TYPE E APPLICATION GUIDE

At Moline, our goal is to provide you with the most reliable products, helpful service, and expert support. We work to make our application guides clear and easy to understand. But if you have further questions, please contact us. 800.242.4633

LUBRICATION - VARIOUS OPERATIONS

Normal Operation

Your Moline bearing has been greased at the factory and is ready to install and run. When establishing a re-lubrication schedule, note that a small amount of grease at frequent intervals is preferable to a large amount of grease at infrequent intervals. Table 1 below is a general guide for Lubrication. It should be noted that certain conditions may require a change of lubricating periods as dictated by experience.

High Speed Operation

At higher operating speeds, too much grease may cause overheating. In these cases, the amount of lubrication can only be determined by experience. If excess grease in the bearing causes overheating, it will be necessary to remove the grease fitting and run for 10 minutes. This will allow excess grease to escape. Then wipe off excess grease and replace the grease fitting.

Operating Temperatures

Normal temperature may range from "cool or warm to the touch" up to a point of "too hot to touch for more than a few seconds," depending on the bearing size, speed and surrounding conditions. Abnormally high bearing temperature may indicate faulty lubrication practices and/or misalignment. Unusually high temperature accompanied by excessive leakage of grease indicates too much grease. High temperature with no grease showing at the seals, particularly if the bearing is noisy, usually indicates too little grease.

Special Operating Conditions

Refer acid, chemical, extreme or other special operating conditions to the factory.

LUBRICATION INSTRUCTIONS

All Moline bearings are factory lubricated with No. 2 consistency lithium base grease that is suitable for most normal applications. Many ordinary cup greases will disintegrate at speeds far below those at which Moline bearings will operate successfully if proper grease is used. Relubricate with lithium base grease or a grease that is compatible with original lubricant and suitable for roller bearing service. It should be noted that when re-lubricating, adding a small amount of grease on a frequent basis is preferable to a large amount of grease infrequently. In unusual cases consult the factory or a reputable grease supplier.

Storage or Special Shutdown

If equipment will be idle for some time, before shutting down, add grease to the bearing, rotating the sleeve to distribute grease. If possible, cover the bearing to protect from dust and other contaminants. This will ensure protection of the bearing, particularly when exposed to severe environmental conditions. After lengthy storage, add a small amount of fresh grease before running.

TABLE 1 - LUBRICATION CHART

HOURS RUN PER DAY	SUGGESTED LUBRICATION PERIOD IN WEEKS							
	1 TO 250 RPM	251 TO 500 RPM	501 TO 750 RPM	751 TO 1000 RPM	1001 TO 1500 RPM	1501 TO 2000 RPM	2001 TO 2500 RPM	2501 TO 3000 RPM
8	12	12	10	7	5	4	3	2
16	12	7	5	4	2	2	2	1
24	12	5	3	2	1	1	1	1

Read Operations and Lubrication sections above before establishing lubrication schedule.

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After choosing the best bearing, make sure you specify the optimal grease for the application. We use premium Timken™ All Purpose lithium grease to assemble our bearings.
Moline Bearing has access to many of the differing Lubricants on the market today. If you have special or specific performance requirements from the lubricant used for your application, please contact us with the details and we will be glad to accommodate your request.

RADIAL/THRUST LOAD RATINGS

Moline Type E bearings have the capacity to carry heavy radial, thrust, and combined radial/thrust loads. The maximum recommended load which can be applied is limited by various components in the system, such as the bearing, housing, shaft, shaft attachment, speed and life requirements as listed in this catalog.

Select a bearing from the Type E Radial Load Ratings selection chart in pages 48-51 having a radial load rating at the operating speed equal to or greater than the calculated "Equivalent Radial Load" for a desired L10 life. This simple method is all that is required for the majority of applications and provides for occasional average shock loads. (Equivalent Radial Load = P). L10 Hours of Life is the life that may be expected from at least 90% of a given group of bearings operating under identical conditions.

For L10 Hours of Life other than those listed in the Type E Radial Load Ratings selection chart in pages 48-51, multiply the Equivalent radial load by one of the following factors:

For 50,000 L10 Hours of Life use the factor of 1.16; 80,000 - 1.34. Then select a bearing from the bold face (30000) L10 ratings only in the selection chart having a rating equal to or greater than this value.

Heavy Service

For heavy shock loads, frequent shock loads or severe vibrations, add up to 50% (according to severity of conditions) to the Equivalent Radial Load to obtain a modified radial load.

