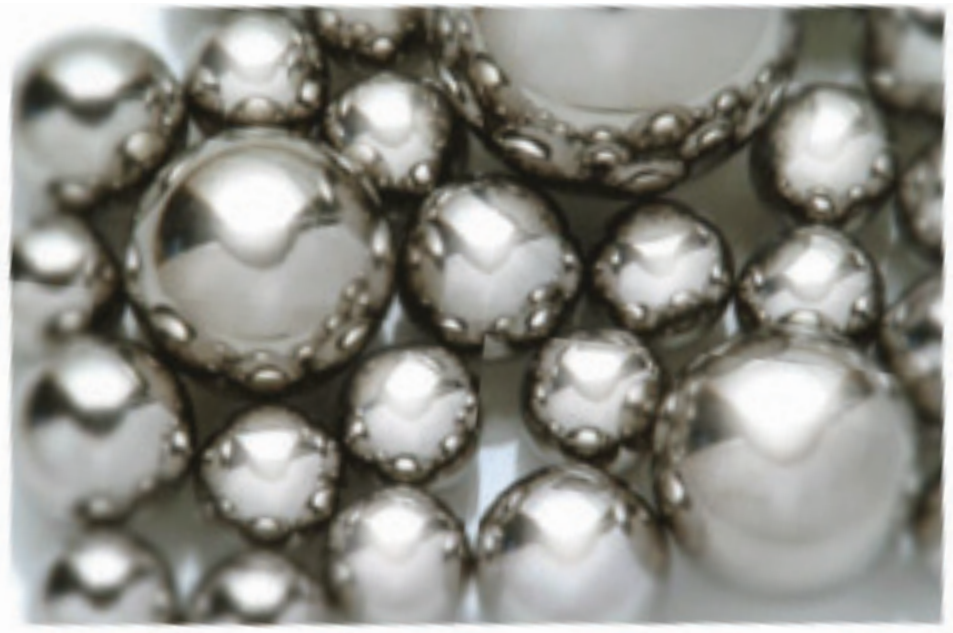
Kugle katalog



A/S DANSK KUGLELEJE CENTER

Tlf: 44 84 33 88 - **Email:** dkc@dkc-as.dk

Indhold

Dimensional Conversion Chart

Inch Fractions	Inch Decimals	Metric (mm)	Weight 1000 balls (kg)	Approximate Qty per Litre	Inch Fractions	Inch Decimals	Metric (mm)	Weight 1000 balls (kg)
1/64	.0156	0.397	.00026	-	-	.7480	19.000	27.98
-	.0197	0.500	.00051	-	3/4	.7500	19.050	28.20
1/32	.0312	0.794	.00210	2,100,000	25/32	.7812	19.844	31.87
-	.0394	1.000	.00407	1,210,000	-	.7874	20.000	32.63
3/64	.0469	1.190	.00688	695,000	13/16	.8125	20.637	35.85
-	.0472	1.200	.00704	676,700	-	.8268	21.000	37.77
-	.0590	1.500	.01377	347,000	27/32	.8437	21.431	40.15
1/16	.0625	1.588	.01632	289,000	-	.8661	22.000	43.43
5/64	.0781	1.984	.03187	151,000	7/8	.8750	22.225	44.78
-	.0787	2.000	.0326	146,000	-	.9055	23.000	49.63
3/32	.0937	2.381	.0550	87,000	29/32	.9062	23.019	49.75
-	.0984	2.500	.0638	75,500	15/16	.9375	23.812	55.07
7/64	.1094	2.778	.0875	55,000	-	.9449	24.000	56.39
-	.1181	3.000	.1101	43,000	31/32	.9687	24.606	60.77
1/8	.1250	3.175	.1305	37,000	-	.9842	25.000	63.73
-	.1378	3.500	.1749	27,200	1	1.0000	25.400	66.84
9/64	.1406	3.572	.1859	25,700	-	1.0236	26.000	71.69
5/32	.1562	3.969	.2550	18,700	1.1/16	1.0625	26.987	80.17
-	.1575	4.000	.2610	18,500	-	1.1024	28.000	89.54
11/64	.1719	4.366	.3394	14,300	1.1/8	1.1250	28.575	95.17
-	.1772	4.500	.3716	13,000	-	1.1811	30.000	110.10
3/16	.1875	4.762	.4406	10,700	1.3/16	1.1875	30.162	111.90
-	.1968	5.000	.5099	9,500	1.1/4	1.2500	31.750	130.50
-	.2165	5.500	.6786	7,150	-	1.2598	32.000	133.70
7/32	.2187	5.556	.6996	6,800	1.5/16	1.3125	33.337	151.10
15/64	.2344	5.953	.8605	5,450	-	1.3386	34.000	160.30
-	.2362	6.000	.8810	5,400	1.3/8	1.3750	34.925	173.80
1/4	.2500	6.350	1.044	4,550	-	1.3780	35.000	174.90
-	.2559	6.500	1.120	4,300	-	1.4173	36.000	190.30
17/64	.2656	6.747	1.253	3,800	1.7/16	1.4375	36.512	198.50
-	.2756	7.000	1.399	3,400	-	1.4960	38.000	223.80
9/32	.2812	7.144	1.487	3,250	1.1/2	1.5000	38.100	225.60
-	.2953	7.500	1.721	2,800	1.9/16	1.5625	39.687	255.00
19/64	.2969	7.541	1.749	2,750	-	1.5748	40.000	261.00
5/16	.3125	7.938	2.040	2,350	1.5/8	1.6250	41.275	286.80
-	.3150	8.000	2.088	2,150	1.11/16	1.6875	42.862	321.20
-	.3346	8.500	2.505	1,900	1.3/4	1.7500	44.450	358.20
11/32	.3437	8.731	2.715	1,750	-	1.7716	45.000	371.70
-	.3543	9.000	2.973	1,600	1.13/16	1.8125	46.037	398.00
23/64	.3594	9.128	3.102	1,480	1.7/8	1.8750	47.625	440.60
-	.3740	9.500	3.497	1,350	1.15/16	1.9375	49.212	486.10
3/8	.3750	9.525	3.525	1,300	-	1.9685	50.000	509.90
25/64	.3906	9.922	3.983	1,150	2	2.000	50.800	534.70
-	.3937	10.000	4.079	1,125	2.1/8	2.1250	53.975	641.40
13/32	.4062	10.319	4.481	1,050	-	2.1653	55.000	678.60
-	.4331	11.000	5.429	820	2.1/4	2.2500	57.150	761.30
7/16	.4375	11.112	5.597	810	-	2.3622	60.000	881.00
-	.4528	11.500	6.203	720	2.3/8	2.3750	60.325	895.40
29/64	.4531	11.590	6.219	720	2.1/2	2.5000	63.500	1044.40
15/32	.4687	11.906	6.884	620	-	2.5590	65.000	1120.10
-	.4724	12.000	7.048	615	2.5/8	2.6250	66.675	1209.00
31/64	.4844	12.303	7.596	610	2.3/4	2.7500	69.850	1390.10
1/2	.5000	12.700	8.355	550	-	2.7559	70.000	1484.70
-	.5118	13.000	8.961	490	2.7/8	2.8750	73.025	1588.40
17/32	.5312	13.494	10.02	450	-	2.9528	75.000	1720.70
-	.5512	14.000	11.19	410	3	3.000	76.200	1804.70
9/16	.5625	14.288	11.90	380	3.1/8	3.1250	79.375	2039.80
-	.5905	15.000	13.77	325	-	3.1500	80.000	2088.30
19/32	.5937	15.081	13.99	320	3.1/4	3.2500	82.550	2294.40
5/8	.6250	15.875	16.32	300	-	3.3464	85.000	2530.90
-	.6299	16.000	16.70	275	3.1/2	3.5000	88.900	2865.70
21/32	.6562	16.669	18.89	240	-	3.5433	90.000	2993.40
-	.6693	17.000	20.04	230	-	3.7401	95.000	3521.10
11/16	.6785	17.462	21.72	205	3.3/4	3.7500	95.250	3524.70
-	.7087	18.000	23.79	190	-	3.9370	100.000	4078.80
23/32	27187	18.256	24.82	180	4	4.000	101.600	4277.70

