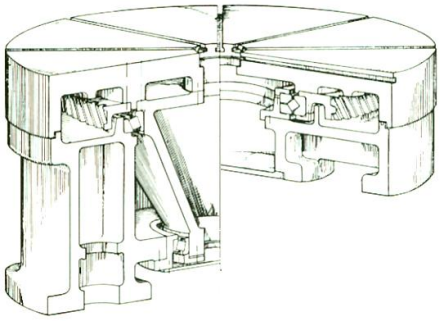
Advantages of a Crossed Tapered Roller Bearing (XR)

This is intended to describe the inherent advantages of a Crossed Roller Bearing (XR) solution as used in the table of Vertical Axis Machine tools such as vertical lathes, vertical machining centers or grinding machines.

Most of these advantages are the result of the bearing concept itself.

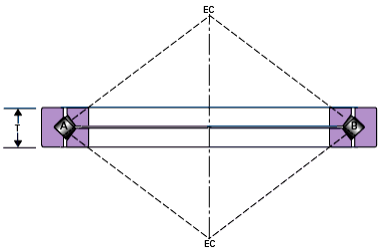
Bearing Description:

A Crossed Roller Bearing features two sets of bearing races and rollers brought together (with alternate rollers facing opposite directions) within a section height not much greater than that of a single row bearing. The large bore, relative to the outside diameter allows large space for other surrounding equipment



- ***Benefits: compactness, small cross section***

The steep angle tapered geometry of the bearing causes the effective center of each of the race (load carrying point) to be projected far away along the axis resulting in a total effective bearing spread many times greater than the width of the bearing itself.



- ***Benefits: high stability and better load sharing***

The most popular form of XR bearing is the TXRDO featuring a double outer race and two inner races, with rollers spaced by nylon separators

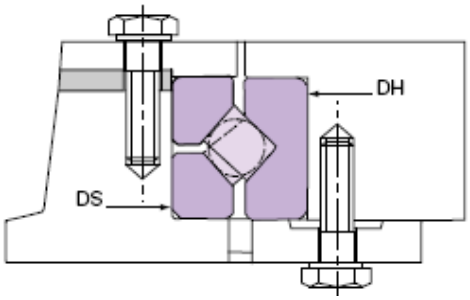
- ***Benefits: easy assembly, simple manufacturing, low inertia and low running torque***

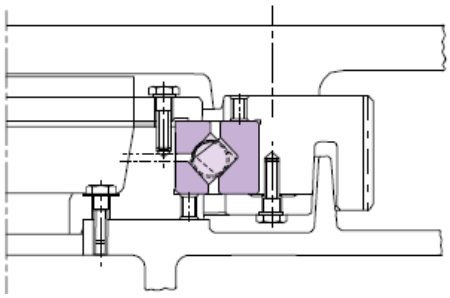
Timken XR bearings are manufactured from case-carburized steel

- ***Benefits: wear resistant surfaces and tough, shock-resistant core***

Table design

The bearing compactness ends up to a very simple table / bearing arrangement with a minimum of machining and an ample space to fit other equipment:





- The outer ring is tight fitted into the bore of the gear ring
- The inner rings are tight fitted onto the central pivot
- Final setting (preload) is achieved by grinding the relevant segments that are very accessible

The combination of two bearing rows in the space of one offering a large effective spread allows reducing the total height of the spindle (pivot) compared to more traditional arrangements using two outlying bearings

- ***Benefits: compactness and reduced height of the table design ending up to economy on material and machining***
- ***Benefits: simple isostatic arrangement***
- ***Benefits: easy to assemble and to adjust***
- ***Benefits: maximum accuracy of rotation***

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Performance

- ***Load capacity***
  The Tapered Roller design allows the bearing to support both radial and axial loads and any combination of both, giving then to the solution a very strong load capacity in a small envelope.

- ***Tilting stiffness / rigidity***
  The large effective spread of both bearing rows ensures a high inherent stability. In addition this design permits to the bearing to withstand high overturning moments developed by non centered axial loads or to minimize the radial deflection due to large over hanged radial cutting efforts.

- ***Precision***
  Line contacts, due to roller guidance, in conjunction with the capability to preload the bearing ensure maximum rigidity and minimum run-out under customized optimum preload. The compactness and limited cross section of the bearing minimize the risk of running errors due to thermal effects. In addition, our suggestion to grind the table surface “on the bearing” after assembly ensures a maximum accuracy to the global machine.

- ***Speed capability***
  The large bore / small cross section concept using light rollers in conjunction with forced oil circulation lubrication gives to the solution an optimum speed capacity. In addition, the low starting torque resulting from the bearing design (small roller geometry, nylon separators) gives a close control of the angular indexing together with a smooth and cool running.

- ***Lubrication***
  Lubrication can be achieved by oil circulation and level or grease. Most of applications, however, because of a relatively high speed are using oil circulation. The geometry of the Crossed Roller Bearing and the table concept allow providing the oil inlet between both inner rings. This arrangement will facilitate the distribution of the oil within the bearing due to the natural pumping effect of the Tapered Roller Bearing design. In addition, additional oil jets, control of oil flows, possibility of cooling make this lubrication mode very efficient and user friendly.

- ***Benefit of the preload***
  The capability of a XR bearing to be preloaded brings to the machine some indisputable advantages as:
  - ✓ Maximum rigidity
  - ✓ Optimum overall performance
  - ✓ Precision of rotation
  - ✓ Less subject to vibration / better dumping effect
  - ✓ Inhibition of fretting corrosion under stationary vibrating conditions.

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Summary of advantages using an XR bearing concept

- ✓ *Compactness and small cross section provides a simplified table design together with a maximum running accuracy.*
- ✓ *Wide effective spread ensures high stability.*
- ✓ *Simplified design, reduction of spindle length and machining bring economy.*
- ✓ *Limited changes in geometry due to thermal expansion*
- ✓ *Low starting torque ensures a close control of angular indexing.*
- ✓ *Maximum rigidity and minimum run out guaranteed by optimum preload.*
- ✓ *Optimum preload inhibits fretting corrosion under stationary vibrating conditions.*
- ✓ *Simple but efficient lubrication.*
- ✓ *Nylon separators bring low inertia.*
- ✓ *Smooth and cool running.*
- ✓ *Line contact geometry of the roller / race contact provides maximum rigidity and excellent guidance for running precision.*
- ✓ *Case carburized steel provides tough, shock resistant core and hard wear-resistant surfaces.*
- ✓ *Easy to assemble together with easy access for adjustment for either original mounting or maintenance purposes.*