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ABREX™
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ABREX™

Abrasion resistant steel plate

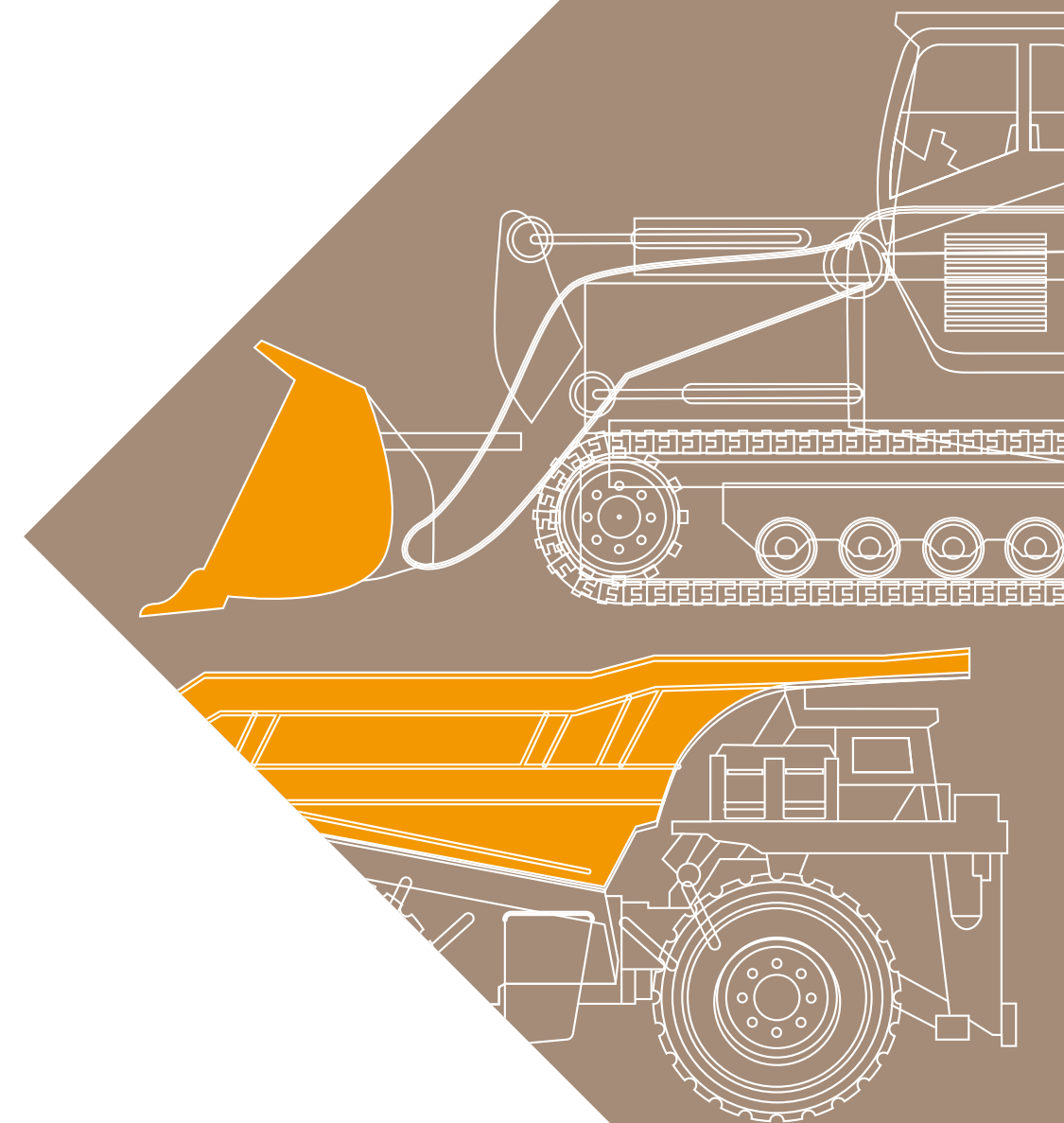
耐磨钢板



NIPPON STEEL CORPORATION

Steel
Plates

厚板



Foreword

The WEL-TEN AR Series and the WEL-HARD Series from the former Nippon Steel and the SUMIHARD Series from the former Sumitomo Metal are all widely used abrasion resistant steel plates which meet the needs for higher strength steel for applications in construction and other types of industrial machinery. Here NIPPON STEEL is proud to introduce the new ABREX™* Series. We appreciate your support and look forward to receiving your orders for these products.

*ABREX™ stands for ABrasion Resistance EXcellent.

前言

前新日铁的“WEL-TEN AR系列”、“WEL-HARD系列”产品及前住金的“SUMIHARD系列”产品，作为建设机械等各种产业机械的耐磨损部件材料，一直得到着广大客户的青睐。

本次，作为“ABREX™※系列”钢板，日本制铁又新推出了标准类型3种、高韧性类型2种的产品，继续满足广大客户的要求。

※“ABREX™”，是ABrasion Resistance EXcellent的英文首字母缩写。具有高耐磨损性钢板的含义。

Advantages of Using ABREX™

The use of abrasion resistant ABREX™ steel plate markedly reduces the weight of structural members exposed to severe abrasive conditions. Compared with regular steel, ABREX™ steel plate reduces structural weight and delivers economic merits. Adoption of high performance abrasion resistant ABREX™ will prolong the service life of machinery and components.

采用 ABREX™ 钢板的优点

ABREX™钢板为磨损严重的部件材料的轻量化做出贡献。
从普通钢转换用ABREX™钢板，可得到轻量化，实现经济性优点。
采用具有高耐磨损性ABREX™钢板，可延长机械和部件的寿命。

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Introducing the ABREX™ Series／ABREX™系列钢板的种类

The ABREX™* Series can be used for various applications, including wear-resistant parts for construction machinery and various industrial machines. All of our products are maintained at very low impurity levels, making them well suited to welding and formability.

ABREX™*系列可用于各种应用，包括建筑机械和各种工业机械的耐磨部件。
我们所有的产品都保持在非常低的杂质水平，使其非常适合焊接和成形。

●Specifications by Type and Designation／规格的种类及符号

Designation 牌号	Plate Thickness 板厚 t (mm)	Brinell Hardness (HBW)*1 布氏硬度	
		Aiming 目标值	Range 保证值
ABREX 400	6 (4.5) ～100	400	360～440
ABREX 450	6 (4.5) ～ 50	450	410～490
ABREX 500	6 (4.5) ～ 50	500	450～550

Please consult with us with regard to the figures in parenthesis above.
对于（ ）内的数值，请咨询。

*1 : The Brinell Hardness value is an average of measurements taken from three points on the steel plate surface. A section of the surface from which the decarburized layer is ground off by about 0.7mm should be used as the specimen surface. Prior consultation is recommended in the case of using thicknesses and hardness surpassing those listed above.

布氏硬度为钢板表面的3点平均值。测量面是以切削表面约0.7mm，为去除脱碳层的面。
有关以上标准规格以外的硬度和厚度，进行咨询。

*2 : The Charpy Impact Test shall be applied to steel plates thicker than 12mm.

对于夏氏冲击试验，使用12mm以上板厚

Designation 牌号	Thick- ness 板厚 (mm)	Chemical Composition (%) *1 化学成分											
		C	Si	Mn	P	S	Ni	Cr	Mo	B	PCM (t: thickness)*2 (t : 厚度)		
											t≤25	t≤50	t>50
ABREX 400	~100	≤0.21	≤1.20	≤2.00	≤0.025	≤0.010	≤1.00	≤1.20	≤.060	≤0.005	≤0.30	≤0.35	≤0.35
ABREX 450	~50	≤0.23	≤1.20	≤2.00	≤0.025	≤0.010	≤1.00	≤1.20	≤0.60	≤0.005	≤0.36	≤0.36	—
ABREX 500	~50	≤0.35	≤1.20	≤2.00	≤0.015	≤0.010	≤1.00	≤1.20	≤0.60	≤0.005	≤0.42	≤0.42	—

*1: Elements other than those listed in the table can be added as necessary.

