CONTENTS

Chapter 1

Performance & Achievements

The wear resistant steel is designed by lower alloyed and clean controlled technique. It exhibits high strength, high hardness, good wear resistance and good weldability.

Standard, Chemical Composition & Mechanical Property

Standard, Condition and Specification

Grade	Standard	Condition	Specification		
			Thickness / mm	Width / mm	Length / m
NM360	Q/3201NG215-2013	Q + T	5 ~ 8	1600 ~ 2600	≤ 20
			8~ 70	1600 ~ 3200	
NM400	Q/3201NG215-2013	Q + T	5 ~ 8	1600 ~ 2600	≤ 20
			8~ 70	1600 ~ 3200	
NM450	Q/3201NG215-2013	Q + T	5 ~ 8	1600 ~ 2600	≤ 20
			8~ 70	1600 ~ 3200	
NM500	Q/3201NG215-2013	Q + T	5 ~ 8	1600 ~ 2600	≤ 20
			8~ 70	1600 ~ 3200	
NM550	Q/3201NG215-2013	Q + T	5 ~ 8	1600 ~ 2600	≤ 20
			8~ 70	1600 ~ 3200	

Note: Products can be applied under the agreements. Q : Quench, T : Tempering

Chemical Compositionδwt.%, maxε

Grade	C	Si	Mn	P	S	Al	Cr	B	Mo	Ni
NM360	0.18	0.40	1.45	0.012	0.002	0.060	0.50	0.0020	0.40	--
NM400	0.22	0.40	1.50	0.012	0.002	0.060	0.90	0.0020	0.40	0.50
NM450	0.25	0.60	1.50	0.012	0.002	0.060	1.00	0.0020	0.50	0.50
NM500	0.32	0.60	1.50	0.012	0.0015	0.060	1.10	0.0023	0.60	0.50
NM550	0.37	0.60	1.60	0.010	0.0015	0.060	1.30	0.0025	0.70	0.80

Mechanical Property

Grade	B. Hardness / HB	Y. Strength R_{el} / MPa	T. Strength R_m / MPa	Elongation A_{50} / %	Impact Absorption Energy KV_2 / J (-20℃)	90° Bend
NM360	360~420	≥ 900	≥ 1100	≥ 12	≥ 40	R = 2.0a
NM400	380~440	≥ 950	≥ 1150	≥ 10	≥ 40	R = 2.5a

(Continued)

Grade	B. Hardness /HB	Y. Strength R_{eL}/MPa	T. Strength R_m/MPa	Elongation A_{50}/%	Impact Absorption Energy KV_2/J(-20ć)	90° Bend*
NM450	420~480	≥ 1050	≥ 1350	≥ 9	≥ 24	R=3.0a
NM500	470~530	≥ 1250	≥ 1500	≥ 9	≥ 24	R=3.5a
NM550	525~580	≥ 1350	≥1650	≥7	≥ 24	--

Note: R-Bending radius; a-Thickness.

Wear-resistant Performance

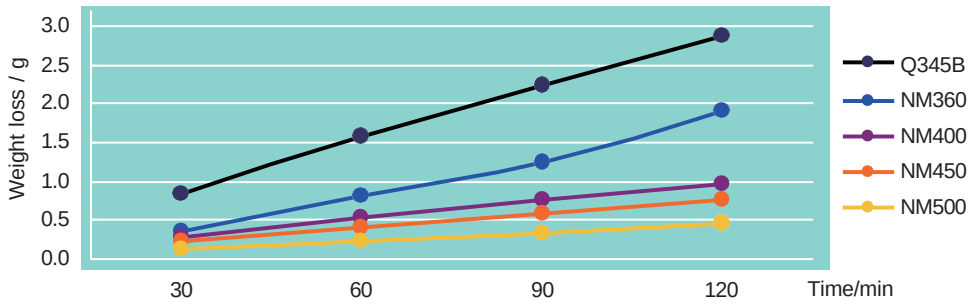
Wearing refers to the continuous damage or loss of materials on the object surface during opposite motion. Wearing has a lot of types including the abrasive wear, adhesive wear, corrosion wear, erosion wear, contact fatigue wear, impact wear and micro wear, etc.

There are many influence factors to wearing, including working conditions (load, speed, movement), lubrication condition, environmental factors (humidity, temperature, medium), material factors (composition, microstructure, mechanical properties), parts surface quality, physical and chemical properties, etc. Each change of these factors change could lead to a change in abrasion, and then the wear mechanism.

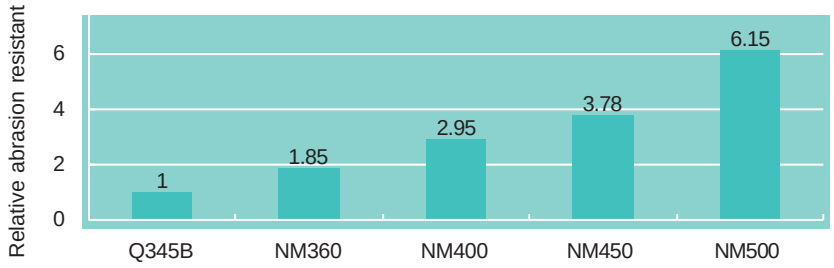
Improving the wear performance needs to take acount of many respects, such as the structure, environment and work system, etc. Material performance is only one factor of wear of the work-piece.

❖ Abrasion Test

Test condition·wear contact size,10mm×10mm-impact energy 2J-grinding material 8-10 mesh quartz sand-flow rate 70g/h.

