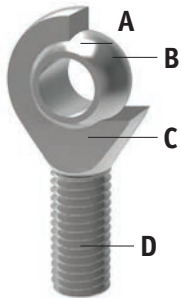


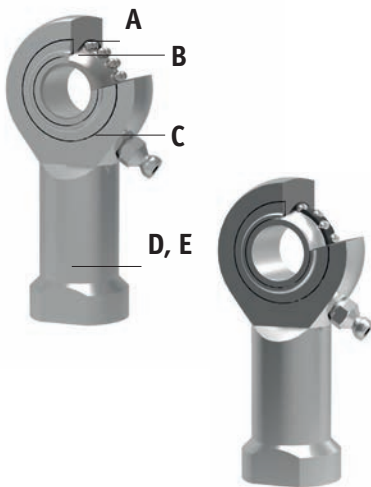
All of our rod ends incorporate either a plain spherical bearing, ball bearing, or roller bearing. Below is an overview of each type.

Plain spherical bearings



- A** Made from Polyamid-PTFE-fibreglass-compound, maintenance free, absorbs any foreign particles
- B** Ball made of bearing steel, hardened, ground, polished and hard chromium plated, ensures reliable corrosion protection
- C** No clearance - radial clearance 0-10µm
- D** All rod ends housings made of forged steel, tempered, extremely high loads resistant

Ball and roller bearings



- A** Radial clearance: 10-30µm, low friction
- B** Inner ring made of bearing steel, hardened ball grooves polished
- C** Shields on both sides protect against rough dirt penetration
- D** All rod ends housings are made of forged steel, case hardened bearing race
- E** Low maintenance due to long-term greasing, especially suitable for high speed large swiveling angles or rotating movements

Rod ends and water



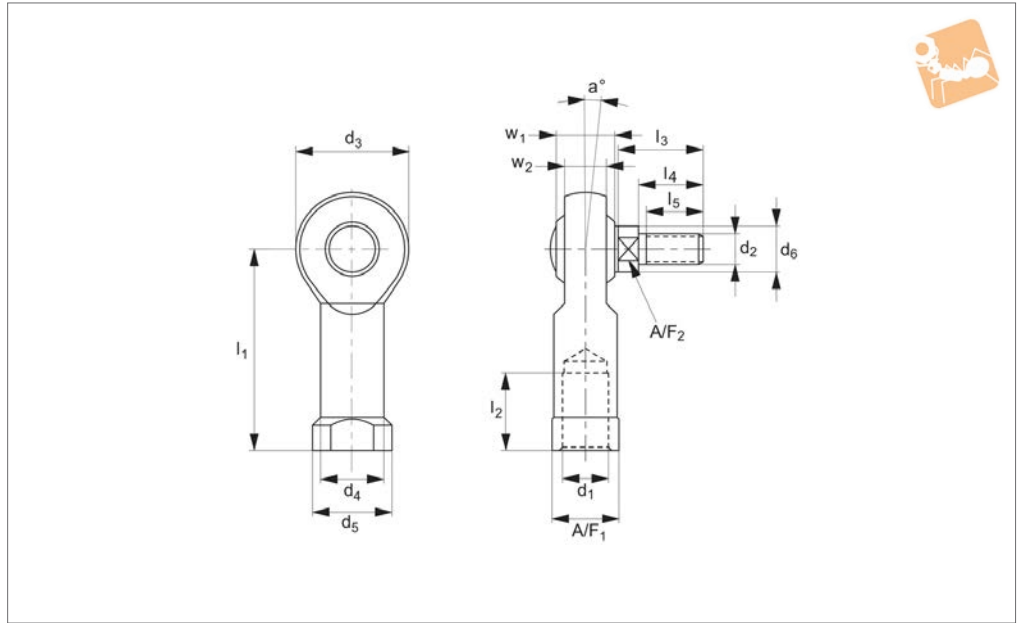
Stainless steel versions

Most of our rod ends are available in stainless steel as standard

High grade AISI 316 stainless steel available on request



R3610



Material

Body: surface zinc plated
 Race: steel/ bronze - PTFE composite.
 Inner ring: bearing steel, hardened ground and spherical surface chromium plates.
 Outer ring: brass body pressed around,

outer race lined with bronze - PTFE composite.

Technical Notes

Maintenance free. Sizes according to DIN ISO 12240-4 series K.

Tips

Standard thread is right hand thread.
 Rod end studs are all right hand threads.

Important Notes

*Denotes fine pitch threads.

Order No.	Thread hand	d ₁	d ₂	l ₁	w ₁	d ₃	d ₄	d ₅	d ₆	l ₂	Weight g
R3610.R006	Right	M6	M6	30	9	20	10.0	13	9.0	12	22
R3610.R008	Right	M8	M8	36	12	24	12.5	16	10.5	16	47
R3610.R010	Right	M10	M10	43	14	28	15.0	19	13.0	20	77
R3610.R011	Right	M10 x 1,25*	M10	43	14	28	15.0	19	13.0	20	77
R3610.R012	Right	M12	M12	50	16	32	17.5	22	15.0	22	100
R3610.R013	Right	M12 x 1,25*	M12	50	16	32	17.5	22	15.0	22	100
R3610.R014	Right	M14	M14	57	19	36	20.0	25	17.0	25	160
R3610.R015	Right	M14 x 1,5*	M14	57	19	36	20.0	25	17.0	25	160
R3610.R016	Right	M16	M16	64	21	42	22.0	27	19.0	28	220
R3610.R017	Right	M16 x 1,5*	M16	64	21	42	22.0	27	19.0	28	220
R3610.L006	Left	M6	M6	30	9	20	10.0	13	9.0	12	22
R3610.L008	Left	M8	M8	36	12	24	12.5	16	10.5	16	47
R3610.L010	Left	M10	M10	43	14	28	15.0	19	13.0	20	77
R3610.L011	Left	M10 x 1,25*	M10	43	14	28	15.0	19	13.0	20	77
R3610.L012	Left	M12	M12	50	16	32	17.5	22	15.0	22	100
R3610.L013	Left	M12 x 1,25*	M12	50	16	32	17.5	22	15.0	22	100
R3610.L014	Left	M14	M14	57	19	36	20.0	25	17.0	25	160
R3610.L015	Left	M14 x 1,50*	M14	57	19	36	20.0	25	17.0	25	160
R3610.L016	Left	M16	M16	64	21	42	22.0	27	19.0	28	220
R3610.L017	Left	M16 x 1,50*	M16	64	21	42	22.0	27	19.0	28	220

Order No.	l ₃	l ₄	l ₅	w ₂	A/F ₁	A/F ₂	a °	Static load C ₀ kN max.
R3610.R006	18.5	13	10	6.75	11	8	13	7.7
R3610.R008	23.5	17	13	9.00	14	8	14	12.9
R3610.R010	28.0	21	17	10.50	17	12	13	18.0
R3610.R011	28.0	21	17	10.50	17	12	13	18.0
R3610.R012	32.5	25	20	12.00	19	14	13	24.0
R3610.R013	32.5	25	20	12.00	19	14	13	24.0
R3610.R014	37.5	29	22	13.50	22	14	16	31.0
R3610.R015	37.5	29	22	13.50	22	14	16	31.0