Thrust load values shown in the table below are recommended as a guide for normal applications that will give adequate L10 life. Where substantial radial load is also present, it is advisable to calculate the L10 life to assure it meets the requirements. The effectiveness of the shaft attachment to carry thrust load depends on proper tightening of the set screws, shaft tolerance, and shaft deflections. Therefore, it is advisable to use auxiliary thrust carrying devices such as shaft shoulder, snap ring, or a thrust collar to locate the bearing under heavier thrust loads or where extreme reliability is desired.

RPM RANGE	20–200	201–2000	OVER 2000
Recommended Thrust Load	C90/4	C90/8	C90/12

The shaft tolerances recommended in Table 2 on page 44 are adequate under normal radial, thrust, and combination radial/thrust load applications. The radial load is limited by the attachment to the shaft (see table on following page 43). Since the allowable load, especially at low speed, is very large, the shaft should be checked to assure adequate shaft strength.

The magnitude and direction of both the thrust and radial load must be taken into account when selecting a housing. When pillow blocks are utilized, heavy loads should be directed through the base. Where a load pulls the housing away from the mounting base, both the hold down bolts and housing must be of adequate strength. Auxiliary load carrying devices such as shear bars are advisable for side or end loading of pillow blocks and radial loads for flange units.

To determine the L10 hours of life for loads and RPM's not listed, use the following equation:

$$L_{10} = \left(\frac{C_{90}}{P}\right)^{10/3} \times \frac{1{,}500{,}000}{RPM}$$

Where:
L_{10} = Life, hours
C_{90} = Dynamic Capacity, lbs. (page 43)
P = Equivalent Radial Load, lbs.

When the load on a two row roller bearing is solely a radial load with no thrust (axial) load, the load is shared equally by both rows of rollers and the equivalent load is the same as the actual load. However, when a thrust (axial) load is applied, the loading on the two rows is shared unequally depending on the ratio of thrust to radial load. The use of the X (radial factor) and Y (thrust) factor from the table on page 43. convert the actual applied thrust and radial loads to equivalent radial load which has the same effect on the life of a bearing as a radial load of this magnitude.

$$P = XFR + YFA$$

Where:
P = Equivalent radial load, lbs.
FR = Radial load, lbs.—
(see page 37 for allowable slip fit maximum)
FA = Thrust (axial) load, lbs.
e = Thrust load to radial load factor (page 43)
X = Radial load factor (page 43)
Y = Thrust load factor (page 43)

To find X and Y, first calculate FA/FR and compare to e. Determine X and Y from the Thrust Factors and Seal Speeds chart on page 43. Light Thrust FA/FR less than or equal to e or heavy thrust FA/FR greater than e.

Substitute all known values into the equivalent radial load equation. The equivalent radial load (P) thus determined can be used in the L_{10} life formula or compared to the allowable equivalent radial load rating desired in the expanded rating table to select a bearing.

If the calculated value of P is less than FR then use P = FR.

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Type E Thrust Factors and Seal Speeds

SHAFT SIZE	e	LIGHT THRUST IF FA/FR≤E		HEAVY THRUST IF FA/FR≥E		LOAD RATING		SEAL SPEED LIMITS		MAXIMUM SLIP FIT RADIAL LOAD FR**
		X	Y	X	Y	DYNAMIC C_{90}* LBS.	STATIC C_0 LBS.	CONTACT RPM	LABYRINTH RPM	
1 - 1 1/4 25mm	.49	.87	1.77	.70	2.14	3810	15760	3800	4490	3100
1 3/8 - 1 7/16 35mm	.46	.87	1.89	.70	2.28	6100	26000	3200	3820	5000
1 1/2 - 1 11/16 40mm	.44	.87	1.96	.70	2.37	7860	33000	2800	3320	6400
1 3/4 - 2 45mm 50mm	.33	.87	2.64	.70	3.18	10300	43000	2650	3050	8400
2 3/16 55mm	.36	.87	2.38	.70	2.87	10900	48200	2300	2730	8900
2 1/4 - 2 1/2 60mm 65mm	.40	.87	2.17	.70	2.63	11600	54000	2100	2420	9500
2 11/16 - 3 70mm 75mm	.46	.87	1.87	.70	2.26	12300	61200	1965	2060	10000
3 3/16 - 3 1/2 80mm 85mm 90mm	.50	.87	1.71	.70	2.07	19600	108600	1640	1640	16000
3 15/16 - 4 100mm	.49	.87	1.77	.70	2.14	26900	154000	1530	1530	22000
4 7/16 - 4 1/2 110mm 115mm	.53	.87	1.63	.70	1.97	33000	188400	1360	1360	27000
4 15/16 - 5 125mm	.47	.87	1.83	.70	2.21	45500	266000	1200	1200	35000
5 7/16 - 6 130mm 135mm 140mm 150mm	.54	.87	1.76	.70	2.12	41500	354000	915	915	42400
6 7/16 - 7 160mm 170mm 180mm	.54	.87	1.61	.70	1.95	70500	574000	750	790	72000

* C90—Dynamic capacity based on a rated life of 90 million revolutions or 3,000 hours at 500 RPM.