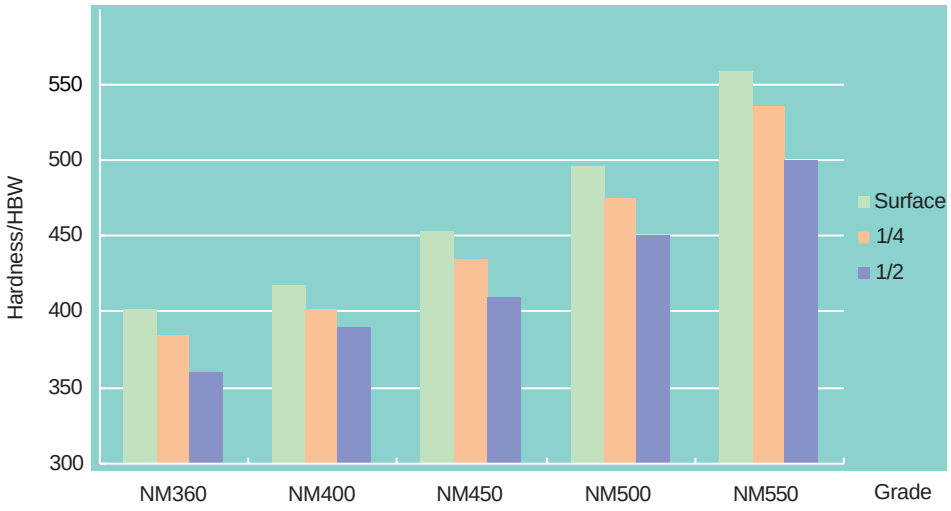


Wear-resistant steel abrasion performance

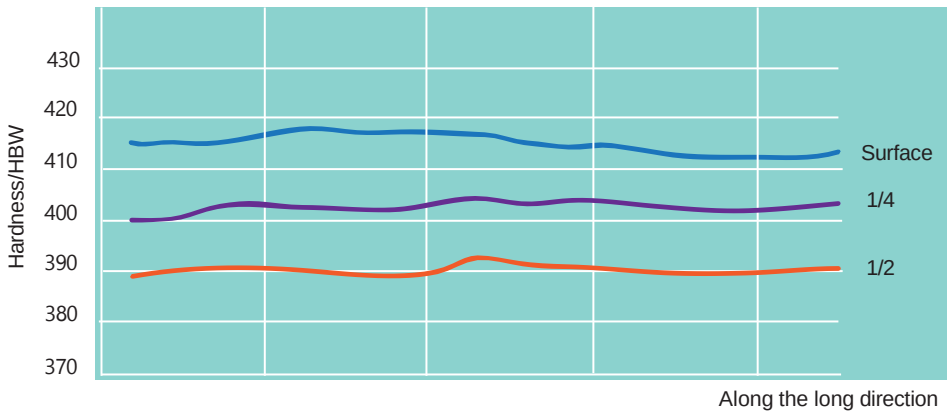


We

Hardness



The typical hardness in cross section of wear-resistant steel plate (40 mm)



The typical hardness distribution along the direction of steel plate length of NM400 (40 mm)

Application Fields and Achievements

A series of wear-resistant steel plates of NM360, NM400, NM450, NM500 and NM550 are mainly used in machinery products in mining, construction, cement, port, electric power and metallurgy, such as scraping machine, bulldozers, excavators, loaders, dump truck, cement machinery, power plant coal injection equipment, harvesters, chute, crusher, crusher, mixer, screening equipment, broken tools and barges, etc. Using wear-resistant steel plate can greatly improve the performance of the equipment and prolong service life to reduce the production cost.

A series of wear-resistant steel plate has been passed technological evaluation by many companies, such as ZhangJiakou Coal Mining Machinery CO., Ltd., Tiandi Benniu Industrial Croup CO., Ltd. and Caterpillar CO., Ltd.. They are widely used in many domestic state-owned and foreign-funded enterprises with good evaluation.

Wear-resistant steel plates of NM450, NM500 ahave been exported to more than 20 countries, such as South America, South Africa, Britain and Spain.

Main achievements of wear-resistant steel plate

No.	Application Fields	Application Products	Grade	Thickness / mm
1	Mining machinery	Crusher, Wide body of mine car, Electric wheel dump truck	NM400NjNM450	6~20
2	Coal mine machinery	Boring machine, Scraper machine	NM360NjNM450	20~60
3	Cement, Power plant	Chute, Chimney	NM450NjNM550	5~20
4	Engineering, Port machinery	Bucket, Shovel, Paver	NM400NjNM450	8~60
5	Environmental protection machinery	City environmental sanitation vehicle	NM400NjNM500	4~20




Chapter 2

Cutting & Forming

Hot Cutting

For wear-resistant steel plate, hot cutting (such as flame cutting, plasma cutting, laser cutting) is the good cutting method. Appropriate cutting parameters (such as size of the nozzle, the gas pressure, cutting method, cutting speed and so on) should be applied according to the actual situation of processing factory to guarantee the cutting quality.

The surface state of steel has obvious influence on cutting quality. The surface pretreatment is needed before cutting to the steel plate, and the clearing cutting area of the upper and lower surface is also needed. The oxide coating, rust and oil stain should be removed from the work piece surface before cutting.

Characteristics of different cutting methods

Cutting Method	Cutting Speed /(mm/min)	Cutting Edges Width /mm	HAZ /mm	Size Tolerance /mm
Flame Cutting	150 ~ 700	2 ~ 5	4 ~ 10	±2.0
Plasma Arc Cutting	1200 ~ 6000	2 ~ 4	2 ~ 5	±1.0
Laser Cutting	600 ~ 2200	Ĩ1	0.4 ~ 3	±0.2

Cutting Crack and Prevention Measures

With the increase thickness and hardness of wear-resistant steel plate, the cutting crack is tend to take place. In order to effectively prevent the cutting crack, the following measures are suggested:

(1) Preheating. The preheating is needed before cutting. The preheating temperature depends on the steel grade and thickness. Preheating can use the flame or electric heating. The cutting surface should be heated uniformly to avoid local overheating.

Recommended preheating temperature for cutting wear-resistant steel plate

Grade	Thickness / mm	Preheating Treatment / ℃
NM400	40 ~ 60	100 ~ 200
NM450	40 ~ 50	100 ~ 200
NM500	30 ~ 50	100 ~ 200
NM550	20 ~ 50	150 ~ 200

(2) Low speed cutting. Keeping lower cutting speeds can prevent or reduce the cutting crack. But the effect is not as good as with preheating.

Recommended maximum cutting speed of flame cutting

Thickness / mm	Maximum Cutting Speed / (mm/min)			
	NM400	NM450	NM500	NM550
12	-	-	-	-
15	-	-	-	-
20	-	-	-	-
25	-	-	300	270
30	-	-	250	230
35	-	-	230	190
40	-	230	200	160
45	230	200	170	140
50	210	180	150	130
60	190	160	130	110
70	180	150	110	100

(3) Slow cooling rate. Slow cooling can reduce the risk of cutting crack. Putting the work piece together which is still warm after cutting and covering them with asbestos blanket will reduce the cooling rate and decrease the cracks consequently.

