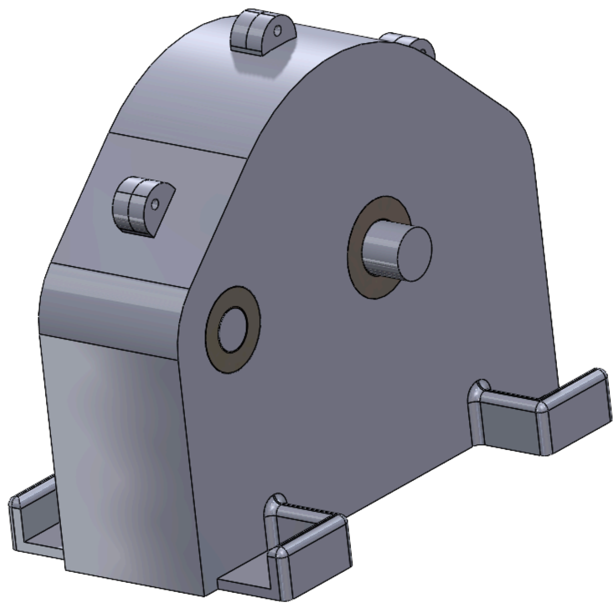
Gearbox Design Project



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ME 472 Mechanical System Design

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Table of Content

Introduction

In this gearbox design project, the speed and torque output of the CH440 Engine must be reduced and increased by a total of 12:1, respectively. Through this project, the design of the transfer box casing will be designed to meet such constraints. It will house an input shaft and 2 output shafts connected through a universal joint. Choices will be made in the types of gears that will be used, the dimensions of the shafts, the needed bearings, and the materials, all the parts considered in the design.

The engine will first be passed through a CVT, leaving a total of 4:1 speed reduction and torque increase by the transfer case. Given an initial input shaft diameter of one inch, verification of changing diameters will be made through stress and deflection analysis and force analysis of the bearing reactions and the gear outputs. For simplicity, only the engine's maximum output power specifications will be considered in the design.

Several specifications are given about the transfer box casing as a constraint for the design. The maximum dimension is 4” x 10” x 13”, with an input shaft parallel to two collinear output shafts, being mountable from the bottom, and must be optimized to minimize space and materials.

Synthesize and Modeling

In SOLIDWORKS, the gears were first designed to ensure they fit within the dimensions of the transfer box. Afterward, a simple rod design for the shafts is made to fit. The transfer box was designed last and the result was a form-fitting oval-shaped box because a rectangular box would have unoccupied spaces. Two holes are created on the back for the shafts to be held in place. This is the optimal size for the gears while wasting no material. The bottom of the box is extended and a bracket is added, allowing the transfer box to be mountable. Once the box is complete, assembling begins. First, the shafts are mated to the hole of the transfer box. The output shaft should extrude an inch out of the box. Finally, the bearings and wheels are mated onto the shafts and the box.

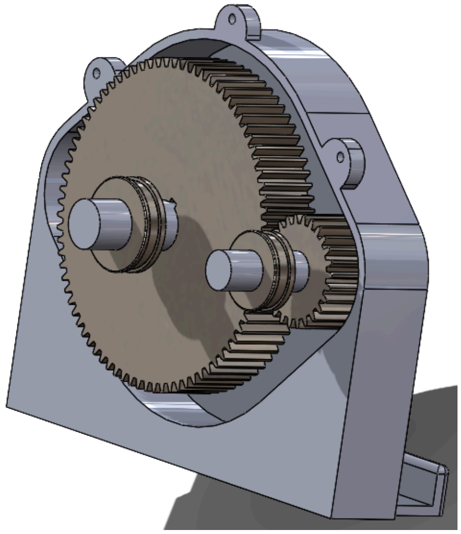


Figure 1: Isotropic View of the Inside of the Transfer Box

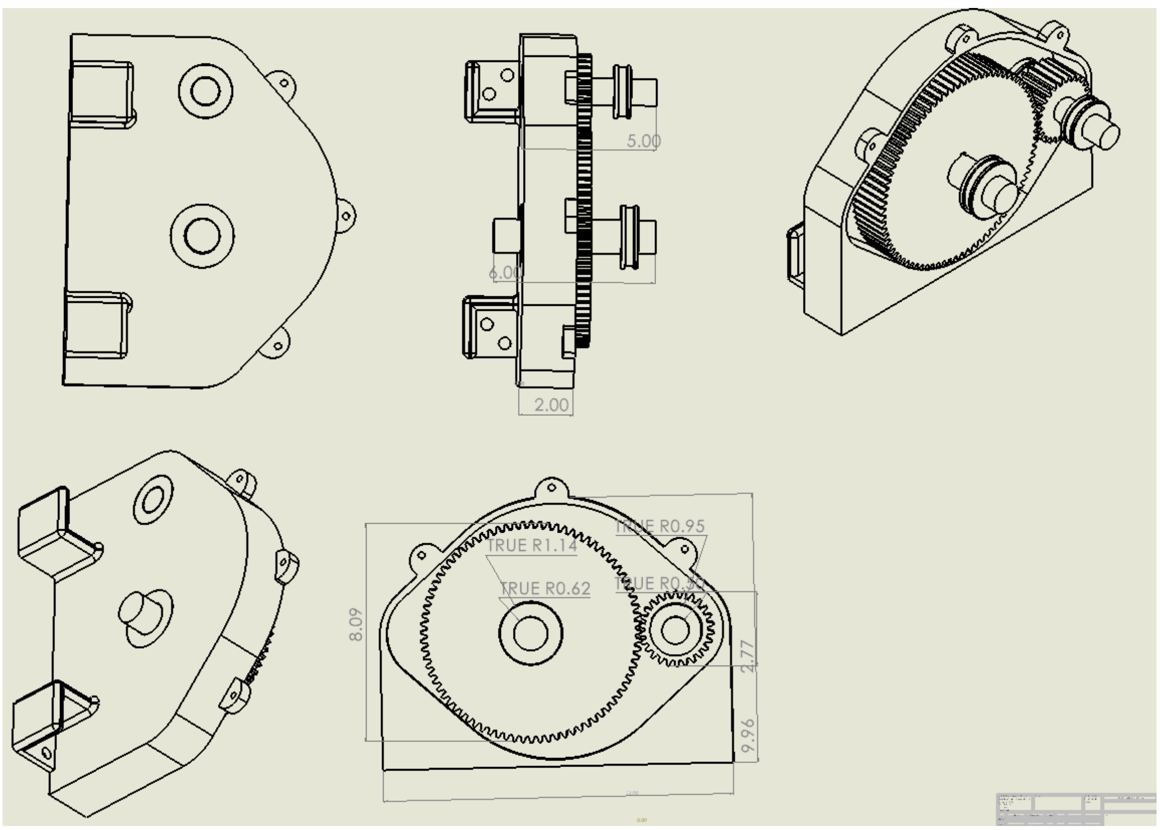


Figure 2: Technical Drawing of the Transfer Box in Half

Force Analysis

In order to begin the design of the assembly, it is important to lay out the free-body diagram of the force experienced along the shaft. The force input of the gears must first be done, through a determination of the W^t, which will be split into several components on the shaft at the point of the gear's contact. Assuming a ϕ = 20°, as standard for most gear applications, and an ψ angle value of 0° for spur gear, the values of W_r and W_a can be determined.

