ALLOY STEELS - 4140

AISI /SAE 4140 (UNS G 41400)
CHROMIUM-MOLYBDENUM STEEL

TYPICAL ANALYSIS

C.	Mn.	P.	S.	Si.	Cr.	Mo.
.38/.43	.75/1.00	.035 MAX.	.040 MAX.	.15/.35	.80/1.10	.15/.25

THIS CHROMIUM-MOLYBDENUM ALLOY STEEL IS OIL-HARDENING STEEL OF RELATIVELY HIGH HARDENABILITY, AND IS AMONG THE MOST WIDELY USED AND VERSATILE MACHINERY STEEL. THE CHROMIUM CONTENTS PROVIDES GOOD HARDNESS PENETRATION AND THE MOLYBDENUM IMPARTS UNIFORMITY OF HARDNESS AND HIGH STRENGTH.
THIS GRADE IS ESPECIALLY SUITABLE FOR FORGING AS IT HAS SELF-SCALING CHARACTERISTICS IT RESPONDS READILY TO HEAT TREATMENT AND IS COMPERATIVELY EASY TO MACHINE IN THE HEAT TREATED CONDITION. IN THE HEAT TREATED CONDITION TENSILE STRENGTHS OF 170,000 PSI. FOR SMALL SECTIONS AND 140,000 PSI. FOR LARGER SECTIONS ARE ATTAINABLE, ALL COMBINED WITH GOOD DUCTILITY AND RESISTANCE TO SHOCK. THIS STEEL RESISTS CREEP IN TEMPERATURES UP TO 540 DEGREES CELSIUS AND MAINTAIN ITS PROPERTIES EVEN AFTER LONG EXPOSURE AT THESE RELATIVELY HIGH WORKING TEMPERATURES.
IN THE HARDENED AND TEMPERED CONDITION, THIS STEEL POSSESSES GOOD WEAR RESISTANCE. THE WEAR RESISTANCE CAN CONSIDERABLY INCREASED BY FLAME - OR INDUCTION HARDENING, OR ALTERNATIVELY, IT MAY BE NITRIDED.

TYPICAL APPLICATIONS

SHAFTS, GEARS, BOLTS, COUPLINGS, SPINDLES, TOOL HOLDERS, SPROCKETS, HYDRAULIC MACHINERY SHAFTS. FOR THE OIL INDUSTRY-DRILL COLLARS, KELLY BARS, TOOL JOINTS, SUBS, ETC.

MECHANICAL PROPERTIES - ANNEALED

THE FOLLOWING ARE AVERAGE VALUES AND MAY BE CONSIDERED AS REPRESENTATIVE:

	1"	2-1/4"	4-1/2"	7-3/4"
TENSILE STRENGTH, PSI.	**98,000**	**101,500**	**100,000**	**100,000**
YIELD STRENGTH, PSI.	**61,000**	**62,000**	**57,000**	**58,500**
ELONGATION, % IN 2"	**23.0**	**26.0**	**25.0**	**21.0**
REDUCTION IN AREA, %	**54.0**	**55.0**	**56.0**	**59.0**
BRINELL HARDNESS	**197**	**212**	**202**	**197**

(CONTINUED)

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MECHANICAL PROPERTIES - HEAT TREATED AND STRESS RELIEVED

THE FOLLOWING ARE AVERAGE VALUES AND MAY BE CONSIDERED AS REPRESENTATIVE:

	3-1/4"	4-1/2"	6-1/4"	8"
TENSILE STRENGTH, PSI.	156,165	145,870	136,590	139,780
YIELD STRENGTH, PSI.	141,085	126,005	111,070	114,695
ELONGATION, % IN 2"	17.1	16.0	18.1	15.5
REDUCTION IN AREA, %	55.9	49.8	55.1	46.9
BRINELL HARDNESS	321	331	311	321

MECHANICAL PROPERTIES - HEAT TREATED RC 22 MAX. FOR SOUR GAS.

THE FOLLOWING ARE AVERAGE VALUES AND MAY BE CONSIDERED AS REPRESENTATIVE:

	2-1/2"	4"	6-1/4"	9-1/2"
TENSILE STRENGTH, PSI.	106,600	108,177	108,118	105,000
YIELD STRENGTH, PSI.	92,060	88,834	86,424	82,405
ELONGATION, % IN 2"	25.0	28.7	26.7	31.0
REDUCTION IN AREA, %	69.0	66.7	67.0	66.4
HARDNESS - RC	21	18	18	18

MECHANICAL PROPERTIES - HEAT TREATED TO ASTM A.193 GRADE B7

THE FOLLOWING ARE AVERAGE VALUES AND MAY BE CONSIDERED AS REPRESENTATIVE:

	3/4"	1-1/4"	2"	3"
TENSILE STRENGTH, PSI.	154,000	131,000	140,000	134,000
YIELD STRENGTH, PSI.	142,000	119,000	126,000	107,000
ELONGATION, % IN 2"	20.0	18.0	18.0	19.0
REDUCTION IN AREA, %	57.0	55.0	56.0	22.0
BRINELL HARDNESS	311	269	286	277

(CONTINUED)

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THERMAL TREATMENTS	DEGREES IN CELSIUS
FORGING	COMMENCE AT 1200° MAX. FINISH AT 950°
ANNEALING	815/850° COOL SLOWLY IN FURNACE
NORMALIZING	870/900° COOL IN AIR
HARDENING	820/870° OIL QUENCH
TEMPERING	430/700° ACCORDING TO PROPERTIES REQUIRED

MACHINABILITY

4140 IN THE ANNEALED CONDITION HAS A MACHINABILITY RATING OF 66% OF AISI B-1112.
AVERAGE SURFACE CUTTING SPEED IS 110 FEET PER MINUTE.

SHEAR STRENGTH

THE ULTIMATE SHEAR STRENGTH IS APPROXIMATELY 63% OF THE ULTIMATE TENSILE STRENGTH.

WELDABILITY

4140 IS ON THE BORDER LINE OF WELDABILITY BECAUSE OF ITS RELATIVELY HIGH CARBON CONTENT. IT CAN BE WELDED BY ANY OF THE COMMON WELDING PROCESSES PROVIDING THE SECTION IS PREHEATED AND STRESS RELIEVED AFTER WELDING.
THE GRADE OF WELDING ROD TO BE USED DEPENDS UPON THE THICKNESS OF SECTION, DESIGN, AND SERVICE REQUIREMENTS, ETC.