[Materials]
Varieties and Applications 1

1.General Steel Materials

Type	Material Code	Applications	Comment	JIS	Flat Bar	Square Bar	Hexagonal Bar	Round Bar	Steel Plate	Section Steel
Rolled Steel for General Structure	1018 Carbon Steel	General Machine Parts	Fine Workability and Weldability	JIS G 3101	0	0		0	0	0
Polished Steel Bar (Cold-Drawn)	JIS-SS400D	General Machine Parts	Excellent Precision and Surface Roughness. Ready for use directly after slight cutting.	–	0	0	0	0		
Carbon Steel for Machine Structural Use	1045 Carbon Steel	General Machine Parts	Fit for Hardening Tensile Strength 58kgf/mm²	JIS G 4051	0	0	0	0	0	
	1049 Carbon Steel		Fit for Hardening Tensile Strength 66kgf/mm²							
Carbon Tool Steel	W1-9 Tool Steel	Shafts, Pins, etc.	For Drill Rod (Round Bar) SK4 surface-finished after cold drawing. Class 7(–DG7)=h7 Class 8(–DG8)=h8 Class 9(–DG9)=h9.	JIS G 4401	0			0		
	W1-8 Tool Steel				0			0	0	
Alloy Tool Steel	JIS-SKS93	Hardening Parts	Deformation caused by Hardening is much less than that of SK material.	JIS G 4404	0	0		0		
	01 Tool Steel									
Chrome Molybdenum Steel	4137 Alloy Steel	General machine Parts requiring strength. Screws, etc.	Tensile Strength 70kgf/mm², Tensile Strength after Hardening & tempering: 95 kgf/mm² or more. Hardness: HB270 or more. Hardening: HRC50 or more.	JIS G 4105	0	0	0	0	0	
	SCM415 Alloy Steel									
	JIS-SCM420									
Sulfuric and Sulfur Compound Free Cutting Steel	1212 Carbon Steel	General Machine Parts (Free-Cutting steel)	Made of carbon steel plus sulfur to enhance machinability.	JIS G 4804		0	0	0		
	12L13 Carbon Steel		Free-Cutting Steel containing sulfur and lead.							
	12L14 Carbon Steel									
High Carbon Chrome Bearing Steel	52100 Bearing Steel	Roller bearings, etc.	Bearing Steel	JIS G 4805				0		
Cold-Rolled Steel Plate	Low Carbon Steel	Covers, cases, etc.	Rolled at an almost ambient temperature. High dimensional precision and fair texture. Fine machinability. Easy to bend, wring and cut. Fine Weldability.	JIS G 3141					0	
Hot-Rolled Steel Plate	Low Carbon Steel	General machine structural parts.	Plates for general use are 6 mm or less in thickness.	JIS G 3131					0	

2. Stainless Steel Materials

Type	Material Code	Applications	Comment	Magnetism	JIS	Flat Bar	Square Bar	Hexagonal Bar	Round Bar	Steel Plate	Section Steel
Austenite	303 Stainless Steel	Machine parts requiring antirusting	18-8 Free-Cutting Stainless Steel, Non-Magnetic. More Machinable than SUS304	None*	JIS G 4303~	Good			Good		
Austenite	304 Stainless Steel	Machine parts requiring antirusting	Most Versatile Antirusting and Heat-Resisting Steel for General Use	None*		Good	Good	Good	Good	Good	Good
Austenite	316 Stainless Steel	Machine parts requiring antirusting	More resisting to seawater and other media than SUS304.	None*		Good			Good	Good	
Martensite	440C Stainless Steel	Machine parts requiring antirusting (Less corrosion resistant than austenite.)	Fit for Hardening.	Available					Good		
Martensite	410 Stainless Steel	Machine parts requiring antirusting (Less corrosion resistant than austenite.)	Fit for Hardening. Fine Machinability.	Available					Good		

*(P)Martensite exhibits magnetic properties. Machining of Austenite may cause magnetic properties.

