



Special Duty

SPECIAL DUTY-DOUBLE ROW TAPERED ROLLER BEARINGS

DODGE Special Duty Double Row Tapered Roller Bearings have the highest capacity of all DODGE Tapered Roller Bearings. They carry heavy radial loads and combined radial and thrust loads. The maximum recommended load which can be applied is limited by various components in the system such as bearing, housing, shaft, shaft attachment, speed and life requirements as listed in this catalog. DODGE Special Duty Tapered Roller Bearings have been applied successfully even when these limits have been exceeded under controlled operating conditions. Contact DODGE Application Engineering (864) 284-5700 for applications which exceed the recommendations of this catalog.

L₁₀ Hours Life* --- The life which may be expected from at least 90% of a given group of bearings operating under identical conditions.

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

Where:

C₉₀ = Dynamic Capacity (Table 4, pg. B11-25), lbs

P = Equivalent Radial Load, lbs.

GENERAL

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. Consult DODGE Application Engineering for additional selection assistance.

Thrust load values shown in the table below are recommended as a guide for general applications that will give adequate L₁₀ life for pillow blocks. The maximum thrust load should not exceed values shown on Table 6. Where substantial radial load is also present, it is advisable to calculate actual L₁₀ life to assure that it meets the requirements. The effectiveness of the shaft attachment to carry thrust load depends on proper tightening, shaft tolerance (see table below) 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 thrust loads heavier than shown below, or where extreme reliability is desired.

RPM RANGE	20-200	201-2000	Over 2000
Recommended Thrust Load	C ₉₀ /4	C ₉₀ /8	C ₉₀ /12

The shaft tolerances recommended below are adequate for normal radial and radial/thrust load applications. Since the

allowable load, especially at a 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 uplift loads are involved, see Table 9, pg. B11-29 for maximum values.** 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 load for flange units.

Shaft Size	Tolerance, Inches
Up To 1-1/2"	+0.000-.002"
1-9/16 To 2-1/2"	+0.000-.003"
2-1/2 To 4"	+0.000-.004"
4-3/16 To 6"	+0.000-.005"
6-7/16 To 8"	+0.000-.006"

L₁₀ Life Adjustment - The calculated L₁₀ Life obtained from this procedure is subject to life adjustment factors in accordance with ABMA standards described on page B16-9. Consult Application Engineering for assistance.

SELECTING BEARINGS SUPPORTING RADIAL LOADS ONLY

1. Define L₁₀ Life Hours desired.
2. Establish bearing radial load, F_R (F_R = P for Pure Radial Load Conditions). The DODGE program BEST can be used to find application loads.
3. Establish RPM.

Using the easy selection Table 5, pg. B11-26 find, under the RPM column, the equivalent radial load that equals or is higher than the application radial load for the desired life. The shaft size on the far left will be the minimum shaft size that you can use for your application. If the desired life is different than the values shown on the chart, use alternate Method A shown below.

Example:

1. L₁₀ Life = 30,000 Hours
2. Radial load = 3800 lbs.
3. RPM = 1,000

At the intersection of the 1,000 RPM column and the 30,000 hours L₁₀ life row, the equivalent radial load of 4362 lbs. Exceeds the 3800 lbs. Radial load for shaft sizes 2-1/8" to 2-1/4". A bearing with bore ranging from 2-1/8" to 2-1/4" may be used for this application.

FEATURES/BENEFITS PAGE B11-3	SPECIFICATION B11-20	SELECTION B11-23	SELECTION/DIMENSIONS PAGE B11-30
---------------------------------	-------------------------	---------------------	-------------------------------------



SELECTION

Special Duty

ALTERNATE METHOD A - SELECTING A BEARING FOR AN L₁₀ LIFE VALUE NOT SHOWN IN THE EASY SELECTION CHART.

The L₁₀ life equation can be rearranged so that the bearing dynamic capacity C is identified in terms of L₁₀, RPM and P.

$$C_{90} = \left(\frac{L_{10} \times \text{RPM}}{1,500,000} \right)^{0.3} \times P$$

(P = F_R for Pure Radial Load Conditions)

Since the L₁₀, RPM, and P are known, solve for C₉₀. Select from the dynamic capacity column on Table 4, pg. B11-25 the C₉₀ value equal to or greater than the C₉₀ value just calculated. The bore size on the far left represents the bore size selection. Check that the application RPM does not exceed the MAX. RPM on Table 4. When selecting an L₁₀ life of less than 30,000 hours, particular attention must be paid to shaft deflection and proper lubricant selection.

