

STEEL PLATES

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ASTM A 36

Specification for Structural Steel Plate

DISCUSSION

ASTM A 36 steel is a widely accepted general purpose structural quality steel offering a constant 36 ksi min. yield point for all thicknesses of material. It is widely used in the construction of buildings, bridges and other structures by means of welding, bolting or riveting. This steel is useful because of its wide availability.

NOTCH TOUGHNESS

While these steels are not normally recommended where low temperature notch toughness is critical, they have been used in many bridges and other dynamically loaded structures at temperatures at least as low as those found in the settled areas of Canada. Some improvement in the low temperature notch toughness can be obtained by specifying KILLED FINE GRAIN PRACTICE on all thicknesses, but no consistent minimum value can be expected unless impact testing has been specified by the purchaser.

CORROSION RESISTANCE

These steels have the same atmospheric corrosion resistance as plain carbon steels, however, this may be enhanced by specifying copper additions.

WELDABILITY

ASTM A 36 steel can be easily welded, using good shop or field practices by all of the usual methods; shielded metal-arc, submerged-arc, gas metal-arc and resistance welding.

GAS CUTTING

This material can be gas cut using good shop or field practices. Cutting of this material generally does not require preheating, but the steel temperature should not normally be below 50°F during cutting.

FORMABILITY

ASTM A 36 can be cold formed using conventional equipment and good shop practices. Suggested minimum cold forming radii are given in the table.

Cont'd

ASTM A 36 (cont'd)

Specification for Structural Steel Plate

**FABRICATING PRACTICE FOR COLD FORMING
WITH BEND LINES PERPENDICULAR TO ROLLING DIRECTION**

Thickness of Material	Suggested Minimum Inside Radius
Up to ½" incl.	1½t
Over ½" to 1" incl.	2 t
Over 1" to 1½" incl.	3 t
Over 1½" to 2" incl.	4 t

MECHANICAL PROPERTIES

Yield point, min. Ksi	up to & incl. 8" thick 36 over 8" thick 32
Tensile strength, Ksi	58-80
Elongation in 8 in., min., %	20
Elongation in 2 in., min., %	23

CHEMICAL REQUIREMENTS

Thickness, in.	All	To ¾	Over ¾ to 1½ incl.	Over 1½ to 2½ incl.	Over 2½ to 4 incl.	Over 4
Carbon, max, %	0.26	0.25	0.25	0.26	0.27	0.29
Manganese, %	...	...	0.80-1.20	0.80-1.20	0.85-1.20	0.85-1.20
Phosphorus, max, %	0.04	0.04	0.04	0.04	0.04	0.04
Sulfur, max, %	0.05	0.05	0.05	0.05	0.05	0.05
Silicon, %	...	0.40	0.40	0.15-0.40	0.15-0.40	0.15-0.40
Copper, min, % when copper steel is specified	0.20	0.20	0.20	0.20	0.20	0.20

ASTM A 283

Specification for Low and Intermediate Tensile Strength Carbon Steel Plate of Structural Quality

DISCUSSION

ASTM A 283 covers low and intermediate tensile strength carbon steel plates for general manufacturing and constructional applications. This material is normally supplied in the rimmed or semi-killed types of steel and is particularly suitable for the economical production of assemblies requiring a considerable amount of forming. Variations in low temperature impact properties are great and these steels are not recommended for those applications requiring low temperature notch toughness.

CORROSION RESISTANCE

This material has the same atmospheric corrosion resistance as plain carbon steel but this may be enhanced by the use of copper additions.

WELDABILITY

ASTM A 283 steels can be readily welded, using good shop or field practices by all the usual methods; shielded metal-arc, submerged-arc, gas metal-arc and resistance welding together with suggested preheat temperatures.

GAS CUTTING

ASTM A 283 plates may be gas cut using good shop or field practices. Cutting of this material generally does not require preheating.

FORMABILITY

These steels can be readily cold formed using conventional equipment and good shop practices. Grade A material will provide the greatest cold formability with grades B, C and D providing progressively less formability in that order.

Cont'd

ASTM A 283 (cont'd)

Specification for Low and Intermediate
Tensile Strength Carbon Steel Plate of Structural Quality

**FABRICATING PRACTICE FOR COLD FORMING WITH BEND LINES
PERPENDICULAR TO ROLLING DIRECTION**

Thickness of Material	Suggested Minimum Inside Radius			
	Grade A	Grade B	Grade C	Grade D
Up to ¼" incl.	1t	1t	1t	1t
Over ¼" to ½" incl.	1t	2t	2½t	3t
Over ½" to 1" incl.	2t	4t	Hot Form	Hot Form
Over 1" to 2" incl.	4t	Hot Form	Hot Form	Hot Form
Over 2"	Hot Form	Hot Form	Hot Form	Hot Form

MECHANICAL PROPERTIES

	Grade A	Grade B	Grade C	Grade D
Yield point min., Ksi	24	27	30	33
Tensile strength, Ksi	45/60	50/65	55/75	60/80
Elongation in 8" min., %	27	25	22	20
Elongation in 2" min., %	30	28	25	23

CHEMICAL REQUIREMENTS

	Heat Analysis, %
Phosphorus, max	0.035
Sulfur, max	0.04
Copper, when copper steel is specified, min	0.20

ASTM A 285

Specification for Low and Intermediate Tensile Strength Carbon Steel Plates for Pressure Vessels

DISCUSSION

ASTM A 285 covers three grades of low and intermediate tensile strength carbon steel plates intended for fusion-welded pressure vessels up to a maximum of 2" thick. This material is normally supplied in the rimmed or semi-killed types and is particularly suitable for economic production for low-pressure vessels coming under the jurisdiction of the ASME Pressure Vessel Code.

CORROSION RESISTANCE

This material has the same atmospheric corrosion resistance as plain carbon steel, but this may be enhanced by the use of copper additions.

WELDABILITY

ASTM A 285 steels can be readily welded, using good shop or field practices by all the usual methods; shielded metal-arc, submerged-arc, gas metal-arc and resistance welding. This material conforms to welding category P1 of the ASME Pressure Vessel Code. Welded vessels under the ASME Code will normally require post weld heat treatment of 1100°F for 1 hour per inch of thickness.

GAS CUTTING

ASTM A 285 steels can be gas cut using good shop or field practices. Cutting of this material generally does not require preheating.

FORMABILITY

ASTM A 285 steels can be readily cold formed using conventional equipment and good shop practices. Grade A material will provide the greatest cold formability with Grade B and Grade C providing progressively poorer formability in that order. Suggested minimum cold forming radii are shown in the table below.

