Taylor
Special Steels Ltd

M35

M35 HIGH SPEED STEEL

COMPOSITION %	C	Cr	Mo	W	Co	V	
	0.93	4.20	5.0	6.40	4.80	1.80	
STANDARDS	AISA M35, W.Ne.3243, S6-5-2-5, EMo5Co5 JIS SKH55, SS 2723, ISO S8, AFNOR Z90WDKCV 6.5.5.4.2						
CONDITION AS	Soft-annealed			Max 260 HB			
AS SUPPLIED	Cold Drawn			Max 300 HB			
	Cold Rolled			Max 320 HV			

M35 is a conventionally manufactured cobalt alloyed high-speed steel. The various stages of the manufacturing process are chosen and controlled so that an end product is obtained with a good structure in terms of carbide size and distribution. this is a distinct advantage for the finished tool.

M35 is characterised by

all-round applicability
good machine-ability
good performance
good hot hardness

APPLICATIONS

M35 is a high-speed steel suitable for cutting tools such as, broaches, taps, milling, reamers, hobs, shapers cutters, saws etc. In terms of performance, M35 is an all-round steel to be used in cutting conditions where demands for hot hardness are of importance. M35 is also suitable for cold work applications, where exacting demands are imposed on wear resistance. The steel possesses an admirable combination of wear resistance and toughness and in these respects superior to the high alloyed cold work steels.

PROPERTIES

M35 is medium-alloyed and has a good machinability containing Cobalt for increased hot hardness. The composition of M35 makes for a good combination of toughness and hardness. By virtue of these well balanced properties M35 has come into very wide use for cutting tools.

PHYSICAL PROPERTIES

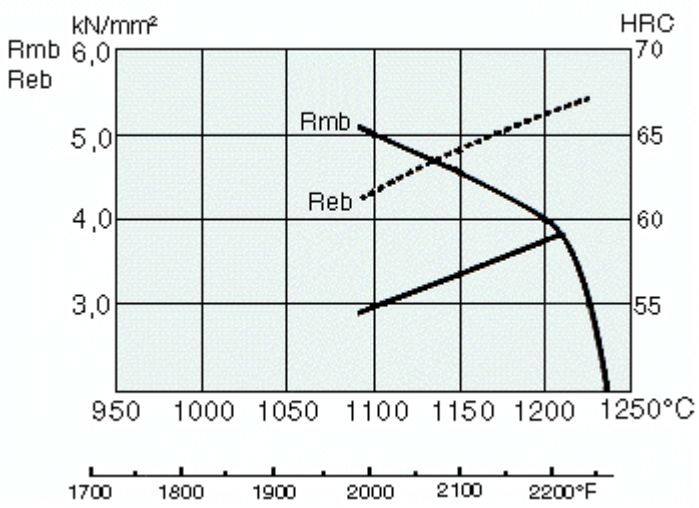
		TEMPERATURE °C / °F		
		20 / 70	400 / 750	600 / 1110
DENSITY	Kg/m³ lbs/in³	8150 .294	8050 .290	7990 .228
MODULUS OF ELASTICITY	kN/mm³² psi	230 $34 \cdot 10^{6}$	205 $31 \cdot 10^{6}$	184 $27 \cdot 10^{6}$
COEFFICIENT OF THERMAL EXPANSION FROM 20°C / 70°F	per °C per °F	- -	$11.6 \cdot 10^{-6}$ $6.4 \cdot 10^{-6}$	$11.9 \cdot 10^{-6}$ $6.6 \cdot 10^{-6}$
THERMAL CONDUCTIVITY	W/m °C Btu/sq. ft. h °F/in.	24 166	28 194	27 187
SPECIFIC HEAT	J/kg °C Btu/lb °F	420 0.10	510 0.12	600 0.14

METHODS OF MAKING TOOLS

M35 can be worked in the same way as other high-speed steels by plastic forming, machining, grinding, electrical discharge machining, welding and polishing. M35 is amenable to cold forming. In grinding, local heating of the surface, which might alter the temper, must be avoided. Grinding wheel makers can furnish advice on the choice of grinding wheels. Machining is carried out using carbide or high-speed steel tools.

