Lamina™

Ball-Bearing Products

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Ball-Bearing Components

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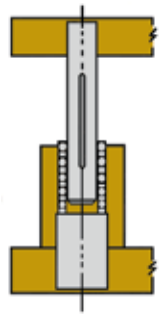
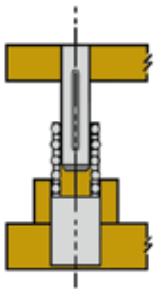
Ball-Bearing Operating Data & Design Selection

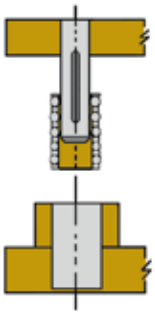
In component selection, varied characteristics must be taken into consideration when selecting length of guide post, bushing and ball-bearing retainer, such as stroke, shut height and type of operation. To help in your selection, we have supplied engineering data and instructions that should be used as a guide when making your component selection. The following conditions should be considered for the most effective performance in a specific application.



FULL CONTACT PRE-LOAD



PRE-LOAD RELIEVED AT TOP OF STROKE

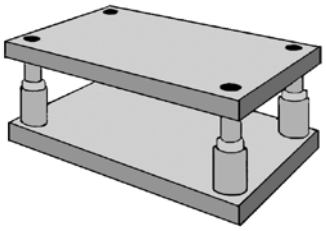


FULL DISENGAGEMENT

In this condition the guide post, bushing and ball-bearing retainer remain in full contact throughout the stroke cycle. This selection is beneficial and recommended for high speed, high production, short stroke dies.

This may be accomplished by selecting the bushing length that allows the guide post to disengage the bushing at the beginning of the stroke or cycle. This will result in the loss of pre-load while the ball-bearing retainer is still within the bushing.

This condition may be utilized with long stroke dies. It also provides safe operation by eliminating pinch points and prevents foreign materials from entering the bushing. A further benefit is it allows for registration of the ball-bearing retainer on each stroke. Removal of the punch holder or die holder from press is possible without total removal of dies.



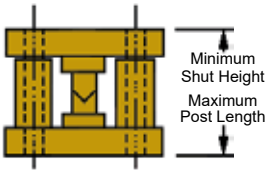
This condition is permissible when the ball retainer must totally disengage the bushing on applications requiring long strokes. Safety precautions (as outlined on page 16) should always be taken when employing this method.

It should also be noted that the above illustration depicts the proper way to assemble (insert) the guide post and ball-bearing retainer into the bushing.

When in a pre-loaded (rolling press fit) condition, the ball-bearing retainer will travel half the distance of movement. In a die set application it would be half the distance of the press stroke.

Ball-Bearing Component Installation Instructions

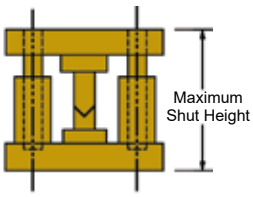
Figure 1



Punch Holder in contact with Bushing
Punch and die life depleted

Figure 1 (Minimum Shut Height) determines maximum guide post length and maximum bushing height. This will prevent post bottoming on bolster at minimum shut height if nominal post length is same as minimum shut height.

Figure 2

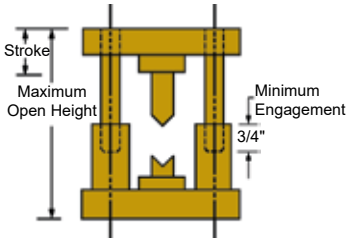


New Punch and Die

The maximum shut height added to the stroke equals the maximum open height (Figure 3) indicating the minimum engagement for the guide post in the required bushing. It is considered ideal for the minimum engagement to be at least 3/4". If it is less than 3/4", however, the arrangement shown in Figure 4 is recommended.

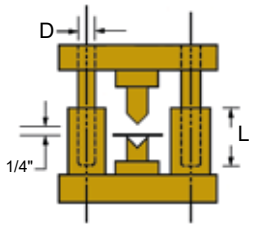
Keeping in mind that only a small part of the stroke on most dies actually does the work, when conditions shown in Figure 4 are acceptable, together with conditions shown in Figures 1 and 2, there is no need to be concerned with the full length of the stroke and maximum open height.

Figure 3



When required strokes are longer than normal, guide post and retainer, if necessary, may be totally disengaged from bushing on the upward travel, provided (A) operation is vertical, (B) operation is limited to no more than 150 strokes per minute, (C) the ram and gib alignment of the press are accurate.

Figure 4



The bushing must always be engaged by the guide post minimum of 3/4" if the operation is included or if speed surpasses 150 strokes per minute. The guide post bushing must engage the retainer during the entire operation, or what is known as full contact pre-load operation.

GENERAL INFORMATION SPECIFICATIONS

1. The ball-bearing retainer travels half the distance the pin travels or one-half the stroke length.

2. The maximum post length equals(=) minimum shut height minus (-) 1/4" Figure 1. If post length should be greater than minimum shut height it will be necessary to provide clearance for projecting post when press is at bottom of stroke.

3. Maximum straight sleeve length Figure 1 equals (=) minimum shut height minus (-) punch holder thickness minus (-) 1/4". Select nearest standard length.

4. Maximum retainer length equals (=) bushing length minus (-) 1/2".

Post slot lengths available upon request.

Ball-Bearing Assembly Lubrication Recommendation

In operation of ball assembly, add lubricant once each 8-hour shift by spray or brush application. Use a lightweight spindle oil like Lamina BALL-LUBE™.
NEVER USE GREASE.

BALL-SCRUBB™ removes heavy soils, dirt or grease from ball-bearing guide pin assemblies.

Just spray it on, wait 3 minutes and spray again. Then blow off excess with compressed air.

BALL-SCRUBB™ is an industrial strength cleaner with rust inhibitors, specially formulated to clean debris and grease from all types of ball-bearing assemblies.

BALL-LUBE™, when applied after **BALL-SCRUBB™**, locks out wear by chemically bonding to precision surfaces. It provides a tough, long-lasting shield that protects against oxidation and rust.

BALL-LUBE™ lubricates assemblies and gives them longtime protection against wear, oxidation and heat.

Spray liberally on ball-bearing assemblies.

BALL-LUBE™ & BALL-SCRUBB™			
PART NUMBER	**DESCRIPTION**	**PART NUMBER**	**DESCRIPTION**
ARL016	1 Pint BALL-LUBE™ spray	**ARS016**	1 Pint BALL-SCRUBB™ Spray
ARL384	1 Case (24) 1 Pint BALL-LUBE™	**ARS384**	1 Case (24) 1 Pint BALL-SCRUBB™
ARL128	1 Gallon BALL-LUBE™	**ARS128**	1 Gallon BALL-SCRUBB™
ARL640	5 Gallons BALL-LUBE™	**ARS640**	5 Gallons BALL-SCRUBB™