The force W^t is found from the gears, where $\phi_n = \phi$ for spur gears. Using the relations between the forces of the gear:

$$W_a = W^t tan\psi \;=\; 0$$

$$W_r = W^t tan\phi_n \;=\; 532.8\, tan\, 20 \;=\; 193.923\, lbf$$

With such information, the reactions at the bearings can then be calculated as followed by the free-body diagram

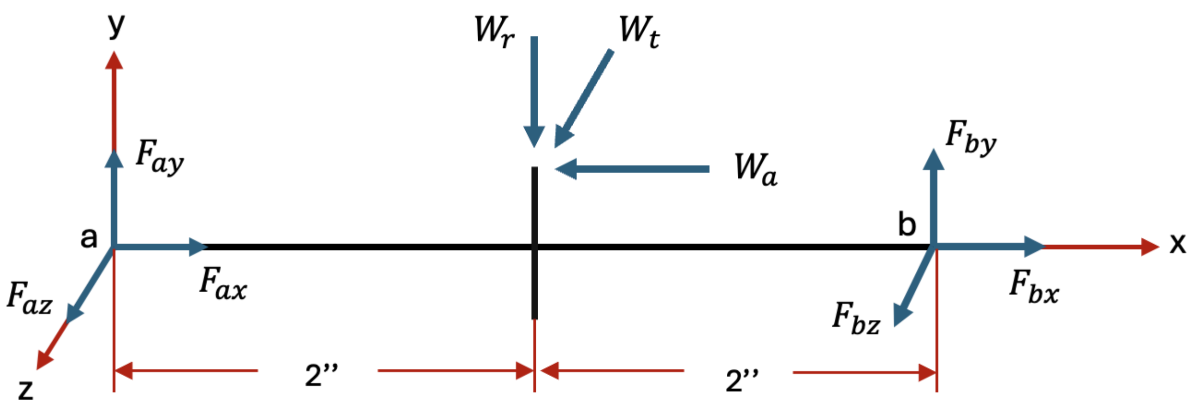


Figure 3: Free body diagram of the input shaft of the gearbox. Points A and B represent the location of the bearing. Force from the gear is represented by forces W^t, W_r and W_a.

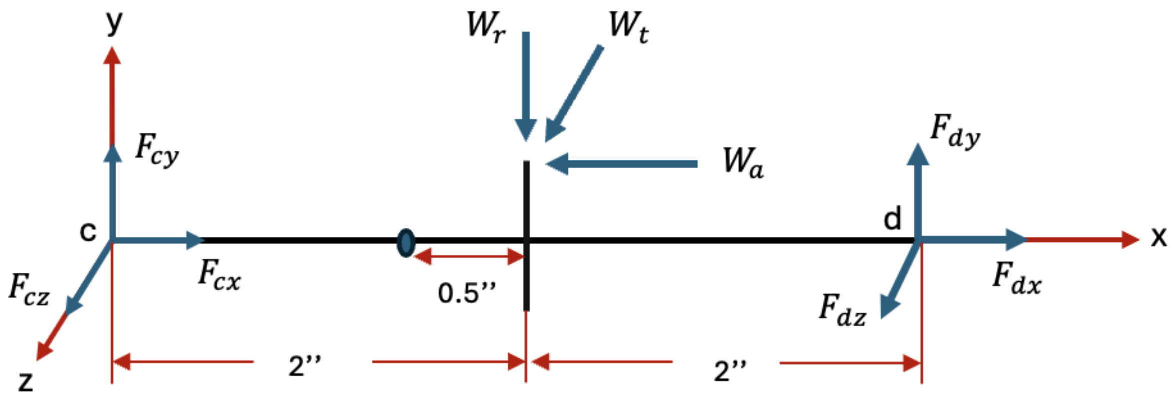


Figure 4: Free body diagram of the output shafts of the gearbox. Points C and D represent the location of the bearing. Force from the gear is represented by forces W^t, W_r and W_a. The universal joint is attached 0.5" from the gear to the left.

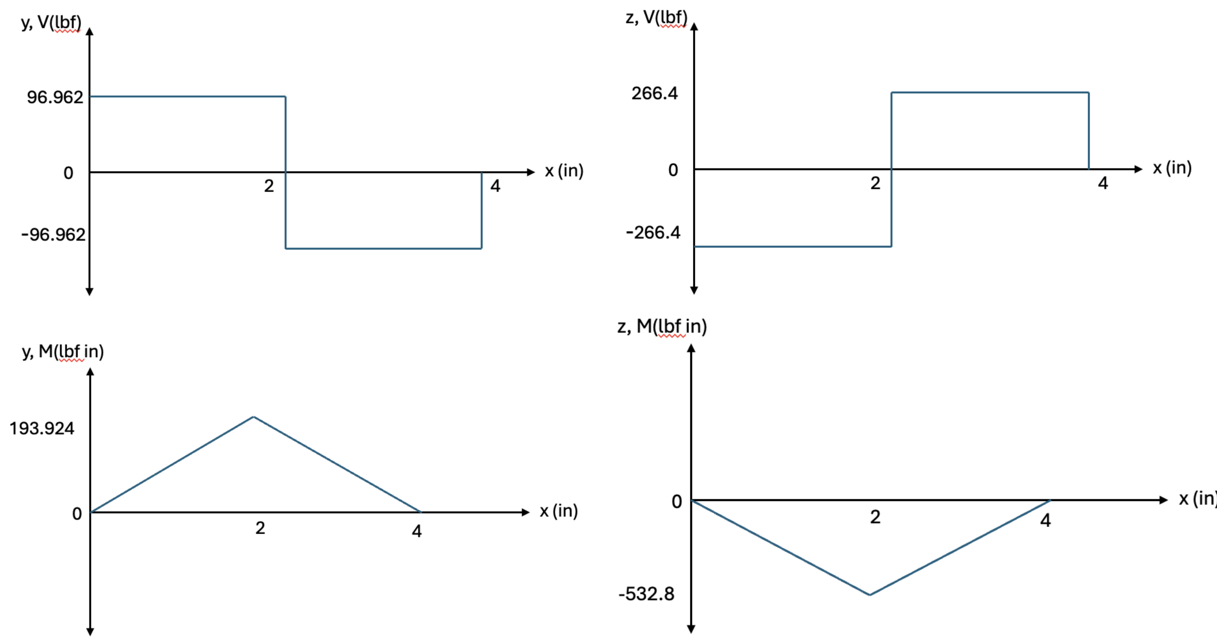


Figure 5: Moment and Shear diagrams obtained from the forces on the shafts in both xy and xz plane.

To determine the reaction force, the following equilibrium equations can be used:

$$\sum M_z = 193.923 * 2) + F_{by}(4) = 0$$

$$\sum F_y = F_{ay} + F_{by} - W_r = 0$$

$$\sum M_y = 532.8(2) + F_{bz}(4) = 0$$

$$\sum F_z = F_{bz} + F_{az} + 532.8 = 0$$

The output shafts will be connected via a joint to concur the same reaction forces at the bearings. Results are tabulated:

Bearing	$F_y(lbf)$	$F_z(lbf)$
a	96.962	-266.4
b	96.962	-266.4
c	96.962	-266.4
d	96.962	-266.4

Figure 6: Bearing reaction forces obtained from force analysis. Bearing corresponds with shafts in figure

Material Selection

The materials designed for all parts of the gearbox are made to both meet the stress and deflection needs while also limiting materials based on reducing total cost.
In selecting the materials for the gears, the total bending force and stress due to surface durability was first determined from the requirements of the gearbox. After such analysis, the material selected was one that met the criteria stated above and decided with a factor of safety of 2, to be AISI 1060 Q&T at 1000°F
In designating the material for the shaft, a force and stress analysis was done to determine the values such shaft will handle. A material was chosen to be able to handle such loads with our chosen design factor of safety of 2 to withstand yielding. The material was chosen to be AISI 1010 HR steel.

The key is designated to have a lower factor of safety yet still able to withstand the stresses such parts will be under. The key material selection was decided after the other parts were designed for such reasons.

For determining the bearing to be used, the first step is to determine the type of bearing based on the application. From the force analysis, it can be seen that both thrust and radial loads exist which led to the decision of using tapered roller bearings. Timken bearings are chosen for this analysis.