** If load exceeds maximum allowable slip fit radial load, snug to light press fit of shaft is required.

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MOUNTING INSTRUCTIONS

It is critical to the performance of the bearing that it be mounted properly. Failure to follow proper mounting practice may result in reduced bearing life.

TABLE 2 - SHAFT SIZING

SHAFT DIAMETER	SHAFT TOLERANCES
1 – 1½ 35mm	Plus .0000" to minus .0005" Plus .0000" to minus .013mm
1⅝ – 4 40mm – 100mm	Plus .0000" to minus .0010" Plus .0000" to minus .025mm
4 7/16 – 6 110mm – 140mm	Plus .0000" to minus .0015" Plus .0000" to minus .038mm
6 7/16 – 7 160mm – 180mm	Plus .0000" to minus .0020" Plus .0000" to minus .051mm

For best results, clean the shaft and bore of the bearing. The shaft should be straight, free of burrs and nicks, and the correct size, Table 2. Lubricate the shaft and bearing bore with grease or oil to facilitate assembly. Slip bearing into position. When light press fit is required, press against the end of the inner ring of bearing. Do not strike or exert pressure on the housings or seals. Bolt the unit to the support, using shims where necessary to align bearing. Use shims that cover across the entire housing base.

Determine the final shaft position and hand tighten set screws firmly onto shaft. If possible, rotate the shaft slowly under load. If there is any strain, or vibration, it could be due to incorrect alignment, a bent shaft or bent supports. Tighten set screws alternately in small increments to the torque value listed Table 3. To ensure full locking of the inner race to the shaft, after 24 hours of operation the set screws should be retightened.

TABLE 3 - SET SCREW TORQUE

SHAFT SIZE IN	SHAFT SIZE MM	SET SCREW SIZE UNC	TORQUE (IN - LBS)
1	25	¼ – 20	80
1 3/16 - 1 ¼	-----	5/16 – 18	165
1 ⅜ - 1 7/16	35	5/16 – 18	165
1 ½ - 1 11/16	40	5/16 – 18	165
1 ¾ - 2	45 - 50	⅜ – 16	290
2 3/16	55	⅜ – 16	290
2 ¼ - 2 ½	60 - 65	⅜ – 16	290
2 11/16 - 3	70 - 75	½ – 13	620
3 3/16 - 3 ½	80 - 90	½ – 13	620
3 15/16 - 4	100	⅝ – 11	1325
4 7/16 - 4 ½	110 - 115	⅝ – 11	1325
4 15/16 - 5	125	⅝ – 11	1325
5 7/16 - 6	130 - 150	¾ – 10	2150
6 7/16 - 7	160 - 180	¾ – 10	2150

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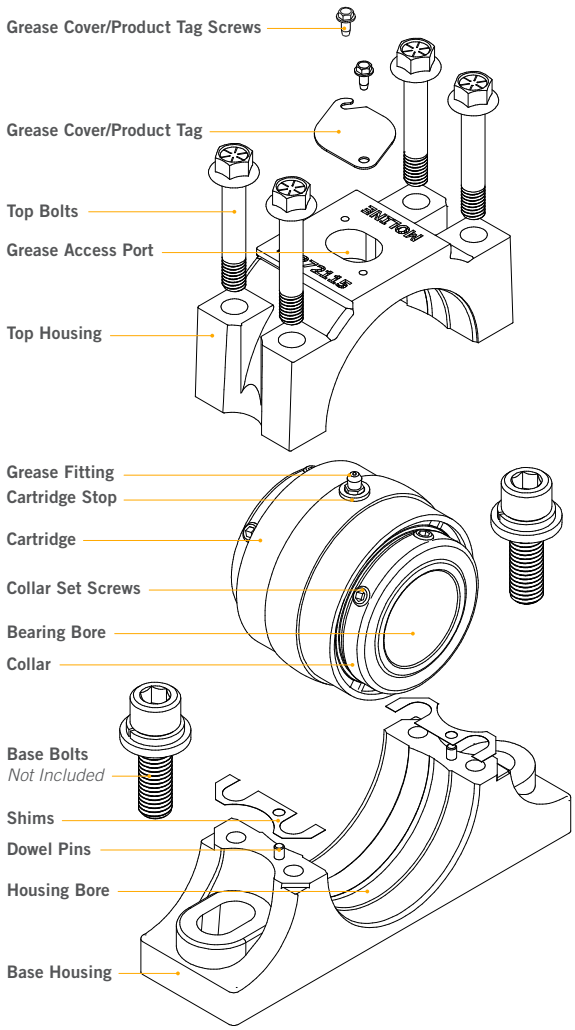
FITTING OR REPLACING A CARTRIDGE IN A SPLIT E1000 PILLOW BLOCK HOUSING

