素案　25.10.20作成　日本高周波鋼業㈱　谷井

JHX

堅硬輝星 (Jian Ying Hui Xing)

- New Global Standard Steel
Changes the Concept for Production of Plastic Molds

2025.00.00

NIPPON KOSHUHA STEEL CO., LTD.

Characteristics and application of JHX

■Characteristics

① Outstanding mirror surface property

Realization of homogeneity and high cleanliness owing to excellent refining and heat treatment technology.
Hardness of 36HRC and a high degree of mirror surface can be obtained.

② Stable hardness to the center

Realization of uniform hardness from the circumference to the center. Good mirror surface and embossing properties are obtained because variations in mirror surface and embossing are small.

③ Outstanding welding reparability

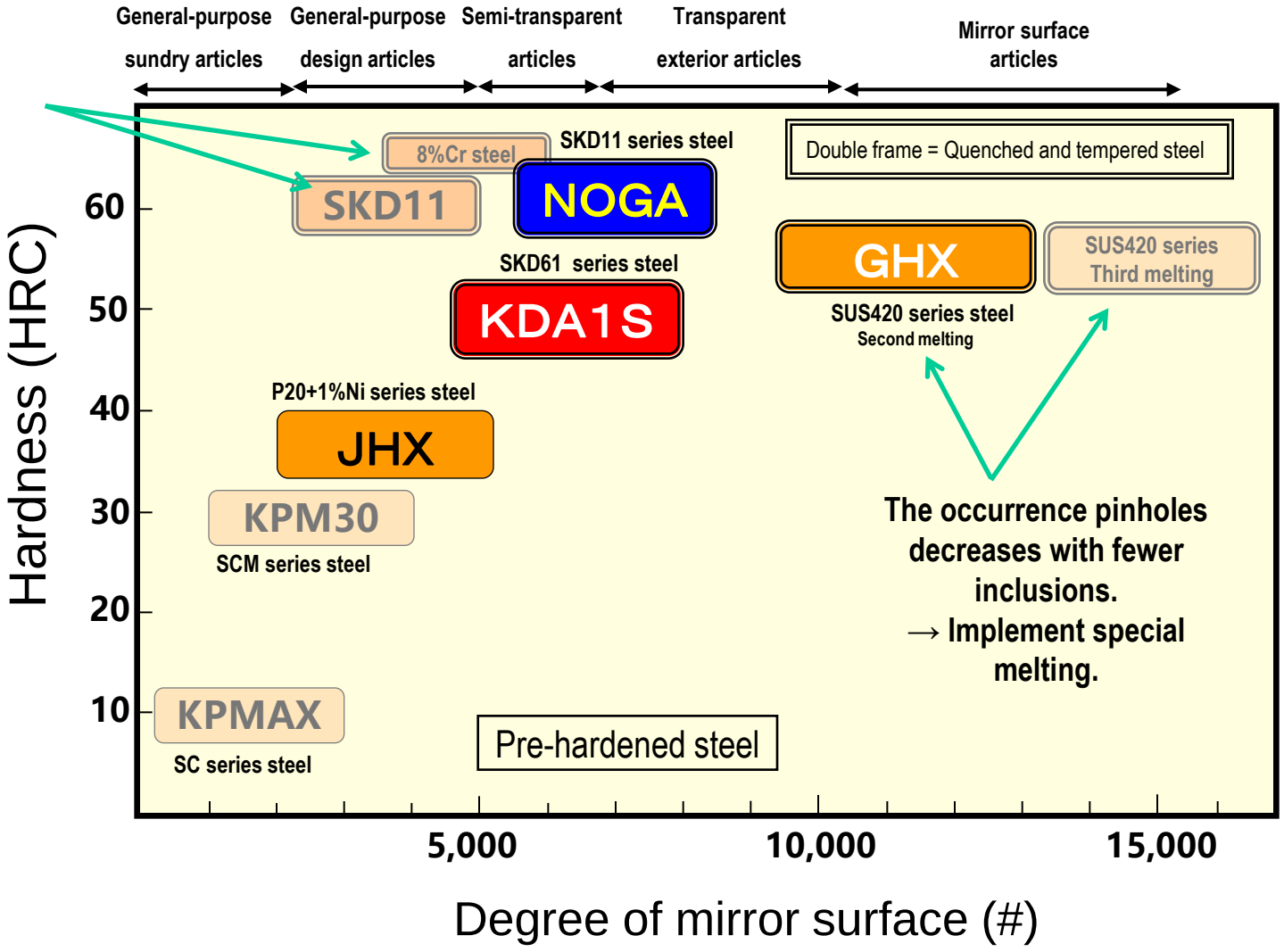
Weld cracks can be reduced owing to design composition with low crack sensitivity.

■Application

- Resin injection molding die, resin extrusion molds
- Blow molding dies
- Forming tools
- Dies for low-temperature die-casting
- Structural components, shafts, mold components, etc.

Positioning of steel for plastic molds

The mirror surface deteriorates if coarse carbide exists.