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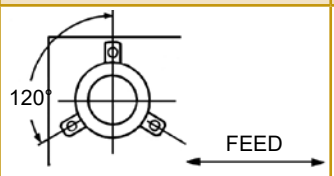
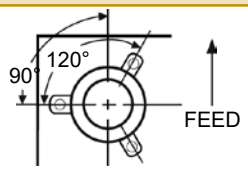
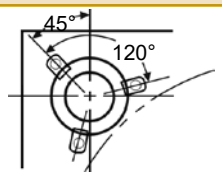
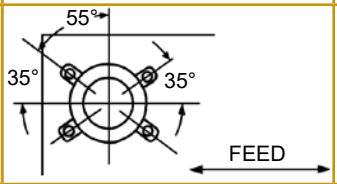
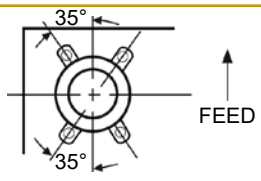
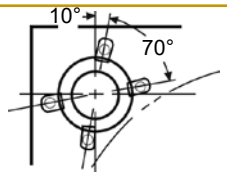
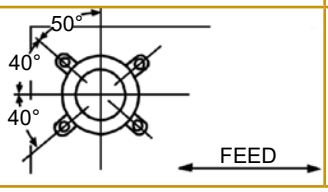
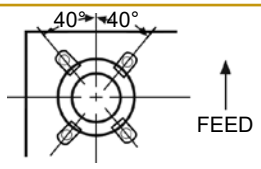
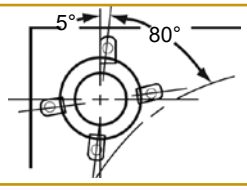
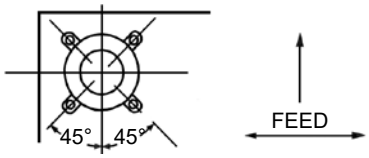
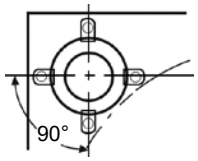
BALL-BEARING DEMOUNTABLE COMPONENT CLAMP ARRANGEMENTS

Nom. Pin Dia.	Standard Left-Right Feed	Front to Back Feed (Center Post die Sets	Round Dies
1, 1¼ & 1½			
1¾, 2, 2½ & 3			
1¾, 2, 2½ & 3			
1¾, 2, 2½ & 3			

BOLT CIRCLE DIAMETERS

DEMOUNTABLE BALL-BEARING BUSHINGS

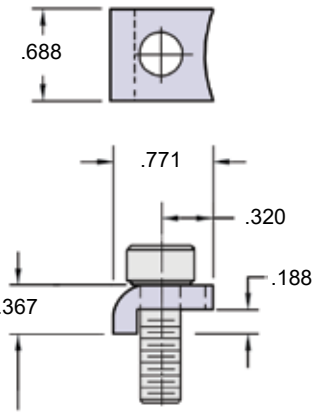
Nom. Bushing Diameter	Bolt Circle Diameter
1	2.438
1-1/4	2.813
1-1/2	3.125
1-3/4	3.438
2	4.000
2-1/2	4.500
3	5.000

DEMOUNTABLE BALL-BEARING PINS

Nom. Pin Diameter	Bolt Circle Diameter
1	1.750
1-1/4	2.000
1-1/2	2.250
1-3/4	2.625
2	2.875
2-1/2	3.375
3	3.875

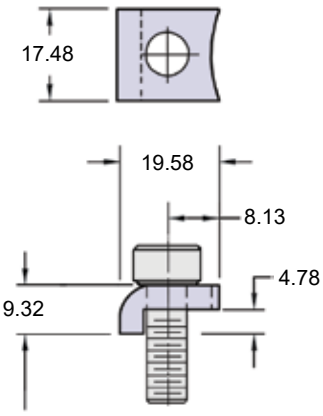
TOE CLAMP DIMENSIONS

INCH

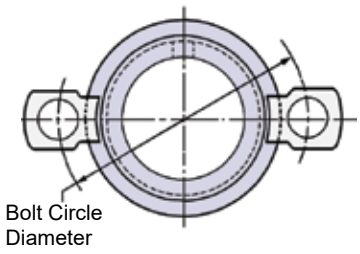


x-40-Clamp &
5/16-18x3/4 Screw

METRIC



X-40-Clamp &
F010810 Metric Screw
(M8 x 1.25-20mm)

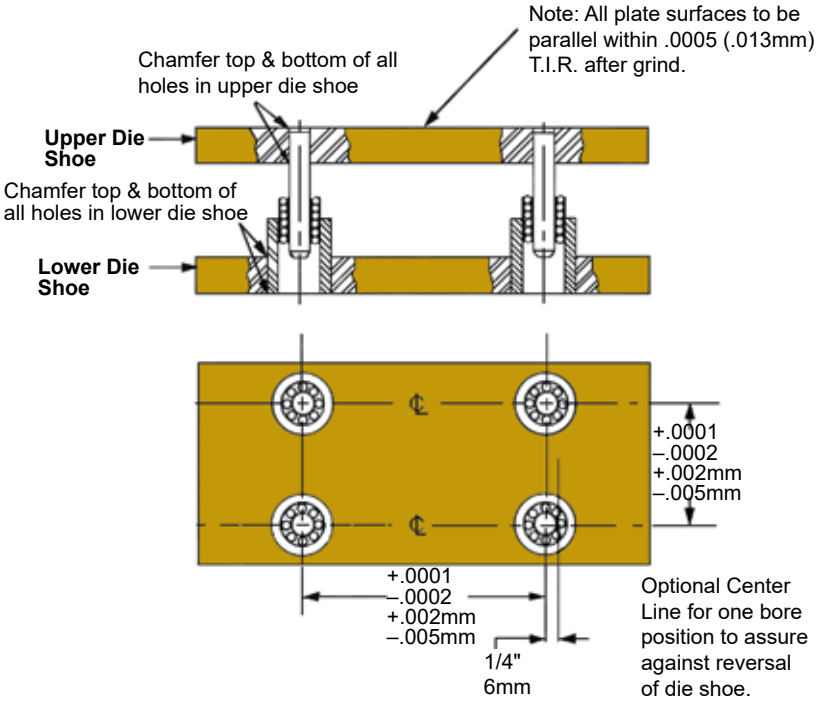


Drawing above refers to X-40 Clamps

REPLACEMENT KITS CLAMPS & SCREWS – X40-CLAMPS

PART NUMBER	Nom. Pin Diameters	# Clamps & Screws per Kit	No. of Kits Needed	PART NUMBER	Nom. Pin Diameters	# Clamps & Screws per Kit	No. of Kits Needed
CSK200002	5/8 - 7/8	2	1	**CSK20052**	18 - 19	2	1
CSK200003	1 - 1-3/4	3	1	**CSK20053**	24 - 42	3	1
CSK200002	2 - 2-1/2	2	2	**CSK20052**	50 - 80	2	2
CSK200003	3 - 4-1/2	3	2				

Ball-Bearing Boring Procedures & Dimensions for Precision Dies



1. Grind die shoe plates parallel within .0005 per foot (.013mm). Then deburr and thoroughly clean plates.

2. Clamp upper and lower shoes together and mount in boring machine.

3. Sweep and strip top surface of plate in boring machine. Shim as required to achieve "0" indicator reading of ($^{+.0001\ +.002mm}_{-.0002\ -.005mm}$) T.I.R. All bores to the square to plate surfaces within ($^{+.0001\ +.002mm}_{-.0002\ -.005mm}$) T.I.R.

4. Step bore in line with hole patterns to dimensions show on chart. All bores to be square to plate surfaces within ($^{+.0001\ +.002mm}_{-.0002\ -.005mm}$) T.I.R.

5. Chamfer both ends of bore.

Complete interchangeability of Lamina ball-bearing guide pins, bushings and retainers makes select fitting unnecessary. No modifications, such as grinding, honing or lapping will be required if mounting and boring instructions which are shown on this page are carefully followed.

