

# LINEAR MOTION SYSTEM COMPONENTS



**LINEAR MOTION SYSTEM COMPONENTS**

PIC Design has added a most comprehensive selection of precision components for linear motion applications. Our standard components range in shaft and bearing sizes from 1/4 in. to 1-1/2 in. diameter and linear guides with travel from 4 in. to 35 in.

*All components are available in inch and metric sizes.*

**PIC Linear Motion Products — A Brief Overview**

**PRECISION SHAFTING**

Precision case hardened and ground shafting include C-1060 steel case hardened to Rockwell 60-65C, 440C stainless steel case hardened to Rockwell 50-55C as well as precision ground 303 stainless steel (Rockwell 70-95B typical).

**PRE-DRILLED SHAFTING**

Shafting is available with pre-drilled and tapped mounting holes matching our pre-drilled shaft support rails.

**SUPPORT RAILS**

Aluminum support rails for intermittent or continuous support can be supplied with or without mounting holes.

**SHAFT SUPPORT HANGERS**

Cast aluminum shaft hangers to accommodate PIC shaft sizes.

**LINEAR BEARINGS — RECIRCULATING BALL**

The linear bearings of high precision enable endless rectilinear motion with contained rolling recirculating balls. Available in closed, adjustable or open styles.

**LINEAR SELF-LUBE NON METALLIC BEARINGS**

Engineered plastic, self-lubricating bearings, interchangeable with all makes of linear ball bearings (preventing catastrophic failure). Use it for linear or rotational motion with hardened shafting or with lower cost, non-corrosive "soft" 300 series stainless steel ground shafting. Available in closed, adjustable and open style.

**CERAMIC COATED LINEAR BEARINGS**

Ceramic coated hard aluminum alloy with rotary/linear motion capability and low friction. Allows speeds up to 400 SFM, loads up to 5000 PSI with PV factor of 40,000.

**LINEAR BEARING BRACKETS (PILLOW BLOCKS), CARRIAGE TOPS AND PRE-ASSEMBLED SUB-SYSTEMS**

Offered to assist customers in selecting the most appropriate linear motion components and sub-systems.

**SPECIALS**

Custom sub systems available to customer specifications using PIC linear motion components.

# TECHNICAL SECTION

Whatever your application, PIC Design offers a linear motion component that will work for you. Determine all loads, magnitude and direction, force and torque for your system requirements. Use of this data should enable users to select individual components, then select and specify all parts from this comprehensive offering.

## END SUPPORTS VS. RAIL SUPPORT

Knowing the load to be carried by the linear motion system will help determine the proper diameter of the shafts.

By using the shaft deflection table below, you can estimate the amount each shaft will deflect at the center of the stroke under maximum load. If deflection must be minimized, a continuous or intermittent support rail should be used.

## BEARING SPEEDS

Linear bearing systems using recirculating ball bearings can travel at about 250 ft./min.; ceramic coated bearings at about 400 ft./min.; and our PIC self-lubricating linear bearing at 200 ft./min.

## SHAFT HARDNESS

Rockwell 55 to 60C is required for "no grooving" of the shaft when using recirculating ball bearings or ceramic coated bearings. Use our PIC C1060 hardened and ground steel shaft; or where application dictates, 440 C stainless steel hardened and ground shaft. PIC self-lube linear bearings can be used with above shafting as well as the more economical and corrosion resistant "soft" 303 stainless steel (Rockwell 70-95B).

## LINEAR MOTION GUIDES (See Section 2 — Linear Slides)

These guides offer excellent positioning accuracy, low friction, high load bearing capabilities and greater compactness with recirculating ball or crossed roller slide design.

## LUBRICATION

In applications where operating speeds are low and loads are light, linear recirculating ball bearings can be used without lubrication. However, to protect the highly polished bearing surfaces from corrosion and wear, a lubricant is recommended for most applications. Use light oil for good surface adhesion and greater bearing protection.

