



Kushal Metal & Steel Industries Pvt. Ltd.



Success comes from Harmony....
and win comes from Innovation



Scan Me



Introduction

Dinesh Hardware Mart was established in the year 1968, followed by establishment of KMSI in 1987. KMSI is a steel trading & stock holding company dealing in all kinds of High Speed Steel, Cold Work Tool Steel, Hot Work Tool Steel, Plastic Mould Steel, Corrosion Resistant Steel, Nitrating Steel, 2% Beryllium Copper, Ec copper, in form of Flat bars, Round bars, Sheets, Heavy blocks, Tool blanks, Finished tools & additionally its tailored products to suit any customers special cutting & machining requirement. Our sole aim is to serve tool room with quality tool steel at very reasonable price. Being in this business for almost half century our basic aim is to keep our customer on leading edge now and in future.

We are committed to established the name of Kushal Metal & Steel Industries as an origination of trust providing cost effective special steel to establish brand equity of Kushal Metal & Steel Industries and meeting all said & implied need of costumer to create total satisfaction trough highly motivated employees involvement & continuous quality & service improvement. Today we are glad to have achieved a fair degree success in just 45 years with numbers of satisfied customers both new and old.

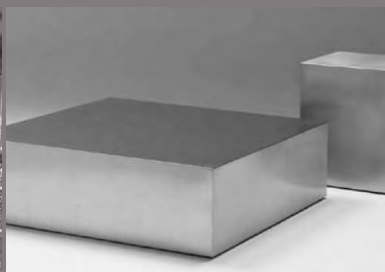
In the year of 2012 KMSI made a successful joint venture with the global major in the manufacturing of steel TG International, China with Kushal Metal & Steel Industries, India. Company Was formed TGK Special steel focuses on HIGH SPEED STEEL, HOT WORK STEEL, COLD WORK STEEL OF ESR HIGHER PROCESS MATERIAL.

Tool & Alloy Steel is mainly used for tools & different type of dies and mould making.

We have constantly strived to improve tool life by adopting cost effective technology and holding the best quality of steel in our stock. We keep pace with new developments and have added these upgraded steel in our stock list to serve our high quality demand customers with quick deliveries.

We assist our customers, by providing quality material as and when required; from deliveries and cut to size; meeting all quality parameters. We have a very sound infrastructure to help us in our endeavor to serve our valued users helping them to reduce their inventory. Also we have start our own laboratory with different type of testing facilities like Chemical, Ultra, Hardness testing etc.

1. We are committed to continuously improve and upgrade our infrastructure to world class standards.
2. Our material stocking capacity in our 3 yards together is over 3000 tons and have over 10 cutting machines running at these centers to serve the ever increasing delivery requirement of our esteemed clients.
3. We have our own machining shop which can help our customers with some value addition and also save their downtime with regards to Raw Material.
4. With overall staff strength of over 40 dedicated people we can also claim to have one of the fastest responding people to the queries of our end users.
5. We plan to open warehouses in Delhi, Bangalore & Chennai within a short time.





Kushal Metal & Steel Industries Pvt. Ltd.

Sole Distributor



GLORIA MATERIAL
TECHNOLOGY CORP.



Nippon Koshuha
Steel Co., Ltd.

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NGK INSULATORS, LTD.
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Authorised Dealer

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TOOLOX®
ENGINEERING & TOOL STEEL



DONGBEI SPECIAL STEEL GROUP CO., LTD.

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SANYO
SPECIAL
STEEL





OUR VISION

- Innovate and provide Best Steel Grades from reputed manufacturers around world
- Open up branches across India
- Contribute to India's Growth
- Provide value added services – material machining, cut pieces & tailor made material



OUR MISSION

- Our main aim is to provide quality tool steel for manufacturing units/tool rooms across India
- Provide service & material to take our clients into a non inventory module
- Being the first choice for our customers



CORE VALUES

- **Accountability:** We accept our individual and team responsibilities and we meet our commitments. We take responsibility for our performance in all of our decisions and actions.
- **Co-operation:** Good mutual cooperation across positions and departments is the basis for a pleasant working atmosphere in which employees feel good about themselves and what they are doing. The outmoded oppositions between production and maintenance, factory and administration, production and sales no longer have any places. A modern company must be based on teamwork and mutual trust, on striving together for continuous improvement.
- **Empowerment:** To empower our talented people to take the initiative and to do what's right.
- **Innovation:** We are creative in delivering value to our fellow associates, customers, shareowners, manufacturers and the community. We anticipate change and capitalize on the many opportunities that arise.
- **Leadership:** We encourage leadership among employees to develop and maintain a talent pool.
- **Life, Health and Environment:** We seek to improve our wellbeing, our working conditions and the surroundings in which we live in.
- **Open communication:** All team members are encouraged to openly share their opinions and views.
- **Positive Change:** Embracing and capitalizing on change, recognizing that every employee must be empowered to stimulate continuous improvement in all aspects of our business.
- **Professionalism:** We strive to fulfill our responsibilities to the highest possible standards throughout.
- **Teamwork:** Our team is supportive of each other's efforts, loyal to one another, and care for each other both personally and professionally.



ELECTRIC ARC FURNACE



Ladle Finery



Electric Arc Furnace



VOD



Electric Annealing Furnace



Electroslag Remelting



HSS Ingot Casting



Radial Forging



Powder Metallurgy High Speed Steel

Chemical Analysis

Grade	C	Cr	Mo	V	W
TPMM4	1.33	4.15	4.60	3.95	5.60
TPM330	1.28	4.10	5.00	3.00	6.40
TPM558	1.65	4.82	2.10	10.50	8.10
TPM638	1.28	4.2	5.0	3.1	8.5
TPM6711	2.30	4.2	7.0	6.5	6.5

Grade Equivalent

TIANGONG	US Standard	ERASTEEL	BOHLER
TPMM4	M4	ASP2004	S690
TPM330	M3-2	ASP2023	5790
TPM558	S390	ASP2052	--
TPM638	SS590	ASP2030	--
TPM6711	--	ASP2060	--

High Speed Steel

Chemical Analysis

Germany DIN	USA AISI	Chemical Analysis (typical value) % Min - Max										Delivery Conditions		Applications
Grade		C	S	P	Si	Mn	Cr	Mo	V	W	Co	Heat Treatment	Hardness (HB)	
1.3343	M-2	0.86-0.94	≤ 0.003	≤ 0.026	0.20-0.45	0.20-0.40	3.75-4.50	4.50-5.50	1.60-2.20	5.90-6.75	–	Annealed	≤255	Standard high-speed steel grade. High toughness and good cutting power owing to its well-balanced alloy composition; thus suitable for a wide variety to applications. It is used to manufacture knives, thread cutting & twist drills, sendzimer rolls, taps, broaches & milling tools, reamers, metal/circular saws, wood working & cold forming tools.
TG M2A Sp. grade for taps		0.83-0.85	MAX 0.010	MAX 0.030	0.30-0.40	0.20-0.40	3.90-4.20	4.80-4.85	1.80-1.90	6.00-6.20	Nb 0.10-0.12	Annealed	≤255	TGM2A is a special grade containing low percentage of carbon to increase toughness & added Niobium to find crystal grains of steel to obtain high strength & toughness specially suited for taps & tabs of thread tools.
TG M2B Sp. for Hobs & Broches		0.89	≤ 0.003	≤ 0.026	0.30-0.40	0.20-0.40	3.90-4.20	4.80-4.85	1.80-1.90	6.00-6.20	Nb 0.10-0.12	Annealed	≤255	Due to favorable hardness and abrasion resistance, it's mainly used to fabricate tools to cut materials which are difficult to be cut. It's mainly used as various cutting tools, for example, drilling bits, screw taps, milling cutters, drawing tools, roller cutters, etc.
1.3243	M-35	0.88-0.95	≤ 0.030	≤ 0.030	0.20-0.40	0.20-0.45	3.80-4.50	4.75-5.50	1.75-2.15	6.00-6.75	4.55-5.50	Annealed	≤255	It is one of the W-Mo Co hss grade with good cutting character. The res hardness, hot hardness and wearing resistance are all better than W6Mo5Cr4V2.
1.3247	M-42	1.05-1.15	–	–	0.15-0.65	0.15-0.40	3.50-4.25	9.00-10.00	0.95-1.35	1.15-1.85	7.75-8.75	Annealed	≤285	Milling Cutters, Twist Drills, Taps, Broaching Tools, Cold Work Tools.
1.3207	T-42	1.25-1.40	–	–	0.20-0.30	0.20-0.30	3.80-4.30	3.20-3.80	3.00-3.50	9.00-9.80	9.80-10.80	Annealed	≤285	Turning and Milling tools for roughing and finishing works, wood working tools highly stressed cold works tools, tool bits.
TG 4241		0.90-0.95	≤ 0.020	≤ 0.030	0.80-1.20	0.25-0.40	4.00-4.50	2.00-2.50	1.00-1.30	4.00-4.50	–	Annealed	≤285	It is an economical low alloy high-speed steel with good red hardness, good toughness and thermal plasticity. It is generally used soft and moderate intensity metal.
TG 4341		0.83-0.93	≤ 0.020	≤ 0.030	0.70-1.20	0.20-0.40	4.00-4.50	3.00-3.50	1.20-1.80	4.00-4.50	–	Annealed	≤285	

Grade Equivalent

DIN STANDARD	BRAZIL	AUSTRIA	SLOVANIA	JIS	AMERICAN
1.3343	VWM2	S600	BRM2	SKH51	M-2
1.3243	VK5E	S705	BRCMO	SKH55	M-35
1.3247	VKM42	S500	BRCMO2	SKH59	M-42
1.3207	VK10E	S700	BRU	SKH57	T-42

Production Process:

EAF → LF → VD → ESR → BLOOM IN FOLLOWING MACHINE : QUICK FORGING (12.5MN), HAMMER, PRECISION FORGING → { Precision Forging : Φ 81-300mm
Hot Rolled Annealed Peeled : Φ 14.5-80.0mm
Hot Rolled Sand Blasted : Φ 1.0 -13.5mm (Coil)
Cold Drawn or Centreless Ground : Φ 1.0-14.4mm

REDUCTION RATIO : As 1:4 or 1:5 | UNDER ANNEALED CONDITION : Hardness : HB205-255

DELIVERY STATUS : As Cold drawn / Hot rolled / forged, in annealed condition.

SIZE : SQUARE

4mm to 80mm

SIZE : ROUNDS

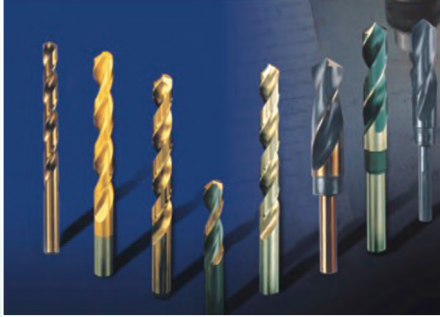
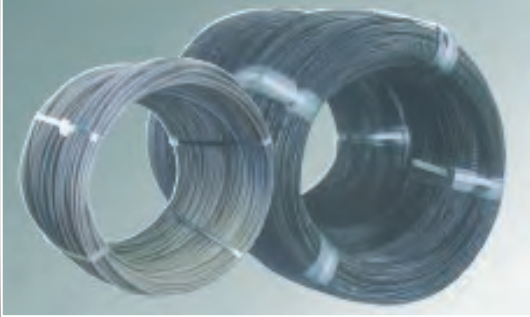
Cold Drawn/ Ground Bar	Hot Rolled Annealed Peeled Bar	Forged Annealed Turned Bar
Φ 1.0 - 14.4mm	Φ 14.5 - 80.0mm	Φ 81.0 - 300.0mm

SIZE : HOT ROLLED FLAT BARS /
SAND BLASTED MACHINED STRAIGHT

Thickness	Width
4mm - 205mm	4mm - 810mm

SIZE : SHEET/STRIPS

0.5mm - 12mm





Premium Hot Work Steel

Chemical Analysis

TG Grade	Equ. Grade ASSAB / BOHLER	Production Technology	Chemical Analysis (typical value) % Min - Max								Applications
			C	Mn	Si	S	P	Cr	Mo	V	
TGE13	W302 ISOBLOC	EAF+LF+VD+ESR, structure refining process	0.38	0.35	0.90	≤ 0.002	≤ 0.015	5.0	1.35	0.95	- For various metal pressure casting molds, for example: automobile engine cylinder body, cylinder cover, gearbox shell molds. - Hot extrusion molds, mainly for hot extrusion of aluminium profiles. - High-quality plastic molds, for example, high abrasion resistance plastic molds for automobiles.
TGGP13	ORVAR SUPREME	EAF+LF+VD+ESR, special smelting + special forging+structure refining process	0.38	1.45	1.1	≤ 0.001	≤ 0.009	5.3	1.45	1.0	- Long-life Al, Mg and Zn alloy pressure casting molds, for example: automobile engine cylinder body, cylinder cover, gearbox shell molds. - Long-scale hot extrusion molds: for example, aluminium alloy hot extrusion molds for high-speed rails and metros. - Precise hot forging molds: for example, automobile engine crankshaft and connecting rod molds, gear molds of gear boxes.
TGE23	DIEVAR	EAF+LF+VD+ESR, special smelting + special forging+structure refining process	0.37	0.4	0.3	≤ 0.001	≤ 0.015	5.0	2.2	0.45	- Mainly used for processing of light alloy-metal pipes, rods, extruded carrier rods, molds, and extruded molds, etc. - Pressure casting equipment, molded trimming die, compression moulding inserts, etc. - Hot shearing blades, plastic molds, etc.
TGGP11	W400VMR	EAF+LF+VD+ESR, special smelting + special forging+structure refining process	0.37	0.37	1.0	≤ 0.001	≤ 0.009	5.2	1.3	0.45	- Pressure casting molds. - Hot extrusion molds of aluminium, copper and magnesium ally. - High-polishing plastic injection molds.