BORE SIZE CHART FOR BALL-BEARING BUSHINGS & PINS

Nominal Guide Pin Diameter	BORE SIZE for Tap Fit of Steel Sleeve Bushings AB1 & ABM	BORE SIZE for WRING FIT of Demountable Steel Guide Bushings ABG	BORE SIZE for PRESS FIT of Straight Guide Pins AP1 & APM	BORE SIZE for Tap Fit of Demountable Flanged Guide Pins APG
3/4	1.3872 / 1.3867	**N/A**	.7515 / .7510	**N/A**
1	1.7172 / 1.7167	1.7168 / 1.7163	1.0015 / 1.0010	1.0016 / 1.0011
1-1/4	2.1072 / 2.1067	2.1068 / 2.1063	1.2510 / 1.2505	1.2516 / 1.2511
1-1/2	2.4372 / 2.4367	2.4368 / 2.4363	1.5010 / 1.5005	1.5016 / 1.5011
1-3/4	2.7472 / 2.7467	2.7468 / 2.7463	1.7510 / 1.7505	1.7516 / 1.7511
2	3.1622 / 3.1617	3.1618 / 3.1613	2.0006 / 2.0001	2.0016 / 2.0011
2-1/2	3.6822 / 3.6817	3.6818 / 3.6813	2.5006 / 2.5001	2.5016 / 2.5011
3	4.1822 / 4.1817	4.1818 / 4.1813	3.0006 / 3.0001	3.0016 / 3.0011
32mm	54.005 / 53.995	53.972 / 53.960	31.959 / 31.945	31.965 / 31.953
40mm	65.005 / 64.995	64.972 / 64.956	39.959 / 39.945	39.964 / 39.952
50mm	81.005 / 80.995	80.971 / 80.959	49.949 / 49.932	49.964 / 49.952
63mm	95.005 / 94.995	94.972 / 94.960	62.949 / 62.932	62.964 / 62.952
80mm	112.005 / 111.995	111.972 / 111.960	79.949 / 79.932	79.964 / 79.952

Straight Sleeve Bushing Installation Instructions

In order to avoid the bushing close-in which occurs as a result of pressfit, these bushings should be retained with a Bushing Mount. When so installed, it is not necessary to hone the bushing bore after installation, and the bushing fit will be correct.

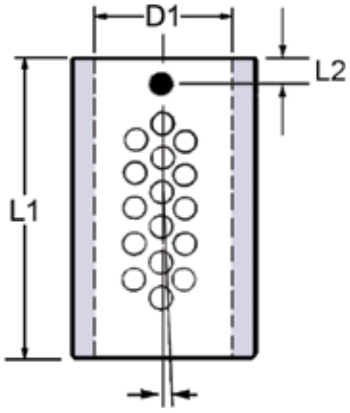
APPLICATION OF BUSHING MOUNT

1. Degrease bushing OD and die shoe bore with alcohol, acetone or other volatile solvent and wipe dry.
2. Apply Bushing Mount sparingly and wring bushing into die shoe.
3. Allow a 4-hour cure at 72° F. Do not disturb bushing until cure is complete.

BUSHING MOUNT:
Part number 9-60-82

Ball-Bearing – Retainers

Radial placement reduces wear and tracking



Lamina ball-bearing retainers (AR1) are made of a heat-treated aluminum alloy that combines lightness and strength.

Each retainer is quality inspected for dimensional tolerance and all burrs are removed prior to ball insertion.

Ball bearings are of the highest quality ISO 3290 Grade 24, continually inspected to meet our exacting tolerance.

After the ball bearings have been inserted into the retainer, they are then staked using Lamina's unique method that allows free movement with maximum security.

After staking, the retainers are then scrubbed to remove all metal particles that could cause accelerated tracking and grooving in the post and bushing.

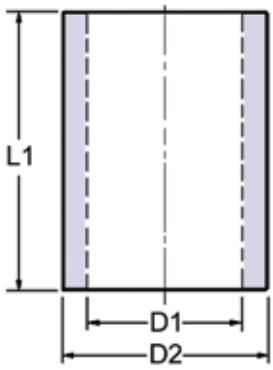
Ball bearings are placed in retainers in an off-line radial pattern that offers optimum life in high or low speed presses.

Ball-bearing retainers are fastened to the guide post by means of a set screw and slot in guide post and are interchangeable with other manufacturers using this method.

BALL-BEARING RETAINER (STANDARD)			
PART NUMBER	**D1**	**L1**	**L2 SET SCREW**
AR1-0606	3/4"	1.50	.250
AR1-0607		1.75	
AR1-0608		2.00	
AR1-0609		2.25	
AR1-0610		2.50	
AR1-0806	1"	1.50	
AR1-0807		1.75	
AR1-0808		2.00	
AR1-0809		2.25	
AR1-0810		2.50	
AR1-1008	1-1/4"	2.00	
AR1-1009		2.25	
AR1-1010		2.50	
AR1-1011		2.75	
AR1-1012		3.00	
AR1-1013		3.25	
AR1-1210	1-1/2"	2.50	
A41-1211		2.75	
AR1-1212		3.00	
AR1-1213		3.25	
AR1-1214		3.50	
AR1-1215		3.75	
AR1-1411	1-3/4"	2.75	
AR1-1412		3.00	
AR1-1413		3.25	
AR1-1414		3.50	
AR1-1415		3.75	
AR1-1416		4.00	
AR1-1417		4.25	
AR1-1613	2"	3.25	
AR1-1614		3.50	
AR1-1615		3.75	
AR1-1616		4.00	
AR1-1617		4.25	
AR1-1618		4.50	
AR1-1622		5.50	
AR1-2018	2-1/2"	4.50	.313
AR1-2020		5.00	
AR1-2022		5.50	
AR1-2024		6.00	
AR1-2025		6.25	
AR1-2026		6.50	
AR1-2028		7.00	
AR1-2420	3"	5.00	
AR1-2424		6.00	
AR1-2428		7.00	

Part numbers highlighted in blue designate that the retainer length is recommended for general die set applications. Lengths not highlighted are for limited space use and special applications.

Ball-Bearing Sleeve Bushings – Press Fit



Lamina's Ball-Bearing Guide Assembly Bushings (AB1) are made from vacuum degassed chrome alloy steel, hardened to precise Rockwell limits to give minimum tracking, grooving and downtime.

Lamina's ball-bearing bushings are ground and honed to exacting tolerance limits. Using electronic and air checking instruments on the I.D. and O.D. make them interchangeable and do not require select fitting.

The top is chamferred on the I.D. to minimize wear and aid alignment when disengagement is required.

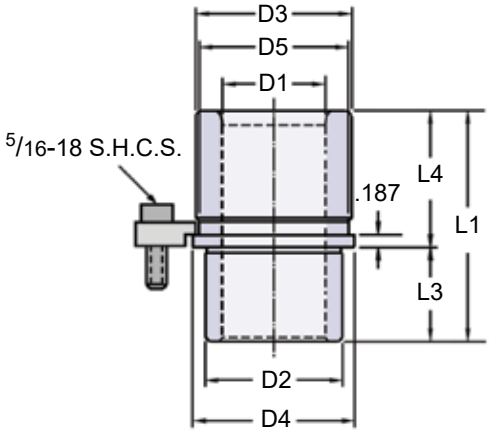
To minimize bushing close-in which is a result of press fit and to eliminate any additional grinding or honing, boring instructions are provided in this catalog.