Part	Material	Ultimate Strength (kpsi)	Yield Strength (kpsi)
Spur Gears	AISI 1060 Q&T @ 1000°F	140	111
Key	1006 HR Steel	43	24
Shafts	1010 HR Steel	47	26

Figure 7: Material choices and important mechanical properties of the gear, key and shaft.

Design for Stress

I. Gears

For the input gear, given the information on the engine speed and torque output, while suing an 3:1 CVT output, it is given $n = 1200\ rpm,\ \tau_{in} = 666\ in - lb$. From this, the minimum number of teeth and pitch diameter is found for avoiding interference for spur gears, where k =1 for full depth teeth. m is the gear ratio remaining after the 3:1 CVT conversion, leaving a 4:1 gear ratio.

$$N_p = \frac{2k}{(1+2m)sin^2\phi}\left(m + \sqrt{m^2 + (1 + 2m)sin^2\phi}\right)$$

$$N_G = \frac{N_p^2 sin^2\phi - 4k^2}{4k - 2N_p sin^2\phi}$$

pitch diameter of 8 in was used and $N_p = 20\ Teeth$. The diameter of the pinion gear can be determined with:

$$d = \frac{N}{P}$$

$$d_p = \frac{20}{8} = 2.5\ in$$

In determining the bending stress experienced by the gear to decide on the proper material selections, the forces are first determined:

$$W^t = \frac{2T_{input}}{d_p}$$

$$W^t = \frac{2(666\ in - lb)}{2.5\ in} = 532.8\ lb$$

Using the Lewis stress bending formula, first the lewis form factor is determined to be $Y = 0.322$ for a 20 teeth pinion gear.

$$V = \frac{\pi d_p n}{12}$$

$$V = \frac{\pi 2.5(1200)}{12} = 3769.91\ ft/min$$

Considering the dynamic factor in the final stress calculations,

$$K_v = \frac{1200 + V}{1200}$$

$$K_v = \frac{1200 + 3769.91}{1200} = 4.14$$

In the final calculations, the formula for lewis bending stress is determined as

$$\sigma = \frac{W^t P}{FYK_v}$$

$$\sigma = \frac{532.8\ x\ 8}{1.5\ x\ 0.322\ x\ 4.14}$$

$$\sigma = 2.132\ kpsi$$

Similar procedure is done in determining the driven gear stress

$$given\ n = 300\ rpm,\ \tau_{in} = 2664\ in{\cdot}lb$$

The number of teeth is found from using the gear ratio and input gear dimensions:

$$N_G = 4\ x\ 20 = 80\ \ Teeth$$

The diameter is found with the same pitch diameter:

$$d_G = \frac{80}{8} = 10\ \ in$$

The force experienced would be the same contact force from the input gear:

$$W^t = \frac{2(2664\ in-lb)}{10\ \ in} = 532.8\ lb$$

$$V = \frac{\pi 10(300)}{12} = 785.4\ ft/min$$

The bending stress is then calculated, accounting got the dynamic factor:

$$K_v = \frac{1200 + 785.4}{1200} = 1.65$$

$$\sigma = \frac{532.8\ x\ 8}{1.5\ x\ 0.4374\ x\ 1.65}$$

$$\sigma = 3.937\ kpsi$$

Now taking into account, the surface durability:
The elastic coefficient is first found from:

$$C_p = 1/(\pi(\frac{1-V_p^{\ 2}}{E_p} + \frac{1-V_G^{\ 2}}{E_G})^{1/2}$$

For values of V_p, V_G and E_p, E_G, using steel would give

$$V_p = V_G = 0.242 \text{ and } E_p = E_G = 50(10^6).$$

$$C_p = 1/(\pi(\frac{1-0.242^2}{30(10)^6} + \frac{1-0.242^2}{30(10)^6})^{1/2} = 2252\ psi$$

$$r_1 = \frac{2.5}{2} sin20 \; = \; 0.427 \; in$$

$$r_2 = \frac{10}{2} sin20 \; = \; 1.717 \; in$$

Finally the stress is calculated from:

$$\sigma_c = - C_p [\frac{K_v n W^t}{F cos\phi} (\frac{1}{r^1} + \frac{1}{r^2})^{1/2}$$

$$\sigma_c = 2252[\frac{1.65(2)(532.8)}{1.5cos(20)} (\frac{1}{0.427} + \frac{1}{1.717})^{1/2}$$

$$\sigma_c = \; 136 \; kpsi$$

Given that the stress due to the surface durability is the prominent stress, it will be used in deciding the material of the gears.

The center distance between the gears can found with:

$$C \; = \frac{d_p + d_G}{2}$$

$$C \; = \frac{2.5 + 10}{2} \; = \; 6.25 \; in$$

II. Shaft

To determine the moment of the shafts, the moment diagram constructed earlier is used

$$M_{total} = \sqrt{M_y^{\,2} + M_z^{\,2}} \; = \; \sqrt{193.924^2 + 532.8^2} = 566.99 \; lbf \cdot in$$

$$T \; = \; 666 \; lbf \cdot in$$

The stresses on the input shaft is then calculated:

$$\sigma \; = \frac{32M}{\pi d^3} = \frac{32(566.99)}{\pi(1)^3} = 5.7775 \; kpsi$$

$$\tau = \frac{16T}{\pi d^3} = \frac{16(666)}{\pi 1^3} = 3.092 \; kpsi$$

Given the initial diameter dimensions of the input shaft, a material can be determined by obtaining the factor of safety with properties of the chosen material. The endurance strength is calculated for dynamic loading using results yielded from the force analysis. Given alternating stress case it can be assumed that: $M_a = M_m \; = \; \frac{M_{max} + M_{min}}{2}$, $T_a = T_m \; = \; \frac{T_{max} + T_{min}}{2}$

$$M_a = M_m = \frac{566.82 + 0}{2} \; = \; 283.495 \; lbf \; in$$

$$T_a = T_m = \frac{666 + 0}{2} \; = \; 333 \; lbf \; in$$

Choosing a material of 1010 HR steel, the material properties can be used to first find the endurance strength:

$$S_e' = \frac{S_{ut}}{2} = 21.5\ kpsi$$

To modify the endurance strength, the marine factors must be determined first. The surface of the shaft is determined to be machined which follows the following calculations for the surface factor:

$$k_a = aS_{ut}^{\ b}$$

$$k_a = 2(47)^{-0.217} = 0.867$$

The size factor can be determined from the initial diameter:

$$k_b = 0.879(d)^{-.107}\ for\ 0.3 \leq d \leq 2\ in$$

$$k_b = 0.879\ (1)^{-.107} = 0.879$$

For the loading factor, due to combined load: $k_c = 1$

Assuming that the remaining marine factors $k_d = k_e = k_f = 1$

$$S_e = k_a k_b k_c k_d k_e k_f S_e'$$

$$S_e = (0.867)(0.879)(21.5) = 17.916\ kpsi$$

To determine the viability, the factor of safety is determined for the chosen material using Goodman's equation.

$$\frac{1}{n_f} = \frac{16}{\pi d^3}\{\frac{1}{se}((4K_f M_a)^2 + (3K_{fs} T_a)^2)^{1/2} + \frac{1}{S_{ut}}((4K_f M_m)^2 + (3K_{fs} T_m)^2)^{1/2}\}$$

Solving with the values obtained,

$$\frac{1}{n_f} = \frac{16}{\pi 1^3}\{\frac{1}{17.916*10^3}((4 * 566.82)^2 + (3 * 333)^{1/2} + \frac{1}{47*10^3}((4 * 566.82)^2 + (3 * 333)^{1/2}\}$$

$$n_f = 3.15$$

For the output shaft, the calculations are similar but due to the increased torque, the final diameter must account for such increase. Assuming the same material, the goodman's equation can be solved iteratively by using various diameters to obtain a factor of safety of at least 2.