Material Comparison Chart

Material AISI no.	Equivalents	Hard-ness HRc	Corrosion Resistance													
			Air	Water				Food			Liquor			Dilute Acids		
			Industrial	salt air	wet	domestic water	sea water	Food Product	Fruit & Veg	Dairy	Hot	Dye	HCL	H2S04	HNO3	Phoshoric
Low Carbon AISI 1010-16	Wks. 10010 ASTM A29 EN32	60 min	3	T	4	4	T	T	T	T	T	T	T	T	T	T
High Carbon AISI 1065-85	Wks. 1.0616 C85 EN8-9	60 min	3	T	4	4	T	T	T	T	T	T	T	T	T	T
High Carbon Chrome Alloy AISI 52100	Wks. 1.3505 100 CR6 EN31	60/67	3	T	4	4	T	T	T	T	T	T	T	T	T	T
Stainless Steel AISI 440C	Wks 1.4125 X105 CR M017	57/60	2	3	2	2	T	2	2	3	T	4	T	T	T	T
Stainless Steel AISI 420	Wks. 1.3541 X45 CR13 EN56D	52/55	2	4	1	1	T	3	3	2	T	3	T	T	T	T
Stainless Steel AISI 302/304	Wks. 1.4301 X5 CR NI 1810 EN58E	25/39	2	1	1	1	1	1	2	2	1	4	2	2	2	2

Numbers indicate order of preference	
1 = Excellent	V = Varies
2= Good	T = Will not withstand conditions
3 = Fair	* = Satisfactory only over 75% concentration
4 = Poor	

Carbon Chrome Alloy

General Information

This is an oil-hardened steel, which is universally used by the ball and roller bearing industry. The steel has high hardness and good resistance to deformation with excellent wear resistance. Usually vacuum degassed and uniformly through hardened in atmosphere controlled electric furnaces.

International Equivalents

AISI 52100, EN31, JIS G4805 SUJ2, Wks 1.3505

Material Specification

Composition	
C	0.95 - 1.10 %
Cr	1.30 - 1.60 %
Mn	0.25 % Max
Si	0.15 - 0.30 %
P	0.03 % Max
S	0.025 % Max

Hardness	
HRc	60 - 67

Mechanical Properties	
Tensile Strength	325,000 psi
Yield Strength	295,000 psi
Density	0.283 lbs/cu in

Size Range
0.635mm (0.025") to 101.6mm (4")

Standard Grades Available
5
10
25
100
500

Crushing Loads for Chrome Steel

Diameter		Minimum Crushing Load	Diameter		Minimum Crushing Load	Diameter		Minimum Crushing Load
inch	mm	Kg	inch	mm	Kg	inch	mm	Kg
1/8	3.175	666	31/64	12.303	7350	1	25.400	26600
-	3.500	792	1/2	12.700	7780	1 1/16	26.987	29600
5/32	3.969	990	17/32	13.494	8660	1 1/8	28.575	32800
-	4.000	1000	9/16	14.288	9590	1 3/16	30.162	36100
-	4.500	1240	-	15.000	10500	1 1/4	31.750	39500
3/16	4.762	1370	19/32	15.081	10600	1 5/16	33.337	43100
-	5.000	1490	5/8	15.875	11600	1 3/8	34.925	46800
7/32	5.556	1800	21/32	16.668	12600	1 7/16	36.512	50600
15/64	5.953	2020	11/16	17.462	13700	1 1/2	38.100	54600
-	6.000	2060	23/32	18.256	14800	1 5/8	41.275	62900
1/4	6.350	2280	3/4	19.050	16000	1 3/4	44.450	71700
17/64	6.746	2535	25/32	19.843	17200	1 7/8	47.625	81100
9/32	7.144	2810	-	20.000	17400	2	50.800	90900
5/16	7.938	3380	13/16	20.637	18400	2 3/16	55.562	106500
11/32	8.731	4000	27/32	21.431	19700	2 1/4	57.150	112000
3/8	9.525	4670	7/8	22.225	21000	2 5/16	58.735	116500
-	10.000	5090	29/32	23.018	22300	2 1/2	63.500	135000
13/32	10.318	5380	15/16	23.812	23700	2 3/4	69.850	159800
7/16	11.112	6140	31/32	24.606	25100	3	76.200	186500
15/32	11.906	6940	-	25.000	25900	4	101.600	309500

Low Carbon Steel (Case Hardened)

General Information

Balls of this type are generally used in applications where there are only moderate loads and slow rotating parts, for example Castors, Conveyors and non-precision bearings. There is a significant price saving compared to High Carbon Chrome balls.

