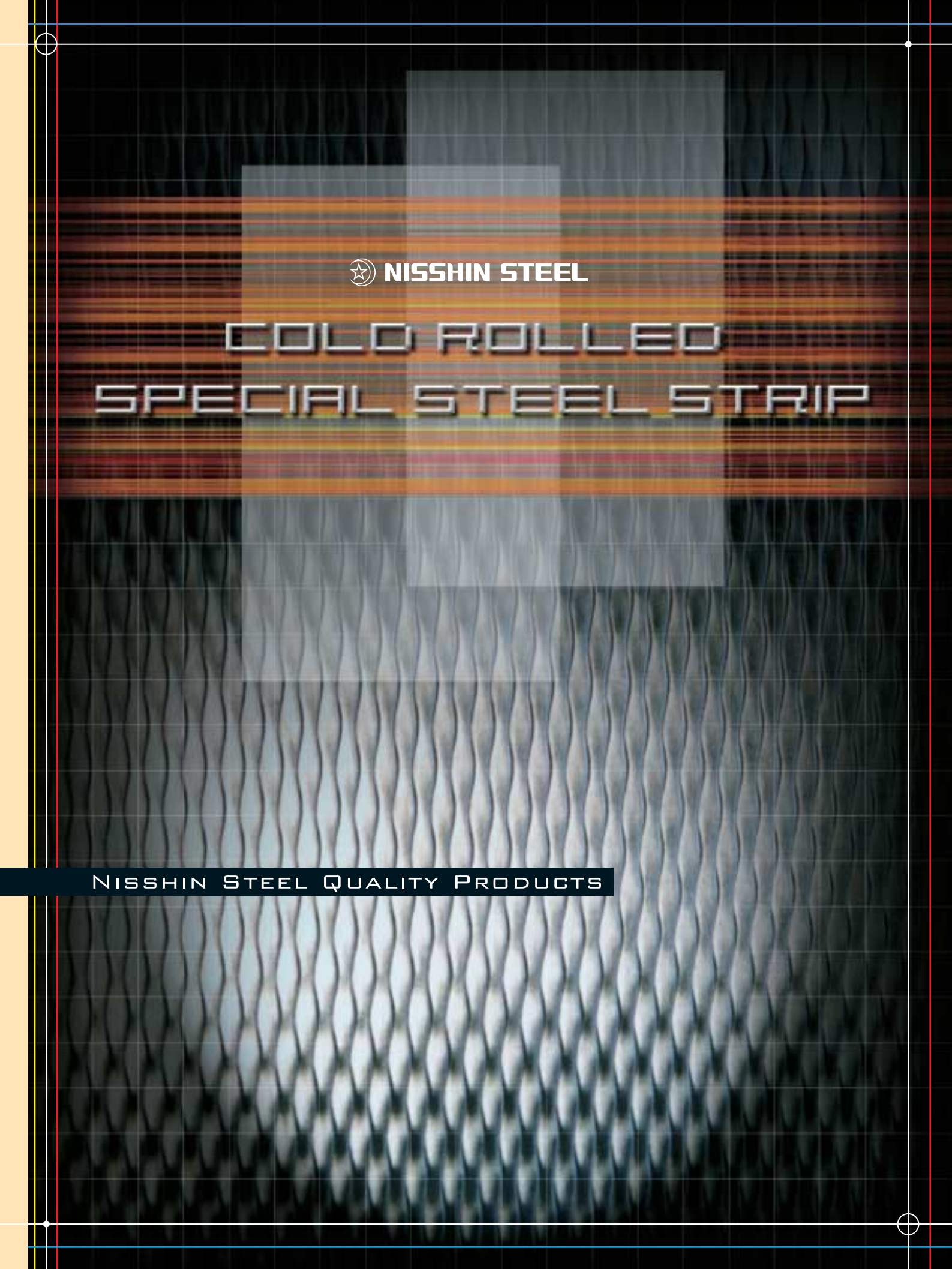

NISSHIN STEEL
COLD ROLLED
SPECIAL STEEL STRIP
Nisshin Steel Quality Products

Contents

Foreword

Nisshin's Moonstar cold-rolled special steel strip is a sophisticated steel product manufactured using the latest automated steelmaking systems, which incorporate the Company's wealth of experience and advanced technology. Cold-rolled special steel strip is used in numerous fields, such as precision machinery, that require a high degree of quality and accuracy as well as excellent formability. To meet these requirements, Nisshin has introduced state-of-the-art facilities, including an integrated computer-controlled manufacturing system that spans all processes from the initial steelmaking to the final cold-roll finishing.

Features

1

Nisshin expertly adjusts manufacturing conditions for each product according to its application and processing and heat treatment methods.

2

Nisshin possesses the latest facilities and control technology, ensuring superb quality and uniformity.

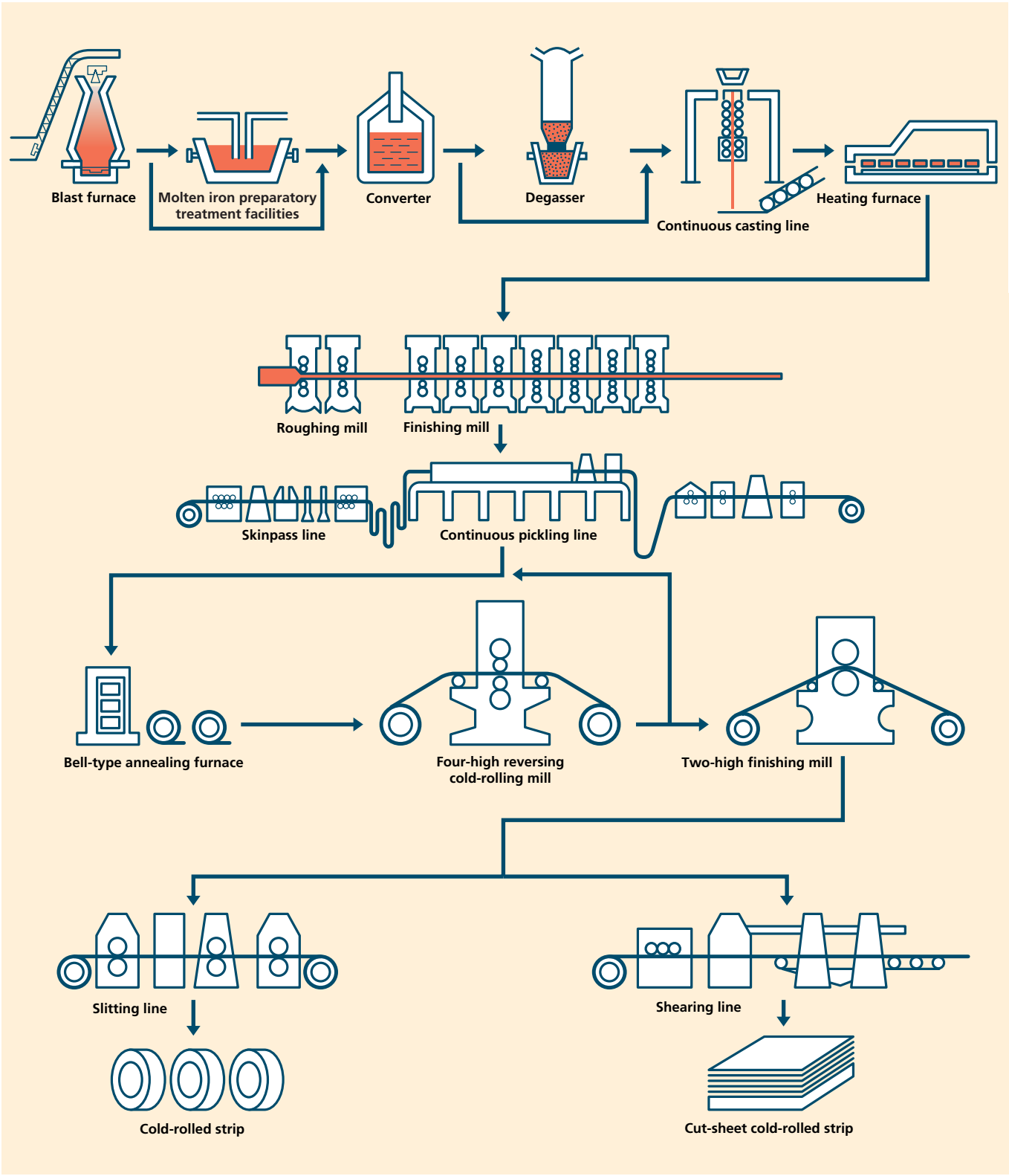
3

In addition to Japan Industry Standard(JIS) steel, Nisshin offers a broad spectrum of its own proprietary steel with various outstanding characteristics.