根据需要，可添加上述以外的元素。

*2: Pcm = C + $\frac{Si}{30}$ + $\frac{Mn}{20}$ + $\frac{Cu}{20}$ + $\frac{Ni}{60}$ + $\frac{Cr}{20}$ + $\frac{Mo}{15}$ + $\frac{V}{10}$ + 5B(%)

●Typical Properties and Characteristics／特性例

Designation 牌号	Thick- ness 板厚 (mm)	Chemical Composition 化学成分 (%)		Brinell Hardness 布氏硬度 (HBW)	Mechanical Properties (Reference Values) 机械特性（参考值）						
		PCM (%)	Ceq*1 (%)		Tensile Tests 抗拉试验		Bending Tests*2 弯曲试验			Charpy Impact Test 夏氏冲击试验	
					Yield Strength 屈服强度 (N/mm²)	Tensile Strength 抗拉强度 (N/mm²)	Bend radius (t:thickness) 半径 (t:厚度)	Angle 角度	Result 结果	Temperature 温度 (°C)	Absorbed Energy 冲击功 (J)
ABREX 400	25	0.27	0.49	406	1025	1259	3t	180°	No cracking 无裂缝	0 -20	38 30
ABREX 450	25	0.31	0.50	457	1192	1469	3t	180°	No cracking 无裂缝	0	57
ABREX 500	25	0.36	0.54	514	1373	1552	3t	180°	No cracking 无裂缝	0	43
Test Condition 试验要领				JIS Z2243 Surface JIS Z2243 表面	JIS No.5 or No.4 T-Direction JIS5号或者4号 C方向		JIS No.1 T-Direction JIS 1号 C方向			2mmV Notch, L-Direction 2mmV 字形缺口 L 方向	

*1: $Ceq = C + \frac{Mn}{6} + \frac{(Cu+Ni)}{15} + \frac{(Cr+Mo+V)}{5}$

*2: See P12 for Bending Formability.

弯曲加工性请参照第11页。

●Precautions for Use／使用时注意事项

Increasing the thickness of the steel plate will lead to a slight decrease in the hardness of the central portion of the plate. In the event that these steel plates need to perform at high temperatures, please consult with us prior to placing your order.

当板厚增加时，板厚中心部的硬度会出现若干减少的倾向。

在高温环境下使用时，请另行咨询。

在低温环境下使用时，请使用高韧性类型产品。

Size Availability／可制造的范围

●ABREX™ 400

(Length: m)／(长度：m)

Thickness 厚度 (mm)	Width 宽度 (mm)	1000 and over 以下		1200 over 超过 ~1400 and less 以下		1400 S 1600	1600 S 1800	1800 S 2000	2000 S 2200	2200 S 2400	2400 S 2600	2600 S 2800	2800 S 3000	3000 S 3200	3200 S 3400	3400 S 3600	3600 S 3800	3800 S 4000	4000 S 4200	4200 S 4400	4400 S 4500
		1000 and over 以下		1200 over 超过 ~1400 and less 以下		1400 S 1600	1600 S 1800	1800 S 2000	2000 S 2200	2200 S 2400	2400 S 2600	2600 S 2800	2800 S 3000	3000 S 3200	3200 S 3400	3400 S 3600	3600 S 3800	3800 S 4000	4000 S 4200	4200 S 4400	4400 S 4500
5< ≤6						10.0															
6< ≤7																					
7< ≤8								15.0													
8< ≤9																					
9< ≤10																					
10< ≤12																					
12< ≤14																					
14< ≤16																					
16< ≤18																					
18< ≤20																					
20< ≤30																					
30< ≤32										16.0											15.0
32< ≤34																		15.5	14.5	14.5	
34< ≤36																		15.0	14.5	14.0	13.5
36< ≤38																	15.0	14.5	13.5	13.0	13.0
38< ≤40																15.5	14.5	13.5	13.0	12.5	12.0
40< ≤42															15.5	14.5	14.0	13.0	12.5	12.0	11.5
42< ≤44																15.5	14.5	14.0	13.0	12.5	11.0
44< ≤46																	15.0	14.0	13.5	12.5	10.5
46< ≤48																	15.5	14.5	13.5	12.5	10.0
48< ≤50																	15.0	14.0	13.0	12.5	10.0
50< ≤52																	14.5	13.5	13.0	12.0	9.0
52< ≤54																	14.5	13.5	13.0	12.0	9.0
54< ≤56																	14.5	13.5	12.5	12.0	9.0
56< ≤58																	11.5	10.5	10.0	9.5	7.0
58< ≤60																	11.5	10.5	10.0	9.5	7.0
60< ≤65																	11.5	10.5	10.0	9.5	
65< ≤70																	11.5	10.5			

●ABREX™ 450, 500

(Length: m)／(长度：m)

Thickness 厚度 (mm)	Width 宽度 (mm)	1000 and over 以下		1200 over 超过 ~1400 and less 以下		1400 S 1600	1600 S 1800	1800 S 2000	2000 S 2200	2200 S 2400	2400 S 2600	2600 S 2800	2800 S 3000	3000 S 3200	3200 S 3400	3400 S 3600	3600 S 3800	3800 S 4000	4000 S 4200	4200 S 4400	4400 S 4500
		1000 and over 以下		1200 over 超过 ~1400 and less 以下		1400 S 1600	1600 S 1800	1800 S 2000	2000 S 2200	2200 S 2400	2400 S 2600	2600 S 2800	2800 S 3000	3000 S 3200	3200 S 3400	3400 S 3600	3600 S 3800	3800 S 4000	4000 S 4200	4200 S 4400	4400 S 4500
5< ≤6						10.0															
6< ≤7																					
7< ≤8																					
8< ≤9																					
9< ≤10																					
10< ≤12																					
12< ≤14																					
14< ≤16																					
16< ≤18																					
18< ≤20																					
20< ≤30																					
30< ≤32																					
32< ≤34																					
34< ≤36																					
36< ≤38																					
38< ≤40																					
40< ≤42																					
42< ≤44																					
44< ≤46																					
46< ≤48																					
48< ≤50																					
50< ≤52																					
52< ≤54																					
54< ≤56																					
56< ≤58																					
58< ≤60																					
60< ≤65																					
65< ≤70																					

(1) The figures quoted in the tables above represent the lengths of steel plate that can be manufactured. (2) Please consult us about the range indicated by the color pink in the tables above. (3) We will clarify issues related to flatness and rust-resistance with regard to the manufacture of one-sided short blast steel plate with a thickness of less than 15.0mm. (4) Please consult us with regard to dimensions outside of the range detailed in the above tables. (5) The minimum plate length is 3m.

(1) 表内の数値表示可製造の長さ。(2) “ ” 范围内的，请咨询。(3) 对于板厚 15.0mm 以下的单面喷丸表面加工，尤其是有关平坦度及除锈度，在与客户洽谈后进行制造。(4) 对于上表以外的尺寸，也接受咨询。(5) 最小长度为 3m。

Abrasion Resistance / 耐磨损性

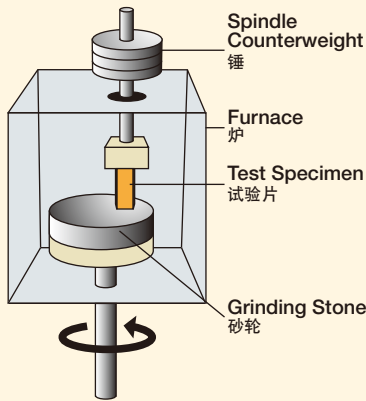
The loss in the mass of steel due to abrasion decreases as the surface hardness of steel increases. Accordingly, it is necessary for steel, for which abrasion resistance is required, to have higher surface hardness. NIPPON STEEL's abrasion resistant ABREX™ steel plate is designed by placing priority on resistance to abrasion caused by earth and sand. It offers excellent scratching abrasion resistance 2 to 5 times that specified for mild steel.