Hot Work Steel

Chemical Analysis

Germany DIN	USA AISI	Chemical Analysis (typical value) % Min - Max										Delivery Conditions		Applications
Grade		C	S	P	Si	Mn	Ni	Cr	Mo	V	W	Heat Treatment	Hardness (HB)	
1.2344	H-13	035-042	≤0.030	≤0.030	0.80-1.20	0.25-0.50	--	4.80-5.50	1.20-1.50	0.85-1.15	--	Annealed	≤ HB235	Hot-work tool steel for universal use. Pressure casting dies and metal extrusion tools for processing light metals, forging dies, moulds, screws and barrels for plastic processing, nitrided ejectors, hot-shear blades. Suitable for Aluminium Extrusion Die & Aluminium Copper Forging Dies.
1.2345	H-13 M	047-052	≤0.030	≤0.030	0.80-1.20	0.25-0.50	--	4.80-5.50	1.20-1.50	0.85-1.15	--	Annealed	≤ HB235	
1.2343	H-11	033-041	≤0.030	≤0.030	0.80-1.20	0.20-0.50	--	4.80-5.50	4.70-5.20	1.10-1.50	--	Annealed	≤ HB235	Hot-work tool steel for universal use. Pressure casting dies and metal extrusion tools for processing light metals, forging dies, moulds, screws and barrels for plastic processing, shrink rings, hot-shear blades.
1.2343M	H-11 M	047-052	≤0.030	≤0.030	0.80-1.20	0.20-0.50	--	4.80-5.50	4.70-5.20	1.10-1.50	--	Annealed	≤ HB235	
1.2365	H-10	028-035	≤0.02	≤0.03	0.10-0.40	0.15-0.45	--	2.70-3.20	2.70-3.20	0.40-0.70	--	Annealed	≤ HB230	Heavy-metal linings, extrusion rams, piercing mandrels, die inserts, heavy-metal diecasting tools. Good Tempering resistance Thermal conductivity and Hardness as compare with H13. Suitable for Aluminium Extrusion Die, and Aluminium Copper forging die.
1.2581	H21	026-036	--	--	0.15-0.50	0.15-0.40	--	3.00-3.75	--	0.30-0.60	9.00-9.50	Annealed	≤ HB240	The H21 tungsten hot-work tool steels are mainly used for hot-working dies and toolings, e.g., die casting, extrusion and hot-forming of parts.
1.2367 SUP	--	0.37	≤0.001	≤0.015	0.4	0.45	--	5.0	2.8	0.55	--	Annealed	≤ HB240	Life pressure casting molds; Forged molds and inserts; Hot extrusion molds.
1.2714	L6	0.50-0.65	MAX 0.005	MAX 0.025	0.10-0.40	0.65-0.95	1.60-1.80	1.00-1.20	0.45-0.55	0.07-0.15	--	Q & T	HB 360/400	Forging dyes of all types, hammer forging dyes upto largest dimensions, tools for tube & rod extrusions such as bolsters, mandrels, plungers etc.

Grade Equivalent

STANDARD	BRAZIL	AUSTRIA	EN	SLOVANIA	ITALY	JIS	TAIWAN	AMERICAN	Swiden
1.2344	VM13IM	W302	X40CrMoV5-1	UTOP M02-EFS	ESKY0S2	SKD61	GMH13 (ESR)	H-13	--
1.2343	TENAX300	W300	X38CrMoV5-1	UTOP M01-EFS	--	--	GMH11	H-11	--
1.2365	VCM	W320	32CrMoV12-28	UTOP 33-EFS	--	SKD7	GMH10 (ESR)	H-10	--
1.2714	VMO	W500	56NiCrMoV7	UTOP EX2	ESKY0S2 73	SKT4	GMKT4	L6	--
1.2367	--	W360	--	--	--	--	--	--	--
STANDARD	AISI		DIN	JISS	SWIDEN		AUSTRIA		DAIDO
TGGP11	H11		1.2343	--	VIDAR SUPEIOP		W400VMR		--

Production Process:

Production Process:

Round Bar : EAF → LF → VD → ESR → (5TONS HAMMER) →

Forged Annealed Turned	: Φ 81.0-810.0mm
Hot Rolled Annealed Peeled	: Φ 14.5-80.0mm
Cold Drawn or Centreless Ground	: Φ 2.0-14.4mm

→ ANNEALED CONDITION

Flat Bar : EAF → LF → VD → ESR → FORGED → HOT ROLLED (850) → ANNEALED CONDITION

SIZE : ROUNDS

Cold Drawn/ Ground Bar	Φ 2.0 - 14.4mm	Hot Rolled Annealed Peeled Bar	Φ 14.5 - 80.0mm	Forged Annealed Turned Bar	Φ 81.0 - 810mm
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SIZE : HOT ROLLED FLAT BARS / SAND BLASTED MACHINED STRAIGHT

Thickness: 5mm - 410mm	Width: 10mm - 810mm
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REDUCTION RATIO:
As 1:6 or 1:7

UT STANDARD:
SEP 1921, (DEC.84)E/e

DELIVERY STATUS:
In Annealed Condition





Premium Cold Work Steel

Chemical Analysis

GERMANY DIN	USA AISI	Chemical Analysis (typical value) % Min - Max									Delivery Conditions	
Grade		C	S	P	Si	Mn	Cr	Mo	V	W	Heat Treatment	Hardness (HB)
TSFD2	D2	1.5	≤ 0.015	≤ 0.03	0.35	0.4	7.8	1.90	0.25	--	Annealed	<255
TSFDC53	DC53	0.93	≤ 0.010	≤ 0.03	0.95	0.40	7.8	1.90	0.25	--	Annealed	<248

Cold Work Steel

Chemical Analysis

GERMANY DIN	USA AISI	Chemical Analysis (typical value) % Min - Max									Delivery Conditions	
Grade		C	S	P	Si	Mn	Cr	Mo	V	W	Heat Treatment	Hardness (HB)
1.2379	D2	1.50-1.60	≤ 0.030	≤ 0.030	0.10-0.40	0.15-0.45	11.00-12.00	0.70-0.90	0.90-1.10	--	Annealed	<255
1.2080	D3	1.90-2.20	≤ 0.030	≤ 0.030	0.10-0.40	0.15-0.45	11.00-12.00	--	0.20-0.20	--	Annealed	<248
1.2510	O1	0.85-0.95	--	--	0.20-0.40	1.00-1.30	0.40-0.60	--	0.10	0.40-0.60	Annealed	<212
TSFDC53	DC53	0.90-1.05	≤ 0.020	≤ 0.025	0.80-1.10	1.10-0.45	7.50-8.50	1.80-2.10	0.20-0.35	--	Annealed	<248
1.2357	S7	0.45-0.60	--	--	0.45-0.55	0.65-0.80	3.20-3.40	--	0.20-0.35	--	Annealed	<229
1.2550	S1	0.55-0.70	--	--	0.60-0.80	0.25-0.35	--	--	0.10-0.20	1.90-2.20	Annealed	<255
1.2363	A2	1.0	≤ 0.010	≤ 0.030	--	0.7	5.1	1.15	0.3	--	Annealed	<255
1.2379	TSFD2	1.45-1.60	≤ 0.03	≤ 0.03	0.10-0.60	0.20-0.60	11.0-13.0	0.70-1.0	--	--	Annealed	<255
1.2767	-	0.45	≤ 0.03	≤ 0.03	0.35	0.25	1.35	0.25	≤ 0.1	--	Annealed	<255

Applications :

- 1.2379** Used for long run tooling application where wear resistance is important, such as blanking or forming dies and thread rolling rolls and thread rolling dies, cold extrusion tools, woodworking, cutting and stamping tools for sheet thicknesses up to 6mm, precision cutting tools up to 12 mm. Cold pilger mandrels, circular-shear blades, deep-drawing tools. Pressure pads and highly resistant plastic moulds. Toughness better than D3.possibility of nitrating.
- 1.2080** Tools for cutting sheets up to 4mm thickness, trimming dies, blanking dies for paper and plastics, long and round-section shear blades for sheet thicknesses up to 2 mm, drawing and deep drawing tools. Woodworking tools, stone pressing tools, pressure pads and highly wear-resistant plastic moulds, profile rolls.
- 1.2510** Application include short run tooling for blanking dies, cold forming dies and cutting tools operating at ambient temperature. For working tools, cutting blades, sizing and stamping tools.
- 1.2363** Blanking dies, rolls, shear blades, cold pilger mandrels, cold coining dies. Moulds for the processing of plastics.
- DC53** One fold toughness than SKD11, 520-530 C with 61-63 HRC to get rid of risk about cracking when processing, very suitable for surface hardening treatment to improve the longevity of moulds.
- 1.2357** Chisels, rivet sets, punches, driver bolts. Hot punching & shearing.
- 1.2550** For cutting tools(dyes, punches) for plate, wood working tools, blanking dyes for cutting sheet metals upto 12mm thickness., trimming & splitting dyes, shear blades, chipping knives, pneumatic chisels, coining tools, cold shear blades, ejectors.

Grade Equivalent

DIN STANDARD	BRAZIL	AUSTRIA	EN	SLOVANIA	ITALY	JIS	AMERICAN
1.2379	VD2	K110	X155CrVMo12-1	OCR12VM	DUYO S2379	SKD11	D-2
1.2080	--	K100	X210Cr12	OCR12VM	--	SKD1	D-3
1.2510	VND	K460	100MnCrW4	OW4	--	SKS3	O-1

Production process:

Round Bar :

EAF → LF → VD → ESR → BLOOM FORGED (5TONS HAMMER) →

Forged Annealed Turned	: φ 81.0-1500mm	→ ANNEALED CONDITION
Hot Rolled Annealed Peeled	: φ 14.5-80.0mm	
Centreless Ground	: φ 2.0-14.4mm	

Flat Bar :

EAF → LF → VD →

FORGED	→ HOT ROLLED (850) → ANNEALED CONDITION
(5TONS HAMMER)	
HOT ROLLED (910)	

REDUCTION RATIO : As 1:4 or 1:5 | **UT STANDARD :** SEP 1921, (DEC.84)E/e | **DELIVERY STATUS :** As Hot Rolled & Forged, Delivery Condition : Annealed

SIZE : ROUNDS

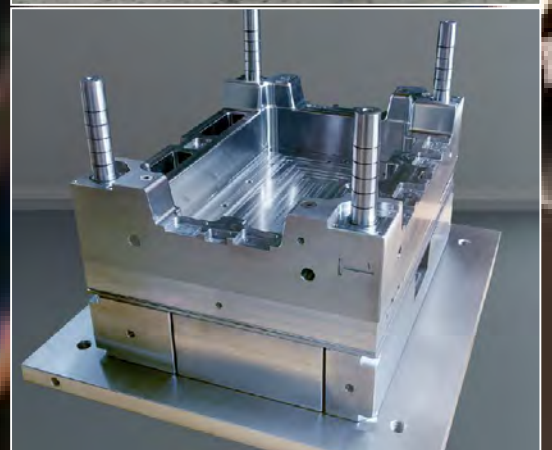
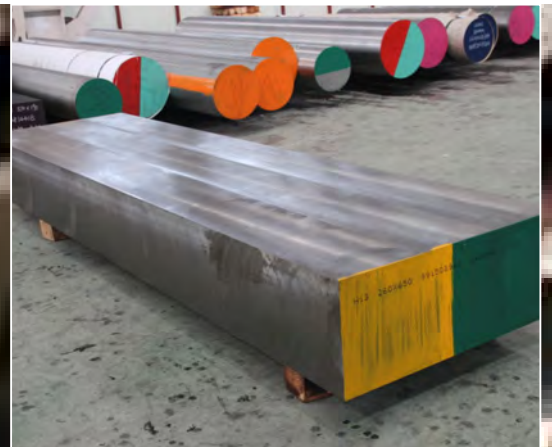
Cold Drawn/ Ground Bar	Hot Rolled Annealed Peeled Bar	Forged Annealed Turned Bar
φ 2.0 - 14.4mm	φ 14.5 - 80.0mm	φ 81.0 - 1500mm

SIZE : HOT ROLLED FLAT BARS / SAND BLASTED MACHINED STRAIGHT

Thickness	Width
5mm - 410mm	10mm - 810mm

SIZE : SHEET

0.5mm to 12mm





Plastic Mould Steel

Chemical Analysis

Germany DIN	Chemical Analysis (typical value) % Min - Max											Delivery Conditions		Applications
Grade	C	S	P	Si	Mn	Ni	Cr	Mo	V	Cu	Others	Heat Treatment	Hardness (HB)	
1.2311	0.35-0.45	MAX 0.030	MAX 0.030	0.20-0.40	1.30-1.60	—	1.80-2.10	0.15-0.25	—	—	—	Q & T	280/325	Injection moulds of medium & large size, high deformation resistance with good polishability. Suitable for bottle crates, T.V housing, fridge door, buckets etc.
1.2312	0.35-0.45	0.05-0.10	MAX 0.030	0.20-0.40	1.30-1.60	—	1.80-2.10	0.15-0.25	—	—	—	Q & T	280/325	Tools for plastic & synthetic plastic processing, moulds for pressure diecasting recipient sleeves, brake dies. Also used for large moulds(truck bumpers for instance).
1.2738 1.2738 HH	0.35-0.45	MAX 0.030	MAX 0.030	0.20-0.40	0.30-0.60	0.90-1.20	1.80-2.10	0.15-0.25	—	—	—	Q & T	280/320 Or 380/420	Synthetic plastic moulding dies for large moulds for bigger diameters & blow moulds. Better through hardening properties for cross section of 400mm & more.
1.2714	0.50-0.65	MAX 0.005	MAX 0.025	0.10-0.40	0.65-0.95	0.60-0.80	1.80-1.20	0.45-0.55	0.07-0.15	—	—	Q & T	360/400	Forging dies of all types, hammer forging dies upto largest dimensions, tools for tube & rod extrusions such as bolsters, mandrels, plungers etc.
1.7225	0.38-0.45	MAX 0.035	MAX 0.035	0.30-0.40	0.75-1.00	0.15-0.25	0.80-1.10	—	—	—	—	As Rolled/ Forged	MAX 295	Statically & dynamically stressed components for vehicles, engines & machines. For parts of larger cross-sections, crankshafts, gears.
1.6582	0.38-0.45	MAX 0.035	MAX 0.040	0.15-0.35	0.60-0.80	1.65-2.00	0.70-0.90	0.20-0.30	—	—	—	Black Forged & Annealed	MAX 230	Permanently stressed machine, engine & vehicle parts when high strength & toughness are required.
1.2327	0.83-0.90	MAX 0.030	MAX 0.030	0.15-0.35	0.30-0.45	—	1.60-2.90	0.20-0.35	0.05-0.15	—	—	Black Forged & Spl. Annealed	180.220	Cold rolls, back up rolls, straightening rolls, non ferrous 2 & 4 high roll mills.

