

ASK Steel balls

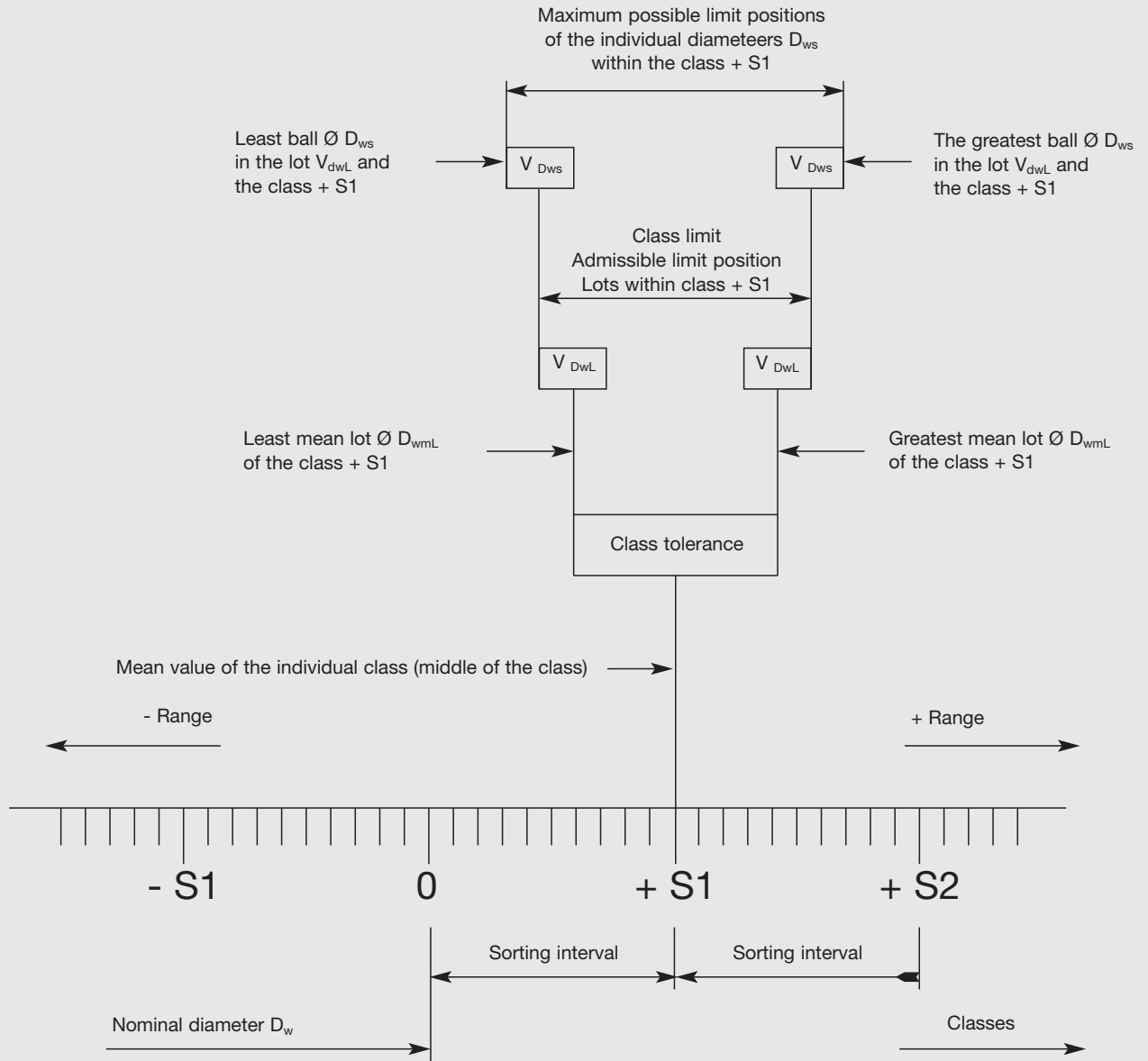
Balls are normally used as roller bodies in roller bearings. There are, however, other uses such as in recirculating ball steerings or as valve balls, etc.