$$\frac{1}{n_f} = \frac{16}{\pi 1^3}\{\frac{1}{17.916**10^3}((4 * 566.82)^2 + (3 * 1332)^{1/2} + \frac{1}{47*10^3}((4 * 566.82)^2 + (3 * 1332)^{1/2}\}$$

$$n_f = 1.07$$

Through several iterations, it can be concluded with a diameter of 1.25 in, the necessary factor of safety can be achieved:

$$\frac{1}{n_f} = \frac{16}{\pi * 1.25^3}\{\frac{1}{16.71*10^3}((4 * 566.82)^2 + (3 * 1332)^{1/2} + \frac{1}{47*10^3}((4 * 566.82)^2 + (3 * 1332)^{1/2}\}$$

$$n_f = 2.09$$

III. Key

For the proper key length determination, the failure mode must be determined by obtaining the length for any possible type of failure. The force experience on the keyway is due to the input torque, since the key will be placed on the input shaft.

$$F = \frac{T}{r}$$

$$F = \frac{666}{0.5} = 1332\ lbf$$

In designing for shear failure, a material was first chosen for the key. The equivalent shear yield strength is found from the yield strength first:

$$S_{sy} = 0.557 S_y$$

$$S_{sy} = 0.557(24) = 13.368\ kpsi$$

Choosing a factor of safety less than that of the shafts, the length can be solved with the following:

$$\frac{S_{sy}}{n} = \frac{2F}{tl}$$

Solving for the length and using a factor of safety of 1.5,

$$l = 1332(\frac{2}{0.2})(\frac{24}{1.5})$$

$$l = 0.747\ in$$

The second possible failure can be due to crushing which can be found from:

$$\frac{S_y}{n} = \frac{F}{0.2l}$$

$$\frac{24}{1.5} = \frac{1332}{0.2/2l}$$

$$l = 0.8325\ in$$

The $l = 0.8325\ in$ is determined to be used for the design as the main mode of failure can be seen as crushing.

IV. Bearings

In determining the ideal dimensions, a load rating life of 20 kh was chosen as recommended for machines of 8 h full utilizations. From the force analysis, the induced loads and dynamic equivalent load is calculated.

$$F_{rA} = (F_{az}^2 + F_{ay}^2)^{1/2}$$

$$F_{rA} = (266.4^2 + 96.962^2)^{1/2} = 283.497\ lbf$$

The gear was placed in the center of the shaft, leading to symmetric reaction forces, giving

$$F_{rB} = F_{rA}.$$

The induced load is then calculated from the radial loads

$$F_{iA} = 0.47F_{rA}/K$$

The value of factor K is unknown therefore, an iterative process must be performed with an initial guess of 1.5.

$$F_{iA} = F_{iB} = 0.47(283.497)\ /1.5\ =\ 55.53\ lbf$$

The dynamic equivalent load is determined by:

$$F_{eA} = 0.4(F_{rA}) + K(F_{iB} + F_{ae})$$

$$F_{eb} = F_{rB}$$

Given that there are no F_{ae},

$$F_{eA} = 0.4(283.497) + 1.5(88.83) = 246.69\ lbf$$

$$F_{eb} = 283.497\ lbf$$

In this design, to simplify the decision process, the maximum dynamic equivalent load is taken to be $F_{eb} = 283.497\ lbf$.

A reliability of 0.99 was used for each bearing, giving a compound reliability of 0.995

The catalogue rating can be calculated from:

$$C_{10} = apf * F_{eb}[\frac{X_D}{x_o+(\theta-x_o)(1-R_D)^b}]^{1/a}$$

Where $x_D = \frac{60L_Dn_D}{L_R}$, with a rated 30 kh, a speed of 1200 rpm for the input shaft and 300 rpm for the output shaft, and a rating life of $90(10^6)$ revolutions.

$$input\ shaft:\ x_D = \frac{60(50{,}000)(1200)}{90(10^6)} = 24$$

$$output\ shaft:\ x_D = \frac{60(50{,}000)(300)}{90(10^6)} = 6$$

Using the weibull parameters for manufacturer 2 (Timken) from table 11-6 and using a application factor of 1:

$$C_{10} = apf * 283.497[\frac{X_D}{x_o+(\theta-x_o)(1-R_D)^b}]^{1/a}$$

Several iterations were done to determine the final catalogue ratings.

$$input\ shaft:\ C_{10} = 1313.2\ lbf$$

$$output\ shaft:\ C_{10} = 866.37\ lbf$$

The final choices for bearings from the catalogue rating:

$input\ shaft$: $k = 1.64\ C_{10} = 1440\ lbf$, $bore\ d = 0.7087\ in$ for both a and b bearing

Part Number - Inner: 05070X Outer: 05185-S

$output\ shaft$: $k = 1.22\ C_{10} = 1180\ lbf$, $bore\ d = 0.75\ in$

Part number - Inner: 4A, Outer: 6

Final dimensions

Gear	Number of teeth	Face Width	Pitch Diameter
Pinion Gear	20	1.5	2.5
Driven Gear	80	1.5	10

Figure 8: Final Gear Dimensions

Shaft	Diameter (in)	Factor of Safety
Input Shaft (1)	1	3.15
Output Shafts (2)	1.25	2.094

Figure 9: Final Shaft Dimensions

Bearing	$C_{10}(lbf)$	Bore d (in)	Inner	Outer
a	1440	0.7087	05070X	05185-S
b	1440	0.7087	05070X	05185-S
c	1180	0.75	4A	6
d	1180	0.75	4A	6

Figure 10: Final Bearing Choices

Conclusion

The design of the gearbox included design choices for the bearings, shaft, keyway, and gears. The design of the gears were first done by using the given gear ratios and output of the CVT from the engine. The gear ratio was used to first determine the number of teeth and diameter of the gears to avoid interference. The choice was made to use spur gears as minimal constraint was given for the necessity of other complex gear geometry. The material for the gear was chosen through an analysis of stress contributed both by bending and surface durability. The final material was chosen by using a factor of safety of 2. The dimensions of the shaft was determined by using the initial input shaft constraint of 1 inch. Goodman's equation was utilized to determine a material that had a factor of safety over 2. Such analysis was done by first determining the forces of the gear and bearing reaction. The output shaft design was then determined through the same process but solving iteratively and obtaining the material and diameter that meets the FOS requirements.

The keyway length was determined by finding the critical failure mode and determining a material that met the design FOS of 1.5. Finally fro the bearing design, taper roller bearing was chosen as it allowed support for axial and radial loads. The catalogue rating was determined with a reliability of 0.99 on each bearing. Using the Timken catalog, the final bearing can be chosen through an iterative process.