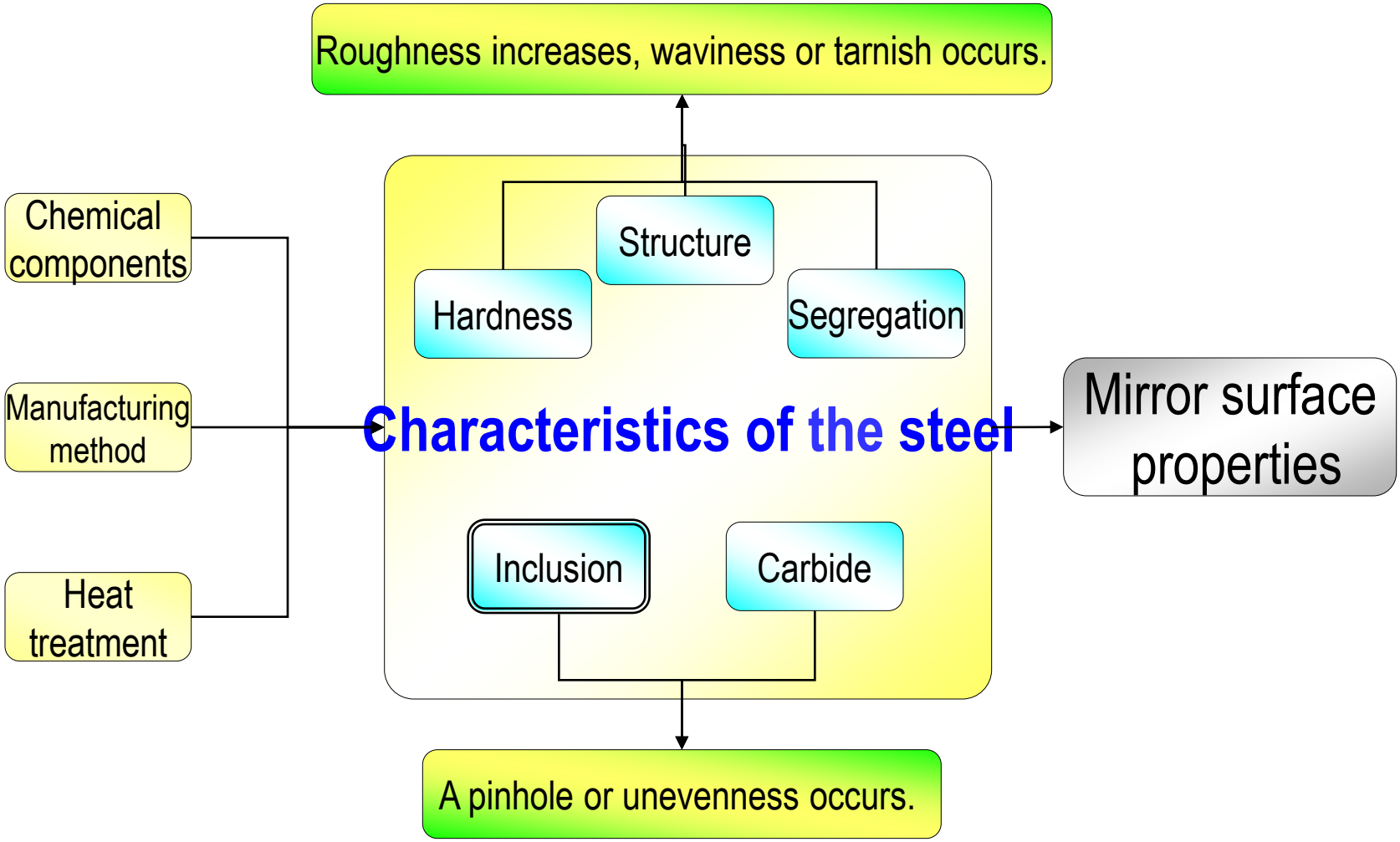
Good

The occurrence pinholes decreases with fewer inclusions.
→ Implement special melting.

With harder steel, polishing scratches are fewer and a higher mirror surface can be obtained.

Improvement of the mirror surface property

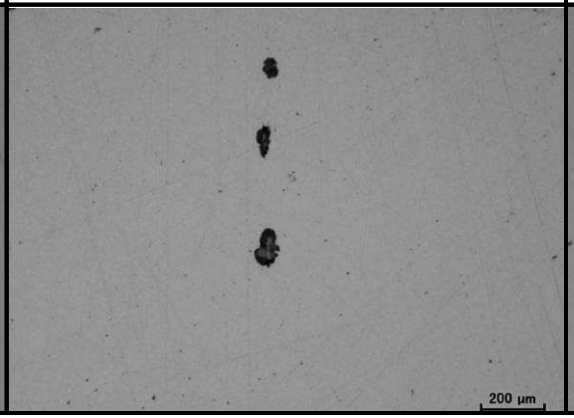
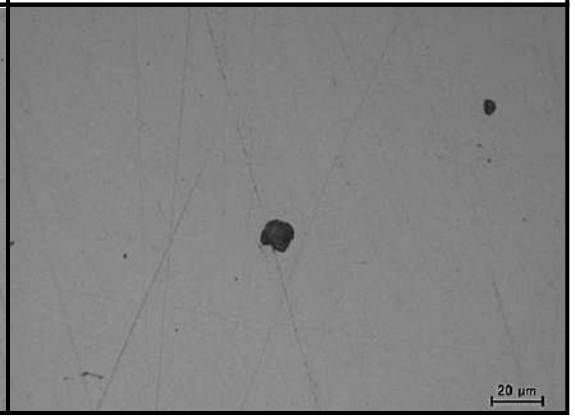
■ Factors affecting the mirror surface property



