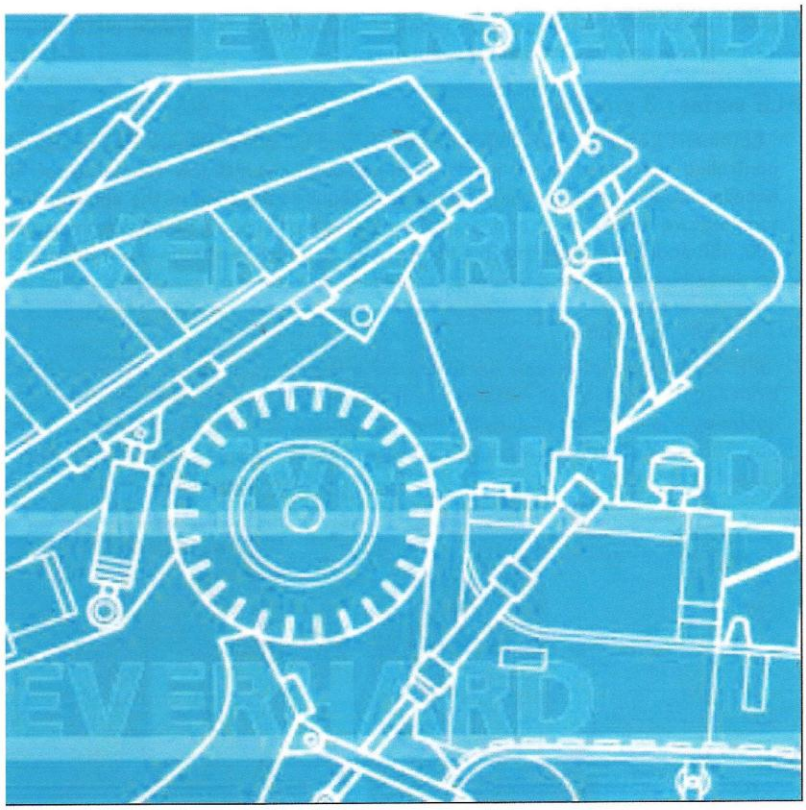
EVERHARD ™
LE and C Series

Abrasion-Resistant Steel Plate

- EVERHARD™, Reliable Forever -



JFE Steel Corporation

Establishment of new grades; EVERHARD C series

JFE Steel corporation can produce 8 grades of abrasion-resistant steel plate basically; the standard series and alloy series with 3 and 2 grades of hardness respectively, a super abrasion resistant grade, as well as 400 grade, 450 grade and 500 grade with high toughness, providing a complete product line that can meet a wide range of applications. It adds above, at this time, we have established C(means center) series, which set the narrower Brinell hardness range and also adopt it's center value as grade name.

◆Standard series: 3 grades

This series consists of grades produced with the main emphasis on their hardness levels, the chemical composition being basically simple with boron added while the addition of other alloying elements is restrained in viewpoint of manufacturing cost reduction.

◆Alloy series: 2 grades

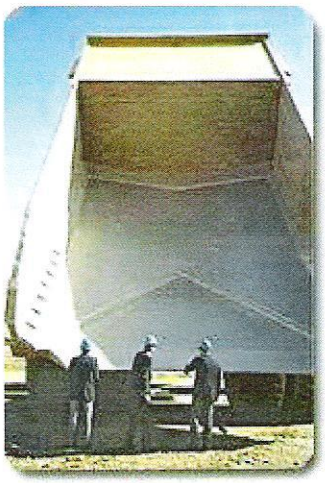
This series contains alloying elements in greater quantities than the standard series. The prescribed hardness is guaranteed for plate thickness up to 100mm and at the same time, consideration has been given to low-temperature(0°C) toughness which is in case of EVERHARD 360A(hardness: 400 grade), 500A(hardness: 500 grade), plate thickness is 13.1～50mm and 13.1～25mm respectively.

◆LE series: 3 grades

LE(means Leading Edge) series had developed by micro-alloying technology and controlled heat treatment, consideration has been given to low-temperature(-40°C) excellent toughness. The high toughness is required because of the application in low temperature environment and/or suffering with high impact. Brinell hardness levels are 400, 450 and 500 grade. And this series have also high resistance to weld-cracking, then presents high quality and safety of weld joint.