4

Aside from ordinary annealing and hard-drawn finishes, Nisshin also implements PPC, PT, and other finishes aimed at speeding up hardening and conserving heat.

Manufacturing Process



Types of Cold-Rolled Special Steel Strip

Listed below are the principal types of cold-rolled special steel strip manufactured by Nisshin. Standard products are in bold. Please consult Nisshin regarding product types that are not listed in these tables.

1.Carbon Steel and Carbon Steel for Machine Structural Use

JIS	Nisshin Standard	SAE	Chemical Composition （%）				
			C	Si	Mn	P	S
	N15CK		0.10～0.15	0.15～0.35	0.30～0.60	0.030	0.035
S15C			0.13～0.18	0.15～0.35	0.30～0.60	0.030	0.035
S15CK			0.13～0.18	0.15～0.35	0.30～0.60	0.025	0.025
S25C			0.22～0.28	0.15～0.35	0.30～0.60	0.030	0.035
S30CM			0.27～0.33	0.15～0.35	0.60～0.90	0.030	0.035
S35CM			0.32～0.38	0.15～0.35	0.60～0.90	0.030	0.035
S45CM			0.42～0.48	0.15～0.35	0.60～0.90	0.030	0.035
	N45B		0.43～0.50	0.15～0.35	0.40～0.65	0.030	0.035
	NCL1		0.45～0.50	0.15～0.30	0.60～0.90	0.035	0.040
S48C			0.45～0.51	0.15～0.30	0.60～0.90	0.030	0.035
S50CM			0.47～0.53	0.15～0.30	0.60～0.90	0.030	0.035
	N50B		0.48～0.55	0.15～0.30	0.40～0.65	0.030	0.035
		SAE1050	0.48～0.55	0.15～0.35	0.60～0.90	0.030	0.050
S53C			0.50～0.56	0.15～0.35	0.60～0.90	0.030	0.035
	N55D		0.52～0.58	0.10	0.60～0.90	0.030	0.035
S55CM			0.52～0.58	0.15～0.35	0.60～0.90	0.030	0.035
		SAE1055	0.50～0.60	0.15～0.30	0.60～0.90	0.030	0.050
S58C			0.55～0.61	0.15～0.35	0.60～0.90	0.030	0.035
S60CM			0.55～0.65	0.15～0.30	0.60～0.90	0.030	0.035
		SAE1060	0.55～0.65	0.15～0.30	0.60～0.90	0.030	0.050
		SAE1065	0.60～0.70	0.15～0.30	0.60～0.90	0.030	0.050
S65CM			0.60～0.70	0.15～0.30	0.60～0.90	0.030	0.035
	N63C		0.60～0.65	0.15～0.30	0.70～0.90	0.030	0.035
	N70C		0.65～0.75	0.15～0.30	0.60～0.90	0.030	0.035
		SAE1070	0.65～0.75	0.15～0.30	0.60～0.90	0.030	0.050
S70CM			0.65～0.75	0.15～0.30	0.60～0.90	0.030	0.035
	NK11		0.65～0.75	0.35	0.50～0.80	0.030	0.030
		SAE1075	0.70～0.80	0.15～0.30	0.40～0.70	0.030	0.050
S75CM			0.70～0.80	0.15～0.30	0.60～0.90	0.030	0.035
		SAE1080	0.75～0.88	0.15～0.30	0.60～0.90	0.030	0.050
		SAE1085	0.80～0.98	0.15～0.30	0.70～1.00	0.030	0.050
		SAE1090	0.85～0.98	0.15～0.30	0.60～0.90	0.030	0.050

2.Carbon Tool Steel

JIS	Nisshin	SAE	Chemical Composition (%)				
			C	Si	Mn	P	S
SK120M (SK2M)			1.10～1.30	0.35	0.50	0.030	0.030
SK105M (SK3M)			1.00～1.10	0.35	0.50	0.030	0.030
		SAE1095	0.90～1.03	0.15～0.30	0.30～0.50	0.030	0.050
SK95M (SK4M)			0.90～1.00	0.35	0.50	0.030	0.030
		SAE1086	0.80～0.93	0.15～0.30	0.30～0.50	0.030	0.030
SK85M (SK5M)			0.80～0.90	0.35	0.50	0.030	0.030
SK75M (SK6M)			0.70～0.80	0.35	0.50	0.030	0.030
	NCL2		0.60～0.73	0.35	0.50	0.030	0.030
SK65M (SK7M)			0.60～0.70	0.35	0.50	0.030	0.030

3.Alloy Tool Steel

JIS	Nisshin Standard	Chemical Composition (%)									
		C	Si	Mn	P	S	Cu	Ni	Cr	W	V
SKS5M		0.75～0.85	0.35	0.50	0.030	0.030	0.25	0.70～1.30	0.20～0.50	—	—
SKS51M		0.75～0.85	0.35	0.50	0.030	0.030	0.25	1.30～2.00	0.20～0.50	—	—
	NKS32	0.77～0.83	0.35	0.30～0.50	0.030	0.030	0.25	2.00～2.50	0.25	—	—
	NKS36	0.85～0.95	0.35	0.60	0.030	0.030	0.25	0.30～0.70	0.15～0.35	—	—
	NKS37	0.85～0.95	0.35	0.50	0.030	0.030	0.25	0.70～1.30	0.50	—	—
	NKS41	0.75～0.85	0.15～0.35	0.50	0.030	0.030	0.25	1.30～2.00	0.20～0.50	—	0.20～0.30
	NKS49	0.90～1.00	0.15～0.35	0.30～0.50	0.030	0.030	0.25	—	0.20～0.40	—	—
	NKS56	1.10～1.30	0.35	0.50	0.030	0.030	0.25	0.25	0.20～0.50	—	—
	NKS59	0.80～0.90	0.35	0.80～1.00	0.030	0.030	0.25	—	0.40～0.60	—	—
	NKS60	0.80～0.85	0.35	0.50	0.030	0.030	0.25	0.25	0.40～0.60	—	0.25～0.35
	NKS62	0.58～0.63	0.15～0.35	0.60～0.90	0.030	0.030	0.25	0.25	0.35～0.60	—	0.15～0.25

4.Nickel Chromium Steel

JIS	Chemical Composition (%)							
	C	Si	Mn	P	S	Cu	Ni	Cr
SNC631M	0.27～0.35	0.15～0.35	0.35～0.65	0.030	0.030	0.30	2.50～3.00	0.60～1.00
SNC836M	0.32～0.40	0.15～0.35	0.35～0.65	0.030	0.030	0.30	3.00～3.50	0.60～1.00
SNC415M	0.12～0.18	0.15～0.35	0.35～0.65	0.030	0.030	0.30	2.00～2.50	0.20～0.50
SNC815M	0.12～0.18	0.15～0.35	0.35～0.65	0.030	0.030	0.30	3.00～3.50	0.60～1.00