<Reference: Corrosion Resistance of Stainless Steel>

Testing Method

Conforms to the JIS H 8502 Cycle Test

Method as a complex corrosion test

Test Conditions

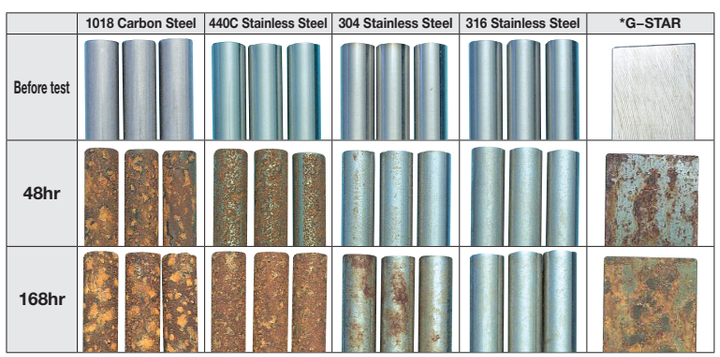
(1) Salt water spray test (5%NaCl. 35˚C) 2hr

(2) Drying (60˚C) 4hr

(3) Wetting (95%RH. 35˚C) 2hr

One cycle takes 8 hr.

Appearance of test piece 48 hr, 168 hr before test.



*G-STAR is martensite stainless steel (pre-hardened steel) manufactured by the Daido Special Steel Co., Ltd.

3.Aluminum Alloy Materials

Type	Material Code	Applications	Comment	JIS	Flat Bar	Square Bar	Hexagonal Bar	Round Bar	Section Steel
Al–Cu Alloy	A2011	General-Use Strength Materials	Free-Cutting Alloy. It excels in machinability but has worse corrosion resistance.	JIS H 4000			Good		
Al–Cu Alloy	A2017	General-Use Strength Materials	High Strength and Machinability Duralumin		Good		Good	Good	
Al–Mg Alloy	A5052	General Machine Parts Covers, cases, etc.	Most typical aluminum alloy with medium strength. With high fatigue strength in comparison with its strength and high corrosion resistance to seawater.		Good			Good	
Al–Mg Alloy	A5056	General Machine Parts	It has fine machined surface and high corrosion resistance to seawater. It has fine machined surface and high corrosion resistance to seawater.				Good		
Al–Mg–Si Alloy	A6061	General Machine Parts	Heat-treated corrosion resisting alloy. High durability owing to T6 treatment.		Good		Good		
Al–Mg–Si Alloy	A6063	General Machine Parts and Structural Material	Weaker than 6061, but more extrudable. Applicable to complex cross-sections shapes. Good corrosion resistance and surface treatment.		Good	Good			Good
Al–Zn–Mg Alloy	A7075	Jigs and Dies	It is one of the strongest aluminum alloys but has worse corrosion resistance. Extra Super Duralumin		Good				

JIS Acronyms for Non-Ferrous Metal

P	Plate, Strip, Disk
PC	Laminate
BE	Extruded Bar
BD	Drawn Bar
W	Drawn Wire
TE	Seamless Extruded Tube
TD	Seamless Drawn Tube

TW	Welded Tube
TWA	Arc-Welded Tube
S	Extruded Section
BR	Riveted Bar
FD	Die-Forged Part
FH	Free-Forged Part