Improvement of the mirror surface property

■ Types of non-metallic inclusions

Representative inclusions existing in the 420 Series steel

A series MnS	B series Al_2O_3	D series Al_2O_3
		

A series: Sulfide-based

B series: Alumina-based

C series: Silicate-based

D series: Granular oxide-based

Improvement of the mirror surface property

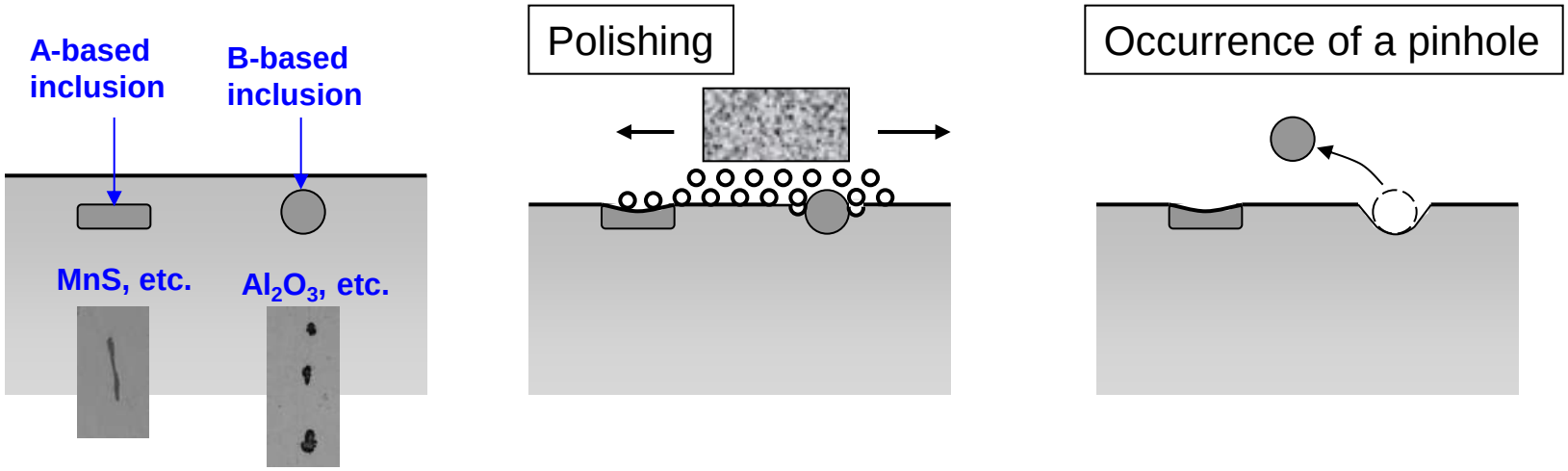
■ Causes of pinholes

A pinhole during mirror polishing is mainly caused by non-metallic inclusions.

The pinhole's shape:

A-based inclusions: Wide and shallow due to preferential polishing because of softness

B-based inclusions: Narrow and deep by dropping due to hardness



Rework: Influence on the mirror surface property

A-based inclusion: Possible → Minor

B-based inclusion: Difficult → Major

Mirror surface properties

Polishing condition

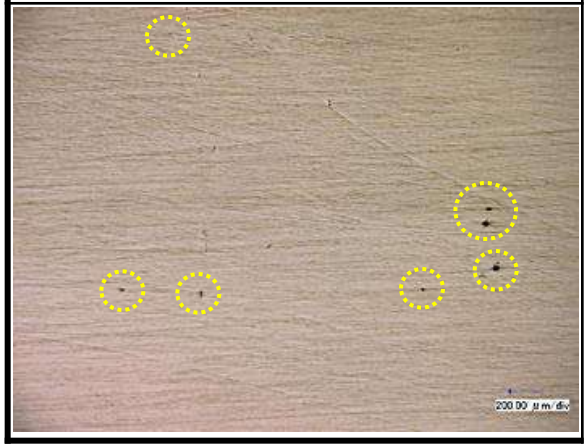
Grindstone 1000 → Paper 800 → Paper 1200 → Paper 1,500 → Diamond #1,800 → Diamond #3,000 → Diamond #5,000

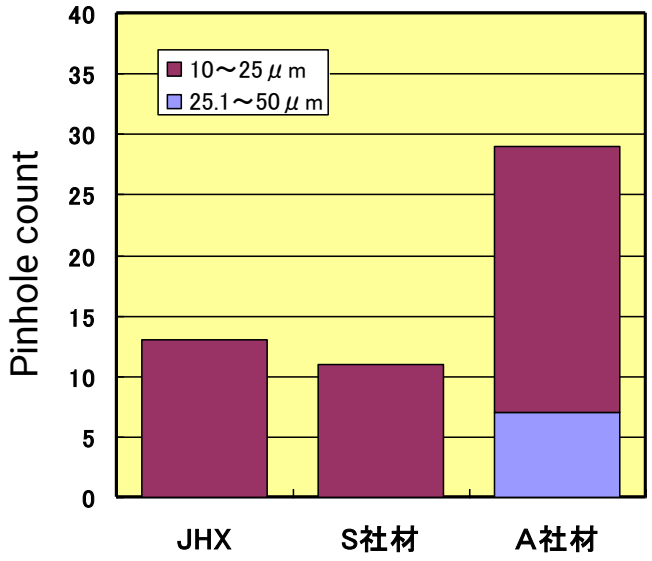
TP dimensions: 20x50x100 mm. A surface of 50x100 is manually polished.

JHX

Material of company S

Material of company A





Result of pinhole measurement

Result of determining inclusions

鋼種	部位	点算法				標準図法							
						A型		B型		C型		D型	
		A系	B系	C系	A+B+C	薄い	厚い	薄い	厚い	薄い	厚い	薄い	厚い
JHX	中心	0.017	0.008	0.008	0.033	0.5	0.0	0.5	0.0	0.0	0.0	1.0	0.5
	t/2,w/4	0.004	0.004	0.004	0.012	0.0	0.5	0.5	0.0	0.0	0.0	1.0	0.5
S社材	中心	0.000	0.000	0.033	0.033	0.0	0.0	0.5	0.5e	0.0	0.0	1.5	0.5e
	t/2,w/4	0.000	0.000	0.008	0.008	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.5
A社材	中心	0.021	0.017	0.000	0.038	1.5	1.5e	1.0	1.0e	0.0	0.0	0.5	0.5e
	t/2,w/4	0.017	0.012	0.004	0.033	1.0	2.0e	1.5	2.0e	0.0	0.0	0.5	0.5e
SCM系	中心	0.112	0.004	0.004	0.120	1.5	1.5	0.5	0.0	0.0	0.0	1.0	0.5
	t/2,w/4	0.100	0.004	0.008	0.112	1.5	1.5	0.5	0.5	0.0	0.0	1.0	0.5