5.Nickel Chromium Molybdenum Steel

JIS	SAE	Chemical Composition (%)								
		C	Si	Mn	P	S	Cu	Ni	Cr	Mo
SNCM625		0.20～0.30	0.15～0.35	0.35～0.60	0.030	0.030	0.30	3.00～3.50	1.00～1.50	0.15～0.30
SNCM630		0.25～0.35	0.15～0.35	0.35～0.60	0.030	0.030	0.30	2.50～3.50	2.50～3.50	0.30～0.70
SNCM240		0.38～0.43	0.15～0.35	0.70～1.00	0.030	0.030	0.30	0.40～0.70	0.40～0.60	0.15～0.30
SNCM439		0.36～0.43	0.15～0.35	0.60～0.90	0.030	0.030	0.30	1.60～2.00	0.60～1.00	0.15～0.30
SNCM447		0.44～0.50	0.15～0.35	0.60～0.90	0.030	0.030	0.30	1.60～2.00	0.60～1.00	0.15～0.30
SNCM220M		0.17～0.23	0.15～0.35	0.60～0.90	0.030	0.030	0.30	0.40～0.70	0.40～0.65	0.15～0.30
SNCM415M		0.12～0.18	0.15～0.35	0.40～0.70	0.030	0.030	0.30	1.60～2.00	0.40～0.65	0.15～0.30
SNCM420		0.17～0.23	0.15～0.35	0.40～0.70	0.030	0.030	0.30	1.60～2.00	0.40～0.60	0.15～0.30
SNCM815		0.12～0.18	0.15～0.35	0.30～0.60	0.030	0.030	0.30	4.00～4.50	0.70～1.00	0.15～0.30
SNCM616		0.13～0.20	0.15～0.35	0.80～1.20	0.030	0.030	0.30	2.80～3.20	1.40～1.80	0.40～0.60
	SAE8615	0.16～0.18	0.15～0.35	0.70～0.90	0.030	0.040	0.30	0.40～0.70	0.40～0.60	0.15～0.25
	SAE8617	0.15～0.20	0.15～0.35	0.70～0.90	0.030	0.040	0.30	0.40～0.70	0.40～0.60	0.15～0.25
	SAE8620	0.18～0.23	0.15～0.35	0.70～0.90	0.030	0.040	0.30	0.40～0.70	0.40～0.60	0.15～0.25
	SAE8622	0.20～0.25	0.15～0.35	0.70～0.90	0.030	0.040	0.30	0.40～0.70	0.40～0.60	0.15～0.25

6.Chromium Steel

JIS	Nisshin Standard	SAE	Chemical Composition (%)							
			C	Si	Mn	P	S	Cu	Ni	Cr
SCr430			0.28～0.33	0.15～0.35	0.60～0.90	0.030	0.030	0.30	0.25	0.90～1.20
SCr435			0.33～0.38	0.15～0.35	0.60～0.85	0.030	0.030	0.30	0.25	0.90～1.20
SCr440			0.38～0.43	0.15～0.35	0.60～0.85	0.030	0.030	0.30	0.25	0.90～1.20
SCr445			0.43～0.48	0.15～0.35	0.60～0.90	0.030	0.030	0.30	0.25	0.90～1.20
		SAE5046	0.44～0.49	0.15～0.35	0.75～1.00	0.030	0.040	0.30	0.25	0.20～0.35
	NCR247		0.44～0.51	0.15～0.35	0.75～1.00	0.035	0.035	0.30	0.25	0.30～0.60
SCr415			0.13～0.18	0.15～0.35	0.60～0.90	0.030	0.030	0.30	0.25	0.90～1.20
SCr420			0.18～0.23	0.15～0.35	0.60～0.85	0.030	0.030	0.30	0.25	0.90～1.20

7.Chromium Molybdenum Steel

JIS	SAE	Chemical Composition (%)								
		C	Si	Mn	P	S	Cu	Ni	Cr	Mo
SCM430M		0.28～0.33	0.15～0.35	0.60～0.85	0.030	0.030	0.30	0.25	0.90～1.20	0.15～0.30
	SAE4130	0.28～0.33	0.15～0.35	0.40～0.60	0.030	0.040	0.30	0.25	0.80～1.10	0.15～0.25
SCM435M		0.33～0.38	0.15～0.35	0.60～0.85	0.030	0.030	0.30	0.25	0.90～1.20	0.15～0.30
SCM440M		0.38～0.43	0.15～0.35	0.60～0.85	0.030	0.030	0.30	0.25	0.90～1.20	0.15～0.30
SCM415M		0.13～0.18	0.15～0.35	0.60～0.85	0.030	0.030	0.30	0.25	0.90～1.20	0.15～0.30
SCM420		0.18～0.23	0.15～0.35	0.60～0.90	0.030	0.030	0.30	0.25	0.90～1.20	0.15～0.25

Types of Cold-Rolled Special Steel Strip


Continuous casting


Converter


Vertical continuous casting machine

8.Manganese Steel

JIS	SAE	Chemical Composition （%）								
		C	Si	Mn	P	S	Cu	Ni	Cr	Ni+Cr
	SAE1524	0.19～0.25	0.15～0.30	1.35～1.65	0.030	0.050	0.30	0.20	0.20	0.35
	SAE1536	0.30～0.37	0.15～0.30	1.20～1.50	0.030	0.050	0.30	0.20	0.20	0.35
	SAE1541	0.36～0.44	0.15～0.30	1.35～1.65	0.030	0.050	0.30	0.20	0.20	0.35
SMn443		0.40～0.46	0.15～0.35	1.35～1.65	0.030	0.030	0.30	0.25	0.35	—
SMn420		0.17～0.23	0.15～0.35	1.20～1.50	0.030	0.030	0.30	0.25	0.35	—
	SAE1552	0.47～0.55	0.15～0.30	1.20～1.50	0.030	0.050	0.30	0.20	0.20	0.35

9.Spring Steel

JIS	Chemical Composition （%）							
	C	Si	Mn	P	S	Cu	Cr	V
SUP6M	0.55～0.65	1.50～1.80	0.70～1.00	0.035	0.035	0.30	—	—
SUP7	0.55～0.65	1.80～2.20	0.70～1.00	0.035	0.035	0.30	—	—
SUP9M	0.50～0.60	0.15～0.35	0.65～0.95	0.035	0.035	0.30	0.65～0.95	—
SUP10M	0.45～0.55	0.15～0.35	0.65～0.95	0.035	0.035	0.30	0.80～1.10	0.15～0.25

10.High-Carbon Chromium Bearing Steel

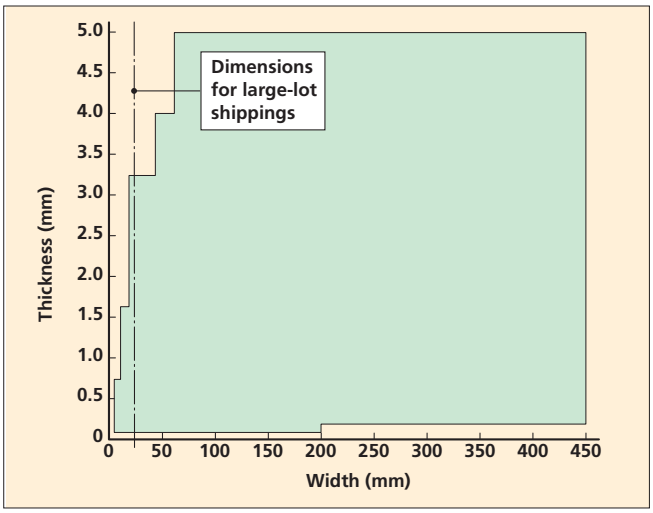
JIS	Chemical Composition （%）							
	C	Si	Mn	P	S	Cr	Cu	Mo
SUJ2	0.95～1.10	0.15～0.35	0.50	0.025	0.025	1.30～1.60	0.25	0.08

Manufacturable Range

Production range changes in accordance with dimensional tolerance hardness.
The production range of cold-rolled special steel strip is shown in Diagrams 1 and 2.
Please consult Nisshin regarding dimensions other than those shown in the diagrams.