References

[1] Budynas, R.G., Nisbett, J. K., Shigley's Mechanical Engineering Design, 10th edition, McGraw-Hill, 2015.
[2]American Gear Manufacturers Association. (1965). AGMA standard system : design of general industrial double-enveloping wormgears. Washington, D.C. :American Gear Manufacturers Association.
[3] Timken Tapered Roller Bearings catalog

Appendix

Table 14-2 Values of Lewis Form Factor Y

Number of Teeth	Y	Number of Teeth	Y
12	0.245	28	0.353
13	0.261	30	0.359
14	0.277	34	0.371
15	0.290	38	0.384
16	0.296	43	0.397
17	0.303	50	0.409
18	0.309	60	0.422
19	0.314	75	0.435
20	0.322	100	0.447
21	0.328	150	0.460
22	0.331	300	0.472
24	0.337	400	0.480
26	0.346	Rack	0.485

Figure A1: Lewis Form Factor [1]

Table 13-2: Tooth Sizes in General Use

Diametral Pitch P(teeth/in)	
Coarse	2, $2\frac{1}{4}$, $2\frac{1}{2}$, 3, 4, 6, 8, 10, 12, 16
Fine	20, 24, 32, 40, 48, 64, 80, 96, 120, 150, 200

Module m(mm/tooth)	
Preferred	1, 1.25, 1.5, 2, 2.5, 3, 4, 5, 6, 8, 10, 12, 16, 20, 25, 32, 40, 50
Next Choice	1.125, 1.375, 1.75, 2.25, 2.75, 3.5, 4.5, 5.5, 7, 9, 11, 14, 18, 22, 28, 36, 45

Figure A2: Tooth Size [1]

Table 6–2 Curve Fit Parameters for Surface Factor, Equation (6–18)

Surface Finish	Factor a		Exponent b
	S_{ut}, kpsi	S_{ut}, MPa	
Ground	1.21	1.38	−0.067
Machined or cold-drawn	2.00	3.04	−0.217
Hot-rolled	11.0	38.6	−0.650
As-forged	12.7	54.9	−0.758

Figure A3:finish parameters for surface factor [1]

Table 11-6 Weibull Parameters

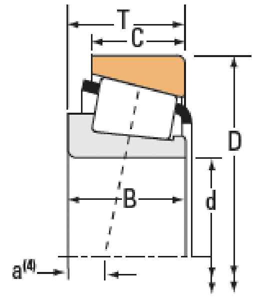
Manufacturer	Rating Life, Revolutions	Weibull Parameters Rating Lives x_0	θ	b
1	$90(10^6)$	0	4.48	1.5
2	$1(10^6)$	0.02	4.459	1.483

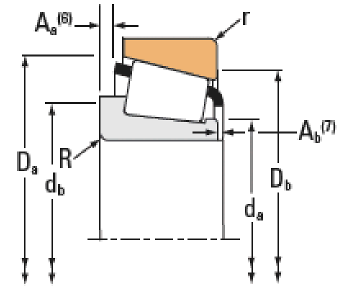
Figure A4: Weibull Parameters [1]

Table 11–4 Bearing-Life Recommendations for Various Classes of Machinery

Type of Application	Life, kh
Instruments and apparatus for infrequent use	Up to 0.5
Aircraft engines	0.5–2
Machines for short or intermittent operation where service interruption is of minor importance	4–8
Machines for intermittent service where reliable operation is of great importance	8–14
Machines for 8-h service that are not always fully utilized	14–20
Machines for 8-h service that are fully utilized	20–30
Machines for continuous 24-h service	50–60
Machines for continuous 24-h service where reliability is of extreme importance	100–200

TYPE TS

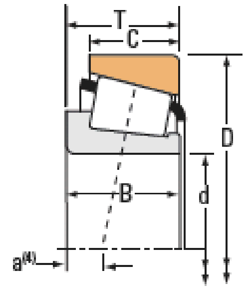


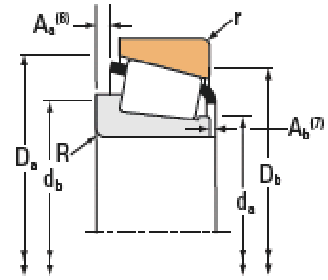


Bearing Dimensions			Load Ratings							Part Number	
Bore d	O.D. D	Width T	Dynamic[1] C_1	Factors[2] e	Y	Dynamic[3] C_{90}	C_{a90}	Factors[2] K	Static C_0	Inner	Outer
mm in.	mm in.	mm in.	N lbf			N lbf	N lbf		N lbf		
7.937 0.3125	31.991 1.2595	10.008 0.3940	10800 2430	0.41	1.48	2800 630	1940 437	1.44	9230 2070	A2031	A2126
9.525 0.3750	31.991 1.2595	10.008 0.3940	10800 2430	0.41	1.48	2800 630	1940 437	1.44	9230 2070	A2037	A2126
11.112 0.4375	34.988 1.3775	10.998 0.4330	13200 2960	0.45	1.32	3410 767	2640 594	1.29	11500 2580	A4044	A4138
11.987 0.4719	31.991 1.2595	10.008 0.3940	10800 2430	0.41	1.48	2800 630	1940 437	1.44	9230 2070	A2047	A2126
12.680 0.4992	34.988 1.3775	10.998 0.4330	13200 2960	0.45	1.32	3410 767	2640 594	1.29	11500 2580	A4049	A4138
12.700 0.5000	34.988 1.3775	10.998 0.4330	13200 2960	0.45	1.32	3410 767	2640 594	1.29	11500 2580	A4050	A4138
12.700 0.5000	38.100 1.5000	13.495 0.5313	20900 4690	0.28	2.18	5410 1220	2550 574	2.12	17100 3840	00050	00150
14.989 0.5901	34.988 1.3775	10.998 0.4330	13200 2960	0.45	1.32	3410 767	2640 594	1.29	11500 2580	A4059	A4138
15.875 0.6250	34.988 1.3775	10.998 0.4330	14300 3230	0.32	1.88	3720 836	2030 456	1.83	13900 3130	L21549	L21511
15.875 0.6250	39.992 1.5745	12.014 0.4730	13400 3020	0.53	1.14	3480 782	3140 705	1.11	12300 2770	A6062	A6157
15.875 0.6250	41.275 1.6250	14.288 0.5625	24000 5400	0.31	1.93	6230 1400	3310 745	1.88	21300 4780	03062	03162
15.875 0.6250	42.862 1.6875	14.288 0.5625	18800 4230	0.70	0.85	4870 1100	5860 1320	0.83	17400 3920	11590	11520
15.875 0.6250	42.862 1.6875	16.670 0.6563	31400 7070	0.33	1.81	8150 1830	4620 1040	1.76	29200 6560	17580	17520
15.875 0.6250	47.000 1.8504	14.381 0.5662	26700 6010	0.36	1.68	6930 1560	4230 952	1.64	25400 5720	05062	05185
15.875 0.6250	49.225 1.9380	19.845 0.7813	42800 9630	0.27	2.26	11100 2500	5050 1140	2.20	40500 9100	09062	09195
15.875 0.6250	49.225 1.9380	23.020 0.9063	42800 9630	0.27	2.26	11100 2500	5050 1140	2.20	40500 9100	09062	09194
15.875 0.6250	53.975 2.1250	22.225 0.8750	55100 12400	0.59	1.02	14300 3210	14400 3250	0.99	42500 9560	21063	21212