SELECTING BEARINGS SUPPORTING COMBINATION RADIAL AND THRUST LOADS

When a bearing supports both a radial load and a thrust load, 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 Table 4 converts the applied thrust load and radial loads to an equivalent radial load having the same effect on the life of the bearing as a radial load of this magnitude.

The equivalent radial load $P = XF_R + YF_A$

Where:

- P = Equivalent radial load, lbs.
- FR = Radial load, lbs.
- FA = Thrust (axial) load, lbs.
- e = Thrust load to radial load factor (Table 4)
- X = Radial load factor (Table 4)
- Y = Thrust load factor (Table 4)

To find X and Y, calculate FA/FR and compare to e for the selected bore size. Determine X and Y from Table 4, pg. B11-25

depending on whether FA/FR is equal to or less than e, or FA/FR is greater than e. Substitute all known values into the equivalent radial load equation. P (equivalent radial load) can be used in the life formula to determine L₁₀, or it can be compared to the allowable equivalent radial load ratings for the speed and hours life desired in the easy selection Table 5, pg. B11-26 & B11-27.

SELECTING BEARINGS SUPPORTING ONLY THRUST LOADS

Tapered Roller Bearings perform extremely well under pure thrust load applications. Use $P = YF_A$ for the equivalent radial load. The value of Y is obtained from Table 4, pg. B11-25 for $FA/FR > e$. Substitute Y and F_A into the equivalent load equation. P (equivalent radial load) can be used in the life formula to determine L₁₀ or it can be compared to the allowable equivalent radial load ratings for the speed and hours life desired in the easy selection Table 5, pg. B11-26 & B11-27.

LUBRICATION

DODGE Special Duty Tapered Roller Bearings are lubricated at the factory with Mobilgrease XHP222. This grease will adequately handle low and medium speeds with low and medium loads at normal temperatures as defined on Table 8, pg. B11-29 For very low and high speeds, for heavy loads and for low and high temperatures, special greases must be used. Contact DODGE Application Engineering (864) 284-5700. DODGE engineers will recommend bearings and lubricants for the above unusual conditions. DODGE also has the expertise to custom design and build special bearings for your needs. The only maintenance requirement for DODGE Tapered Roller Bearings is periodic relubrication at regular intervals as outlined in the appropriate instruction manuals.

INSTALLATION AND MAINTENANCE

In nearly all applications good design practice requires two bearings supporting the shaft. In cases where three or more bearings are installed, unless precautions are taken to line the bearings up, both vertically and horizontally, it is possible to induce heavy loads. In the case of two bearings, alignment is not as critical, especially with DODGE Special Duty Tapered Roller Bearings. Special Duty bearings are designed to allow as

The DODGE Bearing Evaluation and Selection Technique (BEST) is a menu driven computer program that calculates bearing loads, fatigue life and operating temperature for a two bearing shaft system based on user supplied input parameters. This interactive program is available at www.ptwizard.com under the Product Selection area.

FEATURES/BENEFITS PAGE B11-3	SPECIFICATION B11-20	SELECTION B11-23	SELECTION/DIMENSIONS PAGE B11-30
---------------------------------	-------------------------	---------------------	-------------------------------------



Special Duty

much as 2° to 5° of static misalignment up to 8" bore size. 1° to 1.5° for bore sizes greater than 8". To ensure good alignment, mounting surfaces must be checked for flatness and must lie in the same plane. When tightening base bolts and cap bolts, each

bolt should be alternately tightened in incremental torque values until full torque is achieved to prevent the angular shifting of the pillow block that occurs when one bolt is tightened to its full torque. Shimming may be required to minimize misalignment.

