Heat Treatment for Steel Materials

Name	Vickers hardness (HV)	Hardening depth (mm)	Strain	Applicable materials	Typical materials	Remarks
Through hardening	Max. 750	All	Varies according to the material.	High-C steel C>0.45%	SKS3 SKS21 SUJ2 SKH51 SKS93 SK4 S45C	• Should not be used for long parts such as spindles or for precision parts.
Carburizing	Max. 750	Standard 0.5 Max. 2	Medium	Low-C steel C<0.3%	SCM415 SNCM220	• Localized hardening is possible. • Hardening depth must be specified on drawings. • Suitable for precision parts
Induction hardening	Max. 500	1～2	Large	Medium-C steel C 0.3～0.5%	S45C	• Localized hardening is possible. • Expensive in small volumes • Good fatigue resistance
Nitriding	900～1000	0.003～0.008	Small	Nitriding steel	SACM645	• Highest hardening hardness • Suitable for precision parts • Suitable for sliding bearing spindles
Tufftride®	Carbon steel 500 SUS 1000	0.01～0.02	Small	Steel materials	S45C SCM415 SK3 Stainless steel	• Good fatigue resistance and wear resistance • Same corrosion resistance as zinc plating • Not suitable for precision parts because polishing following the heat treatment is not possible. • Suitable for oil-free lubrication
Bluing				Wire rod	SWP—B	• Low temperature annealing • Enhances elasticity by removing internal stress during forming

Hardness Test Methods and Applicable Parts

Test method	Principle	Applicable heat-treated parts	Characteristics	Remarks
1. Brinell hardness	• A ball indenter (steel or carbide alloy) is used to indent the test surface. Hardness is given by dividing the test load by the surface area, which was found from the diameter of the indentation.	• Annealed parts • Normalized parts • Anchored materials	① Suitable for uneven materials and forged products because the indent is large. ② Not suitable for small or thin specimens	JIS Z 2243
2. Rockwell hardness	• The standard or test load is applied via a diamond or ball indenter, and the hardness value is read from the tester.	• Hardened parts and tempered parts • Carburized surfaces • Nitrided surfaces • Thin sheets of copper, brass, bronze, or similar materials ※Rockwell C scale (HRC) is not suitable for materials such as narrow pins and thin sheets.	① Hardness value can be obtained quickly. ② Suitable as an intermediate test of actual products ③ Caution is required because there are many types. ※ There are many types of Rockwell hardness testers, including the A scale (HRA), B scale (HRB), C scale (HRC), and D scale (HRD).	JIS Z 2245
3. Shore hardness	• The specimen is set on a table and a hammer is dropped from a set height. Hardness is determined based on how high the hammer bounces.	• Hardened parts and tempered parts • Nitrided parts • Large parts treated by carburizing or similar process	① Extremely easy to operate. Data can be obtained quickly. ② Suitable for large parts ③ Because indent is small and not noticeable, this test is suitable for actual products. ④ Compact and light-weight. Portable.	JIS Z 2246
4. Vickers hardness	• A diamond square pyramid indenter with a vertex angle of 136 degrees is used to create an indentation in the test surface. The hardness value is found from the test load and the surface area of the indent, computed from the length of the diagonal lines of the indent. (Conversion is performed automatically.)	• Materials with a thin hardened layer created by induction hardening, carburizing, nitriding, electroplating, ceramic coating, etc. • Hardened layer depth in carburized and nitrided parts	① Suitable for small and thin specimens ② Because the indenter is diamond, this test can be used with materials of any hardness.	JIS Z 2244