Definitions, terms

G	class, ball quality in accordance with ISO 3290 and DIN 5401 (2002,08)
Dw	nominal diameter of the ball
Dws	single diameter of a ball. Distance between two parallel planes that touch the surface of the ball.
Dwm	mean diameter of the ball lot. Arithmetic mean of the largest and smallest single diameter Dws of a ball.
DwmL	mean diameter of a ball lot. Arithmetic mean of the largest and smallest mean ball Δ Dwm in a lot.
IG	sorting interval. Amount by which the admissible size of the nominal diameter of the ball is evenly distributed.
Los	a certain number of balls manufactured under the same conditions (one machine filling).
Ra	surface roughness in accordance with DIN 4768.
ST	grade tolerance. Range in which the DwmL may vary within one classification (the same amount as IG).

tDw	shape tolerance. Deviation from the ball shape.
VDwA	fluctuation in the diameter in one classification. The difference between the largest and the smallest diameter Dwm in one classification. Applies to G500 to G700 and for special balls.
VDwL	fluctuation in the diameter in one lot. The difference between the largest and smallest mean diameter Dwm in one lot. Applies to G3 to G200.
VDws	difference between the largest and smallest single diameter.
Sorte	distance of the mean ball (in a lot (for VDwL) or the subset of a lot (for VDwA) to the nominal diameter of the ball Dw, rounded up to the integral multiplication of the sorting interval IG.
For G3 to G200:	The lots are assigned to the categories according to their statistical mean, i.e. a maximum excess of
	$\frac{VDws}{2}$
	$\frac{VDwL}{2}$
For special balls:	Sorting in accordance with DIN 5401, version 2002,08
Tolerances of hardened steel balls (DIN 5401, version 2002,08)	

Relations between lot and class sizes



Tolerances of hardened steel balls (DIN 5401, version 2002, 08)

Class (grade)	Diameter of the ball		Tolerances of a ball in the lot			Tolerance		Sorting range and classification		
			Size tolerance	Shape tolerance	Roughness	of a lot	Sorting interval			
	Nominal size		V_{Dws}	tDw	R_a	$V_{DwL}^{1)}$	I_G, S_t			
	greater than	up to	max.	max.	max.	max.				
	mm	mm	μm			μm		μm		
G3*)	-	12	0.08	0.08	0.01	0.13	0.5	-5...-0.5	0	+0.5...+5
G5*)	-	12	0.13	0.13	0.014	0.25	1	-5...-1	0	+1...+5
G10*)	-	25	0.25	0.25	0.02	0.5	1	-9...-1	0	+1...+9
G16*)	-	25	0.4	0.4	0.025	0.8	2	-10...-2	0	+2...+10
G20*)	-	38	0.5	0.5	0.032	1	2	-10...-2	0	+2...+10
G28*)	-	50	0.7	0.7	0.05	1.4	2	-12...-2	0	+2...+12
G40*)	-	100	1	1	0.06	2	4	-16...-4	0	+4...+16
G100	-	150	2.5	2.5	0.125	5	10	-40...-10	0	+10...+40
G200	-	150	5	5	0.2	10	15	-60...-15	0	+15...+60
G500	-	25	25	25	-	50	50	-50	0	+50
	25	50	25	25	-	75	75	-75	0	-75
	50	75	25	25	-	100	100	-100	0	+100
	75	100	32	32	-	125	125	-125	0	+125
	100	125	38	38	-	150	150	-150	0	+150
	125	150	44	44	-	175	175	-175	0	+175
G600	all	-	-	-	-	400	-		0	
G700	all	-	-	-	-	2000	-		0	