Table 4: Special Duty Roller Bearings Radial/Thrust Factors

Bore Size	e	F _A /F _R ≤ e		F _A /F _R ≥ e		Dynamic Capacity C ₉₀ (TS)		Maximum RPM
		X	Y	X	Y	LBS.	NEWTONS	
1-3/8 to 1-11/2	0.31	1	0	0.40	1.97	7,717	34,337	3250
1-9/16 to 1-3/4	0.43	1	0	0.40	1.39	8,177	36,373	2900
1-7/8 to 2	0.46	1	0	0.40	1.31	8,266	36,769	2700
2-1/8 to 2-1/4	0.49	1	0	0.40	1.23	10,716	47,681	2300
2-3/8 to 2-1/2	0.51	1	0	0.40	1.18	11,010	48,990	2180
2-5/8 to 3	0.27	1	0	0.40	2.23	21,331	94,912	1830
3-3/16 to 3-1/2	0.43	1	0	0.40	1.39	23,553	104,800	1510
3-11/16 to 4	0.43	1	0	0.40	1.41	35,145	156,380	1330
4-7/16 to 4-1/2	0.49	1	0	0.40	1.23	35,145	156,380	1120
4-15/16 to 5	0.46	1	0	0.40	1.31	43,550	214,339	1040
5-7/16 to 6	0.48	0.87	1.80	0.70	2.18	62,000	275,873	860
6-1/2 to 7	0.54	0.87	1.61	0.70	1.95	68,700	305,685	760
7-15/16 to 8	0.34	0.87	2.55	0.70	3.08	79,200	352,406	700
8-1/2 to 10	0.45	0.87	1.90	0.70	2.30	76,500	340,392	550
11 to 12	0.34	0.87	2.53	0.70	3.06	124,000	551,746	490

COMPARING SPHERICAL TO TAPER ROLLER BEARING

The dynamic capacity C (spherical) and C₉₀ (taper) are not to the same base.

To compare basic dynamic capacities, multiply C x .259 and compare to C₉₀.



SELECTION

Table 5: Dodge Special Duty Tapered Roller Bearings

Bore Size	Hours Life	Allowable Equivalent Radial Load Rating (Lbs.) At Various Revolutions Per Minute												
		50	100	250	500	750	1000	1250	1500	1750	2000	2500	3000	3500
1-3/8	5,000	13210	10730	8151	6621	5862	5378	5029	4762	4546	4368	4085	3868	3693
	10,000	10730	8715	6621	5378	4762	4368	4085	3868	3693	3548	3318	3142	3000
	30,000	7717	6268	4762	3868	3425	3142	2938	2782	2656	2552	2386	2259	2157
	50,000	6621	5378	4085	3318	2938	2695	2521	2386	2279	2189	2047	1938	1851
1-7/16	5,000	13997	11369	8637	7015	6212	5698	5329	5045	4817	4628	4329	4098	
	10,000	11369	9235	7015	5698	5045	4628	4329	4098	3913	3759	3516	3329	
	30,000	8177	6642	5045	4098	3629	3329	3113	2948	2814	2704	2529	2394	
	50,000	7015	5698	4329	3516	3113	2856	2671	2529	2414	2320	2169	2054	
1-11/16	5,000	14149	11493	8731	7092	6279	5760	5387	5100	4870	4679	4376		
	10,000	11493	9335	7092	5760	5100	4679	4376	4143	3956	3800	3554		
	30,000	8266	6714	5100	4143	3668	3365	3147	2980	2845	2733	2556		
	50,000	7092	5760	4376	3554	3147	2887	2700	2556	2441	2345	2193		
2	5,000	18343	14899	11318	9193	8140	7467	6984	6612	6313	6065			
	10,000	14899	12102	9193	7467	6612	6065	5673	5371	5128	4927			
	30,000	10716	8704	6612	5371	4756	4362	4080	3863	3688	3543			
	50,000	9193	7467	5673	4608	4080	3743	3500	3314	3164	3040			
2-1/8	5,000	18847	15308	11629	9446	8364	7672	7175	6794	6487	6232			
	10,000	15308	12434	9446	7672	6794	6232	5828	5518	5269	5062			
	30,000	11010	8943	6794	5518	4886	4482	4192	3969	3789	3641			
	50,000	9446	7672	5828	4734	4192	3845	3596	3405	3251	3123			
2-1/2	5,000	36514	29658	22530	18300	16204	14864	13902	13162	12567				
	10,000	29658	24090	18300	14864	13162	12074	11292	10691	10208				
	30,000	21331	17326	13162	10691	9466	8684	8121	7689	7342				
	50,000	18300	14864	11292	9172	8121	7450	6967	6597	6298				
3	5,000	40317	32748	24877	20207	17892	16413	15350	14533					
	10,000	32748	26600	20207	16413	14533	13331	12468	11804					
	30,000	23553	19131	14533	11804	10452	9588	8967	8490					
	50,000	20207	16413	12468	10127	8967	8226	7693	7284					
3-1/2	5,000	60160	48865	37121	30152	26698	24491	22905						
	10,000	48865	39691	30152	24491	21686	19893	18604						
	30,000	35145	28547	21686	17614	15597	14307	13381						
	50,000	30152	24491	18604	15112	13381	12274	11480						
4	5,000	60160	48865	37121	30152	26698	24491							
	10,000	48865	39691	30152	24491	21686	19893							
	30,000	35145	28547	21686	17614	15597	14307							
	50,000	30152	24491	18604	15112	13381	12274	11480						
4-1/2	5,000	74548	60551	45998	37362	33083	30348							
	10,000	60551	49183	37362	30348	26872	24650							
	30,000	43550	35374	26872	21827	19327	17729							
	50,000	37362	30348	23054	18726	16581	15210							
5	5,000	74548	60551	45998	37362	33083	30348							
	10,000	60551	49183	37362	30348	26872	24650							
	30,000	43550	35374	26872	21827	19327	17729							
	50,000	37362	30348	23054	18726	16581	15210							
UNIFIED SAF	5,000	24491	19893	15112	12274	10869	9970	9324						
	10,000	19893	15112	12274	10869	9970								
	30,000	14307	11480	9324	7614	6729	6183	5747	5389	5081	4811	4571	4351	4151
	50,000	12274	10869	9970										