Shaft Deflection Table For Use In Design And Application Of Linear Motion Devices

Shaft Diameter	Deflection Per Pound at Center of Shaft Supported at Ends (Not Fixed)												
	Length of Unsupported Section (inches)												
	4	6	8	10	12	16	20	24	30	36	42	48	72
1/4"	2.34x10 <sup>-4</sup>	7.90x10 <sup>-4</sup>	1.87x10 <sup>-3</sup>	3.66x10 <sup>-3</sup>	6.33x10 <sup>-3</sup>	1.50x10 <sup>-2</sup>	2.93x10 <sup>-2</sup>	5.06x10 <sup>-2</sup>	1.00x10 <sup>-1</sup>				
3/8"	4.81x10 <sup>-5</sup>	1.62x10 <sup>-4</sup>	3.85x10 <sup>-4</sup>	7.15x10 <sup>-4</sup>	1.30x10 <sup>-3</sup>	3.07x10 <sup>-3</sup>	5.72x10 <sup>-3</sup>	1.04x10 <sup>-2</sup>	1.93x10 <sup>-2</sup>	3.33x10 <sup>-2</sup>	5.29x10 <sup>-2</sup>	7.90x10 <sup>-2</sup>	
1/2"	1.45x10 <sup>-5</sup>	4.90x10 <sup>-5</sup>	1.16x10 <sup>-4</sup>	2.27x10 <sup>-4</sup>	3.93x10 <sup>-4</sup>	9.30x10 <sup>-4</sup>	1.80x10 <sup>-3</sup>	3.14x10 <sup>-3</sup>	6.13x10 <sup>-3</sup>	1.06x10 <sup>-2</sup>	1.68x10 <sup>-2</sup>	2.51x10 <sup>-2</sup>	8.47x10 <sup>-2</sup>
3/4"	2.86x10 <sup>-6</sup>	9.68x10 <sup>-6</sup>	2.29x10 <sup>-5</sup>	4.48x10 <sup>-5</sup>	7.74x10 <sup>-5</sup>	1.83x10 <sup>-4</sup>	3.58x10 <sup>-4</sup>	6.20x10 <sup>-4</sup>	1.21x10 <sup>-3</sup>	2.09x10 <sup>-3</sup>	3.32x10 <sup>-3</sup>	4.95x10 <sup>-3</sup>	1.67x10 <sup>-2</sup>
1"	9.01x10 <sup>-7</sup>	3.08x10 <sup>-6</sup>	7.03x10 <sup>-6</sup>	1.42x10 <sup>-5</sup>	2.46x10 <sup>-5</sup>	5.84x10 <sup>-5</sup>	1.14x10 <sup>-4</sup>	1.97x10 <sup>-4</sup>	3.85x10 <sup>-4</sup>	6.64x10 <sup>-4</sup>	1.05x10 <sup>-3</sup>	1.57x10 <sup>-3</sup>	5.30x10 <sup>-3</sup>
1 1/4"	3.72x10 <sup>-7</sup>	1.25x10 <sup>-6</sup>	2.98x10 <sup>-6</sup>	5.81x10 <sup>-6</sup>	1.00x10 <sup>-5</sup>	2.38x10 <sup>-5</sup>	4.65x10 <sup>-5</sup>	8.05x10 <sup>-5</sup>	1.57x10 <sup>-4</sup>	2.71x10 <sup>-4</sup>	4.30x10 <sup>-4</sup>	6.42x10 <sup>-4</sup>	2.17x10 <sup>-3</sup>
1 1/2"	1.79x10 <sup>-7</sup>	6.05x10 <sup>-7</sup>	1.43x10 <sup>-6</sup>	2.80x10 <sup>-6</sup>	4.84x10 <sup>-6</sup>	1.15x10 <sup>-5</sup>	2.24x10 <sup>-5</sup>	3.87x10 <sup>-5</sup>	7.56x10 <sup>-5</sup>	1.31x10 <sup>-4</sup>	2.07x10 <sup>-4</sup>	3.10x10 <sup>-4</sup>	1.03x10 <sup>-3</sup>
2"	5.66x10 <sup>-8</sup>	1.91x10 <sup>-7</sup>	4.53x10 <sup>-7</sup>	8.85x10 <sup>-7</sup>	1.53x10 <sup>-6</sup>	3.62x10 <sup>-6</sup>	7.08x10 <sup>-6</sup>	1.22x10 <sup>-5</sup>	2.39x10 <sup>-5</sup>	4.13x10 <sup>-5</sup>	6.55x10 <sup>-5</sup>	9.78x10 <sup>-5</sup>	3.30x10 <sup>-4</sup>

## Basic Dynamic Load Rating (C)

This term means such load that, when a certain number of identical linear systems are individually run in the same conditions, 90% of them can run with the load (with a constant value in a constant direction) for a distance of 50 x 10<sup>3</sup> meters without damage caused by rolling fatigue.