The main feature of this type of ball is the Carburised case with a soft core giving resistance to shock loads, good load carrying ability and excellent resistance to surface wear.

International Equivalents

AISI 1010, JIS SWRM 12, EN32 ASTM A/29, Wks 1.0010

Material Specification

Composition	
C	0.10 - 0.15%
Mn	0.30 - 0.60%
P	0.045% Max
S	0.045% Max
Si	0.10 - 0.40% Max

Hardness	
HRc	60 min

Mechanical Properties	
Tensile Strength	53,000 psi
Yield Strength	44,000 psi
Density	0.284 lbs/cu in

Size Range
1.588mm (1/16") to 12.700mm (1/2")

Standard Grades Available
100
200
500
1000

Minimum Case Depth

Ball Diameter	Case Depth
1.5mm - 2.0mm	0.4mm
2.1mm - 3.0mm	0.5mm
3.1mm - 4.5mm	0.6mm
4.6mm - 5.5mm	0.8mm
5.6mm - 6.5mm	0.9mm
6.6mm - 9.5mm	1.1mm
9.5mm - 11.0mm	1.4mm
11.1mm - 12.5mm	1.7mm
12.6mm - 14.0mm	1.8mm
14.1mm - 19.0mm	1.9mm
19.1mm - 38.0mm	2.0mm

High Carbon Steel (Through Hardened)

General Information

Balls of this material have the advantage of being through hardened to HRc 60 min and will take higher loads and provide longer life than case hardened carbon balls, for such applications as the cycle industry, and yet remain substantially cheaper than balls manufactured from high carbon chrome alloy steel.

International Equivalents

AISI 1065-85, EN8-9, C85 Wks 1.1269

Material Specification

Composition	
C	0.85%
Si	0.35%
Mn	0.6%
P	0.022%
S	0.022%

Hardness	
HRc	60 min

Mechanical Properties	
Tensile Strength	106,400 psi
Density	0.284 lbs/cu in

Size Range
3.175mm (1/8") to 38.1mm (1 1/2")

Standard Grades Available
100
500
1000

Stainless Steel AISI 302/304

General Information

AISI 302 and 304 balls are for applications where material toughness and resistance to corrosion are more important than hardness. They have good corrosion resistance to the food environment, oxidizing solutions and most organic chemicals. Applications are valves, aerosol and finger pumps. Corrosion resistance is higher after annealing and passivation. Not resistant to sulphuric acids.

International Equivalents

DIN X5 CR Ni 18.09, AFN Z6 CN 18.09, EN58E, JIS SUS 304 Wks 1.4301

Material Specification

Composition	302	304
C	0.15 % Max	0.08 % Max
Cr	17 - 19 %	18 - 20 %
Ni	8 - 10 %	8 - 10 %
Si	1.0 % Max	1.0 % Max
Mo	1.0 % Max	-
Mn	2.0 % Max	2.0 % Max
P	0.045 % Max	0.045 % Max
S	0.03 % Max	0.03 % Max

Hardness	
HRc	25 - 39
H.B.	140 - 160

(Annealed hardness on request)

Mechanical Properties	
Tensile Strength	100,000 - 180,000 psi
Yield Strength	50,000 - 150,000 psi
Density	0.286 lbs/cu in

Size Range
1.588mm (1/16") to 50.80mm (2")

Standard Grades Available
50
100
200
1000

Stainless Steel AISI 316

General Information

Similar to AISI 302/304 but, with the addition of molybdenum improves corrosion resistance particularly to sulphuric acid compounds. These balls are used extensively in applications where contact is made with inks, photographic chemicals, bleaches, dyes and nitric acids. This is the only austenitic steel for ball manufacture and can be non magnetic.

International Equivalents

AFN 26 CND. 17.11, DIN X5 CR Ni Mo 17122, JIS SUS 316, Wks 1.4401

Material Specification

Composition	316	316L
C	0.08 % Max	0.03 % Max
Cr	16 - 18 %	16 - 18 %
Ni	10 - 14 %	10 - 14 %
Si	1.0 % Max	1.0 % Max
Mo	2 - 3 % Max	2 - 3 % Max
Mn	2.0 % Max	2.0 % Max
P	0.045 % Max	0.045 % Max
S	0.03 % Max	0.03 % Max

Hardness	
HRc	25 - 39
H.B.	140 - 160

Mechanical Properties	
Tensile Strength	180,000 psi
Yield Strength	150,000 psi
Density	0.290 lbs/cu in

Size Range
1.588mm (1/16") to 50.80mm (2")

Standard Grades Available
50
100
200
1000

Stainless Steel AISI 420

General Information

Balls of this material have a lower chrome content than 440C, and are used in application where the more rigid corrosion resistance requirements can be relaxed. They have fair resistance to fresh water, steam, oil gasoline, blood, perspiration, alcohol and food environment. However will not pass 40 hours salt spray test.

International Equivalents

AISI 420, JIS SUS 420, JI X20 CR13, Z40 C13, EN56D, Wks 1.4034

Material Specification

Composition	
C	0.15 - 0.36 %
Cr	12 - 14 %
Si	1.0 % Max
Mn	1.0 % Max
P	0.04 % Max
S	0.03 % Max

Hardness	
HRc	52 - 55

Mechanical Properties	
Tensile Strength	275,000 psi
Specific Weight	0.280 lbs/cu in

Size Range
1.588mm (1/16") to 50.80mm (2")

Standard Grades Available
100
500
1000

Stainless Steel AISI 440C

General Information

These balls give maximum hardness with good corrosion resistance to fresh water, steam, crude oil, gasoline, alcohol, food environment, blood and perspiration. In addition this material is ferro-magnetic and makes a fair permanent magnet. Balls are deep freeze stabilised after heat treatment.

International Equivalents

AISI 440C, DINX105 CR Mo17, JIS SUS 440C, Z100CD17 Wks 1.4125

Material Specification

Composition	
C	0.95 - 1.20 %
Cr	16 - 18 %
Si	1.0 % Max
Mn	1.0 % Max
P	0.04 % Max
S	0.03 % Max
Mo	0.75 % Max

Hardness	
HRc	57 - 60

Mechanical Properties	
Tensile Strength	285,000 psi
Yield Strength	275,000 psi
Density	0.277 lbs/cu in

Size Range
0.635mm (0.025") to 101.6mm (4")

Standard Grades Available
10
25
50
1000

Silicon Nitride (Si3N4) Ceramic Balls – Toshiba Material TSN-03NH

Toshiba material TSN-03NH is certified to meet ASTM F2094 Class I requirements, the highest industry classification for silicon nitride bearing materials.