BALL-BEARING BUSHINGS – STRAIGHT SLEEVE

PART NUMBER	NOM PIN DIA	D1	D2	L1	PART NUMBER	NOM PIN DIA	D1	D2	L1	PART NUMBER	NOM PIN DIA	D1	D2	L1
AB1-0607				1.625	**AB1-1214**				3.375	**AB1-1618**				4.375
AB1-0608				1.875	**AB1-1215**				3.625	**AB1-1619**				4.625
AB1-0609				2.125	**AB1-1216**				3.875	**AB1-1620**				4.875
AB1-0610				2.375	**AB1-1217**				4.125	**AB1-1621**				5.125
AB1-0611				2.625	**AB1-1218**				4.375	**AB1-1622**				5.375
AB1-0612	3/4"	1.1272 / 1.1269	1.3872 / 1.3867	2.875	**AB1-1219**				4.625	**AB1-1624**				5.875
AB1-0613				3.125	**AB1-1220**				4.875	**AB1-1626**				6.375
AB1-0614				3.375	**AB1-1221**				5.125	**AB1-1628**				6.875
AB1-0615				3.625	**AB1-1222**				5.375	**AB1-1630**	2"	2.5021 / 2.5018	3.1622 / 3.1617	7.375
AB1-0616				3.875	**AB1-1224**	1-1/2"	1.8771 / 1.8768	2.4372 / 2.4367	5.875	**AB1-1632**				7.875
AB1-0618				4.375	**AB1-1226**				6.375	**AB1-1634**				8.375
AB1-0624				5.875	**AB1-1228**				6.875	**AB1-1636**				8.875
AB1-0808				1.875	**AB1-1230**				7.375	**AB1-1640**				9.875
AB1-0809				2.125	**AB1-1232**				7.875	**AB1-1642**				10.375
AB1-0810				2.375	**AB1-1234**				8.375	**AB1-1644**				10.875
AB1-0811				2.625	**AB1-1236**				8.875	**AB1-1648**				11.875
AB1-0812				2.875	**AB1-1240**				9.875	**AB1-1652**				12.875
AB1-0813				3.125	**AB1-1242**				10.375	**AB1-1656**				13.875
AB1-0814				3.375	**AB1-1244**				10.875	**AB1-2022**				5.375
AB1-0815				3.625	**AB1-1248**				11.875	**AB1-2024**				5.875
AB1-0816	1"	1.3772 / 1.3769	1.7172 / 1.7167	3.875	**AB1-1412**				2.875	**AB1-2026**				6.375
AB1-0817				4.125	**AB1-1414**				3.375	**AB1-2028**				6.875
AB1-0818				4.375	**AB1-1415**				3.625	**AB1-2030**				7.375
AB1-0819				4.625	**AB1-1416**				3.875	**AB1-2032**				7.875
AB1-0820				4.875	**AB1-1417**				4.125	**AB1-2034**				8.375
AB1-0822				5.375	**AB1-1418**				4.375	**AB1-2036**	2-1/2"	3.0021 / 3.0018	3.6822 / 3.6817	8.875
AB1-0824				5.875	**AB1-1419**				4.625	**AB1-2038**				9.375
AB1-0826				6.375	**AB1-1420**				4.875	**AB1-2040**				9.875
AB1-0828				6.875	**AB1-1421**				5.125	**AB1-2042**				10.375
AB1-1010				2.375	**AB1-1422**				5.375	**AB1-2044**				10.875
AB1-1011				2.625	**AB1-1424**				5.875	**AB1-2048**				11.875
AB1-1012				2.875	**AB1-1426**	1-3/4"	2.1270 / 2.1267	2.7472 / 2.7467	6.375	**AB1-2052**				12.875
AB1-1013				3.125	**AB1-1428**				6.875	**AB1-2056**				13.875
AB1-1014				3.375	**AB1-1430**				7.375	**AB1-2424**				5.875
AB1-1015				3.625	**AB1-1432**				7.875	**AB1-2426**				6.375
AB1-1016				3.875	**AB1-1434**				8.375	**AB1-2428**				6.875
AB1-1017				4.125	**AB1-1436**				8.875	**AB1-2430**				7.375
AB1-1018	1-1/4"	1.6271 / 1.6268	2.1072 / 2.1067	4.375	**AB1-1438**				9.375	**AB1-2432**				7.875
AB1-1019				4.625	**AB1-1440**				9.875	**AB1-2434**				8.375
AB1-1020				4.875	**AB1-1442**				10.375	**AB1-2436**	3"	3.5020 / 3.5017	4.1822 / 4.1817	8.875
AB1-1022				5.375	**AB1-1444**				10.875	**AB1-2438**				9.375
AB1-1024				5.875	**AB1-1448**				11.875	**AB1-2440**				9.875
AB1-1026				6.375	**AB1-1452**				12.875	**AB1-2442**				10.375
AB1-1028				6.875	**AB1-1612**				2.875	**AB1-2444**				10.875
AB1-1032				7.875	**AB1-1614**				3.375	**AB1-2448**				11.875
AB1-1036				8.875	**AB1-1615**	2"	2.5021 / 2.5018	3.1622 / 3.1617	3.625	**AB1-2452**				12.875
AB1-1212	1-1/2"	1.8771 / 1.8768	2.4372 / 2.4367	2.875	**AB1-1616**				3.875	**AB1-2456**				13.875
AB1-1213				3.125	**AB1-1617**				4.125					

See page 5 for bore size information.

Ball-Bearing – Bushings –Tap Fit



Demountable shoulder bushings offer all the advantages of straight sleeve bushings and combine them with the convenience of easy assembly and disassembly.

These clamp type bushings are meant to be wring fit into the die shoe and should never be forced or inserted by hammering.

X-40-Clamps and socket head screws are provided to hold the bushings in place.

Clamping information is on page 4.
See page 5 for bore size information.

Unground demountable bushings are available by special order only.

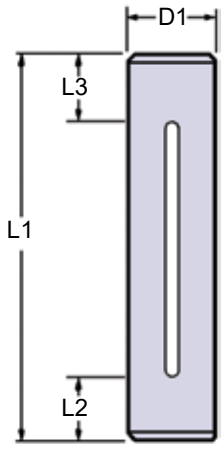
BALL-BEARING BUSHINGS – DEMOUNTABLE

PART NUMBER	NOM PIN DIA	D1	D2	D3	D4	D5	L1	L3	L4
ABG0808	1"	1.3772 / 1.3769	1.7163 / 1.7160	1.920	1.995	1.775	1.875	1.000	0.875
ABG0809							2.125		1.125
ABG0811							2.625		1.625
ABG0812							2.875		1.875
ABG0813							3.125		2.125
ABG0814							3.375		2.375
ABG0815							3.625		2.625
ABG1010	1-1/4"	1.6271 / 1.6268	2.1063 / 2.1060	2.200	2.355	2.125	2.375	1.000	1.375
ABG1011							2.625		1.625
ABG1012							2.875		1.875
ABG1013							3.125		2.125
ABG1014							3.375		2.375
ABG1015							3.625		2.625
ABG1016							3.875		2.875
ABG1017							4.125		3.125
ABG1018							4.375		3.375
ABG1020							4.875		3.875
ABG1022							5.375		4.375
ABG1024							5.875		4.875
ABG1212	1-1/2"	1.8771 / 1.8768	2.4363 / 2.4360	2.500	2.675	2.425	2.875	1.250	1.625
ABG1213							3.125		1.875
ABG1214							3.375		2.125
ABG1215							3.625		2.375
ABG1216							3.875		2.625
ABG1217							4.125		2.875
ABG1218							4.375		3.125
ABG1219							4.625		3.375
ABG1220							4.875		3.625
ABG1222							5.375		4.125
ABG1224							5.875		4.625
ABG1412	1-3/4"	2.1270 / 2.1267	2.7463 / 2.7460	2.875	2.995	2.755	2.875	1.250	1.625
ABG1414							3.375		2.125
ABG1416							3.875		2.625
ABG1417							4.125		2.875
ABG1418							4.375		3.125
ABG1419							4.625		3.375
ABG1420							4.875		3.625
ABG1421							5.125		3.875
ABG1422							5.375		4.125
ABG1424							5.875		4.625
ABG1426							6.375		5.125
ABG1428							6.875		5.625
ABG1430							7.375		6.125
ABG1612	2"	2.5021 / 2.5018	3.1613 / 3.1610	3.375	3.565	3.295	2.875	1.250	1.625
ABG1614							3.375		2.125
ABG1615							3.625		2.375
ABG1616							3.875		2.625
ABG1617							4.125		2.875
ABG1618							4.375		3.125
ABG1619							4.625		3.375
ABG1620							4.875		3.625
ABG1621							5.125		3.875
ABG1622							5.375		4.125
ABG1624							5.875		4.625
ABG1626							6.375		5.125
ABG1628							6.875		5.625
ABG1630							7.375		6.125
ABG2011	2-1/2"	3.0021 / 3.0018	3.6813 / 3.6810	3.875	4.075	3.765	2.625	1.250	1.375
ABG2020							4.875		3.625
ABG2022							5.375		4.125
ABG2024							5.875		4.625
ABG2026							6.375		5.125
ABG2028							6.875		5.625
ABG2030							7.375		6.125
ABG2420	3"	3.5020 / 3.5017	4.1813 / 4.1810	4.500	4.575	4.275	4.875	1.250	3.625
ABG2422							5.375		4.125
ABG2424							5.875		4.625
ABG2426							6.375		5.125
ABG2428							6.875		5.625
ABG2430							7.375		6.125

Ball-Bearing Guide Posts – Press Fit

Lamina's Precision Guide Post (AP1) for ball-bearing assemblies are made from chrome alloy steel, hardened to provide maximum protection against tracking and accelerated wear.