## Static Safety Factor (fs)

This factor is used to derate the basic static load (Co) for the sake of safety, depending on the conditions of use as shown in Table 1.

Table 1. Static Safety Factors

Condition of use	Low limit of fs
When in regular operating condition	1~2
When especially smooth running performance is needed	2~4
When the equipment is subject to vibration and shock	3~5

## Basic Static Load Rating (Co)

This term defines a static load such that, at the contacting position where the maximum stress is exercised, the sum of the permanent deformation of the rolling body and that of the rolling plane is 0.0001 time of the diameter of the rolling body.

## Rating Life (L)

Rating life is the total travelling distance that 90% of a group linear systems of the same size can reach without causing any flaking when they operate under the same conditions.

The rating life can be obtained from the following equation with the basic dynamic load rating and the load on the linear system:

$$\text{For ball type: } L = \left( \frac{C}{P} \right)^3 \cdot 50$$

$$\text{For roller type: } L = \left( \frac{C}{P} \right)^{10/3} \cdot 50$$

L: Rating life (km) C: Basic Dynamic load rating (kgf)  
P: Load (kgf)

# PRECISION CASE HARDENED & GROUND SHAFTING

Inch and Metric

For Linear Motion Applications



## Materials and Hardness:

AISI C-1060\* steel, case hardened to Rockwell 60-65C  
 440 C stainless steel, case hardened to Rockwell 50-55C  
 303 stainless steel, (for use with engineered plastic bearings),  
 has approximate hardness of Rockwell 75-95B.  
 \*C-1060 can be supplied with hard satin chrome finish at additional cost.  
 (Adds .0001 to .0002 to diameter).

**Finish:** Normally between 10 and 16 micro-inches RMS. Other finishes can be furnished to meet special requirements.

**Length Tolerances:** Shafting is stocked in 6 to 10 foot lengths, and is supplied to required lengths  $\pm 1/16"$  ( $\pm 1.5\text{mm}$ ). If required, closer length tolerances can be supplied at additional cost.

**Straightness:** With the exception of 1/4" and 3/8" diameters, the standard straightness tolerance is .001"-.002" per foot cumulative. Straighter lengths to meet more stringent requirements can be supplied at additional cost.

**Chamfered Ends:** Normally, all shafts are rough cut. Precision chamfers or other dimensions are classified as a special fabrication and carry extra charges.

**Maximum Lengths:** The maximum lengths in stock for each diameter are shown in the tables.

## HOW TO ORDER

When ordering shafts that do not require any special machining, simply add length (in inches or mm) requirement to Part Number. Example: A10-8-20".

### Inch Shaft Diameters

Nominal Diameter (Inches)	Size & Tol. (Inches)	Max Length (ft)	C-1060 Steel Hardened & Ground		440 C stainless Hardened & Ground		303 Stainless Steel Ground Part No.
			Case Depth	Part No.	Case Depth	Part No.	
1/4	.2485/.2490 .2490/.2495	6	.040	A10-4 A10L-4	—	—	A11-4 —
3/8	.3735/.3740 .3740/.3745	6	.040	A10-6 A10L-6	—	—	A11-6 —
1/2	.4985/.4990 .4990/.4995	6	.060	A10-8 A10L-8	.060	A12-8 —	A11-8 —
5/8	.6235/.6240 .6240/.6245	10	.060	A10-10 A10L-10	.060	A12-10 —	A11-10 —
3/4	.7485/.7490 .7490/.7495	10	.060	A10-12 A10L-12	.060	A12-12 —	A11-12 —
1	.9985/.9990 .9990/.9995	10	.080	A10-16 A10L-16	.080	A12-16 —	A11-16 —
1 1/4	1.2485/1.2490 1.2490/1.2495	10	.080	A10-20 A10L-20	.080	A12-20 —	A11-20 —
1 1/2	1.4984/1.4989 1.4989/1.4994	10	.080	A10-24 A10L-24	.080	A12-24 —	A11-24 —

Note: L Series shafting should be used with self-aligning linear bearings.

