

Induction Hardened and Ground Linear Shafts product overview

Series	Description
NI-W metric sizes	Induction hardened and ground linear shafts steel grade: Cf53, C55E / $\phi 4 - 100$ mm

Steel grades correspondents

EN	Werkstoff	DIN	B.S.	UNI	JIS	GOST	AISI SAE ASTM
C53	1.1213	Cf53 (C53G)	070M55	C53	S50C	50	1050
C55E	1.1203	Ck55	060A57, 070M55	C55	S55C, S55CM	55	1055
C45E	1.1191	Ck45	080M46	C45	S45C	45	1045
C60E	1.1221	Ck60	060A62, 070M60	C60	S58C	60, 60G, 60GA	1064

Chemical composition - % by weight

Steel grade	Norm	C	Si	Mn	P	S	Cr	Ni.	Mo	V
Cf53	DIN 17212	0.50 \div 0.57	0.15 \div 0.35	0.40 \div 0.70	max. 0.025	max. 0.035	-	-	-	-
C55E	EN 10083-2	0.52 \div 0.60	max. 0.4	0.60 \div 0.90	max. 0.030	max. 0.035	max. 0.40	max. 0.40	max. 0.1	-
C45E	EN 10083-2	0.42 \div 0.50	max. 0.4	0.50 \div 0.80	max. 0.030	max. 0.035	max. 0.40	max. 0.40	max. 0.1	-
C60E	EN 10083-2	0.57 \div 0.65	max. 0.4	0.60 \div 0.90	max. 0.030	max. 0.035	max. 0.40	max. 0.40	max. 0.1	-

Mechanical properties for steel bars

Steel grade	Diameter ϕ mm	Tensile strength R_m N/mm ²	Yield strength $R_{p0.2}$ N/mm ²	Elongation A_5 %	Hardness Brinell HB
Cf53+N	$\phi \leq 16$	610 - 760	min. 340	min. 16	min. 183
	$16 < \phi \leq 100$	610 - 760	min. 340	min. 16	-
C55E+N	$\phi \leq 16$	min. 680	min. 370	min. 11	min. 208
	$16 < \phi \leq 100$	min. 640	min. 330	min. 12	min. 198
C45E+N	$\phi \leq 16$	min. 620	min. 340	min. 14	min. 190
	$16 < \phi \leq 100$	min. 580	min. 305	min. 16	min. 172
C60E+N	$\phi \leq 16$	min. 710	min. 380	min. 10	min. 218
	$16 < \phi \leq 100$	min. 670	min. 340	min. 11	min. 203

N=normalized

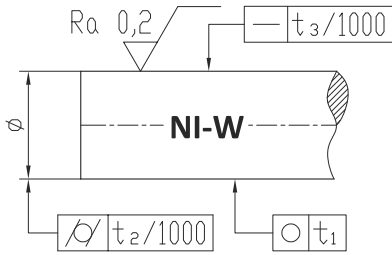


NI-W

metric sizes

Induction Hardened and Ground Linear Shafts

steel grade: Cf53, C55E



Shaft Diameter \varnothing	Weight	Series	Standard length	Surface hardening depth SHD	Roundness (circularity) t1 max.	Parallelism (cylindricity) t2 max.	Straightness t3 max.	Standard tolerance ISO h6
mm	kg/m		mm	mm	μm	μm	mm/m	μm
4	0.10	NI-W 4	4000	0.4 + 0.4	4	6	0.30	0 / -8
5	0.15	NI-W 5	4000	0.4 + 0.4	4	6	0.25	0 / -8
6	0.22	NI-W 6	6000	0.4 + 0.4	4	6	0.25	0 / -8
8	0.39	NI-W 8	6000	0.4 + 0.4	4	6	0.20	0 / -9
10	0.62	NI-W 10	6000	0.4 + 0.4	4	6	0.20	0 / -9
12	0.89	NI-W 12	6000	0.6 + 0.6	5	8	0.20	0 / -11
16	1.58	NI-W 16	6000	0.6 + 0.6	5	8	0.20	0 / -11
20	2.46	NI-W 20	6000	0.9 + 0.8	6	9	0.20	0 / -13
25	3.85	NI-W 25	6000	0.9 + 0.8	6	9	0.15	0 / -13
30	5.55	NI-W 30	6000	0.9 + 0.8	6	9	0.15	0 / -13
35	7.55	NI-W 35	6000	1.5 + 1.3	7	11	0.15	0 / -16
40	9.86	NI-W 40	6000	1.5 + 1.3	7	11	0.15	0 / -16
50	15.41	NI-W 50	6000	1.5 + 1.3	7	11	0.15	0 / -16
60	22.20	NI-W 60	6000	2.2 + 1.6	8	13	0.15	0 / -19
80	39.44	NI-W 80	6000	2.2 + 1.6	8	13	0.15	0 / -19

