MINERD & SONS, INC.

STEEL/METALS GLOSSARY

101 Red Nine Lane

Lawrence, PA 15055

Phone: 724-745-2878

Fax: 724-745-4282

TABLE OF CONTENTs

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

ALLOY STEEL

4140 Chromium-Molybdenum Steel

Oil-hardening chromium-molybdenum steel has good strength and wear resistance, excellent toughness and ductility with the ability to resist stress and creep at prolonged high temperatures (up to 1000º F). Also available in leaded grades that have greatly improved machinability, but should not be used in applications over 400º F.
Elevated temperatures cause lower ductility in leaded grades.
Applications: Drill collars, high temperature bolts, sprockets, kelly bars, reamer bodies, rotary table shafting, oil well tool joints, spindles, stay bolts, tractor axles, tractor arms, axle shafts, valves, bolts, subs, couplings, trailer axles, winch shafts, piston rods, rams, hydraulic machinery shafts, precision lead screws, chain links, zinc die-casting dies.
Analysis: C - .38/.43 Max., Mn - .75/1.00, P - .035 Max., S - .04 Max.,
Si - .15/.35, Cr - .80/1.10, Mo - .15/.25
Mechanical Properties: Annealed
Tensile Strength (psi) 140,000
Yield Point (psi) 90,000
Elongation (% in 2”) 20
Reduction of Area (%) 45
Brinell Hardness: 285
Weldability: Difficult but can be welded by any of the common welding processes providing section is preheated and stress relieved after welding. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc. When welding leaded material, adequate ventilation should be provided to prevent accumulation of fumes. Forging: Excellent forge stock due to self-scaling characteristics. Forge at 2100º F - 2200º F.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

ALUMINUM

6061 Aluminum Angles

This is the most versatile of the heat treatable aluminum alloys. This alloy offers a wide range of mechanical properties and corrosion resistance. It is easily fabricated and has good formability.
Applications: Screw machine parts, structural components, truck bodies and frames. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.
Analysis: Cu - .15/.40, Si - .40/.80, Fe - .70 Max., Mn - .15 Max.,
Mg - .80/1.2, Zn - .25 Max., Cr - .04/.35, Ti - .15 Max.
Mechanical Properties: (T6-T651 bare)
Tensile Strength (psi) 45,000
Yield Point (psi) 40,000
Elongation (in 2" for 1/2" dia.) 17
Brinell Hardness 95
Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the T4 and T6 conditions.
Weldability: All methods including furnace brazing. Forming: In T4 condition, fairly severe forming operations may be accomplished.
Heat Treating: Treatable.

6063 – T52 Aluminum Angles

This grade is commonly referred to as the architectural alloy. Developed as an extrusion alloy with relatively high tensile properties, excellent finish characteristics and high corrosion resistance.
Applications: Moldings and extruded trim for stores and homes both interior and exterior. Used extensively for anodized parts.
Analysis: Cu - .10 Max., Si - .20/.60, Fe - .35 Max., Mn - .10 Max., Mg - .45/.90, Zn - .10 Max., Cr - .10 Max., Ti - .10 Max.
Mechanical Properties: (T52)
Tensile Strength (psi) 27,000
Yield Point (psi) 21,000
Elongation (in 2" for 1/2" dia.) 12
Brinell Hardness: 60

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

ALUMINUM (Continued)

Machinability: For automatic screw machine operations rated between 75% and 85% of 2011 in the T5 condition. It is 60% of 2011 in the O condition, and 50% in the T42 condition.

6061 Aluminum Beams

This is the most versatile of the heat treatable aluminum alloys. This alloy offers a wide range of mechanical properties and corrosion resistance. It is easily fabricated and has good formability.
Applications: Screw machine parts, structural components, truck bodies and frames. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.
Analysis: Cu - .15/.40, Si - .40/.80, Fe - .70 Max., Mn - .15 Max.,
Mg - .80/1.2, Zn - .25 Max., Cr - .04/.35, Ti - .15 Max.
Mechanical Properties: (T6-T651 bare)
Tensile Strength (psi) 45,000
Yield Point (psi) 40,000
Elongation (in 2" for 1/2" dia.) 17
Brinell Hardness: 95
Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the T4 and T6 conditions.
Weldability: All methods including furnace brazing. Forming: In T4 condition, fairly severe forming operations may be accomplished.
Heat Treating: Treatable.