### Metric Shaft Diameters

Nominal Diameter (mm)	Tolerance $\mu\text{m}$	Max. Length (mm)	C-1060 Steel Hardened & Ground		440C Stainless Steel* Hardened & Ground		303 Stainless Steel Ground Part No.
			Case Depth	Part No.	Case Depth	Part No.	
5	0/-10	700	1.0	MA10-05	1.0	MA12-05	MA11-05
8	0/-10	1500	1.0	MA10-08	1.0	MA12-08	MA11-08
12	0/-10	3000	1.0	MA10-12	1.0	MA12-12	MA11-12
16	0/-10	3000	1.5	MA10-16	1.5	MA12-16	MA11-16
20	0/-12	3000	1.5	MA10-20	1.5	MA12-20	MA11-20
25	0/-12	3000	1.5	MA10-25	1.5	MA12-25	MA11-25
30	0/-12	3000	2.0	MA10-30	2.0	MA12-30	MA11-30
40	0/-15	3000	2.0	MA10-40	2.0	MA12-40	MA11-40

\*Special Orders Only.

Metric Conversion To Inches: .03937 x metric dimension

Inch Conversion To Metric: 25.4 x inch dimension

## SPECIAL PRECISION MACHINING

Quotations are provided after receipt of a faxed drawing, rough sketch or verbal description. Indicate quantity required.

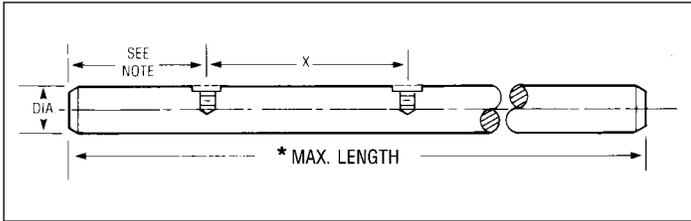
Phone: 800-243-6125 ■ FAX: 203-758-8271  
E-Mail: info@pic-design.com

**PIC** DESIGN®

# PRE-DRILLED SHAFTS

TYPE D Solid AISI C-1060, 440C & 303 Stainless Steel Shafts With Pre-drilled & Tapped Mounting Holes

Inch and Metric



Example: A10-8D24 = C1060 shaft, 1/2 diameter predrilled, 24" long.

## PRE-DRILLED SHAFTS

INCH SHAFT DIAMETERS							METRIC SHAFT DIAMETERS					
Nominal Diameter (inch)	Diameter Tolerance	"X" Space ±.015 (inch)	Tap Size	C1060 Steel Hardened & Ground Part No.	440C S.S. Hardened & Ground Part No.	303 S.S. Ground Part No.	Nominal Diameter (mm)	Diameter Tolerance (µm)	"X" Space ±.38 (mm)	Tap Size	C1060 Steel Hardened & Ground Part No.	303 S.S. Ground Part No.
1/2	.4990/.4995	4	6-32	A10-8D	A12-8D	A11-8D	12	0/-10	120	M4 x .7	MA10-12D	MA11-12D
5/8	.6240/.6245	4	8-32	A10-10D	A12-10D	A11-10D	16	0/-10	150	M5 x .8	MA10-16D	MA11-16D
3/4	.7490/.7495	6	10-32	A10-12D	A12-12D	A11-12D	20	0/-12	150	M6 x 1.0	MA10-20D	MA11-20D
1	.9990/.9995	6	1/4-20	A10-16D	A12-16D	A11-16D	25	0/-12	200	M8 x 1.25	MA10-25D	MA11-25D
1 1/4	1.2490/1.2495	6	5/16-18	A10-20D	A12-20D	A11-20D	30	0/-12	200	M10 x 1.5	MA10-30D	MA11-30D
1 1/2	1.4989/1.4994	8	3/8-16	A10-24D	A11-24D	A11-24D	40	0/-15	200	M10 x 1.5	MA10-40D	MA11-40D