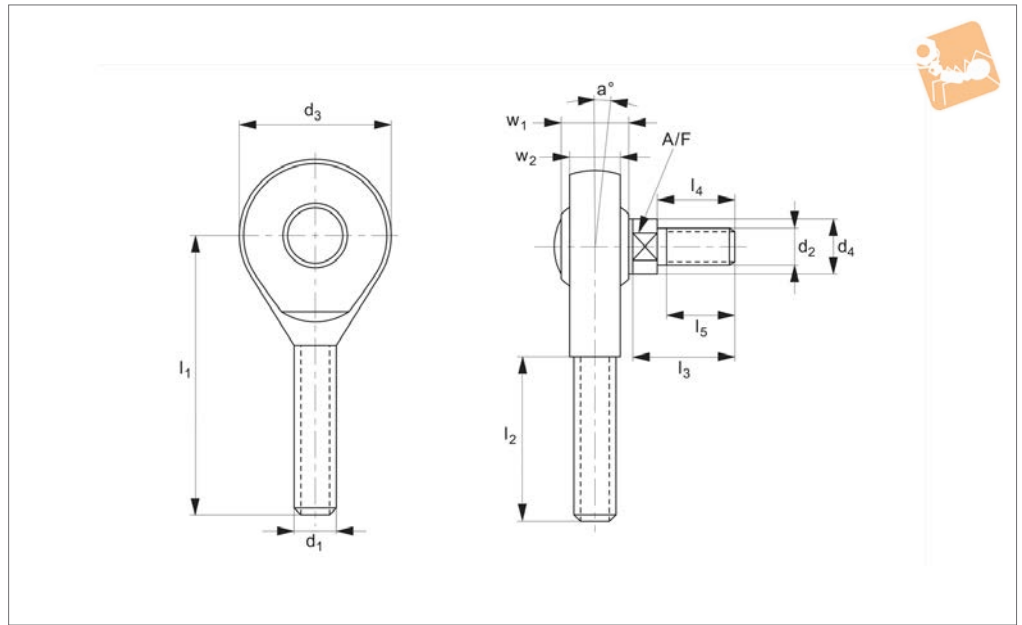
Rod End with Stud - Female

Rod Ends

Order No.	l_3	l_4	l_5	w_2	A/F_1	A/F_2	α	Static load C_0 kN max.
R3610.R016	42.5	33	24	15.00	22	17	15	39.0
R3610.R017	42.5	33	24	15.00	22	17	15	39.0
R3610.L006	18.5	13	10	6.75	11	8	13	7.7
R3610.L008	23.5	17	13	9.00	14	8	14	12.9
R3610.L010	28.0	21	17	10.50	17	12	13	18.0
R3610.L011	28.0	21	17	10.50	17	12	13	18.0
R3610.L012	32.5	25	20	12.00	19	14	13	24.0
R3610.L013	32.5	25	20	12.00	19	14	13	24.0
R3610.L014	37.5	29	22	13.50	22	14	16	31.0
R3610.L015	37.5	29	22	13.50	22	14	16	31.0
R3610.L016	42.5	33	24	15.00	22	17	15	39.0
R3610.L017	42.5	33	24	15.00	22	17	15	39.0



R3611



Material

Body: surface zinc plated.
 Race: steel/ bronze - PTFE composite.
 Inner ring: bearing steel, hardened ground and spherical surface chromium plates.
 Outer ring: brass body pressed around,

outer race lined with bronze - PTFE composite.

Technical Notes

Maintenance free, sizes according to DIN ISO 12230-4 series K.

Tips

Standard thread is right hand thread.
 Rod end studs are all right hand threads.

Order No.	Thread hand	d ₁	d ₂	l ₁	w ₁	d ₃	d ₄	l ₂	l ₃	Weight g
R3611.R006	Right	M6	M6	36	9	20	9.0	21	18.5	20
R3611.R008	Right	M8	M8	42	12	24	10.5	25	23.5	38
R3611.R010	Right	M10	M10	48	14	28	13.0	28	28.5	55
R3611.R012	Right	M12	M12	54	16	32	15.0	32	32.5	85
R3611.R014	Right	M14	M14	60	19	36	17.0	36	37.5	140
R3611.R016	Right	M16	M16	66	21	42	19.0	37	42.5	210
R3611.L006	Left	M6	M6	36	9	20	9.0	21	18.5	20
R3611.L008	Left	M8	M8	42	12	24	10.5	25	23.5	38
R3611.L010	Left	M10	M10	48	14	28	13.0	28	28.5	55
R3611.L012	Left	M12	M12	54	16	32	15.0	32	32.5	85
R3611.L014	Left	M14	M14	60	19	36	17.0	36	37.5	140
R3611.L016	Left	M16	M16	66	21	42	19.0	37	42.5	210

Order No.	l ₄	l ₅	w ₂	A/F	a°	Static load C ₀ kN max.
R3611.R006	13	10	6.75	8	13	7.7
R3611.R008	17	13	9.00	8	14	12.9
R3611.R010	21	17	10.50	12	13	18.0
R3611.R012	25	20	12.00	14	13	24.0
R3611.R014	29	22	13.50	14	16	31.0
R3611.R016	33	24	15.00	17	15	39.0
R3611.L006	13	10	6.75	8	13	7.7
R3611.L008	17	13	9.00	8	14	12.9
R3611.L010	21	17	10.50	12	13	18.0
R3611.L012	25	20	12.00	14	13	24.0
R3611.L014	29	22	13.50	14	16	31.0
R3611.L016	33	24	15.00	17	15	39.0

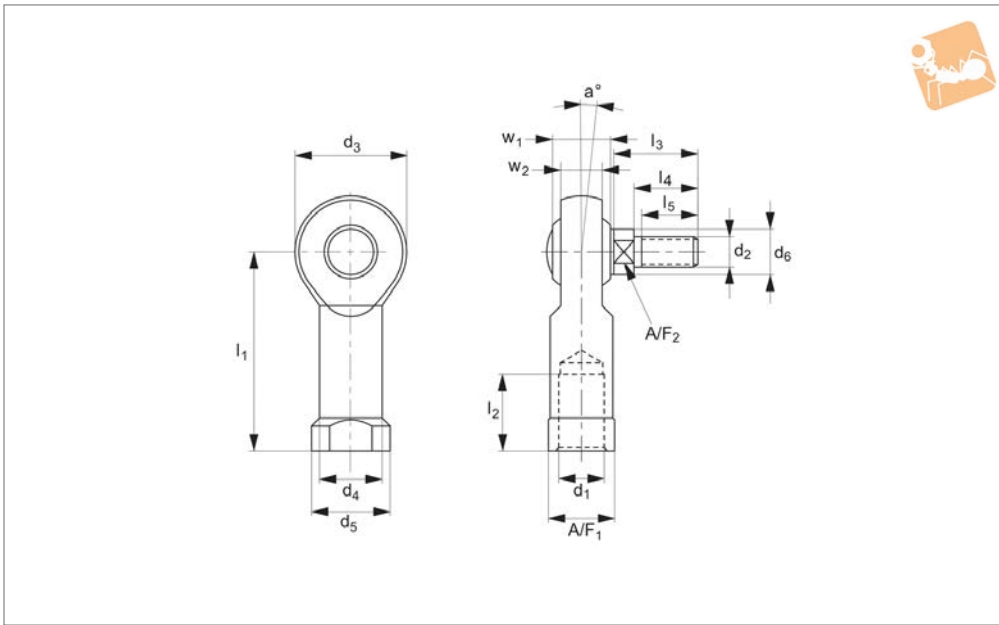


Stainless Rod End with Stud Female

Rod Ends



R3613



Material

Body: stainless steel (AISI 304)
 Race: steel/ bronze - PTFE composite.
 Inner ring: stainless steel, hardened and ground (AISI 304).
 Outer ring: brass body pressed around, outer race lined with bronze - PTFE compo-

site.
 Joint ball: stainless steel (AISI 440C)

Technical Notes

Maintenance free. Sizes according to DIN ISO 12740-4, series K

Tips

Standard thread is right hand thread.
 Rod end studs are all right hand threads.

Important Notes

*denotes fine pitch threads.

