VANGUARD STEEL LTD.

PRODUCT MANUAL

ALLOY STEELS - 3312

AISI /SAE 3312 (UNS G 33106)

A 3-1/2% NICKEL-CHROMIUM CASE HARDENING ALLOY STEEL

TYPICAL ANALYSIS

C.	Mn.	P. MAX.	S. MAX.	Si.	Ni.	Cr.
0.08/0.13	.045/0.60	0.025	0.025	0.20/0.35	3.25/3.75	1.40/1.75

A HIGH ALLOY CARBURIZING STEEL POSSESSING SUPREME TOUGHNESS AND FATIGUE RESISTANCE IN BOTH CARBURIZED AND NON-CARBURIZED CONDITION. ITS ALLOY CONTENT PROVIDES EXTREMELY HIGH CORE STRENGTH, ALLOWING THIS STEEL TO BE USED FOR TOUGHER APPLICATIONS THAN THE WIDELY USED **AISI 8620.** IT CAN BE AIR HARDENED FOR MINIMAL DISTORTION WHEN HEAT TREATING INTRICATE SHAPES. IT RETAINS EXCELLENT LOW-TEMPERATURE PROPERTIES, AND AS SUCH IS USEFUL FOR SHOCK RESISTANT MACHINE PARTS IN AREAS SUBJECT TO INTENSE COLD. IT MAY BE USED IN THE HEAT-TREATED NON-CARBURIZED CONDITION FOR APPLICATIONS REQUIRING EXTRA STRENGTH AND TOUGHNESS. NORMALLY, THIS GRADE IS SUPPLIED IN THE ANNEALED CONDITION.

TYPICAL APPLICATIONS

HEAVY DUTY GEARS, TRANSMISSION COMPONENTS, PINIONS, PISTON PINS, SPLINE SHAFTS, ROCK DRILLING BIT BODIES, PLASTIC MOLDS, ETC.

MECHANICAL PROPERTIES - ANNEALED

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

TENSILE STRENGTH, PSI	**105,000**
YIELD STRENGTH, PSI	**78,000**
ELONGATION, %	**24**
REDUCTION IN AREA, %	**64**
BRINELL HARDNESS	**212**

(CONTINUED)

ALLOY STEELS - 3312

AISI /SAE 3312 (UNS G 33106)

MECHANICAL PROPERTIES - HARDENED AND TEMPERED-UNCARBURIZED TEMPERING TEMPERATURE - 540° DEGREES CELSIUS

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

	1"	4"	8"
TENSILE STRENGTH, PSI	136,200	132,000	112,000
YIELD STRENGTH, PSI	117,700	108,500	97,000
ELONGATION, %	19	17	20
REDUCTION IN AREA, %	63	57.5	70
BRINELL HARDNESS - CORE	294	285	235

MECHANICAL PROPERTIES - HARDENED AND TEMPERED-CARBURIZED SINGLE REFININGTEMPERING TEMPERATURE - 200º DEGREES CELSIUS

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

	1"	4"	8"
TENSILE STRENGTH, PSI	172,500	152,500	148,500
YIELD STRENGTH, PSI	132,000	108,500	100,000
ELONGATION, %	20	22.5	18.5
REDUCTION IN AREA, %	60	63.5	63.5
BRINELL HARDNESS - CORE	341	311	293

THERMAL TREATMENTS	DEGREES IN CELSIUS	
FORGING	COMMENCE AT 1175-1230 °	FINISH AT 870/925 ° BURY IN MICA
ANNEALING	830/855 ° COOL IN FURNACE	
NORMALIZING	870/925 ° AIR COOL	

(CONTINUED)

ALLOY STEELS - 3312

AISI /SAE 3312 (UNS G 33106)

THERMAL TREATMENTS	DEGREES IN CELSIUS
HARDENING & TEMPERING	(UNCARBURIZED) - 815/840° OIL QUENCH, OR 840/870° AIR QUENCH. TEMPER IMMEDIATELY ACCORDING TO STRENGTH LEVEL REQUIRED AT 200/600°.
CASE HARDENING	SINGLE REFINING TREATMENT AFTER CARBURIZING AT 898/929° COOL TO ROOM TEMPERATURE. REHEAT TO 770/800° OIL QUENCH AND TEMPER AT 200°.