6061 Aluminum Channels

This is the most versatile of the heat treatable aluminum alloys. This alloy offers a wide range of mechanical properties and corrosion resistance. It is easily fabricated and has good formability.
Applications: Screw machine parts, structural components, truck bodies and frames. Alclad 6061 is used where appearance and better corrosion resistance with good strength are required.
Analysis: Cu - .15/.40, Si - .40/.80, Fe - .70 Max., Mn - .15 Max.,
Mg - .80/1.2, Zn - .25 Max., Cr - .04/.35, Ti - .15 Max.
Mechanical Properties: (T6-T651 bare)
Tensile Strength (psi) 45,000
Yield Point (psi) 40,000

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

ALUMINUM (Continued)

Elongation (in 2" for 1/2" dia.) 17
Brinell Hardness: 95
Machinability: Rated between 70% and 80% of 2011 in the T4 and T6 conditions, and 50% in the T4 and T6 conditions.
Weldability: All methods including furnace brazing. Forming: In T4 condition, fairly severe forming operations may be accomplished.
Heat Treating: Treatable.

6063 – T52 Aluminum Channels

This grade is commonly referred to as the architectural alloy. Developed as an extrusion alloy with relatively high tensile properties, excellent finish characteristics and high corrosion resistance.
Applications: Moldings and extruded trim for stores and homes both interior and exterior. Used extensively for anodized parts.
Analysis: Cu - .10 Max., Si - .20/.60, Fe - .35 Max., Mn - .10 Max., Mg - .45/.90, Zn - .10 Max., Cr - .10 Max., Ti - .10 Max.
Mechanical Properties: (T52)
Tensile Strength (psi) 27,000
Yield Point (psi) 21,000
Elongation (in 2" for 1/2" dia.) 12
Brinell Hardness: 60
Machinability: For automatic screw machine operations rated between 75% and 85% of 2011 in the T5 condition. It is 60% of 2011 in the O condition, and 50% in the T42 condition.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

BRASS

C330 Brass

Normally only available in tubing products, it has a good balance of workability and, because of the presence of lead, machinability.

Applications: Industrial: Power and Pump Cylinder Liners, Power and Pump Cylinders; **Ordnance**: Primers. Plumbing: plumbing accessories, pump lines, trap lines, j bends, plumbing brass goods.

Analysis: Cu - 66%, Zn - 33.5%, Fe - .07%, Pb - .5%

Common Fabrication Processes: Forming and bending, machining, piercing and punching.

Mechanical Properties: (room temperature, 68º F (20ºC)

Ultimate Tensile Strength (psi) 65,300

Yield Strength (psi) 50,000

Elongation (%) 32

Rockwell Hardness: B80

Machinability: Machinability rating is 60. Hot Forming: Poor. Cold Working: Excellent.

Joining Techniques: Excellent for: Soldering. Good for: Brazing; Fair for: Oxyacetylene, gas shield arc, spot and butt welding.; Not Recommended for: Coated metal arc and seam welding.

C360 Brass

The most commonly used of the brass rod and bar items. The presence of lead creates a highly machinable material that can be cut, drilled and shaped easily.

Applications: Architecture: Terrazzo strip; Automotive: Sensor bodies, thermostat parts, fluid connectors, threaded inserts for plastic; Builders Hardware: lock bodies, fittings, hardware; Consumer: hot combs (to straighten hair); Fasteners: screws, nuts, bolts; Industrial: faucet components, pinions, automatic screw machine parts, pneumatic fittings, gears, nozzles, valve stems, valve trim, valve seats, gauges, fluid connectors, screw machine products, adapters, unions; Plumbing: faucet stems, plumbers' brass goods, faucet seats, plumbing fittings.