Corrosion Resistance

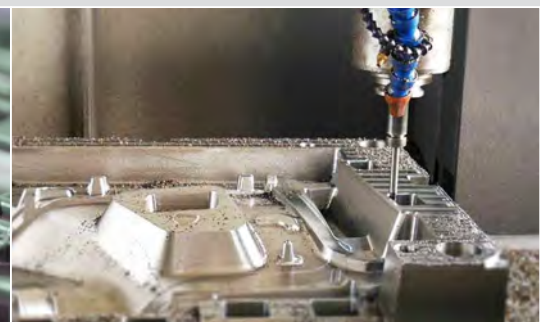
Chemical Analysis

Germany DIN	USA AISI	INDIAN IS	Chemical Analysis (typical value) % Min - Max								Delivery Conditions		Applications
Grade			C	S	P	Si	Mn	Ni	Cr	Mo	Heat Treatment	Hardness (HB)	
1.2083 ESR	420 SS	XY2Cr13	0.38-0.45	MAX 0.030	MAX 0.030	0.95-1.00	0.95-1.00	—	12.50-14.50	—	Q&T	280/320	Moulds for processing plastics with corrosive acting synthetic & abrasive filters, dies for artificial resins. Cutting tools, all types of knives, shears & surgical instruments.
1.2316	420 FMOD	X36CrMo17	0.33-0.43	MAX 0.030	MAX 0.030	0.95-1.00	1.00-1.30	0.90-1.00	15.00-17.00	1.00-1.30	Q&T	280/320 OR 380/420	Dies for pressing chemically aggressive compounds. Spindles, belt, pulp engines, cutters, valves, components for fittings for temperature upto 600 degrees.
GEST80	NAK 80		0.10-0.15	≤0.015	≤0.005	0.10-0.40	0.30-0.50	2.80-3.00	0.20-0.50	0.20-0.30	Q&T	380/420	Transparent products & others for which mirror finished surface are particularly important. Products for which electrical discharge machined surfaces are very important. It can be used in place of Aventurine-etching due to better EDM surface. It does not need stress relieving even after heavy machining. also has uniform hardness.
174PH	PHX SUPRA	—	0.05	CU 3.50	—	—	—	4.50	15	—	Q&T	380/420	PHX Supra is used for tools/ moulds for the processing of corrosive plastics. Also used for plastic piping & plumbing injection moulds. moulds with strong corrupt resisting used for camera lens, dies for pressing chemically aggressive compounds. high polished tools and moulds for processing of high corrosive plastics, tools for plastic extrusion. Aircraft component.

Mould Base Steel

Chemical Analysis

Germany DIN	USA AISI	INDIAN IS	Chemical Analysis (typical value) % Min - Max					Delivery Conditions		Applications
Grade			C	S	P	Si	Mn	Heat Treatment	Hardness (HB)	
1.1730	1045	C-45	0.45-0.50	MAX 0.030	MAX 0.030	0.30-0.35	0.70-0.75	As Rolled/ Forged	MAX 207	Cold heading dies, top & bottom plates for plastic die casting, die casting tools, hand tools, tongs, agricultural tools & blanking tools.





High Speed Steel

BÖHLER S600

Application Segments

Cutting Tools

Automotive

Available Product Variants

Long Products*

Plates

* Presented data refer exclusively to long products.
Please observe the detailed explanations at the end of the data sheet (pdf).

Product Description

BÖHLER S600 – "The high-speed steel"

Ideal for mills, twist drills, and taps, broaches, cold-work tools. BÖHLER S600 is the most commonly used high-speed steel and is the starting material for our customers who deal with high-speed steel

Process Melting

Airmelted or Airmelted + ESR (ISORAPID)

Properties

- Toughness & Ductility : high
- Wear Resistance : high
- Compressive strength : high
- Edge Stability : high
- Grindability : high
- Hot Hardness (red hardness) : high

Applications

- Broaches and Reamers
- Gear Cutting, Shaving and Shaping Tools
- Powder Pressing
- Special Cutting Tools
- Wear parts
- Cold Forming / Coining
- Injection Components
- Rolling
- Standard Parts (Molds, Plates, Pins, Punches)
- Thread rolling
- Fine Blanking, Stamping, Blanking
- Other Automotive Components (Turbochargers, Piston Rings, Sensors, etc.)
- Shearing / Machine Knives
- Twist Drills and Taps
- Blades for Sawing Machines

Technical data

Material designation	Standards
1.3343 SEL	4957 EN ISO
HS6-5-2C EN	

Chemical Composition (wt. %)

C	Cr	Mo	V	W
0.9	4.1	5	1.8	6.2

Delivery condition

Annealed

Hardness (HB)	max. 280
Ultimate tensile strength (UTS) (MPa)	max. 950
Tensile Strength (MPa)	max. 950

Hardened and Tempered

Hardness (HRC) min. 62 | bars hardened and tempered (BHT)

Heat treatment

Annealing

Temperature	770 to 840 °C
Controlled slow cooling in furnace (10-20°C/h (50-68°F/h) to approx. 600°C (1110°F), air	

Stress relieving

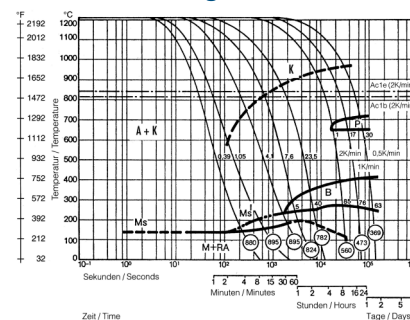
Temperature	600 to 650 °C
Slow cooling furnace. To relieve stresses set up by extensive machine or in tools of intricate shape. After through heating, hold in neutral atmosphere for 1 to 2 hours.	

Hardening and Tempering

Temperature	1,100 to 1,210°C
Salt bath, vacuum Preheating: 1st stage - 500°C, 2nd stage - 850°C 3rd stage - 1050°C Austenitising: 1100 - 1210°C, holding time after complete heating 80 seconds, maximum 150 seconds, to avoid material damage due to overheating. Quenching: oil, warm bath (500 - 550°C), gas	

Temperature	550 to 570°C
Slow heating to tempering temperature immediately after austenitising. Dwell time in the furnace 1 hour per 20mm material thickness (at least 1 hour) Slow cooling to room temperature 3 tempering cycles recommended Hardness see tempering chart	

Continuous cooling CCT curves

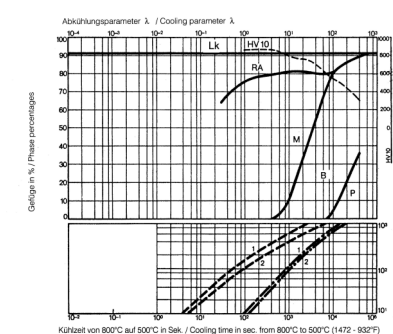


Austenitising temperature: 1210°C (2210°F)

Holding time: 180 seconds

A....Austenite
B....Bainite
K....Carbide
P....Pearlite
M....Martensite
RA...Retained Austenite

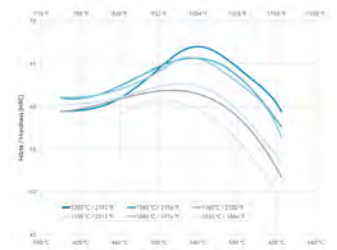
Quantitative phase diagram



A....Austenite
B....Bainite
K....Carbide
P....Pearlite
M....Martensite
RA...Retained Austenite
1....Edge or Face
2....Core
3....Jominy test: distance from quenched end
-- oilcooling
- - - aircooling

Tempering Chart

Vacuum
Holding time 3 x 2 hours
Specimen size: square 25 mm



Physical Properties

Temperature (°C)	20
Density (kg/dm³)	8.07
Thermal conductivity (W/(m.K))	21.8
Specific heat (kJ/kg K)	0.433
Spec. electrical resistance (Ohm.mm²/m)	0.47
Modulus of elasticity (10³N/mm²)	219

Thermal Expansions between 20°C | 68°F and...

Temperature (°C)	100	200	300	400	500	600	700
Thermal expansion (10 ⁻⁶ (m.K))	11.5	11.7	12.2	12.4	12.7	13	12.9



High Speed Steel

BÖHLER S705

Application Segments

Cutting Tools

Automotive

Available Product Variants

Long Products*

Plates

* Presented data refer exclusively to long products.
Please observe the detailed explanations at the end of the data sheet (pdf).

Product Description

BÖHLER S705 – "The Industrial One"

The conventional high-speed steel for industrial applications in machining. With a well-balanced alloy position and cobalt content, this type always manages to get the job done. Cobalt-alloyed molybdenum high-speed steel with high hardness, excellent cutting properties, outstanding compressive strength, high hot hardness, and good toughness.

Process Melting

Airmelted

Properties

- Toughness & Ductility : good
- Edge Stability : high
- Wear Resistance : high
- Grindability : good
- Compressive strength : very high
- Hot Hardness (red hardness) : very high

Applications

- Broaches and Reamers
- Special Cutting Tools
- Twist Drills and Taps
- Gear Cutting, Shaving and Shaping Tools
- End Mills
- Blades for Sawing Machines

Technical data

Material designation	Standards
1.3243 SEL	4957 EN ISO
HS6-5-2-5 EN	

Chemical Composition (wt. %)

C	Cr	Mo	V	W	Co
0.92	4.1	5	1.9	6.2	4.8

Delivery condition

Annealed

Hardness (HB)	max. 280 Drawn max 290HB
Tensile Strength (N/mm ²)	max. 980

Heat treatment

Annealing

Temperature	770 to 840 °C
-------------	---------------

Controlled slow cooling in furnace (10 to 20 °C/h / (50 to 68 °F/h) to approx. 600 °C (1112 °F), air cooling.

Stress relieving

Temperature	600 to 650 °C
-------------	---------------

Slow cooling in furnace. || To relieve stresses set up by extensive machining or in tools of intricate shape. || After through heating, maintain a neutral atmosphere for 1-2 hours.

Hardening and Tempering

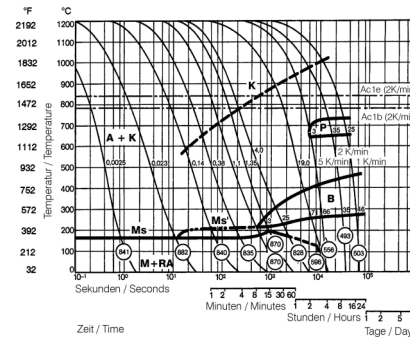
Temperature	1,190 to 1,230 °C
-------------	-------------------

Salt bath, vacuum || Preheating: 1st stage – 500 °C, 2nd stage – 850 °C, 3rd stage – 1050 °C || Austenitising: 1190 - 1230 °C, holding time after complete heating 80 seconds, maximum 150 seconds, to avoid material damage due to overheating. || Quenching: oil, warm bath (500 - 550 °C), gas

Temperature	550 to 570 °C
-------------	---------------

Slow heating to tempering temperature immediately after austenitising. || Dwell time in the furnace 1 hour per 20mm material thickness (at least 1 hour) || Slow cooling to room temperature || 3 tempering cycles recommended || Hardness see tempering chart

Continuous cooling CCT curves

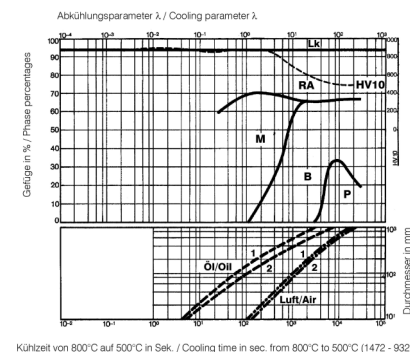


Austenitising temperature: 1200 °C (2192 °F)

Holding time: 180 seconds

A....Austenite
B....Bainite
K....Carbide
P....Pearlite
M....Martensite
RA...Retained Austenite

Quantitative phase diagram



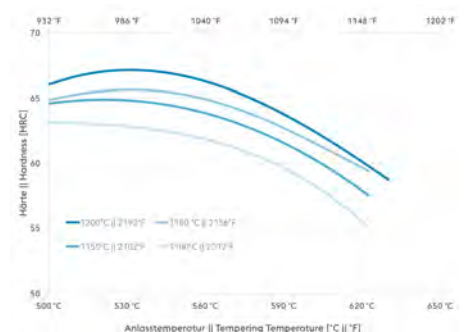
A....Austenite
B....Bainite
K....Carbide
P....Pearlite
M....Martensite
RA...Retained Austenite
1....Edge or Face
2....Core
3....Jominy test: distance from quenched end

Kühlzeit von 800 °C auf 500 °C in Sek. / Cooling time in sec. from 800 °C to 500 °C (1472 - 932 °F)

Tempering Chart

Holding time
3 x 2 hours

Specimen size:
square 25 mm



Physical Properties

Temperature (°C)	20
Density (kg/dm ³)	7.9
Thermal conductivity (W/(m.K))	21
Specific heat (kJ/kg K)	0.42
Spec. electrical resistance (Ohm.mm ² /m)	0.49
Modulus of elasticity (10 ³ N/mm ²)	224

Thermal Expansions between 20 °C | 68 °F and...