MACHINABILITY

3312 IN THE ANNEALED CONDITION HAS A MACHINABILITY RATING OF 40% OF AISI B-1112. AVERAGE SURFACE CUTTING SPEED IS 65 FEET PER MINUTE.

SHEAR STRENGTH

THE ULTIMATE SHEAR STRENGTH IS APPROXIMATELY 62% OF THE ULTIMATE TENSILE STRENGTH.

ALLOY STEELS - 4130

AISI /SAE 4130 (UNS G 41300)

CHROMIUM-MOLYBDENUM STEEL

TYPICAL ANALYSIS

C.	Mn.	P.	S.	Si.	Cr.	Mo.
.28/.33	.40/.60	.035 MAX.	.040 MAX.	.15/.35	.80/1.10	.15/.25

A THROUGH-HARDENING ALLOY OF GREAT VERSATILITY. THE CHROMIUM AND MOLYBDENUM CONTENT SUFFICES TO PROVIDE THROUGH HARDNESS PENETRATION IN FAIRLY LIGHT SECTIONS. GOOD MECHANICAL PROPERTIES MAY BE OBTAINED BY NORMALIZING WHERE THE REQUIRED STRENGTH IS NOT TOO HIGH. THIS GRADE RESPONDS TO NITRIDING FOR WEAR AND ABRASION RESISTANCE.
THE CARBON CONTENT CAUSES THIS ALLOY TO BE CONSIDERED AS AN OIL OR WATER HARDENING GRADE.

TYPICAL APPLICATIONS

SHAFTING, WELLHEAD COMPONENTS, AXLES, GEARS, SPROCKETS, TOOL JOINTS, PISTON RODS, ETC.

MECHANICAL PROPERTIES - ANNEALED

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

TENSILE STRENGTH, PSI	**80,000**
YIELD STRENGTH, PSI	**56,000**
ELONGATION, %	**25**
REDUCTION IN AREA, %	**57**
BRINELL HARDNESS	**149**

(CONTINUED)

ALLOY STEELS - 4130

AISI /SAE 4130 (UNS G 41300)

CHROMIUM-MOLYBDENUM STEEL

THERMAL TREATMENTS	DEGREES IN CELSIUS
FORGING	COMMENCE AT 1200° MAX. FINISH AT 950°
ANNEALING	830/855° COOL SLOWLY IN FURNACE
NORMALIZING	870/930° COOL IN AIR
HARDENING	840/870° WATER QUENCH 855/885° OIL QUENCH
TEMPERING	430/700° ACCORDING TO PROPERTIES REQUIRED

MACHINABILITY

4130 IN THE ANNEALED CONDITION HAS A MACHINABILITY RATING OF 72% OF AISI B-1112. AVERAGE SURFACE CUTTING SPEED IS 120 FEET PER MINUTE.

WELDABILITY

THIS GRADE MAY BE WELDED BY ANY OF THE COMMON WELDING PROCESSES. PREHEATING AND POSTHEATING ARE RECOMMENDED FOR DIFFICULT SEGMENTS. THE GRADE OF WELDING ROD TO BE USED DEPENDS UPON THE THICKNESS OF SECTION, DESIGN, SERVICE REQUIREMENTS, ETC.

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)

ALLOY STEELS - 4140

AISI /SAE 4140 (UNS G 41400)

CHROMIUM-MOLYBDENUM STEEL

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)

ALLOY STEELS - 4140

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

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.