Order No.	Thread hand	d ₁	d ₂	l ₁	w ₁	d ₃	d ₄	d ₅	d ₆	l ₂	Weight g
R3613.R006	Right	M6	M6	30	9	20	10.0	13	9.0	12	22
R3613.R008	Right	M8	M8	36	12	24	12.5	16	10.5	16	47
R3613.R010	Right	M10	M10	43	14	28	15.0	19	13.0	20	77
R3613.R011	Right	M10 x 1,25*	M10	43	14	28	15.0	19	13.0	20	100
R3613.R012	Right	M12	M12	50	16	32	17.5	22	15.0	22	100
R3613.R013	Right	M12 x 1,25*	M12	50	16	32	17.5	22	15.0	22	100
R3613.R014	Right	M14	M14	57	19	36	20.0	25	17.0	25	160
R3613.R015	Right	M14 x 1,5*	M14	57	19	36	20.0	25	17.0	25	160
R3613.R016	Right	M16	M16	64	21	42	22.0	27	19.0	28	220
R3613.R017	Right	M16 x 1,5*	M16	64	21	42	22.0	27	19.0	28	220
R3613.L006	Left	M6	M6	30	9	20	10.0	13	9.0	12	22
R3613.L008	Left	M8	M8	36	12	24	12.5	16	10.5	16	47
R3613.L010	Left	M10	M10	43	14	28	15.0	19	13.0	20	77
R3613.L011	Left	M10 x 1,25*	M10	43	14	28	15.0	19	13.0	20	100
R3613.L012	Left	M12	M12	50	16	32	17.5	22	15.0	22	100
R3613.L013	Left	M12 x 1,25*	M12	50	16	32	17.5	22	15.0	22	100
R3613.L014	Left	M14	M14	57	19	36	20.0	25	17.0	25	160
R3613.L015	Left	M14 x 1,50*	M14	57	19	36	20.0	25	17.0	25	160
R3613.L016	Left	M16	M16	64	21	42	22.0	27	19.0	28	220
R3613.L017	Left	M16 x 1,50*	M16	64	21	42	22.0	27	19.0	28	220

Order No.	l ₃	l ₄	l ₅	w ₂	A/F ₁	A/F ₂	a°	Static load C ₀ kN max.
R3613.R006	18.5	13	10	6.75	11	8	13	7.7
R3613.R008	23.5	17	13	9.00	14	8	14	12.9
R3613.R010	28.0	21	17	10.50	17	12	13	18.0
R3613.R011	28.0	21	17	10.50	17	12	13	18.0
R3613.R012	32.5	25	20	12.00	19	14	13	24.0
R3613.R013	32.5	25	20	12.00	19	14	13	24.0

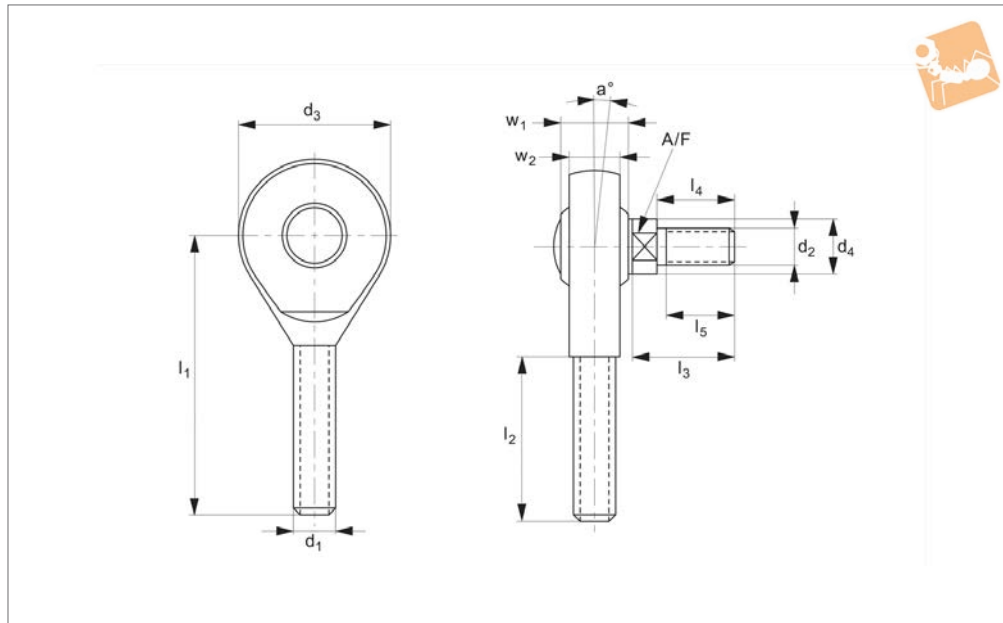


Order No.	l_3	l_4	l_5	w_2	A/F_1	A/F_2	a	Static load C_0 kN max.
R3613.R014	37.5	29	22	13.50	22	14	16	31.0
R3613.R015	37.5	29	22	13.50	22	14	16	31.0
R3613.R016	42.5	33	24	15.00	22	17	15	39.0
R3613.R017	42.5	33	24	15.00	22	17	15	39.0
R3613.L006	18.5	13	10	6.75	11	8	13	7.7
R3613.L008	23.5	17	13	9.00	14	8	14	12.9
R3613.L010	28.0	21	17	10.50	17	12	13	18.0
R3613.L011	28.0	21	17	10.50	17	12	13	18.0
R3613.L012	32.5	25	20	12.00	19	14	13	24.0
R3613.L013	32.5	25	20	12.00	19	14	13	24.0
R3613.L014	37.5	29	22	13.50	22	14	16	31.0
R3613.L015	37.5	29	22	13.50	22	14	16	31.0
R3613.L016	42.5	33	24	15.00	22	17	15	39.0
R3613.L017	42.5	33	24	15.00	22	17	15	39.0



Stainless Rod End with stud Male

Rod Ends



R3614

ROD ENDS

Material

Body: stainless steel (AISI 304)
Race: steel/ bronze - PTFE composite.
Inner ring: stainless steel, hardened and ground (AISI 304)
Outer ring: brass body pressed around,

outer race lined with bronze - PTFE composite.

Joint ball: stainless steel (AISI 440C)

Technical Notes

Maintenance free, sizes according to DIN

ISO 12240-4 series K.

Tips

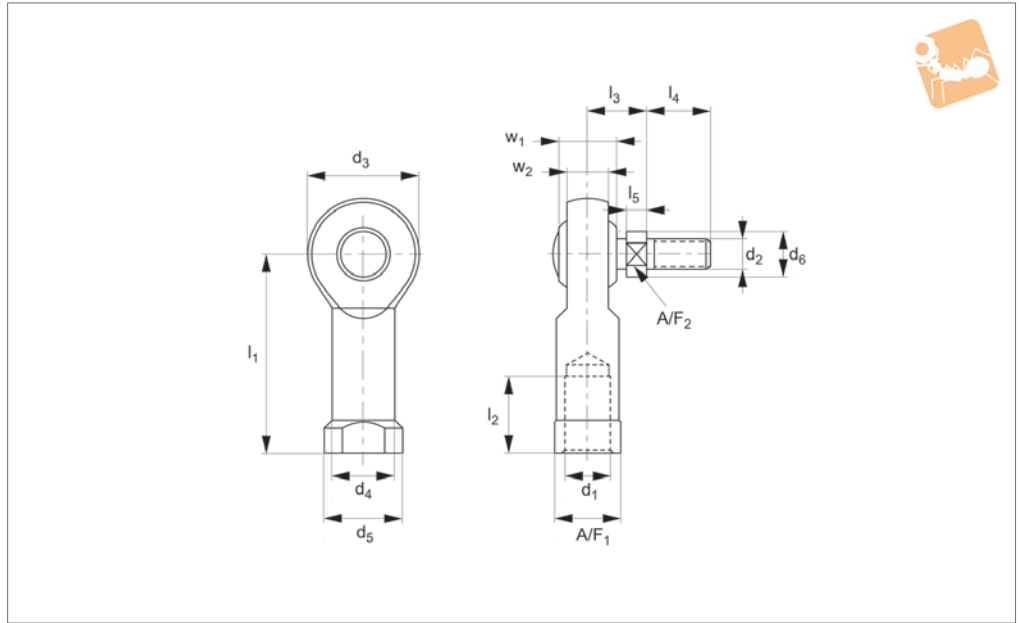
Standard thread is right hand thread.
Rod end studs are all right hand threads.