Mirror surface properties

Polishing condition

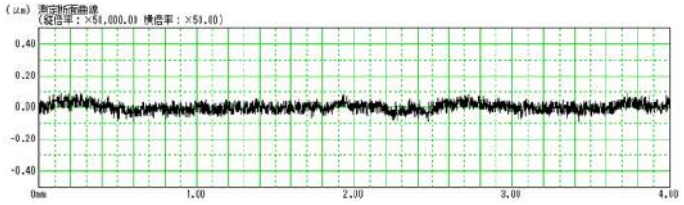
Grindstone 1000 → Paper 800 → Paper 1200 → Paper 1,500 → Diamond #1,800 → Diamond #3,000 → Diamond #5,000

TP dimensions: 20x50x100 mm. A surface of 50x100 is manually polished.

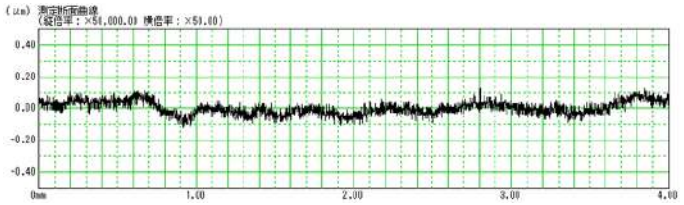
鋼種	砥石	ペーパー			ダイア		
	1,000	800	1,200	1,500	#9	#6	#4
JHX	問題なし	←	←	←	←	ピンホール発生	ピンホール大
S社材	問題なし	←	←	←	←	ピンホール発生	ピンホール大
A社材	問題なし	←	←	←	ピンホール発生	ピンホール大	ピンホール多

The quality level of the mirror surface of JHX is higher than that of company A's material and equal to or higher than that of company S.

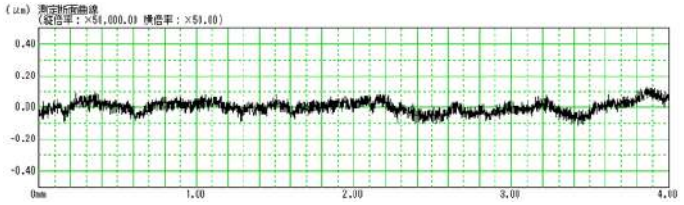
JHX

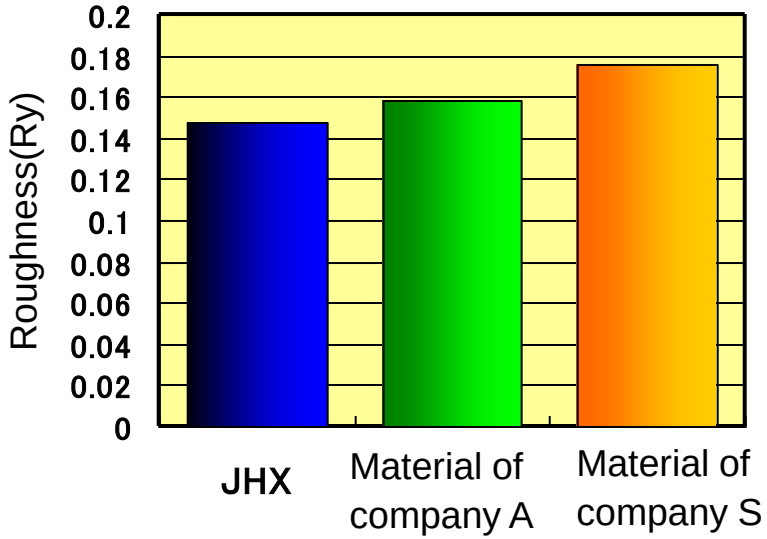


Material of company S



Material of company A





Embossing property

The level of the embossing property of JHX is equal to that achieved by the materials from other manufacturers.

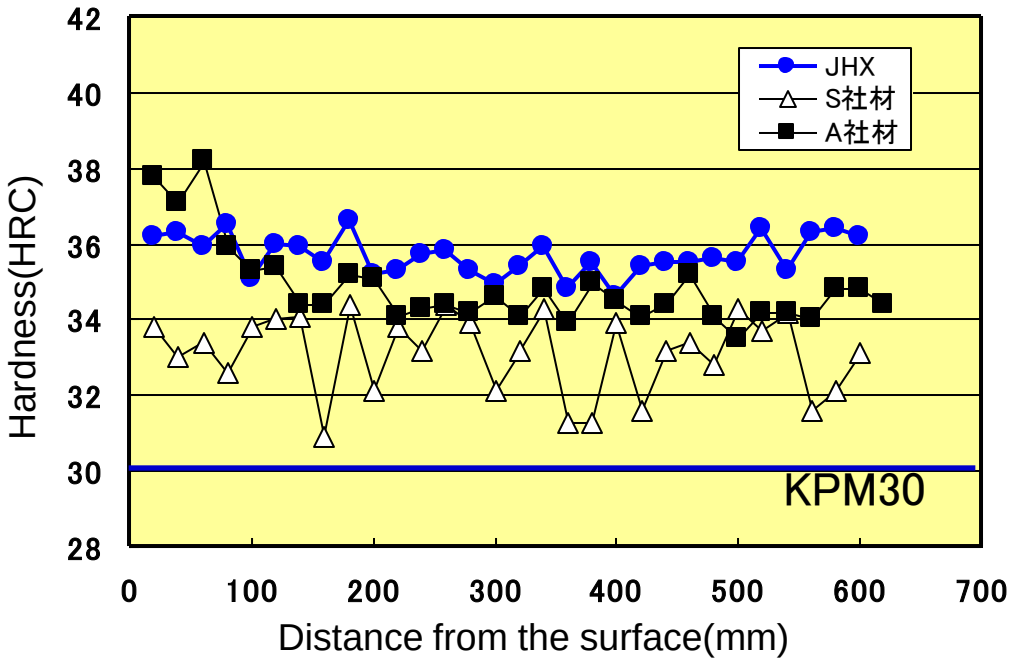
	JHX	Material of company A
Leather grain		
Satin finish		