Temperature (°C)	100	200	300	400	500	600	700
Thermal expansion (10 ⁻⁶ m/(m.K))	10.5	10.83	11.14	11.47	11.81	12.12	12.44



The NGK Ultra Supra II Plus enable high-cycle plastic forming, improves quality, and ensure a long life for casting mols.

NGK Ultra Supra II Plus Features

----- thermal conductivity and ----- temperature hardness, the ----- beryllium-copper alloy ----- the following features as casting mold material used for plastic forming

1. Accelerates the cooling of casting molds and shortens the forming cycle.
2. Improves the quality of formed products
3. Ensure a long life for casting molds

Machinability

While this material offers cutting performance similar to steel of quality hardness, even better performance can be achieved by slightly changing the machining conditions.

Weldability

Because this copper alloys has excellent thermal conductivity use a TIG welder in this following manner:
Use high welding amperage, approximately 3 times that for steel
Use a welding 3 rod made of a compatible.

Standard Plates in Stock

Plates with various sizes are available.

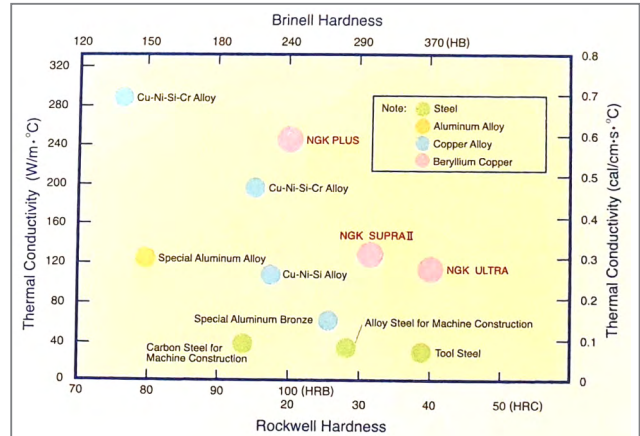
Thickness (mm)	Tolerance	Length
T12-350	+1-0	1000-2000

Standard Round Bars in Stock

Round Bars with various sizes are available

Diameter (mm)	Tolerance	Length
Ø 20-55	±0-25	1000-2000
Ø 55-120	+1-0	

Casting Mold Material Chart



Physical and Mechanical Features

	Thermal Conductivity (w/m ² ·°C)	Thermal Expansion Coefficient (1/°C)	Elasticity Coefficient (KN/mm ²)	Hardness (Rockwell)
NGK PLUS	245	17.6x10 ⁻⁶	132	B92-105
NGK SUPRA II	145	17.8x10 ⁻⁶	127	C30-34
NGK ULTRA	130	17.8x10 ⁻⁶	127	C36-42

Other than the hardness, it is a representative figure.

Rods

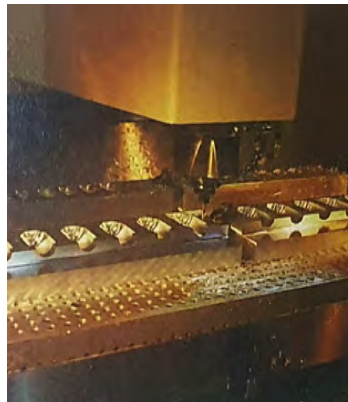
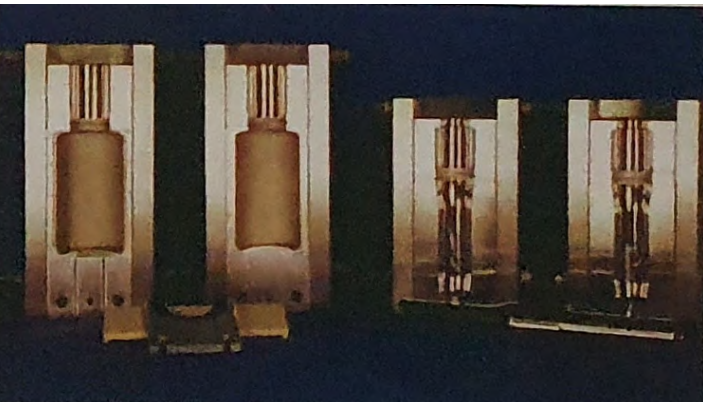
- SPECIFICATIONS
- AMS 4533 (AT)
 - AMS 4534 (HT)
 - AMS 4650 (A)
 - AMS 4651 (H)
 - ASTM B196

Plate

- C17200/17510
- 0.75" - 8" THICK

Size Ranges

- 0.062" - 8"





General Advantages of Beryllium Copper

- TREMENDOUS STRENGTH
- EXCELLENT TOUGHNESS AND DUCTILITY
- EXCELLENT FATIGUE STRENGTH
- EXCELLENT CORROSION RESISTANCE
- VERY GOOD CONDUCTIVITY
- NON-SPARKING ; NON-MAGNETIC
- EXCELLENT WEAR RESISTANCE

► ULTRA, SUPRA, PLUS

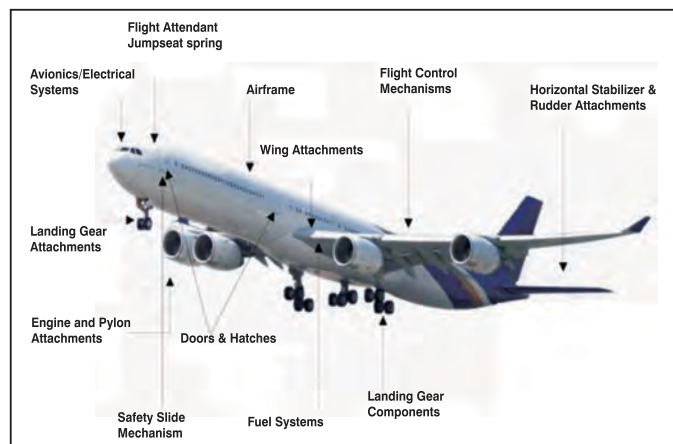
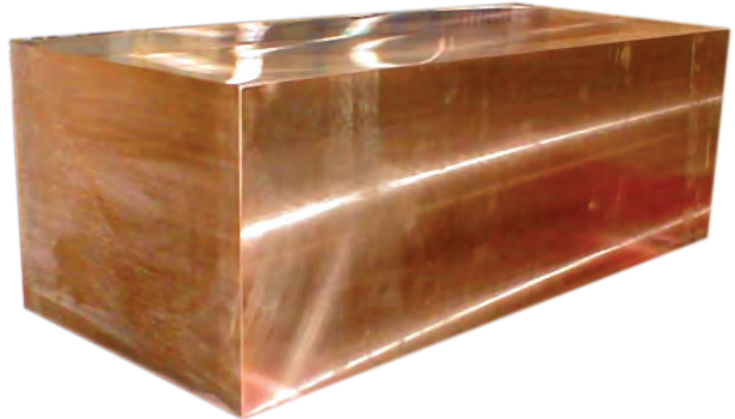
Plate : t20-300 x w500 x L1000-2000

Rod : Ø20-300 x L1000 - 1500

► MP15

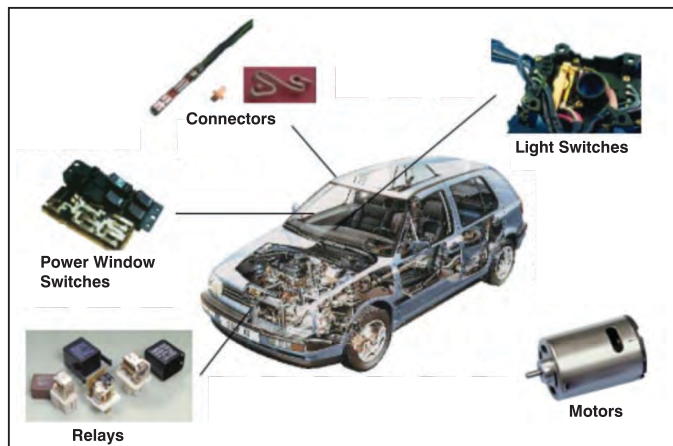
Plate : t60-240 x w450-500 x L800-1500

Rod : Ø25-200 x L1000



Aerospace Applications

- Commercial and Military Aircraft Bushings
- Landing Gear
- Nose to Tail
- Aircraft Connectors



Automotive Applications

- RWMA Electrodes
- Gun Arms, Shanks, Adapters, Tips and Caps.
- High Temperature and Vibration.
- Beryllium Copper maintains high performance even under harsh conditions.





• Plastic Mould Steel

GMTC	AISI	DIN	Size (mm): $5 \leq \phi \leq 600$
420Mod	420	1.2083	
1.2738	-	1.2738	
P20	P20	1.2311	
1.2316	-	1.2316	
630(17-4PH)	S17400	AMS 5622, AMS 5643	

Above steel grades are available in ESR

• Cold Work Tool Steel

GMTC	AISI	DIN	Size (mm): $5 \leq \phi \leq 410/$
D2	D2	1.2379	
1.2080	D3	1.2080	
A2	A2	1.2363	

Above steel grades are available in ESR

GMTC	AISI	DIN	Size (mm): $5 \leq \phi \leq 600$
S1	S1	1.2542	
S7	S7	1.2355	
1.2767		1.2767	

1. Above steel grades are available in ESR
2. Also supply flat bars, square bars, & mold blocks

• Hot Work Tool Steel

GMTC	AISI	DIN	Size (mm): $5 \leq \phi \leq 650$
H11	H11	1.2343	
H13	H13	1.2344	
1.2365		1.2365	
L6	L6	1.2714	

