Mechanical Linkages

Mechanical Linkages

- Rod Ends and Ball Joints

Introduction

Series SEE Rod Ends and Ball Joints are compact self aligning spherical bushings that can support a large radial load and a bi-directional axial load at the same time. They are classified as maintenance free and lubrication type. A smooth rotational and oscillary motion can be achieved with superior anti wear and loading properties in each type.

They are used in control and link mechanisms ideally suited for application in Automobiles, Trucks, Textile machinery, Farm equipment, Earth Moving equipment, Machine Tools, Packaging machinery, Industrial Robots, Ultra Light Aircraft, Compressor industry, amongst others.

Series SEE Rod Ends and Ball Joints have either a female thread or male thread on the body and they can be easily assembled on to machines.

- Rod End Series manufactured dimensionally conforming to ISO 12240 Part IV : 1998. (Series SEF/SEM)
- Ball Joint Series manufactured dimensionally conforming to DIN 71802.(Series SCJ)
- High strength designs with good wear resistance
- Self lubricating reinforced thermoplastic raceway for excellent bearing characteristics and maintenance free operation

Standard Materials (Rod Ends):

Body Housing	low Carbon Steel, zinc plated
Spherical Ball	low Carbon Steel, chrome plated
Bearing Raceway	self lubricating reinforced engineering thermoplastic (Polyamide with Mos2)

Standard Materials (Ball Joints):

Body Housing	low Carbon Steel, zinc plated
Ball Stud	low Carbon Steel, zinc plated
Bearing Bush	self lubricating reinforced engineering thermoplastic (Polyamide with Mos2)
Dust cover	Polychloroprene

Technical & Safety Information

The values shown in the tables are expected minimum results based on actual tests performed on production samples. These results are presented for design guidelines only and do not imply or constitute a warranty. Suitable safety factors are required.

Care should be used in tightening a nut against the ball to prevent distortion. In applications where excessive vibration is encountered, self locking nylon insert nuts or lock washers should be used to secure the ball.

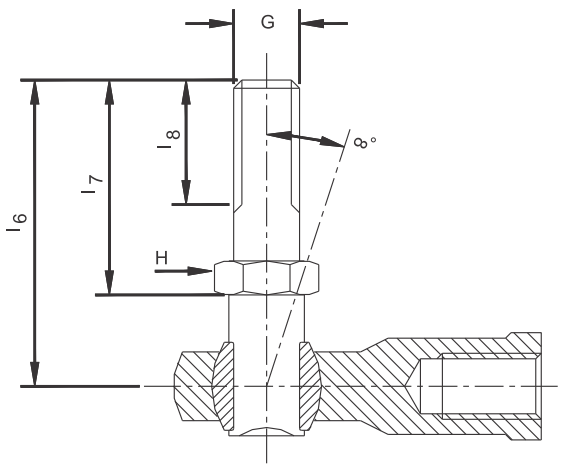
The plated balls may be chipped or distorted by excessive clamping pressure, resulting in increased torque, wear and premature failure.

Please also see note regarding interchangeability of products on back inside page.

Mechanical Linkages

- Ball Joints

LSEF



Body	forged low Carbon Steel, Zinc Plated
Ball	52100 Steel, Rc 56 min., Hard Chrome Plated
Race	MoS_2 impregnated Polyamide Engineering Thermoplastic
Threaded Stud	machined low Carbon Steel, Zinc Plated, Heat treated

Product Code	G	l_6 mm	l_7 mm	l_8 mm	H mm	∞ °	BALL DIA. inch
LSEF 05	M5 x 0.80	26.00	18.00	11.00	8.00	18	7/16"
LSEF 06	M6 x 1.00	31.00	19.00	12.00	10.00	18	1/2"
LSEF 08	M8 x 1.25	38.00	26.00	16.00	11.00	18	5/8"
LSEF 10	M10 x 1.50	44.50	30.00	20.00	14.00	18	3/4"
LSEF 12	M12 x 1.75	52.00	37.50	24.00	17.00	18	7/8"
LSEF 14	M14 x 2.00	58.50	41.00	25.00	17.00	18	1"
LSEF 16	M16 x 2.00	62.50	43.50	28.00	19.00	18	1 1/8"
LSEF 18	M18 x 1.50	71.50	51.00	30.00	22.00	18	1 1/4"
LSEF 20	M20 x 1.50	77.00	56.00	35.00	24.00	18	1 3/8"