1. Please note that each Moline Split E1000 Bearing has been properly assembled at the factory as a "paired" and "installation ready" Complete Unit. Top Housings and Base Housings are paired and are not interchangable. Shims should NOT be removed.
2. When disassembling or reassembling, all component parts should be kept clean. All mating surfaces should be clean as any buildup or debris will result in incorrect bearing assembly and performance.
3. Moline Split E1000 Housings have Dowel Pins which ensure mating of the Top and Base Housings to accurately align when reassembling.



4. Prior to lubrication and assembly, ensure that the Housing Bore is free of any old buildup or debris. Lightly lubricate the Top and Base Housing Bore with Anti-Seize compound before installing the Cartridge.
5. Fit Cartridge into the mounted Base Housing making sure to center and orient the Cartridge properly. Align the Grease Fitting with the Grease Access Port in the Top Housing. Then fit the Top Housing, securing it first by loosely tightening the Top Bolts to firmly hold all of the component parts while adjusting and aligning the Cartridge and shaft.
6. If needed, and only after proper and accurate measurement, add or remove shims between Top Housing and Base Housing as required to obtain a "snug" fit of Cartridge in the Complete Unit with Top Bolts tightened to the specified torque in Table 4.

TABLE 4 - TOP BOLT TORQUE (GRADE 8 BOLTS)

BORE SIZE	BOLT SIZE INCHES UNC	TORQUE FT - LBS
1 3/16 - 1 1/4	5/16 – 18	20-25
1 3/8 - 1 7/16	5/16 – 16	35-45
1 1/2 - 1 11/16	5/16 – 16	35-45
1 3/4 - 2	3/8 – 14	55-70
2 3/16	3/8 – 14	55-70
2 1/4 - 2 1/2	3/8 – 13	85-110
2 11/16 - 3	1/2 – 13	85-110
3 3/16 - 3 1/2	1/2 – 11	170-210
3 15/16 - 4	5/8 – 11	170-210
4 7/16 - 4 1/2	5/8 – 10	300-380
4 15/16 - 5	5/8 – 10	300-380

7. Check for a "snug" fit by gently moving the Cartridge so as not to damage the grease fitting, this can be performed with a small wide blade screwdriver against the base or catridge stop of the Grease Fitting through the Grease Access Port located in the Top Housing. Please note that care must be taken to avoid damage to the Grease Fitting due to excessive force.

8. The "snug" fit becomes a matter of judgment. A "loose" or "sloppy" fit may allow the Cartridge to move in its Top and Base Housing thus wearing the mating surfaces and Housing Bore. Too tight of a fit will not permit the unit to move and compensate for misalignment and for shaft deflection caused by belt pull and dead weight.

9. Install bearings as per the following installation instruction

INSTALLATION OF ALL BEARINGS

1. Moline Split E1000 Bearings are assembled and shipped using Grade 8 Bolts. Use of Grade 8 Bolts allows for installation in Light, Medium and Heavy Load applications.

2. Please note that a Moline Split E1000 Bearing has been properly assembled at the factory as a "paired" and "installation ready" Complete Unit. Top Housings and Base Housings are paired and are not interchangable. Shims should NOT be removed.

3. Clean all mating surfaces as any buildup or debris will result in inaccurate bearing assembly and performance. Inspect the Shaft, Housing Bore and Cartridge of the bearing. At this point check for burrs or nicks that would inhibit performance.

INSTALLATION FOR MEDIUM SPEEDS WITH NORMAL AND HEAVY LOADS

4. The following steps can be applied to both Expansion and Non-Expansion bearing set-up.

5. Clean the shaft and Bore. Lubricate with light oil.

6. Position and mount Base Housing to the proper mounting surface on your equipment. Insert and hand tighten Base Bolts so that the Base Housing is free to move during alignment. Once the correct position is affirmed you will tighten to your equipment's specific torque requirements. For heavy loads and high-speed applications, use Grade 8 Base Bolts for mounting.

7. Loosen set screws in Cartridge collar and slide Cartridge into position on the shaft.

8. Accurately place the Cartridge and Shaft into the center of the Base Housing. For expansion bearings locate unit in center of its axial travel or at extreme if maximum expansion is required.