ALLOY STEELS - 4145 H MODIFIED HTSR

AISI /SAE 4145 (UNS G 41450) MODIFIED HTSR

CHROMIUM-MOLYBDENUM STEEL TO ASTM A 29, A 370, A 434 CLASS BD E 112

TYPICAL ANALYSIS

C.	Mn.	P.	S.	Si.	Cr.	Mo.	Ni.
.42/.49	.75/1.30	.035 MAX.	.040 MAX.	.15/.35	.75/1.20	.15/.45	1.00 MAX.

THIS ALLOY STEEL IS USED PRIMARILY FOR THE MANUFACTURE OF TOOLS IN THE OIL INDUSTRY. SUPPLIED WITH A STRAIGHTNESS TOLERANCE OF 1/8" IN ANY 5 FOOT LENGTH, WITH A GRAIN SIZE OF 6 OR FINER, AS PER ASTM E 112. THIS STEEL IS HEAT TREATED AND HARDENED BY WATER QUENCH, TEMPERED, STRESS RELIEVED AND SUPPLIED IN A ROUGH TURNED CONDITION.
ALL BARS ARE ULTRASONIC TESTED, WITH CHARPY V IMPACT @ 57 DEGREES CELSIUS FT. LBS. WITH MINIMUM AVERAGE VALUE OF 3 READINGS. NO MORE THAN ONE SINGLE VALUE SHALL BE LOWER THAN 5 FT. LBS. BELOW STATED AVERAGE VALUE.
CAN BE SUPPLIED TO COMPLY TO API SPEC. 7 IN THE MANUFACTURE OF DRILL COLLARS IN 31 TO 31-1/2 FOOT BARS.

MECHANICAL PROPERTIES - (LONGITUDINAL, 1" BELOW SURFACE).

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

	UNDER 5"	5" - 7"	7" & OVER
TENSILE STRENGTH, PSI.	**145,000**	**140,000**	**135,000**
YIELD STRENGTH, PSI.	**125,000**	**110,000**	**100,000**
ELONGATION, % IN 2"	**14.0**	**14.0**	**14.0**
REDUCTION IN AREA, MIN. %	**40-54**	**40-54**	**40-54**
HARDNESS - SURFACE BHN	**285-341**	**285-341**	**285-341**
HARDNESS - 1" BELOW SURFACE	**285**	**285**	**285**
CHARPY V-NOTCH FT. LB.	**45**	**45**	**45**

ALL TESTS ARE PERFORMED TO ASTM A 370.

WELDABILITY

4145 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.

ALLOY STEELS - 4340

AISI /SAE 4340 (UNS G 43400)

NICKEL-CHROMIUM-MOLYBDENUM STEEL

TYPICAL ANALYSIS

C.	Mn.	P.	S.	Si.	Cr.	Ni.	Mo.
.38/.43	.60/.80	.035 MAX.	.040 MAX.	.15/.35	.70/.90	1.65/2.00	.20/.30

THE "KING" OF THE HARDENING GRADES OF CONSTRUCTIONAL ALLOY STEELS. A RICH ALLOY CONTENT, THIS NICKEL-CHROMIUM-MOLYBDENUM STEEL, POSSESSES MUCH DEEPER HARDENABILITY THEN THE 4100 SERIES. THIS IS THE MOST EXTENSIVELY USED MACHINERY STEEL WITH AN EXCEPTIONAL RANGE OF STRENGTH, TOUGHNESS AND DUCTILITY. THE ADVANTAGE IS REALIZED PRINCIPALLY WHERE HIGH STRENGTH IS REQUIRED IN HEAVY SECTIONS. THE HIGH FATIGUE-TENSILE RATIO OF 4340 MAKES IT IDEAL FOR HIGHLY STRESSED PARTS OPERATING UNDER THE MOST SEVERE CONDITIONS, AND MAY BE USED IN BOTH ELEVATED AND LOW TEMPERATURE ENVIRONMENT. IT HAS REMARKABLE NON-DISTORTING PROPERTIES FOR AN ALLOY STEEL. IT HAS GOOD WEAR RESISTANCE AND SHOULD BE USED WHERE THE GREATEST MARGIN OF SAFETY IS DESIRED.

TYPICAL APPLICATIONS

COUPLINGS, HEAVY DUTY SHAFTING, GEARS, DIES, HIGH STRENGTH MACHINE PARTS, CRANKSHAFTS, ARBORS, HIGH TENSILE BOLTS AND STUDS, MINE-DRILLING PARTS, BORING BARS, DOWN HOLE DRILLING COMPONENTS ETC.

MECHANICAL PROPERTIES - ANNEALED

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

	1"	2"	4"	8"
TENSILE STRENGTH, PSI.	**114,000**	**110,000**	**106,000**	**104,000**
YIELD STRENGTH, PSI.	**91,000**	**86,000**	**85,500**	**81,500**
ELONGATION, % IN 2"	**20.0**	**23.0**	**21.0**	**22.0**
REDUCTION IN AREA, %	**46.0**	**49.0**	**50.0**	**48.0**
BRINELL HARDNESS	**229**	**223**	**217**	**217**

(CONTINUED)

ALLOY STEELS - 4340

AISI /SAE 4340 (UNS G 43400)