由磨损引起的重量损耗因钢表面硬度的增加而减少。因此，要求具有耐磨损性的钢必须是表面硬度高的钢。日本制铁的ABREX™钢板，是重视对土砂、岩石等耐磨损性而设计的。与软钢相比，按硬度等级具有2~5倍的耐磨损性。

Properties and Characteristics / 特性例

Gouging Abrasion Test Results / 刨槽磨损试验结果

Abrasion Test Equipment / 磨损试验机



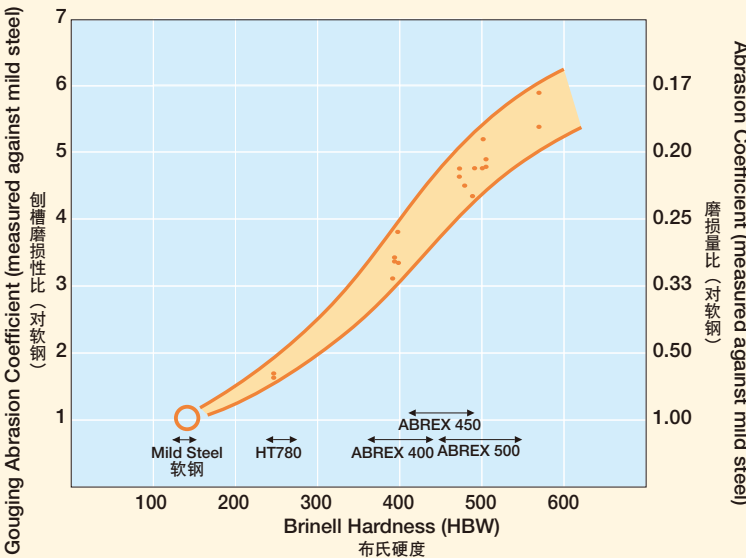
Test Conditions / 试验条件

The test specimen is pressed against the grinding stone and the grinding stone is rotated. The resulting abrasion is measured.

- Rotating speed : 30rpm
- Test duration : 20min
- Load : 29.4kg/cm²
- Ambient temperature : 200°C
- Grinding Stone : Special grindstone for use at high temperatures

将试验片按压在砂轮上，通过旋转砂轮，测量其磨损量。

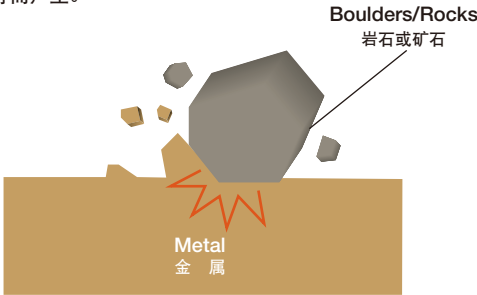
- 旋转速度 : 30rpm
- 试验时间 : 20min
- 负载 : 29.4kg/cm²
- 气氛温度 : 200°C
- 砂轮 : 高温专用砂轮



Gouging Abrasion / 刨槽磨损

Boulders and rocks cause abrasion when they gouge and scrape a metallic surface. Due to repeated heavy loads and impacts, relatively large portions of the metallic surface can suffer damage, leading to the formation of grooves and dents. This can occur to shovels, etc. when tasked with excavating a rock face.

在挖掘、粉碎岩石或矿石等时而产生的磨损。通过施加负载和冲击，能从金属表面拔取较大的金属块，以此形成槽状磨损痕迹。在挖掘岩盘时由铲车等而产生。



Precautions for Use / 使用时注意事项

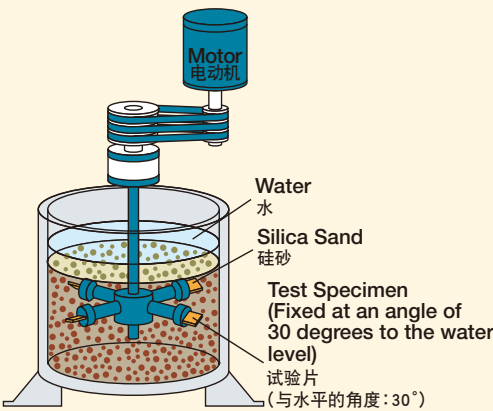
The amount of abrasion will change depending on the usage environment.

磨损量因使用环境而有所变化。

Properties and Characteristics / 特性例

Scratching Abrasion Test Results (Moisture Type Testing) / 擦痕磨损试验结果 (湿式)

Abrasion Test Equipment / 磨损试验机



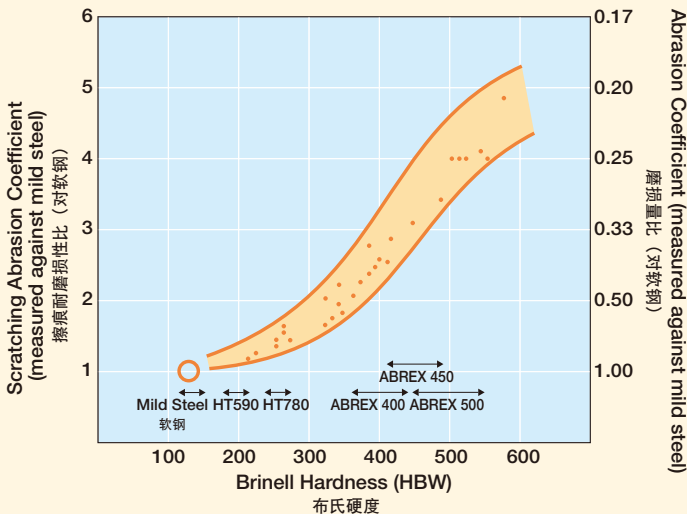
Test Conditions / 试验条件

Silica sand is suspended in water and the test specimen spun through this water. The resulting abrasion is measured.

- Container : 580mm in diameter
- Sand : The silica sand is in suspension in the water to a maximum level some 150mm above the test specimen.
- Water : Water is added until it reaches a level some 10mm above the level of the sand.
- Test specimen : 50mm x 50mm; 5mm thick
- Rotating speed : 3.7m/s

在含水的砂中旋转磨损试验片，测量其磨损量。

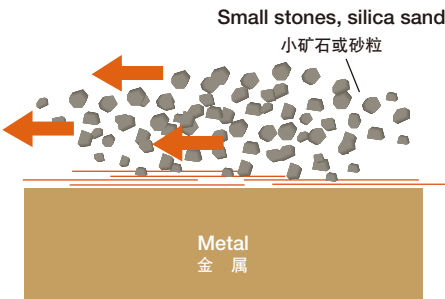
- 使用容器 : φ580mm
- 砂 : 在试验片上装入高150mm的硅砂。
- 水 : 在砂面上注入高10mm的水。
- 试验片 : 50mm x 50mm 厚度5mm
- 旋转条件 : 3.7m/s



Scratching Abrasion / 擦痕磨损

Comparatively small stones and silica sand caused abrasion when they come into contact with a metallic surface. As the load and force of impact is slight, any bumps and scrapes are relatively small. This can occur to the steel used in the load-bearing bay of a dump truck, etc. when filled with earth and gravel.

