SPECIFICATION

The first step in choosing the correct bearing for an application is to determine the forces which it will support in service. The forces will depend on the exact configuration of the system and will probably include some, or all, of the following.

- The weight of the shaft, including gears and other shaft attachments.
- Gear mesh reaction forces, due to torque transmission (see below).
- Gear separation due to anti-backlash forces.
- Forces due to belt or pulley tensions.
- Axial pre-load forces.

GEAR MESH REACTIONS

In order to calculate the loads which will be applied to the bearings in the simply supported spur gear pass arrangement shown on the facing pages, it is first necessary to calculate the forces at the gear mesh.

The tangential forces at the gear can be calculated from the following equation,

$$W_t = T/r$$

where T = Torque
and r = Radius

and the separating force at the gear mesh can be calculated from,

$$W_r' = W_t \tan\phi_t$$

where ϕ_t = transverse pressure angle
= normal pressure angle for spur gears
= 20º for our standard gears

$$W_r' = 0.364 W_t$$

(for 20º pressure angle spur gear)

If required, the total radial load at the gear mesh can be calculated from the final equation,

$$W_r = \sqrt{(W_t)^2 + (W_r')^2}$$

Bearing loads

Position	Forces At These Positions		
	Tangential Force	Separating Force	Total Radial Load
Gear Mesh	W_t	W_r'	W_r
Bearing A	$W_{r1} = \frac{W_t a}{a+b}$	$W_{r2} = \frac{W_r' a}{a+b}$	$W_{rA} = \sqrt{(W_{r1})^2 + (W_{r2})^2}$
Bearing B	$W_{r3} = \frac{W_t b}{a+b}$	$W_{r4} = \frac{W_r' b}{a+b}$	$W_{rB} = \sqrt{(W_{r3})^2 + (W_{r4})^2}$
Bearing C	$W_{r5} = \frac{W_t c}{c+d}$	$W_{r6} = \frac{W_r' c}{c+d}$	$W_{rC} = \sqrt{(W_{r5})^2 + (W_{r6})^2}$
Bearing D	$W_{r7} = \frac{W_t d}{c+d}$	$W_{r8} = \frac{W_r' d}{c+d}$	$W_{rD} = \sqrt{(W_{r7})^2 + (W_{r8})^2}$

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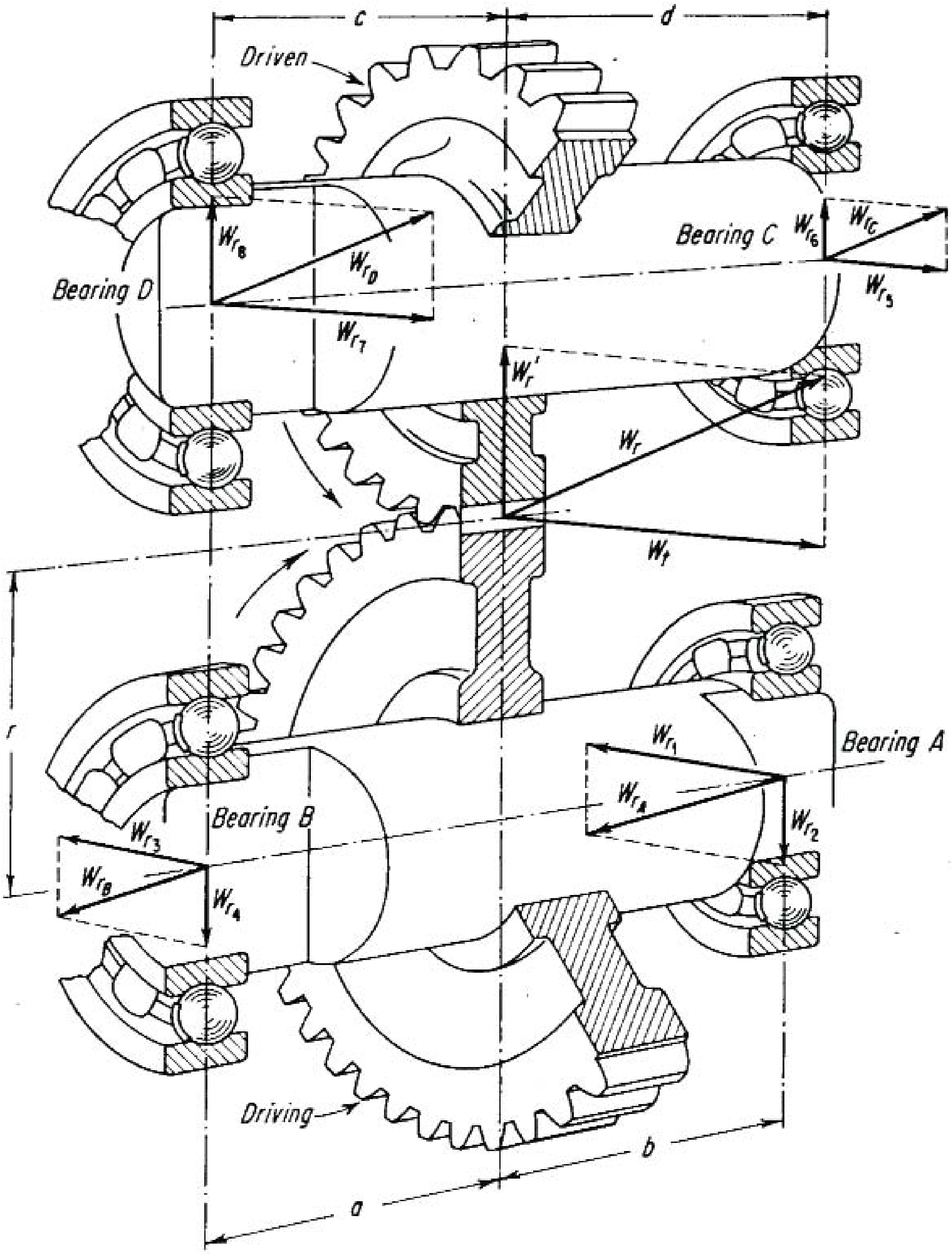
For bearing life calculations based on these radial loads see page 32.