Cont'd

ASTM A 285 (cont'd)

**Specification for Low and Intermediate
Tensile Strength Carbon Steel Plates for Pressure Vessels**

**FABRICATING PRACTICE FOR COLD FORMING WITH BEND LINES
PERPENDICULAR TO ROLLING DIRECTION**

Thickness of Material	Suggested Minimum Inside Radius		
	Grade A	Grade B	Grade C
Up to ¼" incl.	1t	1t	1t
Over ¼" to ½" incl.	1t	2t	2½t
Over ½" to 1" incl.	2t	4t	Hot Form
Over 1" to 2" incl.	4t	Hot Form	Hot Form

MECHANICAL PROPERTIES

	Grade A	Grade B	Grade C
Yield point min., ksi	24	27	30
Tensile strength, ksi	45/65	50/70	55/75
Elongation in 8" min., %	27	25	23
Elongation in 2" min., %	30	28	27

CHEMICAL REQUIREMENTS

Elements	Composition, %		
	Grade A	Grade B	Grade C
Carbon, max ^A	0.17	0.22	0.28
Manganese, max			
Heat analysis	0.90	0.90	0.90
Product analysis	0.98	0.98	0.98
Phosphorus, max ^A	0.035	0.035	0.035
Sulfur, max ^A	0.035	0.035	0.035

^A Applies to both heat and product analyses.

ASTM A 242

Specification for High Strength Low Alloy Structural Steels

DISCUSSION

ASTM A 242 covers high strength low alloy steel shapes, plates and bars for welded, riveted or bolted construction intended primarily for use as structural members where saving in weight or added durability are important.

CORROSION RESISTANCE

These steels have enhanced atmospheric corrosion resistance of at least 4 times that of carbon structural steels. This is due, in part, to the tightly adhering oxide coating which develops under most atmospheric conditions. The protection effect of the oxide provides greatly extended life. Under favourable conditions these steels may be used in an exposed unpainted condition in buildings and other structures.

WELDABILITY

ASTM A 242 steels can be welded using good shop or field practices by all of the usual methods; shielded metal-arc, submerged-arc, gas metal-arc and resistance welding.

GAS CUTTING

These steels may be gas-cut using good shop or field practices. Use of preheat for cutting or post-heat for softening cut edges will be governed by the chemical composition and hardening characteristics of the particular alloy steel involved.

FORMABILITY

ASTM A 242 steels can be cold formed using conventional press brake equipment and good shop practices. Material 1 inch thick and over, forms best in the normalized condition though this is not mandatory.

Cont'd

ASTM A 242 (cont'd)

Specification for High Strength Low Alloy Structural Steels

**FABRICATING PRACTICE FOR COLD FORMING WITH BEND LINES
PERPENDICULAR TO ROLLING DIRECTION**

Thickness of Material	Suggested Minimum Inside Radius
Up to 3/4" incl.	2 t
Over 3/4" to 1" incl.	2½t
Over 1" to 1½" incl.	2½t
Over 1½" to 2" incl.	3 t
Over 2" to 4" incl.	3½t

MECHANICAL PROPERTIES

	Plates		
	Up to 3/4"	Over 3/4" to 1½"	Over 1½" to 4"
Yield point min., Ksi	50	46	42
Tensile strength min. Ksi	70	67	63
Elongation in 8" min., %	18	18	18
Elongation in 2" min., %	21	21	21

CHEMICAL REQUIREMENTS

(%)

Carbon, max	0.15
Manganese, max	1.00
Phosphorus, max	0.15
Sulfur, max	0.05
Copper, min.	0.20

ASTM A 515

Specification for Carbon Steel Plates for Pressure Vessels for Intermediate and Higher Temperature Service

DISCUSSION

ASTM A 515 covers steel plates of intermediate tensile strength for pressure vessels to be operated at intermediate or higher temperatures. The four grades offer excellent combinations of strength, weldability and toughness to permit designers flexibility in the design of pressure vessels coming under the jurisdiction of the ASME Pressure Vessel Code.

The plates are produced from fully killed steels and may be ordered to have an austenitic grain size from 1 to 5 for improved creep resistance and added resistance to graphitization at elevated temperatures.

This material cannot be expected to provide adequate notch toughness, even in the normalized condition, to perform satisfactorily on low temperature pressure vessels.

CORROSION RESISTANCE

This material has the same atmospheric corrosion resistance as plain carbon steel.

WELDABILITY

ASTM A 515 steels can be readily welded, using good shop or field practices by all of the usual methods; shielded metal-arc, submerged-arc, gas metal-arc and resistance welding. This material conforms to Welding Category P1 of the ASME Pressure Vessel Code. Since many plates may exceed 0.30% carbon content and 1 inch in thickness, special preheat requirements should be carefully checked. Welded vessels under the ASME code normally will require post weld heat treatment of 1100°F for 1 hour per inch of thickness.

GAS CUTTING

ASTM A 515 plates can be gas cut using good shop or field practices. Plates over 0.30% carbon content and over 1 inch in thickness may display some edge hardening; if this is a problem, preheat to 200°F is suggested. Cutting of this material should not normally be carried out at a metal temperature below 50°F.

FORMABILITY

This material can be readily cold formed using conventional equipment and good shop practices. Grade 55 material provides the greatest degree of formability, with progressively decreasing formability for grades 60, 65 and 70. Suggested minimum cold forming radii are given in the table.

Cont'd

ASTM A 515 (Cont'd)

Specification for Carbon Steel Plates for Pressure Vessels for Intermediate and Higher Temperature Service

FABRICATING PRACTICE FOR COLD FORMING WITH BEND LINES PERPENDICULAR TO ROLLING DIRECTION

Thickness of Material	Suggested Minimum Inside Radius		
	Grade 60	Grade 65	Grade 70
Up to ¼" incl.	1½t	2t	2½t
Over ¼" to ½" incl.	3 t	3t	4 t
Over ½" to 1" incl.	Hot Form	Hot Form	Hot Form

MECHANICAL PROPERTIES

	Grade 60	Grade 65	Grade 70
Yield point min., Ksi	32	35	38
Tensile strength, Ksi	60/80	65/85	70/90
Elongation in 8" min., %	21	19	17
Elongation in 2" min., %	25	23	21

CHEMICAL REQUIREMENTS

Elements	Composition, %		
	Grade 60	Grade 65	Grade 70
Carbon, max ⁴ :			
1 in. and under	0.24	0.28	0.31
Over 1 to 2 in., incl.	0.27	0.31	0.33
Over 2 to 4 in., incl.	0.29	0.33	0.35
Over 4 to 8 in., incl.	0.31	0.33	0.35
Over 8 in.	0.31	0.33	0.35
Manganese, max:			
Heat analysis	0.90	0.90	1.20
Product analysis	0.98	0.98	1.30
Phosphorus, max ⁴	0.035	0.035	0.035
Sulfur, max ⁴	0.035	0.035	0.035
Silicon:			
Heat analysis	0.15-0.40	0.15-0.40	0.15-0.40
Product analysis	0.13-0.45	0.13-0.45	0.13-0.45

⁴ Applies to both heat and product analyses.