Comparison of TSN-03NH with ASTM F2094

Properties	Method	Unit	Material Class			TSN-03NH (Average level)
			I	II	III	
Flexural Strength	3 point (Mean)	MPa	900	800	600	1100
	Weibull modulus		12	9	7	20
Hardness	HV20kg		1460	1360	1300	1500
Fracture Toughness	Indentation Fracture Resistance, IE??R	MPa√m	≥6.0	≥5.0	≥5.0	7.0
Porosity Size	SEM or Microscope	μm	≤10	≤10	≤25	<1

Reasons for choosing Silicon Nitride over Steel

OEM's choose Silicon Nitride over Steel for a variety of reasons, some of which are -

- Density of 40% lower than Steel
- 60% less weight than Steel
- Excellent corrosion resistance against harsh chemicals and environments
- Superior surface Ra 0.004μm / 0.010μm possible depending on size
- 100% Higher hardness
- Life expectancy can be as much as 10 times more than steel
- Operating temperatures up to 800ºC
- Less bearing operating noise

Silicon Nitride balls made from Toshiba material TSN-03NH in sizes ranging from 1mm to 57.15mm (2.1/4") from Grade 3 up to Grade 28 (or lower if required).

The extremely versatile production capacity in our manufacturing divisions enables us to offer batches of less than 500g (1lb) up to 80kgs (180lbs) in standard and intermediate sizes.

With the aid of our sophisticated production and inspection processes, we can produce Silicon Nitride Balls to customer specifications and measure critical characteristics using the following equipments / techniques -

- Taylor Hobson Talyrond 73 – Roundness / Harmonics
- Taylor Hobson Surface Analyzer – Surface Finish (Ra)
- SKF Steyr Waviness Analyzer – Roundness / Waviness
- Heidenhain & Movomatic Comparators – Diameter
- FPI / Dye Penetrant Inspection

Standard sizes are constantly in production or available from stock and so deliveries to customers can be processed quickly and efficiently.

Non standard sizes are available upon request.

General Information ceramic balls

Ceramic balls are particularly suited to harsh environments. Their main advantages over steel is that they have a density of 40% lower than steel. Have 29% lower thermal expansion and are 150% harder. In certain high-speed applications their life is extended by as much as a hundred times. The three main materials used are Alumina Oxide, Zirconia Oxide and Silicon Nitride.

The following chart shows comparisons between the three.

Material Specifications

	Alumina Oxide	Zirconia Oxide	Silicon Nitride
Composition	99.5% Al2O3 / 0.5% other	97% ZrO2 / 3% MgO	87% Si3N4 / 13% other
Hardness	1700 Hv	80 - 84 Ra	1400 - 1700 Hv
Ultimate Tensile Strength	31,000 psi	60,000 psi	-
Ultimate Compressive Strength	>300,000 psi	285,000 psi	>570,000 psi
Modulus of Elasticity	53 x106 psi	29 x106 psi	44-45 x106 psi
Maximum Working Temperature	1400oC	2400oC	1000oC
Corrosion Resistance	Inert except for hydruofluric and hot concentrated sulphuric acids.	Inert to most substances, not recommended for environments of hydrochloric or strong alkaline solutions.	Inert to most substances.

Tungsten Carbide Cobalt Binder

General Information

Tungsten Carbide materials have a unique combination of properties, high compressive strength, hardness and resistance to wear, as well as an ability to withstand shock and impact. Typical applications are valves, flowmeters, ball screws and linear bearings. Balls from this material are also used for ballizing, gauging and ball pens.

Material Specification

Composition	
Tungsten Carbide	93 - 100%
Cobalt	5 - 7 %

Hardness	
Hra	90.5 - 91.5

Mechanical Properties	
Density	14.947 - 15.0% g/cm3
Thermal Conductivity	100 W/m/oC
Electrical Resistivity	20 u ohms/cm
Linear Expansion Coefficient 20 - 400oC	4.9 10-6/oC
Linear Expansion Coefficient 20 - 800oC	5.3 10-6/oC
Transverse Rupture Strength @ 20oC	2600 N/mm2
Fracture Toughness K c @ 20oC	12 MN/m2
Compressive Strength @ 20oC	6200 N/mm2
Poisson's Ratio	0.22
Magnetic Properties	Slightly magnetic

Size Range
1.588mm (1/16") to 50.800mm (2")

Standard Grades Available
5
10
25
100

Tungsten Carbide Nickel Binder

General Information

Conventional Tungsten Carbides (with Cobalt binder) has limited corrosion resistance, which makes them unsuitable for applications in which the wear parts are operating under both severe abrasive and corrosive conditions.
As a general rule straight Tungsten Carbide (with Cobalt Binder) is resistant to corrosion down to pH 7. By comparison, tests have shown that our Tungsten Carbide (with Nickel binder) material is resistant to corrosion down to pH 2 or 3.

Composition	
Tungsten Carbide	90 - 92 %
Nickel Based Binder	8 - 10 %

Hardness	
Hra	88 - 89

Mechanical Properties	
Density	14.968 g/cm3
Transverse Rupture Strength @ 20oC	2600 MN/m2
Compressive Strength @ 20oC	6870 MN/m2

Size Range
0.635mm (0.025") to 50.800mm (2")

Standard Grades Available
5
10
25
100

Plastic Balls

General Information

Plastic balls are manufactured from standard and speciality polymer resins in sizes from 3/32" (2.381mm) to 5" (127mm). Balls above 1" (25.4mm) are manufactured from extruded rod.

Plastic balls are a cost-effective substitute for metallic balls in low load bearings. They are also used as agitators in aerosol spray cans, lightweight check valves, medical diagnostics and a wide variety of other applications.

Tolerances to +/-0.0005" (+/-0.0125mm) are possible for certain materials such as nylon and acetal. Surfaces can be tailored from rough to highly polished finishes.

The following chart shows comparisons between the five main types.