较小的矿石或砂粒摩擦金属表面而产生的磨损。由于负载、冲击力较小，因此，磨损痕迹也较浅。由装载土砂的翻斗车等而产生。

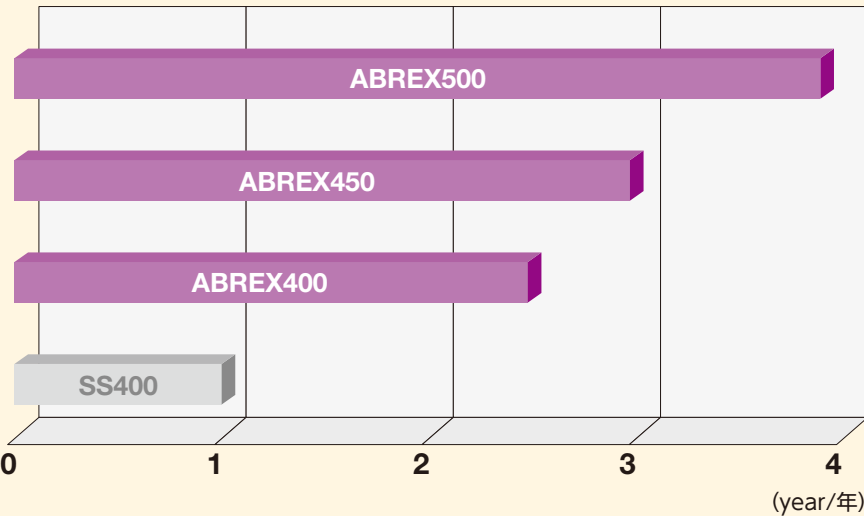


Useful life (for mild steel)

In a grinding wear environment where mild steel perforates within one year

使用寿命 (对软钢)

在磨损环境下，软钢在一年内穿孔



Weldability／焊接性

Abrasion-resistant steel has extremely high tensile strength, and as a result, it is highly susceptible to cold cracking. What this means in terms of welding is that it underlines the importance of selecting the most appropriate welding materials as well as managing the preheating process correctly. Moreover, joint restraint conditions as well as other weld criteria such as welding heat input and weld bead length, etc. in addition to weld time, environmental conditions and the management of weld materials all require special attention. See “ABREX™ Welding Guideline” for details.

由于耐磨钢强度非常高，故低温裂纹敏感性高，因此，在焊接时，选择焊接材料和管理预热温度很重要。并且，还请注意接头的约束条件、焊接热量输入和焊道长等焊接条件、焊接时的环境条件、焊接材料的管理等。详细请参照《ABREX™焊接指南》。

●Properties and Characteristics／特性例

CTS Cracking Test Results (Based on JIS Z 3154)／CTS开裂试验结果（JIS Z3154：搭接头焊接开裂试验）

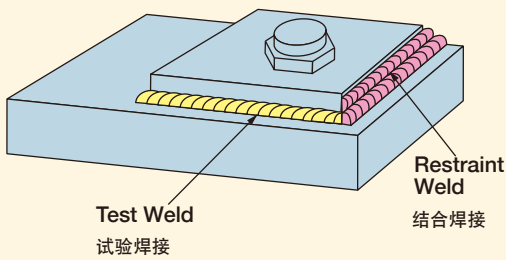
Designation 符号	Plate Thickness (mm) 板厚	The test results 有无裂缝	
		SMAW	GMAW
ABREX 400	25	○	○
ABREX 450	25	○	○
ABREX 500	25	○	○

○: No cracking
○：无裂缝

Test Method／试验方法

Item 项目	SMAW	GMAW
Temperature 温度	Room Temperature 常温	Room Temperature 常温
Heat Input kJ/mm 热量输入	1.73	0.85
Welding Material 焊接材料	L-55	YM-60C
Hydrogen Content mL/100g 氢量	3.48	1.62

Test Specimen／试验片



●Precautions for Use／使用时注意事项

Take care when preheating – heating a steel plate over the recommended preheating temperature will cause the plate to decrease its hardness. Please ensure that the steel plate is not heated over 200 degrees Celsius.

因预热时加热使钢板温度过度上升，会产生钢板的硬度降低的现象，因此，请注意钢板温度尽量不要超过 200℃。

●A Guide to Preheating Temperatures／预热温度的大致目标值

General welding materials／一般焊接材料

Steel Material 钢材	Welding Material 焊接材料	Welding Condition 焊接条件	Plate Thickness (mm) 板厚					
			~11	~20	~25	~36	~50	~100
ABREX 400	YM-26 YM-28S	Typical welding (Small Restraints) 普通焊接 (约束小)	RT	RT	50℃	50℃	75℃	125℃
		Repair Welding (Medium Restraints) 修补焊接 (约束中)	RT	RT	75℃	75℃	100℃	150℃
ABREX 450		Typical welding (Small Restraints) 普通焊接 (约束小)	RT	RT	50℃	75℃	75℃	—
		Repair Welding (Medium Restraints) 修补焊接 (约束中)	RT	50℃	75℃	100℃	100℃	—
ABREX 500		Typical welding (Small Restraints) 普通焊接 (约束小)	RT	50℃	75℃	100℃	125℃	—
		Repair Welding (Medium Restraints) 修补焊接 (约束中)	RT	100℃	100℃	150℃	150℃	—

HI: 1.7kJ/mm Diffusible hydrogen content: <3mL/100g / 焊接线能量输入: 1.7KJ/mm、扩散氢含量: <3mL/100g
RT: Room Temperature / 室温

Welding materials capable of reducing preheating work (CF wire)／可减少预热工作的焊丝（cf 焊丝）

Steel Material 钢材	Welding Material 焊接材料	Welding Condition 焊接条件	Plate Thickness (mm) 板厚					
			~11	~20	~25	~36	~50	~100
ABREX 400	SF-1CF SX-60CF	Typical welding (Small Restraints) 普通焊接 (约束小)	RT	RT	RT	RT	RT	50℃
		Repair Welding (Medium Constraints) 修补焊接 (约束中)	RT	RT	RT	RT	RT	75℃
ABREX 450		Typical welding (Small Restraints) 普通焊接 (约束小)	RT	RT	RT	RT	RT	—
		Repair Welding (Medium Constraints) 修补焊接 (约束中)	RT	RT	RT	RT	50℃	—
ABREX 500		Typical welding (Small Restraints) 普通焊接 (约束小)	RT	RT	RT	RT	RT	—
		Repair Welding (Medium Constraints) 修补焊接 (约束中)	RT	RT	RT	75℃	75℃	—

HI: 1.7kJ/mm Diffusible hydrogen content: <1mL/100g / 焊接线能量输入: 1.7KJ/mm、扩散氢含量: <1mL/100g
RT: Room Temperature / 室温

In order to avoid cold cracking, the steel plate needs to undergo the required preheating. This can be approximated depending on various factors such as the carbon equivalent, the hydrogen content of the weld metal, the yield strength of the weld metal, the heat input and plate thickness to name but a few*1. The preheating temperatures shown in the table are calculations in gas shield arc welding with heat input of 1.7kJ/mm using the welding material for 590MPa class or less assuming hydrogen content of 3mL/100g*1.

However, appropriate preheating temperatures are also affected by external factors such as outside temperature, path numbers, groove form as well as the preheating method, etc. so please use these figures as a guide.

*1: pp347-357 No. 3 Volume 13, Collection of Papers from the Japan Welding Society (1995); N.Yurioka and T.Kasuya Also: P163 Steel Materials and Welding, Welding Digest 10 (1999), Sanpo Publishing Inc.

