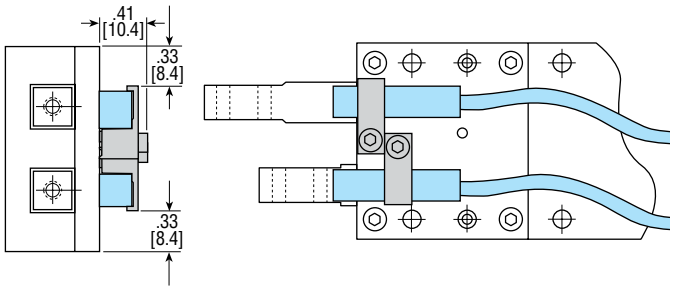
4 mm ROUND INDUCTIVE PROXIMITY SWITCHES

PART NO.	DESCRIPTION
18430-001-02	NPN (Sink) 2 meter cable
18430-002-02	PNP (Source) 2 meter cable

6 mm SQUARE

Illustrated below is a suggested method of installing switch targets for use with a 6 mm inductive proximity switch. Suggested maximum gap between target and switch is .032 inch [0.8 mm].





6 MM SQUARE INDUCTIVE PROXIMITY SWITCHES

PART NO.	DESCRIPTION
18431-001-02	NPN (Sink) 2 meter cable
18431-002-02	PNP (Source) 2 meter cable

Numbers in [ ] are for metric units.