Analysis: Cu - 60/63%, Zn - 35.5%, Fe - .35% Min., Pb - 2.5-3.7%

Common Fabrication Processes: Machining, roll threading and knurling;

Mechanical Properties: (room temperature, 68º F (20ºC)

Ultimate Tensile Strength (psi) 58,000

Yield Strength (psi) 45,000

Elongation (%) 25

Rockwell Hardness: B78

Machinability: Machinability rating is 100. No material of comparable strength machines faster and produces better surface finishes than C360. Hot Forming: Fair. **Cold Working**: Fair.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

BRASS (Continued)

Corrosion Resistance: Excellent.
Joining Techniques: Excellent for: Soldering. Good for: Brazing; Fair for: Butt weld; Not Recommended for: Oxyacetylene, gas shield arc welding, coated metal arc, spot, and seam welding.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

BRONZE

Bronze

Bronze is an alloy of metal that is copper based with tin as the main additive. Some tins, though, can have phosphorus, manganese, aluminum, or silicon as the main alloying ingredient. Bronze is typically strong, tough, and corrosion resistant with high electrical and thermal conductivity.

SAE 660

The most commonly used bronze in bushing and bearing applications, it is easy to machine and provides long life in applications where wear is an issue.
Applications: Automotive: Automotive fittings; Fasteners: washers; Industrial: pump impellers, diesel engine wrist pin bushings, forging press toggle lever bearings, hydraulic press stuffing box, hydraulic press main lining, main spindle bearings, machine tool bearings, bearings for cranes, trunion bearings, roll neck bearings, rolling mill bearings, linkage bushings for presses, fuel pump bushings, water pump bushings, pump fixtures, fittings, insert bearings, bearings, thrust washers, pumps, bushings, machine parts, general purpose bushings.
Analysis: Cu - 83%, Sn - 7%, Pb - 7%, Zn - 3%
Mechanical Properties: (Minimal) Continuous Cast
Ultimate Tensile Strength (psi) 35,000
Yield Strength (psi) 20,000
Elongation (%) 10
Machinability: Rated at 70% of free machining brass.
Joining Techniques: Excellent for: Soldering; Good for: Brazing. Not Recommended for: Oxyacetylene, gas shielded arc, and coated metal arc welding.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

COPPER

Copper
Known for its malleability and ductility, heat conductivity, and electrical conductivity. Copper alloys are generally red or pinkish in color.

110 Copper

Copper, ETP, Electrolytic Tough Pitch. Has conductivity of 101% IACS. Ductile, anneal resistant.
Applications: Architecture: Skylight frames, roofing, building fronts, flashing, gutters, spouting, downspouts; Automotive: gaskets, radiators; Builders Hardware: butts, tacks, nails, soldering copper, rivets, cotter pins, ball floats; Building: screening, wire screening; Consumer: Christmas ornaments; Fasteners: fasteners; Industrial: printing rolls, chimney cap screens, heat exchangers, anodes, kettles, chlorine cells, rotating bands, road bed expansion plates, vats, pressure vessels, chemical process equipment, pan; Electrical: terminals, switches, radio parts, contacts, trolley wire, magnet wire, bus bars, terminal
connectors, conductors, electrical, stranded conductors, wire, electrical;
Analysis: Cu - 99.9%
Common Fabrication Processes: Blanking, coining, coppersmithing, drawing, etching, forming and bending, heading and upsetting, hot forging and pressing, piercing and punching, roll threading and knurling, shearing, spinning, squeezing and swaging, stamping.
Mechanical Properties: (room temperature, 68º F (20ºC) HO4 Full Hard Temper
Flats (ETP) Rounds (ETP) Squares (ETP)
Ultimate Tensile Strength (psi) 50,000
Yield Strength (psi) 45,000
Hardness: B50
Machinability: The machinability rating of this alloy is 20. (Where Alloy 360 FC Brass is 100).
Corrosion Resistance: Excellent.
Forging: The hot forgeability rating of this alloy is 65. (Forging brass = 100). The recommended hot working temperature for this alloy is between 1400º and 1600º F. Hot Working: Excellent.
Cold Working: Excellent.
Annealing: Between 700º F and 1200º F. Joining Techniques: Excellent for: Soldering; Good for: Brazing and butt weld; Fair for: Gas shield arc welding; Not Recommended for: Oxyacetylene, coated metal arc, spot, and seam welding.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