Order No.	Thread hand	d ₁	d ₂	l ₁	w ₁	d ₃	d ₄	Weight g
R3614.R006	Right	M6	M6	36	9	20	9.0	20
R3614.R008	Right	M8	M8	42	12	24	10.5	38
R3614.R010	Right	M10	M10	48	14	28	13.0	55
R3614.R012	Right	M12	M12	54	16	32	15.0	85
R3614.R014	Right	M14	M14	60	19	36	17.0	140
R3614.R016	Right	M16	M16	66	21	42	19.0	210
R3614.L006	Left	M6	M6	36	9	20	9.0	20
R3614.L008	Left	M8	M8	42	12	24	10.5	38
R3614.L010	Left	M10	M10	48	14	28	13.0	55
R3614.L012	Left	M12	M12	54	16	32	15.0	85
R3614.L014	Left	M14	M14	60	19	36	17.0	140
R3614.L016	Left	M16	M16	66	21	42	19.0	210

Order No.	l ₂	l ₃	l ₄	l ₅	w ₂	A/F	a °	Static load C ₀ kN max.
R3614.R006	21	18.5	13	10	6.75	8	13	7.7
R3614.R008	25	23.5	17	13	9.00	8	14	12.9
R3614.R010	28	28.5	21	17	10.50	12	13	18.0
R3614.R012	32	32.5	25	20	12.00	14	13	24.0
R3614.R014	36	37.5	29	22	13.50	14	16	31.0
R3614.R016	37	42.5	33	24	15.00	17	15	39.0
R3614.L006	21	18.5	13	10	6.75	8	13	7.7
R3614.L008	25	23.5	17	13	9.00	8	14	12.9
R3614.L010	28	28.5	21	17	10.50	12	13	18.0
R3614.L012	32	32.5	25	20	12.00	14	13	24.0
R3614.L014	36	37.5	29	22	13.50	14	16	31.0
R3614.L016	37	42.5	33	24	15.00	17	15	39.0



R3616.i



Material

Housing and Stud: Yellow zinc plated steel.
Ball: Zinc plated, surface hardened steel

forced nylon bearing race.
Female thread, Maintenance free, yellow zinc is not RoHS Compliant.

Rod end studs are all right hand threads.

Technical Notes

Features an injection molded, fibre rein-

Tips

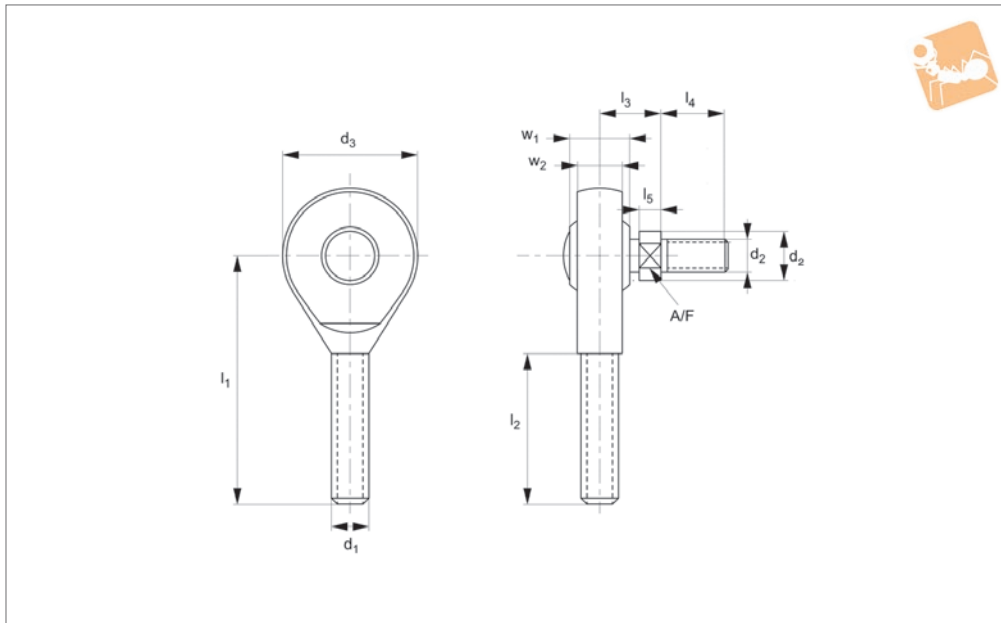
Standard thread is Right hand thread.

Order No.	Thread hand	d ₁	d ₂	l ₁	w ₁	d ₃	d ₄
R3616.I190	Right	10-32	10-32	1.062	0.312	0.625	0.406
R3616.I250	Right	1/4-28	1/4-28	1.312	0.375	0.750	0.469
R3616.I313	Right	5/16-24	5/16-24	1.375	0.437	0.875	0.500
R3616.I375	Right	3/8-24	3/8-24	1.625	0.500	1.000	0.687
R3616.I500	Right	1/2-20	1/2-20	2.125	0.625	1.312	0.875
R3616.I625	Right	5/8-18	5/8-18	2.500	0.750	1.500	1.000
R3616.I750	Right	3/4-16	3/4-16	2.875	0.875	1.750	1.125
R3616.IL190	Left	10-32	10-32	1.062	0.312	0.625	0.406
R3616.IL250	Left	1/4-28	1/4-28	1.312	0.375	0.750	0.469
R3616.IL313	Left	5/16-24	5/16-24	1.375	0.437	0.875	0.500
R3616.IL375	Left	3/8-24	3/8-24	1.625	0.500	1.000	0.687
R3616.IL500	Left	1/2-20	1/2-20	2.125	0.625	1.312	0.875

Order No.	d ₅	l ₂	l ₃	l ₄	l ₅	w ₂	A/F ₁	A/F ₂	α
R3616.I190	0.187	0.562	0.437	0.437	0.125	0.250	0.312	0.321	25
R3616.I250	0.304	0.750	0.469	0.562	0.125	0.281	0.375	0.375	25
R3616.I313	0.356	0.750	0.531	0.687	0.125	0.344	0.437	0.437	25
R3616.I375	0.424	0.937	0.644	0.906	0.187	0.406	0.562	0.500	25
R3616.I500	0.564	1.187	0.875	1.125	0.250	0.500	0.750	0.625	25
R3616.I625	0.622	1.500	1.000	1.125	0.375	0.562	0.875	0.750	25
R3616.I750	0.747	1.562	1.187	1.812	0.375	0.687	1.000	1.000	25
R3616.IL190	0.187	0.562	0.437	0.437	0.125	0.250	0.312	0.321	25
R3616.IL250	0.304	0.750	0.469	0.562	0.125	0.281	0.375	0.375	25
R3616.IL313	0.356	0.750	0.531	0.687	0.125	0.344	0.437	0.437	25
R3616.IL375	0.424	0.937	0.644	0.906	0.187	0.406	0.562	0.500	25
R3616.IL500	0.564	1.187	0.875	1.125	0.250	0.500	0.750	0.625	25



Imperial Male Rod End with Stud with Nylon bearing race



R3617.i

ROD ENDS

Material

Housing and Stud: Yellow zinc plated steel.
Ball: Zinc plated, surface hardened steel.

forced nylon bearing race.
Female thread, Maintenance free, yellow zinc is not RoHS Compliant.

end studs are all Right hand threads.