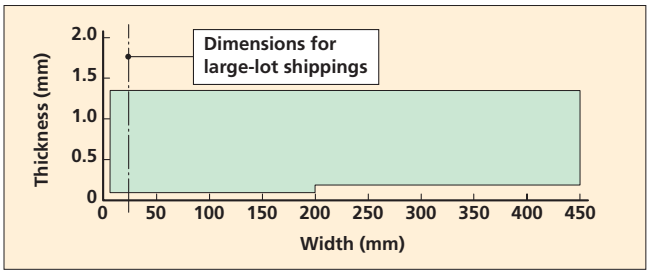
1.Strip Dimensions

Diagram-1



Type of Steel	Carbon Steel	S10C～S85CM, S09CK,S15CK,S20CK, SAE1015～SAE1090
		N45B, N55D, N63C,N70C, N15CK, NCL1, NK11
	Carbon Tool Steel	SK95M (SK4M) , SK85M (SK5M) , SK75M (SK6M) , SK65M (SK7M) , SAE1086,SAE1095, NCL2
	Alloy Tool Steel	SKS5M,SKS51M, NKS32,NKS36,NKS37,NKS59,NKS60,NKS62
	Alloy Steel	SCM435M,SCM440M,SCM415M,SCM420,SNC631M,SNC836M,SNC415M,SNC815M,SNCM240,
		SNCM625,SNCM439,SNCM815,SNCM447,SNCM616,SNCM220M,SNCM415M, SNCM420
		SAE8615～8622,SAE4130,SAE1524,SAE1536,SAE1541,SAE1552,SAE5046, NCR247,
		SCr430,SCr435,SCr440,SCr445,SCr415,SCr420,SMn443,SMn420
	Spring Steel	SUP3, SUP6M,SUP9M,SUP10M

Diagram-2

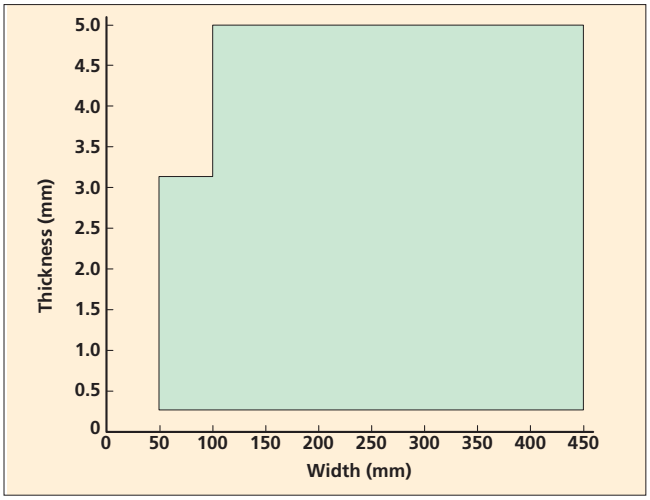


Type of Steel	Alloy Tool Steel	SKS7M, NKS56
	Alloy Steel	SUJ2

2.Cut-Sheet Dimensions

Cut-sheet cold-rolled special steel strip is available in any of the production ranges shown in Diagrams 1, 2, and 3, with lengths of 1,000 mm to 2,500 mm.

Diagram-3



Dimensions and Configurations

Size and configurational tolerance values are indicated in the tables below and right.
Consult Nisshin regarding materials with values outside the ranges listed in the tables.

1.Thickness Tolerance

Several different grades of thickness allowance—A(standard) and S, SS, and SSS(special)—are available. The thickness is measured arbitrarily at more than 10 mm from the edge of the steel. When the width is 20 mm or less, the steel is measured in the center portion.

(Units：mm)

Thickness \ Grade / Width	A	S	SS	SSS
	Less than 450	Less than 450	Less than 400	Less than 200
0.10 and <0.15	±0.010	±0.008	±0.007	±0.006
0.15 and <0.25	±0.015	±0.010	±0.008	±0.007
0.25 and <0.40	±0.020	±0.015	±0.010	±0.008
0.40 and <0.60	±0.025	±0.020	±0.015	±0.010
0.60 and <0.90	±0.030	±0.025	±0.020	±0.015
0.90 and <1.20	±0.040	±0.030	±0.025	±0.020
1.20 and <1.60	±0.050	±0.040	±0.030	±0.025
1.60 and <2.10	±0.055	±0.050	±0.040	±0.030
2.10 and <2.60	±0.060	±0.055	±0.050	±0.040
2.60 and <3.25	±0.065	±0.060	±0.050	±0.045
3.25 and <4.00	±0.080	±0.070	±0.060	±0.050
4.00 and <5.00	±0.090	±0.080	±0.070	—

2.Width Tolerance

(Units：mm)

Thickness \ Grade / Width	A		S	
	Less than 200	More than 200, less than 450	Less than 200	More than 200, less than 450
<0.60	±0.15	±0.25	±0.10	±0.20
0.60 and <1.20	±0.20	±0.30	±0.15	±0.25
1.20 and <3.25	±0.25	±0.40	±0.20	±0.35
3.25 and <4.00	±0.25	±0.40	±0.20	±0.35
4.00 and <5.00	±0.40	±0.55	±0.35	±0.50

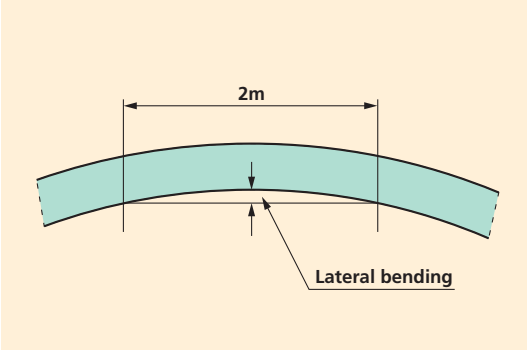
3.Lateral Bending Tolerance

Lateral bending tolerance values (except for the first and last meters) are shown right. They are arbitrarily measured every two meters.

(Units : mm)

Width \ Grade	Lateral Bending Tolerance Value		
	A	S	SS
10 and <20	20	15	12
20 and <40	15	10	8
40 and <80	8	6	4
80 and 450	4	3	—

Diagram-4



4.Longitudinal Tolerance

This table shows the longitudinal tolerance for cold-rolled special steel strip that has been sheared into cut-sheets.

(Units : mm)

Length \ Width	Less than 200	More than 200, less than 450
950 and 2,000	+5 −0	+10 −0
2,000>and 2,500	+10 −0	+20 −0

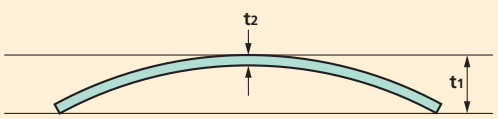
5.Flatness Tolerance

This table gives the flatness tolerance, which is determined by deducting the thickness of the material from the total warp. This value is pertinent only for cold-rolled special steel strip that has been sheared into cut-sheets.