Material Specifications

	Acetal (Delrin)	Polyamide (Nylon 66)	Polyethylene Low Density	Polyethylene High Density	PTFE
Physical Properties					
Specific Gravity	1.42	1.13-1.15	0.910-0.925	0.941-0.965	2.14-2.20
Water absorption, 1/8" thick specimen, 24h saturation (%)	0.25-0.40	1.0-1.3	<0.01	<0.01	<0.01
Dielectric strength, 1/8" thick specimen, short time (V/mil)	500 (90ml)	600b	450-1000	450-500	480
Mechanical Properties					
Tensile strength at break (psi)	-	12.000b 11.000c	600-2300	3100-5500	2000-5000
Elongation at break (%)	25-75	60b 300c	90-800	20-130	200-400
Tensile yield strength (psi)	95000-12.000	8000b 6500c	800-1200	3000-4000	-
Compressive strength (rupture or yield) (psi)	18.000@10%	15.000b(yld.)	-	2700-3600	1700
Flexural strength (rupture or yield) (psi)	14.000	17.000b 6100c	-	-	-
Tensile modulus (103 psi)	520	-	14-38	60-180	58-80
Compressive modulus (103 psi)	670	-	-	-	60
Flexural modulus(103 psi)	380-430	420b 185c	8-60	100-260	80
Izod impact. Ft-lb/.in.of notch (1/8" thick specimen)	1.3-2.3	0.8-1.0b 2.1c	No break	0.5-20	3
Hardness Rockwell/Shore	M94	R120b M83b	D40-51	D60-70	D50-55
Thermal properties					
Coef. of linear thermal expansion (106in./in/oC)	100	80	100-2220	110-130	-
Deflection temperature Flexural load oF @264psi	255	167b	90-105	110-130	-
@66psi	338	474b	100-121	140-190	250
Thermal conductivity 10-cal.-cm/sec-cm2-oC	5.5	5.8	8	11-12	6.0

Grade	Sphericity		Tolerance		Surface
	Inches	**mm**	**Inches**	**mm**	
0*	0.0005	0.0125	+/-0.0005	0.0125	Polished
I	0.0005	0.0125	+/-0.001	0.025	Polished
II	0.001	0.025	+/-0.002	0.050	Unpolished
III	0.005	0.125	+/-0.005	0.125	Unpolished

*Only available in certain materials

Other Materials

Phosphor Bronze

PB102 CDA-464 SAE C-464000, Cu 92-94%, Sn 6-8%
Good corrosion resistance, widely used as an electrical conductor.
Hardness HRb 75-98

Brass

Cu 59/65, Zn 35/37
Good corrosion resistance in ambient air and sea water, unstable in acid and alkalis.
Hardness HB 75

Glass

SiO2 70.9, Al2O3 0.1, CaO 11.9, Na2O 8.9, K2O 7.3
Used for applications where chemical resistance, high electrical insulation performance and high hardness is required. This type is soda glass but lead glass and boro silicate are available.
Hardness Morse 6

Aluminium

Al 99, Cu 0.15, Mn 0.05, Zn 0.1
Low weight, good electrical and heat conductivity, high corrosion resistance but low mechanical strength (Duralumin is hardenable to HB 105).
Hardness HB 43

Hastelloy C

Ni 57, Cr 16.5, Mo 17, W 4.5, Fe 5
Used in place of high speed steels when high temperatures are involved - stable up to 1040oC (1900oF).
Hardness HB 241

Polishing Media

Spheric-Trafalgar can supply Polishing Balls and Polishing Shapes in most materials. Specific quality requirements should be discussed with our sales personnel.

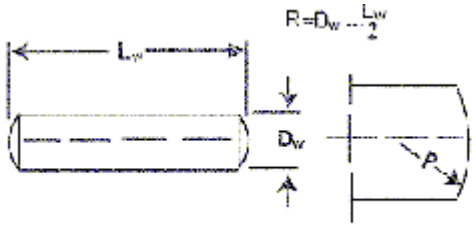
Rollers

Needle Rollers and Cylindrical Rollers, which are normally manufactured from Chrome Steel, can be made in virtually any material, providing the quantity required is sufficient for production.

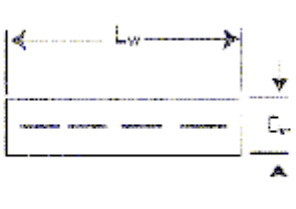
Size Range -

Needle Rollers: 1.5 x 4.5 - 8mm x 55mm

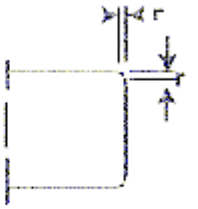
Cylindrical Rollers 2.5 x 5 - 50mm x 70mm



Form A (Rounded ends)



Form B (Square ends)



Corner chamfer

Diameter Dw (mm)		Corner Chamfer r (mm)	
Over	Up To	min.	max.
-	>3	>0.1	>0.4
3	5	0.1	0.6

Length Lw (mm)		Tolerance (mm)	
Over	Up To	From	To
>-	>6	>+0	>-0.18
6	10	+0	-0.22
10	18	+0	-0.27
18	30	+0	-0.33
30	50	+0	-0.33

Dimensional and Geometrical Accuracy

Quality Class or Grade	Deviations and Tolerances for diameter Dw			Roundness Tolerance (DIN 7184) (µm)
	Deviation (mm)	Tolerance of one sort (µm)	Division of sorts Deviations (µm)	
G2	0 - 10	2	0-2-1-3-2-4-3-5-4-6-5-7-6-8-7-9-8-10	0.8
>G3	>0 - 10	>3	>0-3-1.5-4.5-3-6-4.5-3-6-4.5-7.5-6-9-7-10	>1.2
G5	0 - 10	5	0-5-3-8-5-10	

Technical definition

Single Diameter of a Ball
The distance between two parallel planes tangent to the surface of the ball.

Mean Diameter of a Ball
The arithmetic mean of the largest and the smallest actual single diameters of the ball.

Ball Diameter Variation
The difference between the largest and the smallest actual single diameters of the ball.

Deviation from Spherical Form
The greatest radial distance in any radial plane between a sphere circumscribed around the ball surface and any point on the ball surface

Lot
A definite quantity of balls manufactured under conditions which are presumed uniform and which is considered and identified as an entity.

Lot Mean Diameter
The arithmetic mean of the mean diameter of the largest ball and that of the smallest ball in the lot

Lot Diameter Variation
The difference between the mean diameter of the largest ball and that of the smallest ball in the lot.