◆C series: 4 grades

JFE Steel corporation have established C(means center) series, which set the narrower Brinell hardness range at surface and also adopt it's center value as grade name by accuracy improvement of alloying element content at the time of steel making process, etc. This series arranged 4 grade of hardness levels 400, 450 about standard series and LE series.



■Comparison with conventional grades

Table1 Comparison with conventional grades and new grades

Conventional			New grade			Concept of new grade
Grade	Thick. (mm)	Brinell Hardness	Grade	Thick. (mm)	Brinell Hardness	
EVERHARD 360	6～50	≧361	EVERHARD C400	6～100	400±30	Narrow range of Brinell hardness guaranteed
EVERHARD 360A	6～100					
EVERHARD 360LE	6～32	361～440	EVERHARD C400LE	6～60		Narrow range of Brinell hardness guaranteed Thickness enlarged
EVERHARD 400	6～50	≧401	EVERHARD C450	6～100	450±25	
EVERHARD 400LE	6～32	410～490	EVERHARD C450LE	6～50		
EVERHARD 500	6～50	≧477	-			
EVERHARD 500A	6～100					
EVERHARD 500LE	6～32	477～556				

■Specification of new grade

Table2 Mechanical properties of new grades

New grade	Thick (mm)	Brinell Hardness	Charpy Impact Value			Chemical composition	
			Thick (mm)	Temp. (℃)	Energy (J)	Thick (mm)	Ceq.(IIW)
EVERHARD C400	6.0～100	400±30	-			-	
EVERHARD C400LE	6.0～60.0		6.0～11.9	-		6.0～19	≦0.40
			12.0～32	-40	≧ 27	19.1～32	≦0.43
			32.1～60			32.1～60	≦0.58[1)]
EVERHARD C450	6.0～100	450±25	-			-	
EVERHARD C450LE	6.0～50.0		6.0～11.9	-		6.0～19	≦0.50
			12.0～32	-40	≧ 27	19.1～32	≦0.53
			32.1～60			32.1～60	≦0.65[1)]

Ceq = ・・・

■Test results of EVERHARD C400LE

Table3　Brinell hardness at surface

Thick.(mm)	Brinell hardness　(　): Ave.	Spec.
50.8	413,405,429,425,425 (419)	Ave. 400±30
60	423,411,421,413,411 (416)	