Quality Codes for Aluminum and Aluminum Alloys

Code		Definition	Description
F		Plain Manufactured Material	Completed as a product, without any order for thermal refining. Extruded or forged material, not thermally refined.
H112		Wrought material, for which certain mechanical properties are guaranteed without the need of hardening.	
O		Brought into the softest state by annealing.	Completely re-crystallized by annealing. A thermally treated alloy should be cooled at a temperature below the annealing temperature to prevent the effect of annealing completely.
H	H1n	Hardened by cold working.	n is a numeral from 1 to 9, representing the degree of hardening. "8" represents hard material, and "4" represents the state halfway 1/2 between 0 and hard material. "2" represents the level halfway between 0 and 1/2 hardness, and "6" the state halfway between 1/2 hardness and hard material.
	H2n	Hardened and then properly softened by heat.	
	H3n	Stabilized after cold working.	
T	T1	Cooled after high-temperature working and then allowed to age naturally.	Quenched at the end of a cold working process and allowed to age and harden at ambient temperature. Extruded material is typical material processed in this way. Cold working such as correction may be conducted unless it affects the strength. Used for an alloy such as 6063, for which the effect of quenching can be realized by cooling after hot working (extrusion).
	T3	Allowed to age naturally after solution treatment and cold working.	Cold working is conducted for plates, rods, tubes, etc. to enhance the strength in some cases, and to improve the corrective dimension precision in other cases, with an obvious effect. T361 when cold working is performed to a higher degree than that for T3.
	T351	Allowed to age naturally after solution treatment and cold working.	Cold working is conducted to enhance the strength after solution treatment, and then it is tension processed to give 1.5% to 3% permanent distortion to remove residual tension, and allowed to age naturally.
	T4	Natural aging after solution treatment	Aging is usually completed after exposure to ambient temperature for approx. 4 days. In the case of 7N01, however, aging is a longer process. The tensile property upon the elapse of one month is adopted as referential data. The variety that is given T4 treatment by a user under specified conditions is called T42.
	T5	Hardened through artificial aging after high-temperature processing and quenching	Hardened through artificial aging to improve the mechanical properties and stabilize the dimensions. Used for an alloy or casting such as 6063, for which the effect of quenching can be realized by cooling after hot working (extrusion).
	T6	Hardened through artificial aging after solution treatment.	Excellent strength can be attained for a thermally treated alloy without cold working in the typical heat treatment process. An item that is given T6 treatment by a user under specified conditions is called T62.
	T61	Wrought Materials: Hardened through artificial aging after solution treatment by quenching with lukewarm water. Casting:Tempered after hardening	Quenched with lukewarm water to prevent distortion due to the main hardening. The conditions for hardening through artificial aging are adjusted to attain strength exceeding that accomplished by regular T6 treatment.
	T7	Stabilized after solution treatment	Overaging surpassing those needed for hardening through artificial aging is carried out to attain the maximum strength, because special properties are adjusted somewhat at the expense of strength.
	T73	Overaging after solution treatment.	Overaging after solution treatment to rectify the tendency to crack due to corrosion under stress. Specified in 7075, forgings, of JIS.
	T7352	Overaging after removal of residual stress after solution treatment.	Overaging after removal of residual stress by compression to retain 1% to 5% permanent deformation subsequent to solution treatment, in order to rectify the tendency to crack due to corrosion under stress. Included in free-forged part, 7075.
	T8	Hardened through artificial aging after cold working subsequent to solution treatment.	Cold working performed, with a noticeable effect, to improve the mechanical properties or to rectify drawbacks or improve dimension precision. Called T83 when the sectional area is reduced 3%through cold working. Called T86 when the reduction rate is 6%. These procedures are performed to enhance the strength.
	T9	Cold working after hardening through artificial aging subsequent to solution treatment.	Cold working is necessary to enhance the strength.

4. Copper Alloy Materials

Type	Material Code	Applications	Comment	JIS	Square Bar	Hexagonal Bar	Round Bar	Steel Plate
Brass Plate	C28000 Brass	For Regular Sheet Metal Machining Name Plates and Instrument Panels	Used in high strength and ductile sliding parts. Brass	JIS H 3100				Good
Free-Cutting Brass (Extruded Bar)	C3604 BD Brass (JIS)	General turming bolts screws, nuts, etc.	Good Machinability	JIS H 3250	Good	Good	Good	

5. Cast and Forged Products, Copper Alloy Castings

Type	Material Code	Applications	Comment	JIS
Gray Cast Iron, Class3	Alloy Cast Iron Class No. 30	Cast Machine Parts	–	JIS G 5501
Gray Cast Iron, Class4	Alloy Cast Iron Class No. 35		–	JIS G 5501
Spheroidal Graphite Cast Iron, Class4	JIS-FCD600		–	JIS G 5502
Bronze Casting, Class 6	JIS-BC6	Bearings, sleeves, bushings and general machine parts.	High pressure resistance and abrasion resistance, and good machinability.	JIS H 5111

6. Steel Pipe Materials

Type	Material Code	Applications	Comment	JIS
Carbon Steel Pipe for Ordinary Piping	White Pipe (Zinc Galvanic) SGP Black Pipe (No Plating)	Piping Parts	At ambient temperature(Gas pipe). A is metric specification. B is inch specification.	JIS G 3452
Carbon Steel Pipe for Machine Pressure Service	JIS-STPG370 (JIS STPG38)	Piping Parts	Operation temperature 350˚C. A is metric specification. B is inch specification.	JIS G 3454
Carbon Steel Pipe for Machine Structural Use	JIS-STKM	General Machine Parts Hollow Shafts.	Available for class 11 to class 20.	JIS G 3445
Seamless Brass Pipe (Regular class)	JIS-C22700T	–	Easy Flaring, Bending, Wringing and Plating	JIS H 3300