Nominal Ball Diameter Tolerance
The maximum allowable deviation of any ball lot mean diameter from the Nominal Ball Diameter

Specific Diameter
The amount by which the lot mean diameter differs from the nominal diameter, accurate to the marking increment for that grade

Ball Grade
A specific combination of dimensional form and surface roughness tolerances. A ball grade is designated a grade number.

Ball Gauge
The prescribed small amount by which the lot mean diameter should differ from nominal diameter, this amount being one of an established series of amounts

Ball Gauge Deviation
The difference between the lot mean diameter and the sum of the nominal diameter and the ball gauge

Surface Roughness
>Surface roughness consists of all those irregularities which form surface relief and which are conventionally defined within the area where deviations of form and waviness are eliminated

Waviness
The more widely spaced circumferential component of surface texture.

Hardness
The measure of resistance to penetration of the ball surface or truncated flat of the ball by a specific indenting shape as determined by specified methods.

ASDMA/AFBMA

Tolerances by Grade for Individual Balls				Tolerances by Grade for Lots of Balls			
	VDws	ΔRw	Ra	VDwt		ΔS	
Ball Grade	Allowable Ball Dia. Variation	Allowable Deviation from Spherical Form	Maximum Surface Roughness Arithmetic Average	Allowable Lot Dia. Variation	Nominal Ball Diameter Tolerance	Allowable Ball Gauge Deviation High Low	Container Marking Increment
INCH							
3	.000003	.000003	0.5	.000005	*	+.000030 -.000030	.000010
5	.000005	.000005	0.8	.000010	*	+.000050 -.000030	.000010
10	.000010	.000010	1	.000020	*	+.000050 -.000040	.000010
16	.000016	.000016	1	.000032	*	+.000050 -.000040	.000010
24	.000024	.000024	2	.000048	*	+.0001 -.0001	.000010
48	.000048	.000048	3	.000096	*	*	.00005
100	.0001	.0001	5	.0002	±.0005	*	*
200	.0002	.0002	8	.0004	±.001	*	*
500	.0005	.0005	*	.001	±.002	*	*
1000	.001	.001	*	.002	±.005	*	*
METRIC µm							
3	0.08	0.08	0.012	0.13	*	+0.75 -0.75	0.25
5	0.13	0.13	0.02	0.25	*	+1.25 -1	0.25
10	0.25	0.25	0.025	0.5	*	+1.25 -1	0.25
16	0.4	0.4	0.025	0.8	*	+1.25 - 1	0.25
24	0.6	0.6	0.05	1.2	*	+2.5 -2.5	0.25
48	1.2	1.2	0.08	2.4	*	*	1.25
100	2.5	2.5	0.125	5	±12.5	*	*
200	5	5	0.2	10	±25	*	*
500	13	13	*	25	±50	*	*
1000	25	25	*				

DIN 5401

ΔS

Grade	Dw Nominal Ball Diameter		Gauge Allowance	VDws µm max.	tDw µm max.	Ra5) µm max.	VDwL µm max.	VDwA µm max.	IG;ST µm max.	Mean allowances in Each Grade (µm)		
G3	-	12,7	± 5,32	0,08	0,08	0,010	0,13	-	0,5	-5 .. .-0.5	0	+0.5 ... +5
G5	-	12,7	± 5,63	0,13	0,13	0,014	0,25	-	1	-5 ... -1	0	+1 ... +5
G10	-	25,4	± 9,75	0,25	0,25	0,020	0,5	-	1	-9 ... -1	0	+1 ... +9
G16	-	25,4	± 11,4	0,4	0,4	0,025	0,8	-	2	-10 ... -2	0	+2 ... +10
G20	-	38,1	± 11,5	0,5	0,5	0,032	1	-	2	-10 ... -2	0	+2 ... +10
G28	-	50,8	± 13,7	0,7	0,7	0,050	1,4	-	2	-12 ... -2	0	+2 ... +12
G40	-	100	± 19	1	1	0,060	2	-	4	-16 ... -4	0	+4 ... +16
G80	-	100	± 14	2	2	0,1	-	4,0	4	-12 ... -4	0	+4 ... +12
G100	-	150	± 47,5	2,5	2,5	0,1	5	-	10	-40 ... -10	0	+10 ... +40
G200	-	150	± 72,5	5	5	0,15	10	-	10	-60 ... -10	0	+10 ... +60
G300	-	25,4	± 70	10	10	0,2	-	20	20	-60 ... -20	0	+20 ... +60
G300	25,4	50,8	± 105	15	15	0,2	-	30	30	-90 ... -30	0	+ 30 ... +90
G300	50,8	75	± 140	20	20	0,2	-	40	40	-120 ... -40	0	+40 ... +120
G500	-	25,4	± 75	25	25	-	-	50	50	-50	0	+50
G500	25,4	50,8	± 112,5	25	25	-	-	75	75	-75	0	+75
G500	50,8	75	± 150	25	25	-	-	100	100	-100	0	+100
G500	75	100	± 187,5	32	32	-	-	125	125	-125	0	+125
G500	100	125	± 225	38	38	-	-	150	150	-150	0	+150
G500	125	150	± 262,5	44	44	-	-	175	175	-175	0	+175
G600	all		± 200	-	-	-	-	400	-	-	0	-
G700	all		± 1000	-	-	-	-	2000	-	-	0	-

Symbols & Explanations

Dw	Nominal ball diameter
Dws	Single diameter of a ball
Dwm	Mean diameter of a ball
VDws	Ball diameter variation
VDwl	Lot diameter variation
Ra	Surface roughness
ΔS	Deviation from ball gauge
tDw	Deviation from spherical form (roundness)
IG	Sorting gauges

Dw Nominel kugle diameter
Dws Single diameter af en kugle
Dwm Middel diameteren af en kugle (1 parti´s største og mindste kugle delt med 2) (9,5 + 10,2 delt 2 = 9,85 mm)
VDws Kugle diameter variation af den enkelte kugle (målt på kryds og på tværs)
VDwl Parti diameter variation (målt i ét parti)
Ra Overfladeruhed
ΔS Afvigelse fra målekugle, man kan selv vælge dette udsving op til denne afvigelse (specielt fremstilles)
tDw Afvigelse fra kugleform (rundhed)
IG Sorterings mål

Mean allowances in each grade: Hvad hver "grade" må have af udsving fra minus til plus tolerance .