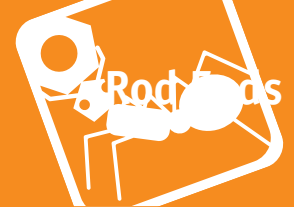
Technical Notes

Features an injection molded, fibre rein-

Tips

Standard thread is Right hand thread, rod

Order No.	Thread hand	d ₁	d ₂	l ₁	w ₁	d ₃	d ₄	l ₂	l ₃	l ₄	l ₅	w ₂	A/F	a _o
R3617.I250	Right	10-32	10-32	1.562	0.375	0.750	0.304	1.000	0.469	0.562	0.125	0.281	0.375	25
R3617.I313	Right	5/16-24	5/16-24	1.875	0.437	0.875	0.356	1.250	0.531	0.687	0.125	0.344	0.437	25
R3617.I375	Right	3/8-24	3/8-24	2.000	0.500	1.090	0.424	1.250	0.644	0.906	0.187	0.406	0.500	25
R3617.I500	Right	1/2-20	1/2-20	2.437	0.625	1.380	0.564	1.500	0.875	1.125	0.250	0.500	0.625	25
R3617.I625	Right	5/8-18	5/8-18	2.625	0.750	1.500	0.622	1.625	1.000	1.125	0.375	0.562	0.750	25
R3617.I750	Right	3/4-16	3/4-16	2.875	0.875	1.750	0.747	1.750	1.187	1.812	0.375	0.687	1.000	25
R3617.IL250	Left	10-32	10-32	1.562	0.375	0.750	0.304	1.000	0.469	0.562	0.125	0.281	0.375	25
R3617.IL313	Left	5/16-24	5/16-24	1.875	0.437	0.875	0.356	1.250	0.531	0.687	0.125	0.344	0.437	25
R3617.IL375	Left	3/8-24	3/8-24	2.000	0.500	1.090	0.424	1.250	0.644	0.906	0.187	0.406	0.500	25
R3617.IL500	Left	1/2-20	1/2-20	2.437	0.625	1.380	0.564	1.500	0.875	1.125	0.250	0.500	0.625	25



Pages 106 - 109

Heavy Duty Rod Ends - integral spherical plain bearing

Male and female series K rod ends, maintenance free. These are our most popular range of heavy duty rod ends.

Sizes Bore diameters 5mm up to 30mm.



Pages 110 - 113

Heavy Duty Rod Ends - integral spherical plain bearing

Male and female series E rod ends, maintenance free.

Sizes Bore diameters 6mm up to 60mm.



Pages 114 - 1120

Heavy Duty Rod Ends - integral ball bearing

Male and female series K rod ends. R3559 and R3560 have different bore sizes in relation to the thread size. All require maintenance.

Sizes Bore diameters 6mm up to 30mm.



Pages 121 - 123

Heavy Duty Rod Ends - integral roller bearings

Male and female series E rod ends, require maintenance.

Sizes Bore diameters 12mm up to 30mm.



Pages 129 - 135

Stainless Steel Heavy Duty Rod Ends - integral spherical plain bearing

Male and female rod ends maintenance free. R3565 and R3566 K series rod ends, R3567 and R3568 E series rod ends.

Sizes R3565 and R3566 bore diameters 5mm up to 30mm. R3567 and R3568 bore diameters 6mm up to 60mm.



Pages 136 - 138

Low Cost Rod Ends - with spherical plain bearing

These are our most popular male and female rod ends. Maintenance free.

Sizes Female-bore diameters 5mm up to 12mm; Male-bore diameters 5mm up to 16mm.



Low Cost Rod Ends - spherical plain bearing

Male and female series E rod ends, maintenance free.

Sizes Bore diameters 6mm up to 80mm.



Pages 139 - 145

Stainless Steel Low Cost Rod Ends - spherical plain bearing

Male and Female Series K rod ends, maintenance free.

Sizes Bore diameters 5mm up to 20mm.



Pages 146 - 147

Plastic Rod Ends

Male and female rod ends, Series K and Series E rod ends.

Sizes Bore diameters 2mm up to 30mm.



Pages 150 - 157

Rod Ends with Studs

Steel and Stainless steel, male and female maintenance free.

Sizes M6 up to M16.

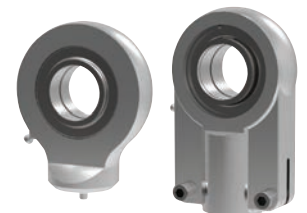


Pages 158 - 165

Hydraulic Rod Ends - spherical plain bearings

Various options from Weld on base through to female thread, require maintenance.

Sizes Bore diameters up to 160mm.

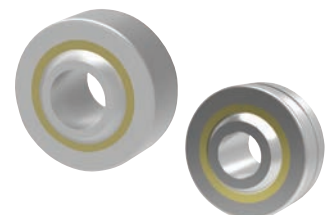


Pages 166 - 179

Spherical Plain Bearings - steel and stainless steel

Series K and series E spherical bearings. R3640 are our lowest cost, most popular option. R3641 and stainless steel R3642 require maintenance. R3640, R3644, and stainless steel R3645 are maintenance free.

Sizes Bore diameters 5mm up to 30mm.



Pages 182 - 186



Rod ends with integral maintenance-free spherical plain bearings

In many cases heavy-duty rod ends with integral spherical plain bearings are most often used. They are above all used for small swivelling or tilting movements at low speeds. They stand out for their high load capacity and can also be used for shock-like loads. The rod end ball slides on a plastic bearing shell consisting of a glass fibre-filled nylon/teflon compound. This design assures a maintenance-free rod end. Heavy-duty plain bearing rod ends have slight initial movement friction and virtually no clearance. The plastic material used has another advantage in that it can absorb many foreign particles so that no damage can occur. The balls of heavy-duty rod ends with integral spherical plain bearings are hard chrome plated. This reliable corrosion protection ensures that the function of the rod end will not be affected by a corroded ball surface under humid operating conditions.

Rod ends with integral ball bearings

This design is especially suitable for high speeds, large swivelling angles or rotating movements with relatively low or medium loads. Prominent technical features are the low bearing friction, long-time greasing as well as the sealing against some dirt penetration (by means of shields on both sides). Under normal operating conditions the rod ends are maintenance-free.

Greasing nipples are provided for lubrication in case of rough operations and maximum loads. To avoid incompatibility with the production lubrication, we recommend lubrication with a calcium-complex-soap-grease. A special heat treatment procedure gives the rod end housing a raceway hardness adapted to the antifriction bearing, ensuring at the same time high stability with changing loads.

Rod ends with integral roller bearings

This design based on the structure of a self-aligning roller bearing is preferably used for high speed, large tilting angles or rotating movements under high loads. Compared to rod ends with ball bearings, rod ends with self-aligning roller bearings have essentially higher basic load ratings. This design is equipped with a cage to minimise the rolling friction and heat build-up. These rod ends, with long-time lubrication are under normal operating conditions maintenance-free.

Greasing nipples are provided for lubrication in case of rough operations and maximum loads. To avoid incompatibility with the production lubrication, we recommend lubricating with a calcium-complex-soap-grease.

Shields on both sides limit dirt particles from penetrating into the bearing. The rod ends with roller bearings are, subjected to a special heat treatment to obtain a raceway hardness adapted to the antifriction bearings, ensuring at the same time a high stability with changing loads.