ASTM A 516

Specification for Carbon Steel Plates for Pressure Vessels for Moderate and Lower Temperature Service

DISCUSSION

ASTM A 516 covers steel plates of intermediate tensile strength for pressure vessels to be operated at atmospheric or lower temperatures. The four grades offer excellent combinations of strength, weldability and toughness to permit designers flexibility in the design of pressure vessels coming under the jurisdiction of the ASME Pressure Vessel Code.

The plates are produced from fully killed fine grained steels and in the normalized condition will meet the requirements of ASTM A 20: 15 ft.-lbs. energy at -50°F on Charpy V-Notch specimens.

Since A 516 plates are made to a silicon-aluminum deoxidation practice they are not recommended for elevated service temperatures above 850°F.

CORROSION RESISTANCE

This material has the same atmospheric corrosion resistance as plain carbon steel.

WELDABILITY

ASTM A 516 steels can be readily welded, using good shop or field practices by all of the usual methods; shielded metal-arc, submerged-arc, gas metal-arc and resistance welding. This material conforms to Welding Category P1 of the ASME Pressure Vessel Code. Welded vessels under the ASME code normally will require post weld heat treatment of 1100°F for 1 hour per inch of thickness.

GAS CUTTING

ASTM A 516 plates can be gas cut using good shop or field practices. Cutting of this metal should not normally be carried out at a metal temperature below 50°F.

FORMABILITY

This material can be readily cold formed using conventional equipment and good shop practices. Grade 55 material provides the greatest degree of formability, with progressively decreasing formability for grades 60, 65 and 70. Suggested minimum cold forming radii are given in the table.

Cont'd

ASTM A 516 (Cont'd)

Specification for Carbon Steel Plates for Pressure Vessels for Moderate and Lower Temperature Service

FABRICATING PRACTICE FOR COLD FORMING WITH BEND LINES PERPENDICULAR TO ROLLING DIRECTION

Thickness of Material	Suggested Minimum Inside Radius			
	Grade 55	Grade 60	Grade 65	Grade 70
Up to ¼" incl.	1 t	1½t	2t	2½t
Over ¼" to ½" incl.	2½t	3 t	3t	4 t
Over ½" to 1" incl.	Hot Form	Hot Form	Hot Form	Hot Form

MECHANICAL PROPERTIES – PLATES

	Grade 55	Grade 60	Grade 65	Grade 70
Yield point min., Ksi	30	32	35	38
Tensile strength, Ksi	55/65	60/72	65/67	70/85
Elongation in 8" min., %	23	21	19	17
Elongation in 2" min., %	27	25	23	21

CHEMICAL REQUIREMENTS

Elements	Composition, %			
	Grade 55	Grade 60	Grade 65	Grade 70
Carbon, max ^A :				
½ in. and under	0.18	0.21	0.24	0.27
Over ½ in. to 2 in., incl.	0.20	0.23	0.26	0.28
Over 2 to 4 in., incl.	0.22	0.25	0.28	0.30
Over 4 to 8 in., incl.	0.24	0.27	0.29	0.31
Over 8 in.	0.26	0.27	0.29	0.31
Manganese:				
½ in. and under:				
Heat analysis ^B	0.60-0.90	0.60-0.90	0.85-1.20	0.85-1.20
Product analysis ^B	0.55-0.98	0.55-0.98	0.79-1.30	0.79-1.30
Over ½ in.:				
Heat analysis	0.60-1.20	0.85-1.20	0.85-1.20	0.85-1.20
Product analysis ^B	0.55-1.30	0.79-1.30	0.79-1.30	0.79-1.30
Phosphorus, max ^A	0.035	0.035	0.035	0.035
Sulfur, max ^A	0.035	0.035	0.035	0.035
Silicon:				
Heat analysis	0.15-0.40	0.15-0.40	0.15-0.40	0.15-0.40
Product analysis	0.13-0.45	0.13-0.45	0.13-0.45	0.13-0.45

^A Applies to both heat and product analysis.

^B For each reduction of 0.01 percentage point below the specified maximum for carbon, an increase of 0.06 percentage point above the specified maximum for manganese is permitted, up to a maximum of 1.50 % by heat analysis and 1.60 % by product analysis.

CSA G40.21

STRUCTURAL QUALITY STEELS

In this format, the standard clearly identifies the types of steel that should be considered whenever resistance to brittle fracture is a design consideration; Type WT, AT or QT. These designations also alert the steel producer to the fact that the intended application requires a steel that is capable of displaying a specific level of notch toughness.

To further simplify and expedite the ordering of Type WT, AT or QT steel and to eliminate possible confusion between the designer and the producer, one of five categories of notch toughness must be selected and specified. For every grade covered by these types, each category represents a specific level of absorbed energy at a particular temperature as indicated in Tables 2 & 3.

For example, if designers require a 50 Ksi minimum yield weathering steel with certified impact testing of 20 ft. lbs. at 0°F, they simply specify 50 AT, Category 2. Thus there can be no confusion at the steel producer, or at any step between the designer and the steel mill about the exact product required.

With these changes, the design community has been provided with a logical, comprehensive range of structural steels that reflects the requirements of today's designs and applications.

CAN/CSA-G40.21

STRUCTURAL QUALITY STEELS

TYPE W – WELDABLE STEEL

Steels of this type meet specified strength requirements and are suitable for general welded construction where notch toughness at low temperatures is not a design requirement. Applications may include buildings, compression members of bridges, etc.

TYPE WT – WELDABLE NOTCH-TOUGH STEEL

Steels of this type meet specified strength and Charpy V-Notch impact requirements and are suitable for welded construction where notch toughness at low temperature is a design requirement. The purchaser, in addition to specifying the grade, must specify the required category of steel that establishes the Charpy V-Notch test temperature and energy level. Applications may include primary tension members in bridges and similar elements.

TYPE R – ATMOSPHERIC CORROSION-RESISTANT STEEL

Steels of this type meet specified strength requirements. The atmospheric corrosion resistance of these steels in most environments is substantially better than that of carbon structural steels with or without a copper addition.* When properly exposed to the atmosphere, these steels can be used bare (unpainted) for many applications. These steels may be welded readily up to the maximum thickness covered by this Standard. Applications include unpainted siding, unpainted light structural members, etc, where notch toughness at low temperature is not a design requirement.

TYPE A – ATMOSPHERIC CORROSION-RESISTANT WELDABLE STEEL

Steels of this type meet specified strength requirements. The atmospheric corrosion resistance of these steels in most environments is substantially better than that of carbon structural steels with or without a copper addition.* When properly exposed to the atmosphere, these steels can be used bare (unpainted) for many applications. These steels are suitable for welded construction where notch toughness at low temperature is not a design requirement and are often used unpainted. Applications are similar to those for Type W.