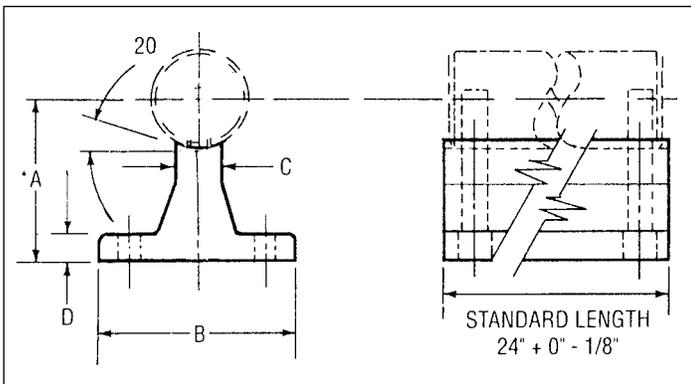
\* Maximum length available is 6 feet (1830 mm).  
For longer lengths, please contact factory

Note: Standard first hole dimension on in-stock shafts is 1/2 of "X" dimension but different first-hole locations may be specified when ordering, providing its location is not more than the "X" hole spacing.

# ALUMINUM SHAFT SUPPORT RAILS

Type PSR Extruded Aluminum Shaft Support Rails (Solid Rail — No Holes)

Inch And Metric



These rails are supplied without mounting holes and can be used horizontally or vertically to provide optimum rigidity (see pre-drilled aluminum rails for sizes and specifications). Shaft support rails are available in standard lengths of 24" + 0", -1/8 (600 + 0, -3.2 mm), but can be supplied to meet shorter length requirements or placed end to end to meet longer length requirements.

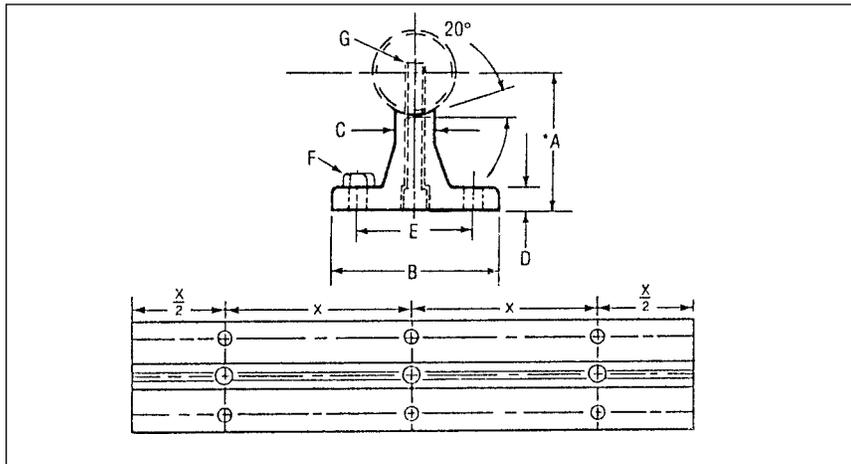
Note: To accommodate in-between shaft sizes, use the shaft support rail size that comes closest to the diameter of your shaft. If shaft diameter falls in between, use the next larger rail.

Inch Sizes						Metric Sizes					
Nom. Shaft Dia. (in)	A* ± .002	B	C	D	Part No.	Nom. Shaft Dia. (mm)	A* ± .08	B (mm)	C (mm)	D (mm)	Part No.
1/2	1.125	1 1/2	1/4	3/16	PSR-8	12	28.32	38.1	6.4	4.8	MPSR-12
5/8	1.125	1 5/8	5/16	1/4	PSR-10	16	28.77	41.3	8.0	6.4	MPSR-16
3/4	1.500	1 3/4	3/8	1/4	PSR-12	20	38.72	44.5	9.5	6.4	MPSR-20
1	1.750	2 1/8	1/2	1/4	PSR-16	25	44.22	54.0	12.7	6.4	MPSR-25
1 1/4	2.125	2 1/2	9/16	5/16	PSR-20	30	46.85	54.0	12.7	6.4	MPSR-30
1 1/2	2.500	3	11/16	3/8	PSR-24	40	64.44	76.2	17.5	9.5	MPSR-40

# PRE-DRILLED ALUMINUM SHAFT SUPPORT RAILS

Inch and Metric

Mate With Type PD Shafts



## ORDERING INFORMATION

When ordering standard 24" support rails with mounting holes, order by part number only (for example PSR-20-PD). If a shorter length is required, specify part number and exact length (for example PSR-20 - PD, 18" long). We provide cutting service at a slight additional charge.

