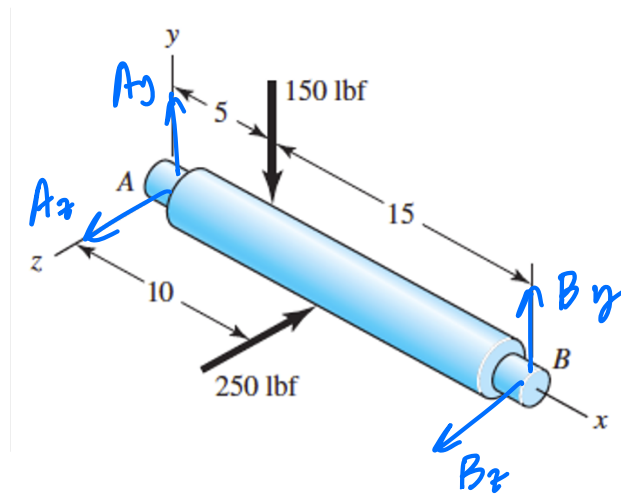**INSTRUCTIONS**:

This quiz is open-book, open-note, and you may work with your classmates.

GIVEN:

The steel shaft shown is supported by ball bearings at locations A and B. Dimensions are in inches.

A catalog page with bearing specifications is attached.

FIND:

a) The radial load supported by bearing A.

b) Using the bearing specifications attached, how many cycles do you predict for bearing A for 95% reliability?

a)　Sum moments in the z-direction about B

$$\Sigma M_z = 0 \rightarrow (150 \text{ lbf})(15 \text{ in}) - A_y \cdot 20 \text{ in} = 0$$

$$A_y = 112.5 \text{ lbf}$$

Sum moments in the y-direction about B

$$\Sigma M_y = 0 \rightarrow -(250 \text{ lbf})(10 \text{ in}) + A_z \cdot 20 \text{ in} = 0$$

$$A_z = 125 \text{ lbf}$$

$$F_A = \sqrt{A_z^2 + A_y^2} = \sqrt{112.5^2 + 125^2} = 168 \text{ lbf}$$

b) $a_1 F_R L_R^{1/a} = F_D L_D^{1/a}$

$a_1 = 0.64$

$F_R = 4002 \text{ lbf}$

$L_R = 10^6$

$a = 3$ for ball bearing

$F_D = 168 \text{ lbf}$ (from part a)

$$L_D = \left(\frac{a_1 F_R}{F_D} \right)^a L_R$$

$$= \left(\frac{0.64 \cdot 4002}{168} \right)^3 \cdot 10^6$$

$L_D = 3.2 \cdot 10^9 \text{ cycles}$

RLS 8

Deep groove ball bearings

Bearing data

Tolerances,
Normal (metric), P6, P5, Normal (inch),
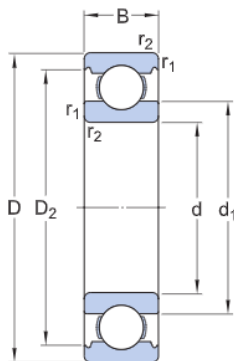Radial internal clearance,
Classes C2 to C5

Bearing interfaces

Seat tolerances for standard conditions,
Tolerances and resultant fits

Technical specification

Aftermarket only	Yes

DIMENSIONS

d	1 in	Bore diameter
D	2.25 in	Outside diameter
B	0.625 in	Width
d_1	≈ 1.4008 in	Shoulder diameter
D_2	≈ 1.9421 in	Recess diameter
$r_{1,2}$	min. 0.063 in	Chamfer dimension

ABUTMENT DIMENSIONS

d_a	min. 1.2992 in	Diameter of shaft abutment
D_a	max. 1.9685 in	Diameter of housing abutment
r_a	max. 0.0591 in	Radius of shaft or housing fillet
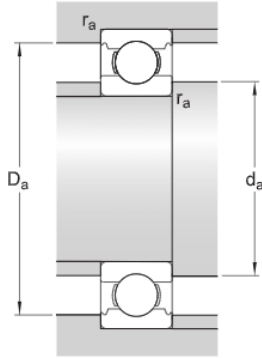
CALCULATION DATA

$F_R = C_{10}$

Basic dynamic load rating	C	4 002 lbf
Basic static load rating	C_0	2 169 lbf
Fatigue load limit	P_u	91 lbf
Reference speed		24 000 r/min
Limiting speed		17 000 r/min
Minimum load factor	k_r	0.025
Calculation factor	f_0	13

MASS

Mass bearing	0.3814 lb

TOLERANCE CLASS

Dimensional tolerances	Normal
Radial run-out	Normal