

A Brief Guide to Linkage Design

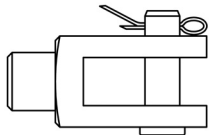
This guide will help you design a cost effective and suitable linkage for you application. However, please contact our Technical Department for detailed advice on 01483 28 6784.

The linkage end fittings

Your particular application will determine the selection of end fittings - clevises, ball joints, rod ends etc. Will your linkage be affected by a) environment - dust heat/cold, b) high/ low loads, c) small / large angles of "articulation", d) weight, e) restricted space, f) life expectancy, g) initial assembly method and subsequent need for easy removal.

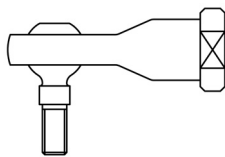
Obviously your choice will be affected by the shape of the part that the linkage will be joined to. If one end is connected to an activating valve, for instance on the controls of a Backhoe Loader, then invariably a Clevis (Yoke or Fork End) with relevant Clevis Pin will be required.

DIN 71752 clevis fitted with R3450 clevis pin and R3440 clip



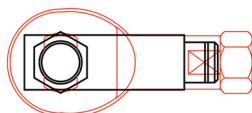
Clevises are normally used where articulation is only required in one plane. In most cases the other end of this type of linkage would require some form of right angle Ball Joint or studded Rod End as they are usually bolted directly into a Bell Crank or Lever of some sort. Ball joints provide conical movement of the male Ball Stud. When specifying this type of right angle Ball Joint consideration should be taken as to the location of the joint. Is it up inside the Cab or exposed to the elements under the machine. Construction equipment can encounter some very harsh conditions. Where will the equipment be used, in the salty atmosphere of a dockyard, in the frozen wastes of Alaska or out in the Arizona desert?

R3610 series rod end with right angled threaded ball stud.



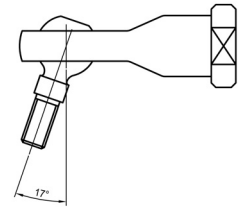
When designing a control linkage a Ball Joint with very little or no backlash is an advantage to provide a nice positive feel to the controls of the machine. Vibration is another factor. A Ball Joint fitted to the control pump of a Skidsteer will encounter a tremendous amount of vibration and could promote premature wear. When space is an issue, a Ball Joint is usually preferred over a Rod End (Sometimes known as a Rose Joint).

In a confined space, a ball joint is preferable to a rod end (shown here with the red outline against the outline of the typical ball joint).



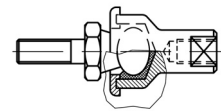
If the application requires a large angle of articulation, our Rod Ends with stud are manufactured to provide up to 34° inclusive of conical movement.

Rod end with stud can provide up to 34° inclusive conical movement.



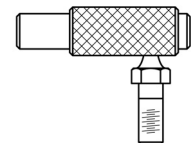
In some instances where there is minor misalignment between parts to be linked, an In-line Ball Joint will be suitable but note that these are not designed to be used under tension.

In-line ball joint where linear misalignment is an issue.



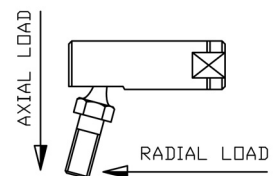
The method of assembly on your production line needs to be considered and whether the linkage may subsequently need to be disconnected and reassembled at times. If you need easy removal we suggest our Quick release ball joints.

R3535 type ball joint provides quick release capability.



Ball Joints are usually loaded radially, however, axial pull out loads should still be considered to avoid the ball stud pulling out of its corresponding socket when fully articulated. Life expectancy is dependant on many application variables. Therefore we ask our customers to carry out their own testing once we have recommended a suitable linkage configuration.

Ball Stud shown in over articulated position so that neck of stud is forced against the edge of the ball cavity. This condition should be avoided.



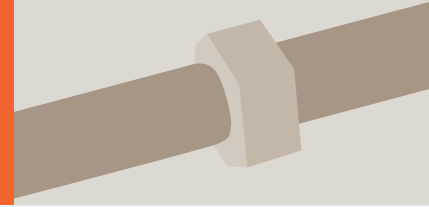


Table 1. Advantages of different types of ball joint

Advantages	R3490	R3530	R3550/R3610	R3500	R3535
Smooth action, backlash free	✓		✓		
Suitable for vibration applications	✓		✓		✓
May be assembled by customer or to pre installed stud	✓				
Available with dust seal	✓	✓			
Low cost	✓	✓			
High Pull out loads		✓	✓		
Available in Stainless Steel	✓	✓	✓	✓	
Suitable where limited space is an issue		✓			
Inch version available		✓	✓		✓
Good wear resistance			✓		
Durable construction			✓		
Male Threaded body available	✓	✓	✓		
Quick release					✓

Connecting rod

We recommend the use of cropped to length and thread rolled rods. These provide a considerable cost saving compared with the alternative – machined rods with cut threads. Cropped Rods do not provide a chamfered end but it is still easy to “start a thread”. We recommend that the rod is specified with left and right hand threaded ends to provide more precise length adjustment. Obviously this is suitable only for straight rods without bends. Spanner flats or knurls can also be added to aid adjustment.

General specification tips

We always recommend the use of standard catalogue items rather than specials which can incur high costs unless required in large quantities.

Specifying a “Loose assembled linkage” can save the extra cost of a setting fixture especially on short batch runs. A linkage quoted thus would be supplied with locking nuts finger tight.

Specify LH/RH threads on rods to provide infinite adjustment. RH/RH would require a tolerance equal to the thread pitch between the centres of the end fittings.

Specifying Ball Joints with a gaiter fitted provides better protection from ingress of foreign bodies.

When possible, it is best to get Springfix involved at the early stages of a development program so that we can advise you on the best cost effective solution to your linkage requirements.

We usually supply complete linkages with the end fittings pre-assembled to connecting rods ready for you to fit on your production line. However we are happy to provide you with the individual parts for you to assemble your own linkages.