Cont'd

CAN/CSA-G40.21

STRUCTURAL QUALITY STEELS (Cont'd)

TYPE AT – ATMOSPHERIC CORROSION-RESISTANT WELDABLE NOTCH-TOUGH STEEL

Steels of this type meet specified strength and Charpy V-Notch impact requirements. The atmospheric corrosion resistance of these steels in most environments is substantially better than that of carbon structural steels with or without a copper addition.* When properly exposed to the atmosphere, these steels can be used bare (unpainted) for many applications. These steels are suitable for welded construction where notch toughness at low temperature is a design requirement. The purchaser, in addition to specifying the grade, must specify the required category of steel that establishes the Charpy V-Notch test temperature and energy level. Applications may include primary tension members in bridges and similar elements.

TYPE Q – QUENCHED AND TEMPERED LOW ALLOY STEEL PLATE

Steels of this type meet specified strength requirements. While these steels may be readily welded, the welding and fabrication techniques are of fundamental importance and must not adversely affect the properties of the plate, especially the heat-affected zone. Applications may include bridges and similar structures.

TYPE QT – QUENCHED AND TEMPERED LOW ALLOY NOTCH-TOUGH STEEL PLATE

Steels of this type meet specified strength and Charpy V-Notch impact requirements. They provide good resistance to brittle fracture and are suitable for structures where notch toughness at low temperature is a design requirement. The purchaser, in addition to specifying the grade, must specify the required category of steel that establishes the Charpy V-Notch test temperature and energy level. While these steels may be welded readily, the welding and fabrication techniques are of fundamental importance and must not adversely affect the properties of the plate, especially the heat-affected zone. Applications may include primary tension members in bridges and similar elements.

** For methods of estimating the atmospheric corrosion resistance of low-alloy steels, see ASTM Standard G101.*

CHEMICAL COMPOSITION BY HEAT ANALYSIS OF PLATES

Grade						
Metric	Imperial	C, max	Mn	P	S, max	Si ^{(a)(b)}
260W	38W	0.20 ^(e)	0.50-1.50	0.04 max	0.05	0.40 max
300W	44W	0.22 ^(f)	0.50-1.50	0.04 max	0.05	0.40 max
350W	50W	0.23	0.50-1.50	0.04 max	0.05	0.40 max
400W	60W	0.23	0.50-1.50	0.04 max	0.05	0.40 max
480W	70W	0.26	0.50-1.50	0.04 max	0.05	0.40 max
550W	80W	0.15	1.75 max ^(g)	0.04 max	0.05	0.40 max
260WT	38WT	0.20 ^(e)	0.80-1.50	0.03 max	0.04	0.15-0.40
300WT	44WT	0.22 ^(f)	0.80-1.50	0.03 max	0.04	0.15-0.40
350WT	50WT	0.22 ^(f)	0.80-1.50 ^(g)	0.03 max	0.04	0.15-0.40
400WT	60WT	0.22	0.80-1.50 ^(g)	0.03 max	0.04	0.15-0.40
480WT	70WT	0.26	0.80-1.50 ^(g)	0.03 max	0.04	0.15-0.40
550WT	80WT	0.15	1.75 max ^(g)	0.03 max	0.04	0.15-0.40
350R	50R	0.16	0.75 max	0.05-0.15	0.04	0.75 max
350A	50A	0.20	0.75-1.35 ⁽ⁿ⁾	0.03 max	0.04	0.15-0.50
400A	60A	0.20	0.75-1.35 ⁽ⁿ⁾	0.03 max	0.04	0.15-0.50
480A	70A	0.20	1.00-1.60	0.025 max	0.035	0.15-0.50
550A	80A	0.15	1.75 max ^(g)	0.025 max	0.035	0.15-0.50
350AT	50AT	0.20	0.75-1.35 ⁽ⁿ⁾	0.03 max	0.04	0.15-0.50
400AT	60AT	0.20	0.75-1.35 ⁽ⁿ⁾	0.03 max	0.04	0.15-0.50
480AT	70AT	0.20	1.00-1.60	0.025 max	0.035	0.15-0.50
550AT	80AT	0.15	1.75 max ^(g)	0.025 max	0.035	0.15-0.40
700Q	100Q	0.20	1.50 max	0.03 max	0.04	0.15-0.40
700QT	100QT	0.20	1.50 max	0.03 max	0.04	0.15-0.40

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Legend

- A silicon content of 0.15 to 0.40% is required for Type W steel over 40mm (1½ in.) in thickness or bar diameter, except as modified by footnote (b).
- At the purchaser's request or at the producer's discretion, the steel may be made with no minimum silicon content, provided that the steel contains a minimum of 0.015% acid soluble aluminum or 0.020% total aluminum content.
- Aluminum may be used as a grain refining element without prior approval by the purchaser and, when so used, shall not be included in the summation of grain refining elements included in Table 3. The elements columbium (also known as niobium) and vanadium may be used singly or in combination up to the total percentage indicated, except where columbium is used singly or in combination with vanadium in plates thicker than 14mm (½ in) or shapes heavier than Group 1, in which case the silicon content shall be 0.15% minimum. This restriction does not apply if the steel fulfills the requirements of footnote (b).
- A minimum copper content of .20% may be specified by the purchaser on all grades.
- For thicknesses over 100mm (4 in), the carbon maximum shall .22%.
- For thicknesses over 100mm (4 in), the carbon maximum shall .23%.

CHEMICAL COMPOSITION BY HEAT ANALYSIS OF PLATES (cont'd)

Grade		Grain refining elements ^(e)				Grain-size
Metric	Imperial	max	Cr	Ni	Cu ^(d)	
260W	38W	0.10	—	—	—	—
300W	44W	0.10	—	—	—	—
350W	50W	0.10	—	—	—	—
400W	60W	0.10	—	—	—	(h)
480W	70W	0.10	—	—	—	(h)
550W	80W	0.15	—	—	—	(h)
260WT	38WT	0.10	—	—	—	(k)
300WT	44WT	0.10	—	—	—	(k)
350WT	50WT	0.10 ⁽ⁱ⁾	—	—	—	(k)
400WT	60WT	0.10 ⁽ⁱ⁾	—	—	—	(k)
480WT	70WT	0.10 ⁽ⁱ⁾	—	—	—	(k)
550WT	80WT	0.15 ⁽ⁱ⁾	—	—	—	(k)
350R	50R	0.10	0.30-1.25 ^(m)	0.90 max ^(m)	0.20-0.60 ^(m)	
350A	50A	0.10	0.70 max ^(p)	0.90 max ^(p)	0.20-0.60	(k)
400A	60A	0.10	0.70 max ^(p)	0.90 max ^(p)	0.20-0.60	(k)
480A	70A	0.12	0.70 max ^(p)	0.25-0.50 ^(p)	0.20-0.60	(k)
550A	80A	0.15	0.70 max ^(p)	0.25-0.50 ^(p)	0.20-0.60	(k)
350AT	50AT	0.10	0.70 max ^(p)	0.90 max ^(p)	0.20-0.60	(k)
400AT	60AT	0.10	0.70 max ^(p)	0.90 max ^(p)	0.20-0.60	(k)
480AT	70AT	0.12	0.70 max ^(p)	0.25-0.50 ^(p)	0.20-0.60	(k)
550AT	80AT	0.15	0.70 max ^(p)	0.25-0.50 ^(p)	0.20-0.60	(k)
700Q	100Q	—	Boron 0.0005-0.005		—	Fine grain
700QT	100QT	—	Boron 0.0005-0.005		—	Fine grain

(g) With the prior agreement of the purchaser, the manganese content may be increased, provided that the sum of the carbon content plus 1/2 of the manganese content does not exceed 0.40% for Grade 350WT (50WT) or .42% for Grades 400WT (60WT), 480WT (70WT), 550W (80W), 550WT (80WT), 550A (80A), and 550AT (80AT).