Bearing Dimensions											Geometry Factors			Bearing Weight
			Shaft			Housing			Cage					
Width B	Width C	Eff. Ctr. a[4]	Max Shaft Fillet Radius R[5]	Backing Shoulder Dia. d_a	Backing Shoulder Dia. d_b	Max Housing Fillet Radius r[5]	Backing Shoulder Dia. D_a	Backing Shoulder Dia. D_b	A_a[6]	A_b[7]	G_1	G_2	C_g	
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.				kg lbs.
10.785 0.4246	**7.938** 0.3125	**-3.0** -0.12	**0.5** 0.02	**12.5** 0.49	**13.0** 0.51	**1.3** 0.05	**29.0** 1.14	**26.0** 1.02	**-0.3** -0.01	**1.5** 0.06	1.7	3.2	0.0308	**0.05** 0.10
10.785 0.4246	**7.938** 0.3125	**-3.0** -0.12	**1.3** 0.05	**13.5** 0.53	**15.0** 0.59	**1.3** 0.05	**29.0** 1.14	**26.0** 1.02	**-0.3** -0.01	**1.5** 0.06	1.7	3.2	0.0308	**0.05** 0.10
10.988 0.4326	**8.730** 0.3437	**-2.5** -0.10	**1.3** 0.05	**15.5** 0.61	**17.5** 0.69	**1.3** 0.05	**32.0** 1.26	**29.0** 1.14	**0.1** 0.00	**1.2** 0.05	2.3	4.1	0.0355	**0.05** 0.13
10.785 0.4246	**7.938** 0.3125	**-3.0** -0.12	**0.8** 0.03	**15.5** 0.61	**16.5** 0.65	**1.3** 0.05	**29.0** 1.14	**26.0** 1.02	**-0.3** -0.01	**1.5** 0.06	1.7	3.2	0.0308	**0.04** 0.09
10.988 0.4326	**8.730** 0.3437	**-2.5** -0.10	**0.8** 0.03	**17.5** 0.69	**17.5** 0.69	**1.3** 0.05	**32.0** 1.26	**29.0** 1.14	**0.1** 0.00	**1.2** 0.05	2.3	4.1	0.0355	**0.05** 0.12
10.988 0.4326	**8.730** 0.3437	**-2.5** -0.10	**1.3** 0.05	**17.0** 0.67	**18.5** 0.73	**1.3** 0.05	**32.0** 1.26	**29.0** 1.14	**0.1** 0.00	**1.2** 0.05	2.3	4.1	0.0355	**0.05** 0.12
14.072 0.5540	**11.112** 0.4375	**-5.1** -0.20	**1.5** 0.06	**16.5** 0.65	**19.0** 0.75	**0.8** 0.03	**34.0** 1.34	**33.0** 1.30	**-0.4** -0.02	**1.3** 0.06	3.1	2.9	0.0329	**0.08** 0.18
10.988 0.4326	**8.730** 0.3437	**-2.5** -0.10	**0.8** 0.03	**19.0** 0.75	**19.5** 0.77	**1.3** 0.05	**32.0** 1.26	**29.0** 1.14	**0.1** 0.00	**1.2** 0.05	2.3	4.1	0.0355	**0.04** 0.11
10.998 0.4330	**8.712** 0.3430	**-3.3** -0.13	**1.3** 0.05	**19.5** 0.77	**21.5** 0.85	**1.3** 0.05	**32.5** 1.28	**29.0** 1.14	**-0.3** -0.02	**1.4** 0.06	3.0	5.4	0.0348	**0.06** 0.11
11.153 0.4391	**9.525** 0.3750	**-1.5** -0.06	**1.3** 0.05	**20.5** 0.81	**22.0** 0.87	**1.3** 0.05	**37.0** 1.46	**34.0** 1.34	**0.5** 0.02	**1.6** 0.07	2.9	5.6	0.0404	**0.08** 0.16
14.681 0.5780	**11.112** 0.4375	**-5.1** -0.20	**1.3** 0.05	**20.0** 0.79	**21.5** 0.85	**2.0** 0.08	**37.5** 1.48	**34.0** 1.34	**0.3** 0.01	**1.4** 0.06	4.2	4.0	0.0384	**0.09** 0.21
14.288 0.5625	**9.525** 0.3750	**-1.3** -0.05	**1.5** 0.06	**22.5** 0.89	**24.5** 0.96	**1.5** 0.06	**39.5** 1.56	**34.5** 1.36	**1.5** 0.05	**0.7** 0.03	3.4	4.6	0.0465	**0.10** 0.22
16.670 0.6563	**13.495** 0.5313	**-5.8** -0.23	**1.5** 0.06	**21.0** 0.83	**23.0** 0.91	**1.5** 0.06	**39.0** 1.54	**36.5** 1.44	**0.4** 0.01	**1.9** 0.08	5.3	4.5	0.0423	**0.12** 0.27
14.381 0.5662	**11.112** 0.4375	**-4.1** -0.16	**1.5** 0.06	**21.0** 0.83	**23.5** 0.93	**1.3** 0.05	**42.5** 1.67	**40.5** 1.59	**0.2** 0.00	**1.3** 0.05	5.8	5.5	0.0448	**0.14** 0.29
21.539 0.8480	**14.288** 0.5625	**-9.1** -0.36	**0.8** 0.03	**21.5** 0.85	**22.0** 0.87	**1.3** 0.05	**44.5** 1.75	**42.0** 1.65	**2.2** 0.09	**0.7** 0.03	8.0	4.0	0.0452	**0.19** 0.44
21.539 0.8480	**17.462** 0.6875	**-9.1** -0.36	**0.8** 0.03	**21.5** 0.85	**22.0** 0.87	**3.5** 0.14	**44.5** 1.75	**39.0** 1.54	**2.2** 0.09	**0.7** 0.03	8.0	4.0	0.0452	**0.21** 0.47
21.839 0.8598	**15.875** 0.6250	**-5.8** -0.23	**0.8** 0.03	**26.4** 1.03	**29.0** 1.14	**2.3** 0.09	**50.0** 1.97	**43.0** 1.69	**1.3** 0.05	**2.0** 0.08	7.0	4.1	0.0558	**0.25** 0.57

TYPE TS

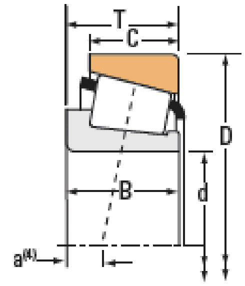


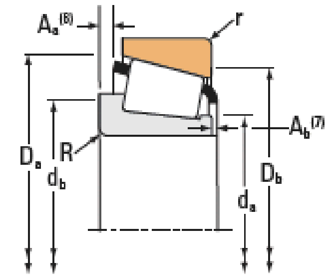


Bearing Dimensions			Load Ratings							Part Number	
Bore d	O.D. D	Width T	Dynamic[1] C_1	Factors[2] e	Y	Dynamic[3] C_{90}	C_{a90}	Factors[2] K	Static C_0	Inner	Outer
mm in.	mm in.	mm in.	N lbf			N lbf	N lbf		N lbf		
22.225 0.8750	51.994 2.0470	15.011 0.5910	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07087	07204
22.225 0.8750	52.000 2.0472	15.011 0.5910	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07087X	07205
22.225 0.8750	52.388 2.0625	19.368 0.7625	47900 10800	0.29	2.05	12400 2790	6200 1390	2.00	48300 10900	1380	1328
22.225 0.8750	53.975 2.1250	19.368 0.7625	47900 10800	0.29	2.05	12400 2790	6200 1390	2.00	48300 10900	1380	1329
22.225 0.8750	53.975 2.1250	19.368 0.7625	45400 10200	0.31	1.95	11800 2650	6200 1390	1.90	45300 10200	1755	1730
22.225 0.8750	56.896 2.2400	19.368 0.7625	45400 10200	0.31	1.95	11800 2650	6200 1390	1.90	45300 10200	1755	1729
22.225 0.8750	56.896 2.2400	19.368 0.7625	45400 10200	0.31	1.95	11800 2650	6200 1390	1.90	45300 10200	1755	1729X
22.225 0.8750	57.150 2.2500	19.845 0.7813	48400 10900	0.33	1.82	12500 2820	7080 1590	1.77	50200 11300	1975	1922
22.225 0.8750	57.150 2.2500	22.225 0.8750	55300 12400	0.35	1.73	14300 3230	8510 1910	1.69	55100 12400	1280	1220
22.225 0.8750	58.738 2.3125	19.050 0.7500	48400 10900	0.33	1.82	12500 2820	7080 1590	1.77	50200 11300	1975	1932
22.225 0.8750	60.325 2.3750	19.845 0.7813	48400 10900	0.33	1.82	12500 2820	7080 1590	1.77	50200 11300	1975	1931
22.225 0.8750	61.912 2.4375	36.512 1.4375	88600 19900	0.28	2.13	23000 5160	11100 2500	2.07	89800 20200	3655	3620
22.225 0.8750	62.000 2.4409	17.983 0.7080	48200 10800	0.24	2.48	12500 2810	5170 1160	2.42	49200 11100	246X	242
22.225 0.8750	66.421 2.6150	23.813 0.9375	76600 17200	0.25	2.36	19900 4470	8640 1940	2.30	81700 18400	2684	2631
22.606 0.8900	47.000 1.8504	15.500 0.6102	35100 7900	0.47	1.27	9110 2050	7380 1660	1.24	33000 7420	LM72849	LM72810
23.812 0.9375	50.005 1.9687	13.495 0.5313	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07093	07196
23.812 0.9375	50.292 1.9800	14.224 0.5600	35600 8010	0.37	1.60	9230 2080	5910 1330	1.56	32900 7400	L44640	L44610