为避免低温裂纹所需的预热温度，能从碳当量、焊接金属氢量、焊接金属屈服强度、热量输入量、板厚等中进行一定程度的推算¹⁾。上述温度的计算前提是对采用热量输入量 1.7kJ/mm 的气体保护弧焊的接头，焊接金属扩散性氢量 3mL/100g¹⁾；而适当预热温度，也受到室外空气温度、焊道数、坡口形状、预热方法等的影响，因此，请作为一个大致目标值加以考虑。

1) N.Yurioka and T.Kasuya；《焊接学会论文集》、第 13 卷、第 3 号、pp347-357、1995。；或《焊接丛书 10. “钢铁材料的焊接”》产报出版（1999），p.163。

Welding Materials／焊接材料

●Recommended Welding Materials／推荐的焊接材料

1) In case of not requiring the abrasion resistance for the weld metal (Common for all grades of steel)／在不考虑焊接部的耐磨损性时(各钢种共通)

Welding Method 焊接方法			Brand 品号	Classification 规格	Example of Weld Metal Hardness 焊接金属的硬度一例 Hv (98N)	Criteria (Plate thickness of 20mm) 施工条件一例 (板厚 20mm)	Notes 备注
Shielded Metal Arc Welding 焊条电弧焊			L-55	JIS Z 3211 E4916U AWS A5.1 E7016	180	Heat input equal to or less than 3.0kJ/mm 热量输入 ≤ 3.0kJ/mm	For all positions Low hydrogen type 全位置焊接用低氢系
Gas Metal Arc Welding 气体保护弧焊	General type 一般类型	Solid wire 实心焊丝	YM-26	JIS Z 3312 YGW11 AWS A5.18 ER70S-G	180	Heat input equal to or less than 2.0kJ/mm 热量输入 ≤ 2.0kJ/mm	With CO ₂ gas 适用于碳酸气
			YM-28S	JIS Z 3312 YGW15 AWS A5.18 ER70S-G	200	Heat input equal to or less than 3.0kJ/mm 热量输入 ≤ 3.0kJ/mm	With Ar-CO ₂ gas 适用于混合气
		Flux-cored wire 药芯焊丝	SF-1	JIS Z 3313 T49J0T1-1CA-UH5 AWS A5.20 E71T-1C-H4	200	Heat input equal to or less than 3.0kJ/mm 热量输入 ≤ 3.0kJ/mm	With CO ₂ gas 适用于碳酸气
			SX-26	JIS Z 3313 T49J0T15-0CA-UH5 AWS A5.18 E70C-3C H4	200	Heat input equal to or less than 3.0kJ/mm 热量输入 ≤ 3.0kJ/mm	With CO ₂ gas 适用于混合气
	Preheat reduction type 预热减少类型	CF wire (Flux-cored wire) CF 焊丝 (药芯焊丝)	SF-1CF	JIS Z 3313 T49J0T1-1CA-UH5 AWS A5.20 E71T-1C-H2	200	Heat input equal to or less than 3.0kJ/mm 热量输入 ≤ 3.0kJ/mm	For All position with CO ₂ gas 适用于所有位置
			SX-60CF	JIS Z 3313 T59J1T15-0CA-G-UH5 AWS A5.28 E80C-G H2	230	Heat input equal to or less than 3.0kJ/mm 热量输入 ≤ 3.0kJ/mm	Flat-position, horizontal fillet with CO ₂ gas 平焊位置, 水平角焊缝

2) In case of requiring the abrasion resistance for the weld metal (Common for all grades of steel)／在考虑焊接部的耐磨损性时(各钢种共通)

Welding Method 焊接方法			Brand 品号	Classification 规格	Example of Weld Metal Hardness 焊接金属的硬度一例 Hv (98N)	Criteria (Plate thickness of 20mm) 施工条件一例 (板厚 20mm)	Notes 备注
Shielded Metal Arc Welding 焊条电弧焊			L-80	JIS Z 3211 E7816-N5CM3U AWS A5.5 E11016-G	250	Heat input equal to or less than 3.0kJ/mm Preheated to at least 100°C 热量输入 3.0kJ/mm 预热 ≥ 100°C*	For all positions Low hydrogen type 全位置焊接用低氢系
			L-100EL	WES 4101 EK9516	320	Heat input equal to or less than 3.0kJ/mm Preheated to at least 100°C 热量输入 3.0kJ/mm 预热 ≥ 100°C*	For all positions Low hydrogen type 全位置焊接用低氢系
Gas Metal Arc Welding 气体保护弧焊	General type 一般类型	Solid wire 实心焊丝	YM-80C	JIS Z 3312 G78A2UCN5M3T AWS A5.28 ER110S-G	260	Heat input equal to or less than 2.0kJ/mm Preheated to at least 50°C 热量输入 ≤ 2.0kJ/mm 预热 ≥ 50°C*	With CO ₂ gas 适用于混合气
			YM-80A	JIS Z 3312 G78A4UMN5C1M3T AWS A5.28 ER110S-G	270	Heat input equal to or less than 3.0kJ/mm Preheated to at least 50°C 热量输入 3.0kJ/mm 预热 ≥ 50°C*	With Ar-CO ₂ gas 适用于混合气
	Preheat reduction type 预热减少类型	CF wire (Flux-cored wire) CF 焊丝 (药芯焊丝)	SF-80CF	JIS Z 3313 T780T1-1CA-N4M2-UH5 AWS A5.29 E111T1-GC-H2	260	Heat input equal to or less than 2.0kJ/mm Preheated to 50°C or less 热量输入 2.0kJ/mm 预热 ≤ 50°C*	For All position with CO ₂ gas 适用于所有位置
			SX-80CF	JIS Z3313 T782T15-0CA-N4C1M2-UH5 AWS A5.28 E110C-G H2	260	Heat input equal to or less than 3.0kJ/mm Preheated to 50°C or less 热量输入 3.0kJ/mm 预热 ≤ 50°C*	Flat-position, horizontal fillet with CO ₂ gas 平焊位置, 水平角焊缝

*The welding material will have a required preheating temperature, as will the steel plate. The higher temperature should be applied in these cases.
* 这是焊接材料所需的预热温度，应依照钢板所需的预热温度的较高温度进行预热。

If preheating is not possible, or if you want to omit or reduce preheating work, you can use "CF Wire," which significantly reduces hydrogen content compared to general welding materials. For more details about "CF Wire," please contact separately.
如果无法进行预热，或者希望省略或减少预热作业，可以使用与一般焊接材料相比大幅降低氢含量的“CF线材”。有关“CF线材”的详细信息，请另行咨询。

Please direct any inquires to:
NIPPON STEEL WELDING & ENGINEERING CO.,LTD.
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Tokyo 135-0016 JAPAN
Tel: +81-3-6388-9000
Fax: +81-3-6388-9160
www.weld.nipponsteel.com

联系地址：日铁溶接工业株式会社
邮编 135-0016 东京都江东区东阳 2-4-2
新宫大厦
电话：03-6388-9000
传真：03-6388-9160
www.weld.nipponsteel.com