(h) See Clauses 5.3 and 5.4.

(i) A nitrogen content of 0.01 to 0.02% may be used if the nitrogen content does not exceed 1/2 of the vanadium content.

(k) Types WT, A, AT, Q, and QT steel shall be supplied using a fine grain practice.

(m) The combined contents of chromium, nickel, and copper shall be not less than 1.00%.

(n) The manganese content may be increased to 1.60% maximum, provided that the sum of the carbon content plus 1/2 of the manganese content does not exceed 0.43%.

(p) The combined total of the chromium and nickel contents shall be not less than 0.40%.

Notes

(1) In order to meet the required mechanical properties, the manufacturer may use additional alloying elements with the prior approval of the purchaser.

(2) The usual deoxidation practice is fully killed.

MECHANICAL PROPERTIES OF PLATES

Grade		Tensile strength, ksi	Yield point, ksi, minimum			
			Up to 2½ in	>2½ in ≤4 in	>4 in ≤6 in	>6 ≤8
260W	38W	60-85 [§]	38	36	36	36
300W	44W	65-90 [§]	44	40	40	40
350W	50W	65-95 [§]	50	46	46	—
400W	60W	75-100	60	—	—	—
480W	70W	85-115	70	—	—	—
550W	80W	90-125	80	—	—	—
260WT	38WT	60-85*	38	36	36	—
300WT	44WT	65-90*	44	40	40	—
350WT	50WT	70-95*	50	46	46	—
400WT	60WT	75-100	60	—	—	—
480WT	70WT	85-115	70	—	—	—
550WT	80WT	90-125	80	—	—	—
350R	50R	70-95	50	—	—	—
350A	50A	70-95	50	50	—	—
400A	60A	75-100	60	—	—	—
480A	70A	85-115	70	—	—	—
550A	80A	90-125	80	—	—	—
350AT	50AT	70-95	50	50	—	—
400AT	60AT	75-100	60	—	—	—
480AT	70AT	85-115	70	—	—	—
550AT	80AT	90-125	80	—	—	—
700Q	100Q	110-130	100	90	—	—
700QT	100QT	110-130	100	90	—	—

Cont'd

MECHANICAL PROPERTIES OF PLATES

(cont'd)

Grade		Elongation*† % minimum			
		Longitudinal		Transverse‡	
		In 8 in	In 2 in	In 8 in	In 2 in
Metric	Imperial				
260W	38W	20	23	18	21
300W	44W	20	23	18	21
350W	50W	19	22	17	20
400W	60W	16	18	13	15
480W	70W	15	17	12	14
550W	80W	13	15	10	12
260WT	38WT	20	23	18	21
300WT	44WT	20	23	18	21
350WT	50WT	19	22	17	20
400WT	60WT	18	20	15	17
480WT	70WT	15	17	12	14
550WT	80WT	13	15	10	12
350R	50R	19	21	16	18
350A	50A	19	21	17	19
400A	60A	18	21	15	18
480A	70A	15	17	12	14
550A	80A	13	15	10	12
350AT	50AT	19	21	17	19
400AT	60AT	18	21	15	18
480AT	70AT	15	17	12	14
550AT	80AT	13	15	10	12
700Q	100Q	–	18	–	16
700QT	100QT	–	18	–	16

* Per cent elongation is not specified or required for rolled floor plate.

† Where per cent elongation in both 8 in and 2 in is specified, only one gauge length needs to be determined and reported.

‡ Transverse values apply only to plate wider than 24 in.

§ Plates for API applications shall have an upper limit of tensile strength 20 ksi above the specified minimum.

Notes:

- (1) For material having a thickness less than 0.312 in, see Clause 8.3.1.1 of CSA G40.20. For material having a thickness greater than 3.5 in, see Clause 8.3.1.2 of CSA G40.20.
- (2) The yield strength value may be measured by 0.5% extension-under-load or 0.2% offset method.

STRUCTURAL QUALITY STEELS

STANDARD CHARPY IMPACT ENERGY

Grade		Minimum Average Absorbed Energy		
		Categories 1-4		
Metric	Imperial	J	Ft. Lbs.	Category 5
260WT	38WT	20	15	To be specified by purchaser †
300WT	44WT	20	15	
350WT	50WT	27	20	
380WT	55WT	27	20	
400WT	60WT	27	20	
480WT	70WT	27	20	
550WT	80WT	27	20	
350AT	50AT	27	20	To be specified by purchaser †
400AT	60AT	27	20	
480AT	70AT	27	20	
550AT	80AT	27	20	
700QT	100QT	34	25	

* Energy levels given are for Charpy V-notch longitudinal specimens.

† Before specifying, availability of product should be verified.

Note: Absorbed energy values obtained from Charpy V-notch tests conducted at a particular testing temperature cannot be used to determine expected values at any other temperature. Values other than those shown and transverse testing may be available upon consultation between the purchaser and the manufacturer, and shall be ordered as category 5 material.

CHARPY IMPACT TEST** TEMPERATURE

Category	Standard test temperature	
	°C	°F
1	0	32
2	-20	0
3	-30	-20
4	-45	-50
5	To be specified by purchaser †	

* Temperatures given are for Charpy V-notch longitudinal specimens. By agreement between manufacturer and purchaser, specimens may be cut transverse to the rolling direction.

† Before specifying, availability of product should be verified.

Note: At the manufacturer's discretion, the actual test temperature may be lower than the standard test temperature, provided that the minimum average absorbed energy specified for the category is obtained at the lower temperature. Actual test temperatures shall be reported together with the absorbed energy values.