1. Above steel grades are available in ESR & VAR
2. Also supply flat bars, square bars & mold blocks

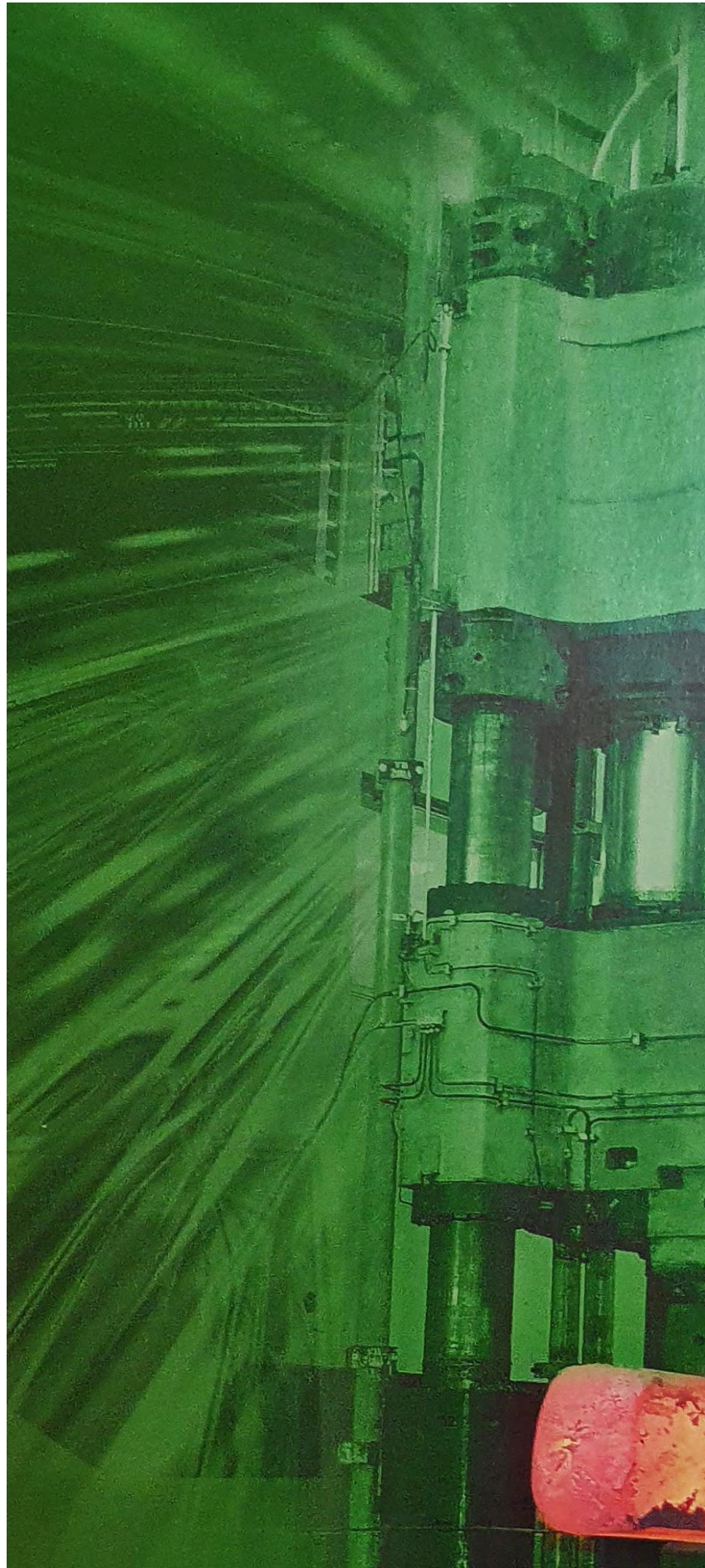
• High Speed Steel Series

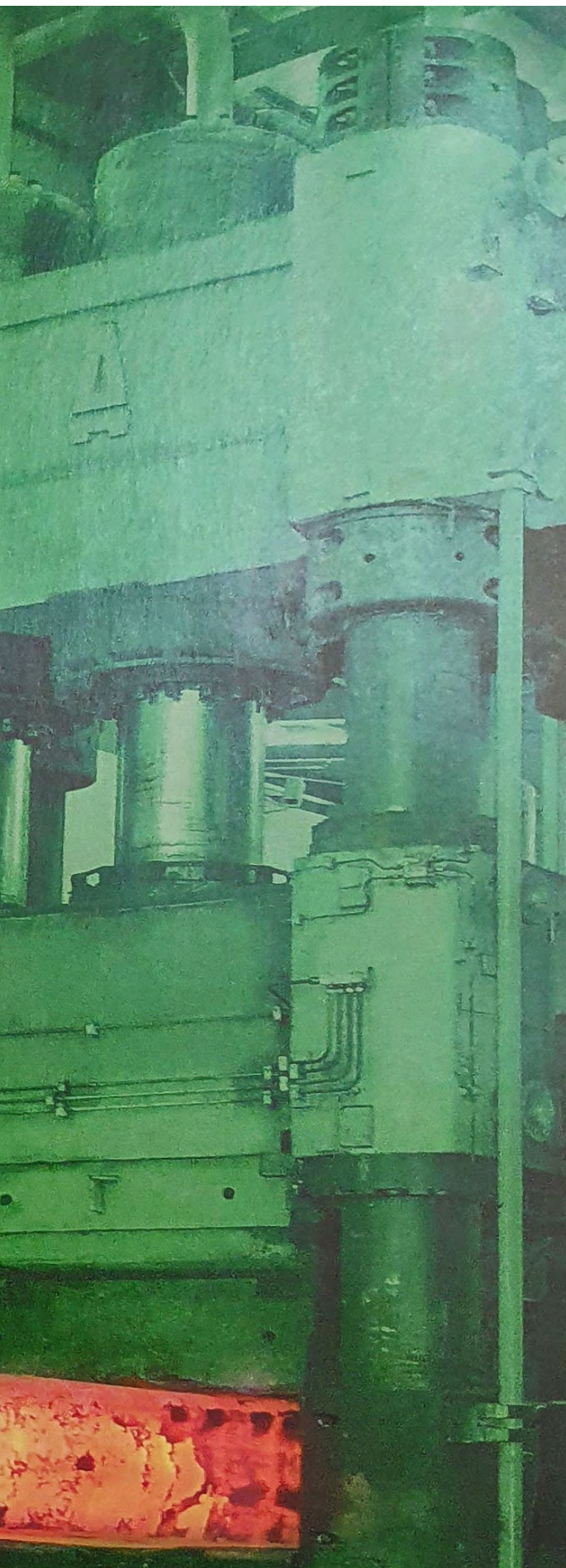
GMTC	AISI	DIN	Size (mm): $5 \leq \phi \leq 233$
M2	M2	1.3343	
M35	M35	1.3243	
M42	M42	1.3245	

Above steel grades are available in ESR & VAR

Application:

Cutting Tools, Shaving cutter, Punches, Mould & Dies.





• Titanium Alloy Series

Ti-Bar

Size (mm): $5 \leq \phi \leq 350$

Grade:

Commercial : ASTM B348/B381, Gr.1, Gr.2, Gr.3, Gr.5, Gr.12, β -Ti(1023), AMS 4921

Medical Implants : ASTM F136, ISO5832.3, ASTM B348, Gr.23(ELI), ASTM F67 & ISO5832.2 (pure titanium), AMS 4930, ASTM F1472.

Aerospace : AMS 4928Q, AMS MIL-T9047, AMS 6931, AMS 6930, AMS 4965, AMS 4967.

• Stainless Steel Series

• 400 Series

GMTC	AISI	DIN	Related Specs	Size (mm): $5 \leq \phi \leq 600$
403	403	1.4006	ASTM A182, ASTM A276, ASTM A473, ASTM A479 AMS-QQS-763, JIS G4303, NAC MR 0175/ISO 15156	
410	410	1.4006	AMS 5612, AMS 5613, AMS-QQS-763 ASTM A182, ASTM A193, ASTM A276, ASTM A314, ASTM A473, ASTM A479 JIS G4303, NORSOK-M-CR-701 NACE MR 0175/ISO 15156, EN 10088-3	
416	416	1.4005	AMS 5610 TYPE II, EN 10088-3, ASTM A314, ASTM A473, ASTM A582, JIS G4303	
420	420	1.4021 1.4028 1.2083	AMS 5621, AMS-QQS-763, ASTM A276, EN10088-3 JIS G4303, NACE MR 0175/ISO 15156	
F6NM	F6NM		ASTM A182, NACE MR 0175/ISO 15156	
430	430	1.4016	ASTM A276, ASTM A314, ASTM A473, ASTM A479 AMS 5627, AMS-QQS-763	
430F	430F	1.4014	ASTM A314, ASTM A581, ASTM A582, ASTM A473 JIS G4303	
431	431	1.4057	ASTM A276, ASTM A473, ASTM A479 AMS 5628, JIS 4303	
1.2316		1.2316	ISO 4957	

1. Above steel grades are available in ESR and heat treated by quenching-tempering.
2. Above steel grades in flat bars, square bars & mold blocks.

GMTC	AISI	DIN	Related Specs	Size (mm): $5 \leq \phi \leq 410$
4408	4408	1.4112	ASTM A276, ASTM A314, ASTM A473, AMS-QQS-763, EN 10088-3, JIS G4303, SEW 400	
440C	440C	1.4125	ASTM A276, ASTM A314, ASTM A473, ASTM A756 AMS 5630, AMS 5618, AMS 5880, AMS-QQ-763 EN 10088-3, JIS G4303, SEW 400	

Above steel grades are available in ESR & VAR

• Duplex (Ferritic-Austenitic Series)

Size (mm): $5 \leq \phi \leq 315$

GMTC	AISI	UNS	DIN	Related Specs
1.4462	F51	S31803 S32205	1.4462	ASTM A182, ASTM A276, EN 10088-3 NACE MR 0175/ISO 15156, NORSOK M-630

Above steel grades are available in ESR

• Fe Based Super Alloy

GMTC	UNS	Related Specs	Size (mm): $5 \leq \phi \leq 200$
A286	S66286	AMS 5731, AMS 5732, AMS 5734, AMS 5737, ASTM A453, ASTM B637	

Above steel grades are available in ESR



SIMOLD...



SITHERM...



SIHARD...



SIMOLD

CHEMICAL COMPOSITION



SIJ GRADE	CHEMICAL COMPOSITION (MAS.%)										ACHIEVED
	W. NR.	C	Si	Mn	Cr	Mo	Ni	V	W	Others	HARDNESS
SIMOLD 2083	1.2083	0,46	max 1,0	max 1,0	13,5	/	/	/	/	/	55 - 57 HRC
SIMOLD 2085	1.2085	0,35	0,4	0,45	16	/	/	/	/	S 0,070	45 - 51 HRC
SIMOLD 2311	1.2311	0,4	0,3	1,45	1,95	0,2	/	/	/	/	52 HRC
SIMOLD 2738	1.2738	0,4	0,3	1,4	1,9	0,2	1	/	/	/	52 HRC
SIMOLD 2316	1.2316	0.39	max 1,0	max 1,50	17	1,05	/	/	/	/	49 HRC

SIHARD

CHEMICAL COMPOSITION



SIJ GRADE	CHEMICAL COMPOSITION (MAS.%)										ACHIEVED
	W. NR.	C	Si	Mn	Cr	Mo	Ni	V	W		HARDNESS
SIHARD 2379	1.2379	1,55	0,25	0,3	11,5	0,7	/	1	/		62-64 HRC
SIHARD 2767	1.2767	0,45	0,25	0,3	1,35	0,25	4	/	/		56 RC
SIHARD 2357	1.2357	0,5	0,3	0,6	3,3 0,2	1,5	/		/		59-61 HRC
SIHARD 2510	1.2510	0,95	0,25	0,3	11.5	0,7	/	1	/		62-64 HRC
SIHARD 2842	1.2842	0,9	0,25	2	0.35	/	/	0,1	/		63-65 HRC

SITHERM

CHEMICAL COMPOSITION



SIJ GRADE	CHEMICAL COMPOSITION (MAS.%)								ACHIEVED
	W. NR.	C	Si	Mn	Cr	Mo	V		HARDNESS
SITHERM 2343	1.2343	0,38	1	0,4	5,1	1,25	0,4		50 - 56 HRC
SITHERM 2344	1.2344	0,4	1,05	0,4	5,15	1,35	1		52 - 56 HRC
SITHERM 2365	1.2365	0,32	0,25	0,3	2,95	2,8	0,55		44 - 54 HRC
SITHERM 2367	1.2367	0,38	0,4	0,4	5	3	0,6		55 HRC



**“ONCE
TOOLOX
ALWAYS
TOOLOX”**

SSAB
TOOLOX®
 ENGINEERING & TOOL STEEL

**“Too good
to be true”**

TOOLOX 33 | TOOLOX 40 | TOOLOX 44 | TOOLOX 46

ENGINEERING & TOOL STEEL

Toolox® Advantages

The statement on the front page comes from many users worldwide after they tried Toolox for the first time.

Why? What are the advantages with Toolox?

- **Toolox is a pre-hardened engineering and tool steel:**
You do not need to send your component away for heat treatment after machining. It is already done!
- **Toolox is designed to be shaped:**
The steel is extremely clean, has a homogeneous microstructure and excellent dimensional stability when machining, which provides you with an outstanding material also very suitable for surface engineering such as polishing, texturing and nitriding.
- **Toolox has excellent properties at elevated temperatures:**
It is excellent for tools and components working of elevated (up to 590°C) temperatures.
- **Toolox is available in different formats:**
The properties are wrapped up in either plates or rounds, you choose the best dimension for you.

Toolox® 33

Plate thickness (mm)	Round bars diameter (mm)	Hardness (HBW)
6-350	21-400	275-325
Impact toughness Test temperature		Impact energy, Charpy-V, min)
20°C		35

Toolox® 40

Plate thickness (mm)	Hardness (HBW)
6-130	360-420
Impact toughness Test temerature	Impact energy, Charpy-V, min)
20°C	20

Toolox® 44

Plate thickness (mm)	Round bars diameter (mm)	Hardness (HBW)
6-400	21-400	410-475
Impact toughness Test temperature		Impact energy, Charpy-V, min)
20°C		18

Typical chemical composition	Toolox® 33	Toolox® 40	Toolox® 44
C	0.23%	0.28%	0.32%
Si	1.1%	1.1%	0.9%
Mn	0.8%	0.6%	0.8%
P	Max 0.011%	Max 0.011%	Max 0.011%
S	Max 0.003%	Max 0.002%	Max 0.003%
Cr	Max 1.60%	Max 1.30%	Max 1.70%
Mo	Max 0.80%	Max 1.10%	Max 1.40%
V	Max 0.12%	Max 0.12%	Max 0.17%
Ni	Max 1.0%	Max 1.4%	Max 1.4%
CEIIW	0.65 (Max 0.69)	0.80 (Max 0.84)	0.96 (Max 1.00)
CET	0.39 (Max 0.42)	0.47 (Max 0.50)	0.57 (Max 0.60)





Toolox® Applications

► Moulding ► Hot forming ► Applications working at elevated temperatures ► Stamping, punching ► Machine components

Inclusions	Toolox® 33	Toolox® 40	Toolox® 44
Inclusion size (equiv. diam.)	6 micron	6 micron	6 micron
Area fraction	0.015%	0.015%	0.015%
Aspect Ratio	1.2	1.2	1.2

TYPICAL VALUES

Toolox® 33 - Mechanical Properties	-20°C	+20°C	+200°C	+300°C	+400°C	+500°C
Hardness (HBW)		300	305	290	270	
Hardness (HRC)		~29	~30	~29	~26	
Yield strength $R_{p0.2}$ (MPa)		850	690	680	590	560
Tensile strength R_m (MPa)		980	900			
Elongation, A5, (%)		16	12			
Reduction of Area Z (%)		55				
Impact toughness, Charpy-V (J)	41	100	170	180	180	

Toolox® 40 - Mechanical Properties	-20°C	+20°C	+200°C	+300°C	+400°C	+500°C
Hardness (HBW)		400				
Hardness (HRC)		~40				
Yield strength $R_{p0.2}$ (MPa)		1150	1010	990	900	780
Tensile strength R_m (MPa)		1260	1170	1160	1060	900
Elongation, A5, (%)		14	14	14	15	16
Impact toughness, Charpy-V (J)	18	38				

Toolox® 44 - Mechanical Properties	-20°C	+20°C	+200°C	+300°C	+400°C	+500°C
Hardness (HBW)		450	440	415	380	345
Hardness (HRC)		~45	~44	~42	~38	~35
Yield strength $R_{p0.2}$ (MPa)		1300	1150	1040	980	825
Tensile strength R_m (MPa)		1450	1340	1270	1190	1010
Elongation, A5, (%)		13	10	12	14	19
Reduction of Area Z (%)		35				
Impact toughness, Charpy-V (J)	13	30	60	80	80	

Physical Properties	+20°C		+200°C		+400°C	
	Toolox® 33	Toolox® 44	Toolox® 33	Toolox® 44	Toolox® 33	Toolox® 44
Heat conductivity (W/m*K)	35	34	35	32	30	31
Thermal expansion coefficient (10 ⁻⁶ /K)	13.1	13.5	13.1	13.5	13.1	13.5





Toolox® 46 Round Bars

Chemical composition

C	Si	Mn	P	S	Cr	Ni	Mo	V	Ti	Cu	Al	Nb	B	N	CEV
.343	1.04	.77	.008	.001	1.49	1.19	2.00	.14	.012	.03	.003	.018	.0014	.003	1.28

Plate thickness (mm)	Round bars diameter (mm)	Hardness (HBW)
6-350	151-353	430-490
Impact toughness Test temperature		Impact energy, Charpy-V, min)
20°C		35

General Product Description

Toolox®46 round bar is a steel delivered already heat treated to a very high hardness.

