

## Alloy Tool Steels

### Chemical Composition, Applications and Heat Treatment

#### Outline

#### Chemical Composition and Heat Treatment of Alloy Tool Steels

Application	Steel Grade				Chemical Composition (%)									Heat Treatment			Hardness	
	NACHI	Related Standards			C	W	Mo	Cr	V	Co	Mn	Ni	Si	Annealing (°C)	Hardening (°C)	Tempering (°C)	Annealed hardness (HB)	Working hardness (HB)
		AISI	DIN WNr	JIS														
Cold working	MCR1				Patented grade									850–880 SC	1050–1100 OQ	500–600 AC	Max255	55–62
	MDS9				1.05	1.6	0.3	0.5						830–880 SC	1000–1050 OQ	500–560 AC	Max210	55–62
	SRM6				0.75	1.3	1.0		2.0				820–860 OQ		150–400 AC	54–60		
	ICS22				Patented grade									700–950 SC	900–960 CarburizeOQ	150–300 AC	Max197	58–64 on surface
Impact Resistance	SRS6				Patented grade									760–820 SC	860–900 OQ	150–600 AC	Max241	40–55
Hot working	MDS1				Patent pending									820–870 SC	1000–1050 OQ	520–600 AC	Max210	52–59
	HDN1				Patented grade									800–850 SC	1020–1070 OQ	550–650 AC	Max225	Max55

SC: Slow cooling OQ: Oil quenching AC: Air cooling

#### Principle Applications of Alloy Tool Steels

Category	Nachi Grade	Properties	Application
Cold working press molds and dies	MDS9	Less heat treatment deformation Good wear resistance	Cold-drawn dies, bending shaping dies, punch pins Cold-forged dies, press punches for tablets
Formed tools	MDS9 SRM6	Good wear resistance High toughness	Roll threading tools, Roll threading rolls Coining dies, Forming rolls, rolling rolls
Shearing tools	MCR1	High wear resistance	Shear blades, slitting shear knives Cutter knives, pulverizer blades
Impact resistance tool	SRS6	High strength, toughness and hardenability	Chisels, shearing machine knives, shanks
Hot Forming Press Dies	HDN1 MDS1	Good heat checking sensitivity	Gears, bolts, nuts, hot work dies for bearings
Hot Forming Press Dies	MDS1	High hot working strength	Punches, dies, sleeves, die-cast dies