SCHEDULE OF TESTS*

Grade Metric	Imperial	Chemical composition	Tensile test	Impact test
260W	38W	X	X	—
300W	44W	X	X	—
350W	50W	X	X	—
400W	60W	X	X	—
480W	70W	X	X	—
550W	80W	X	X	—
260WT	38WT	X	X	X
300WT	44WT	X	X	X
350WT	50WT	X	X	X
380WT	55WT	X	X	X
400WT	60WT	X	X	X
480WT	70WT	X	X	X
550WT	80WT	X	X	X
350R	50R	X	X	—
350A	50A	X	X	—
400A	60A	X	X	—
480A	70A	X	X	—
550A	80A	X	X	—
350AT	50AT	X	X	X
400AT	60AT	X	X	X
480AT	70AT	X	X	X
550AT	80AT	X	X	X
700Q	100Q	X	X	—
700QT	100QT	X	X	X

* Grain size tests are conducted when specifically ordered on the purchase document. Grain size tests are not usually specified when impact tests are required (see Clauses 7.1.3, 7.2.2, 9.1.2, and 9.1.5 of CSA Standard CAN/CSA-G40.20).

CSA G40.21

FABRICATING PRACTICE FOR COLD FORMING WITH BEND LINES PERPENDICULAR TO ROLLING DIRECTION

Suggested Minimum Inside Radius

		Thickness in inches				
Grade		Under	¼" to	½" to	1" to	Over
Metric	Imperial	¼"	under ½"	under 1"	1½"	1½"
260W	38W	1½t	2 t	3t	4t	–
300W	44W	1½t	2 t	3t	4t	–
350W	50W	2½t	3 t	4t	–	–
400W	60W	3½t	3½t	6t	–	–
480W	70W	5 t	5 t	–	–	–
260WT	38WT	1½t	2 t	3t	4t	4t
300WT	44WT	1½t	2 t	3t	4t	5t
350WT	50WT	2½t	3 t	4t	–	–
400WT	60WT	3½t	3½t	6t	–	–
480WT	70WT	4 t	5 t	6t	–	–
350R	50R	2 t	3 t	–	–	–
350A & AT	50A & AT	2 t	3 t	5t	–	–
400A & AT	60A & AT	3 t	4 t	6t	–	–
480A & AT	70A & AT	4 t	5 t	6t	–	–
700Q & QT	100Q* & QT*	2 t	2 t	2t	3t	3t

t = thickness in inches

* Do not hot form.

Plates to all G40.21 grades can be satisfactorily formed on a press brake or other conventional cold bending equipment. There is a considerable difference in the formability of the different grades due to the strength level and chemical composition differences. Therefore, care must be exercised when forming is required. It is assumed that the bend is not carried out on an edge that has been flame-hardened by gas cutting, or heavily burred or work hardened by shearing unless some special edge preparation, such as grinding or chipping has been performed.

Hot forming is recommended for all thicknesses not showing a value.

Since temperature can be a major cause of bend failure, bending should never be performed at a metal temperature below 15°C.

Material of 50KSI yield strength and higher will require greater bending and hold down force than lower strength steels. Provisions should also be made for a greater than usual degree of springback.

ABRASION RESISTANT STEEL

Abrasion Resistant Steel Plate and Sheet is intended to meet the requirements for a low cost abrasion resisting steel. It is a high carbon-manganese-silicon steel with better workability than carbon steel of the same hardness range. With proper practice this steel can be cut, welded, drilled, rolled formed and machined. Dependent upon the type of wear (i.e. impact loading, grinding, sliding or cutting) and nature of the material handled, A.R. Steel will last from 2 to 10 times longer than ordinary structural steel. The atmospheric corrosion resistance is equal to structural carbon steel.

A.R. Steel is supplied from our stocks in the as rolled condition and further expensive heat treatment is not required to develop its abrasion resisting properties.

When it is desired, however, to increase the abrasion resistance, the strength, or to improve the impact properties, heat treatment is employed.

CHEMICAL COMPOSITION

C	Mn.	P	S
0.30-0.45	1.10-1.65	0.025 max.	0.025 max.

Typical mechanical properties (not guaranteed)

A.R. STEEL	
As Rolled	
Yield point PSI	65,000
Ultimate Tensile Strength PSI	105,000
Elongation in 8"	15%
Brinell Hardness	217

TORCH CUTTING:

Thicknesses up to ½" may be torch cut without preheating when the material is to be used as a liner, wear plate or similar applications where no additional fabrication is required.

For heavier material and all thicknesses where subsequent processing by welding or fabricating is involved or where the steel is to be used as a structural member, preheating to 260°C (500°F) is recommended.

WELDING:

Because of the relatively high hardenability of A.R. Steel preheating and maintaining this interpass temperature is required on all thicknesses. Low hydrogen rods of the E90XX or E100XX series are recommended.

FORMING AND BENDING:

A.R. Steel can be readily hot formed and can be cold formed if proper precautions are taken. For intricate forming and for all material over ½", hot fabrication is recommended at temperatures not less than 815°C (1500°F). A reduction of hardness may occur.

QUENCHED AND TEMPERED STEELS

There are basically two types of Quenched and Tempered steels stocked: Abrasive Resistant and Constructional Alloy.

Q and T CONSTRUCTIONAL ALLOY

This metal is used where high strength, good weldability and improved notch toughness are required. Typical applications include heavy construction equipment and bridges.

Q and T ABRASIVE RESISTANT STEEL

These steels are used where abrasive resistance and good impact values are important. Typical applications include liner plates in hoppers, chutes and trucks for the mining, transportation and pulp and paper industries.

AVAILABILITY

Q & T steel plate is available in thicknesses from $\frac{1}{4}$ " up to $2\frac{1}{2}$ ".

NOTCH TOUGHNESS

Q & T steel plate is normally produced and certified to impact values of 20 ft. lbs. at -50°F. Higher values are subject to inquiry.

WELDABILITY

Q & T steel plate is readily weldable by all major plate welding processes, provided that proper welding procedures are used. Special attention should be given to electrode selection. Preheat may be required for heavy thickness plates.

FORMABILITY

Because of the generally low carbon and alloy levels, Q & T steel can be cold-formed satisfactorily. For bend lines perpendicular to rolling direction, a minimum inside radius of $2t$ should be used when bending plate up to 1" in thickness and a $3t$ radius should be used for plate over 1" to 2" thick. Suitable precautions should be taken to control fabrication procedures, since Q & T steel has two to three times the yield strength of common structural grades. Hot forming of Q & T steel may impair the physical properties of the as-received plate.

CUTTING

This steel can be gas cut using good shop and field practices. Shearing is possible if the capacities of the shear and knives are adequate.

CORROSION RESISTANCE

These steels have the same atmospheric corrosion resistance as plain carbon steel. This may be enhanced somewhat by specifying a minimum copper addition.