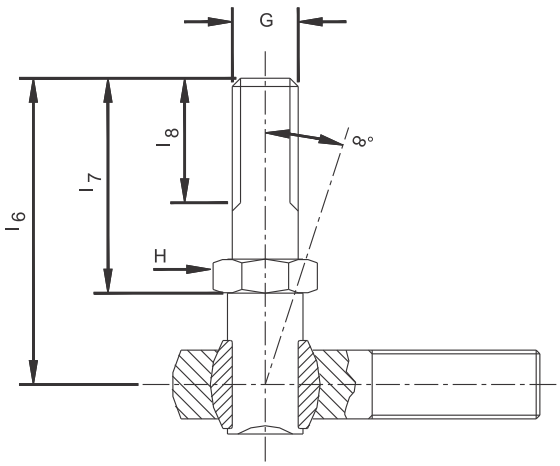
All dimensions in mm unless otherwise specified

For other dimensions, please refer series SEF
Suffix 'R' for right hand thread and 'L' for left hand thread
Suffix 'M' for lubrication type metal race with greasing nipple
Suffix 'T' for self Lubricating PTFE impregnated engineering thermoplastic race
Contact factory for metric fine pitch thread requirement
Contact factory for inch thread requirement

Mechanical Linkages

- Ball Joints

LSEM



Body	forged low Carbon Steel, Zinc Plated
Ball	52100 Steel, Rc 56 min., Hard Chrome Plated
Race	MoS_2 impregnated Polyamide Engineering Thermoplastic
Threaded Stud	machined low Carbon Steel, Zinc Plated, Heat treated

Product Code	G	l_6 mm	l_7 mm	l_8 mm	H mm	∞ °	BALL DIA. inch
LSEM 05	M5 x 0.80	26.00	18.00	11.00	8.00	18	7/16"
LSEM 06	M6 x 1.00	31.00	19.00	12.00	10.00	18	1/2"
LSEM 08	M8 x 1.25	38.00	26.00	16.00	11.00	18	5/8"
LSEM 10	M10 x 1.50	44.50	30.00	20.00	14.00	18	3/4"
LSEM 12	M12 x 1.75	52.00	37.50	24.00	17.00	18	7/8"
LSEM 14	M14 x 2.00	58.50	41.00	25.00	17.00	18	1"
LSEM 16	M16 x 2.00	62.50	43.50	28.00	19.00	18	1 1/8"
LSEM 18	M18 x 1.50	71.50	51.00	30.00	22.00	18	1 1/4"
LSEM 20	M20 x 1.50	77.00	56.00	35.00	24.00	18	1 3/8"

All dimensions in mm unless otherwise specified

For other dimensions, please refer series SEF
Suffix 'R' for right hand thread and 'L' for left hand thread
Suffix 'M' for lubrication type metal race with greasing nipple
Suffix 'T' for self Lubricating PTFE impregnated engineering thermoplastic race
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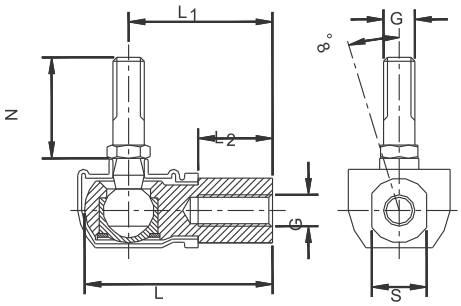
Mechanical Linkages

- Ball Joints

SBJ



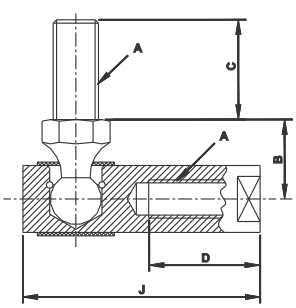
Body	forged low Carbon Steel, Zinc Plated
Ball Stud	machined low Carbon Steel, Zinc Plated
Bushing	MoS_2 impregnated Engineering Thermoplastic
Dust Cover	Polychloroprene