COPPER (Continued)

122 Copper

Applications: Architecture: roofing, flashing, downspouts, gutters. Automotive: oil lines, air lines, hydraulic lines. Building: heater lines, gas lines, air conditioner tubes and condenser sheets, heater units, oil burner tubes. Consumer: refrigerators, air conditioners. Electrical: wire connectors, heater elements. Industrial: gage lines, rotating bands, oil lines in airplanes, hydraulic lines in airplanes, gasoline lines in airplanes, air lines in airplanes, oil coolers in airplanes, tanks, water lines, steam lines, paper lines, pulp lines, distiller tubes, dairy tubes, heat exchanger tubes, evaporator tubes, condenser tubes, brewery tubes, sugar house refinery lines, print rolls, paper rolls, expansion joint tubes, plating hangers, plumbing tube, plating anodes, plating racks, plating anodes, casting molds, tubing, lp gas service, tubing, medical gas-oxygen, kettles, anodes for electroplating, heat exchanger shells. Marine: gasoline lines, oil coolers. Plumbing: plumbing pipe, plumbing fittings.
Analysis: Cu - 99.9%, P - .02% Max.
Common Fabrication Processes: Blanking, coining, coppersmithing, drawing, etching, forming and bending, heading and upsetting, hot forging and pressing, piercing and punching, roll threading and knurling, shearing, spinning, squeezing and swaging, stamping.
Mechanical Properties: (room temperature, 68º F (20ºC)
Ultimate Tensile Strength (psi) 50,000
Yield Strength (psi) 45,000
Machinability: 20. Hot Formed: Excellent. Cold Worked: Excellent. Forgeability: 65.
Joining Techniques: Excellent for: Soldering, brazing, gas shield arc welding. Good for: Oxyacetylene welding and butt weld; Not Recommended for: Coated metal arc, spot, and seam welding.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

GALVANIZED

Galvanized Steel Sheet

Galvanized sheets are hot dip coated with a durable protective coating of zinc. Produced from rimming, capped and semi-killed steel and are intended for uses involving simple bending or moderate forming. They may be bent flat on themselves at any direction at room temperature without cracking.

Applications: For general utility uses such as corrugated siding and roofing, culverts, window frames, heating and ventilating ducting, cornices, eaves troughs, etc. Galvanized sheets are sometimes painted, but when a superior paint retaining surface is desired the use of Electrolytic Zinc Coated Sheets are recommended.

Analysis: C - .15 Max., Mn - .60 Max., P - .035 Max., S - .04 Max.,

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

STAINLESS

303

Chromium-nickel stainless steel with added sulfur or selenium and phosphorus to improve machinability and non-seizing properties. It is the most free machining of the chromium-nickel grades. Non-magnetic in the annealed condition.

Applications: Aircraft parts and parts requiring machining, grinding or polishing with good corrosion resistance. Excellent for moving parts and where low magnetic permeability is required.

Analysis: 303S: C-.15 Max., Mn-2.00 Max., P-.15 Max., S-.15 Max., Se- .15/.40, Si- 1.00 Max., Cr- 17.00/19.00, Ni- 8.00/10.00, Cu- .75 Max., Mo- .75 Max.,

303Se: C- .15 Max., Mn- 2.00 Max., P- .17 Max., S- .04 Max., Se- .15/.40, Si- 1.00 Max., Cr- 17.00/19.00, Ni- 8.00/10.00, Cu- .75 Max., Mo- .75 Max.

Mechanical Properties: (following values are average and are representative)
(1/2" and under)

Tensile Strength (psi) 100,000

Brinell Hardness: 228

Surface Cutting Speed: 130 ft/min. Weldability: Fair. Hardening: Not hardenable by heat treatment. Cold working increases tensile strength and hardness.

Corrosion Resistance: Maximum corrosion resistance in the annealed condition. Free machining elements reduce overall corrosion resistance. Resistance to Scaling: Excellent up to 1600º F in continuous service. In design, beware of high coefficient of expansion.