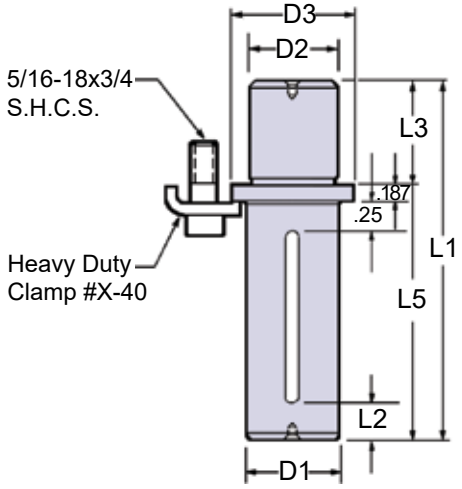
Ground to a high degree of tolerance accuracy that also provides a smooth hard wearing surface to assure free rolling of balls to maintain constant, predictable preload and complete interchangeability, not only with our own but other manufacturers' also.



BALL-BEARING GUIDE POSTS – STRAIGHT

PART NUMBER	NOM PIN DIA	D1	L1	L2	L3	PART NUMBER	NOM PIN DIA	D1	L1	L2	L3
AP1-0612	3/4"	.7530 / .7527	2.875	0.625	0.813	AP1-1422	1-3/4"	1.7530 / 1.7525	5.375	1.313	1.313
AP1-0613			3.125	0.625	0.813	AP1-1423			5.625	1.500	1.500
AP1-0614			3.375	0.625	0.813	AP1-1424			5.875	1.500	1.500
AP1-0615			3.625	0.625	0.813	AP1-1425			6.125	1.500	1.500
AP1-0616			3.875	0.625	0.813	AP1-1426			6.375	1.625	1.750
AP1-0617			4.125	0.625	0.813	AP1-1428			6.875	1.625	1.750
AP1-0618			4.375	0.625	0.813	AP1-1430			7.375	1.625	1.750
AP1-0619			4.625	0.875	1.000	AP1-1432			7.875	1.625	1.750
AP1-0620			4.875	0.875	1.000	AP1-1434			8.375	1.625	1.750
AP1-0622			5.375	0.875	1.000	AP1-1436			8.875	1.625	2.250
AP1-0624			5.875	0.875	1.000	AP1-1438			9.375	1.625	2.250
AP1-0815	1"	1.0030 / 1.0027	3.625	0.875	1.000	AP1-1440			9.875	1.625	2.250
AP1-0816			3.875	0.875	1.000	AP1-1442			10.375	1.625	2.250
AP1-0817			4.125	0.875	1.000	AP1-1444			10.875	1.625	2.250
AP1-0818			4.375	0.875	1.000	AP1-1446			11.375	1.625	2.250
AP1-0819			4.625	0.875	1.250	AP1-1448			11.875	1.625	2.250
AP1-0820			4.875	0.875	1.250	AP1-1450			12.375	1.625	2.875
AP1-0821			5.125	0.875	1.250	AP1-1452			12.875	1.625	2.875
AP1-0822			5.375	0.875	1.250	AP1-1456			13.875	1.625	2.875
AP1-0823			5.625	0.875	1.250	AP1-1460			14.875	1.625	2.875
AP1-0824			5.875	0.875	1.250	AP1-1468			16.875	1.625	2.875
AP1-0826	1-1/4"	1.2530 / 1.2526	6.375	0.875	1.500	AP1-1622	2"	2.0031 / 2.0026	5.375	1.375	1.500
AP1-0828			6.875	0.875	1.500	AP1-1623			5.625	1.375	1.500
AP1-0830			7.375	0.875	1.500	AP1-1624			5.875	1.375	1.500
AP1-0832			7.875	0.875	1.500	AP1-1625			6.125	1.375	1.500
AP1-0834			8.375	0.875	2.000	AP1-1626			6.375	1.750	1.875
AP1-0836			8.875	0.875	2.000	AP1-1627			6.625	1.750	1.875
AP1-1018			4.375	1.000	1.375	AP1-1628			6.875	1.750	1.875
AP1-1019			4.625	1.000	1.375	AP1-1629			7.125	1.750	1.875
AP1-1020			4.875	1.000	1.375	AP1-1630			7.375	1.750	1.875
AP1-1021			5.125	1.000	1.375	AP1-1631			7.625	1.750	1.875
AP1-1022			5.375	1.000	1.375	AP1-1632			7.875	1.750	1.875
AP1-1023			5.625	1.000	1.375	AP1-1634			8.375	1.875	2.250
AP1-1024			5.875	1.000	1.375	AP1-1636			8.875	1.875	2.250
AP1-1026			6.375	1.125	1.750	AP1-1638			9.375	1.875	2.250
AP1-1028			6.875	1.125	1.750	AP1-1640			9.875	1.875	2.250
AP1-1030			7.375	1.125	1.750	AP1-1642			10.375	1.875	2.250
AP1-1032			7.875	1.125	1.750	AP1-1644			10.875	1.875	2.250
AP1-1034			8.375	1.125	1.750	AP1-1646			11.375	1.875	3.000
AP1-1036			8.875	1.125	1.750	AP1-1648			11.875	1.875	3.000
AP1-1040			9.875	1.125	2.250	AP1-1650			12.375	1.875	3.000
AP1-1044			10.875	1.125	2.250	AP1-1652			12.875	1.875	3.000
AP1-1048			11.875	1.175	2.250	AP1-1656			13.875	1.875	3.000
AP1-1218	1-1/2"	1.5030 / 1.5026	4.375	1.375	1.313	AP1-1660			14.875	1.875	3.000
AP1-1219			4.625	1.375	1.313	AP1-1664			15.875	1.875	3.000
AP1-1220			4.875	1.375	1.313	AP1-1668			16.875	1.875	3.000
AP1-1221			5.125	1.375	1.313	AP1-1672			17.875	1.875	3.000
AP1-1222			5.375	1.375	1.313	AP1-2032	2-1/2"	2.5031 / 2.5026	7.875	1.625	2.500
AP1-1223			5.625	1.250	1.563	AP1-2034			8.375	1.625	2.500
AP1-1224			5.875	1.250	1.563	AP1-2036			8.875	2.375	2.750
AP1-1226			6.375	1.250	1.563	AP1-2040			9.875	2.375	3.000
AP1-1228			6.875	1.375	2.000	AP1-2044			10.875	2.375	3.000
AP1-1230			7.375	1.375	2.000	AP1-2048			11.875	2.375	3.000
AP1-1232			7.875	1.375	2.000	AP1-2052			12.875	2.375	3.000
AP1-1234			8.375	1.375	2.000	AP1-2056			13.875	2.375	3.000
AP1-1236			8.875	1.625	2.500	AP1-2068			16.875	2.625	4.000
AP1-1238			9.375	1.625	2.500	AP1-2080			19.875	2.625	4.000
AP1-1240			9.875	1.625	2.500	AP1-2432	3"	3.0031 / 3.0025	7.875	1.875	2.500
AP1-1242			10.375	1.625	2.500	AP1-2434			8.375	1.875	2.500
AP1-1244			10.875	1.625	2.500	AP1-2436			8.875	1.875	2.500
AP1-1246			11.375	1.625	2.500	AP1-2440			9.875	2.875	3.000
AP1-1248			11.875	1.625	2.500	AP1-2444			10.875	2.875	3.000
AP1-1250			12.375	1.625	2.500	AP1-2448			11.875	2.875	3.000
AP1-1252			12.875	1.625	2.500	AP1-2452			12.875	2.875	3.000
AP1-1256			13.875	1.625	2.500	AP1-2456			13.875	2.875	3.000
AP1-1420	1-3/4"	1.7530 / 1.7525	4.875	1.313	1.313	AP1-2468			16.875	2.875	4.000
AP1-1421			5.125	1.313	1.313	AP1-2480			19.875	2.875	4.000