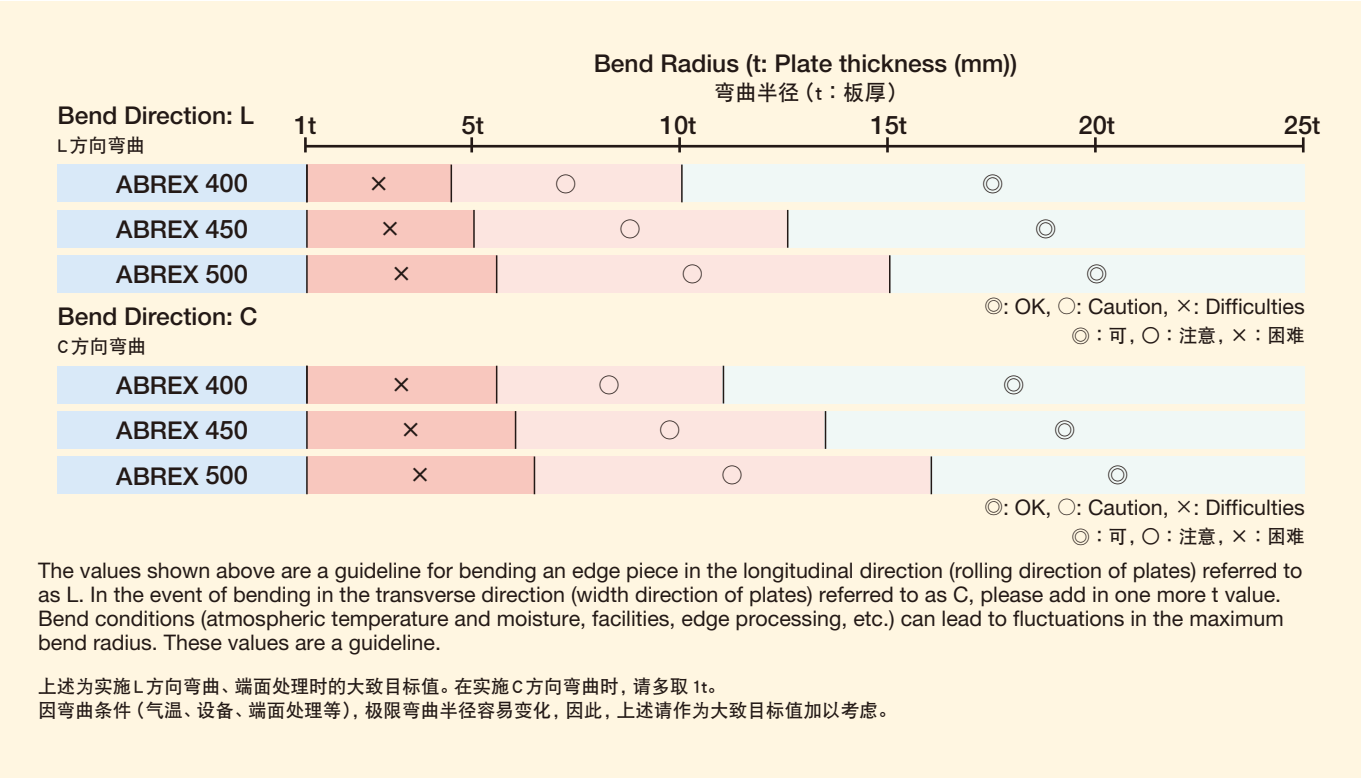


Bending Formability／弯曲加工性

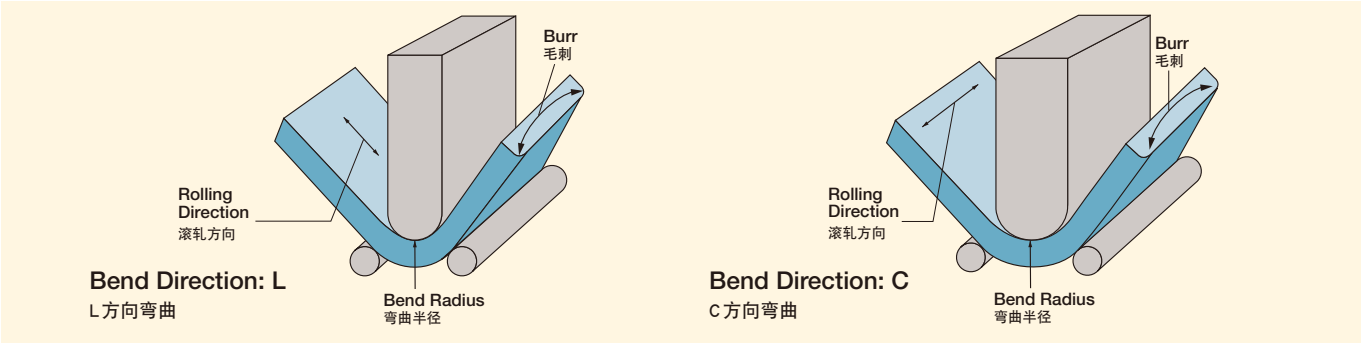
Compared to regular steel, abrasion resistant steel has a lower elongation value and as a result, it is important to take steps to prevent fabrication cracks. Please consider the bend radius, quality of gas cut surface and the bend direction when undertaking fabrication. See "ABREX™ Guidelines for Bending" for details.

耐磨钢与普通钢相比，由于延伸值较低，故对防止加工裂缝的管理很重要。请注意弯曲半径、气体切割断面质量、弯曲方向等加工要领。详细请参照《ABREX™弯曲指南》。

●Guidelines for Maximum Bend Radii／极限弯曲半径的大致目标值



●Properties and Characteristics／特性例



●Precautions for Use／使用时注意事项

Because production of abrasion-resistant steel plate involves special heat treatment, the avoidance of hot working is recommended. Any notches or burrs on the sheared edge can lead to deterioration in the hardness of gas-cut sections, so smooth them out by removing them with a grinder, etc. In the event of bending abrasion-resistant steel to an extremely shallow bending radius, the corners should be beveled and care should be taken to ensure that the bend circumference be implemented in the L rolling direction. Please note that with abrasion-resistant steel plate, spring-back is greater than with conventional steel. In the event where the room temperature is less than 0 degrees Celsius, please avoid undertaking any bending procedures.

由于耐磨钢板的生产涉及特殊的热处理，建议避免热加工。
剪切边缘的任何缺口或毛刺都会导致气割断面硬度下降，因此请使用磨床等将其磨平。
如果将耐磨钢板弯曲至极小的弯曲半径，则应将拐角倒角，并注意确保弯曲圆周沿L形轧制方向进行。
请注意，耐磨钢板的回弹比传统钢板更大。
如果室温低于0摄氏度，请避免进行任何弯曲加工。

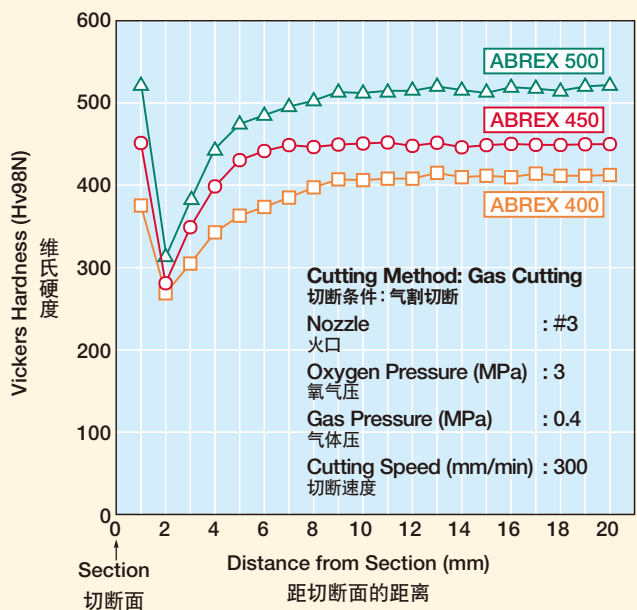
Thermal Cutting Performance / 切断性

ABREX™ can be cut with gas, plasma and laser cutters, but the heat generated by these cutting techniques also affects the steel. Please select the best cutting solution to meet your needs once you have studied the affect of the cutting procedure and method.