304

Similar to Type 302 with excellent mechanical properties, resistance to many corrosive agents. Useful where sanitation and cleanliness are important. Non-magnetic in the annealed condition. Hardness and tensile strength can be increased by cold working, but modified by lowered carbon content providing good resistance to corrosion in welded construction where subsequent heat treatment is not practical.

Applications: Dairy, beverage and food product handling/processing equipment. Used for handling acetic, nitric, and citric acids; organic and inorganic chemicals, dye stuff, crude and refined oils; instruments; hospital equipment; applications requiring welding.

Analysis: C - .08 Max. Mn - 2.00 Max., P - .04 Max., S - .03 Max., Si - 1.0 Max,. Cr - 18.00/20.00, Ni - 8.00/10.50, Cu - .75 Max., Mo - .75 Max.

Mechanical Properties: (following values are average and are representative)

Tensile Strength (psi) 90,000

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

STAINLESS (Continued)

Yield Point (psi) 40,000
Elongation (% in 2") 50
Brinell Hardness: 163
Weldability: Excellent. Surface Cutting Speed: 75 ft/Min.

Corrosion Resistance: Maximum resistance in annealed condition shows good resistance to strong oxidizingacids such as nitric acid, and resists attack by a wide variety of organic and inorganic chemicals. Intergranular corrosion may occur if heated within or cooled through the range of 800º F - 1500º F.
Resistance to Scaling: Excellent at temperatures up to
1600º F in continuous service. In design, beware of high coefficient of expansion.

304L

As per above except: 304L is an extra-low-carbon analysis, the advantage of which is that it precludes any harmful precipitation in the 800º F - 1500º F range, such as might otherwise occur in welding heavier sections.

309

This alloy is known for good strength and oxidation resistance in continuous service temperatures up to 2000º F (1093º C). It is superior to 304 stainless in both strength and corrosion resistance.
Applications: Oven linings, boiler baffles, fire box sheets, furnace components and other high temperature containers.
Analysis: C - .2 Max., Cr - 22.00/24.00, Fe - Balance Mn - 2.00 Max.,
Ni - 12.00/15.00, P - .045 Max., S - .03 Max., Si – 1.0 Max.
Mechanical Properties: (following values are average and are representative)
Tensile Strength (psi)
Yield Point (psi)
Elongation (% in 2")
Brinell Hardness:
Machinability: This alloy machines similarly to type 304 stainless. Its chips are stringy and it will work-harden rapidly. It is necessary to keep the tool cutting at all times and use chip breakers.
Weldability: Most of the austenitic stainless steels can be readily welded using fusion or resistance methods. Oxyacetylene welding is not recommended.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

STAINLESS (Continued)

Hot Working: Working temperatures are 2150º F (1177º C), with reheating necessary at 1800º F (982º C). Rapid quenching is recommended. Full post-work annealing is required to reattain maximum corrosion resistance. Cold Working: Although this alloy has a high work hardening rate, it can be drawn, headed, upset, and stamped. Full annealing is required after cold work to remove internal stress. Cold work will cause an increase in both hardness and strength. Annealing: 1900º - 2050º F (1038º - 1121º C), water quench. Hardening: This alloy does not respond to heat treatment.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

STEEL-COLD ROLLED

Cold Rolled Commercial Quality Carbon Steel Sheet - Oiled

Cold Rolled Commercial Quality Sheets are produced from rimmed, capped and semi-killed steel and are intended for exposed or unexposed parts involving bending, moderate drawing or forming and welding. They may be bent flat on themselves in any direction without cracking.

Applications: Practical experience is usually sufficient to determine whether Commercial Quality or Drawing Quality is required, otherwise, the Scribed Square Test (ASTM A 568) can be helpful. A grid of 1" squares is marked on the section representing the most severe draw. The squares are measured for percent increase in area after drawing. Experience has shown that Commercial Quality is usually satisfactory if the increase in the area is less than 25%. If more than 25%, Drawing Quality is recommended.

Analysis: C - .15 Max., Mn - .60 Max., P - .035 Max., S - .04 Max.