Product Code	G	L mm	L_1 mm	L_2 mm	N mm	S mm	∞ °
SBJ 06	M6 x 1.00	39.00	29.00	16.00	17.00	10.00	18.00
SBJ 08	M8 x 1.25	48.00	36.00	19.00	16.00	14.00	18.00
SBJ 10	M10 x 1.50	60.00	46.00	25.00	25.50	19.00	18.00
SBJ 12	M12 x 1.75	67.00	51.00	27.00	30.00	19.00	18.00
SBJ 14	M14 x 1.75	75.00	57.00	27.00	39.00	22.00	18.00

All dimensions in mm unless otherwise specified

Suffix 'R' for right hand thread and 'L' for left hand thread
Contact factory for metric fine pitch thread requirement
Contact factory for inch thread requirement

SBJA



Body	free cutting steel, Zinc Plated
Ball Stud	free cutting steel, Zinc Plated
Dust Cover	Polychloroprene

Product Code	A	J mm	B mm	C mm	D mm
SBJA 06	M6 x 1.00	41.00	12.00	20.00	16.00
SBJA 08	M8 x 1.25	40.00	13.50	17.50	16.00
SBJA 10	M10 x 1.50	46.00	17.50	22.00	22.00
SBJA 12	M12 x 1.75	63.00	22.50	29.00	28.00

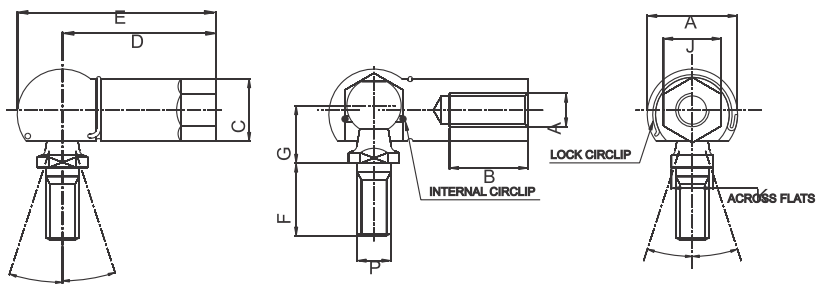
All dimensions in mm unless otherwise specified

Suffix 'R' for right hand thread and 'L' for left hand thread
Contact factory for metric fine pitch thread requirement
Contact factory for inch thread requirement

Mechanical Linkages

- Ball Joints

SCJ



Body	free cutting steel, Zinc Plated, tensile strength 430 - 500 N/mm2
Ball Stud	low Carbon Steel, Heat treated, Zinc Plated, tensile strength 600 N/mm2
Dust Cover	Polychloroprene

Product Code	Thread A	B mm	C mm	D mm	E mm	F mm	H mm	J mm	K mm	G mm	ß°
SCJ 05	M5 x 0.80	10.2	Ø8	22	28.4	10.2	Ø12.8	7	7	9	10
SCJ 06	M6 x 1.00	11.5	Ø10	25	32.4	12.5	Ø14.8	9	8	11	15
SCJ 08	M8 x 1.25	14.0	Ø13	30	39.6	16.5	Ø19.3	11	11	13	15
SCJ 10	M10 x 1.50	15.5	Ø16	35	47.0	20.0	Ø24.0	13	13	16	15
SCJ 12	M12 x 1.75	15.5	Ø16	35	47.0	20.0	Ø24.0	13	13	16	15
SCJ 14-1.50	M14 x 1.50	21.5	Ø22	45	60.0	28.0	Ø30.0	19	16	20	15
SCJ 14	M14 x 2.00	21.5	Ø22	45	60.0	28.0	Ø30.0	19	16	20	15
SCJ 16-1.50	M16 x 1.50	21.5	Ø22	45	60.0	28.0	Ø30.0	19	16	20	15
SCJ 16	M16 x 2.00	21.5	Ø22	45	60.0	28.0	Ø30.0	19	16	20	15

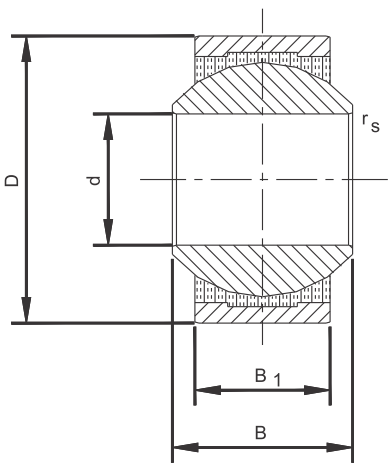
All dimensions in mm unless otherwise specified