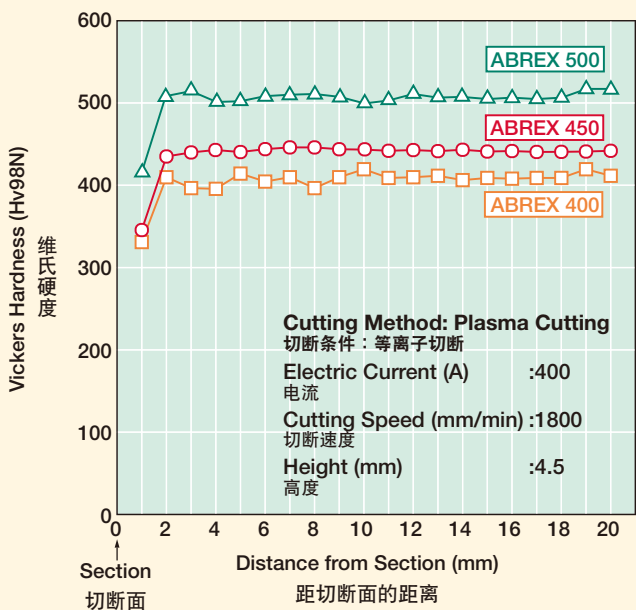
ABREX™钢可进行气体、等离子、激光切断，但其切断面会受到热的影响。请在理解切断面特性的同时，并注意切断要领。

● Properties and Characteristics / 特性例

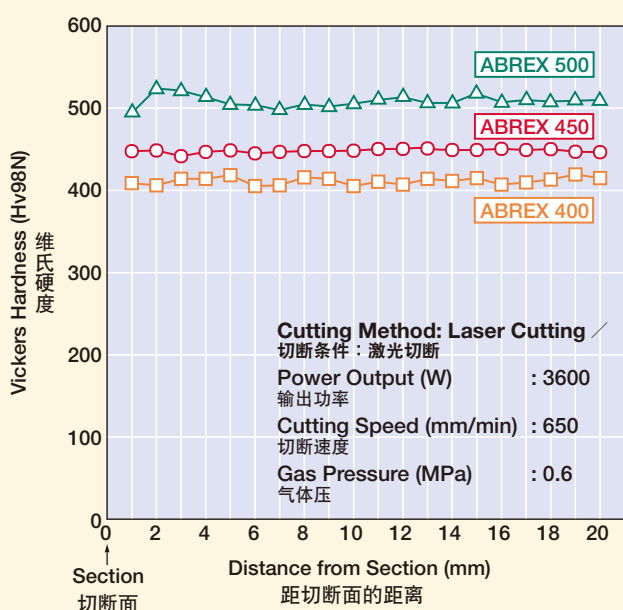
Hardness Distribution for Gas Cutting / 气割切断面的硬度分布



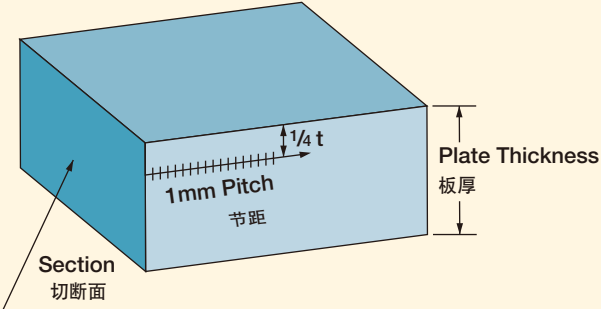
Hardness Distribution for Plasma Cutting / 等离子切断面的硬度分布



Hardness Distribution for Laser Cutting / 激光切断面的硬度分布



Measuring Location / 测量位置



Thickness of Test Specimen / 试验片厚度

Designation 符号	Thickness t (mm) 板厚
ABREX 400	25
ABREX 450	25
ABREX 500	25

● Precautions for Use / 使用时注意事项

In the event that room temperature is 5 degree Celsius or below, some preheating will be required. Please avoid the use of cold water during cutting. Please take special care when cutting small pieces or thin widths, as the hardness of the steel can deteriorate. Notches that result after cutting should be smoothed away with a grinder.

室温在5℃以下时，请稍许预热一下。
在切断时，请避免沾冷水。
在小件、窄宽切断时，会降低其硬度，故请予以注意。
对于因切断而产生的刻痕，请用砂轮机磨光。

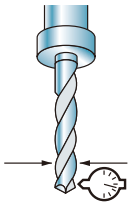
Drilling Workability／钻孔加工性



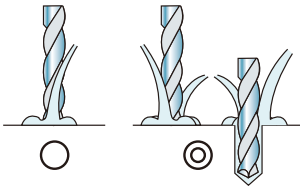
As ABREX™ steel plate is extremely hard and this can make it difficult to form and process, we recommend any drilling take place in a machining center using an ultra-hard metal alloy drill. However, for smaller jobs and working with components, it is often the case that boor-bank drilling machines and high-speed steel drills are used, so here we will introduce our recommended approach to drilling ABREX™ steel plate using a high-speed steel drill.

由于ABREX™钢是高硬度、难以加工材料，因此，我们建议采用超硬合金钻头的钻孔机进行加工。
但是，鉴于在加工小部件材料时，较多采用钻床与高速钢钻孔机组合的情况，因此，介绍一下推荐的采用高速钢钻孔机对ABREX™钢切削的条件。

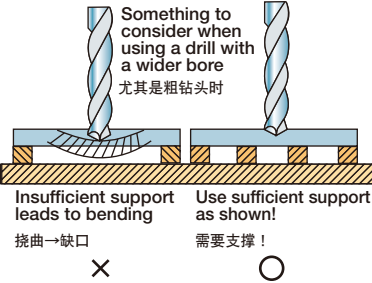
(1) Points to Note when Drilling／钻孔加工时的注意事项



① When attaching the drill, please ensure that the external vibration of the tip of the drill does not exceed 0.03mm.
在安装钻头时，请调整确保外周摆动在0.03mm以下。



② We recommend an aqueous drill lubricant with a high degree of transparency. Please ensure you have sufficient lubricant for the drilling process.
切削油剂，建议使用浸透性良好的水溶性油剂。请充分对孔入口供应油剂。



③ Ensure that the steel plate is secured to prevent vibrations, movement and any bending or warping during drilling.
为了不使被切削材料振动或挠曲，请牢固地支撑。

(2) Recommended Conditions for Drilling／所推荐的切削条件

These are the recommended conditions for using a radial boor bank drilling machine with ABREX™ steel plate.

采用径向钻床钻孔加工的推荐条件如下所示。

Type of Steel 钢种	Type of Drill 钻头	Drilling Speed 切削速度 (m/min)	φ5		φ10		φ15		φ20		φ25		φ30	
			Rotation Speed 旋转速度 (min ⁻¹)	Feed Rate 进给量 (mm/rev)	Rotation Speed 旋转速度 (min ⁻¹)	Feed Rate 进给量 (mm/rev)	Rotation Speed 旋转速度 (min ⁻¹)	Feed Rate 进给量 (mm/rev)	Rotation Speed 旋转速度 (min ⁻¹)	Feed Rate 进给量 (mm/rev)	Rotation Speed 旋转速度 (min ⁻¹)	Feed Rate 进给量 (mm/rev)	Rotation Speed 旋转速度 (min ⁻¹)	Feed Rate 进给量 (mm/rev)
ABREX 500	Powder High Speed Steel 粉末高速钢	5 ~ 8	320 ~ 510	0.05 ~ 0.10	160 ~ 250	0.10 ~ 0.20	110 ~ 170	0.15 ~ 0.30	80 ~ 130	0.15 ~ 0.30	65 ~ 100	0.15 ~ 0.30	55 ~ 85	0.15 ~ 0.30
		6 ~ 10	380 ~ 640	0.05 ~ 0.10	190 ~ 320	0.10 ~ 0.20	130 ~ 210	0.15 ~ 0.30	95 ~ 160	0.15 ~ 0.30	75 ~ 130	0.15 ~ 0.30	65 ~ 110	0.15 ~ 0.30
ABREX 400	Cobalt High Speed Steel 钴高速钢	5 ~ 8	320 ~ 510	0.05 ~ 0.10	160 ~ 250	0.10 ~ 0.20	110 ~ 170	0.15 ~ 0.30	80 ~ 130	0.15 ~ 0.30	65 ~ 100	0.15 ~ 0.30	55 ~ 85	0.15 ~ 0.30