Cross-sectional hardness distribution

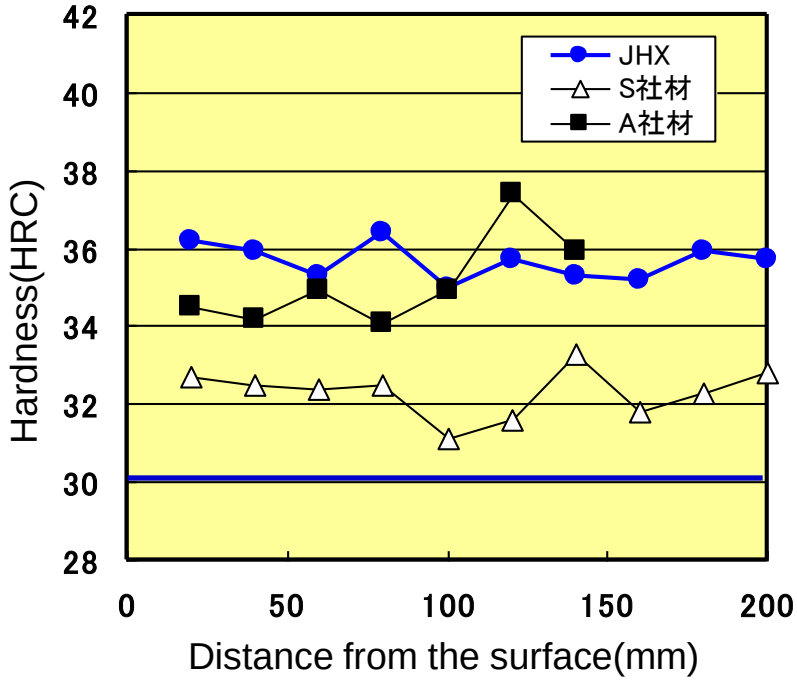
■Cross-sectional hardness distribution

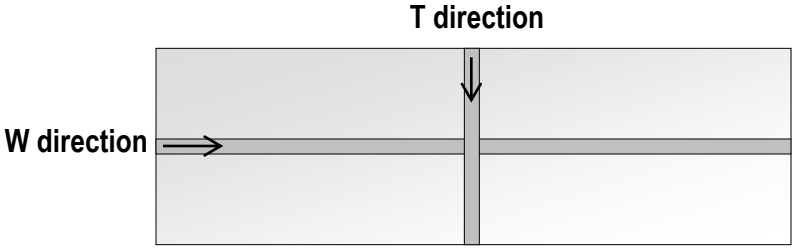
JHX-Quenching media
：Quenching(oil cooled)
：Tempering（air cooled）