Ball-Bearing Guide Posts – Tap Fit



Designed to expedite die repair, these Ball-Bearing flanged guide posts offer:

- **Large savings in maintenance, repair costs and downtime**
- **Wide variety of sizes**
- **Long, trouble-free production runs**
- **Highest quality workmanship and materials**
- **"D2" dimension is finished ground**

Clamps & Screws included

Pins with unground D2 dimensions are available as specials.

BALL-BEARING GUIDE POSTS – DEMOUNTABLE

PART NUMBER	NOM PIN DIA	D1	D2	D3	L1	L2	L3	L5	PART NUMBER	NOM PIN DIA	D1	D2	D3	L1	L2	L3	L5
APG0815					3.625			2.437	APG1626					6.375	1.375		4.437
APG0819					4.625			3.437	APG1627					6.625	1.375		4.687
APG0820					4.875			3.687	APG1628					6.875	1.625		4.937
APG0821					5.125			3.937	APG1629					7.125	1.625		5.187
APG0824	1"	1.0030 / 1.0027	1.0011 / 1.0006	1.312	5.875	0.875	1.188	4.687	APG1630					7.375	1.625		5.437
APG0826					6.375			5.187	APG1632					7.875	1.625		5.937
APG0828					6.875			5.687	APG1634					8.375	1.625		6.437
APG0830					7.375			6.187	APG1636					8.875	1.625		6.937
APG0836					8.875			7.687	APG1638					9.375	1.875		7.437
APG1021					5.125	0.875		3.937	APG1640	2"	2.0031 / 2.0026	2.0011 / 2.0006	2.500	9.875	1.875	1.938	7.937
APG1022					5.375	0.875		4.187	APG1642					10.375	1.875		8.437
APG1023					5.625	0.875		4.437	APG1644					10.875	1.875		8.937
APG1026					6.375	0.875		5.187	APG1648					11.875	1.875		9.937
APG1028	1-1/4"	1.2530 / 1.2526	1.2511 / 1.2506	1.562	6.875	0.875	1.188	5.687	APG1650					12.375	1.875		10.437
APG1030					7.375	0.875		6.187	APG1652					12.875	1.875		10.937
APG1032					7.875	1.125		6.687	APG1656					13.875	1.875		11.937
APG1034					8.375	1.125		7.187	APG1660					14.875	1.875		12.937
APG1036					8.875	1.125		7.687	APG1664					15.875	1.875		13.937
APG1218					4.375	1.125		2.937	APG1668					16.875	1.875		14.937
APG1222					5.375	1.125		3.937	APG1672					17.875	1.875		15.937
APG1223					5.625	1.125		4.187	APG2032					7.875	2.375		5.937
APG1224					5.875	1.125		4.437	APG2034					8.375	2.375		6.437
APG1226					6.375	1.125		4.937	APG2036					8.875	2.375		6.937
APG1228	1-1/2"	1.5030 / 1.5026	1.5011 / 1.5006	1.875	6.875	1.375	1.438	5.437	APG2040					9.875	2.375		7.937
APG1230					7.375	1.375		5.937	APG2044	2-1/2"	2.5031 / 2.5026	2.5011 / 2.5006	3.000	10.875	2.375	1.938	8.937
APG1234					8.375	1.375		6.937	APG2048					11.875	2.375		9.937
APG1236					8.875	1.375		7.437	APG2052					12.875	2.375		10.937
APG1238					9.375	1.375		7.937	APG2056					13.875	2.375		11.937
APG1242					10.375	1.375		8.937	APG2068					16.875	2.375		14.937
APG1424					5.875	1.375		4.187	APG2080					19.875	2.375		17.937
APG1428					6.875	1.375		5.187	APG2432					7.875	1.875		5.437
APG1430					7.375	1.375		5.687	APG2434					8.375	1.875		5.937
APG1432					7.875	1.375		6.187	APG2436					8.875	1.875		6.437
APG1434	1-3/4"	1.7530 / 1.7525	1.7511 / 1.7506	2.250	8.375	1.375	1.688	6.687	APG2440					9.875	2.375		7.437
APG1436					8.875	1.625		7.187	APG2444	3"	3.0031 / 3.0025	3.0011 / 3.0006	3.500	10.875	2.375	2.438	8.437
APG1438					9.375	1.625		7.687	APG2448					11.875	2.375		9.437
APG1440					9.875	1.625		8.187	APG2452					12.875	2.875		10.437
APG1442					10.375	1.625		8.687	APG2456					13.875	2.875		11.437
APG1448					11.875	1.625		10.187	APG2468					16.875	2.875		14.437
									APG2480					19.875	2.875		17.437

See page 4 for toe clamp placement instructions.

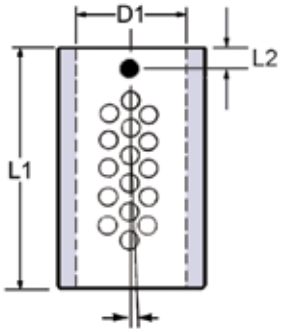
Lamina

Lamina offers a generous range of Metric Ball-Bearing Components to suit your needs.

- **Retainers**
- **Sleeve Bushings**
- **Tap-Fit Bushings (Demountable)**
- **Straight Pins**
- **Tap-Fit Pins (Demountable)**

Specials are available.

Ball-Bearing Retainers – Metric



- Heat-Treated Aluminum
- ISO 3290 Grade 24 Bearings
- Off-line radial pattern
- Set-screw and slot fastening

BALL-BEARING RETAINERS – METRIC			
PART NUMBER	D1 Nom Pin Dia	L1 Length	L2 SET SCREW
ARM032058 **ARM032070** **ARM032083**	32	58 70 83	6.35
ARM040065 **ARM040077** **ARM040096**	40	65 77 96	6.35
ARM050083 **ARM050102** **ARM050114**	50	83 102 114	6.35
ARM063100 **ARM063140** **ARM063178**	63	100 140 178	7.94
ARM080100 **ARM080140** **ARM080178**	80	100 140 178	7.94

Lamina ball-bearing retainers (ARM) are made of a heat-treated aluminum alloy that combines lightness and strength.

Each retainer is quality inspected for dimensional tolerance and all burrs are removed prior to ball insertion.

Ball bearings are of the highest quality ISO 3290 Grade 24, continually inspected to meet our exacting tolerance.

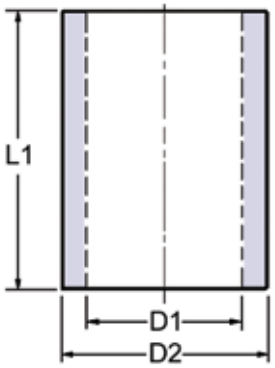
After the ball bearings have been inserted into the retainer, they are then staked using Lamina's unique method that allows free movement with maximum security.

