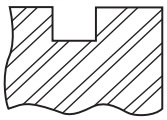
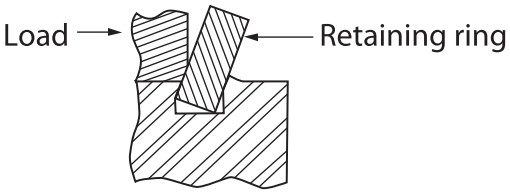
2) Calculations for Retaining Rings (Reference)

(1) Allowable Thrust Load

The allowable thrust load is a load specified when the groove is not deformed and the retaining ring is not sheared.

Deformation of groove





① Allowable Thrust Load of Retaining Ring

The allowable thrust load where static load is applied to a retaining ring can be calculated according to the following formula:

$$R_S = \frac{ADTS_S\pi}{S}$$

RS : Allowable thrust load of ring (N)

A : Shape factors of retaining rings (See Table 1)

D : Shaft diameter or housing diameter (mm)

T : Plate thickness of ring (mm)
The Beveled Rings need to allow for the plate thickness when fit since they may be fit at half of the groove depth in relation to the retained work.

π : Circumference ratio

SS : Strength in shear of ring (N/mm ^{2})
Basic External Ring (Carbon steel) : Approx. 980N/mm ^{2} as a guideline. (According to the JIS B 2804)

S : Safety factor
: General safe factors are listed in a table. (See Table 2)

Table 1

Shape factors of retaining rings (Table)		
Shape of ring	A (Ring)	B (Groove)
Basic External Ring	1.0	1.0
Beveled External Ring	1.0	1.0
Basic Internal Ring	1.0	1.0
Beveled Internal Ring	1.0	1.0
Inverted Internal Ring	0.7	0.5
Inverted External Ring	0.7	0.5
E Ring	0.3	0.3
C Ring	0.5	0.5
U King	0.5	0.5
K Ring	0.5	0.5

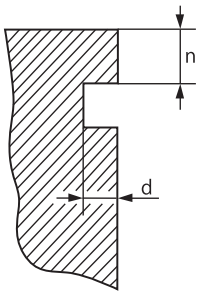
Table 2

Guideline on safe factors (S)	
Type of load	safety factors
Static load	3 or 4
Cyclic load	5
Alternate load	8
Shock load	12

② Thrust Load of Groove

It is necessary to design the groove to obtain a sufficient thrust load of retaining ring.
It is important to set the edge margin in this design.
We recommend that the margin be set as given below to increase the through load of groove.

$$n / d \geqq 3$$

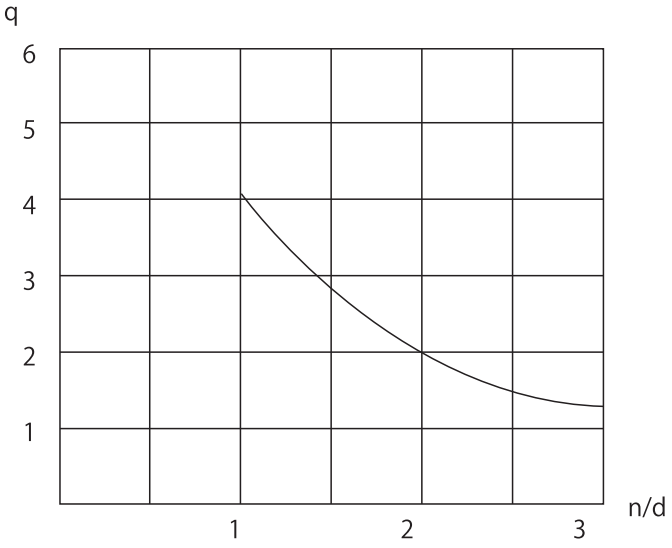


n: Edge margin (mm)
d: Depth of groove (mm)

Note: If the value n/ d is less than 3, care must be taken since the thrust load in the groove is reduced.
Note: For small-sized retaining rings, the value n/d must take a value more than 3.
(Refer to for the table of ring dimension for the recommended dimension.)
If n/ d is equal or more than 3, the allowable thrust load can be calculated according to the following formula:

$$G_1 = \frac{BDdG_y\pi}{Sq}$$

G_1 : Static thrust load in groove (N)
B : Shape factor of ring (See Table 1)
D : Shaft diameter or housing diameter (mm)
d : Depth of groove (mm)
G_y : Yield strength of groove (N/mm^2)
π : Circumference ratio
S : Safety factor (See table 2)
q : Decreasing factor, a value obtained from the value n/d using the graph. However, if the value n/d is 3 or more, the value q is 1.



The above formula assumes that retained parts have sharp corners.
For retained parts having corner radii, care must be taken as the thrust load is reduced.
If the thrust load does not satisfy the requirement because of retained parts having corner radii or chamfers, the thrust load can be improved by inserting a spacer ring like a rigid flat washer in the groove.