1) Tolerance V_{DwA} at G500 to 700 instead of V_{DwL} *) only upon request

Hardness of hardened roller bearing steels in accordance with DIN 17 230

D_w		hardness*)
greater than	up to	
-	12.7	740 up to 900 HV 10**)
12.7	50.8	60 up to 66 HRC
50.8	70	59 up to 65 HRC
70	120	57 up to 63 HRC
120	150	55 up to 61 HRC

*) Surface hardness

These hardness values are attained during heat treatment. The subsequent hardness processing causes cold solidification in the outer marginal zone, leading to certain hardness increases that cannot be calculated for. In the surface region, the upper limit value thus may be slightly exceeded.

For large balls, the core hardness may be slightly less than the values measured in the marginal zones.

**) 62 to 67 HRC are also admissible; the Vickers test is, however, binding.

Tolerances of hardened balls made of stainless steel (DIN 5401, version 2002,08)

Diameter of the ball		Tolerances of a ball in the lot		Tolerance		Sorting range and classification						
Nominal size D_w greater than up to mm		Size tolerance V_{Dws} max. μm	Shape tolerance t_{Dw} max.	of a lot V_{DwA} max. μm	Sorting interval I_G	μm						
-	25	1	2	4	4	-20	-8	-4	0	+4	+8	+20
25	50	1.5	3	6	6	-24	-12	-6	0	+6	+12	+24
50	75	2	4	8	8	-32	-16	-8	0	+8	+16	+32
75	100	2.5	5	10	10	-40	-20	-10	0	+10	+20	+40
100	125	3	6	12	12	-48	-24	-12	0	+12	+24	+48
125	150	3.5	7	14	14	-56	-28	-14	0	+14	+28	+56

Tolerances of non heat-treatable balls made of stainless steel (DIN 5401 T1, version 2002,08)

Copper-tin alloy
Copper-zinc alloy

Diameter of the ball		Tolerances of a ball in the lot		Tolerance		Sorting range and classification						
Nominal size D_w greater than up to mm		Size tolerance V_{Dws} max. μm	Shape tolerance t_{Dw} max.	of a lot V_{DwA} max. μm	Sorting interval I_G	μm						
-	25	5	10	20	20	-60	-40	-20	0	+20	+40	+60
25	50	7.5	15	30	30	-90	-60	-30	0	+30	+60	+90
50	75	10	20	40	40	-120	-80	-40	0	+40	+80	+120

Hardness and materials

Class	Material No.	Abbreviation, alloy	Hardness	
			$D_w \leq 12,7$ mm	$D_w \leq 12,7$ mm
Stainless steel heat treatable hardened in accordance with DIN 17 230	1.3541	X 45 Cr 13	580 to 700 HV 10	54 to 60 HRC
	1.4034	X 46 Cr 13	580 to 700 HV 10	54 to 60 HRC
	1.4037	X 65 Cr 13	640 to 780 HV 10	57 to 63 HRC
	1.3543	X 102 Cr Mo 17	640 to 780 HV 10	57 to 63 HRC
	1.3549	X 89 Cr Mo V 18 I	640 to 780 HV 10	57 to 63 HRC
non heat-treatable in accordance with DIN 17 440	1.4301	X 5 Cr Ni 18 10	135 to 200 HV 10	
	1.4571	X 6 Cr Ni Mo Ti 17 12 2	135 to 200 HV 10	
	1.4580	X 6 Cr Ni Mo Nb 17 12 2	135 to 200 HV 10	
Copper-zinc alloy in accordance with DIN 17 662	2.1030	Cu Sn 8	200 to 220 HB	
Copper-tin alloy in accordance with DIN 17 660	2.0321	Cu Zn 37	180 to 200 HB	
	2.0360	Cu Zn 40	180 to 200 HB	