Static load capacity C_0 (plain bearings)

The static load capacity C_0 is the radially acting static load which does not cause any permanent deformation of the components when the spherical bearing or rod end is stationary, (i.e. the load condition without pivoting, swivelling or tilting movements).

It is also a precondition here that the operating temperature must be at normal room temperature and the surrounding components must possess sufficient stability.

The values specified in the tables are determined by static tension tests on a representative number of series components at 20°C normal room temperature. The static load capacity may vary with lower or higher temperature depending on the material.

In the case of all rod ends with plain bearings, the static load rating refers to the maximum permissible static load of the rod end housing in a tensile direction up to which no permanent deformation occurs at the weakest housing cross-section. The value in the product tables has a safety factor of 1.2 times the tensile strength of the rod ends housing material.

Static load capacity C_0 (roller and ball bearings)

For our rod ends with roller and ball bearings, the static load rating is the load at which the bearing can operate at room temperature without its performance being impaired as a result of deformations, fracture, or damage to the sliding contact surfaces (max 1/10,000th of the ball diameter).

Dynamic load capacity C (plain bearings)

Dynamic load ratings serve as values for calculation of the service life of dynamically-loaded spherical bearings and rod ends. The values themselves do not provide any information about the effective dynamic load capacity of the spherical bearing or rod end. To obtain this information, it is necessary to take into account the additional influencing factors such as load type, swivel or tilt angle, speed characteristic, max. permitted bearing clearance, max. permitted bearing friction, lubrication conditions and temperature, etc.

Dynamic load capacities depend on the definition used to calculate them. Comparison of values is not always possible owing to the different definitions used by various manufacturers, and because the load capacities are often determined under completely different test conditions.

Dynamic load capacity C (roller and ball bearings)

For our rod ends with roller and ball bearings, the dynamic load capacity is the load at which 90% of a large quantity of identical rod ends reach 1 million revolutions before they fail (due to fatigue of the rolling surfaces).

**Permissible load**

The maximum load is defined by the static basic load rating C_0 . If static loads are a combination of radial and axial loads, the equivalent static load will have to be calculated.

Permissible load:

$$P_0 \leq C_0 \text{ (N)}$$

Where: P_0 = Static equivalent load (kN)

Self-aligning ball bearing = $P_0 = F_r + Y_0 \cdot F_a$

Self-aligning roller bearing = $P_0 = F_r + 5 \cdot F_a$

F_a = Axial load

F_r = Radial load

Y_0 = Axial factor, static, see individual product pages

C_0 = Basic static load rating (kN), see individual product pages

Nominal service life

Rod Ends with integral self-aligning ball bearing R3556, R3557, R3559, R3560, R3563, R3564.

Rotating:

$$G_{h_{rot.}} = 10^6 \frac{\left(\frac{C}{P}\right)^3}{60 \cdot n} \text{ (h)}$$

Oscillating:

$$G_{h_{osc.}} = 10^6 \frac{\left(\frac{C}{P \sqrt[3]{\frac{\beta}{90}}}\right)^3}{60 \cdot f} \text{ (h)}$$

Where: P = Dynamic equivalent load (kN)

Self-aligning ball bearing = $P = F_r + Y \cdot F_a$

Self-aligning roller bearing = $P = F_r + 9.5 \cdot F_a$

C = Basic dynamic load (kN), see individual product pages

Y = axial factor, dynamic, see individual product pages

$G_{h_{rot.}}$ = nominal service life for rotation (hours of operation)

$G_{h_{osc.}}$ = nominal service life for rotation (hours of operation)

β = half of swivelling angle (degree), $\beta = 90$ should be used for rotation. **Condition:** Swivelling angle $\beta \leq 3^\circ$. For swivelling angles $\beta < 3^\circ$ we recommend the use of heavy-duty spherical plain bearing rod ends

n = rotation speed (rpm)

f = frequency of oscillation (rpm)

h = hours

Nominal service life

Rod ends with integral self-aligning roller bearing R3561, R3562.

Rotating:

$$G_{h_{rot.}} = 10^6 \frac{\left(\frac{C}{P}\right)^{3,333}}{60 \cdot n} \text{ (h)}$$

Oscillating:

$$G_{h_{osc.}} = 10^6 \frac{\left(\frac{C}{P \sqrt[3]{\frac{\beta}{90}}}\right)^{3,333}}{60 \cdot f} \text{ (h)}$$

See table on page 114 for key to symbols

Calculation example

At the rotating side of a crank mechanism a ball or roller bearing rod end should be installed. The expected service life amounts to at least 5000 hours.

Known: rotation speed $n = 300$ rpm, radial load $F_r = 0,75$ kN

Selected: R3557.R008 = 4,0 kN

$$\begin{aligned} G_{h_{rot.}} &= 10^6 \frac{\left(\frac{C}{P}\right)^3}{60 \cdot n} \\ &= 10^6 \frac{\left(\frac{4,0}{0,75}\right)^3}{60 \cdot 300} = \underline{\underline{8428 \text{ h} > 5000 \text{ h}}} \quad \checkmark \end{aligned}$$



Permissible load

The maximum permissible load is calculated by using equation 1. If static loads are a combination of radial and axial loads, the equivalent static load will have to be calculated using equation 2.

Permissible load:

Equation 1 $P_{max.} = C_0 \cdot C_2 \cdot C_4$

Equation 2 $P = F_r + F_a \leq P_{max.}$

- Where:
- P_{max} = Maximum permissible load (kN)
 - C_0 = static basic load (kN), see individual product pages
 - C_2 = Temperature factor, see below
 - C_4 = Factor for type of load, see below
 - P = Equivalent dynamic load (kN)
 - F_r = Radial load
 - F_a = Axial load (kN), **condition:** $F_a \leq 0.2 \cdot F_r$

Load factor C_4 :

Constant:



C_4 :

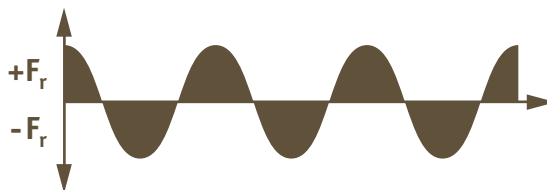
1,0

Pulsating:



0,3

Alternating:



0,2

Temperature factor C_2 :

Up to 60°C	1,0
60°C to 80°C	0,8
80°C to 100°C	0,7
100°C to 120°C	0,8



Permissible sliding velocity

The permissible sliding velocity of heavy-duty rod ends mainly depends on the load and temperature conditions. Heat generated by friction in the rod end housing is the main limitation on sliding velocity. When selecting the rod end size, it is necessary to determine the sliding velocity and the pv-value, which is a product of the specific bearing load p (N/mm²) and the sliding velocity v (m/s).