Hardness distribution in the W direction



Hardness distribution in the T direction





Size of material

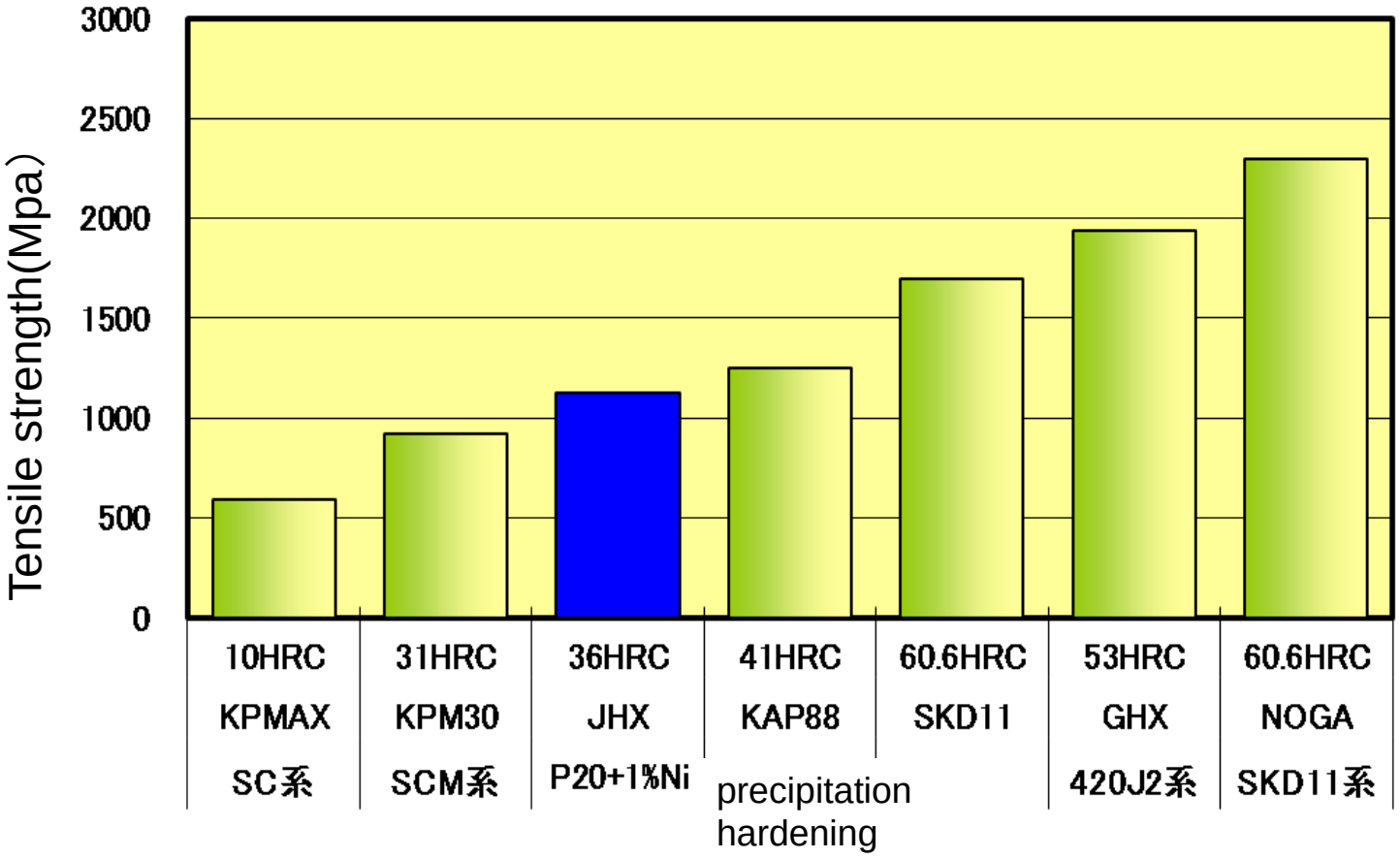
JHX: 205x680 mm

Material of company S: 205x1,250 mm

Material of company A: 156x1,050 mm

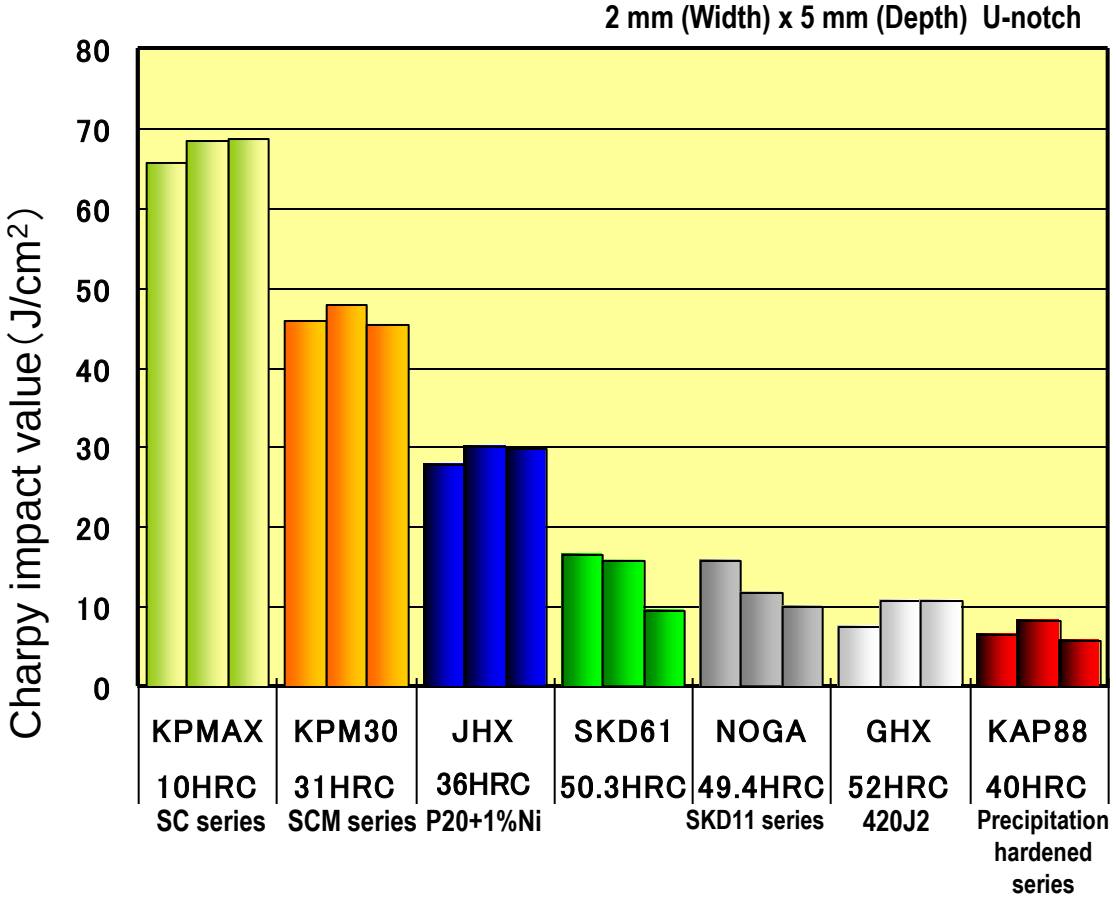
Tensile strength comparison

■Tensile test results



Comparison of toughness values

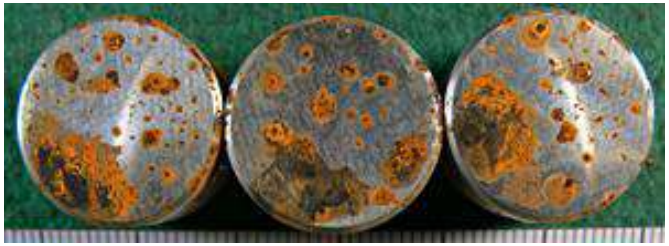
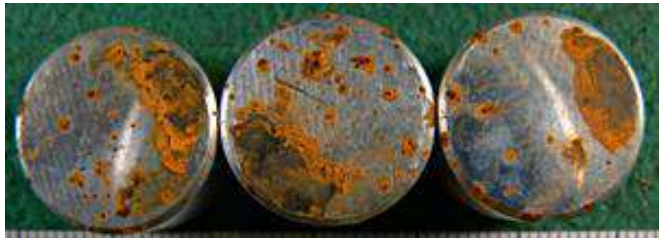
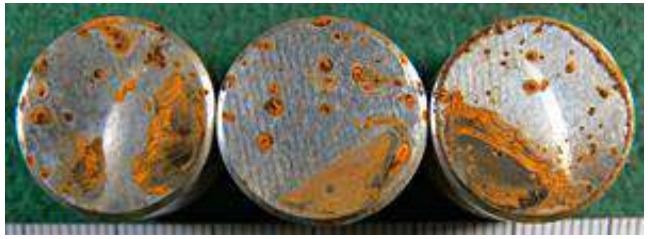
■Charpy impact test results



Notch depth of 2 mm for SKD61 and NOGA
Notch depth of 5 mm for other types of steel

Comparison of corrosion resistance

JHX's corrosion resistance is at the same level as other companies' materials.