- Surface hardness: 62±2 HRC
- Surface roughness: Ra: max. 0.20 μm
- Length tolerance: ±200 mm
- Steel grades: Cf53, C55E, alternative C45E, C60E
- Surface hardening depth, SHD: according to EN ISO 15787
- On request: special lengths, tolerances and dimensions

- The hardening depth (SHD according to EN ISO 15787 or Rht according to DIN 6773) is defined as the distance from the steel surface up to the point where the hardness value is 80% of the minimum guaranteed value of the surface hardness and it is established in accordance with ISO 13012, depending on the shaft's size.

- The minimum guaranteed value of the surface hardness varies between the steel grade.

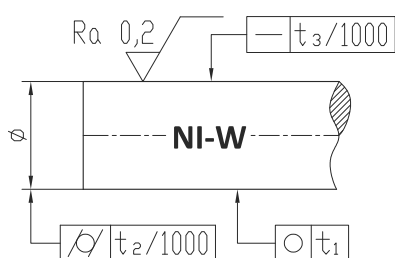


Induction Hardened and Ground Linear Shafts

steel grade: Cf53, C55E

NI-W

imperial sizes



فقط سایز ۱۲.۷ در انبار موجود است بقیه سایزها به سفارش مشتری قابل تحویل می باشد

Shaft Diameter \varnothing		Weight	Series	Standard length	Surface hardening depth SHD	Roundness (circularity) t1 max.	Parallelism (cylindricity) t2 max.	Straightness t3 max.	Standard tolerance Class "L"
mm	inch	kg/m		inch	inch	inch	inch	in/ft	inch
6.35	1/4	0.25	NI-W 6.35	236.22	0.016 + 0.016	0.00016	0.00023	0.00308	-0.0005 / -0.001
9.525	3/8	0.56	NI-W 9.525	236.22	0.016 + 0.016	0.00016	0.00023	0.00246	-0.0005 / -0.001
12.7	1/2	0.99	NI-W 12.7	236.22	0.024 + 0.024	0.00020	0.00031	0.00246	-0.0005 / -0.001
15.875	5/8	1.55	NI-W 15.875	236.22	0.024 + 0.024	0.00020	0.00031	0.00246	-0.0005 / -0.001
19.05	3/4	2.24	NI-W 19.05	236.22	0.035 + 0.032	0.00024	0.00035	0.00246	-0.0005 / -0.001
22.225	7/8	3.04	NI-W 22.225	236.22	0.035 + 0.032	0.00024	0.00035	0.00185	-0.0005 / -0.001
25.4	1	3.98	NI-W 25.4	236.22	0.035 + 0.032	0.00024	0.00035	0.00185	-0.0005 / -0.001
28.575	1 1/8	5.03	NI-W 28.575	236.22	0.035 + 0.032	0.00024	0.00035	0.00185	-0.0005 / -0.001
31.75	1 1/4	6.21	NI-W 31.75	236.22	0.059 + 0.051	0.00028	0.00043	0.00185	-0.0005 / -0.001
34.925	1 3/8	7.52	NI-W 34.925	236.22	0.059 + 0.051	0.00028	0.00043	0.00185	-0.0005 / -0.001
38.1	1 1/2	8.94	NI-W 38.1	236.22	0.059 + 0.051	0.00028	0.00043	0.00185	-0.0006 / -0.0011
44.45	1 3/4	12.17	NI-W 44.45	236.22	0.059 + 0.051	0.00028	0.00043	0.00185	-0.0006 / -0.0011
50.8	2	15.90	NI-W 50.8	236.22	0.087 + 0.063	0.00028	0.00043	0.00185	-0.0006 / -0.0013
57.15	2 1/4	20.13	NI-W 57.15	236.22	0.087 + 0.063	0.00031	0.00051	0.00185	-0.0007 / -0.0015
63.5	2 1/2	24.85	NI-W 63.5	236.22	0.087 + 0.063	0.00031	0.00051	0.00185	-0.0007 / -0.0015
76.2	3	35.78	NI-W 76.2	236.22	0.087 + 0.063	0.00031	0.00051	0.00185	-0.0008 / -0.0017
88.9	3 1/2	48.70	NI-W 88.9	236.22	0.087 + 0.063	0.00039	0.00059	0.00185	-0.0010 / -0.0020
101.6	4	63.61	NI-W 101.6	236.22	0.126 + 0.079	0.00039	0.00059	0.00185	-0.0012 / -0.0024