Bearing Dimensions											Geometry Factors			Bearing Weight
			Shaft			Housing			Cage					
Width B	Width C	Eff. Ctr. a[4]	Max Shaft Fillet Radius R[5]	Backing Shoulder Dia. d_a	d_b	Max Housing Fillet Radius r[5]	Backing Shoulder Dia. D_a	D_b	A_a[6]	A_b[7]	G_1	G_2	C_g	
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.				kg lbs.
14.260 0.5614	**12.700** 0.5000	**-2.8** -0.11	**1.3** 0.05	**27.0** 1.06	**28.5** 1.12	**1.3** 0.05	**48.0** 1.89	**45.0** 1.77	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.15** 0.34
14.260 0.5614	**12.700** 0.5000	**-2.8** -0.11	**1.5** 0.06	**27.0** 1.06	**29.0** 1.14	**2.0** 0.08	**48.0** 1.89	**44.5** 1.75	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.15** 0.34
20.168 0.7940	**14.288** 0.5625	**-7.6** -0.30	**1.5** 0.06	**27.0** 1.06	**29.5** 1.16	**1.5** 0.06	**48.5** 1.91	**45.0** 1.77	**1.3** 0.05	**1.1** 0.05	10.3	5.2	0.0508	**0.20** 0.45
20.168 0.7940	**14.288** 0.5625	**-7.6** -0.30	**1.5** 0.06	**27.0** 1.06	**29.5** 1.16	**1.5** 0.06	**49.0** 1.93	**46.0** 1.81	**1.3** 0.05	**1.1** 0.05	10.3	5.2	0.0508	**0.21** 0.48
19.837 0.7810	**15.875** 0.6250	**-6.9** -0.27	**1.3** 0.05	**27.5** 1.08	**29.0** 1.14	**0.8** 0.03	**50.0** 1.97	**48.5** 1.91	**1.8** 0.07	**0.4** 0.02	10.6	5.4	0.0521	**0.22** 0.49
19.837 0.7810	**15.875** 0.6250	**-6.9** -0.27	**1.3** 0.05	**27.5** 1.08	**29.0** 1.14	**1.3** 0.05	**51.0** 2.01	**49.0** 1.93	**1.8** 0.07	**0.4** 0.02	10.6	5.4	0.0521	**0.25** 0.56
19.837 0.7810	**15.875** 0.6250	**-6.9** -0.27	**1.3** 0.05	**27.5** 1.08	**29.0** 1.14	**1.5** 0.06	**51.0** 2.01	**49.0** 1.93	**1.8** 0.07	**0.4** 0.02	10.6	5.4	0.0521	**0.25** 0.55
19.355 0.7620	**15.875** 0.6250	**-5.8** -0.23	**0.8** 0.03	**29.5** 1.16	**30.5** 1.20	**1.5** 0.06	**53.5** 2.11	**51.0** 2.01	**0.7** 0.03	**1.2** 0.05	12.5	6.3	0.0565	**0.26** 0.57
22.225 0.8750	**17.462** 0.6875	**-6.9** -0.27	**0.8** 0.03	**29.0** 1.14	**29.5** 1.16	**1.5** 0.06	**52.0** 2.05	**49.0** 1.93	* *	* *	11.4	5.5	0.0556	**0.28** 0.63
19.355 0.7620	**15.080** 0.5937	**-5.8** -0.23	**0.8** 0.03	**29.5** 1.16	**30.5** 1.20	**1.3** 0.05	**54.0** 2.13	**52.0** 2.05	**0.7** 0.03	**1.2** 0.05	12.5	6.3	0.0565	**0.27** 0.60
19.355 0.7620	**15.875** 0.6250	**-5.8** -0.23	**0.8** 0.03	**29.5** 1.16	**30.5** 1.20	**1.3** 0.05	**55.0** 2.17	**52.0** 2.05	**0.7** 0.03	**1.2** 0.05	12.5	6.3	0.0565	**0.29** 0.65
38.354 1.5100	**23.812** 0.9375	**-19.8** -0.78	**0.3** 0.01	**30.5** 1.20	**30.5** 1.20	**3.3** 0.13	**58.0** 2.27	**52.0** 2.05	**9.8** 0.38	**0.2** 0.01	17.0	6.4	0.0592	**0.52** 1.12
19.000 0.7480	**16.002** 0.6300	**-6.1** -0.24	**3.5** 0.14	**30.0** 1.18	**34.5** 1.36	**2.0** 0.08	**57.0** 2.24	**55.0** 2.17	**0.0** 0.00	**0.8** 0.03	12.8	8.2	0.0509	**0.29** 0.63
25.433 1.0013	**19.050** 0.7500	**-9.4** -0.37	**1.5** 0.06	**32.0** 1.26	**34.0** 1.34	**1.3** 0.05	**60.0** 2.36	**58.0** 2.28	**0.7** 0.03	**0.8** 0.04	19.3	8.0	0.0598	**0.46** 1.02
15.500 0.6102	**12.000** 0.4724	**-3.0** -0.12	**1.5** 0.06	**28.0** 1.10	**30.0** 1.18	**1.0** 0.04	**44.0** 1.73	**40.5** 1.59	**0.6** 0.02	**0.9** 0.04	7.5	9.0	0.0538	**0.13** 0.28
14.260 0.5614	**9.525** 0.3750	**-2.8** -0.11	**1.5** 0.06	**28.5** 1.12	**30.5** 1.20	**1.0** 0.04	**47.0** 1.85	**44.5** 1.75	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.12** 0.27
14.732 0.5800	**10.668** 0.4200	**-3.3** -0.13	**1.5** 0.06	**28.5** 1.12	**30.5** 1.20	**1.3** 0.05	**47.0** 1.85	**44.5** 1.75	**0.8** 0.03	**0.6** 0.03	8.9	8.9	0.0526	**0.14** 0.29