The chemical composition is based on the successful Toolox®44 product but with a modified chemical composition making this a perfect choice for the most demanding hot work tooling applications. Despite the high hardness, machining can be carried out smoothly with normal carbide tooling.

If necessary the surface properties can be further enhanced with nitriding and PVD.

Dimension Range

Toolox®46 round bars is available in diameters 151.0 - 353.0 mm.

Mechanical Properties

Product	Diameter (mm)	Hardness ¹⁾ (HBW)
Toolox®46 round bar	151.0 - 353.0	430 - 490

¹⁾ Hardness is measured, according to EN ISO 6506-1. Bar hardness is measured on a milled surface, with indents positioned as impact test according to EN 10083.

Impact Properties

Product	Min. impact energy for longitudinal testing, Charpy V 10x10 mm test specimen ¹⁾
Toolox®46 round bar	11 J / 20 °C

¹⁾ Impact testing according to EN 10083.

Ultrasonic testing

Ultrasonic inspection is carried out according to: EN 10228-3 with extra demands according to specification SSAB V6.

Tolerances

Tolerances for Toolox® round bars are according to EN 10060.

Delivery Conditions

Quenched and Tempered at a minimum temperature of 590 °C.

On delivery from SSAB, Toolox® material meet the following specifications:

- Free from mill scale
- Not repair welded

Fabrication and Other Recommendations

Welding, bending and machining

For information concerning welding and fabrication, see SSAB's brochures on www.ssab.com or consult Tech Support.

Appropriate health and safety precautions must be taken when welding, cutting, grinding or otherwise working on the product. Grinding, especially of primer coated products, may produce dust with high particle concentration.

Surface Hardening

Toolox is an excellent steel for different type of surface hardening. The high yield strength and ductility of Toolox make it an ideal base material. Microcracks in the hardened layer stops when reaching the base material. Surface hardening such as laser or induction when done in the right way only changes the properties locally. The steel below the hardened layer keeps its original properties intact.

Nitriding and surface coatings represent a very interesting way to increase hardness, lower friction and some cases improve corrosion resistance. When done below 590 °C the material properties are not affected.



Consistent performance and high heat resistance make **Toolox® 46 Round Bars** ideal for demanding hot work applications

A cost-effective alternative to ESR steels

Toolox® 46 Round Bar has proven to perform on par with or even surpass ESR hot work tool steels in forging and extrusion die applications. With its superior performance, Toolox® 46 offers a more cost-effective solution without compromising quality, reliability, or durability.

Extrusion die test

MATERIAL	TOTAL AMOUNT OF EXTRUDED ALUMINIUM (KG)*	RELATIVE COST**
Toolox® 46 Round Bar	14516	1
High-end ESR hot work tool steel	14420	2

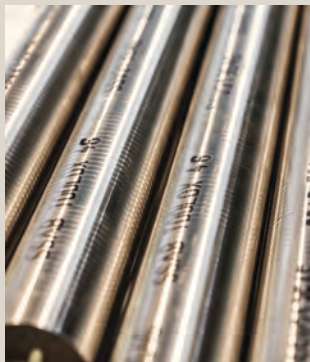
*Extrusion dies nitrided four times during the extrusion run.
**Relative die cost is based on available data for common ESR steels.

Increased molybdenum content

Designed for high-temperature performance, Toolox® 46 can operate continuously at its temperature limit of 600°C, maintaining its original hardness even after cooling to room temperature.

600°C

Ideal for forging and extrusion dies or machine parts exposed to heat.



Ready for surface treatment

The hardness, toughness and uniform microstructure makes Toolox® 46 Round Bar a perfect substrate for surface treatment. It is delivered prehardened to a hardness of 46 HRC all through the material. If necessary, the surface hardness can be increased by nitriding, PVD or other surface treatments.

Toolox® 46 Round Bar in brief

PROPERTIES	DATA
Diameter	151.0-353.0 mm
Hardness	430-490 HBW (EN ISO 6506-1)
Impact energy	11 J at 20 °C (EN 10083)
Tolerances	EN 10060

Outperform every time

With consistency, precision, and endurance at its core, Toolox® 46 Round Bar speeds up production and ensures reliable results—so you can focus on achieving more, worry-free.

Where can Toolox® 46 Round Bars save you time?

As all Toolox® grades, Toolox® 46 Round Bar is delivered in a prehardened state with carefully controlled properties. Its low-carbon, low-carbide composition ensures easy machining with normal carbide tools.

Toolox® provides stability, allowing you to achieve precise dimensions in a single step, eliminating the need for transport to additional quenching, tempering, or final adjustment, and saving you days potentially weeks in production time.

With Toolox® 46, you get a final product that maximizes performance, productivity, and service life, faster than standard ESR tool steel.



All Toolox® steel come with measured and guaranteed properties



Hardness and toughness



Machinability



Surface condition



Thickness



TOOLOX®
ENGINEERING & TOOL STEEL



APPLICATIONS WHERE TOOLOX® SAVES TIME AND IMPROVES PERFORMANCE

MACHINE COMPONENTS

Workshop machinery



Gears and gear racks



Tool holders



Guideways

Process industry



Chain wheels



Steering wheels



Coke wagons

Recycling



Hammer pins



Knives



Shafts



These are some common applications for Toolox® engineering and tool steel. Visit toolox.com for more in-depth presentations of where Toolox® is used for machine components, molds and dies.

Scan the
QR code to
learn more



MOLDS AND DIES

Cold work



Cold forming tools



Punching tools

Hot work



Die casting dies



Forging dies

Plastic



Injection molds



Plastic molds



 HARDNESS AND TOUGHNESS

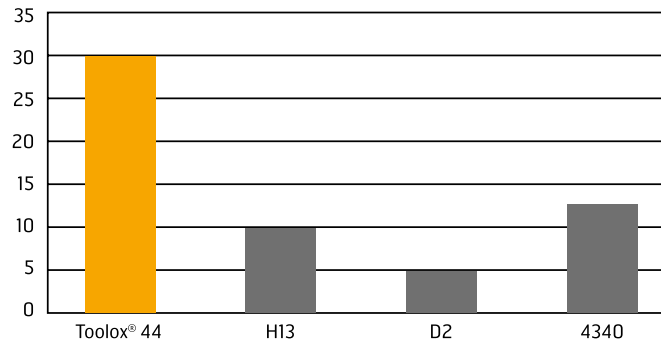
THE BEST OF BOTH WORLDS

Making a hard steel is easy, if you're only looking for hardness. The tricky part is to make a steel that is both hard and tough. A steel such as Toolox®. With hardness that gives a long life time even with highly abrasive applications, and toughness that enables it to withstand cracks and fatigue.

Hard to the core

All Toolox® grades have the same hardness all the way through. You can machine Toolox® plates and round bars to any complex shape, knowing that all surfaces are equally hard.

Impact toughness, Charpy-V (J) at 20°C



The table shows the toughness of Toolox® 44 compared to some standard steels that are heat treated to 45-55 HRC. Toughness values for Toolox® at -20°C are stated in the product certificates.

Grade	Hardness (HB)	Yield strength (MPa)	Tensile strength (MPa)	Elongation A ₅ (%)	Toughness at +20°C (J)
Toolox® 33	275-325	850	980	14	100
Toolox® 44	410-475	1300	1450	13	30

Toolox® 33 has a nominal hardness of 300 HBW. Toolox® 44 has a nominal hardness of 45 HRC, making it the world's hardest fully prehardened tool steel. Datasheets for all Toolox® grades are available at toolox.com.



Toolox® has a fine grained tempered martensitic crystalline structure, a result of quenching at a high cooling rate. The fine grain size gives high toughness.

“

We switched from 1.2379 with 56 HRC to Toolox® 44. Instead of cracking after 5,000 pieces the work piece in Toolox® 44 shows no wear after more than 40,000 pieces.

Ulus Metal, Istanbul

”





PLASTIC MOLD STEEL

Grade	Equivalent to JIS	Hardness	Features	Example of application
KPM1	S55C	27~32HS	Multi-Purpose Plastic Mold Steel	Molding for Large Size
KPMAX	-patent-	27~32HS	High-Machinability Multi-Purpose Plastic Mold Steel	Molding for Large Size; Automotive, Electric Appliances
KPM30		27~33HRC	Superior-Hardness & High Machinability Multi-Purpose Plastic Mold Steel	Molding for Large Size
JHX		33~39HRC	Superior-Hardness Multi-Purpose Plastic Mold Steel	Molding for Large Size
KAP90F	SKD61	38~42HRC	Pre-Hardening Steel(Free Cutting)	Ejector Pin, Mold Parts
KAP65		38~42HRC	High-Grade & Free-Cutting Plastic Mold Steel	Precision Mold
KAP88		38~42HRC	High-Grade & Superior Mirror-Face Plastic Mold Steel	Precision Mold
GHX	SUS420J2	48~52HRC	Excellent Mirror-Face, High-Corrosion Resistance & Superior-Hardness Plastic Mold Steel	High-Grade Precision Mold
NOGA	-patent-	50~61HRC	Superior-Hardness & Superior Mirror-Face Plastic Mold Steel	High-Grade Precision Mold
SM3	SUS440C	55~60HRC	Corrosion- & Wear-Resistance Plastic Mold Steel	Molding of High-Grade Engineering Plastics, Roll

Recommendation!

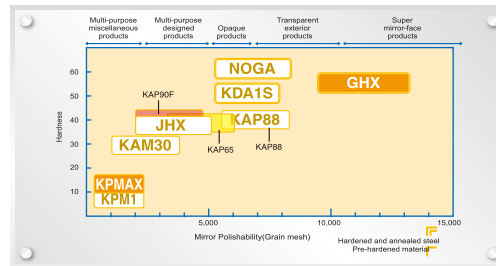
KPMAX

KPMAX is a 30HS type of multi-purpose plastic mold steel that exceeds in heat conductivity.

GHX

GHX is a high grade mold steel that combines superior specularity with high corrosion resistance.

Resin Mold Steel Characteristic



TOOL STEEL FOR COLD WORK

Grade	Equivalent to JIS	Hardness	Features	Example of application
K3M	SKS93	58~63HRC	Carbon Tool Steel	Press Die, Shear blade, Gauge
KS3	SKS3	58~63HRC	Multi-Purpose Tool Steel for Cold Work	Press Die, Shear blade, Gauge
KRCX	-patent-	50~60HRC	High-Machinability Multi-Purpose Tool Steel for Cold Work Flame Hardening Steel	Press Die, Shear blade, Gauge
KD12	SKD12	58~61HRC	Good-Toughness Tool Steel for Cold Work	Plastic Mold, Shear Blade
NOGA	-patent-	58~61HRC	Good-Toughness, Free-Cutting Tool Steel for Cold Work	Press Die, Forming Roll, Shear blade
KD11MAX	-patent-	58~62HRC	Good-Toughness, Superior-Hardness, Free-Cutting Multi-Purpose Tool Steel for Cold Work	Press Die, Forming Roll, Gauge
KD11	SKD11	58~60HRC	Multi-Purpose Tool Steel for Cold Work	Press Die, Forming Roll, Gauge
KPS6		58~62HRC	Corrosion- & Wear-Resistance Tool Steel for Cold Work	Resin injection parts
KD31		58~61HRC	Impact Resistance, High-Grade Tool Steel for Cold Work	Shear blade

Recommendation!

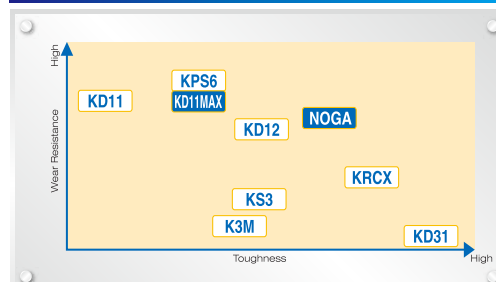
KD11MAX

KD11MAX is a multi-purpose tool steel for cold work which vastly improves upon the hardness, toughness, dimensional stability characteristics in heat treatment and machinability of SKD11.

NOGA

NOGA has achieved the highest level of toughness, dimensional stability characteristics in heat treatment and machinability among tool steel for cold work. NOGA has the optimal steel material structure for PVD coating, and demonstrates its performance like molding dies for high tensile strength steel and cutting blades.

Position of Cold Work Tool Steel Characteristic





SOLE DISTRIBUTOR

TOOL STEEL FOR HOT WORK

Grade	Equivalent to JIS	Hardness	Features	Example of application
KTV	SKT4	35~45HRC	Multi-Purpose Tool Steel for Die Block	Die Block, Press Die, Extrusion Tool
TD3		40~50HRC	Multi-Purpose Tool Steel for Hot Work	Extrusion Tool
KDA	SKD61	42~52HRC	Multi-Purpose Tool Steel for Hot Work	Die for Diecasting, Press Die, Extrusion Tool
KDB	SKD62	42~52HRC	Multi-Purpose Tool Steel for Hot Work	Extrusion Tool
KDA1		42~52HRC	Good-Toughness Tool Steel for Hot Work	Extrusion Tool, Die Block
KDA1S	-patent-	42~52HRC	High-Strength Multi-Purpose Tool Steel for Hot Work	Die for Diecasting, Press Die
KDAMAX	-patent-	42~52HRC	High-Strength & Performance Tool Steel for Hot Work	Die for Diecasting, Press Die, Extrusion Tool
KDH1	SKD7	45~52HRC	High-Strength Tool Steel for Hot Work	Extrusion Tool, Press Die
KDF	SKD8	45~52HRC	High-Strength Tool Steel for Hot Work	Extrusion Tool, Press Die
KDW		45~52HRC	Tool Steel for Die Block	Die Block
UH660	SUH660	30~40HRC	Heat-Resistance Tool Steel for Hot Work	Extrusion Tool

Recommendation!