Use "M" prefix for metric sizes.

Pre-drilled support rails are stocked for immediate delivery in standard 24" (600 mm) lengths, but can easily be cut to size. When longer shafts are to be supported, the rails can be continuously mounted end-to-end or intermittently mounted to any desired length.

## Inch Sizes

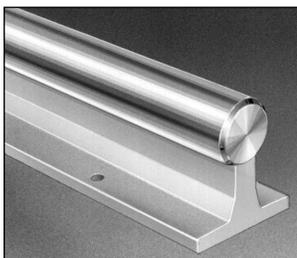
Nominal Shaft Diameter (inch)	A ± .002	B	C	D	E	F Hole	G		X ± .010	Part Number
							Screw	Hole		
1/2	1.125	1 1/2	1/4	3/16	1	.169	6-32 x 7/8	.169	4	PSR-8-PD
5/8	1.125	1 5/8	5/16	1/4	1 1/8	.193	8-32 x 7/8	.193	4	PSR-10-PD
3/4	1.500	1 3/4	3/8	1/4	1 1/4	.221	10-32 x 1 1/4	.221	6	PSR-12-PD
1	1.750	2 1/8	1/2	1/4	1 1/2	.281	1/4-20 x 1 1/2	.281	6	PSR-16-PD
1 1/4	2.125	2 1/2	9/16	5/16	1 7/8	.343	5/16-18 x 1 3/4	.343	6	PSR-20-PD
1 1/2	2.500	3	11/16	3/8	2 1/4	.343	3/8-16 x 2	.406	8	PSR-24-PD

## Metric Sizes

Nominal Shaft Diameter (mm)	A ± .08	B	C	D	E	F Hole	G		X ± .25	Part Number
							Screw	Hole		
12	28.32	38.1	6.4	4.8	25.4	4.8	M4 x .7	4.8	120	MPSR-12-PD
16	28.77	41.3	8.0	6.4	28.6	5.8	M5 x .8	5.8	150	MPSR-16-PD
20	38.72	44.5	9.5	6.4	31.8	6.8	M6 x 1.0	6.8	150	MPSR-20-PD
25	44.22	54.0	12.7	6.4	38.1	6.8	M8 x 1.25	8.8	200	MPSR-25-PD
30	46.85	54.0	12.7	6.4	38.1	6.8	M10 x 1.50	8.8	200	MPSR-30-PD
40	64.44	76.2	17.5	9.5	57.2	8.8	M10 x 1.50	10.8	200	MPSR-40-PD

Mounting hole patterns for various sizes are shown in tables above. The alignment and location of holes are ±.010 (±0.25 mm) non-cumulative.

# SHAFTS AND SUPPORT RAILS ASSEMBLIES



PIC can supply shafts and rails as complete assemblies in 24" length (600 mm) as standard sizes. Other lengths will be quoted on request.

## ORDERING INFORMATION

Order standard 24" long shaft and rail assembly as follows:

C1060 Hardened Steel Shaft A10-X-SR  
 440C Stainless Steel Shaft A12-X-SR  
 303 Stainless Steel Shaft A11-X-SR

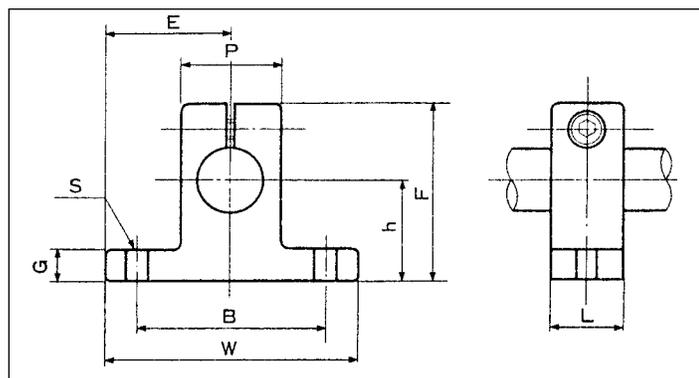
"X" = Size Code for Inch Series.