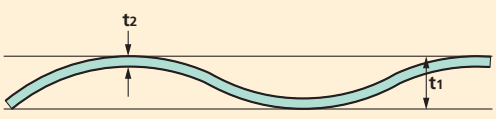
(Units : mm)

Tolerance			Thickness			
			Less than 0.60	More than 0.60, less than 1.20	More than 1.20, less than 3.20	More than 3.20, less than 5.00
Width: Less than 200	Annealed	Widthwise	1.0	1.0	1.5	2.0
		Lengthwise	2.0	3.0	3.0	5.0
	Hard-drawn	Widthwise	1.0	1.5	1.5	2.5
		Lengthwise	3.0	4.0	4.0	6.0
Width: more than 200, Less than 450	Annealed	Widthwise	1.5	2.0	2.5	3.0
		Lengthwise	4.0	5.0	5.0	7.0
	Hard-drawn	Widthwise	1.5	2.0	3.0	4.0
		Lengthwise	6.0	7.0	7.0	9.0

Diagram-5



Widthwise flatness=t_1-t_2



Lengthwise flatness=t_1-t_2

Finish and Hardness

●Cold-rolled special steel strip is available in the following finishes.

Stage	Symbol	Condition
Annealing	A	Annealing is implemented after cold rolling.
Skinpass	S	Annealing and thermal refining are implemented after cold rolling.
Deep drawing	C	Cold rolling is implemented.
Patenting	PT	Patenting treatment and fixed cold rolling are implemented.
PPC	PC	Spheroidal carbide is refined.

Finish and Hardness

Nisshin has annealing materials with both standard and special hardness and manufactures deep-drawn materials with a hardness within a 20-point range of those listed below. Please consult Nisshin with regard to materials with different hardness from that listed in the table.

1.Carbon Steel for Machine Structural Use

Standard	Type of Steel	Annealing Hardness		Deep-Drawing Hardness
		Standard	Special	
		HV	HV	HV
JIS	S15C	140	130	150～180
	S20C	150	140	150～180
	S25C	150	140	150～180
	S30CM	150	140	150～180
	S35CM	150	140	160～240
	S40C	150	140	160～240
	S45CM	160	150	170～240
	S50CM	160	150	180～260
	S55CM	170	160	180～260
	S60CM	170	160	180～280
	S65CM	170	160	180～280
	S70CM	180	170	180～280
	S75CM	180	170	180～280
SAE	SAE1050	160	150	180～260
	SAE1055	170	160	180～260
	SAE1060	170	160	180～280
	SAE1070	180	170	180～280
	SAE1080	180	170	180～280
Nisshin	N63C	170	160	180～280
	N70C	190	180	180～280
	N55D	160	150	—

2.Carbon Tool Steel

Standard	Type of Steel	Annealing Hardness		Deep-Drawing Hardness
		Standard	Special	
		HV	HV	HV
JIS	SK120M (SK2M)	220	200	—
	SK105M (SK3M)	210	190	210～300
	SK95M (SK4M)	200	180	200～280
	SK85M (SK5M)	180	170	200～280
	SK75M (SK6M)	180	170	180～260
	SK65M (SK7M)	180	160	180～260
SAE	SAE1078	180	170	200～280
	SAE1086	180	170	200～280
	SAE1095	220	190	220～280

3.Alloy Tool Steel

Standard	Type of Steel	Annealing Hardness		Deep-Drawing Hardness
		Standard	Special	
		HV	HV	HV
JIS	SKS5M	190	180	200～280
	SKS51M	190	180	200～280
Nisshin	NKS32	200	180	200～280
	NKS36	200	180	200～280
	NKS37	200	180	200～300
	NKS41	200	180	200～260
	NKS49	220	200	220～280
	NKS56	220	200	220～320
	NKS59	220	200	220～280
	NKS60	200	180	220～280

4.Structural-Use Alloy Steel

Standard	Type of Steel	Annealing Hardness		Deep-Drawing Hardness
		Standard	Special	
		HV	HV	HV
JIS	SNCM220M	170	160	—
	SNCM240	180	160	—
	SCr415	170	150	—
	SCr420	170	150	—
	SCM435M	180	160	200～260
	SCM440M	180	160	200～260
	SCM415M	160	150	—
	SMn443	180	160	200～280
SAE	SAE1541	170	150	200～280
	SAE1552	180	160	200～280
	SAE4130	180	160	—
	SAE8615	170	150	—

5.Spring Steel

Standard	Type of Steel	Annealing Hardness		Deep-Drawing Hardness
		Standard	Special	
		HV	HV	HV
JIS	SUP6M	210	190	—
	SUP10M	190	170	200～260

6.High-Carbon Chromium Bearing Steel

Standard	Type of Steel	Annealing Hardness		Deep-Drawing Hardness
		Standard	Special	
		HV	HV	HV
JIS	SUJ2	220	200	—

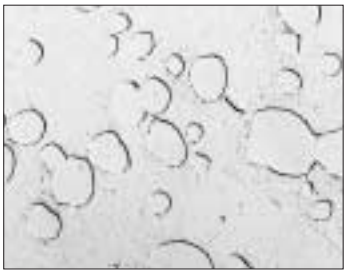
7.Steel with Special Finishes

PPC FINISH

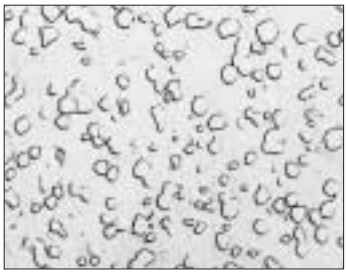
PPC steel is manufactured by finely distributing spheroidized carbides(approximately one-fifth of a carbide particle in diameter) on a special hotrolled strip and possesses the following strengths.

- The austenitization period is short, thereby allowing rapid hardening.
- During annealing, hardness of HV250 can be achieved. Through cold rolling and aging treatment, this can be raised to HV350, making it useful as heat-conserving material.

Standard	Type of Steel	Annealing	Production Range(Thickness)
Nisshin	NK11	HV230～290	0.3～2.0mm
JIS	SK95（SK4）	HV250～310	
	SK85（SK5）		



Ordinary material ×4,600



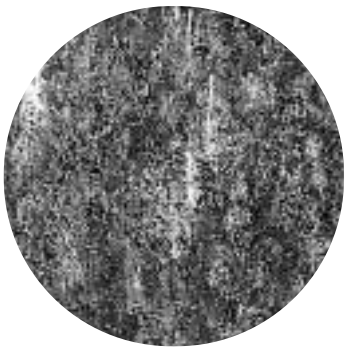
PPC ×4,600

PT FINISH

PT steel is manufactured by applying a patenting treatment and then fixed cold rolling. Hardness of more than HV500 can be obtained through cold rolling and aging treatment.
This steel can be used in ordinary chains and springs and as heatconserving material.