After staking, the retainers are then scrubbed to remove all metal particles that could cause accelerated tracking and grooving in the post and bushing.

Ball bearings are placed in retainers in an off-line radial pattern that offers optimum life in high or low speed presses.

Ball-bearing retainers are fastened to the guide post by means of a set screw and slot in guide post and are inter-changeable with other manufacturers using this method.

Ball-Bearing Sleeve Bushings – Metric



- **Vacuum degassed chrome alloy steel**
- **Ground & honed to exact tolerance limits**
- **Top chamfered on I.D. to aid in alignment**

Lengths up to 300mm – centerless ground
Lengths over 300mm – ground on centers

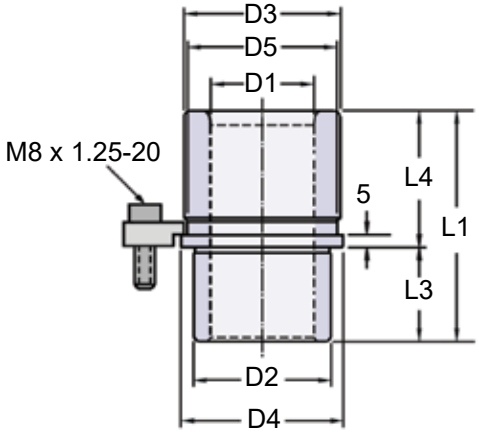
BALL-BEARING SLEEVE BUSHINGS – METRIC									
PART NUMBER	NOM PIN DIA	D1	D2	L1	PART NUMBER	NOM PIN DIA	D1	D2	L1
ABM032075	32	41.986 / 41.979	54.005 / 53.995	75	ABM050175	50	63.986 / 63.978	81.005 / 80.995	175
ABM032080				80	ABM050190				190
ABM032090				90	ABM050200				200
ABM032095				95	ABM050215				215
ABM032100				100	ABM050230				230
ABM032105				105	ABM050250				250
ABM032115				115	ABM050280				280
ABM032125				125	ABM050300				300
ABM032140				140	ABM050330				330
ABM032150				150	ABM050350				350
ABM032165				165	ABM063150	63	76.985 / 76.977	95.005 / 94.995	150
ABM032175				175	ABM063165				165
ABM032200				220	ABM063175				175
ABM032230				230	ABM063190				190
ABM040100	40	49.986 / 49.979	65.005 / 64.995	100	ABM063200				200
ABM040105				105	ABM063215				215
ABM040115				115	ABM063230				230
ABM040120				120	ABM063250				250
ABM040125				125	ABM063280				280
ABM040135				135	ABM063300				300
ABM040140				140	ABM063330				330
ABM040150				150	ABM063350				350
ABM040165				165	ABM080150	80	93.985 / 93.977	112.005 / 111.995	150
ABM040175				175	ABM080165				165
ABM040190				190	ABM080175				175
ABM040200				200	ABM080190				190
ABM040215				215	ABM080200				200
ABM040230				230	ABM080215				215
ABM040250				250	ABM080230				230
ABM040280				280	ABM080250				250
ABM040300				300	ABM080280				280
ABM050125	50	63.986 / 63.978	81.005 / 80.995	125	ABM080300				300
ABM050135				135	ABM080330				330
ABM050140				140	ABM080350				350
ABM050150				150	ABM080500				500
ABM050165				165					

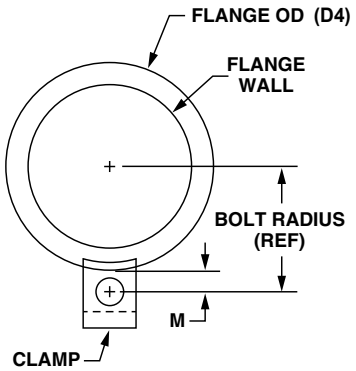
Ball-Bearing Bushings – Tap Fit – Metric

Demountable shoulder bushings offer all the advantages of straight sleeve bushings and combine them with the convenience of easy assembly and disassembly.

These clamp type bushings are meant to be wring fit into the die shoe and should never be forced or inserted by hammering.

X-40-Clamps and socket head screws are provided to hold the bushings in place.



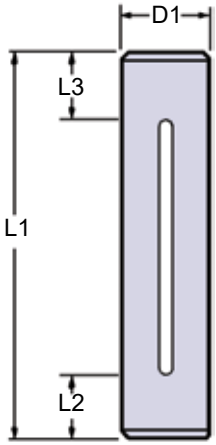


M = Flange OD to Clamp Bolt Center
Bolt Radius = (Flange OD ÷ 2) + M

BALL-BEARING BUSHINGS – DEMOUNTABLE – METRIC

PART NUMBER	NOM PIN DIA	D1	D2	D3	D4	D5	M	Bolt Radius (REF)	L1	L3	L4
ABGM032065	32	41.986 / 41.979	53.959 / 53.951	59.94	61	54.10	6.25	36.75	65	30	35
ABGM032070									70		40
ABGM032075									75		45
ABGM032080									80		50
ABGM032085									85		55
ABGM032090									90		60
ABGM032095									95		65
ABGM032105									105		75
ABGM032110									110		80
ABGM032115									115		85
ABGM032130									130		100
ABGM032140									140		110
ABGM032155									155		125
ABGM040075	40	49.986 / 49.979	64.960 / 64.952	63.50	72	65.10	6	42	75	35	40
ABGM040080									80		45
ABGM040085									85		50
ABGM040090									90		55
ABGM040095									95		60
ABGM040100									100		65
ABGM040110									110		75
ABGM040115									115		80
ABGM040120									120		85
ABGM040125									125		90
ABGM040135									135		100
ABGM040140									140		105
ABGM040155									155		120
ABGM050075	50	63.986 / 63.978	80.959 / 80.951	85.73	91	84.15	6	51.5	75	35	40
ABGM050090									90		55
ABGM050095									95		60
ABGM050100									100		65
ABGM050110									110		75
ABGM050115									115		80
ABGM050125									125		90
ABGM050135									135		100
ABGM050140									140		105
ABGM050155									155		120
ABGM050165									165		130
ABGM050180									180		145
ABGM050190									190		155
ABGM063125	63	76.985 / 76.977	94.960 / 94.952	101.85	105	98.43	6	58.5	125	35	90
ABGM063140									140		105
ABGM063155									155		120
ABGM063165									165		130
ABGM063180									180		145
ABGM063190									190		155
ABGM080125	80	93.985 / 93.977	111.960 / 111.952	114.30	122	113.00	6	67	125	35	90
ABGM080140									140		105
ABGM080155									155		120
ABGM080165									165		130
ABGM080180									180		145
ABGM080190									190		155

Ball-Bearing Guide Posts –Straight – Metric



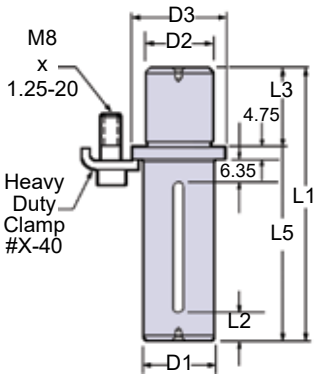
- Hardened chrome alloy steel
- Precision Ground