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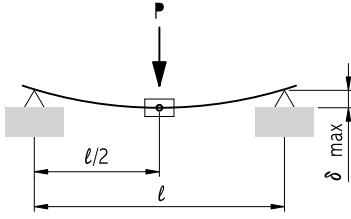
- The minimum guaranteed value of the surface hardness varies between the steel grade.



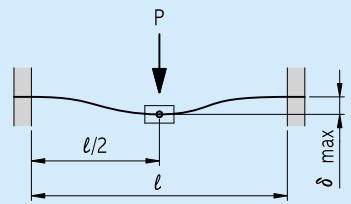
Equations for shaft deflection amount calculation

Variations of support and Load

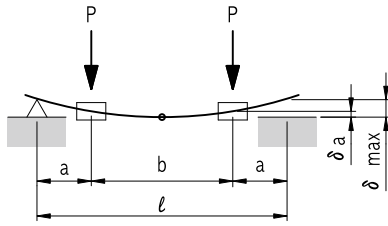
Equation for Deflection Amount



$$\delta_{\max} = \frac{P \cdot l^3}{48 \cdot E \cdot I} = 2,021 \times 10^{-5} \frac{P \cdot l^3}{d^4}$$

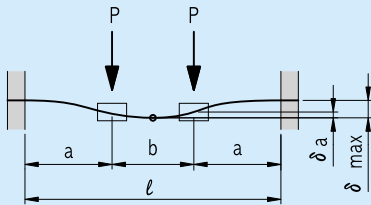


$$\delta_{\max} = \frac{P \cdot l^3}{192 \cdot E \cdot I} = 5,053 \times 10^{-6} \frac{P \cdot l^3}{d^4}$$



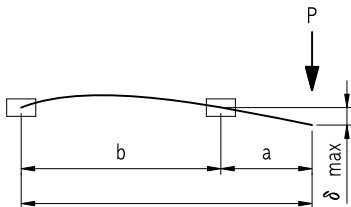
$$\delta_a = \frac{P \cdot a^2}{6 \cdot E \cdot I} (2a+3b) = 1,617 \times 10^{-4} \frac{P \cdot a^2 (2a+3b)}{d^4}$$

$$\delta_{\max} = \frac{P \cdot a^2}{24 \cdot E \cdot I} (3l^2 - 4a^2) = 4,042 \times 10^{-5} \frac{P \cdot a \cdot (3l^2 + 4a^2)}{d^4}$$



$$\delta_a = \frac{P \cdot a^3}{6 \cdot E \cdot I} (2 - \frac{3a}{l}) = 1,617 \times 10^{-4} \frac{P \cdot a^3}{d^4} (2 - \frac{3a}{l})$$

$$\delta_{\max} = \frac{P \cdot a^2}{24 \cdot E \cdot I} (2a+3b) = 4,042 \times 10^{-5} \frac{P \cdot a^2 \cdot (2a+3b)}{d^4}$$



$$\delta_{\max} = \frac{P \cdot a^2 l}{3 \cdot E \cdot I} = 3,234 \times 10^{-4} \frac{P \cdot a^2 l}{d^4}$$

E : Modulus of Longitudinal elasticity 2.1×10^4 (kgf/mm²)

P : Applying Load (kgf)

I : Geometrical Moment of Inertia (mm⁴) ; I = $\pi d^4 / 64$, Hollow shaft : I = $\pi (d^4 - d_i^4) / 64$

d_i : Shaft inner-diameter (mm), d : Shaft Outer-diameter (mm)