Standard	Type of Steel	Hardness
Nisshin	NK11	HV300～400
	NHRS2 ［SK75（SK6）equivalent］	HV450～500

Sorbite structure
Hardness：HRC30～45
Tensile strength：1,180～1,570N/mm^2
Elongation：2%～8%



PT ×400

Applications

1.Carbon Steel for Machine Structural Use

・Clip springs, washers ・Chains ・Tricon plates ・Clutches ・Safety buckles ・Safety shoe toe plates ・Machinery parts
・Thomson blades ・Roll pins ・Speed nuts ・Clips


Safety buckles


Tricon plates


Safety shoe toe plates

2.Carbon Tool Steel

・Clip springs, washers ・Coil springs ・Band saws ・Hacksaws ・Handsaws ・Blades ・Latch needles ・Clutches
・Diaphragm springs ・Horns


Clip springs, washers


Coil springs


Diaphragm frame

3.Alloy Tool Steel

・Beltsaws ・Buzz saws ・Metal band saws ・Chain saw guides ・Music box sound pegs ・Cutters ・Diaphragm springs


Cutters


Buzz saws


Music box sound pegs

4.Structural-Use Alloy Steel

・Chain pushpins ・Safety buckles・Office machinery parts ・Chain links ・Chain links・Chain pushpins
・Office machinery parts ・Safety buckles


Chain, pushpins, and links

5.Spring Steel

・Clip springs,washers ・Disk springs

6.High-Carbon Chromium Bearing Steel

・Thrust washers,retainers

Retainers

7.Steel with Special Finishes

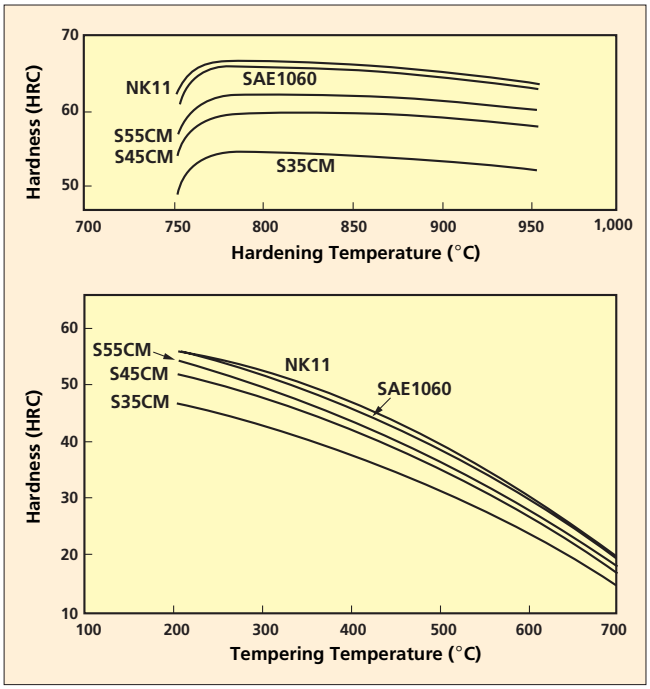
・Ordinary chains ・Springs

Heat Treatment Characteristics

1.Carbon Steel for Machine Structural Use (heat treatment temperature and hardness)

The hardening and tempering curves for representative types of steel are shown in the diagrams right.

Diagram-6

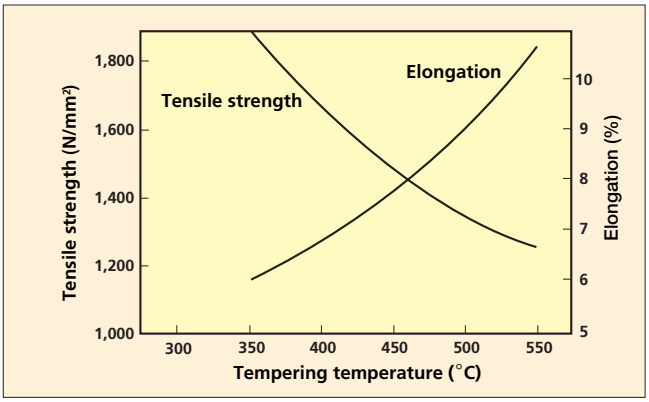


Type of Steel	Water Hardening		Oil Hardening	
	Temperature (℃)	Hardness (HRC)	Temperature (℃)	Hardness (HRC)
S35CM	840～890	46	—	—
S45CM	820～870	53	830～880	51
S50CM	810～860	55	810～860	53
S55CM	800～850	55	810～860	53
S60CM	760～820	59	790～850	57
S65CM	760～820	59	790～850	57
S70CM	760～820	59	790～850	57
SAE1045	820～870	53	830～880	51
SAE1050	810～860	55	810～860	53
SAE1055	800～850	55	810～860	53
SAE1060	760～820	59	790～850	57
SAE1065	760～820	59	790～850	57
SAE1070	760～820	59	790～850	57
N55D	810～850	55	820～860	53
N63C	760～820	58	790～850	56
N70C	760～820	58	790～850	56
NCL1	800～850	56	810～860	54
NK11	760～820	58	790～850	56

2.Carbon Tool Steel (heat treatment temperature and hardness)

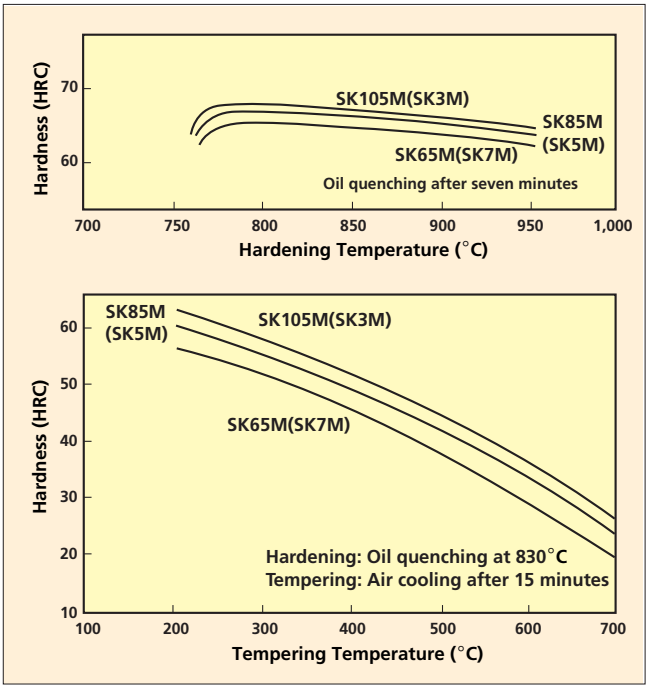
Relation of Tempering temperature, tensile strength, and elongation for SK5M.

Diagram-7



The hardening and tempering curves for representative types of steel are shown right.

Diagram-8



Type of Steel	Water Hardening		Oil Hardening	
	Temperature (℃)	Hardness (HRC)	Temperature (℃)	Hardness (HRC)
SK120M (SK2M)	760～820	62	790～850	60
SK105M (SK3M)	760～820	62	790～850	60
SK95M (SK4M)	760～820	62	790～850	60
SK85M (SK5M)	760～820	62	790～850	60
SK75M (SK6M)	760～820	62	790～850	60
SK65M (SK7M)	760～820	59	790～850	57

3.Alloy Tool Steel (heat treatment temperature and hardness)

The hardening and tempering curves for representative types of steel are shown below.

