

# QUENCHING, SURFACE TREATMENT AND HARDNESS TESTS

Name	Vickers hardness (HV)	Quenching depth (mm)	Strain	Applicable material	Typical materials	Remark
Through hardening	Max. 750	Full depth	Varies according to material.	High-C steel C > 0.45%	SKS3 SKS21 SUJ2 SKH51 SKS93 SK4 S45C	<ul style="list-style-type: none"> <li>• Not applicable to long or precision parts such as spindles, etc.</li> </ul>
Carburizing and quenching	Max. 750	Standard : 0.5 Max. 2	Moderate	Low-C steel C < 0.3%	SCM415 SNCM220	<ul style="list-style-type: none"> <li>• Quenching parts.</li> <li>• Quenching depth specified on drawings.</li> <li>• Applicable to precision parts.</li> </ul>
High frequency quenching	Max. 500	1~2	High	Medium-C steel C 0.3~0.5%	S45C	<ul style="list-style-type: none"> <li>• Quenching parts.</li> <li>• Expensive in small volume lot.</li> <li>• Good strain resistance.</li> </ul>
Nitriding	900~1000	0.1~0.2	Low	Nitriding steel	SACM645	<ul style="list-style-type: none"> <li>• Obtains highest hardness of all quenching techniques.</li> <li>• Applicable to precision parts.</li> <li>• Applicable to spindles for radial bearing.</li> </ul>
Tuftriding	Carbon steel : 500 SUS : 1000	0.01~0.02	Low	Steel materials	S45C SCM415 SK3 Stainless	<ul style="list-style-type: none"> <li>• Good fatigue resistance and wear resistance.</li> <li>• Same corrosion resistance as zinc plating.</li> <li>• Not applicable to precision parts because it can not be polished after heat-treatment.</li> <li>• Applicable to dry bearings.</li> </ul>
Bluing				Wire rod	SWP—B	<ul style="list-style-type: none"> <li>• Low-temperature annealing.</li> <li>• Removes internal stress in forming to enhance elasticity.</li> </ul>

## Hardness tests and applicable parts

Test method	Principle	Applicable heat-treated parts	Features	Remark
1.Brinell hardness	<ul style="list-style-type: none"> <li>• A (Steel or superhard alloy) ball indenter is used to indent the test surface. Hardness is given as a quotient minus the surface area of the indent, computed from the diameter.</li> </ul>	<ul style="list-style-type: none"> <li>• Annealed parts</li> <li>• Normalized parts</li> <li>• Anchored materials</li> </ul>	<ol style="list-style-type: none"> <li>① Applicable to uneven materials and forged products because indent is large.</li> <li>② Not applicable to small or thin specimens.</li> </ol>	JISZ2243
2.Rockwell hardness	<ul style="list-style-type: none"> <li>• The standard or test load is applied via a diamond or boll indenter. Hardness is read on a tester.</li> </ul>	<ul style="list-style-type: none"> <li>• Quenched-Tempered parts</li> <li>• Carburized surfaces</li> <li>• Nitrided surfaces</li> <li>• Thin sheets like copper, brass, bronze, etc.</li> </ul>	<ol style="list-style-type: none"> <li>① Hardness value obtained quickly.</li> <li>② Applicable as intermediate test to actual products.</li> <li>③ 30 types caution required.</li> </ol>	JISZ2245
3.Shore hardness	<ul style="list-style-type: none"> <li>• The specimen is set on a table. A hammer is dropped from a uniform height. Hardness is based on how high the hammer bounces.</li> </ul>	<ul style="list-style-type: none"> <li>• Quenched-Tempered parts</li> <li>• Nitrided parts</li> <li>• Large carburized parts, etc.</li> </ul>	<ol style="list-style-type: none"> <li>① Extremely easy to operate. Data obtained quickly.</li> <li>② Applicable to large parts.</li> <li>③ Indent is kept shallow, therefore is applicable to actual products.</li> <li>④ Compact and light-weight. Portable.</li> </ol>	JISZ2246
4.Vickers hardness	<ul style="list-style-type: none"> <li>• Uses a diamond 136° square pyramid indenter. Hardness value is obtained as the surface area of the indent, computed from the length of the diagonal lines of the indent.</li> </ul>	<ul style="list-style-type: none"> <li>• Thin parts hardened by high frequency quenching, carburizing, nitriding, electrolytic plating, ceramic coating, etc.</li> <li>• Hardened layer depth in carburized and nitrided parts</li> </ul>	<ol style="list-style-type: none"> <li>① Applicable to small and thin specimens.</li> <li>② Applicable to all materials because of diamond indenter.</li> </ol>	JISZ2244