Use diameter for Metric Series.

"M" = Prefix For Metric Sizes

Inch	
Nominal	Size Code
1/2	8
5/8	10
3/4	12
1	16
1 1/4	20
1 1/2	24

# SHAFT SUPPORT BLOCKS / HANGERS



Material: Cast Aluminum

## Inch Shaft Support Blocks / Hangers

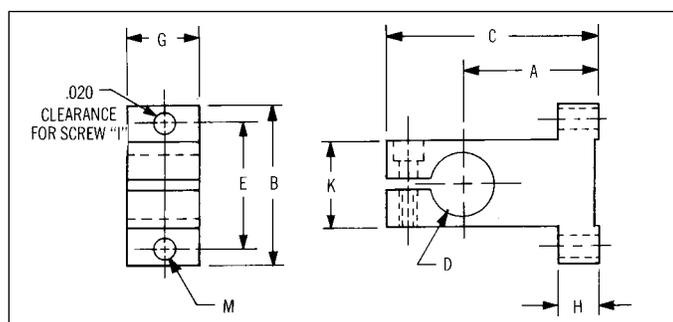
Shaft Diameter (inch)	Dimensions (inch)										Part No.
	h ±.001	E ±.005	W	L	F	G	P	B ±.01	S Hole	Bolt* #	
.250	.6875	.7500	1.500	.500	1.063	.250	.500	1.125	.156	#6	SHA-4
.375	.7500	.8125	1.625	.563	1.187	.250	.688	1.250	.156	#6	SHA-6
.500	1.0000	1.0000	2.000	.625	1.625	.250	.875	1.500	.188	#8	SHA-8
.625	1.0000	1.2500	2.500	.688	1.750	.313	1.000	1.875	.218	#10	SHA-10
.750	1.2500	1.2500	2.500	.750	2.063	.313	1.250	2.000	.218	#10	SHA-12
1.000	1.5000	1.5315	3.063	1.000	2.500	.375	1.500	2.500	.281	#1/4	SHA-16
1.250	1.7500	1.8750	3.750	1.125	3.000	.438	2.000	3.000	.346	#5/16	SHA-20
1.500	2.0000	2.1875	4.375	1.250	3.437	.500	2.250	3.500	.346	#5/16	SHA-24

\*See Y5 Series Mounting Screws

## Metric Shaft Support Blocks / Hangers

Half Dia. (mm)	Dimension (metric sizes)										Part Number
	h ±.02	E ±.05	W	L	F	G	P	B	S	Bolt #	
12	23	21	42	14	37.5	6	20	32	5.5	M5	MSHA-12
16	27	24	48	18	44.0	8	25	38	5.5	M5	MSHA-16
20	31	30	60	20	51.0	10	30	45	6.6	M6	MSHA-20
25	35	35	70	24	60.0	12	38	56	6.6	M6	MSHA-25
30	42	42	84	28	70.0	12	44	64	9.0	M8	MSHA-30
40	60	57	114	36	96.0	15	60	90	11.0	M10	MSHA-40

# PRECISION SHAFT HANGERS — 1/4 to 1 Shaft Diameters Machined



A ±.001	B	C	D +.005 - .000	E	G	H	I*	K	Part No.
.562	1-1/8	1-1/8	.2500	.875	3/8	3/16	#6	5/8	S7-1
.687	1-1/4	1-5/16	.3750	.937	1/2	3/16	#8	5/8	S7-2
.750	1-1/2	1-7/16	.5000	1.125	5/8	1/4	#10	3/4	S7-3
1.000	1-3/4	1-3/4	.6250	1.375	3/4	3/8	#10	7/8	S7-4
1.062	1-7/8	1-7/8	.7500	1.500	7/8	1/2	1/4	1	S7-5
2.125	2-1/4	3-1/16	1.0000	1.750	1	5/8	1/4	1-1/4	S7-6

\*See Y5 Series mounting screws.

Material: Aluminum  
Finish: Black Anodize