DIN 5401

Class	Diameter (Nominal Dimension) (mm)	Gauge Allowance (µm)	Tolerance in Each Grade (µm)	Mean allowances in Each Grade (um)											Permissible Geometric Deviation (µm)
I	Up to 10	±10,2	0,5	-10	...	-1,5	-1	-0,5	0	+0,5	+1	+1,5	...	+10	0,25
II	Up to 25	±10,5	1	-10	...	-3	-2	-1	0	+1	+2	+3	...	+10	+,5
	Up to 25	±11	2	-10	-8	-6	-4	-2	0	+2	+4	+6	+8	+10	1
	Over 25 to 50	±13,5	3		-12	-9	-6	-3	0	+3	+6	+9	+12		1,5
III	Over 50 to 75	±14	4			-12	-8	-4	0	+4	+8	+12			2
	Over 75 to 100	±17,5	5			-15	-10	-5	0	+5	+10	+15			2,5
	Over 100 to 125	±21	6			-18	-12	-6	0	+6	+12	+18			3
	Over 125 to 150	±24,5	7			-21	-14	-7	0	+7	+14	+21			3,5
IV	Up to 10	±14	4			-12	-8	-4	0	+4	+8	+12			2
	Up to 25	±75	50					-50	0	+50					25
	Over 25 to 50	±113	75					-75	0	+75					38
	Over 50 to 75	±150	100					-100	0	+100					50
V	Over 75 to 100	±188	125					-125	0	+125					63
	Over 100 to 125	±225	150					-150	0	+150					75
	Over 125 to 150	±263	175					-175	0	+175					88
	VI	±200	400						0						
	VII								0						

Correction Factor for Different Materials

For balls, unhardened, in rolling bearing steel	10 times
balls, unhardened, in Stainless Steel	10 times
balls, hardened, in Stainless Steel	2 times
balls in bronze and brass	10 times

GB308-84 ISO 3290

Grade	Ball Dia. Variation (μm)	Deviation from Spherical Form (μm)	Surface Roughness (μm)	Lot Dia. Variation (μm)	Gauge Interval (μm)	Preferred Gauge (μm)	Subgauge Interval (μm)	Subgauge (μm)
G3	0.08	0.08	0.010	0.13	0.5	-5...-0.5 0 +0.5...+5	0.1	-0.2,-0.1, 0, +0.1,+0.2
G5	0.13	0.13	0.014	0.25	1	-5...-1 0 +1...+5	0.2	-0.4,-0.2, 0, +0.2,+0.4
G10	0.25	0.25	0.020	0.5	1	-9...-1 0 +1...+9	0.2	-0.4,-0.2, 0, +0.2,+0.4
G16	0.4	0.4	0.025	0.8	2	-10...-2 0 +2...+10	0.4	-0.8,-0.4 0, +0.4,+0.8
G20	0.5	0.5	0.032	1	2	-10...-2 0 +2...+10	0.4	-0.8,-0.4 0, +0.4,+0.8
G24	0.6	0.6	0.040	1.2	2	-12...-2 0 +2...+12	0.4	-0.8,-0.4 0, +0.4,+0.8
G28	0.7	0.7	0.050	1.4	2	-12...-2 0 +2...+12	0.4	-0.8,-0.4 0, +0.4,+0.8
G40	1	1	0.060	2	4	-16...-4 0 +4...+16	0.8	-1.6,-0.8, 0, +0.8,+1.6
G60	1.5	1.5	0.080	3	6	-18...-6 0 +6...+18	1.2	-2.4,-1.2, 0. +1.2,+2.4
G100	2.5	2.5	0.100	5	10	-40...-10 0 +10...+40	2	-4,-2, 0, +2,+4
G200	5	5	0.150	10	15	-60...-15 0 +15...+60	3	-6,-3, 0, +3,+6

Italian Grades

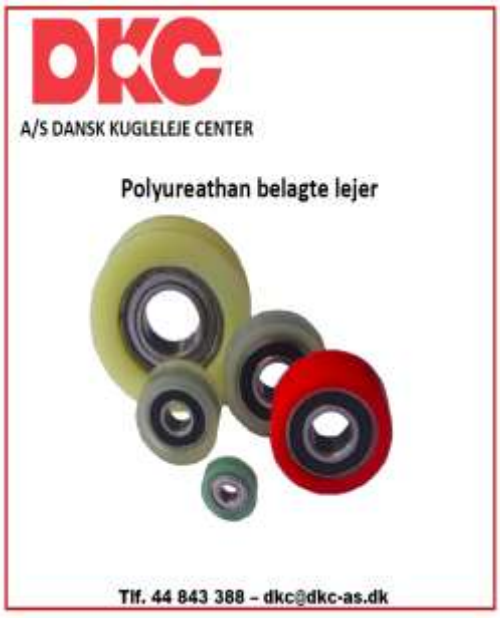
Grade	Diameter (mm)	Sphericity (µm)	Diameter Variation (µm)	Shipment Diameter (µm)	Maximum Roughness (µm)	ISO* Grade	DIN* Grade	AFBMA* Grade
AAAA	0-3 inc	0.15	0.3	± 1.5	0.010	5	-	5
	over 3-6 inc	0.2	0.4	± 2	0.013	10	-	10
	over 6-10 inc	0.2	0.4	± 3	0.015	10	I	10
	over 10-20 inc	0.4	0.8	± 4	0.020	16	-	16
	over 20-30 inc	0.6	1.2	± 5	0.023	-	II	24
	over 30-50 inc	0.9	1.8	± 6	0.028	-	-	24
AAA	0-3 inc	0.2	0.5	± 2	0.012	10	I	10
	over 3-6 inc	0.3	0.6	± 3	0.015	16	I	16
	over 6-10 inc	0.4	0.8	± 4	0.018	16	II	16
	over 10-20 inc	0.5	1	± 5	0.022	20	II	16
	over 20-30 inc	0.8	1.5	± 6	0.025	28	-	24
	over 30-50 inc	1	2	± 8	0.030	40	-	48
AA	0-3 inc	0.4	0.8	± 4	0.015	16	II	16
	over 3-6 inc	0.5	1	± 5	0.018	28	II	24
	over 6-10 inc	0.6	1.2	± 6	0.022	28	III	24
	over 10-20 inc	0.8	1.5	± 7.5	0.025	28	III	24
	over 20-30 inc	1	2	± 10	0.030	40	III	48
	over 30-50 inc	1.5	3	± 12	0.035	-	III	48
A	0-3 inc	0.8	1.2	± 6	0.020	28	III	24
	over 3-6 inc	1	1.5	± 7.5	0.023	40	III	48
	over 6-10 inc	1.2	2	± 8	0.026	40	-	48
	over 10-20 inc	1.5	2.5	± 10	0.030	40	IV	48
	over 20-30 inc	2	3	± 15	0.035	100	IV	100
	over 30-50 inc	2	4	± 20	0.040	100	IV	100
B	0-3 inc	1.2	2.5	± 7.5	0.040	40	III	48
	over 3-6 inc	1.5	3	± 9	0.050	100	III	100
	over 6-10 inc	2	4	± 12	0.060	100	IV	100
	over 10-20 inc	2.5	5	± 15	0.080	100	IV	100
	over 20-30 inc	3	6	± 24	0.100	200	IV	200
	over 30-50 inc	4	8	± 32	0.120	200	IV	200
C	0-3 inc	3	6	± 12	-	100	IV	100
	over 3-6 inc	4	8	± 16	-	-	IV	100
	over 6-10 inc	5	10	± 20	-	200	IV	200
	over 10-20 inc	8	15	± 30	-	200	V	200
	over 20-30 inc	10	20	± 40	-	-	V	300