Lengths up to 300mm – centerless ground
Lengths over 300mm – ground on centers

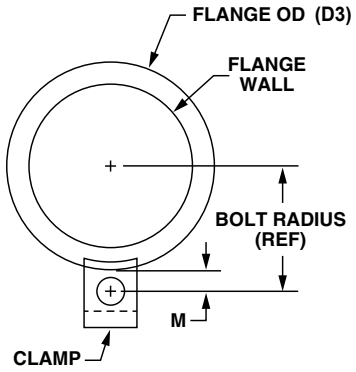
BALL-BEARING GUIDE POSTS – METRIC

PART NUMBER	NOM PIN DIA	D1	L1	L2	L3	# of Slots	PART NUMBER	NOM PIN DIA	D1	L1	L2	L3	# of Slots
APM032125			125	25.4	34.9		APM050215			215	47.6	57.2	
APM032135			135	25.4	34.9		APM050230			230	47.6	57.2	
APM032140			140	25.4	34.9		APM050240			240	47.6	57.2	
APM032145			145	25.4	34.9		APM050250			250	47.6	57.2	
APM032150			150	28.6	44.5		APM050265			265	47.6	57.2	
APM032165			165	28.6	44.5		APM050280			280	47.6	76.2	
APM032175			175	28.6	44.5		APM050290			290	47.6	76.2	
APM032190	32	32.008/32.000	190	28.6	44.5	1	APM050300	50	50.008/50.000	300	47.6	76.2	2
APM032200			200	28.6	44.5		APM050315			315	47.6	76.2	
APM032215			215	28.6	44.5		APM050330			330	47.6	76.2	
APM032230			230	28.6	44.5		APM050360			360	47.6	76.2	
APM032250			250	28.6	57.2		APM050380			380	47.6	76.2	
APM032260			260	28.6	57.2		APM050400			400	47.6	76.2	
APM032280			280	28.6	57.2		APM050430			430	47.6	76.2	
APM032300			300	28.6	57.2		APM050460			460	47.6	76.2	
APM040125			125	34.9	33.3		APM063200			200	41.3	63.5	
APM040135			135	34.9	33.3		APM063215			215	41.3	63.5	
APM040140			140	34.9	33.3		APM063230			230	41.3	63.5	
APM040145			145	31.8	39.7		APM063240			240	60.3	76.2	
APM040150			150	31.8	39.7		APM063250			250	60.3	76.2	
APM040165			165	34.9	39.7		APM063265			265	60.3	76.2	
APM040175			175	34.9	50.8		APM063280	63	63.008/63.000	280	60.3	76.2	2
APM040190			190	34.9	50.8		APM063300			300	60.3	76.2	
APM040200			200	34.9	50.8		APM063315			315	60.3	76.2	
APM040215	40	40.008/40.000	215	34.9	50.8	1	APM063330			330	60.3	76.2	
APM040230			230	41.3	63.5		APM063360			360	60.3	76.2	
APM040240			240	41.3	63.5		APM063380			380	60.3	76.2	
APM040250			250	41.3	63.5		APM063430			430	66.7	101.6	
APM040265			265	41.3	63.5		APM063500			500	66.7	101.6	
APM040280			280	41.3	63.5		APM080200			200	47.6	63.5	
APM040290			290	41.3	63.5		APM080215			215	47.6	63.5	
APM040300			300	41.3	63.5		APM080230			230	47.6	63.5	
APM040315			315	41.3	63.5		APM080250			250	73.0	76.2	
APM040330			330	41.3	63.5		APM080280	80	80.008/80.000	280	73.0	76.2	2
APM040360			360	41.3	63.5		APM080300			300	73.0	76.2	
APM050150			150	34.9	38.1		APM080330			330	73.0	76.2	
APM050165			165	44.5	47.6		APM080360			360	73.0	76.2	
APM050175	50	50.008/50.000	175	44.5	47.6	2	APM080430			430	73.0	101.6	
APM050190			190	44.5	47.6		APM080500			500	73.0	101.6	
APM050200			200	44.5	47.6								

Ball-Bearing Guide Posts – Tap Fit – Metric



- Large savings in maintenance, repair costs and downtime
- Wide variety of sizes
- Long, trouble-free production runs
- Highest quality workmanship and materials
- "D2" dimension is finished ground



M = Flange OD to Clamp Bolt Center
Bolt Radius = (Flange OD ÷ 2) + M

BALL-BEARING GUIDE POSTS – METRIC – Tap Fit

PART NUMBER	NOM PIN DIA	D1	D2	D3	M	Bolt Radius (REF)	L1	L2	L3	L5	PART NUMBER	NOM PIN DIA	D1	D2	D3	M	Bolt Radius (REF)	L1	L2	L3	L5
APGM032115							115	25.4		85	APGM050165							165	44.45		116
APGM032120							120	25.4		90	APGM050170							170	44.45		121
APGM032125							125	25.4		95	APGM050175							175	44.45		126
APGM032135							135	25.4		105	APGM050180							180	44.45		131
APGM032140							140	25.4		110	APGM050190							190	44.45		141
APGM032145							145	25.4		115	APGM050195							195	44.45		146
APGM032150							150	28.58		120	APGM050200							200	44.45		151
APGM032165	32	32.008	31.953	40	5.5	25.5	165	28.58	30	135	APGM050215							215	47.63		166
APGM032175		32.000	31.940				175	28.58		145	APGM050230							230	47.63		181
APGM032190							190	28.58		160	APGM050240							240	47.63		191
APGM032200							200	28.58		170	APGM050250	50	50.008	49.952	63	5.5	37	250	47.63	49	201
APGM032215							215	28.58		185	APGM050260		50.000	49.939				260	47.63		211
APGM032230							230	28.58		200	APGM050280							280	47.63		231
APGM032250							250	28.58		220	APGM050290							290	47.63		241
APGM032280							280	28.58		250	APGM050300							300	47.63		251
APGM032300							300	28.58		270	APGM050315							315	47.63		266
APGM040115							115	34.93		79	APGM050330							330	47.63		281
APGM040120							120	34.93		84	APGM050360							360	47.63		311
APGM040125							125	34.93		89	APGM050380							380	47.63		331
APGM040135							135	34.93		99	APGM050400							400	47.63		351
APGM040140							140	31.75		104	APGM050430							430	47.63		381
APGM040145							145	31.75		109	APGM050460							460	47.63		411
APGM040150							150	31.75		114	APGM063200							200	41.28		151
APGM040165							165	34.93		129	APGM063215							215	41.28		166
APGM040175							175	34.93		139	APGM063230							230	41.28		181
APGM040190							190	34.93		154	APGM063250							250	60.33		201
APGM040200	40	40.008	39.952	48	5.5	29.5	200	34.93	36	164	APGM063280	63	63.008	62.952	76	5.5	43.5	280	60.33	49	231
APGM040215		40.000	39.939				215	41.28		179	APGM063300		63.000	62.939				300	60.33		251
APGM040230							230	41.28		194	APGM063330							330	60.33		281
APGM040240							240	41.28		204	APGM063360							360	60.33		311
APGM040250							250	41.28		214	APGM063430							430	66.68		381
APGM040260							260	41.28		224	APGM063500							500	66.68		451
APGM040280							280	41.28		244	APGM080200							200	47.6		138
APGM040290							290	41.28		254	APGM080215							215	47.6		153
APGM040300							300	41.28		264	APGM080230							230	47.6		168
APGM040315							315	41.28		279	APGM080250							250	73.02		188
APGM040330							330	41.28		294	APGM080280	80	80.008	79.952	93	5.5	52	280	73.02	62	218
APGM040360							360	41.28		324	APGM080300		80.000	79.939				300	73.02		238
APGM050140							140	34.93		91	APGM080330							330	73.02		268
APGM050145	50	50.008	49.952	63	5.5	37	145	34.93	49	96	APGM080360							360	73.02		298
APGM050150		50.000	49.939				150	34.93		101	APGM080430							430	73.02		368
APGM050155							155	44.95		106	APGM080500							500	73.02		438

Commitment to Quality & Customer Satisfaction

Dayton Lamina is a leading manufacturer of tool, die and mold components for the metal-working and plastics industries. As a customer-focused, world-class supplier of choice, we provide the brands, product breadth, distribution network and technical support for all your metal forming needs.

Our goal is to give our customers the most innovative and value-added products and services.

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