TYPE TS





Bearing Dimensions			Load Ratings							Part Number	
Bore d	O.D. D	Width T	Dynamic[1] C_1	Factors[2] e	Y	Dynamic[3] C_{90}	C_{a90}	Factors[2] K	Static C_0	Inner	Outer
mm in.	mm in.	mm in.	N lbf			N lbf	N lbf		N lbf		
23.812 0.9375	50.800 2.0000	15.011 0.5910	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07093	07210X
23.812 0.9375	51.994 2.0470	15.012 0.5910	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07093	07204
23.812 0.9375	53.975 2.1250	19.368 0.7625	45400 10200	0.31	1.95	11800 2650	6200 1390	1.90	45300 10200	1779	1730
23.812 0.9375	56.896 2.2400	19.368 0.7625	45400 10200	0.31	1.95	11800 2650	6200 1390	1.90	45300 10200	1779	1729
23.812 0.9375	61.912 2.4375	28.575 1.1250	88600 19900	0.28	2.13	23000 5160	11100 2500	2.07	89800 20200	3659	3620
23.812 0.9375	65.088 2.5625	22.225 0.8750	54600 12300	0.73	0.82	14200 3180	17700 3990	0.80	55800 12500	23092	23256
23.812 0.9375	66.421 2.6150	23.812 0.9375	76600 17200	0.25	2.36	19900 4470	8640 1940	2.30	81700 18400	2685	2631
24.000 0.9449	55.000 2.1654	25.000 0.9842	79500 17900	0.35	1.70	20600 4630	12500 2800	1.65	71000 16000	JHM33449	JHM33410
24.384 0.9600	79.375 3.1250	25.400 1.0000	92000 20700	0.67	0.90	23900 5360	27300 6130	0.87	76200 17100	43096	43312
24.981 0.9835	50.005 1.9687	13.495 0.5313	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07098	07196
24.981 0.9835	51.994 2.0470	15.011 0.5910	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07098	07204
24.981 0.9835	52.000 2.0472	15.011 0.5910	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07098	07205
24.981 0.9835	61.981 2.4402	16.002 0.6300	43200 9720	0.38	1.57	11200 2520	7340 1650	1.53	44100 9910	17098	17244A
24.981 0.9835	62.000 2.4409	16.002 0.6300	43200 9720	0.38	1.57	11200 2520	7340 1650	1.53	44100 9910	17098	17244
25.000 0.9843	50.005 1.9687	13.495 0.5313	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07097	07196
25.000 0.9843	51.994 2.0470	15.011 0.5910	29100 6540	0.40	1.49	7550 1700	5190 1170	1.45	29600 6650	07097	07204
25.000 0.9843	52.000 2.0472	14.224 0.5600	35600 8010	0.37	1.60	9230 2080	5910 1330	1.56	32900 7400	JL44642A	JL44615

[1] Based on 1 x 10^6 revolutions L_{10} life, for the ISO life-calculation method.
[2] Consult your Timken engineer for instructions on use or review the Timken Engineering Manual on timken.com/catalogs.
[3] Based on 90 x 10^6 revolutions L_{10} life, for The Timken Company life-calculation method. C_{90} and C_{a90} are radial and thrust values.

Bearing Dimensions											Geometry Factors			Bearing Weight
			Shaft			Housing			Cage					
Width B	Width C	Eff. Ctr. a[4]	Max Shaft Fillet Radius R[5]	Backing Shoulder Dia. d_a	Backing Shoulder Dia. d_b	Max Housing Fillet Radius r[5]	Backing Shoulder Dia. D_a	Backing Shoulder Dia. D_b	A_a[6]	A_b[7]	G_1	G_2	C_g	
mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.	mm in.				kg lbs.
14.260 0.5614	**12.700** 0.5000	**-2.8** -0.11	**1.5** 0.06	**28.5** 1.12	**30.5** 1.20	**1.5** 0.06	**47.5** 1.87	**44.5** 1.75	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.14** 0.30
14.260 0.5614	**12.700** 0.5000	**-2.8** -0.11	**1.5** 0.06	**28.5** 1.12	**30.5** 1.20	**1.3** 0.05	**48.0** 1.89	**45.0** 1.77	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.15** 0.33
19.837 0.7810	**15.875** 0.6250	**-6.9** -0.27	**0.8** 0.03	**28.5** 1.12	**29.5** 1.16	**0.8** 0.03	**50.0** 1.97	**48.5** 1.91	**1.8** 0.07	**0.4** 0.02	10.6	5.4	0.0521	**0.21** 0.47
19.837 0.7810	**15.875** 0.6250	**-6.9** -0.27	**0.8** 0.03	**28.5** 1.12	**29.5** 1.16	**1.3** 0.05	**51.0** 2.01	**49.0** 1.93	**1.8** 0.07	**0.4** 0.02	10.6	5.4	0.0521	**0.24** 0.54
30.417 1.1975	**23.812** 0.9375	**-11.9** -0.47	**2.3** 0.09	**31.5** 1.24	**35.5** 1.40	**3.3** 0.13	**58.0** 2.27	**52.0** 2.05	**1.9** 0.07	**0.2** 0.01	17.0	6.4	0.0592	**0.44** 0.96
21.463 0.8450	**15.875** 0.6250	**-2.3** -0.09	**1.5** 0.06	**34.5** 1.36	**38.5** 1.52	**1.5** 0.06	**63.0** 2.48	**53.0** 2.09	**3.7** 0.14	**2.1** 0.08	11.3	6.6	0.0700	**0.36** 0.81
25.433 1.0013	**19.050** 0.7500	**-9.4** -0.37	**0.8** 0.03	**30.0** 1.18	**31.0** 1.22	**1.3** 0.05	**60.0** 2.36	**58.0** 2.28	**0.7** 0.03	**0.8** 0.04	19.3	8.0	0.0598	**0.44** 0.99
25.000 0.9843	**21.000** 0.8268	**-8.9** -0.35	**2.0** 0.08	**30.0** 1.18	**35.0** 1.38	**2.0** 0.08	**52.0** 2.05	**47.0** 1.85	**0.4** 0.01	**1.8** 0.07	13.3	5.8	0.0592	**0.29** 0.65
24.074 0.9478	**17.462** 0.6875	**-2.0** -0.08	**0.8** 0.03	**39.5** 1.56	**40.5** 1.59	**1.5** 0.06	**74.0** 2.91	**67.0** 2.64	**3.4** 0.13	**2.4** 0.10	16.8	7.6	0.0774	**0.65** 1.42
14.260 0.5614	**9.525** 0.3750	**-2.8** -0.11	**1.5** 0.06	**29.0** 1.14	**31.0** 1.22	**1.0** 0.04	**47.0** 1.85	**44.5** 1.75	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.11** 0.26
14.260 0.5614	**12.700** 0.5000	**-2.8** -0.11	**1.5** 0.06	**29.0** 1.14	**31.0** 1.22	**1.3** 0.05	**48.0** 1.89	**45.0** 1.77	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.14** 0.31
14.260 0.5614	**12.700** 0.5000	**-2.8** -0.11	**1.5** 0.06	**29.0** 1.14	**31.0** 1.22	**2.0** 0.08	**48.0** 1.89	**44.5** 1.75	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.14** 0.31
16.566 0.6522	**14.288** 0.5625	**-3.6** -0.14	**1.5** 0.06	**30.5** 1.20	**33.0** 1.30	**1.5** 0.06	**57.0** 2.24	**54.0** 2.13	**0.2** 0.01	**1.9** 0.08	11.8	7.5	0.0579	**0.25** 0.56
16.566 0.6522	**14.288** 0.5625	**-3.6** -0.14	**1.5** 0.06	**30.5** 1.20	**33.0** 1.30	**1.5** 0.06	**57.0** 2.24	**54.0** 2.13	**0.2** 0.01	**1.9** 0.08	11.8	7.5	0.0579	**0.27** 0.60
14.260 0.5614	**9.525** 0.3750	**-2.8** -0.11	**1.5** 0.06	**29.0** 1.14	**31.0** 1.22	**1.0** 0.04	**47.0** 1.85	**44.5** 1.75	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.11** 0.26
14.260 0.5614	**12.700** 0.5000	**-2.8** -0.11	**1.5** 0.06	**29.0** 1.14	**31.0** 1.22	**1.3** 0.05	**48.0** 1.89	**45.0** 1.77	**0.2** 0.01	**1.5** 0.06	7.6	7.1	0.0509	**0.14** 0.31
14.732 0.5800	**10.668** 0.4200	**-3.3** -0.13	**1.3** 0.05	**30.0** 1.18	**32.0** 1.26	**1.3** 0.05	**48.0** 1.89	**45.5** 1.79	**0.8** 0.03	**0.6** 0.03	8.9	8.9	0.0526	**0.14** 0.31

[4] Negative value indicates effective center inside cone (inner-ring) backface.
[5] These maximum fillet radii will be cleared by the bearing corners.
[6] Negative value indicates cage extends beyond cone (inner-ring) backface.
[7] Negative value indicates cage that does not extend beyond cone (inner-ring) front face.

Continued on next page.