Bore diameter and weights for steel balls made of through-hardened bearing steel

Bore diameter of steel ball D_w mm (Inch)		Weight 1000 piece (7.85 g/cm ³) kg appr.
1.588 (1/16 Inch)		0,0165
2		0,0329
2.381 (3/32 Inch)		0,0555
2.5		0,0642
3		0,1110
3.175 (1/8 Inch)		0,1320
3.5		0,1760
3.969 (5/32 Inch)		0,2570
4		0,2630
4.5		0,3750
4.762 (3/16 Inch)		0,4440
5		0,5140
5.5		0,6840
5.556 (7/32 Inch)		0,7050
6		0,8880
6.350 (1/4 Inch)		1,0500
6.5		1,1300
7		1,4100
7.144 (9/32 Inch)		1,5000
7.5		1,7300
7.938 (5/16 Inch)		2,0600
8		2,1100
8.5		2,5200
8.731 (11/32 Inch)		2,7400
9		3,0000
9.525 (3/8 Inch)		3,5500
10		4,1100
10.319 (13/32 Inch)		4,5200
11		5,4700
11.112 (7/16 Inch)		5,6400
11.906 (15/32 Inch)		6,9400
12		7,1000
12.5		8,0300
12.7		8,4200
13		9,0300
13.494 (17/32 Inch)		10,1000
14		11,3000
14.288 (9/16 Inch)		12,0000
15		13,9000
15.081 (19/32 Inch)		14,1000
15.875 (5/8 Inch)		16,4000
16		16,8000
16.669 (21/32 Inch)		19,0000
17		20,2000
17.462 (11/16 Inch)		21,9000
18		24,0000
18.256 (23/32 Inch)		25,0000
19		28,2000
19.05 (3/4 Inch)		28,4000
19.844 (25/32 Inch)		32,1000
20		32,9000
20.638 (13/16 Inch)		36,1000
21		38,1000
22		43,8000
22.225 (7/8 Inch)		45,1000
23.812 (15/16 Inch)		55,5000
24		56,8000
25		64,2000

Bore diameter and weights for steel balls made of hardened stainless steel

Bore diameter of steel ball D_w mm (Inch)		Weight 1000 piece (7.7 g/cm ³) kg appr.
1.588 (1/16 Inch)		0,0136
2		0,0323
2.381 (3/32 Inch)		0,0544
2.5		0,0630
3		0,1090
3.175 (1/8 Inch)		0,1270
3.5		0,1730
3.969 (5/32 Inch)		0,2520
4		0,2580
4.5		0,3670
4.762 (3/16 Inch)		0,4350
5		0,5040
5.5		0,6710
5.556 (7/32 Inch)		0,6910
6		0,8710
6.350 (1/4 Inch)		1,0300
6.5		1,1070
7		1,3800
7.144 (9/32 Inch)		1,4700
7.5		1,7000
7.938 (5/16 Inch)		2,0200
8		2,0600
8.5		2,4760
8.731 (11/32 Inch)		2,6800
9		2,9400
9.525 (3/8 Inch)		3,4800
10		4,0300
10.319 (13/32 Inch)		4,4300
11		5,3660
11.112 (7/16 Inch)		5,5300
11.906 (15/32 Inch)		6,8040
12		6,9700
12.5		7,8700
12.7		8,2600
13		8,8600
13.494 (17/32 Inch)		9,9060
14		11,1000
14.288 (9/16 Inch)		11,7600
15		13,6000
15.081 (19/32 Inch)		13,8280
15.875 (5/8 Inch)		16,1000
16		16,5000
16.669 (21/32 Inch)		18,6730
17		19,8070
17.462 (11/16 Inch)		21,4700
18		23,5000
18.256 (23/32 Inch)		24,5300
19		27,6500
19.05 (3/4 Inch)		27,9000
19.844 (25/32 Inch)		31,5000
20		32,3000
20.638 (13/16 Inch)		35,4400
21		37,3400
22		42,9000
22.225 (7/8 Inch)		44,2600
23.812 (15/16 Inch)		54,4300
24		55,7340
25		63,0000