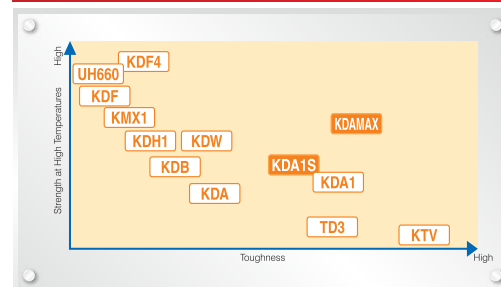
KDA1S

KDA1S is our multi-purpose product that has improved machinability, keeping the same high performance as KDA1. Its impressive resistance against heat cracks and aluminium erosion have attracted a great deal of attention in the world of diecasting metallic molds and press dies for hot forging industries.

KDAMAX

KDAMAX is a material, which remarkably improved that resistance for occurring linear heat cracks in the sharp bottom corner and heavy breakage from the coolant holes of diecasting die.

Position of Hot Work Tool Steel Characteristic



HIGH SPEED TOOL STEEL

Grade	Equivalent to JIS	Hardness	Features	Example of application
KMX1		45~55HRC	Good-Toughness Matrix High Speed Tool Steel	Press Die for Warm Forging
KMX2		57~62HRC	Multi-Purpose Matrix High Speed Tool Steel	Press Die for Cold Forging
KMX3	-patent-	60~65HRC	High-Wear Resistance Matrix High Speed Tool Steel	Press Die, Thread Rolling Die, Roll
H51	SKH51	60~65HRC	Multi-Purpose High Speed Tool Steel	Drill, End Mill, Press Die
HM35	SKH55	60~66HRC	Heat- & Wear-Resistance High Speed Tool Steel	End Mill, Hob, Press Die
HM36	SKH56	60~66HRC	Heat- & Wear-Resistance High Speed Tool Steel	End Mill, Hob, Press Die
MV10	SKH57	52~67HRC	Heat- & Wear-Resistance High Speed Tool Steel	Turning Tool, End Mill, Hob
HM42	SKH59	62~67HRC	Heat- & Wear-Resistance High Speed Tool Steel	Turning Tool, End Mill, Hob
S70	-patent-	65~70HRC	Superior-Hardness & Wear-Resistance High Speed Tool Steel	Drill, End Mill, Turning Tool

Recommendation!

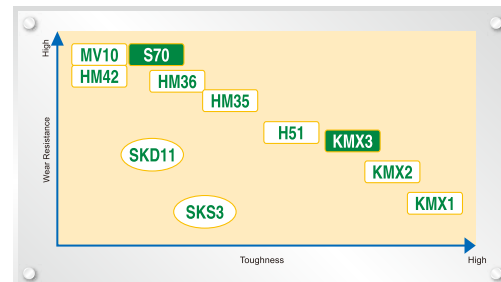
KMX3

KMX3 has an excellent cost effectiveness in addition to the same characteristics as JIS SKH51. Optimum for metallic forms and wear-resistant components

S70

S70 is a type of steel created out of know-how in high speed tool steels accumulated over many years by Nippon Koshuha Steel. S70 has the highest hardness of 70HRC as a dissolution high speed steel.

High Speed Tool Steel Characteristic



**MICROFINE STEEL
HOT WORK TOOL STEEL
KDA1S**

Characteristic of KDA1S

KDA1S is a new type of steel for die-casting that has the same basic functions of the KDA1 and features superior durability and cost-reduction performance.

1) Heat-check Resistance

- Hard to crack in comparison with the SKD61, and has a finer structure.
- Has superior heat-check resistance equivalent to the KDA1 and offers a longer service life.

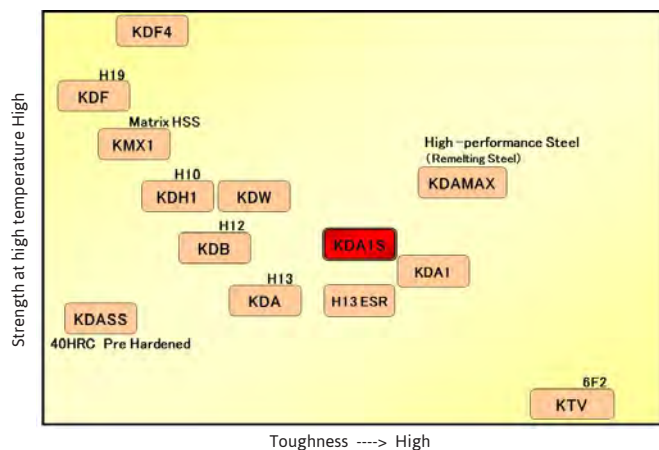
2) A Superior Tenacity

- 80% or more higher tenacity than the SKD61 (in the T direction).

3) Heat-softening Resistance

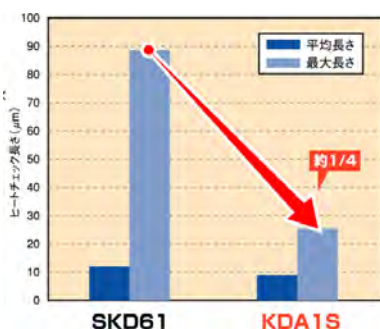
- Heat-softening resistance is twice better than SKD61, can maintain high hardness for long time.

Positioning of KDA1S Characteristic

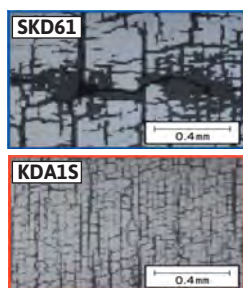


KDA1S Heat-check Resistance

Heat-check Resistance



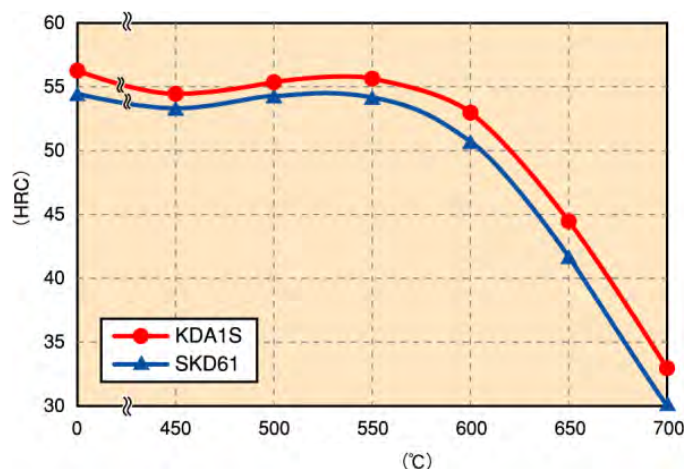
47 ± 0.6HRC
100°C <---> 600°C x 1,000



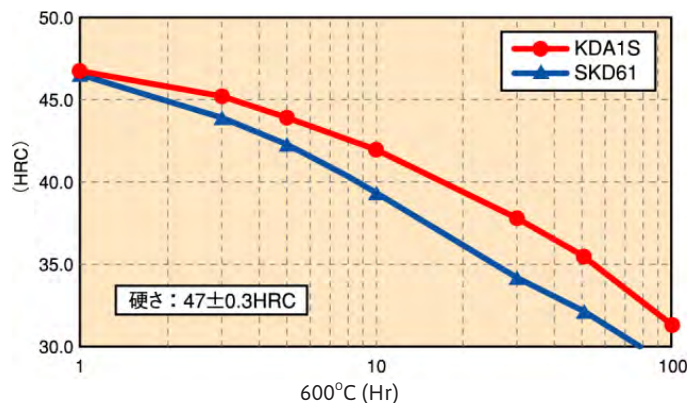
Surface texture Photo at 1,000Cycles

KDA1S Heat treatment and Heat Softening Resistance

QT Hardness Curve



Heat Softening Resistance



Comparison of Characteristics

	JIS/AISI	Wear Resistance	Toughness	Strength at elevated temperature	Softening resistance	Heat Crack Resistance	Machinability	Hardenability
SKD61/H13	SKD61 /H13 ESR	■	■	■	■	■	■	■
SKD61/H13 ESR		■	■	■	■	■	■	■
KDA1		■	■	■	■	■	■	■
KDA1M		■	■	■	■	■	■	■
KDA1S		■	■	■	■	■	■	■
KDAMAX		■	■	■	■	■	■	■
KMX1	Metric HSB	■	■	■	■	■	■	■



NEW HOT WORK DIE STEEL KDA1ESD NIPPON KOSHUHA STEEL CO., LTD.

NEW HOT WORK DIE STEEL KDA1ESD

Characteristics of KDA1ESD

Excellent high temperature property/softening resistance

It has better high temperature property than H13/having good softening resistance

High hardenability

High property can be obtained under the same heat treatment condition as H13

Excellent toughness

It has good hardenability and no harmful primary carbide, so it has excellent toughness.

Main Component of KDA1ESD

unit wt%

	C	Si	Mn	Cr	Mo	W	V
KDA1ESD	0.4	0.3	0.6	4.4	2.0	0.5	0.6
KDA1S	0.4	0.6	0.4	4.8	1.7	--	0.5
H13	0.35	--	--	5.0	1.5	---	1.0

*The numbers above is central value, the actual products may differ slightly from the numbers shown.

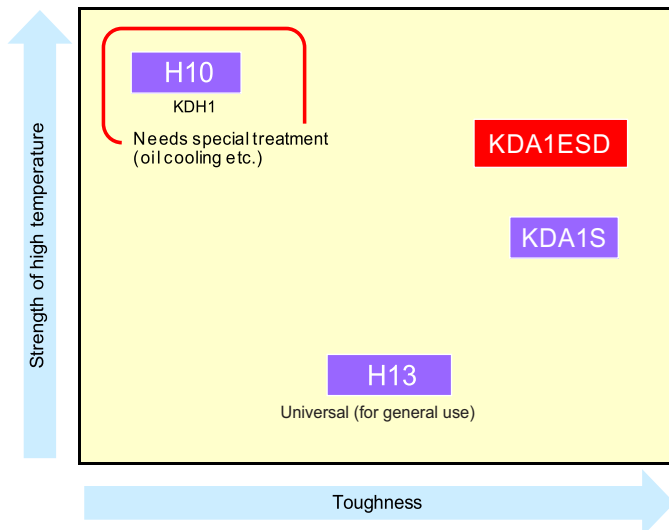
Comparison of Characteristics of KDA1ESD

	High temperature property	Hardenability	Toughness	Abrasion	Heat check*	Machinability*
KDA1ESD	◎	○	○	◎	(○)	(△)
KDA1S	○	○	○	○	○	◎
H13	x	○	△	△	x	○

*Characteristics in parentheses are estimated values from chemical components.

Positioning of KDA1ESD

KDA1ESD has toughness which is equal or better than H13 also has better high temperature strength than H13 Same heat treatment condition as H13



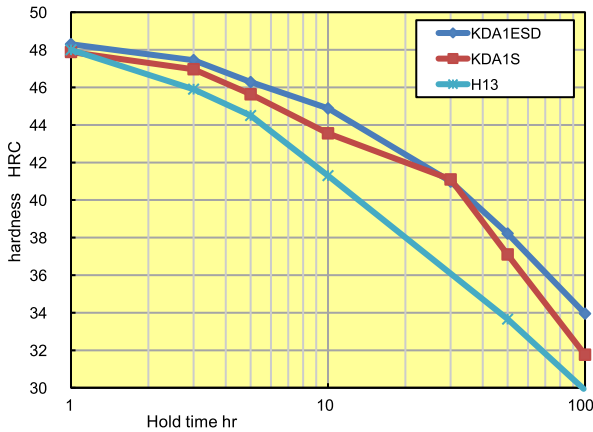
NIPPON KOSHUHA'S HOT DIECAST STEEL

Heat treatment condition for each steel

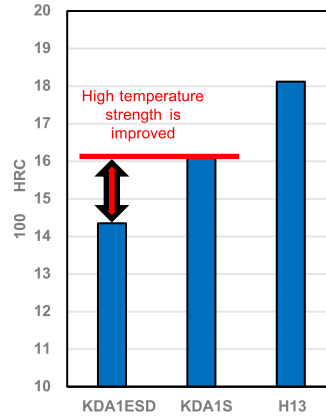
	Heat treatment		
	Quenching temperature °C	Tempering °C	Hardness of tempering, hardening
KDA1ESD	1010 - 1040 Pressurized cooling or oil quenching	550 - 610	42 - 52HRC
KDA1S	1010 - 1040 Pressurized cooling or oil quenching	550 - 610	42 - 52HRC
H13	1010 - 1040 Pressurized cooling or oil quenching	550 - 610	42 - 52HRC
H10	1010 - 1040 Oil quenching	550 - 610	42 - 52HRC
H10 (improved steel)	1010 - 1040 Oil quenching	---	---

Comparison of Characteristics of KDA1ESD High Temperature Property/Softening Resistance

KDA1ESD has good softening resistance which prevent from the hardness decrease that can be caused by being exposed to high temperatures.