(4) When room temperature is lower than 5 ª, and the thickness exceeds 20 mm for wear-resistant steel plate, preheating is suggested firstly before cutting.

Softening by Cutting and Solutions

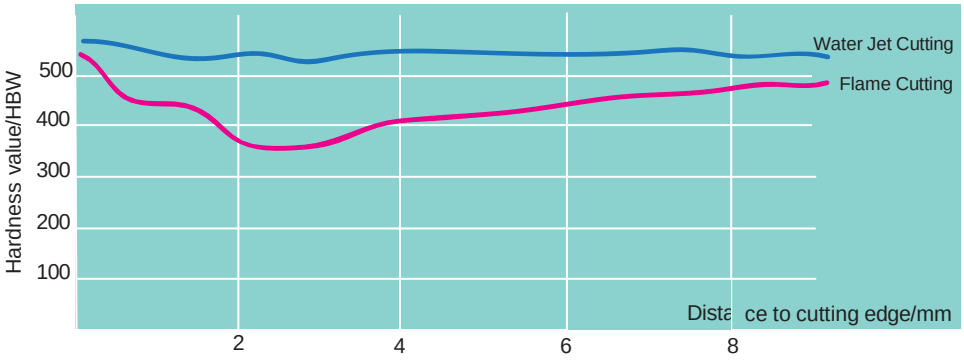
The cutting carried within the space less than 200 mm will cause the softening.

The softening can be prevented by underwater plasma arc cutting, underwater laser cutting or water jet cutting.

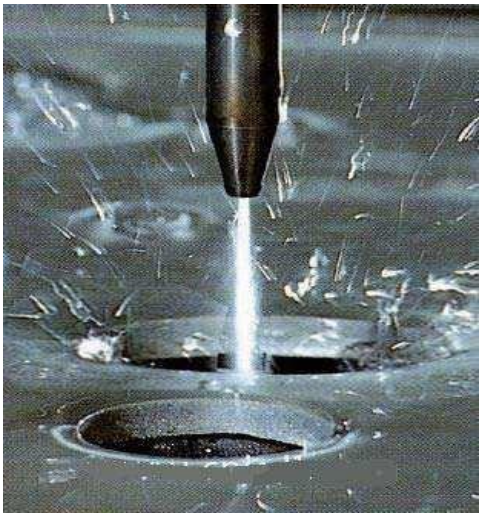
Water Jet Cutting

The water jet cutting is the method in which the water with / without additives is impacted on the work piece at the speed of 500~900 m/s. it exhibits narrow kerf (0.8~1.2 mm) and incision smooth, compared with the hot cutting process.

The water jet cutting belongs to cold cutting without hot damage to materials and without hot deformation, especially no local softening.



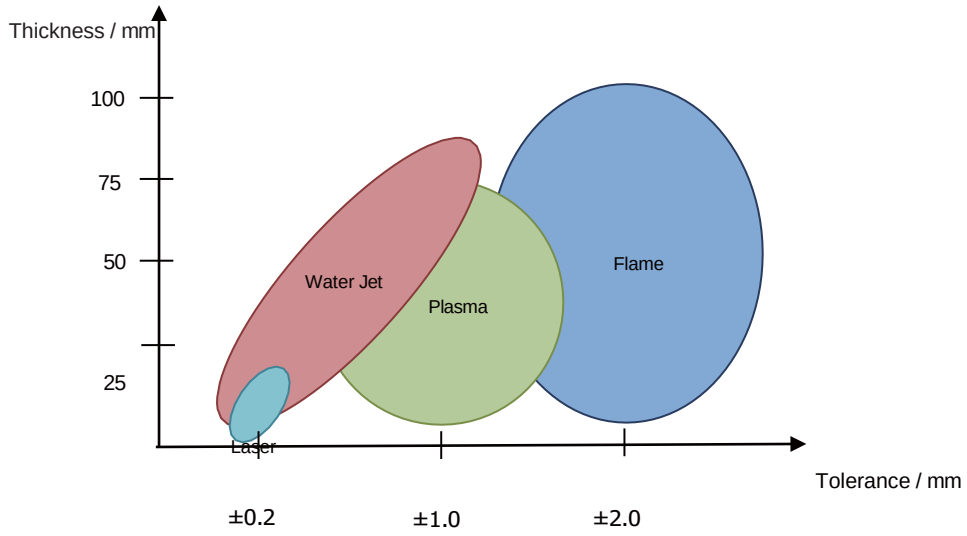
Typical hardness distribution of cutting area for NM500 (20mm) wear-resistant steel plate



Wire Cutting

The wire cutting is suitable for cutting the wear resistant steel plate. The appropriate parameters are selected according to the requirements and the situation of equipment.

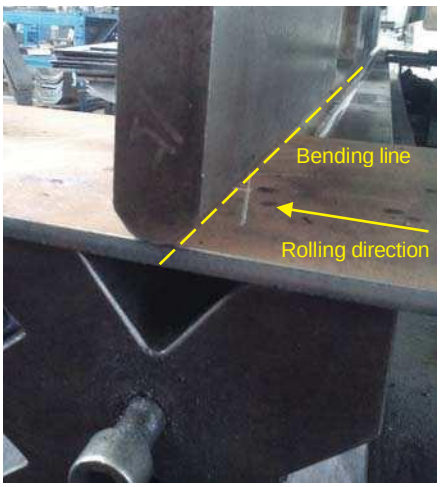
Scope of the Common Cutting Process



Common cutting process scope and tolerance

Cold Forming

For the higher strength steels, the bending force of cold forming is increased, and the elastic recovery is more severe, compared to the lower strength steel with the same thickness. Meanwhile, the elongation is reduced consequently, and the bending formability is changed, which should be taken into consideration.



