



SANBAR® 23

HOLLOW DRILL STEEL

DATOVÝ LIST

Sanbar® 23 is an air-hardening, high chromium-molybdenum alloy steel with good response to surface induction hardening and suitable for carburizing. It has high fatigue strength and wear resistance in the case hardened condition.

CHEMICAL COMPOSITION (NOMINAL)

Chemical composition (nominal) %

C	Si	Mn	P	S	Cr	Mo
0.24	0.3	0.5	≤0.020	≤0.025	3.1	0.5

APPLICATIONS

Sanbar®23 is used for extension rods, shank rods and tapered rods.

FORMS OF SUPPLY

Hollow drill steel is supplied as hollow, hot-rolled, round or hexagon bar. The ends are trimmed square to within 0.15 mm (0.006 in.) maximum.

SURFACE CONDITION AND PROTECTION

Both the outer and inner surfaces are free from harmful slag marks, cracks and scratches. The maximum depth of defects is 0.20 mm (0.008 in.) on the outer surface and 0.15 mm (0.006 in.) on the inner surface.

The outer surface can be supplied dry or oiled for protection against corrosion during transportation. The flushing holes are normally sealed with plastic caps.

STRAIGHTNESS

Maximum deviation is 1 mm per 1000 mm (0.04 in. per 39.4 in.).

FIXED LENGTHS

Fixed lengths can be supplied upon request. The length tolerance for fixed lengths are:

Lengths, mm (in.)	Tolerance, mm (in.)
≤ 3375 (132.87)	+/- 2 (0.0787)
3376-5750 (132.91-226.38)	+/- 3 (0.1181)
> 5750 (226.38)	+/- 4 (0.1575)

Bars are supplied in standard bundles containing max 1500 kg (3300 lbs).

MECHANICAL PROPERTIES

As-delivered condition, typical values

Proof strength	Tensile strength	Hardness
R _{p0.2}	R _m	HRC
MPa (ksi)	MPa (ksi)	
1000 (145)	1350 (196)	38-44

DECARBURIZATION

The maximum permissible decarburization depth is 0.30 mm (0.012 in.) on the outer surface and 0.20 mm (0.008 in.) on the inner surface.

MACHINING

Sanbar® 23 can be machined in the hot rolled condition.

FORGING

Induction heating to 1000–1100°C (1830–2010°F), 10–60 seconds, depending on dimension. Forging range 1100–850°C (2010–1560°F).

Read more about forging of Sanbar® 23 under Fabrication.

HEAT TREATMENT

Annealing (induction heating) 720–770°C (1330–1420°F), cooling in air.

Read more about heat treatment of Sanbar® 23 under Fabrication.

GAS CARBURIZING AND DIRECT QUENCHING

920–930°C (1690–1705°F). Time depends on the required carbon content and the case depth. Cooling in forced air.

Tempering

Recommended surface hardness 57–62 HRC and core hardness 36–44 HRC. Temperature appr. 180 to 230°C (355–450°F) for one hour.

SURFACE INDUCTION HARDENING

Hardening

Induction heating to 900–1000°C (1650–1830°F), 3–6 seconds. Quenching in water or in oil.

Tempering

Recommended surface hardness 50–55 HRC, temperature appr. 150 to 250°C (300–480°F). Tempering may not be needed.

FABRICATION

FORGING

Sanbar® 23 requires rapid heating to the forging temperature and, above all, the soaking time at full temperature should be as short as possible. This will minimize grain growth and decarburization, both of which drastically impair the fatigue strength.

Heat the rod end locally to the correct forging temperature. Forge within the temperature range specified for Sanbar® 23.

HEAT TREATMENT

Surface induction hardening is recommended for Sanbar® 23. Hardening and tempering should be carried out according to the recommendations above. The required case depth must be a function of the thread dimension but is in the area of 1.5 to 3 mm (0.06 to 0.12 in.).

Overall gas carburizing is an alternative method for providing Sanbar® 23 with good fatigue strength and wear

resistant properties. It is very important to control the atmosphere in the furnace by having a stable gas flow and an even temperature. The recommended surface carbon content is 0.4 to 0.6%.

Due to the high chromium content in Sanbar® 23, carbides can be precipitated in the case hardened layer at relatively low surface carbon contents and should be avoided. To increase the toughness, tempering needs to be carried out immediately after carburizing, according to the recommendations above.

The required case depth must be a function of the thread dimension but is in the area of 0.6 to 1.2 mm (0.020 to 0.057 in.). It is essential to ensure that the rods are carburized internally in order to obtain maximum service life. The absence of internal carburizing can be extremely detrimental, especially in corrosive environments.

Sanbar® 23 is very well suited to surface induction hardening. The required case depth must be a function of the thread dimension but is in the area of 1.5 to 3 mm (0.06 to 0.12 in.).

SHOT PEENING

Shot peening of an adequate intensity and coverage is recommended. It improves fatigue strength due to:

- Introduced compressive stresses
- Increased hardness
- Smoother surface defects

CORROSION PROTECTION

Corrosion of a material subjected to fluctuating loads accelerates the fatigue process. In underground

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