Specific bearing load:

$$p = k \cdot \frac{P}{C}$$

Permissible pv-value = 0,5 N/mm² · m/s

- Where: P = Specific bearing load (N/mm²)
 C = Basic dynamic load rating (N), see individual product pages
 k = Specific load factor (N/mm²) for tribological pairing
 k = 50 N/mm²

Mean sliding velocity:

$$V_m = 5,82 \cdot 10^{-7} \cdot d_3 \cdot \beta \cdot f$$

Permissible sliding velocity $v_{max.} = 0,15$ m/s

- Where: V_m = Mean sliding velocity (m/s)
 d_3 = Pivot ball diameter (mm), see individual product pages
 β = Half swivelling angle (degree), for swivelling angle > 180°
 $\beta = 90^\circ$ to be used
 f = Frequency of oscillation (rpm)

Nominal service life:

$$G = C_1 \cdot C_2 \cdot C_3 \cdot \frac{3}{d_3 \cdot \beta} \cdot \frac{C}{P} \cdot 10^8$$

$$G_h = C_1 \cdot C_2 \cdot C_3 \cdot \frac{5}{d_3 \cdot \beta \cdot f} \cdot \frac{C}{P} \cdot 10^6$$

- Where: G = Nominal service life (number of oscillations or revolutions)
 G_h = Nominal service life (hours)
 C_1 = Load direction factor, see table on next page
 C_2 = Temperature factor, see previous page
 C_3 = Material factor, see alignment chart on next page



Where: C_1 = Load direction factor
 $C_1 = 1,0$ = Single load direction

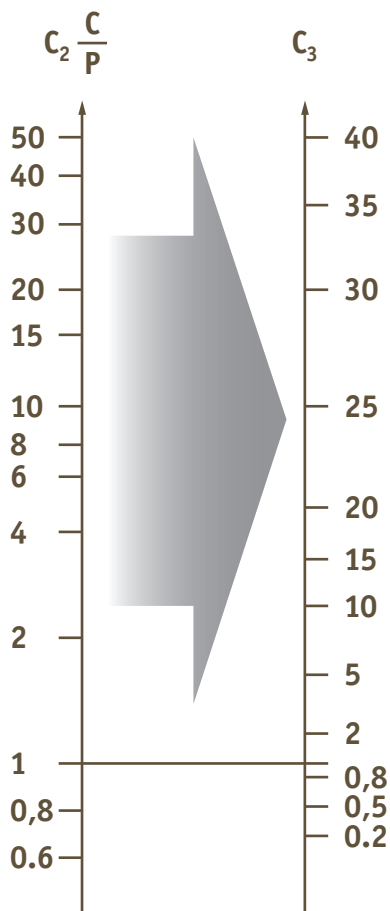
Alternating load direction at $f < 30$ rpm: $C_1 = 0,250$

Alternating load direction at $f > 30$ rpm: $C_1 = 0,125$

Alignment:

To find C_3 calculate $C_2 \cdot \frac{C}{P}$ then using this value on the chart below, read across to C_3

Where: C_2 = Temperature factor
 C = basic dynamic load rating (N) see individual product pages
 P = Specific bearing load (N/mm²)



Calculation example

The rod end assembly of conveyor equipment calls for heavy-duty rod end with a service life of 7000 hours in conjunction with an alternating acting load of 5 kN. 25 swivelling moments with a swivelling angle of 20° take place per minute. The operating temperature amounts to approx. 60° C. The choice is a heavy-duty rod end R3554.R015 with: C = 13,4 kN, d₃ = 22mm.

Checking the permissible load of the rod end:

$$P_{\max.} = C_0 \cdot C_2 \cdot C_4$$

$$P_{\max.} = 41 \cdot 0,2 \cdot 1,0 = 8,2 \text{ kN} > 5,0 \text{ kN}$$

Where: C₀ = 41 kN
 C₂ = 1,0 (temperature 60° C)
 C₄ = 0,2 (alternating load)

Checking the permissible sliding velocity:

$$V_m = 5,82 \cdot 10^{-7} \cdot d_3 \cdot \beta \cdot f = 5,82 \cdot 10^{-7} \cdot 22 \cdot 10 \cdot 25$$

$$= \underline{\underline{0,0032 \text{ m/s} < 0,15 \text{ m/s}}} \quad \checkmark$$

Checking the p · V-value:

$$pV = p \cdot V_m$$

$$pV = 18,66 \cdot 0,0032$$

$$= 0,06 \text{ N/mm}^2 \cdot \text{m/s} < 0,5 \text{ N/mm}^2 \cdot \text{m/s} \quad \checkmark$$

$$p = k \cdot \frac{P}{C} = 50 \cdot \frac{5000}{13400} = 18,66 \text{ N/mm}^2$$

Nominal service life:

$$G_h = C_1 \cdot C_2 \cdot C_3 \cdot \frac{5}{d_3 \cdot \beta \cdot f} \cdot \frac{C}{P} \cdot 10^6$$

$$G_h = 0,25 \cdot 1,0 \cdot 12 \cdot \frac{5}{22 \cdot 10 \cdot 25} \cdot \frac{13,4}{5,0} \cdot 10^6$$

$$= \underline{\underline{7308 \text{ h} > 7000 \text{ h}}} \quad \checkmark$$

Where: C₁ = 0,25 (alternating load direction, f = 25 rpm < 30 rpm)

$$C_3 = C_2 \cdot \frac{C}{P} = 1,0 \cdot \frac{13,4}{5,0} = 2,68$$

See alignment chart (on page 118) C₃ = 12

Where: d₃ = 22
 f = 25 rpm
 β = 10° (half the swivelling angle 20° = 10°)
 C = 13,4 kN
 P = 5,0 kN



Low cost rod ends load ratings

The ultimate radial static load rating is measured as the failure point when a load is increasingly applied to a pin through the rod end's bore and pulled straight up while the rod end is held in place. Note that the actual rating is determined by calculating the lowest of the following three values:

1: Raceway material comprehensive strength (R value):

$$R = E \times T \times X$$

2: Rod end head strength (H value, cartridge type construction):

$$H = \left[\left(\frac{T}{2} \sqrt{D^2 - T^2} \right) + \left(\frac{D^2}{2} \times \sin^{-1} \frac{T}{2} \right) - (\text{O.D. of Bearing} \times T) \right] \times X$$

Angle of $\frac{T}{2}$ expressed in radians

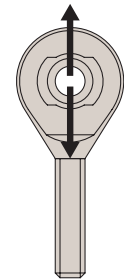
3: Shank strength (S Value) male threaded rod end:

$$S = [(\text{root diameter of thread}^2 \times .78) - (N^2 \times .78)] \times X$$

female threaded rod end:

$$S_2 = [(J^2 \times .78) + (\text{major diameter of thread} \times .78)] \times X$$

- Where: E = Ball diameter
 T = Housing width
 X = Allowable stress
 D = Head diameter
 N = Diameter of drilled hole in shank of male rod end
 J = Shank diameter of female rod end

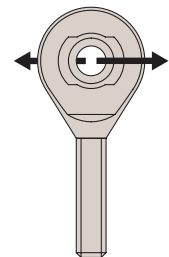


The axial static load capacity is measured as the force required to cause failure via a load parallel to the axis of the bore. Depending on the material types and construction methods, the ultimate axial load is generally 10-20% of the ultimate radial static load. The formula does not account for the bending of the shank due to a moment of force, nor the strength of the stake in cartridge-type construction.

Axial strength (A Value):

$$A = .78 [(E + .176T)^2 - E^2] \times X$$

- Where: X = Allowable stress (see table below)
 E = Ball diameter
 T = Housing width



Material	Allowable stress (PSI)
300 Series Stainless Steel	35,000
Low Carbon Steel	52,000

Rod Ends from Automation Components

ROD ENDS

Operating temperatures

Heavy-duty ball and roller bearing rod ends can be used for operating temperatures between -20°C and $+120^{\circ}\text{C}$. The temperature range of heavy-duty rod ends with integral spherical plain bearing is between -30°C and $+60^{\circ}\text{C}$, without affecting the load capacity. Higher temperatures will reduce the load capacity taken into account for the calculation of the 'working life' under the temperature factor C_2 on page 116.

Loads

The decisive parameters for the selection and calculation of heavy-duty rod ends are size, direction and type of load.