The cold bending force can be calculated according to the following formula

$$P = C\frac{bt^2\sigma_b}{W}$$

Where b— plate width

t— plate thickness

σ_b— plate tensile strength

W— die shoulder width

C— C value is generally 0.6～1.8

Attention:

1. During cold bending of wear-resistant steel plate, bending direction should be parallel to the rolling direction (bending axis is perpendicular to rolling direction)

2. If bending direction is perpendicular to rolling direction, the bending radius should be increased correspondingly.

3. To avoid the risk of crack, flame cut or sheared edges in the bending area should be grinded before cold forming.

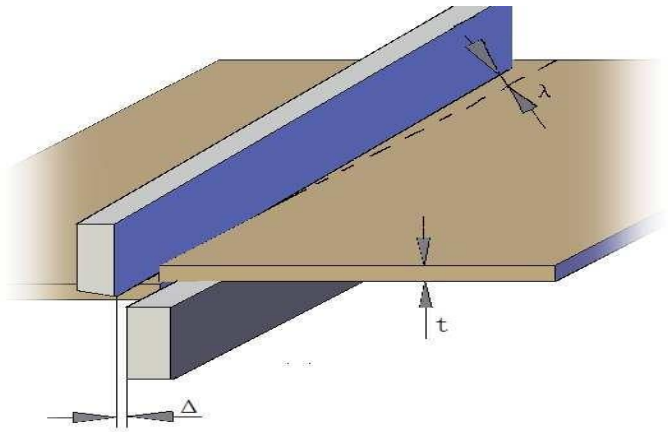
4. Steel stamps on bending surface are forbidden to prevent the risk of crack.

Hot Forming

If the tempering temperature is above the temperature of hot forming for wear resistant steel plate, the properties will be changed. So, the hot forming is not recommended.

Shearing

The wear-resistant steel plate with thickness less than 10 mm can be cut using shear method. As the strength of steel plate is improved, the required shear stress increases and the abrasion increases for tools.



In order to access the good quality of shear for wear-resistant steel plate, the right tools and the proper cutting parameters are needed. In the actual shear operation process, the appropriate parameters are selected according to the stability condition, the blade shears, and the strength, hardness and thickness of steel plates.

(1) Blade. The blade should be hard, sharp, and with slightly rounded corners.

(2) Clearance Δ. This is an important parameter to obtain good cutting quality. Clearance of moving blade and the fixed blade should be increased as the increase of the strength of the steel plate.

(3) Rake angle lambda λ. The shear stress can decrease as the rake angle is increased. But the too small rake angle will cause the deformation of shear connectors.

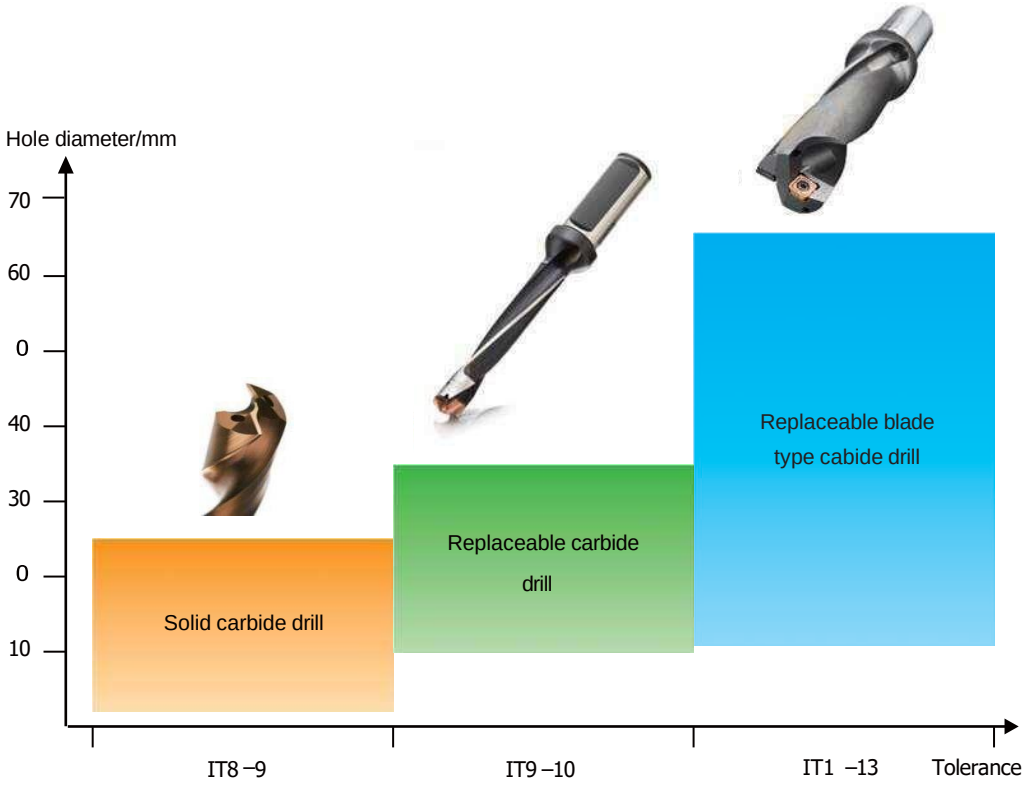
Chapter 3

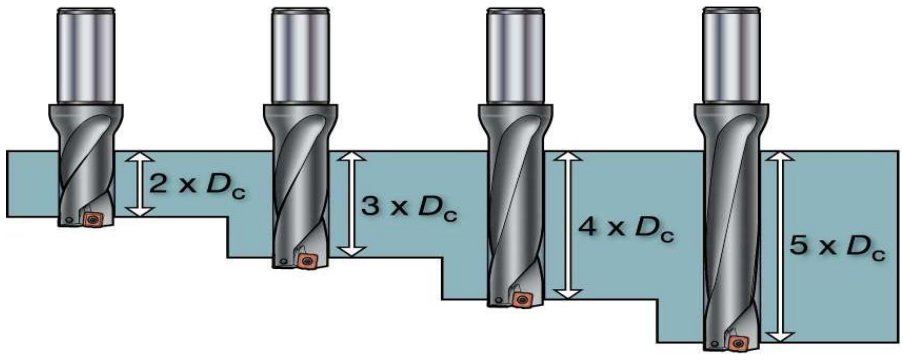
Machining Processing

Drilling

For drilling of wear-resistant steel plate, the most frequently used drills are solid carbide drill, replaceable carbide drill and replaceable blade type carbide drill. The choice of drill type depends on the equipment stability, the clamping force, drill diameter and tolerance.