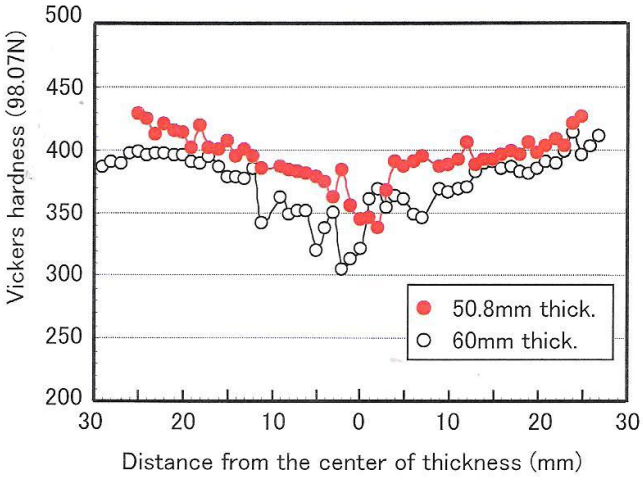


Fig.1　Section hardness distribution

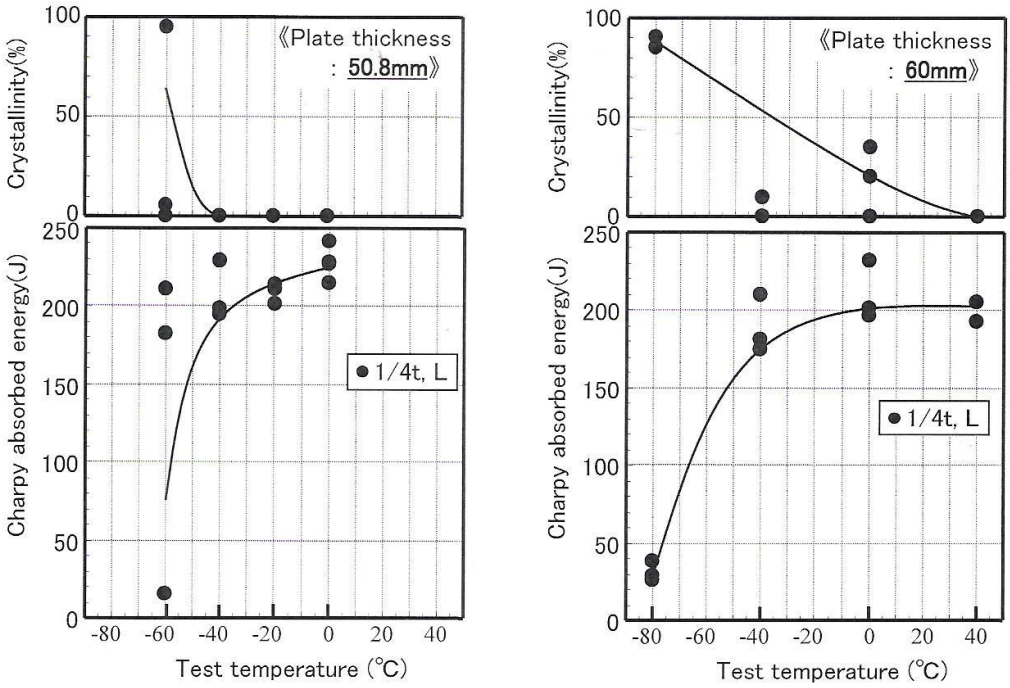


Fig.2　Charpy transition curve

■Test results of EVERHARD C450LE

Table4　Brinell hardness at surface

Thick.(mm)	Brinell hardness　(　): Ave.	Spec.
10	455,482,469,466,466 (468)	Ave. 450±25
15	435,463,458,463,447 (453)	
20	450,452,445,450,452 (450)	
25	442,440,447,445,450 (445)	
32	440,452,447,450,445 (447)	
40	464,453,452,455,458 (456)	
50	468,468,470,467,472 (469)	

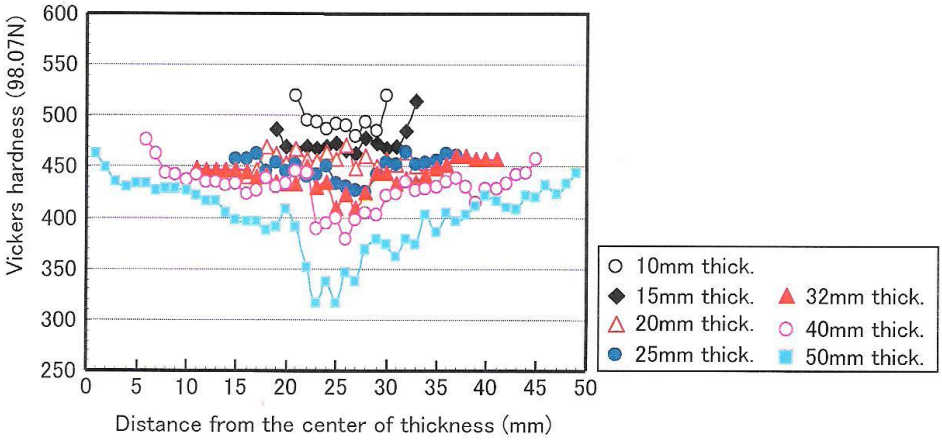


Fig.3　Section hardness distribution

Table5　Mechanical properties

Thick.(mm)	Tensile test					Charpy impact test			
	Test specimen	Direc-tion	0.2%YS (MPa)	TS (MPa)	El. (%)	Test specimen	Direc-tion	Test temp.(℃)	Absorbed energy (J)
10	JIS Z2241 No.5 (All thick-ness)	C	1174	1504	16	JIS Z2242 2mmV 10×10 (1/4t)	L	-40	38,57,43 (46)※
15			1173	1487	18				42,43,41 (42)
20			1121	1442	20				50,42,42 (45)
25			1124	1425	21				46,39,51 (45)
32			1106	1402	24				32,33,34 (33)
40	JIS Z2241 No.4 (1/4t)		1035	1371	16				35,41,50 (42)
50			1008	1290	15				43,32,43 (39)

※Sub size specimen(7.5×10)

■Test results of EVERHARD C400

Table6 Brinell hardness at surface

Thick.(mm)	Brinell hardness ( ) : Ave.	Spec.
25.4	396,399,372,379,387 (387)	Ave. 400±30
50	406,408,401,401,402 (404)	
70	403,415,420,400,409 (409)	