- These values are a guide. Depending on how the steel plate is secured and the hardness of the machining tool, sometimes the appropriate settings will fall outside of this range, so before performing the actual drilling required, we recommend test drilling under the same conditions.
- We do not recommend using a Cobalt High Speed Steel for drilling ABREX 500 steel plate.
- Generally speaking, in terms of performance we recommend high settings for both the drilling speed (rotation speed) and the feed rate. However, this will have an impact on the working life of the drill. Conversely, if you wish to prioritize the working lifespan on the drill as well as the precision of the work, we recommend low settings for both the drilling speed (rotation speed) and the feed rate.
- During drilling, the turnings from the drilling process can sometimes become very long and yet still be attached to the steel plate. When this occurs, trimming these turnings will reduce the burden on the drill.
- These recommendations are made with the proviso that an aqueous drill lubricant is being used. We recommend a good quality aqueous drill lubricant used at less than 20x dilution.
- When using a non-aqueous drill lubricant or when an emulsion lubricant has been diluted over 20 times, please reduce the drilling speed by 20%.
- 上述请作为大致目标值加以考虑。
根据机床的刚性和被切削材料的支撑方法，会有适当条件不符合该范围的情况，因此，建议在实际加工前先进行试切削。
- 对于ABREX 500，不推荐采用钴高速钢。
- 一般在优先加工效率时，切削速度（旋转速度）和进给量均设定于高位侧，但这将付出牺牲钻头寿命的代价。相反，在要求钻头寿命和加工精度时，则建议设定低位侧的条件。
- 在切削加工时，会有切削丝长长连成一串的情况。此时，如果将切削丝切断成短丝，可减轻对钻头的负荷。
- 该推荐切削条件为使用水溶性切削油剂的情况。请使用稀释倍率20倍以下的优质水溶性切削油剂。
- 在使用非水溶性切削油剂或超过20倍的乳剂时，请将切削速度下降20%。

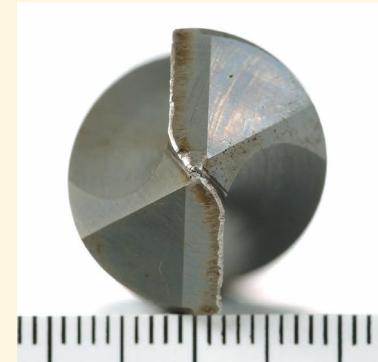
(3) Examples of Drill Process Data (for reference purposes)／钻孔加工数据例[供参考]

This table shows reference data for drilling using a radial boor bank drilling machine.

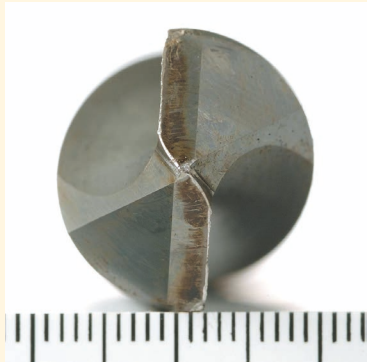
采用径向钻床钻孔加工数据例如下所示。

Type of Steel 钢种	Type of Drill 钻头种类	Drilling Depth 孔深度 (mm)	Machine Tool 机床	Drill Lubricant 切削油剂	Drill Diameter 钻头直径 (mm)	Drill Speed 切削速度 (m/min)	Rotation Speed 旋转速度 (min ⁻¹)	Feed Rate 进给量 (mm/rev)	Plated Through Hole 贯通孔数	Length of Cut 切削长 (mm)
ABREX 500	Powder High Speed Steel 粉末高速钢	25	Standing radial boor bank drilling machine 立式径向钻床	aqueous drill lubricant at 15x dilution 水溶性 15倍 稀释	φ10	5.2	165	0.15	31	775
					φ20	4.7	75	0.25	53	1325
					φ30	4.7	50	0.25	20	500
ABREX 400	Powder High Speed Steel 粉末高速钢	25	Standing radial boor bank drilling machine 立式径向钻床	aqueous drill lubricant at 15x dilution 水溶性 15倍 稀释	φ10	6.3	200	0.15	78	1950
					φ20	6.9	110	0.25	136	3400
					φ30	7.1	75	0.25	42	1050
	Cobalt High Speed Steel 钴高速钢	25	Standing radial boor bank drilling machine 立式径向钻床	aqueous drill lubricant at 15x dilution 水溶性 15倍 稀释	φ10	5.2	165	0.15	123	3075
					φ20	4.7	75	0.25	52	1300
					φ30	4.7	50	0.25	34	850

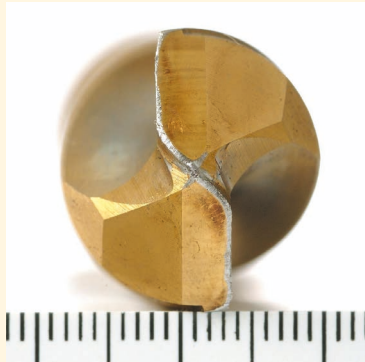
Close-up Photos of Drill Bits (All 3 have a diameter of 20mm)／
钻孔加工后的钻头尖端扩大照片(3件钻头均为直径φ20)



ABREX 500 Powder High Speed Steel
4.7m/min 0.25mm/rev
Plated Through Hole: 53
ABREX 500 粉末高速钢
4.7m/min 0.25mm/rev 53 孔贯通后



ABREX 400 Powder High Speed Steel
4.7m/min 0.25mm/rev
Plated Through Hole: 136
ABREX 400 粉末高速钢
6.9m/min 0.25mm/rev 136 孔贯通后



ABREX 400 Cobalt High Speed Steel
4.7m/min 0.15mm/rev
Plated Through Hole: 52
ABREX 400 钴高速钢
4.7m/min 0.15mm/rev 52 孔贯通后

Examples of the Product in Use／使用例



Bulldozer

推土机



Dump Truck

翻斗车

Crusher

压碎机



Excavator

铲土机

Reference
参考资料

NIPPON STEEL Specifications; Comparison with Former Specifications

日本制铁规格新旧规格对比表

Former NSC Product Name 前新日本制铁	Former Sumitomo Metals Product Name 前住友金属工业	New NIPPON STEEL Name 日本制铁
—	SUMIHARD-K340	—
WEL-HARD400 WEL-TEN AR360E	SUMIHARD-K400	ABREX 400
WEL-TEN AR400E	SUMIHARD-K450	ABREX 450
WEL-HARD500 WEL-TEN AR500E	SUMIHARD-K500	ABREX 500

* With regard to special specification products not included in the above table, please contact us about these specific products.
* 按特别规格制造的规格品种，请另行咨询。

Customer's Comments
客户评价

Hiyoshi Kaisoten
Hiyoshi Kaisoten

Our company has established a warehouse within the premises of the Kimitsu Steel Works and has been engaged in the storage and transportation of steelmaking raw materials such as ferroalloys for many years. We transport hard and heavy ferroalloys daily, but we have had concerns about the frequent need for repairs and replacements of the truck bed's bottom plate, which was made of conventional steel materials and prone to wear. To address this issue, we learned about Nippon Steel's "ABREX™," which excels in wear resistance, and requested its adoption by the body manufacturer.

By adopting "ABREX™," we were able to reduce the thickness of the steel material used for the bottom plate, achieving weight reduction and improving loading efficiency. Additionally, the bottom plate became less prone to wear, eliminating the need for repairs and replacements, leading to the transportation of over 500,000 tons in approximately 10 years. The improvement in loading efficiency due to weight reduction and the increase in operational rate due to maintenance-free operation have greatly contributed to the enhancement of our company's profitability.

公司多年来一直在君津钢铁厂内运营，负责合金铁和其他炼钢原材料的储存和运输。每天运输坚硬而沉重的合金铁导致翻斗车床频繁磨损，需要定期维修和更换。了解到日本制铁的ABREX™的耐磨特性后，公司向车身制造商申请采用。

采用ABREX™使得用于底板的钢材厚度得以减少，实现了减重并提高了装载效率。

ABREX™的耐磨特性使得在大约10年内无需维修或更换，促进了超过50万吨的运输。

装载效率的提高和免维护操作显著提高了公司的盈利能力。



No repairs or replacements needed for approximately 10 years. Completely maintenance-free, making a significant contribution to increased profitability!

约10年无需维修或更换。真正免维护，显著提升收益！