If the processing requirements are allowable, the shorter drill should be the best.





A common type of drill and recommended scope

Recommended drilling parameters

Hole diameter	Drill Type	NM360	NM400	NM450	NM500
		Turning Speed (r/min) / Feed rate (mm/min)			
Φ 5	Solid carbide drill	2500/250	2300/178	1910/152	1592/127
Φ 10	Solid carbide drill	1270/127	1120/90	960/75	800/64
Φ 15	Solid carbide drill	850/85	740/60	640/50	530/42
	Replaceable carbide drill	740/75	640/50	530/40	420/35
Φ 20	Solid carbide drill	640/64	560/45	480/38	400/30
	Replaceable carbide drill	560/55	480/40	400/30	320/25
	Replaceable blade type carbide drill	1200/120	1100/90	950/75	800/65
Φ 25	Replaceable carbide drill	450/45	380/30	320/25	250/20
	Replaceable blade type carbide drill	950/95	900/70	750/60	640/50
Φ 30	Replaceable blade type carbide drill	800/80	750/60	650/50	550/40

Recommended cooling liquid: 8%-10% emulsion.

Chip evacuation during drilling process is very important, as it will affect the hole quality, tool life and reliability. So special attentions should be paid. The drilling parameters should be adjusted to ensure the smooth evacuation for chip.

Drilling common failure and solutions

Failure	Solutions
Vibration	Reducing the drill overhang, enhancing the chucking tools stiffness. Increasing the chucking Stiffness and improving the stability of the work piece. Reducing the cutting speed.
Size increase	Increasing the flow of cooling liquid, cleaning the filter, cleaning the drill hole of cooling liquid. Trying tougher Groove in neighboring (keeping the center blade).
Size decrease	Increasing the flow of cooling liquid, cleaning the filter, cleaning the drill hole of cooling liquid. Trying tougher groove in the center, Trying softer groove at the edge.

Thread Machining

The common thread machining includes tapping and thread milling. The proper method is selected according to the steel grade and the thread diameter. NM360 can be machined by both tapping and thread milling. If the aperture is greater than 15 mm, the thread milling is recommended. NM400 is recommended to be machined using thread milling due to the higher hardness.

Recommended tapping parameters

Grade	Cutting Tool Material	Cutting Speed / (m/min)
NM360	High speed steel	4

Note: It is recommended for wear-resistant steel plates of NM400 and higher levers to use thread milling machining method rather than tap processing thread.

Recommended thread milling parameters

Grade	Cutting Tool Material	Cutting Speed / (m/min)	Feed per Tooth / (mm/z)
NM360	Carbide blade (Hard coat)	120	0.06
NM400		110	0.06
NM450		90	0.06
NM500		80	0.06
NM550		60	0.06

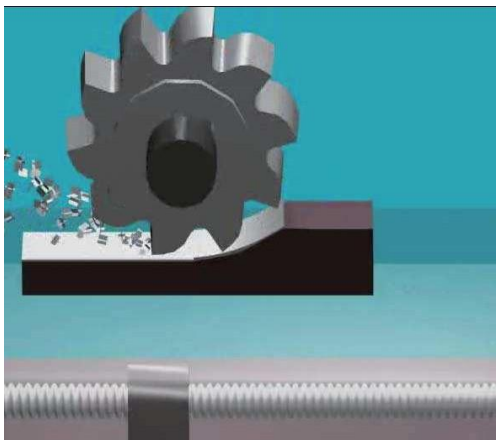
Recommended cooling liquid: 8%-10% emulsion.

Milling

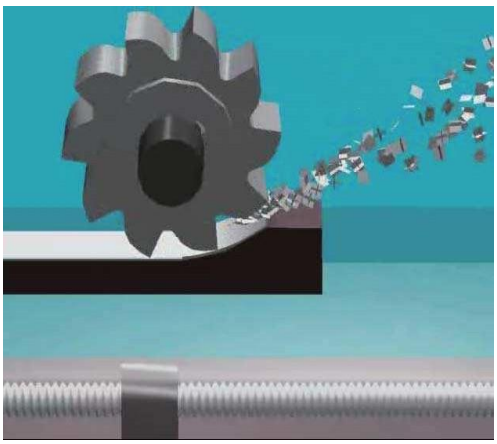
The commonly used processing methods of milling for wear-resistant steel plate include surface milling, square shoulder milling, et, al.

According to the different feeding direction, cutting method is divided into climb milling and inverse milling. Cutting blade starts from the maximum cutting thickness in climb milling, while cutting thickness is zero and then gradually increased in inverse milling. In the practical, climb milling can reduce tool abrasion, prolong the service life of cutting tools, while inverse milling for thin-walled parts processing can reduce the vibration.

The climb milling way is recommended for wear-resistant steel plate.



Climb milling



Inverse milling

Advantages and disadvantages of climb milling and inverse milling

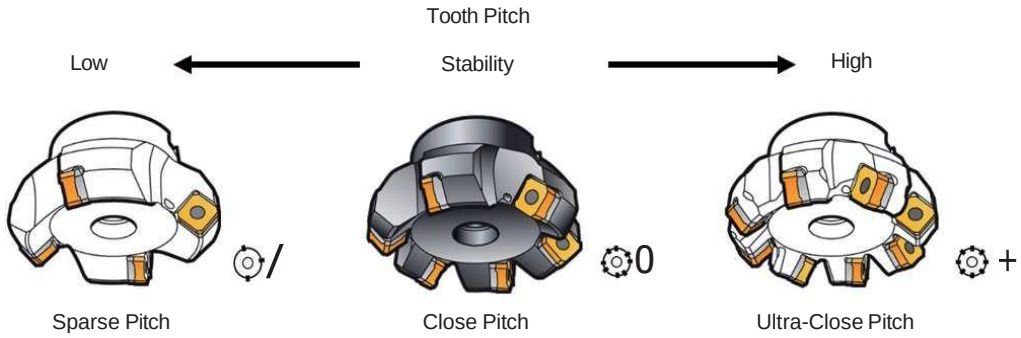
	Climb milling	Inverse milling
Iron filings	Iron filings become thinner. Small tensile stress is on tool when tool is left.	Iron filings become thicker. Large tensile stress is on tool when tool is left.
Reliability of work piece clamping	The downward cutting force compresses the work piece on workbench, which leads to the stable processing.	The upward cutting force cannot compress the work piece on workbench successfully, which leads to the relatively unstable processing.
Stability of cutting process	Good	Bad
Wearing of tool	Small degree	High degree
Channeling move of work bench	Much	Less