Hardness Conversion Chart

Tensile Strength (N/mm2)	Hardness Vickers	Hardness Brinell*	HRB	HRF	HRC	HRA
770	240	228	98.1	114.3	20.3	60.7
785	245	233			21.3	61.2
800	250	238	99.5	115.1	22.2	61.6
820	255	242			23.1	62.0
835	260	247	(101)		24.0	62.4
850	265	252			25.8	62.7
865	270	257	(102)		25.8	63.1
880	275	261			26.4	63.5
900	208	266	(104)		27.1	63.8
915	285	271			27.8	64.2
930	290	276	(105)		28.5	64.5
950	295	280			29.2	64.8
965	300	285			29.8	65.2
995	310	295			31.0	65.8
1030	320	304			32.2	66.4
1060	330	314			33.3	67.0
1095	340	323			34.4	67.6
1125	350	333			35.5	68.1
1155	360	342			36.6	68.7
1190	370	352			37.7	69.2
1220	380	361			38.8	69.8
1255	390	371			39.8	70.3
1290	400	380			40.8	70.8
1320	410	390			41.8	71.4
1350	420	399			42.7	71.8
1385	430	409			43.6	72.3
1420	440	418			44.5	72.8
1455	450	428			45.3	73.3
1485	460	437			46.1	73.6
1520	470	447			46.9	74.1
1555	480	(456)			47.7	74.5
1595	490	(466)			48.4	74.8
1630	500	(475)			49.1	75.3
1665	510	(485)			49.8	75.7
1700	520	(494)			50.5	76.1
1740	530	(504)			51.1	76.4
1775	540	(513)			51.7	76.7
1810	550	(523)			52.3	77.0
1845	560	(532)			53.0	77.4
1880	570	(542)			53.6	77.8
1920	580	(551)			54.1	78.0
1955	590	(561)			54.7	78.4
1995	600	(570)			55.2	78.6
2030	610	(580)			55.7	78.9
2070	620	(589)			56.3	79.2
2105	630	(599)			56.5	79.5
2145	640	(608)			57.3	79.8
2180	650	(618)			58.7	80.0
	660				58.3	80.3
	670				58.8	80.6
	680				59.2	80.8
	690				59.7	81.1
	700				60.1	81.3
	720				61.0	81.8
	740				61.8	82.2
	760				62.5	82.6
	780				63.3	83.0
	800				64.0	83.4
	820				64.7	83.8
	840				65.3	84.1
	860				65.9	84.4
	880				66.4	84.7
	900				67.0	85.0
	920				67.5	85.3
	940				68.8	85.6

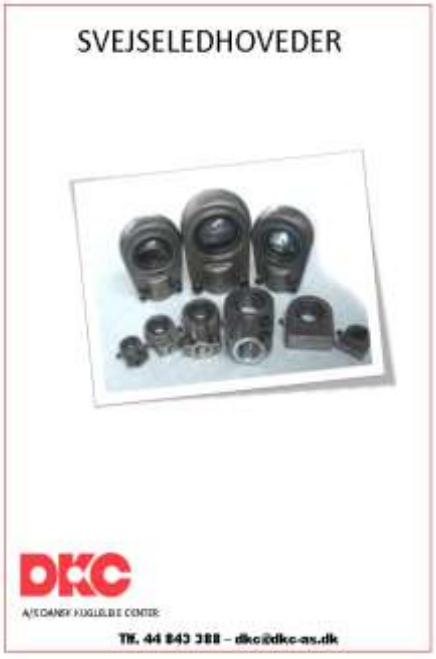
OTHER CATALGOUES

Pixi produkt katalog



Pur-lejer katalog

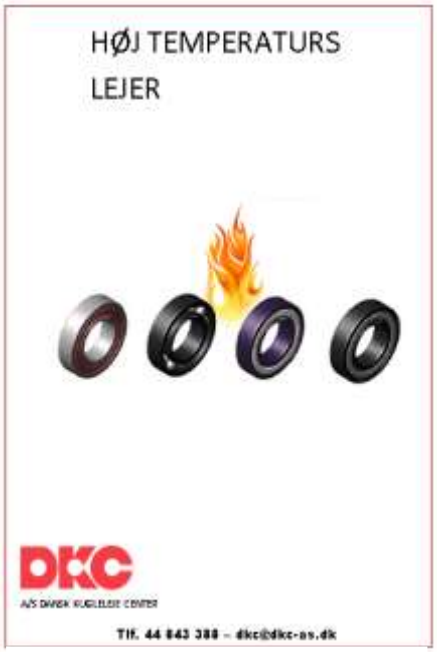
Olietætnings katalog



Svejseledhovede katalog

Ledstangshovede katalog

OTHER CATALGOUES



Hø j temperaturs leje katalog

Rustfrilejer katalog

Nord-Lock katalog

Strømisolerede & Keramiske leje katalog

Kileremme katalog

Kileremskiver katalog

DKC

A/S Dansk Kugleleje Center, Mileparken 29, DK-2730 Herlev, Fax: 44 84 56 20

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