QUENCHED AND TEMPERED STEELS

MECHANICAL PROPERTIES - Q & T 100

	A514 Grade S	A514 Grade B	A514 Grade F	A514 Grade H
Yield Point min, ksi				
-up to $\frac{3}{4}$ "	100	100	100	100
> $\frac{3}{4}$ " to 2 $\frac{3}{4}$ "	100	100	100	100
Tensile Strength, ksi	110-130	110-130	110-130	110-130
Maximum Thickness	2 $\frac{3}{4}$ "	1 $\frac{1}{4}$ "	2 $\frac{1}{2}$ "	2"

CHEMICAL COMPOSITION (% maximum)

	A514 Grade S	A514 Grade B	A514 Grade F	A514 Grade H
Carbon	0.17-0.21	0.12-0.21	0.10-0.20	0.12-0.21
Manganese	1.50	0.70-1.00	0.60-1.00	0.95-1.30
Phosphorus	0.025	0.035	0.035	0.035
Sulfur	0.015	0.035	0.035	0.035
Silicon	0.45	0.20-0.35	0.15-0.35	0.20-0.35
Chromium	0.20-0.65	0.40-0.65	0.40-0.65	0.40-0.65
Molybdenum	0.20-0.40	0.15-0.25	0.40-0.60	0.20-0.30
Boron	0.003	0.005	0.006	0.005

QUENCHED AND TEMPERED STEELS

Mechanical Properties - Q & T 130

Yield Strength	Tensile Strength	Elongation
130 ksi	136 ksi	% minimum 2"
		12

Chemical Composition - Heat Analysis (% Maximum)

	C	Mn	P	S	Si	Mo	B
¼"-1 ½"	0.21	1.50	0.025	0.015	0.45	0.30	0.003
>1 ½"-2 ½"	0.25	1.50	0.025	0.015	0.50	0.60	0.003

NOTCH TOUGHNESS

Produced to a minimum Charpy V-Notch average value of 20 ft. lbs at minus 40°C (40°F). Other testing temperatures and Charpy V-Notch values are available upon request.

QUENCHED AND TEMPERED STEEL

ABRASION RESISTANT

MECHANICAL PROPERTIES	400F	450F	500F
Yield Strength,Ksi	145ksi	n/a	n/a
Tensile Strength, Ksi	175ksi	200ksi	225ksi
Elongation % typical in 2"	15	14	12
Brinnell Hardness	360-440	400-477	477-545
Thickness Range	$\frac{3}{16}$ "-2 $\frac{3}{4}$ "	0.236"-2 $\frac{1}{2}$ "	0.236"-2"
Charpy V-Notch (Typical)	35 ft. lbs @-40°C	30 ft. lbs @-40°C	20 ft. lbs @-40°C

CHEMICAL PROPERTIES heat analysis (% maximum)	400F	450F	500F
Carbon	0.17-0.26	0.23-0.26	0.032
Manganese	1.50	1.50	1.50
Phosphorus	0.025	0.025	0.025
Sulfur	0.015	0.015	0.015
Silicon	0.50	0.50	0.50
Chromium	0.20-0.70	0.40-0.60	0.70
Molybdenum	0.20-0.65	0.35-0.65	0.35
Boron	0.003	0.003	0.003

Contact your Russel Metal Sales department for information related to Forming and Welding Requirements for the various grades of Quenched and Tempered / Abrasion Resistant Steel Plates.

STEEL PLATES WEIGHT CHART

Thickness - ins.		Theoretical Weight lbs./sq. ft.	Thickness - ins.		Theoretical Weight lbs./sq. ft.
fractions	decimal		fractions	decimals	
$\frac{3}{16}$	.1875	7.66	$3\frac{5}{8}$	3.625	148.04
$\frac{7}{32}$	.21875	8.93	$3\frac{3}{4}$	3.75	153.14
$\frac{1}{4}$	.25	10.21	$3\frac{7}{8}$	3.875	158.25
$\frac{9}{32}$	.28125	11.49	4	4.	163.35
$\frac{5}{16}$	.3125	12.76	$4\frac{1}{8}$	4.125	168.46
$1\frac{1}{32}$	.34375	14.04	$4\frac{1}{4}$	4.25	173.56
$\frac{3}{8}$	.375	15.31	$4\frac{3}{8}$	4.375	178.67
$1\frac{3}{32}$	.40625	16.59	$4\frac{1}{2}$	4.5	183.77
$\frac{7}{16}$	.4375	17.87	$4\frac{5}{8}$	4.625	188.88
$1\frac{5}{32}$	.46875	19.14	$4\frac{3}{4}$	4.75	193.98
$\frac{1}{2}$	.5	20.42	$4\frac{7}{8}$	4.875	199.09
$\frac{9}{16}$	.5625	22.97	5	5.	204.19
$\frac{5}{8}$	.625	25.52	$5\frac{1}{8}$	5.125	209.30
$1\frac{1}{16}$	.6875	28.08	$5\frac{1}{4}$	5.25	214.40
$\frac{3}{4}$	.75	30.63	$5\frac{3}{8}$	5.375	219.51
$1\frac{3}{16}$	.8125	33.18	$5\frac{1}{2}$	5.5	224.61
$\frac{7}{8}$	.875	35.73	$5\frac{5}{8}$	5.625	229.72
$1\frac{5}{16}$	.9375	38.29	$5\frac{3}{4}$	5.75	234.82
1	1.	40.84	$5\frac{7}{8}$	5.875	239.93
$1\frac{1}{16}$	1.0625	43.39	6	6.	245.03
$1\frac{1}{8}$	1.125	45.94	$6\frac{1}{8}$	6.125	250.14
$1\frac{3}{16}$	1.1875	48.50	$6\frac{1}{4}$	6.25	255.24
$1\frac{1}{4}$	1.25	51.05	$6\frac{3}{8}$	6.375	260.34
$1\frac{5}{16}$	1.3125	53.60	$6\frac{1}{2}$	6.5	265.45
$1\frac{3}{8}$	1.375	56.15	$6\frac{5}{8}$	6.625	270.55
$1\frac{7}{16}$	1.4375	58.71	$6\frac{3}{4}$	6.75	275.66
$1\frac{1}{2}$	1.5	61.26	$6\frac{7}{8}$	6.875	280.76
$1\frac{5}{8}$	1.625	66.36	7	7.	285.87
$1\frac{3}{4}$	1.75	71.47	$7\frac{1}{8}$	7.125	290.97
$1\frac{7}{8}$	1.875	76.57	$7\frac{1}{4}$	7.25	296.08
2	2.	81.68	$7\frac{3}{8}$	7.375	301.18
$2\frac{1}{8}$	2.125	86.78	$7\frac{1}{2}$	7.5	306.29
$2\frac{1}{4}$	2.25	91.89	$7\frac{5}{8}$	7.625	311.39
$2\frac{3}{8}$	2.375	96.99	$7\frac{3}{4}$	7.75	316.50
$2\frac{1}{2}$	2.5	102.10	$7\frac{7}{8}$	7.875	321.60
$2\frac{5}{8}$	2.625	107.20	8	8.	326.71
$2\frac{3}{4}$	2.75	112.31	$8\frac{1}{2}$	8.5	347.13
$2\frac{7}{8}$	2.875	117.41	9	9.	367.55
3	3.	122.52	10	10.	408.38
$3\frac{1}{8}$	3.125	127.62			
$3\frac{1}{4}$	3.25	132.72			
$3\frac{3}{8}$	3.375	137.83			
$3\frac{1}{2}$	3.5	142.93			

Steel Plates are sold on a theoretical weight, based on a density of .2836 pounds per cubic inch.