7. Spring Materials

Type	Material Code	Applications	Allowable Operating Temperature ˚c	JIS
Piano Wire	Spring Steel (ASTM A228) SWP-8	High strength, homogenous cold-drawn wire. For high quality springs and forming.	110	JIS G 3522
Hard Steel Wire	JIS-SWB	Applicable to universal stress. For low priced springs and forming.	110	JIS G 3521
	JIS-SWC	For high quality springs and forming.	110	
Carbon Steel for Spring Oil Tempered Wire Oil Tempered Steel Wire	JIS-SWO-A JIS SWO-B	Hardening and tempered. For general-purpose springs.	120	JIS G 3560
Carbon Steel for Valve-Spring Oil Tempered Wire. Oil Tempered Steel Wire	JIS-SWV	Hardening and tempered. With a fine surface and uniform tensile strength	120	JIS G 3561
Cr-V Steel for Valve-Spring Oil Tempered Steel Wire	JIS-SWOCV-V	Hardening and tempered. Loads and slightly high Temperatures.	220	JIS G 3565
Ci-Cr Steel for Valve-Spring Oil Tempered Steel Wire	JIS-SWOSC-V	Hardening and tempered. Loads and slightly high Temperatures.	245	JIS G 3566
For Springs Stainless Steel Wire	302 Stainless Steel (WPA) (WPB)	For general corrosion and heat resistance Available for magnetic spring.	290	JIS G 4314
	316 Stainless Steel (WPA) (WPB)	Heat Resistance is good. Higher corrosion resistance than SUS302. Available for magnetic spring.	290	
	631 Stainles Steel-WPC	Precipitation hardening after spring processing. High strength and general corrosion resistance. Available for magnetic spring.	340	

Types of Surface Treatment

Name	Vickers Hardness (HV)	Layer Thickness (μm)	Applicable Materials	Example	Purpose, Features	Reference
Zinc Plating	–	3~20	Steel	Thin Plate Wire	·Antirust, low price. ·Poor appearance.	–
Chromate Plating	–	1~2	Steel	Plate Work Bolts and Nuts.	·Antirust, low price. ·Fit for mass production. ·Poor appearance, however, works instead of nickel plating.	–
Bright Chromate	–	1~2	Steel	–		
Trivalent Chromate	–	1~2	Steel	Bolts and Nuts	·Antirust, low price. ·Do not contain hexavalent chrome.	–
Nickel Plating	–	–	Steel Copper Brass	–	·Improvement of corrosion resistance and decoration ·Chrome plating has more corrosion resistance in the atmosphere.	·Copper base plating as appropriate. ·Not applicable to deep indentations.
Class 1 Plating	500	5~20			·Better appearance than Class 3 plating.	·Material…Buff…UPlating…Buff
Class 3 Plating					–	·Material…Plating
Satin Finish Plating	–	–			·Fatigue resistance. ·Minor flaws remain inconspicuous.	·Material…Satin finish…Plating
Electroless Nickel Plating	500	Specifiable	Steel Stainless Steel Copper Aluminum Alloy Glass Plastic	Parts Unsuitable for Nickel Plating.	·Approx.10 times more expensive than nickel plating. ·Easy film thickness control. ·High corrosion resistance, abrasion resistance. ·Give Conductivity to Non-Metals	–
Kanigen Plating	Up to 1000			Parts hardened after Plating.	·Same as the features of electroless nickel plating. ·Can be hardened by heat treatment after plating.	
Chrome Plating	–	–	Steel Copper Brass	–	·Appearance with gloss ·Good corrosion resistance ·Sliding chrome plating surfaces are easy to stick together.	·Nickel base plating as appropriate. ·Not applicable to deep indentations.
Class 1 Plating	500	5~20			·Better appearance than Class 3 plating.	·Material…Buff…UPlating…Buff
Class 3 Plating					–	·Material…Plating
Satin Finish Plating	–	–			·Fatigue resistance. ·Minor flaws remain inconspicuous.	·Material…Satin finish…Plating
Hard Chrome Plating	1000	10~30		Cylinder Liners	·Excellent abrasion resistance. ·More expensive than other chrome plating.	·Material…Plating (Class 3 Plating)
Black Oxide (Blackening)	–	–	Steel	Bolts Nuts Instruments	·Base coating. ·Appearance(with gloss). ·Rusts more easily than Tufftride	·General Black Oxide
Low Temperature Black Chrome Plating	–	1~2	Steel Copper Stainless Steel	Items requiring high precision, items requiring higher corrosion resistance than blackening.	·Long term antirust performance. ·High corrosion resistance. ·Ultra thin film.	·Low-Temperature Preliminary Treatment. No thermal effect on raw material. Parts coupled with plastic matter, rubber, etc.
Anodize Clear	–	3~5	Aluminum Alloy	–	·Corrosion and abrasion resistance. ·No electric conductivity. ·Heat Resistance	·Some anodize pieces are colored through fine holes in the hard, oxidized film formed on the surface.
Anodize Black	–	5~10				

Apparent Colors of Surface Treatment