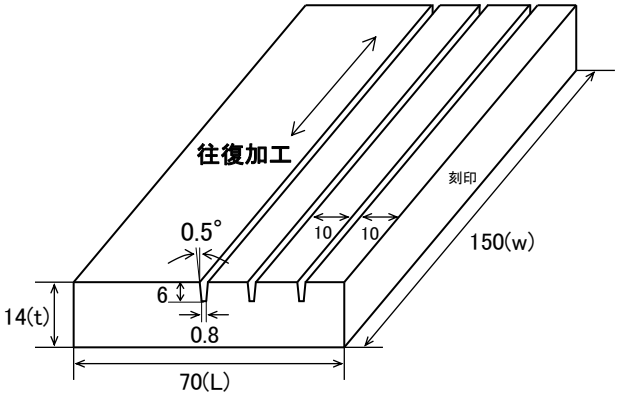
Steel type name	Appearance after test
JHX	
Material of Company S	
Material of Company A	

Test Conditions
1.Tap water
2.Test temperature: 35±2° C
3.Spray air pressure: 1.0 kgf/cm2
4.Test time: 24 hours
Other test conditions conform to JIS Z2371 Salt Spray Test Method.

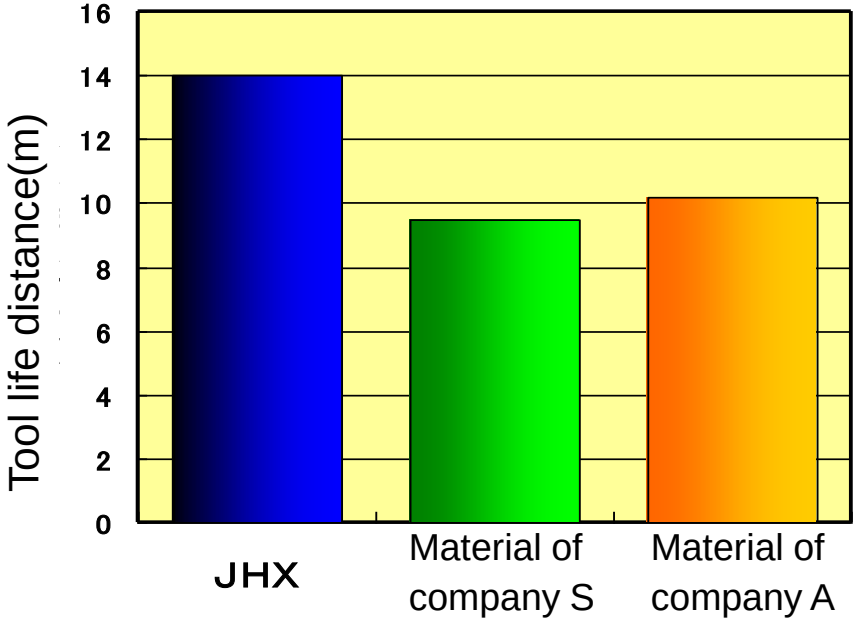
Machinability of JHX

■ End mill

【Cutting conditions】
Tool: Mitsubishi Materials MS4LT-D0080T0030L06
Tool dia: Tip dia. 0.8 mm, Taper half angle 0.5°
Cutting edge length 6 mm, Shank dia. 4 mm, Number of cutting edges 4
Material: Cemented carbide tools + (Al,Ti)N
Milling speed: 2,500 rpm
Feed: 500 mm/min
Depth of cut: Z=0.01 mm Groove cutting
Projection length: 13 mm
Milling direction : Reciprocating machining
Cutting oil: Emulsion