NICKEL-CHROMIUM-MOLYBDENUM STEEL

MECHANICAL PROPERTIES - HEAT TREATED AND STRESS RELIEVED
ASTM A 434 / BD

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

	2-1/4"	3-1/2"	5"	8"
TENSILE STRENGTH, PSI.	141,000	157,615	152,437	138,078
YIELD STRENGTH, PSI.	124,000	144,275	136,628	114,872
ELONGATION, % IN 2"	17.0	18.2	17.8	14.4
REDUCTION IN AREA, %	53.0	55.8	54.6	40.2
BRINELL HARDNESS	285	321	285/311	302/311

THERMAL TREATMENTS — DEGREES IN CELSIUS

FORGING	COMMENCE AT 1200° MAX. FINISH AT 950°
ANNEALING	830/855° COOL SLOWLY IN FURNACE
NORMALIZING	855/900° (DUE TO THE AIR HARDENING PROPERTIES OF 4340, NORMALIZING IS NOT RECOMMENDED EXCEPT WHEN FOLLOWED BY TEMPERING)
HARDENING	815/855° OIL QUENCH
TEMPERING	ACCORDING TO STRENGTH LEVEL REQUIRED

MACHINABILITY

4340 IN THE ANNEALED CONDITION HAS A MACHINABILITY RATING OF 57% OF AISI B-1112 AVERAGE SURFACE CUTTING SPEED IS 95 FEET PER MINUTE.

(CONTINUED)

ALLOY STEELS - 4340

AISI /SAE 4340 (UNS G 43400)

NICKEL-CHROMIUM-MOLYBDENUM STEEL

SHEAR STRENGTH

THE ULTIMATE SHEAR STRENGTH IS APPROXIMATELY 66% OF THE ULTIMATE TENSILE STRENGTH.

WELDABILITY

4340 IS ON THE BORDER LINE OF WELDABILITY BECAUSE OF ITS RELATIVELY HIGH CARBON CONTENTS. 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.

ALLOY STEELS - 8620

AISI /SAE 8620 (UNS G 86200)

NICKEL-CHROMIUM-MOLYBDENUM CASE HARDENING STEEL

TYPICAL ANALYSIS

C.	Mn.	P.	S.	Si.	Cr.	Ni.	Mo.
.18/.23	.70/.90	.035 MAX.	.040 MAX.	.15/.35	.40/.60	.40/.70	.15/.25

AN ALLOY STEEL DESIGNED FOR CASE HARDENING APPLICATIONS. THE NICKEL IMPORTS GOOD TOUGHNESS AND DUCTILITY. THE CHROMIUM AND MOLYBDENUM CONTRIBUTE INCREASED HARDNESS PENETRATION AND WEAR, THAT MAY BE CARBURIZED. THE WELL BALANCED ALLOY CONTENT PERMITS HARDENING TO PRODUCE A HARD WEAR RESISTANT CASE COMBINED WITH A CORE STRENGTH IN THE ORDER OF 125,000 PSI. IT HAS EXCELLENT MACHINABILITY AND RESPONDS WELL TO POLISHING APPLICATIONS. WITH THE BALANCED ANALYSIS, THIS STEEL PROVIDES, UNIFORM CASE DEPTH, HARDNESS AND WEAR PROPERTIES, AND GIVES THE ADVANTAGE OF LOW DISTORTION.

TYPICAL APPLICATIONS

CARBURIZED SPLINED SHAFTS, PISTON PINS, CAM SHAFTS, GUIDE PINS, BUSHINGS AUTOMOTIVE DIFFERENTIAL PINIONS AND TRANSMISSIONS, ARBORS, BEARINGS, SLEEVES KING PINS, CARBURIZED GEARS, GENERAL ENGINEERING PURPOSES.

MECHANICAL PROPERTIES - AS SUPPLIED

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

TENSILE STRENGTH, PSI.	**85,500**
YIELD STRENGTH, PSI.	**52,000**
ELONGATION, % IN 2"	**28.0**
REDUCTION IN AREA, %	**61.0**
BRINELL HARDNESS	**186**

(CONTINUED)

ALLOY STEELS - 8620

AISI /SAE 8620 (UNS G 86200)

NICKEL-CHROMIUM-MOLYBDENUM CASE HARDENING STEEL

THERMAL TREATMENTS	DEGREES IN CELSIUS
FORGING	COMMENCE AT 1200° MAX. FINISH AT 950°
ANNEALING	856/885° COOL IN FURNACE
NORMALIZING	898/926° AIR COOL
HARDENING & TEMPERING	(UNCARBURIZED) - 815/855° OIL OR WATER QUENCH, TEMPER AT 200° TO 650° ACCORDING TO STRENGTH LEVEL REQUIRED

(CARBURIZING) - DIRECT OIL QUENCHED

1. OIL QUENCH DIRECT FROM CARBURIZING TEMPERATURE DRAW AT DESIRED TEMPERATURE FOR AT LEAST 1 - 2 HOURS PER INCH OF SECTION.