Mechanical Properties: (following values are average and are representative)

Commercial Drawing

Tensile Strength (psi) 38-50,000 36-46,000 Yield Point (psi) 25-35.000 23-30,000 Elongation (% in 2") 35-42 38-43

Weldability: Yes.

Forming: Yes.

C1018 Cold Finished Bar

A low carbon steel with medium manganese content.

Applications: Cold forming and bending operations (for severe bends stress relieving may be needed to prevent cracking); carburized parts requiring soft core and high surface hardness such as kingpins, gears, dogs, etc.

Also suitable for parts requiring cold forming such as crimping, swaging or bending.

Analysis: C - .15/.20, Mn - .60/.90, P - .04 Max., S - .05 Max.

Mechanical Properties: (following are minimum properties based on typical 1" bar).

Conforms to ASTM A108.

1" rd Cold 1" rd Hot

Tensile Strength (psi) 64,000 58,000

Yield Point (psi) 54,000 36,000

Elongation (% in 2") 15 25

Reduction of Area (%) 55

Brinell Hardness: 125 120

Machinability: 78% based on 1212 as 100%. Surface Cutting Speed: 130 ft/min.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

STEEL-COLD ROLLED (Continued)

Weldability: Excellent by all processes forming extremely high quality joints and welds.
Hardening: Standard carburizing methods. Hard case and tough core carburize at 1650º F - 1700º F for approx. 8 hrs. Oven cool. Reheat to 1400º F - 1450º F. Water quench and draw at 300º F - 350º F.

C1045 Cold Finished Bar
A medium carbon steel allowing higher strength properties than 1018. A wide range of properties can be obtained.
Applications: Shafts, machinery parts, bolts, pinions, gears.
Analysis: C - .43/.50, Mn - .60/.90, P - .04 Max., S - .05 Max.
Mechanical Properties: (following are minimum properties based on typical 1" bar)
1" rd
Tensile Strength (psi) 82,000
Yield Point (psi) 45,000
Elongation (% in 2") 16
Reduction of Area (%) 32
Brinell Hardness: 162
Machinability: 64% based on 1212 as 100%. Surface Cutting Speed: 95-105 ft/min.
Weldability: Fair. With thin sections and flexible design, gas or arc welding may be used without preheating except in joints over 1/2" to 3/4" thick where preheating is necessary. For equivalent strength in a weld a low alloy filler is recommended. Stress relieving after is recommended. Grade of welding rod to be used depends on thickness of section, design, service requirement, etc.
Hardening: Essentially water hardened (1550º F) although can be quenched in oil (1575º F). Wide range of mechanical properties obtained by tempering between 700º F to 1300º F. Avoid tempering between 500º F and 700º F.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

STEEL-HOT ROLLED

Hot Rolled – Commercial Quality Carbon Steel Plate
Hot Rolled Carbon Steel Plates are produced from basic oxygen process steel.
Applications: Storage tanks, storage bins, welded pipe, bridge construction, freight and passenger cars, barges, tankers, machinery construction, mining cars and equipment, bearing plates for buildings, other structural applications and various parts obtained by flame cutting.
Analysis:
3/4" and under: C - .25 Max., Mn - .60/1.15, P - .04 S - .05
Over 3/4" to 1 1/2": C - .25 Max., Mn - .80/1.20, P - .04 S - .05
Over 1 1/2" to 2 1/2": C - .26 Max., Mn - .80/1.20, P - .04 S - .05, Si - .15/.40
Over 2 1/2" to 4": C - .27 Max., Mn - .85/1.20, P - .04, S - .05, Si - .15/.40
Over 4": C - .29 Max., Mn - .85/1.20, P - .04, S - .05, Si - .15/.40
Mechanical Properties: (following values are average and are representative)
Tensile Strength (psi) 58/80,000
Yield Point (psi) 36,000 Min.
Elongation in 8"***** (%) 18 Min.
* Subject to reduction for thickness under 5/16"
Machinability: 72% based on 1212 as 100%. Surface Cutting Speed: 120 ft/Min.
Weldability: Excellent. Easily welded by all welding processes and the resultant welds and joints are of extremely high quality. Grade of welding rod used depends on welding conditions such as thickness of section, design, service requirements, etc.