Radial or combined loads

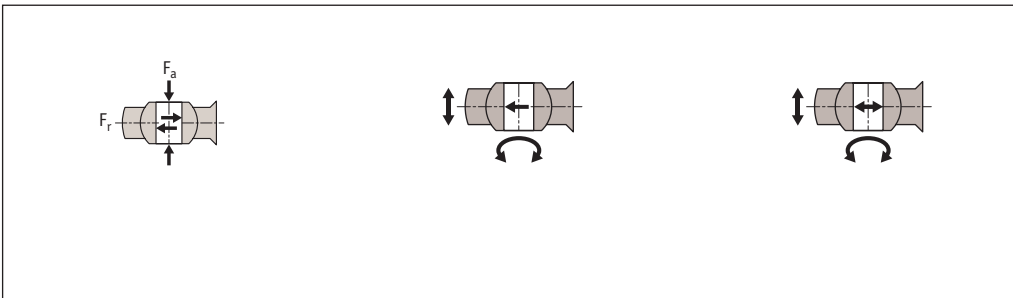
The heavy-duty rod ends have been especially designed to cope with high radial loads. They can be used for combined loads, the axial load share of which does not exceed 20% of the corresponding radial load.

Unilaterally acting load

In this case the load acts only in the same direction, which means that the load area is always in the same bearing section.

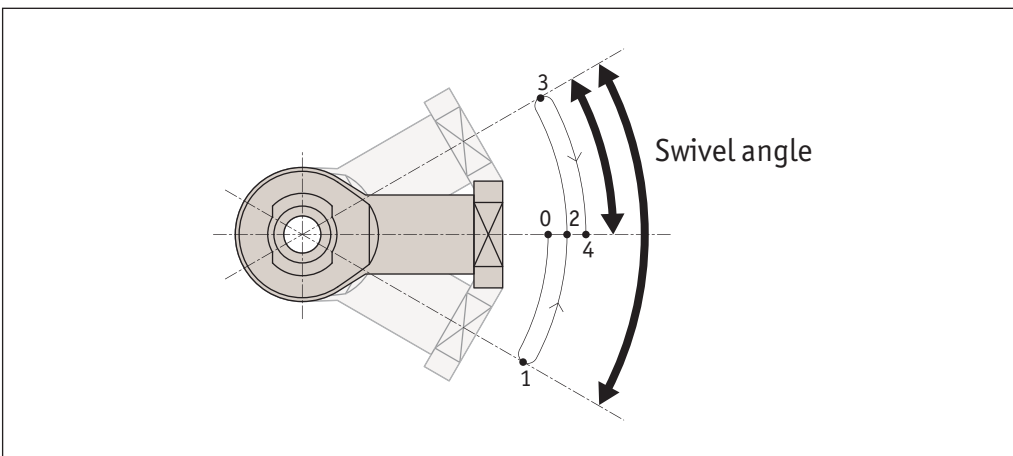
Alternately acting load

In case of alternating loads, the load areas facing each other are alternately loaded and/or relieved, which means that the load changes its direction constantly by approximately 180° .



Swivelling angle

The swivelling angle is the movement of the rod end from one final position to the other. Half the swivelling angle α° is used to calculate the service or 'working life'.

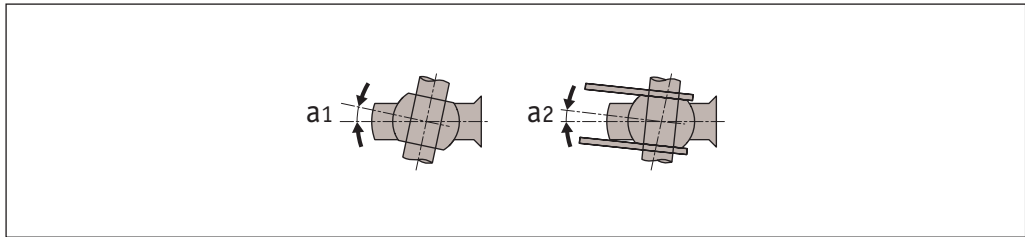




Angle of tilt

The angle of tilt, also called setting angle, refers to the movement of the joint ball and/or the inner ring to the rod end axis (in degrees). The tilting angle (a) indicated in the table for the heavy-duty ball and roller bearing rod ends corresponds to the maximum possible movement being limited by the shields on both sides. It is important that this tilting angle is not exceeded either during installation or operation, as otherwise the shields may be damaged. For heavy-duty plain bearing rod ends a distinction is made between the tilting angles (a1 and a2).

If the movement is not limited by adjacent components, then angle a1 can fully be used without affecting the rod end capacity. Tilting angle a2 is the movement limit when connecting a forked component.



Nominal service life

The term 'nominal service life' is used for heavy-duty ball and roller bearing rod ends and represents the number of swivelling motions or rotations and/or the number of service hours the rod end performs before showing the first signs of material fatigue on the raceway or roller bodies. In view of many factors that are difficult or impossible to assess, the service life of several apparently identical bearings differ under the same operating conditions.

For this reason, the following method for the service life determination of heavy-duty ball and roller rod ends results in a nominal service life being achieved or exceeded by at least 90% of a large quantity of identical rod ends.

Working life

The term 'working life' is used with heavy-duty plain bearing rod ends. It represents the number of swivelling motions or rotations and/ or the number of service hours the heavy duty plain bearing rod end performs before becoming unserviceable due to material fatigue, wear, increased bearing clearance or increase of the bearing friction moment.

The 'working life' is not only influenced by the size and the type of load, it is also affected by a number of factors, which are difficult to assess. A calculation of the exact service life is therefore impossible. Field-experienced standard values for the approximate 'working life' can nevertheless be determined by using the following calculation procedure which is based on numerous results from endurance test runs and values from decades of experience. The values determined by this formula are achieved, if not exceeded, by the majority of the heavy-duty rod ends.

Heavy-duty rod ends (R3550, R3551, R3556, R3557, R3561, R3562, R3563, R3564, R3565, R3566, R3610, R3611, R3613, R3614)

d1		d1mp Tolerance Limit		V _{d1p}	V _{d1mp}	b1s Tolerance Limit		hs, h1s, h2s Tolerance Limit	
over	icl.	upper	lower	max.	max.	upper	lower	upper	lower
	6	+0,012	0	0,012	0,009	0	-0,12	+0,8	-1,2
6	10	+0,015	0	0,015	0,011	0	-0,12	+0,8	-1,2
10	18	+0,018	0	0,018	0,014	0	-0,12	+1,0	-1,7
18	30	+0,021	0	0,021	0,016	0	-0,12	+1,4	-2,1
30	50	+0,025	0	0,025	0,019	0	-0,12	+1,8	-2,7

Heavy-duty rod ends (R3553, R3554, R3559, R3560, R3567, R3568)

d1		d1mp Tolerance Limit		V _{d1p}	V _{d1mp}	b1s Tolerance Limit		hs, h1s, h2s Tolerance Limit	
over	icl.	upper	lower	max.	max.	upper	lower	upper	lower
	10	0	-0,008	0,008	0,006	0	-0,12	+0,8	-1,2
10	18	0	-0,008	0,008	0,006	0	-0,12	+0,8	-1,2
18	30	0	-0,010	0,010	0,008	0	-0,12	+1,0	-1,7
30	50	0	-0,012	0,012	0,009	0	-0,12	+1,4	-2,1
50	80	0	-0,015	0,015	0,011	0	-0,15	+1,8	-2,7

Dimensions and tolerance symbols

- d₁ = nominal bore diameter of the inner ring or joint ball.
- d_{1mp} = mean bore diameter deviation in one plane, arithmetical mean of the largest and smallest bore diameter.
- V_{d1p} = bore diameter variation in one plane, difference between the largest and smallest bore diameter.
- V_{d1mp} = mean bore diameter variation, difference between the largest and smallest bore diameter of one inner ring or joint ball.
- b_{1s} = single inner ring or joint ball width deviation.
- h, h₁, h₂ = single length from inner ring or ball bore centre to shank end.
- h_s, h_{1s}, h_{s2} = single length variation of a single rod end.