(Softening resistance comparing result holding 600°C)

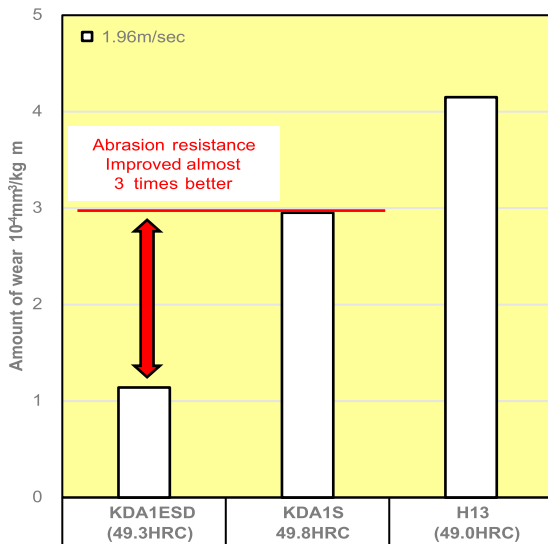


Test condition	
Test machine	: Ohkoshi system abrasion test machine
Work material	: SUJ2(45HRC)
Oil	: Dry
Abrasion speed	: 0.94, 1.96 m/s
Abrasion distance	: 400m
Final weight	: 6.3kgf

Ohkoshi system of abrasion test comparing result

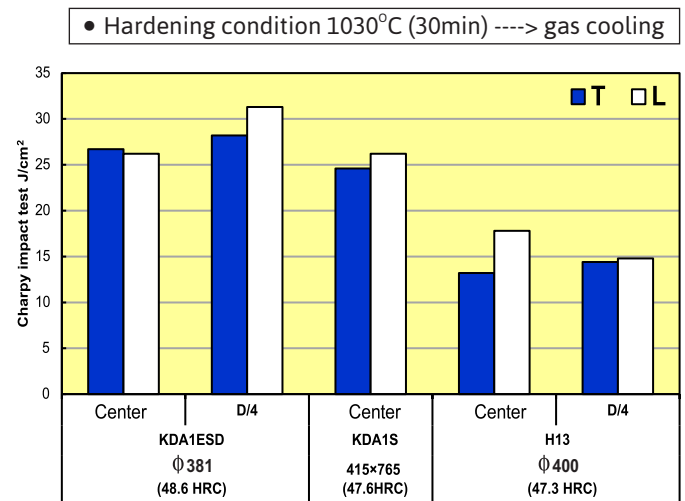
Comparison of Characteristics of KDA1ESD Abrasion Resistance

KDA1ESD has good abrasion resistance, reducing wear of Dies



Comparison of Characteristics of KDA1ESD Charpy Impact Test

Toughness of the KDA1ESD is equal to that of KDA1S.



Charpy impact test comparing result (normal temperature • 2mm U notch)

Characteristics value of KDA1ESD

Thermal conductivity and Thermal expansion coefficient of KDA1ESD is equal to that of H13

Thermal Conductivity J/(g • K)

temperature	KDA1ESD	H13
26	23.7	24.4
100	27.5	26.3
200	27.6	27.8
400	27.8	27.6
600	25.1	26.5

Thermal Expansion coefficient (X 10⁻⁵/°C)

temperature	KDA1ESD	H13
100	11	-
200	11.7	-
400	12.4	12.5
600	13.1	13.6

Young's modulus - Poisson's ratio

temperature	MODULUS	RATIO
23	225GPa	0.28
500	164GPa	0.33



MICRO FINE

KMX1

NIPPON KOSHUHA STEEL CO., LTD.

CHARACTERISTICS OF KMX1

KMX1 is high speed tool steel for hot and warm work with the hardness (50HRC and more). It has excellent high temperature strength, good toughness and thermal shock resistance.

1

Excellent high temperature strength

Harder than that of SKD61, SKD62 and SKD7.

2

Exceptional toughness and thermal shock resistance

Excellent in toughness and thermal shock resistance compared to SKH51 and SKD7

3

Stable nitriding characteristics

Stable nitriding layer with high softening resistance is obtained excellent in thermal fatigue life.

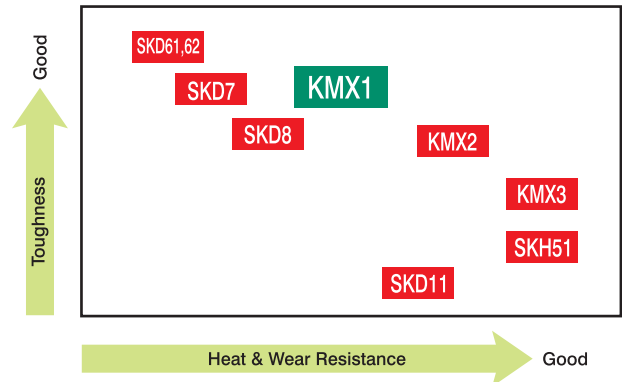
APPLICATION OF KMX1

KMX1 is suitable for the hot forming mold which needs intensity and toughness at high temperature.

Example

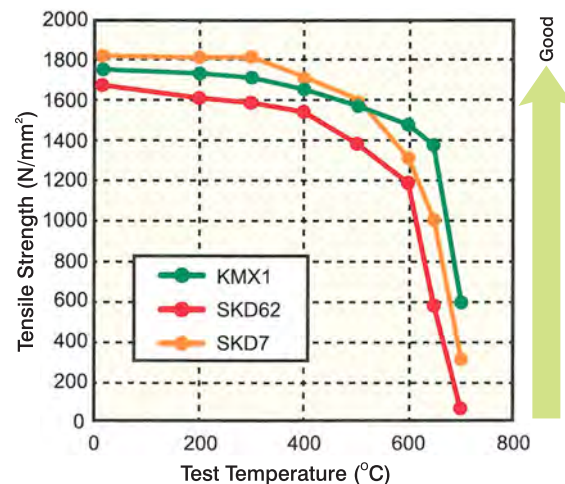
Die, Punch, Insert, Hot extrusion stem, Shear Blades, Tool steel for hot warm forging that needs toughness, Tool steel for hot work that needs heat resistance

POSITION OF KMX1



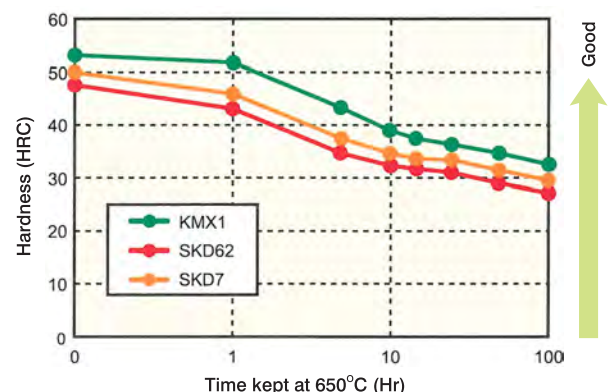
HIGH TEMPERATURE STRENGTH

2 times or more of tensile strength than SKDC62 and 1.4 times or more than SKD7 in a temperature region of 650°C or more.



SOFTENING RESISTANCE

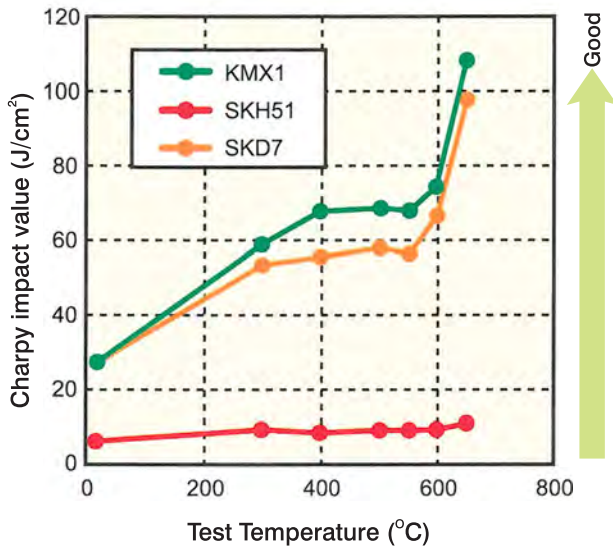
Higher hardness than that of SKD62 and SKD7 even after being held at 650°C for 100 hours.





TOUGHNESS

The impact value at room and high temperature is higher than that of SKH51 and SKD7. Excellent in thermal shock resistance and toughness.

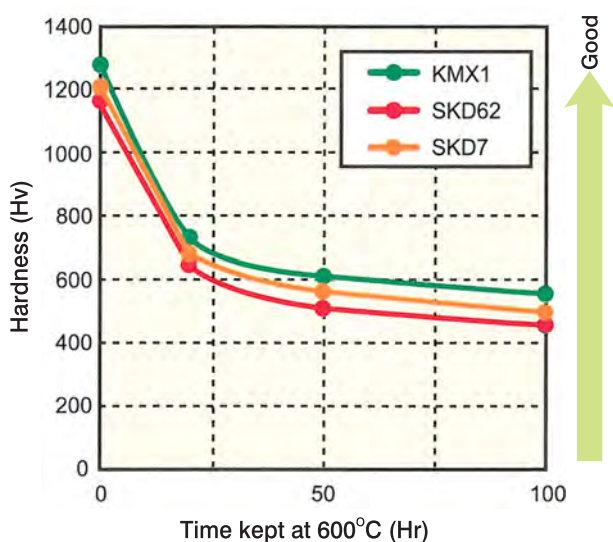


Test Condition

- T.P, Size
10 angle x 55mm
2U Notch

SOFTENING RESISTANCE OF SURFACE OF NITRIDED LAYER

Superior in softening resistance compared to SKD62 and SKD7 after nitriding (tuffriding) and being held 600°C for 100 hours.

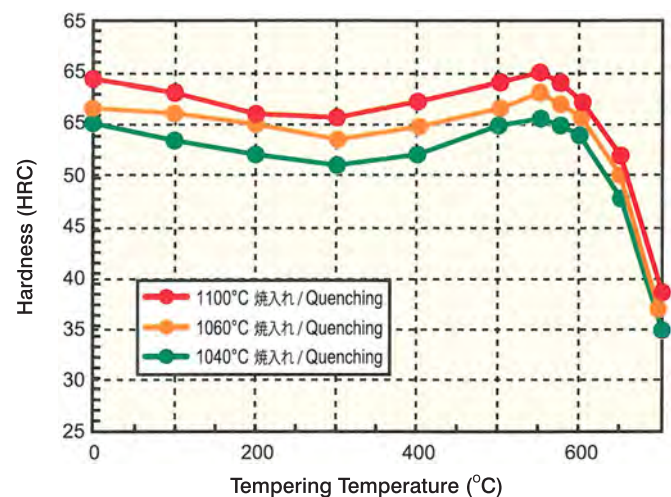


STANDARD HEAT TREATMENT

Recommended Condition

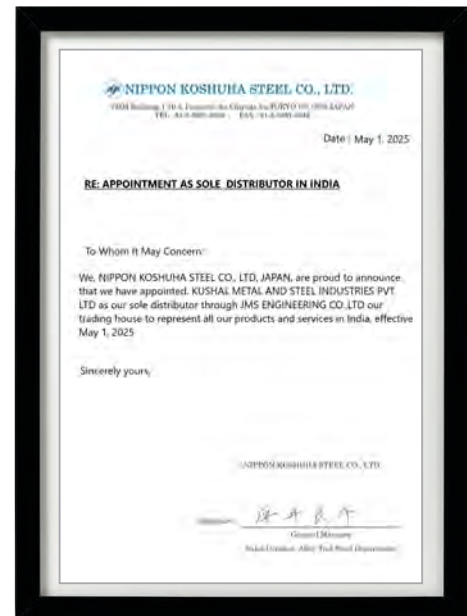
Quenching	Tempering	Hardness
1040-1100°C Oil, Pressurized gas cooling	540-650°C Air cooling x 2 times	45-55 (HRC)

HARDNESS CURVE BY QUENCHING & TEMPERING





CERTIFICATES

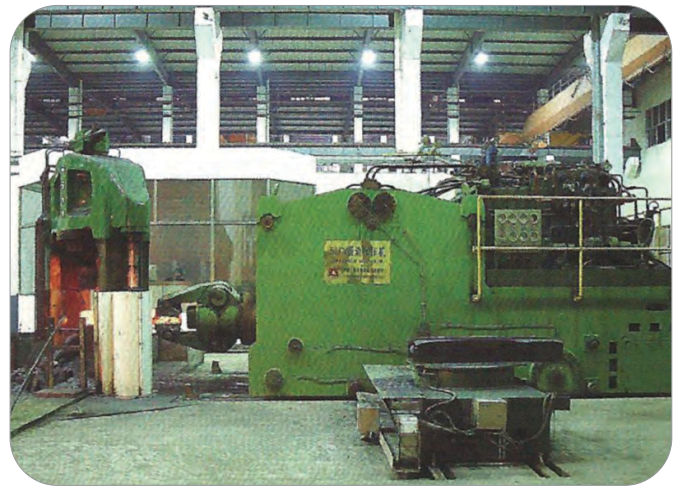




SX32 - 500T Precision Forging Machine



1250 Ton Quick Forging Machine



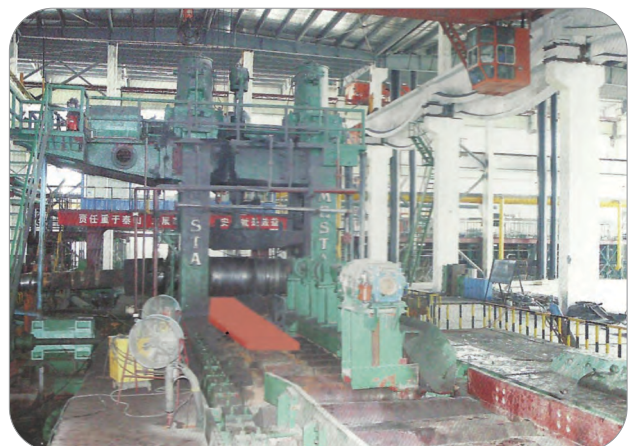
1250Ton Quick Forging Machine



2000 Ton Quick Forging Machine



FLAT BAR ROLLING





Kushal Metal & Steel Industries Pvt. Ltd.

High Speed Steel

Hot Work Steel

Cold Work Steel

Plastic Mould Steel





Kushal Metal & Steel Industries Pvt. Ltd.

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Magazine Street,
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Darukhana, Reay Road [E],
Mumbai-400 010. Maharashtra, INDIA.

UNIT - II

Gala No. 3A/3B, Build 188, Gala No. 3,
Build No. 183, C/o. Indian Corporation,
Mouje Gundavli (Mankholi Phata),
Taluka Bhiwandi, Dist: Thane. (Maharashtra)

UNIT - III

Mr. KEVAL SHAH

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