Diagram-9

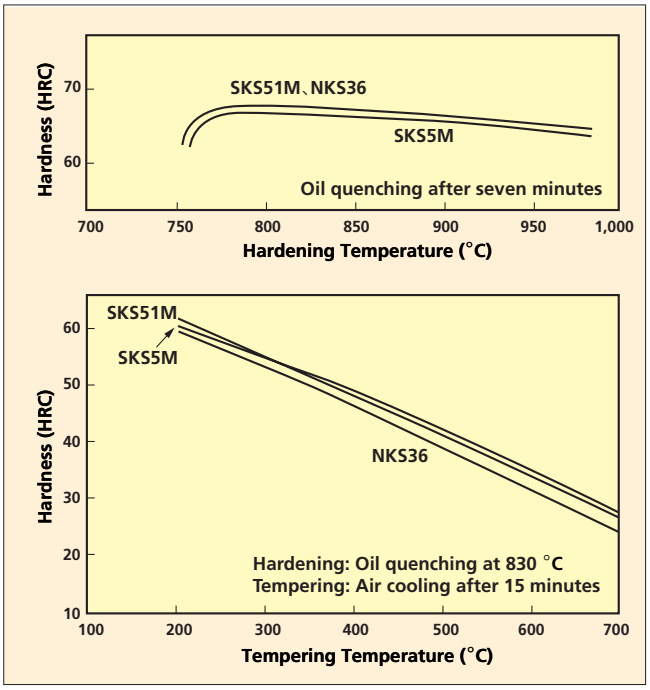
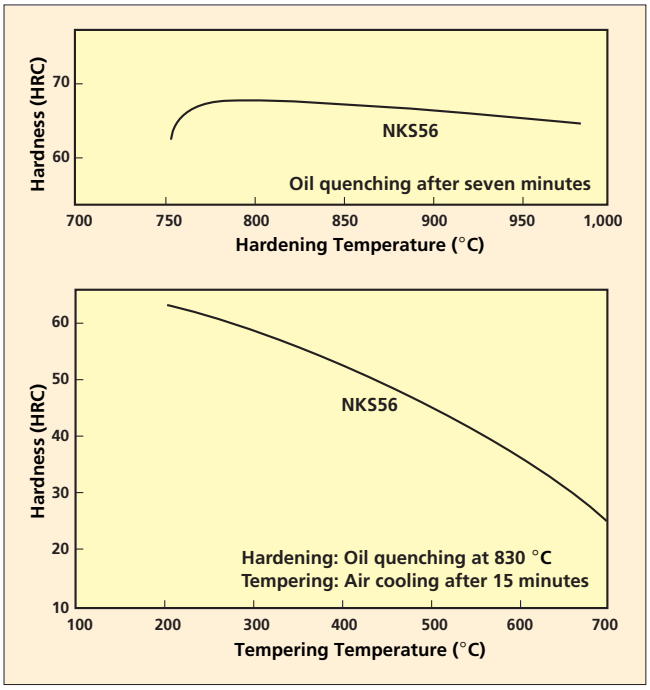


Diagram-10



Type of Steel	Oil Hardening	
	Temperature（℃）	Hardness（HRC）
SKS5M	800～850	61
SKS51M	800～850	61
NKS32	800～850	61
NKS36	800～850	61
NKS37	800～850	62
NKS41	790～850	58
NKS49	800～850	62
NKS56	790～850	64
NKS59	790～850	62
NKS60	790～850	62

4.Alloy Tool Steel for Structural Use (heat treatment temperature and hardness)

Type of Steel	Oil Hardening	
	Temperature（℃）	Hardness（HRC）
SNCM240	820～870	53
SNCM21M	850～900	35
SAE8615	850～900	35
SCr415	850～900	33
SCr420	850～900	35
SCM435M	830～880	48
SCM440M	830～880	51
SCM415M	850～900	35
SAE4130	830～880	45
SAE1541	830～880	54
SAE1552	810～880	54

5.Spring Steel (heat treatment temperature and hardness)

Type of Steel	Oil Hardening	
	Temperature（℃）	Hardness（HRC）
SUP6M	830～860	64
SUP7	830～860	54
SUP9M	830～860	55
SUP10M	840～870	55

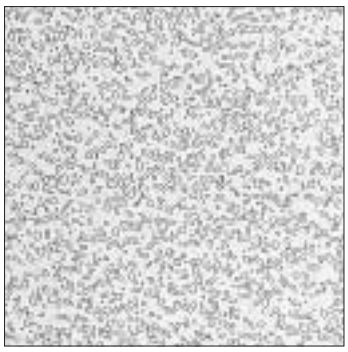
6.High-Carbon Chromium Bearing Steel (heat treatment temperature and hardness)

Type of Steel	Oil Hardening	
	Temperature（℃）	Hardness（HRC）
SUJ2	790～850	62

Microscopic Structure

1.Spheroidized Structure

The photographs above show microscopic views of SK5 with spheroidized cementite.

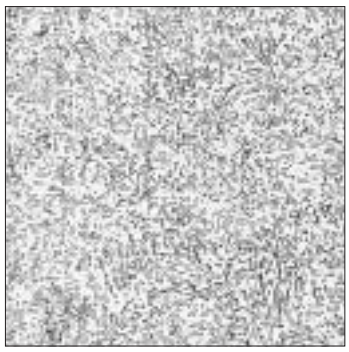


×400

Excellent spheroidization
Corrosion picral

×400

Good spheroidization
Corrosion picral



×400

Limit of spheroidization (C)
Corrosion picral

2.Decarburization

The decarburization depth measurement, which is based on a 50% actual carbon ratio, is listed in the table right.

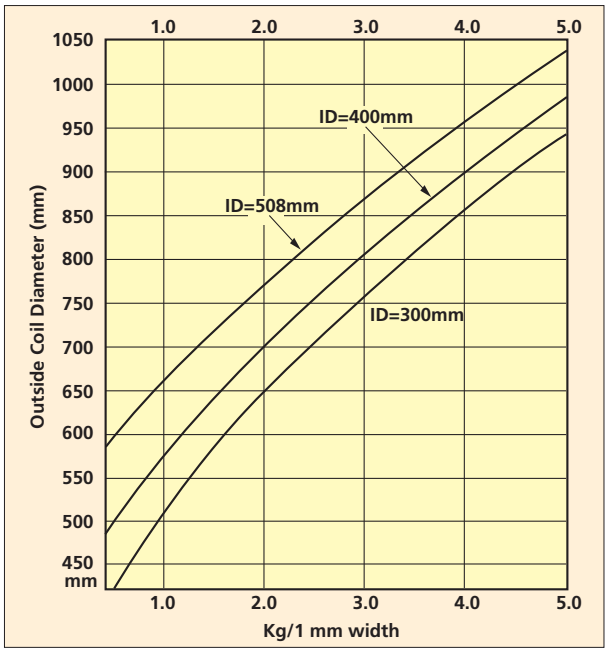
Type of Steel / Carburization Grade / Thickness	Carbon steel Carbon tool steel Alloy tool steel High-carbon chromium bearing steel		Nickel chromium steel Nickel chromium molybdenum steel Chromium steel Chromium molybdenum steel Manganese steel Spring steel	
	Standard	Special	Standard	Special
＜0.40	0.01	0.008	0.01	—
0.40 and ＜1.00	0.03	0.01	0.03	0.02
1.00 and ＜2.40	0.04	0.02	0.05	0.03
2.40 and ＜3.20	0.05	0.03	0.06	0.04
3.20 and 5.00	0.06	0.05	0.07	0.05

Notes : 1. Low-carbon steel equal to or below S30C cannot be used.
2. Measurements are made randomly at least 3 mm from the slit edge.