Suffix 'R' for right hand thread and 'L' for left hand thread
Contact factory for metric fine pitch thread requirement
Contact factory for inch thread requirement

Mechanical Linkages

- Spherical Bearings

SSB



Bearing Sleeve	52100 Steel, min 56 Rc, phosphated
Ball	52100 Steel, min 56 Rc, hard chrome plated
Race	MoS2 impregnated Polyamide Engineering Thermoplastic

Product Code	d H7 mm	D G7 mm	B mm	B_1 mm	r_s min. mm	BALL DIA. inch
SSB 06	6.00	16.00	8.00	6.00	0.30	7/16"
SSB 08	8.00	19.00	10.50	7.50	0.30	9/16"
SSB 10	10.00	22.00	13.00	9.00	0.30	11/16"
SSB 12	12.00	26.00	16.00	12.00	0.30	7/8"
SSB 16	16.00	32.00	20.00	15.00	0.30	1 1/16"
SSB 18	18.00	38.00	23.00	16.50	0.30	1 1/4"
SSB 20	20.00	40.00	25.00	18.00	0.30	1 3/8"

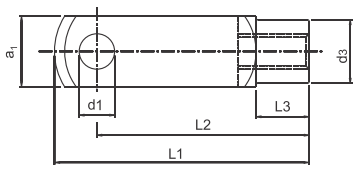
All dimensions in mm unless specified otherwise

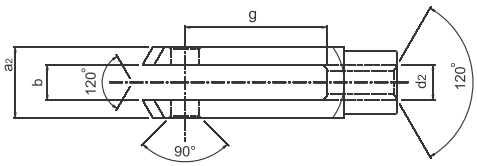
Suffix 'M' for lubrication type metal race with greasing nipple
Suffix 'T' for self Lubricating PTFE impregnated engineering thermoplastic race

Mechanical Linkages

- Clevis / Yoke

CLE





Body Free Cutting Steel, Zinc Plated

Product Code	d 2	d 1	g	a 1 a 2	b	d3	L 1	L 2	L 3
CLE 04 S	M4 x 0.70	Ø4	8	8	4	Ø8	21	16	6
CLE 04 B	M4 x 0.70	Ø4	16	8	4	Ø8	29	24	6
CLE 05 S	M5 x 0.80	Ø5	10	10	5	Ø9	26	20	7.5
CLE 05 B	M5 x 0.80	Ø5	20	10	5	Ø9	36	30	7.5
CLE 06 S	M6 x 1.00	Ø6	12	12	6	Ø10	31	24	9
CLE 06 B	M6 x 1.00	Ø6	24	12	6	Ø10	43	36	9
CLE 08 S	M8 x 1.25	Ø8	16	16	8	Ø14	42	32	12
CLE 08 B	M8 x 1.25	Ø8	32	16	8	Ø14	58	48	12
CLE 10 S	M10 x 1.50	Ø10	20	20	10	Ø18	52	40	15
CLE 10 B	M10 x 1.50	Ø10	40	20	10	Ø18	72	60	15
CLE 12 S	M12 x 1.75	Ø12	24	24	12	Ø20	62	48	18
CLE 12 B	M12 x 1.75	Ø12	48	24	12	Ø20	86	72	18
CLE 14 S	M14 x 2.00	Ø14	28	27	14	Ø24	72	56	22.5
CLE 14 B	M14 x 2.00	Ø14	56	27	14	Ø24	101	85	22.5
CLE 16 S	M16 x 2.00	Ø16	32	32	16	Ø26	83	64	24
CLE 16 B	M16 x 2.00	Ø16	64	32	16	Ø26	115	96	24
CLE 18 S	M18 x 2.50	Ø18	36	36	18	Ø30	94	72	27
CLE 20 S	M20 x 2.50	Ø20	40	40	20	Ø34	105	80	30
CLE 20 B	M20 x 2.50	Ø20	80	40	20	Ø34	145	120	30

All dimensions in mm unless specified otherwise

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Engineering Information

Ball Joint Assembly Tensile Test Procedure

A ball joint assembly is tensile tested by placing the male threaded ball stud in a fixed position and applying increasing tensile force along the axis of the internally threaded housing until rupture occurs. The assembly's ultimate tensile strength, then, is either the maximum tensile stress of the internally threaded housing, or the maximum sheer stress of the male threaded ball stud, whichever ruptures first.