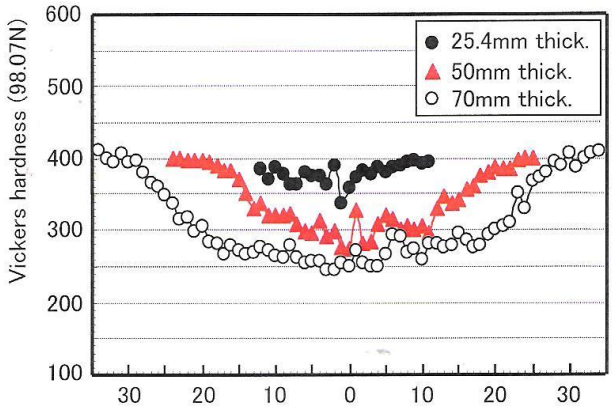


Fig.4 Section hardness distribution

■Test results of EVERHARD C450

Table7 Brinell hardness at surface

Thick.(mm)	Brinell hardness ( ) : Ave.	Spec.
20	437,445,437,437,452 (442)	Ave. 450±25
30	442,440,435,440,435 (438)	
50	437,463,463,458,445 (453)	

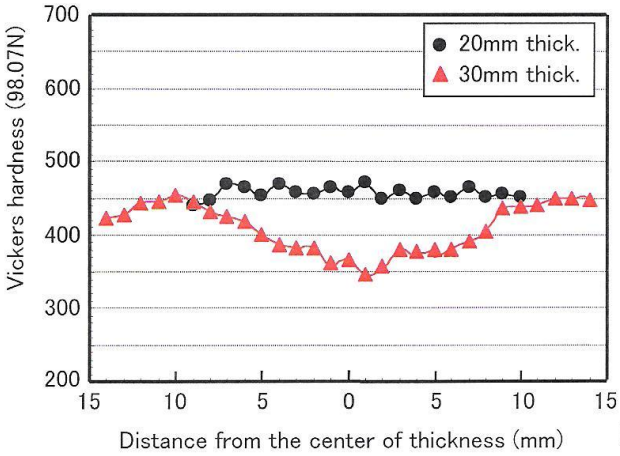


Fig.5 Section hardness distribution

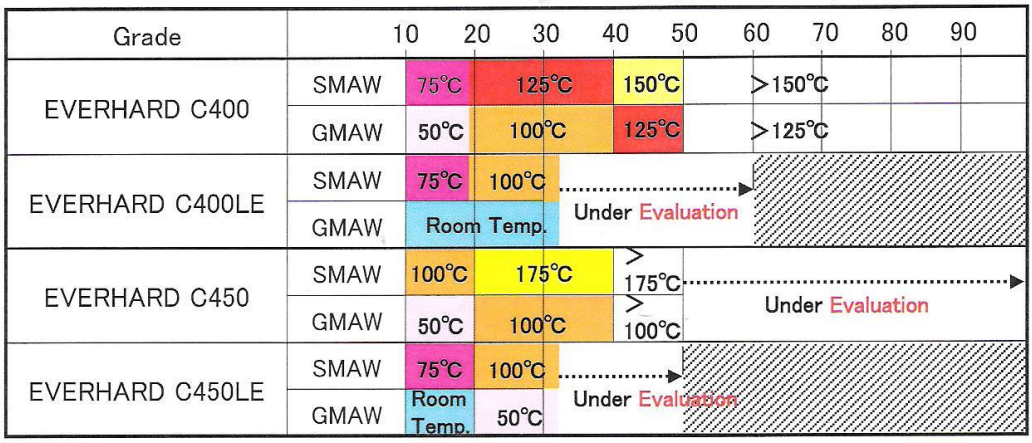
Maximum Available Size

It is the same as written contents on conventional JFE's catalog (Cat.No.C1E-004-07).

Recommendations for excellent fabrication performance

It is the same as written contents on conventional JFE's catalog (Cat.No.C1E-004-07). For example, the recommended preheating temperature based on y-groove weld cracking test(JIS Z 3158) shows as following.

Thickness(mm)



- Decided by y-groove weld cracking test according to JIS Z 3158
- SMAW: Shielded Metal Arc Welding
- GMAW: Gas shielded Metal Arc Welding

Fig.6 Recommended preheating temperature based on y-groove weld cracking test

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