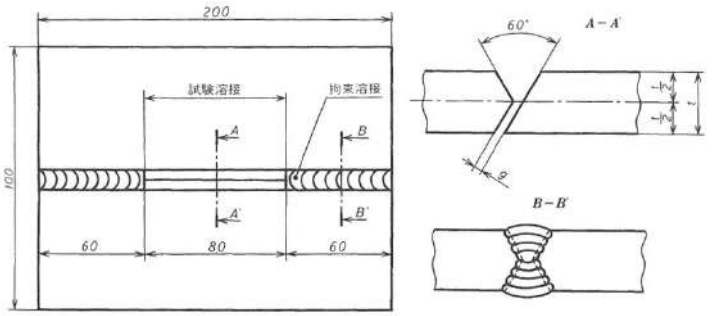
Good machinability

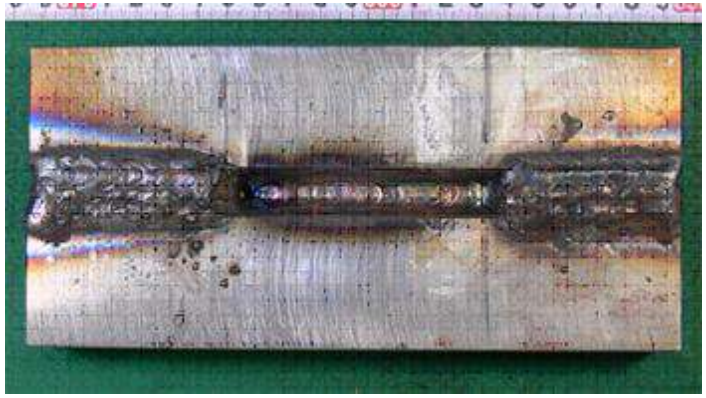


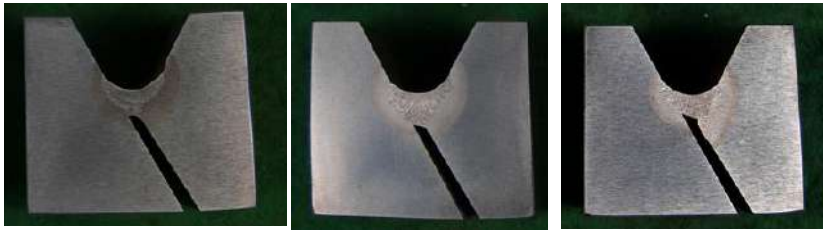
Weldability of JHX

■ Y-type test

Welding method: TIG
Welding rod: TMC-96G φ1.6 (TIG rod for low alloy steel)
(0.06C-0.46Si-0.78Mn-2.26Cr-1.08Mo)
Preheating, post-heating: None







Without cracking

Physical properties of JHX

■ **Elastic modulus：208GPa**

■ **Poisson's ratio：0.28**

■ **Thermal conductivity (W/m・K)**

	27℃	200℃	400℃
JHX	36.4	37.1	35.1
Material of company A	36.1	36.4	31.6
Material of company S	34.9	37.4	39.9
SCM series	36	37	34

■ **Thermal expansion coefficient (x10^{-6}/℃)**

	30～100℃	30～200℃	30～300℃	30～400℃
JHX	11.8	12.4	12.9	13.3
Material of company A	11.9	12.6	12.8	13.4
Material of company S	11.8	12.5	13.0	13.4
SCM series	11.8	12.7	12.9	13.4

Characteristics of JHX

■Changing from precipitation hardened steel

・Can be used for preventing cracks and chipping due to the superior toughness, however, the mirror surface property is slightly inferior.

■Changing from SCM series steel

・The lifetime of a mold can be increased due to the increase in strength and wear resistance.

	Mirror surface	Corrosion resistance	Wear resistance	Strength	Toughness	Weldability	Price
SC series	×	×	×	×	◎	△	◎
SCM series	△	○	△	△	○	△	○
JHX	○	○	○	○	○	△	○
Precipitation hardened steel	◎	×	○	◎	×	◎	×

Property comparison of plastic molds

	Classification	Steel name	Hardness	Mirror surface property	Corrosion resistance	**Wear resistance**	Toughness	Weldability
Pre-hardened	SC series	KPMAX	10	×	×	×	◎	◎
	SCM series	KPM30	31	△	×	×	○	◎
	P20	JHX	36	○	×	△	○	○
	Precipitation hardened steel	KAP88	40	◎	×	△	×	△
Quenched and tempered	SUS420J2 series	GHX	(52)	◎+	◎	○	△	△
	SKD61 series	KDA1S	(52)	○	△	○	△	△
	SUS440C	SM3	(58)	○	○	○	△	△
	SKD11 series	NOGA	(61)	○	△	◎	△	△
		SKD11	(60)	○	○	◎	×	×

Answers to questions

<table>
<tr><th>Question</th><th>answer</th></tr>
<tr><td>Elastic modulus</td><td>208GPa</td></tr>
<tr><td>Poisson‘s ratio</td><td>0.28</td></tr>
<tr><td>Quenching media</td><td>JHX is pre-hardened steel. We provide heat treatment products.
：Quenching(oil cooled)、Tempering(air cooled)</td></tr>
<tr><td>Whether stress relief is necessary after rough processing</td><td>As far as we know, we are not aware of any such measures being implemented.
If you are currently using this method with materials purchased from other companies, we recommend that you also use this method with our materials.</td></tr>
<tr><td>thermal conductivity</td><td><table><tr><td>27℃</td><td>200℃</td><td>400℃</td></tr><tr><td>36.4</td><td>37.1</td><td>35.1</td></tr></table>(W/m･K)</td></tr>
<tr><td>Cutting conditions (roughing, finishing, milling, cutting)</td><td>See next page</td></tr>
</table>

Answers to questions :Cutting conditions

■Recommended processing conditions

Processing details	Processing part	tool	Allowance	pick	Processing form	rotation speed (min^{-1})	Feed rate (mm/min)	Cutting (mm)	cutting speed (m/min)	Feed rate (mm/blade)
Rough processing	Full surface	Φ50Radius (high feed)	1	34	Contour lines	650	3,200	1	102	1.23
Medium rough machining		φ30ボール	0.4	4	Scan line	1,400	1,100	0.6	220	0.39
Semi-finishing		Φ20ボール	0.15	1		3,200	2,500	0.25	201	0.39
Finishing		φ12ボール (超硬ソリッド)	0	0.15		4,300	2,000	0.15	162	0.23

※
pick：Width cut
Contour lines：The tool mainly moves along the XY axis.
The Z axis is constant and moves around the contour at the same height, cutting in stages.
Scan line：All three axes (XYZ) move simultaneously during cutting. It is like machining by tracing the mountain.

■Recommended Tools

Throwaway Radius

company	Cutter	Tool Tip		remarks
	Model	Model	Material	
Mitsubishi	AJX形	JDMW	VP15TF	FTブレーカ
Hitachi Tool	ASR形	EDNW	TB6045	ブレーカなし

Throw-away ball end mill for finishing

company	Cutter	Tool Tip		remarks
	Model	Model	Material	
Hitachi Tool	ABP形	ZPFG	ACS05E	αボール
DIJET	SNM-S形	BNM-S	JC8008	ミラーボール
Mitsubishi	SRF形	SRFT	VP15TF	ミラクルラッシュ