Note - These equations can only be used for spur gear calculations, because they are not affected by self-generated axial forces.

Bearing loads and gear mesh forces diagram



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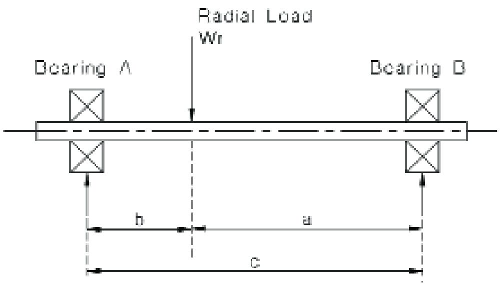
FORCE SHARING

To determine how the forces are shared between a pair of bearings, use the equations below for these two most frequently occurring configurations.

1. Radial Shaft Load Between Two Bearings.

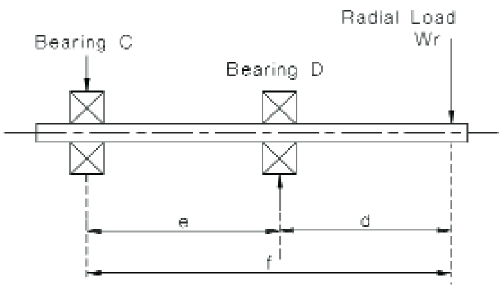
Loads are in constant units



Radial load on bearing $A = \dfrac{Wr * a}{c}$

Radial load on bearing $B = \dfrac{Wr * b}{c}$

2. Overhung Radial Load.



Radial load on bearing $C = \dfrac{Wr * d}{e}$

Radial load on bearing $D = \dfrac{Wr * f}{e}$

The individual bearing loads can then be used to predict the bearing life.

BEARING LIFE

The life of a bearing is defined as the length of time a bearing will operate satisfactorily in the application at its operating speed under applied load. Life predictions depend on a careful definition of failure criteria and consideration of operating environment, mounting practice, lubrication, operating speed and loading. As a guide, the relationship between actual applied load and bearing fatigue life is given below.

$$L_H = \frac{16667}{N}\left(\frac{C}{P}\right)^3$$

L_H = Rated life in hours
N = Speed in rpm
P = Bearing load (e.g. N)
C = Bearing capacity (e.g. N)

INSTALLATION AND HOUSING CONSIDERATIONS

The installation of a bearing will usually be determined by how it fits with its mating components. Interference or transition fits provide the most positive location of the bearing, however, they will require pressing during installation. Clearance fits allow the bearing to be assembled very easily, but could potentially lead to problems depending on the operating conditions. If a press fit is required, it is essential that no appreciable force is transferred through the rolling elements of the bearing during installation.

Special care must be taken when using bearings in aluminium housings, especially when wide temperature variations are expected. It is possible for the contraction of the housing to squash the bearing raceway and remove the radial clearance required for the bearing to operate.

Potential problems with clearance fits:
Fretting - Wearing away of the surface due to rubbing of the components.
Accuracy - Accuracy can be compromised due to unpredictable movement.

Potential problems with interference fits:
Assembly - Can be difficult or impossible without damaging the bearing.
Radial clearance - Can be reduced if the interference is too great.

Note - As a result of continuous product development, Reliance reserves the right without prior notice to change dimensions where this does not affect the function of the item. Please visit our website for the latest product news and developments.

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