Face milling

Shoulder milling

Characteristics of face milling and shoulder milling

	Face Milling	Shoulder Milling
Characteristics	Milling smooth	Application universally
	Balanced cutting force between vertical and axial direction	90°angle of first cutting



Milling tool selection

Recommended parameters of face milling

Grade	Tool Material	Cutting Speed / (m/min)	Feed per Pitch / (mm/z)	Metal Removal Rate / (cm^3/min)
NM360	Carbide blade (Hard coat)	100	0.12	≤ 13.76
NM400		100	0.12	≤ 13.76
NM450		80	0.12	≤ 11.46
NM500		80	0.10	≤ 10.32
NM550		80	0.10	≤ 10.32

Recommended parameters of face milling in fast forward

Grade	Tool Material	Cutting Speed / (m/min)	Feed per Pitch / (mm/z)	Metal Removal Rate / (cm^3/min)
NM360	Carbide blade (Hard coat)	90	0.7	≤ 71.34
NM400		90	0.7	≤ 71.34
NM450		80	0.7	≤ 71.34
NM500		80	0.6	≤ 64.2
NM550		80	0.6	≤ 64.2

Recommended parameters of shoulder milling

Grade	Tool Material	Cutting Speed / (m/min)	Feed per Pitch / (mm/z)	Metal Removal Rate / (cm^3/min)
NM360	Carbide blade (Hard coat)	100	0.12	≤ 3.67
NM400		100	0.12	≤ 3.67
NM450		80	0.12	≤ 3.36

（Continued）

Grade	Tool Material	Cutting Speed / (m/min)	Feed per Pitch / (mm/z)	Metal Removal Rate / (cm^3/min)
NM500	Carbide blade (Hard coat)	80	0.10	≤ 3.36
NM550		80	0.10	≤ 3.36

Common failures and solutions of milling

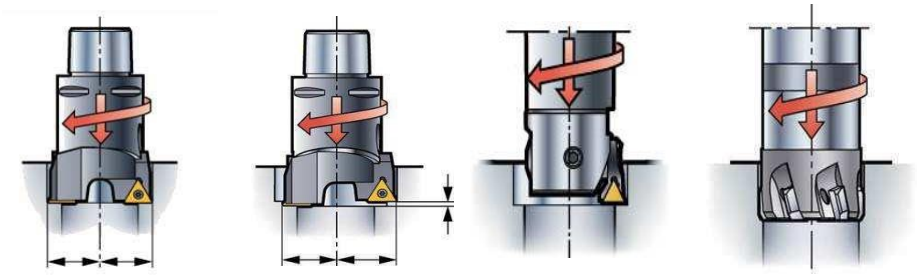
Failures		Solutions
Vibration	Poor rigidity of fixture	Analysis of cutting force direction and to provide fully support or improve fixture. Reducing the cutting depth. With a positive rake angle for cutting method.
	Poor rigidity of work piece in axial direction	Choosing the tooth cutter with unequal tooth pitch. Checking the wear of cutting tool, replacing the tool as the wearing is big. Checking the beat pulsation of hilt, adjusting the cutting parameters as the quantity is large.
	Parameters of cutting	Lowering cutting speed Increasing the feed Changing of cutting depth
Poor surface quality	Too large feed per revolution	Decreasing the feed per revolution, band width of parallel blade adjustment to≤70% If possible, using the Wiper blade (finishing processes)
	Retreated cutting	Checking the spindle tilt and adjust Avoiding the spindle axial run out too large in the finishing process Selecting the tool diameter smaller Ensuring that the tool is not shaking Adjusting the mounting surface
	Collapsing of the work piece	Reducing the amount of feed Selecting the dense teeth or super dense cutter Selecting the main angle more appropriate (45 degrees) and light cutting groove Selecting the sharp blade Attention of the flank wear, avoiding excessive wear

Boring

Boring is the processing method of reaming the pre-hole, rough boring first and then the fine boring.

Course Boring

Fine Boring



Multi-blade boring

High matel removal rate

High efficiency boring

Ladder boring

High matel removal rate

Course boring

Single blade boring

Ordinary fine boring

Reaming

Good surface roughness

Common boring parameter

	Grade	Tool Material	Cutting Speed / (m/min)	Feed per Turn / (mm/r)	Metal Removal Rate / (cm^3/min)
Rough Boring	NM360	Carbide blade (Hard coat)	100	0.15	≤ 25
	NM400		100	0.15	≤ 25
	NM450		90	0.15	≤ 21.88
	NM500		80	0.15	≤ 21.88
	NM550		70	0.15	≤ 18.75
Fine Boring	NM360		120	0.08	≤ 1.25
	NM400		120	0.08	≤ 1.21
	NM450		120	0.08	≤ 1.33
	NM500		120	0.08	≤ 1.33
	NM550		120	0.08	≤ 1.71

Common failure of boring and solutions

Failure	Solutions
Too long broken chip	Improve Increasing cutting speed, reducing the feed per revolution. The groove for chip breaking more open. Using the more open chip breaking groove.
Too short broken chip	Increasing the feed per revolution, lowering cutting speed. The groove for chip breaking more closed. Using the more closed chip breaking groove.
Vibration	Use the interface size as large as possible, using anti-vibration boring tool. Check to make sure all of the units of the tools are assembled correctly.