The values shown in the table are expected minimum results based on actual tests performed on production samples. These results are presented for design guidance only and do not imply or constitute a warranty. Suitable safety factors are required.

Ball Joint Ball Stud Pullout Test Procedure

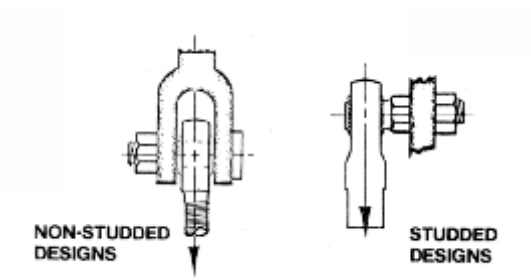
Ball stud pullout strength is tested by locking the internally threaded housing in a fixed position and applying increasing tensile force along the axis of the male threaded ball stud until the ball stud completely disengages from the housing.

The values shown in the table are expected minimum results based on actual tests performed on production samples. These results are presented for design guidance only and do not imply or constitute a warranty. Suitable safety factors are required.

Rod End Assembly Tensile Test Procedure

Tensile testing is conducted with the ball member, or the male threaded ball stud, held in a fixed position. Increasing tensile force is applied along the housing axis until rupture occurs. The ultimate tensile strength of the assembly, then, is either the maximum tensile stress of the housing or the maximum shear stress of the male threaded stud.

The values shown in the table are expected minimum results based on actual tests performed on production samples. These results are presented for design guidance only and do not imply or constitute a warranty. Suitable safety factors are required.



Rod End Radial Static Load Capacity

These loads are maximum static based upon the minimum mechanical properties of the design configuration in the stressed areas. Operating loads for rod ends are based on the radial static load rating, incorporating appropriate safety factors utilized to suit the application. When a rod end is to be applied in full rotation, up to maximum of 700 RPM, the operating load should not exceed 10% of the radial static load.

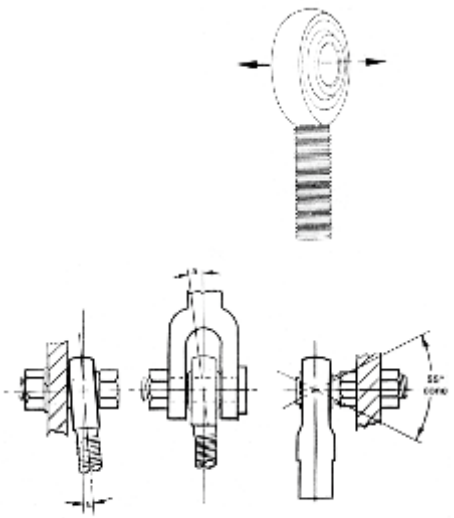
Load ratings listed in the standard detail pages are applicable to rod ends supplied without grease fittings. Load ratings for units employing fittings may be affected due to the lighter cross section in the stressed area.

Mechanical Linkages

Engineering Information

Rod End Axial Static Load Capacity

Axial static load is the force that is applied through the bore of the ball. Maximum axial static load capacity is recommended at 10 percent of radial static load for



Misalignment in Mounting

Rod end angle of misalignment is determined by two factors: 1) the ball and head dimensions and; 2) the type of mounting utilized.

Engineering Applications and Assembly Suggestions

There are several factors pertaining to a specific engineering application, including proper assembly, that should be taken into consideration to insure optimum performance of the chosen linkage components.

1. When mounting ball studs, the hex should be properly tightened and flat against its mating surface. Adequate countersinks, counterbores, or washers may be necessary to provide a tight, flush joint. Refer to the engineering standards, for recommended mounting nut torque values associated with each grade of threaded fastener. Lockwashers and locking nuts should be incorporated for applications involving vibration.
2. It is recommended that a separate stop be incorporated in the linkage system to eliminate the possibility of exceeding the misalignment capability of the ball joint or rod end bearing. An overtravel condition of this type could result in premature failure of the joint.
3. Ball joints and rod end bearings should be mounted with the housing member on top to best utilize the design of the joint with respect to the gravitational force.
4. To determine a part's useful life for a particular application, sample parts should be tested under actual operating conditions.