BEND STRENGTH

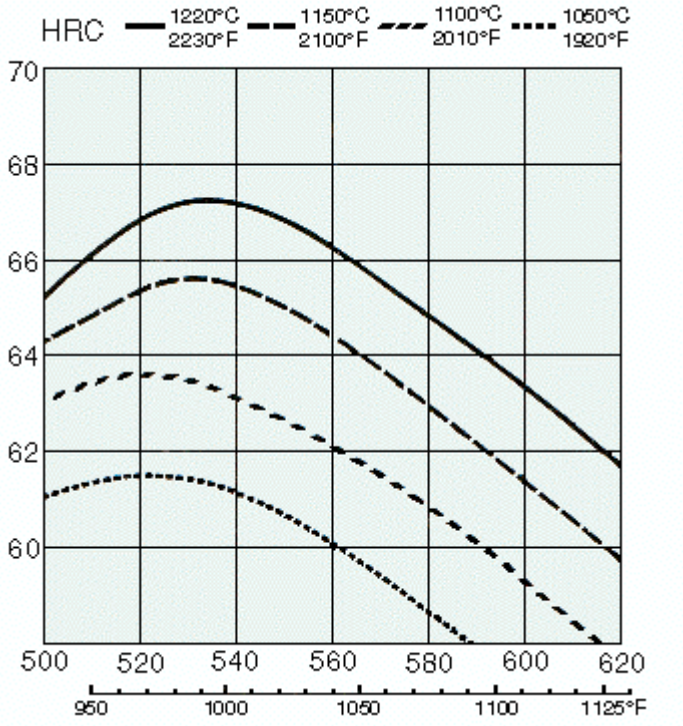
The bend strength is a measure of the toughness of the material. It will be seen from the diagram that toughness and hardness can be controlled by varying the hardening temperature.



Bend strength of a bar with diameter 5 mm after hardening and tempering to 560°C / 1040°F, 2x1 h.
Rmb = Ultimate bend strength kN/mm² , ± 10%
Reb = Bend yield strength kN/mm² , ± 5%
HRC = Hardness ± 1 HRC

HEAT TREATMENT

- Soft-annealing 850°C – 900°C / 1560°F – 1650°F, slow cooling 10°C / 18°F/h to 700°C / 1290°F, hardness max 260 Brinell.
- Stress relieving 600°C – 700°C / 1120°F – 1290°F, approx. 2 hours at temperature, slow cooling to 500°C / 930°F.
- Hardening with preheating in two steps 450°C – 500°C / 840°F – 930°F, 850°C – 900°C / 1560°F – 1650°F and austenitizing at 1050°C – 1220°C / 1920°F – 2230°F. Quenching to about 550°C / 1022°F then cool in air to hand warm
- Tempering at 560°C / 1040°F or higher 2 times for at least 1 hour at full temperature is recommended.



Hardness after hardening, step quenching and tempering 2x1 h of a sample 25 mm Ø.

SURFACE TREATMENT

M35 can be nitrided (a small diffusion zone of 2–20 µm is recommended) or steam - tempered if so desired. M35 is good as substrate material for PVD and CVD coating.

GUIDELINES FOR HARDENING

TOOL	M35	
	Hardening	Tempering twice
Single- edge cutting tools, tool bits, form tools, etc.	1220°C 2230°F	560°C 1040°F
Rotating multi-edge cutting tools, twist drills, saws, milling cutters broaches, taps, etc.	1180°C – 1220°C 2155°F – 2230°F	560°C – 580°C 1040°F –1095°F
Tools for cold work applications, punching, blanking, forming, cold extrusion, etc.	1050°C – 1150°C 1920°F – 2100°F	560°C – 590°C 1040°F – 1095°F

MANUFACTURING PROGRAMME

FROM	Dimensional range Th x W x L	
	mm	inches
Coils Ø	1 – 22	0.039 – 0.866
Round bars Ø	1 – 150	0.039 – 5.906
Forged bars Ø	max dia 400	max dia 15.748
Flat bars	3 – 7, 5x50 – 380	0.118 – 0.295x1.969 14.961
Square bars	4.5 – 130	0.177 – 5.118
Profiles Ø		
Strips	0.3 – 4x5 – 100	0.012 – 0.157 x0.197 – 3.937
Sheets	0.8 – 10x600x860x 800 – 2500	0.031 – 0.394x23.622 – 33.858x31.496 – 98.425
Discs	0.8 – 10 max dia 800	0.031 – 0.394 max dia 31.496
Bimetal edge	0.6 – 3x1 –10	0.024 – 0.118x0.039 – 0.394

The surface condition is drawn, shot blasted, ground, rolled, cold rolled, hot rolled, peeled, rough-machined depending on dimensions and requirements.