Attached: Common calculation formulas for mechanical processing & the meaning of parameters

Common calculation formulas of drilling

Cutting speed $Vc = \frac{Dc \times \pi \times n}{1000}$

Spindle speed $n = \frac{Vc \times 1000}{\pi \times Dc}$

Feed per revolution $fn = \frac{Vf}{n}$

Metal removal rate $Q = \frac{Dc \times fn \times Vc}{4}$

Common calculation formulas of milling

Cutting speed $Vc = \frac{Dcap \times \pi \times n}{1000}$

Spindle speed $n = \frac{Vc \times 1000}{\pi \times Dcap}$

Feed per tooth $fz = \frac{Vf}{n \times Zc}$

Metal removal rate $Q = \frac{ap \times ae \times Vf}{1000}$

Common meaning of parameters of machining processing

Parameters	Meaning	Unit	Parameters	Meaning	Unit
Vc	Cutting speed	m/min	n	Spindle speed	rpm
Dc	Diameter of the drill	mm	Dcap	Diameter of cutting	mm
fn	Feed per revolution	mm/r	fz	Feed / Tooth	mm
Vf	Table feeds (milling)	mm/min	Q	Metal removal rate	cm^3/min
	Rate of penetration (drilling)	cm^3/min	ae	Cutting radial width	mm
ap	Cutting depth	mm	Zc	Effective number of teeth	-

Chapter 4

Welding

Weldability

The wear-resistant steel plate has certain hardening capacity. The improper welding process will lead to welding cracks. Excellent properties of welding joint can be obtained by using reasonable welding method and appropriate welding consumables.

Carbon equivalent

Grade	C_{eq}%
NM360	≤0.46
NM400	≤0.52
NM450	≤0.62
NM500	≤0.65
NM550	≤0.78

Note: Ceq=C+Mn/6+(Cu+Ni)/15+(Cr+Mo+V)/5

Welding Method

The wear-resistant steel plate can be welded by gas metal arc welding, submerged arc welding, and shielded metal arc welding and so on. Common welding method of the series wear-resistant steel plate is shown in the table below.

Common welding method of wear-resistant steel plate

Grade	Available Welding Method	Common Welding Method	Recommended (Coal Mine MachineryŁEngineering Machinery)
NM360	GMAWNjSAWNj SMAW	GMAWNjSMAW	GMAW
NM400	GMAWNjSAWNj SMAW	GMAWNjSMAW	GMAW
NM450	GMAWNjSMAW	GMAWNjSMAW	GMAW
NM500	GMAWNjSMAW	GMAW	GMAW
NM550	GMAWNjSMAW	GMAW	GMAW

Note: GMAW-Gas Metal Arc Welding
SMAW-Shielded Metal Arc Welding
SAW-Submerged Arc Welding

Welding Consumables

For obtaining the high-quality welded joints, the matched welding consumables are needed. If necessary, the qualification of welding procedure is required. The principles should be followed to select the welding consumables:

(1) Undermatching principle. The welding consumable with lower strength and good ductility is used.

(2) When the dissimilar material is welded, the strength and ductility of weld metal should be better than that of one side base metal whose properties is inferior to other side.

(3) Lower hydrogen or super-lower hydrogen electrode is used preferentially in order to avoid the welding cold cracks.

Common welding consumables of wear-resistant steel plate

Grade	GMAW Wire GB/T 8110		Electrode GB/T 5118		SAW Wire & Flux GB/T 12470
	Important Load Structure	Normal Structure	Important Load Structure	Normal Structure	
NM360	ER69-G	ER50-6(CO_2) ER50-3(Ar+20%CO_2 Or Ar +2%~5%O_2)	E7015-X E7016-X	E5016	F55A3-H08MnMoA-H8 Such as : H08MnMoA+SJ101
NM400	ER69-G	ER50-6(CO_2) ER50-3(Ar+20%CO_2 Or Ar +2%-5%O_2)	E7015-X E7016-X	E5016	F55A3-H08MnMoA-H8 Such as : H08MnMoA+SJ101
NM450	ER69-G	ER50-6(CO_2) ER50-3(Ar+20%CO_2 Or Ar +2%-5%O_2)	E7015-X E7016-X	E5016	-
NM500	ER69-G	ER50-6(CO_2) ER50-3(Ar+20%CO_2 Or Ar +2%-5%O_2)	E7015-X E7016-X	E5016	-
NM550	ER69-G	ER50-6(CO_2) ER50-3(Ar+20%CO_2 Or Ar +2%-5%O_2)	E7015-X E7016-X	E5016	-

Welding Preparation

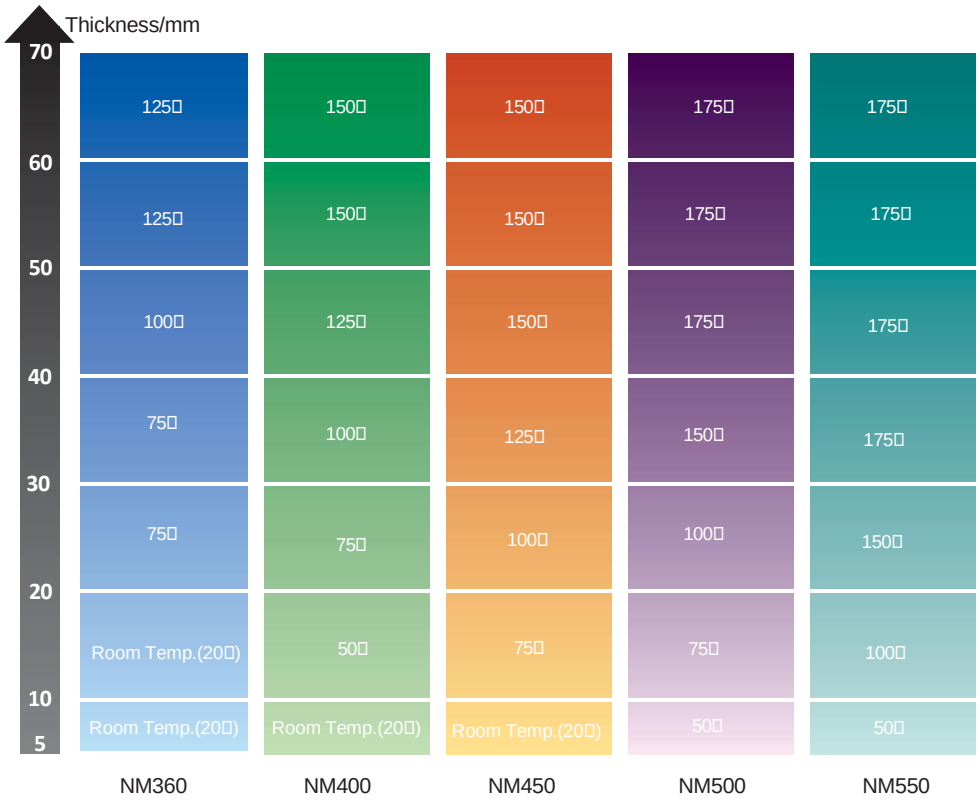
Welding groove should be processed by machining preferentially, or by flame cutting, plasma cutting, and laser cutting as well.