9. Keeping the Top Bolts in the Top Housing slightly loose with a proper tension will allow the Cartridge free movement to align within the Housing. If Top Bolts are too tight the Cartridge will not align properly within the Housing. If needed for proper adjustment the Base Bolts can be slightly loose during alignment so that the Complete Unit can move if needed on the shaft. Maintaining a proper tension during adjustment and setup will help prevent pre-loading or inducing an initial thrust on the bearing.

10. Check to ensure that all Base Bolts have been tightened to your equipment's specific torque requirements.

11. Always replace the Grease Fitting protective Grease Cover/Product Tag.

12. Within the first 24 hours of operation, recheck the Top Bolts - Table 4, Set Screws - Table 3, and Base Housing Bolts to the correct torque specifications.

INSTALLATION FOR HIGH SPEEDS WITH LIGHT LOADS

13. Follow previous steps 1 thru 12 first.

14. For applications that operate at high speeds (above 75% of rated speed) or under light loads (less than 2% of Dynamic Capacity) follow the below instructions.

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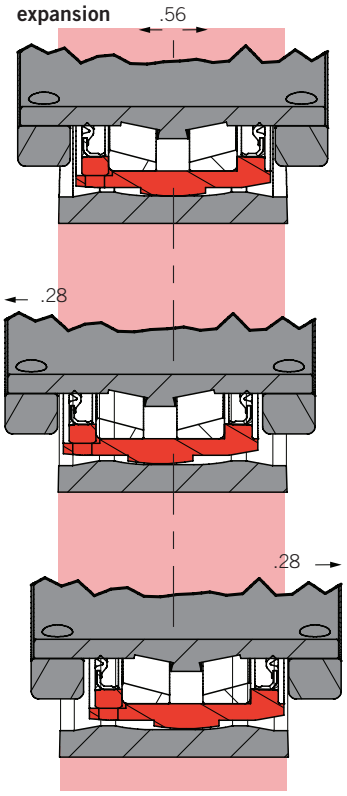
15. Due to the High Speeds and Light Loads, accurate alignment is essential.

For Expansion Units:

a. *Expansion type housings should be placed so the Cartridge can move freely in either direction evenly on the shaft.*

b. *If maximum travel is needed due to greater shaft expansion move the Cartridge to the desired position. Make sure to keep the Grease fitting collar base or stop pin from hitting and restricting free movment.*



For Non-Expansion Units:

a. *Mount a dial indicator on the shaft near the Cartridge face. Place the dial indicator probe so that it contacts the machined surface of the Cartridge Housing, perpendicular to the face of the Cartridge.*

b. *Zero the indicator and sweep or rotate the machined face 360°, noting the total indicator turnout.*

c. *If the total indicator turnout is less than or equal to the value shown on* Table 5*, tighten the Housing Top Bolts per* Table 4*.*

TABLE 5 - TOTAL INDICATOR RUN-OUT (TIR)	
BORE SIZE	**TIR**
1 3/16 - 1 1/4	0.0028
1 3/8 - 1 7/16	0.0030
1 1/2 - 1 11/16	0.0035
1 3/4 - 2	0.0040
2 3/16	0.0040
2 1/4 - 2 1/2	0.0045
2 11/16 - 3	0.0055
3 3/16 - 3 1/2	0.0065
3 15/16 - 4	0.0070
4 7/16 - 4 1/2	0.0080
4 15/16 - 5	0.0085
5 7/16 - 7	0.0090

d. *If the total indicator turnout is greater than shown on* Table 5*, gently tap the machined face of the Cartridge Unit Housing until the total indicator turnout is less than or equal to the value shown on* Table 5*.*

e. *Once Total Indicator Reading (TIR) is achieved, torque the housing Top Bolts per* Table 4*.*

f. *Rotate the shaft and indicator dial again to verify that the total indicator turnout is still less than or equal to the value shown on* Table 5*.*

16. Once Cartridge is accurately placed, tighten Top Bolts to values shown in Table 4.

17. Tighten Cartridge Collar Set Screws to the torque values shown in Table 3.

18. Turn shaft several revolutions to allow alignment of Cartridge(s) in their respective housings. Re-check and re-tighten Top Bolts of both expansion and non-expansion Housings to recommended torque shown in Table 4.

20. Proactive inspection and maintenance of all equipment is critical to healthy bearing life.

21. Always replace the Grease Cover/Product Tag after lubrication.

22. Within the first 24 hours of operation, recheck the Top Bolts - Table 4, Set Screws - Table 3, and Base Housing Bolts to the correct torque specifications.