FEATURES/BENEFITS PAGE B11-3	SPECIFICATION B11-20	SELECTION B11-23	SELECTION/DIMENSIONS PAGE B11-30
---------------------------------	-------------------------	---------------------	-------------------------------------



Table 5: Dodge Special Duty Tapered Roller Bearings

Bore Size	Hours Life	Allowable Equivalent Radial Load Rating (Lbs.) At Various Revolutions Per Minute												
		50	100	250	500	750	1000	1250	1500	1750	2000	2500	3000	3500
5-7/16 5-15/16 6	5,000	106130	86205	65485	53190	47100								
	10,000	86205	70020	53190	43205	38255								
	30,000	62000	50360	38255	31075	27515								
	50,000	53190	43205	32820	26660	23605								
100,000	43205	35090	26660	21655	19175									
6-1/2 6-15/16 7	5,000	117600	95520	72560	58940	52190								
	10,000	95520	77585	58940	47575	42390								
	30,000	68700	55800	42390	34430	30490								
	50,000	58940	47875	36365	29540	26155								
100,000	47875	38885	29540	23995	21245									
7-15/16 8	5,000	135570	110120	83650	67945	60165								
	10,000	110120	89445	67945	55190	48870								
	30,000	79200	64330	48870	39695	35145								
	50,000	67945	55190	41925	34055	30155								
100,000	55190	44830	34055	27660	24490									
8-1/2 9 9-1/2 10	5,000	130950	106365	80800	65630									
	10,000	106365	86395	65630	53310									
	30,000	76500	62135	47250	38340									
	50,000	65630	53310	40495	32895									
100,000	53310	43300	32895	26715										
11 12	5,000	212260	172410	130970	106380									
	10,000	172410	140040	106380	86410									
	30,000	124000	100720	76510	62145									
	50,000	106380	86410	65640	53315									
100,000	86410	70185	53315	43305										

Bearing Reference Guide
 E-Family Roller Bearings
 Specialty Tapered Products
 S-2000
 UNISPHERE II
 IMPERIAL
 UNIFIED SAF



SELECTION

Special Duty

Table 6: Special Duty Pillow Blocks Housing Permissible Thrust Load, Lbs. *

Shaft Size, Inches	2-Bolt	4-Bolt	Shaft Size, Inches	2-Bolt	4-Bolt
1-3/8	1521	---	3-11/16	---	8250
1-7/16			3-3/4		
1-1/2			3-7/8		
1-9/16	1772	---	3-15/16	---	10538
1-5/8			4		
1-11/16			4-7/16		
1-3/4	1964	---	4-1/2	---	12190
1-7/8			4-15/16		
1-15/16			5		
2	2325	---	5-7/16	---	17957
2-1/8			5-15/16		
2-3/16			6		
2-1/4	3122	3122	6-1/2	---	24115
2-3/8			6-15/16		
2-7/16			7		
2-1/2	4375	4375	7-15/16	---	27260
2-5/8			8		
2-11/16			8-1/2		
2-3/4	4375	4375	9	---	38138
2-13/16			9-1/2		
2-7/8			10		
2-15/16	6118	6118	11	---	50655
3			12		
3-3/16					
3-1/4					
3-3/8					
3-7/16					
3-1/2					