Hot Rolled – Commercial Quality Carbon Steel Sheet
Hot Rolled Commercial Quality Sheets are produced from low carbon rimmed, capped or semi-killed steel, and are intended for uses involving simple bending or moderate drawing and welding. They can be bent flat on themselves in any direction at room temperature without cracking on the outside of the bent portion.
Applications: From agricultural implements to automotive equipment, blower and ventilating systems, hot air registers, stub barrels and drums to bins and partitions.
Hot Rolled Sheets may also be used for structural purposes where mechanical property test values are required, in which case ASTM A570 should be specified.
Analysis: C - .15 Max., Mn - .60 Max., P - .035 Max., S - .04 Max.
Weldability: Yes.
Forming: Yes.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

STEEL-HOT ROLLED (Continued)

Hot Rolled Pickled and Oiled Commercial Quality Carbon Steel Sheet
Pickled and Oiled Sheets should be used when the tight oxide scale present on Hot Rolled Sheets is objectionable.
Applications: The superior smooth, clean surface is especially suited for stamping and ordinary drawing applications.
Hot Rolled Sheets may also be used for structural purposes where mechanical property test values are required, in which case ASTM A570 should be specified.

Analysis: C - .25, Mn - .90 Max., P - .04 Max., S - .05 Max.
Mechanical Properties: (following minimum properties apply to Grades 30 and 33)
Grade 30 Grade 33
Tensile Strength (psi) 49,000-52,000
Yield Point (psi) 30,000-33,000
Elongation (% in 2")
(.0255" - .0635") 21 18
(.0636" - .0971") 24 22
(.0972" - .2299") 25 23
Weldability: Yes.
Forming: Yes.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055

TOOL STEEL

AISI A2 Air Hardening Tool Steel

A2 is a 1% carbon, 5% chrome, air-hardening tool steel. A2 is known as a versatile, general purpose grade and has better resistance to abrasion and wear than the “S” series shock resisting tool steels and more toughness and impact strength than the “D” series wear steels. It is used for a wide range of tooling applications ranging from general purpose punches and dies to components for plastic injection molding.

Typical Chemistry: C - 1.00, Mo - 1.00, Cr - 5.00, V 0.20

Machinability: When properly annealed, A2 has a machinability rating of 60 as compared with a 1% Carbon Steel rated at 100. Dimensional Stability: When air quenched from the proper hardening temperature, this grade can be expected to expand approximately .001 in. per in.

Note: Distortion (bending, bowing and twisting) as well as part geometry can add to the variations in movement of a part being hardened.

Thermal Cycling: To avoid decarburization, this grade should be annealed and/or hardened in a controlled neutral atmosphere, vacuum or neutral salt furnace environment.

1. Anneal: Heat to 1650° F. Soak two hours per inch of thickness. Cool 40° F per hour to 900° F. Air cool to room temperature. Approximate annealed hardness 235 HB Max.

2. Stress Relief of Unhardened Material: Heat slowly to 1200º to 1250° F. Soak for two hours per inch of thickness at heat. Slow cool (furnace cool if possible) to room temperature.

3. Hardening: a. Preheat: Heat to 1200° F. Hold at this temperature until thoroughly soaked.

b. Harden: Heat to 1750º to 1800° F. Soak at heat for 45 to 60 minutes per inch of greatest thickness.

c. Quench: Air quench to 150° F. Temper immediately.

d. Temper: Double temper is mandatory. Soak for two hours per inch of thickness at heat. Slow cool to room temperature between tempers. Temper° F Rockwell “C” Temper° F Rockwell “C”As-quenched 64 900 56 400 60 1000 56 500 56 1100 50 600 56 1200 43 800 56 1300 34 Specimens 1” diameter were quenched from 1775° F.

4. Stress Relief Temper: A stress relief temper for hardened material is strongly recommended after significant grinding, or welding, or EDM. Select a temperature that is 25º or 50° F lower than the last tempering temperature used. The values shown in this data sheet are to be used as a guide for estimating purposes only.

MINERD & SONS, INC.
101 Red Nine Lane
Lawrence PA, 15055