2. SINGLE REFINE - BOX COOL FROM PACK CARBURIZING OR AIR COOL FROM OTHER MEDIA. REHEAT TO 829/842º. OIL QUENCH. DRAW AT DESIRED TEMPERATURE FOR MIN. 1 - 2 HOURS PER INCH OF SECTION.

(PROVIDES GOOD CASE HARDNESS AND CORE PROPERTIES)

3. DOUBLE REFINE - BOX COOL FROM CARBURIZING MEDIA. REHEAT TO 829/842°, OIL QUENCH. REHEAT TO 760/787º, OIL QUENCH. DRAW AT DESIRED TEMPERATURE FOR MIN. 1 - 2 HOURS PER INCH OF SECTION.

(PROVIDES OPTIMUM COMBINATION OF CASE HARDNESS, CORE STRENGTH AND TOUGHNESS)

(CONTINUED)

ALLOY STEELS - 8620

AISI /SAE 8620 (UNS G 86200)

NICKEL-CHROMIUM-MOLYBDENUM CASE HARDENING STEEL

MACHINABILITY

8620 IN THE ANNEALED CONDITION HAS A MACHINABILITY RATING OF 68% OF AISI B-1112 AVERAGE SURFACE CUTTING SPEED IS 110 FEET PER MINUTE.

SHEAR STRENGTH

THE ULTIMATE SHEAR STRENGTH IS APPROXIMATELY 70% OF THE ULTIMATE TENSILE STRENGTH.

WELDABILITY

8620 IS SAFE FOR MANUAL ARC WELDING WITHOUT PRE-HEATING. HOWEVER, EVEN AT THIS LOW CARBON LEVEL, PREHEAT IS ADVISABLE IN SECTIONS GREATER THEN 1" OR WHERE A WELDMENT IS SUBJECT TO RESTRAINT AND IS UNABLE TO CONTRACT FREELY DURING COOLING. AS STEEL HARDENABILITY INCREASES, SO SHOULD THE PREHEAT TEMPERATURE.

ALLOY STEELS -EN30B

EN30B-BS 970 GRADE 835M30-BAR

A 4-1/4% NICKEL-CHROMIUM-MOLYBDENUM ALLOY STEEL

TYPICAL ANALYSIS

C.	Mn.	P.	S.	Si.	Cr.	Ni.	Mo.
.28/.33	.40/.60	0.025	0.015	.10/.35	1.10/1.24	4/4.30	.20/.40

TYPICAL APPLICATIONS

THIS STEEL MAY BE USED WHERE TOUGHNESS AND HIGH TENSILE STRENGTH ARE REQUIRED. ONE OF THE MAIN USES IS FOR PLASTIC MOULDS, BUT HAS MANY OTHER APPLICATIONS FOR EXAMPLE: DOWN HOLE TOOLS, ROCK DRILLING BIT BODIES, HEAVY DUTY CONSTRUCTION TOOLS, HEAVY DUTY SHAFTS AND ROLLS, HIGHLY STRESSED GEARS AND TRANSMISSION COMPONENTS.

MECHANICAL PROPERTIES

NORMALIZED, TEMPERED & STRESS RELEIVED-TYPICAL

	UP TO AND INCLUDING 6"	
TENSILE STRENGTH, PSI.	**160,000**	**PSI MIN**
YIELD STRENGTH, PSI.	**130,000**	**PSI MIN**
ELONGATION, % IN 2"	**13.0**	
REDUCTION IN AREA, %	**50.0**	
BRINELL HARDNESS	**320-365**	

CHARPY V-NOTCH MIN. @ -50° F.	**15 FT.-LBS.**
CHARPY V-NOTCH MIN. @ ROOM TEMPERATURE	**45 FT.-LBS.**

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