* The limits above apply to pillow blocks. For thrust loads larger than listed or heavy thrust loading on other style housing, contact DODGE Engineering for recommendation.

Table 7: Special Duty Maximum Total Axial Expansion

Shaft Size - Inches	Special Duty		
	2-Blt. P.B.	4-Blt. P.B.	Fig.
1-3/8 - 1-1/2	3/16	-	3/16
1-9/16 - 1-3/4	5/8	-	1/4
1-7/8 - 2	5/8	-	1/4
2-1/8 - 2-1/4	5/8	-	1/4
2-3/8 - 2-1/2	5/8	5/8	1/4
2-5/8 - 3	3/4	5/8	5/8
3-3/16 - 3-1/2	3/4	3/4	3/4
3-11/16 - 4	-	3/4	1/4
4-7/16 - 4-1/2	-	3/4	5/8
4-15/16 - 5	-	3/4	5/8
5-7/16 - 6	-	3/4	5/8
6-1/2 - 7	-	1-1/2	-
7-15/16 - 8	-	1-1/2	-
8-1/2 - 10	-	1-1/2	-
11 - 12	-	1-1/2	-

Bearing Reference Guide

E-Family Roller Bearings

Specialty Tapered Products

S-2000

UNISPHERE II

IMPERIAL

UNIFIED SAF



Special Duty

Table 8: Definition of Operating Conditions For Tapered Roller Bearings

LOW SPEED	UP TO 20% OF MAX. RPM (TABLE 4)
MEDIUM SPEED	OVER 20% TO 80% OF MAX. RPM
HIGH SPEED	OVER 80% OF MAX. RPM
LIGHT LOAD	UP TO 30% OF C ₉₀ (TABLE 4)
NORMAL LOAD	OVER 30% TO 70% OF C ₉₀
HEAVY LOAD	OVER 70% OF C ₉₀
LOW TEMPERATURE	-100°F TO 20°F
MEDIUM TEMPERATURE	OVER 20°F TO 200°F
HIGH TEMPERATURE	OVER 200°F TO 300°F
VERY HIGH TEMPERATURE	OVER 300°F TO 400°F

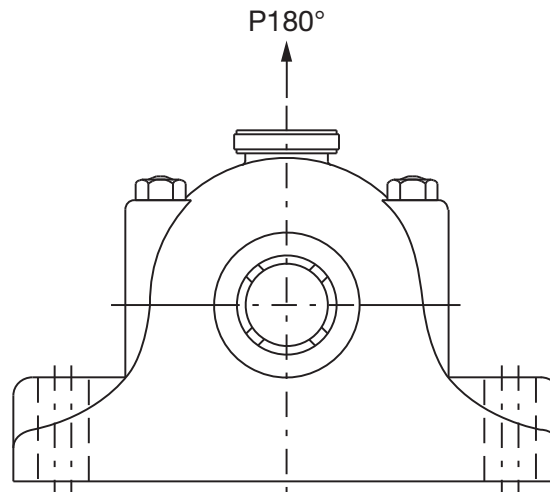


Table 9: Pillow Block Housing Ratings, Special Duty

Shaft Size (Inches)	Housing Strength Lbs. Gray Iron 180°
1-3/8 - 1-1/2	3,470
1-9/16 - 1-3/4	4,430
1-7/8 - 2	5,250
2-1/8 - 2-1/4	7,300
2-3/8 - 2-1/2	7,200
2-5/8 - 3	10,600
3-3/16 - 3-1/2	13,000
3-11/16 - 4	21,600
4-7/16 - 4-1/2	25,800
4-15/16 - 5	22,900
5-7/16 - 6	41,500
6-1/2 - 7	82,000
7-15/16 - 8	104,000