The slag, oxide coating, rust, oil and residual by heat cutting should be removed from the groove and zone near weld. So the metallic luster should be shown.

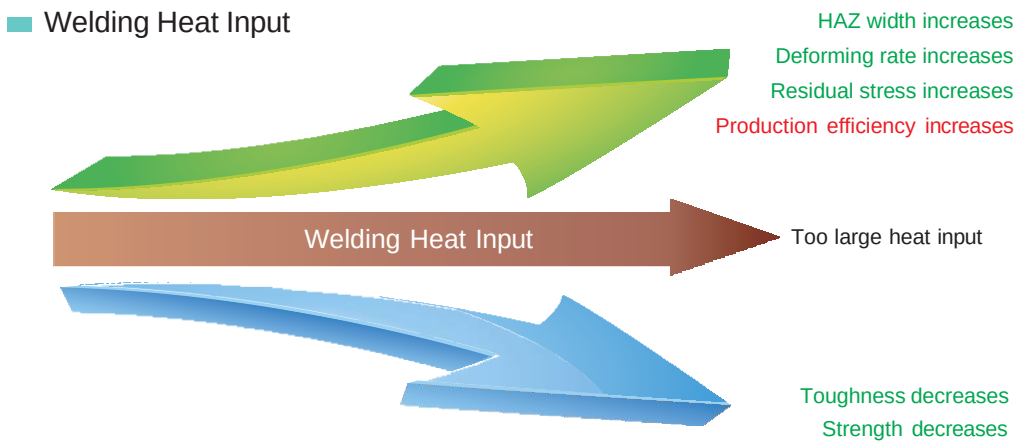
Preheating

The electric heating or flame heating can be used to preheat the work piece. Integral preheating exhibits better effect than local pre-heating. When the local preheating is performed, the preheating distance should be more than 100 mm.

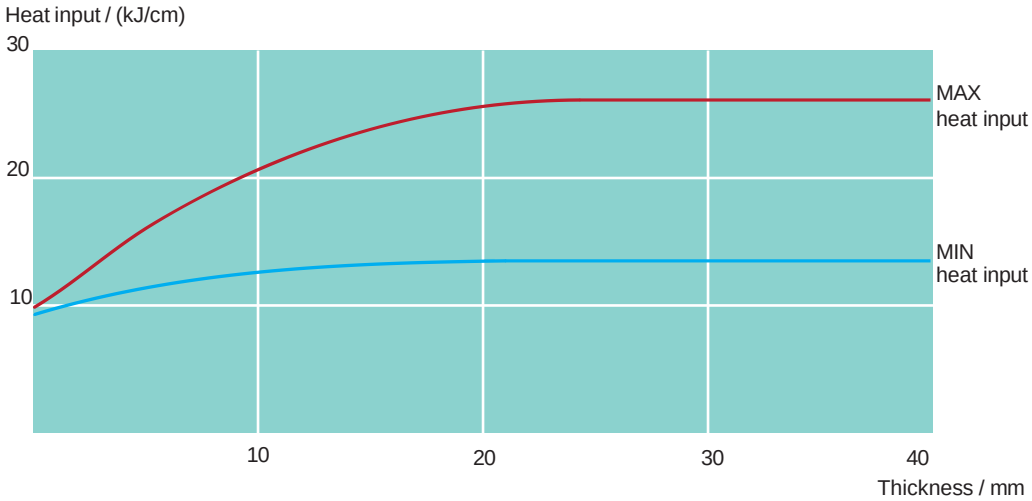
The minimum preheating temperature of GMAW wear-resistant steel plates are as following.



Recommended minimum preheating temperature of GMAW for wear-resistant steel plates



The effect trend of heat input to welding joint performance



Recommended range of weld heat input of wear-resistant steel plate

Welding heat input calculate formula $Q = \frac{K \times U \times I \times 60}{V \times 1000}$

Q =	Heat input(kJ/cm)
U =	Voltage(V)
I =	Current(A)
V =	Weld Speed(mm/min)
K =	Heat coefficient

Welding method	Heat coefficient K
SMAW	0.8
GMAW	0.8
SAW	1.0
GTAW	0.6

The welding parameters are chosen according to the plate thickness, welding position, joint type and shielded gas type. The recommended welding parameters of gas metal arc welding are listed in the following table.

Recommended welding parameters of wear-resistant steel

Parameters	Wire Diameter / mm	Welding Current / A	Arc Voltage / V
Backing welding	Φ1.2	200~240	22~26
Fill welding / Cover welding		260~300	28~31
Tack welding		260~280	28~30

Inter-pass Temperature

The inter-pass temperature should not be lower than the minimum pre-heat temperature. The recommended inter-pass temperature is listed in the following table.

Recommended maximum inter-pass temperature

Grade	NM360	NM400	NM450	NM500	NM550
Max. Inter-pass Temp. /ć	220	220	180	180	170

Slow Cooling Process After Welding

The wear-resistant steel plates with more than 50 mm thickness is recommended to take slow cooling process after welding, such as covered with asbestos blanket, etc.

Post-weld Heat Treatment

The post-weld heat treatment is not recommended for wear-resistant steels because it will affect the properties.

Flame Rectification

The flame rectification is not recommended for wear-resistant steels because of considering the properties.

The machining process parameters included in this manual is the collective research achievements by Institute of Sandvik Efficiency Center of Shanghai. Considering the difference of equipment capacity and working conditions, process parameters should be adjusted according to the actual situation. Please contact the technical department of Institute of Sandvik Efficiency Center.

We sincerely acknowledge Shanghai Efficiency Center of Sandvik for their great support.