Appendix

1.Relation between Inside and Outside Coil Diameters

Diagram-11



Notes : ID : Inside coil diameter
Kg/1 mm width: Product weight/product width
Apparent specific gravity of strip=7.75×10^{-6}kg/mm^3

2.Hardness Conversion Chart (Vickers Hardness Approximate Conversion Values)

Vickers Hardness Number (DPH)	Brinell Hardness No., 10mm Ball, 3,000 kg Load			Rockwell Hardness No.			Rockwell Superficial Hardness No., Superficial Brale Penetrator			Shore Hardness	Tensile Strength N/mm²	Vickers Hardness No., 50kg Load
	Standard Ball	Hultgren Ball	Tungsten Carbide Ball	A Scale, 60kg Load Brale Penetrator	B Scale, 100kg Load, 1/16 in. Diameter Ball	C Scale, 150kg Load Brale Penetrator	15-N Scale, 15kg Load	30-N Scale, 30kg Load	45-N Scale, 45kg Load			
700	—	615	666	81.3	—	60.1	90.3	77.6	66.7	81	—	700
690	—	610	647	81.1	—	59.7	90.1	77.2	66.2	—	—	690
680	—	603	638	80.8	—	59.2	89.3	76.8	65.7	80	2,265	680
670	—	597	630	80.6	—	58.8	89.7	76.4	65.3	—	2,236	670
660	—	590	620	80.3	—	58.3	89.5	75.9	64.7	79	2,197	660
650	—	585	611	80.0	—	57.8	89.2	75.5	64.1	—	2,167	650
640	—	578	601	79.8	—	57.3	89.0	75.1	63.5	77	2,128	640
630	—	571	591	79.5	—	56.8	88.8	74.6	63.0	—	2,099	630
620	—	564	582	79.2	—	56.3	88.5	74.2	62.4	75	2,059	620
610	—	557	573	78.9	—	55.7	88.2	73.6	61.7	—	2,030	610
600	—	550	564	78.6	—	55.2	88.0	73.2	61.2	74	1,991	600
590	—	542	554	78.4	—	54.7	87.8	72.7	60.5	—	1,961	590
580	—	535	545	78.0	—	54.1	87.5	72.1	59.9	72	1,922	580
570	—	527	555	77.8	—	53.6	87.2	71.7	59.3	—	1,893	570
560	—	519	525	77.4	—	53.0	86.9	71.2	58.6	71	1,853	560
550	505	512	517	77.0	—	52.3	86.6	70.5	57.8	—	1,824	550
540	496	503	507	76.7	—	51.7	86.3	70.0	57.0	69	1,795	540
530	488	495	497	76.4	—	51.1	86.0	69.5	56.2	—	1,755	530
520	480	487	488	76.1	—	50.5	85.7	69.0	55.6	67	1,726	520
510	473	479	479	75.7	—	49.8	85.4	68.3	54.7	—	1,687	510
500	465	471	471	75.3	—	49.1	85.0	67.7	53.9	66	1,657	500
490	456	460	460	74.9	—	48.4	84.7	67.1	53.1	—	1,618	490
480	448	452	452	74.5	—	47.7	84.3	66.4	52.2	64	1,589	480
470	441	442	442	74.1	—	46.9	83.9	65.7	51.3	—	1,540	470
460	433	433	433	73.6	—	46.1	83.6	64.9	50.4	62	1,520	460
450	425	425	425	73.3	—	45.3	83.2	64.3	49.4	—	1,471	450
440	415	415	415	72.8	—	44.5	82.8	63.5	48.4	59	1,451	440
430	405	405	405	72.3	—	43.6	82.3	62.8	47.4	—	1,402	430
420	397	397	397	71.8	—	42.7	81.8	61.9	46.4	57	1,383	420
410	388	388	388	71.4	—	41.8	81.4	61.1	45.3	—	1,344	410
400	379	379	379	70.8	—	40.8	81.0	60.2	44.1	55	1,314	400
390	369	369	369	70.3	—	39.8	80.3	59.3	42.9	—	1,275	390
380	360	360	360	69.8	(110.0)	38.8	79.8	58.4	41.7	52	1,245	380
370	350	350	350	69.2	—	37.7	79.2	57.4	40.4	—	1,206	370
360	341	341	341	68.7	(109.0)	36.6	78.6	56.4	39.1	50	1,177	360
350	331	331	331	68.1	—	35.5	78.0	55.4	37.8	—	1,147	350
340	322	322	322	67.6	(108.0)	34.4	77.4	54.4	36.5	47	1,108	340
330	313	313	313	67.0	—	33.3	76.8	53.6	35.2	—	1,079	330
320	303	303	303	66.4	(107.0)	32.2	76.2	52.3	33.9	45	1,040	320
310	294	294	294	65.8	—	31.0	75.6	51.3	32.5	—	1,010	310
300	284	284	284	65.2	(105.5)	29.8	74.9	50.2	31.1	42	971	300
295	280	280	280	64.8	—	29.2	74.6	49.7	30.4	—	961	295
290	275	275	275	64.2	(104.5)	28.5	74.2	49.0	29.5	41	941	290
285	270	270	270	64.2	—	27.8	73.8	48.4	28.7	—	922	285
280	265	265	265	63.8	(103.5)	27.1	73.4	47.8	27.9	40	902	280
275	261	261	261	63.5	—	26.4	73.0	47.2	27.1	—	892	275
270	256	256	256	63.1	(102.0)	25.6	72.6	46.4	26.2	38	873	270
265	252	252	252	62.7	—	24.8	72.1	45.7	25.2	—	853	265
260	247	247	247	62.4	(101.0)	24.0	71.6	45.0	24.3	37	834	260
255	243	243	243	62.0	—	23.1	71.1	44.2	23.2	—	824	255
250	238	238	238	61.6	99.5	22.2	70.6	43.4	22.2	36	804	250
245	233	233	233	61.2	—	21.3	70.1	42.5	21.1	—	785	245
240	228	228	228	60.7	98.1	20.3	69.6	41.7	19.9	34	765	240
230	219	219	219	—	96.7	(18.0)	—	—	—	33	735	230
220	209	209	209	—	95.0	(15.7)	—	—	—	32	696	220
210	200	200	200	—	93.4	(13.4)	—	—	—	30	667	210
200	190	190	190	—	91.5	(11.0)	—	—	—	29	637	200
190	181	181	181	—	89.5	(8.5)	—	—	—	28	608	190
180	171	171	171	—	87.1	(6.0)	—	—	—	26	579	180
170	162	162	162	—	85.0	(3.0)	—	—	—	25	549	170
160	152	152	152	—	81.7	(0.0)	—	—	—	24	520	160
150	143	143	143	—	78.7	—	—	—	—	22	490	150
140	133	133	133	—	75.0	—	—	—	—	21	451	140
130	124	124	124	—	71.2	—	—	—	—	20	431	130
120	114	114	114	—	66.7	—	—	—	—	—	392	120
110	105	105	105	—	62.3	—	—	—	—	—	—	110
100	95	95	95	—	56.2	—	—	—	—	—	—	100

NISSHIN STEEL CO.,LTD

www.nisshin-steel.co.jp

JAPAN
Registered Head Office
Shinkokusai Building, 4-1, Marunouchi 3-chome, Chiyoda-ku,
Tokyo 100-8366, Japan
Telephone: (81-3) 3216-5530 Facsimile: (81-3) 3216-5747

OVERSEAS
Singapore Representative Office
16 Raffles Quay #20-01, Hong Leong Bldg., Singapore 048581
Telephone: (65) 6221-1277/8 Facsimile: (65) 6224-2357

Bangkok Representative Office
Unit 6, 35th Floor, CRC Tower All Seasons Place,
87/2 Wireless Road, Phatumwan, Bangkok 10330, Thailand
Telephone: (66) 2-654-0783 Facsimile: (66) 2-654-0981

Guangzhou Representative Office
Room 1505, Office Tower, CITIC Plaza, 233 Tian He North Road,
Guangzhou 510613, P.R.China
Telephone: (86) 20-3877-1054 Facsimile: (86) 20-3877-1094

Subsidiary
Nisshin Steel USA, LLC
1701 Golf Road, Continental Tower3, Suite1004,
Rolling Meadows, IL 60008 U.S.A.
Telephone: (1-847) 290-5100 Facsimile: (1-847) 290-0826

Nisshin Steel Shanghai Co.,Ltd.
Shanghai Maxdo Centre 3208-3210, 8 Xing Yi Road,
Hongqiao Development Zone, Shanghai 200336, P.R.China
Telephone: (86-21) 5208-0736 Facsimile: (86-21) 5208-0639

Printed in Japan on recycled paper P-02 '08.09
BC03-080930-E