STEEL PLATES WEIGHT CHART

Thickness Size in Inches	Billing Weight per Plate Lbs.	Thickness Size in Inches	Billing Weight per Plate Lbs.
3/16" (7.66 Lbs./Sq. Ft.)		1/4" (10.21 Lbs./Sq. Ft.)	
36 x 96	184	60 x 96	408
36 x 120	230	60 x 120	510
36 x 144	276	60 x 144	613
		60 x 240	1021
48 x 96	245	60 x 384	1634
48 x 120	306		
48 x 144	367	72 x 120	613
48 x 240	613	72 x 144	735
		72 x 240	1225
60 x 120	383	72 x 384	1960
60 x 144	459		
60 x 240	766	84 x 144	858
60 x 384	1225	84 x 240	1429
		84 x 384	2287
72 x 120	459		
72 x 144	551	96 x 144	980
72 x 240	919	96 x 240	1634
72 x 384	1470	96 x 384	2614
84 x 144	643	5/16" (12.76 Lbs./Sq. Ft.)	
84 x 240	1072	36 x 96	306
84 x 384	1715	36 x 120	383
		36 x 240	766
96 x 144	735		
96 x 240	1225	48 x 96	408
96 x 288	1470	48 x 120	510
		48 x 144	613
1/4" (10.21 Lbs./Sq. Ft.)		48 x 240	1021
36 x 96	245	60 x 120	638
36 x 120	306	60 x 144	766
36 x 240	613	60 x 240	1276
		60 x 384	2042
48 x 96	327		
48 x 120	408	72 x 120	766
48 x 144	490	72 x 144	919
48 x 240	817	72 x 240	1531
48 x 288	980	72 x 384	2450

Cont'd

STEEL PLATES WEIGHT CHART

Thickness Size in Inches	Billing Weight per Plate Lbs.	Thickness Size in Inches	Billing Weight per Plate Lbs.
5/16" (12.76 Lbs./Sq. Ft.)		7/16" (17.87 Lbs./Sq. Ft.)	
84 x 144	1072	72 x 120	1072
84 x 240	1787	72 x 144	1286
84 x 384	2859	72 x 240	2144
		72 x 384	3430
96 x 144	1225		
96 x 240	2042	96 x 120	1429
96 x 384	3267	96 x 144	1715
		96 x 240	2859
		96 x 384	4574
3/8" (15.31 Lbs./Sq. Ft.)		1/2" (20.42 Lbs./Sq. Ft.)	
36 x 96	368	36 x 96	490
36 x 120	459	36 x 120	613
36 x 240	919	36 x 240	1225
48 x 96	490	48 x 96	653
48 x 120	613	48 x 120	817
48 x 144	735	48 x 144	980
48 x 240	1225	48 x 240	1634
60 x 120	766	60 x 120	1021
60 x 144	919	60 x 144	1225
60 x 240	1531	60 x 240	2042
60 x 384	2450	60 x 384	3267
72 x 120	919	72 x 120	1225
72 x 144	1103	72 x 144	1470
72 x 240	1838	72 x 240	2450
72 x 384	2940	72 x 288	2940
		72 x 384	3920
84 x 120	1072		
84 x 144	1286	84 x 120	1429
84 x 240	2144	84 x 144	1715
84 x 384	3430	84 x 240	2859
		84 x 384	4574
96 x 120	1225		
96 x 144	1470	96 x 120	1634
96 x 240	2450	96 x 144	1960
96 x 384	3920	96 x 240	3267
		96 x 384	5227
7/16" (17.87 Lbs./Sq. Ft.)			
48 x 96	572		
48 x 144	858		
48 x 240	1429		

Cont'd

STEEL PLATES WEIGHT CHART

Thickness Size in Inches	Billing Weight per Plate Lbs.	Thickness Size in Inches	Billing Weight per Plate Lbs.
⅜" (22.97 Lbs./Sq. Ft.)		¾" (30.63 Lbs./Sq. Ft.)	
96 x 144	2205	72 x 120	1838
96 x 240	3675	72 x 144	2205
96 x 384	5881	72 x 240	3675
		72 x 384	5881
⅝" (25.52 Lbs./Sq. Ft.)		84 x 120	2144
48 x 96	817	84 x 144	2573
48 x 120	1021	84 x 240	4288
48 x 144	1225	84 x 384	7040
48 x 240	2042	96 x 120	2450
60 x 120	1276	96 x 144	2940
60 x 144	1531	96 x 240	4901
60 x 240	2552	96 x 384	7841
60 x 384	4084	⅞" (35.73 Lbs./Sq. Ft.)	
72 x 120	1531	48 x 96	1143
72 x 144	1838	48 x 120	1429
72 x 240	3063	48 x 240	2859
72 x 384	4901	60 x 120	1787
84 x 120	1787	60 x 240	3573
84 x 144	2144	72 x 120	2144
84 x 240	3573	72 x 144	2573
84 x 384	5717	72 x 240	4288
96 x 120	2042	72 x 384	6861
96 x 144	2450	96 x 120	2859
96 x 240	4084	96 x 144	3430
96 x 384	6534	96 x 240	5717
		96 x 384	9148
⅞" (30.63 Lbs./Sq. Ft.)		1" (40.84 Lbs./Sq. Ft.)	
48 x 96	980	48 x 96	1307
48 x 120	1225	48 x 120	1634
48 x 144	1470	48 x 240	3267
48 x 240	2450	60 x 120	2042
60 x 120	1531	60 x 144	2450
60 x 144	1838	60 x 240	4084
60 x 240	3063	60 x 384	6534
60 x 384	4901		

Cont'd

STEEL PLATES WEIGHT CHART

Thickness Size in Inches	Billing Weight per Plate Lbs.	Thickness Size in Inches	Billing Weight per Plate Lbs.
1" (40.84 Lbs./Sq. Ft.)		1 3/8" (56.15 Lbs./Sq. Ft.)	
72 x 120	2450	48 x 120	2246
72 x 144	2940	48 x 240	4492
72 x 240	4901		
72 x 384	7841	96 x 120	4492
		96 x 240	8984
84 x 120	2559		
84 x 240	5717		
96 x 120	3267	1 1/2" (61.26 Lbs./Sq. Ft.)	
96 x 144	3920		
96 x 240	6534	48 x 96	1960
96 x 384	10455	48 x 120	2450
		48 x 240	4901
1 1/8" (45.94 Lbs./Sq. Ft.)		60 x 120	3063
48 x 96	1470	60 x 240	6126
48 x 120	1837		
48 x 240	3675	72 x 120	3676
		72 x 144	4411
72 x 120	2757	72 x 240	7351
72 x 144	3308	72 x 300	9187
72 x 240	5513		
		96 x 144	5881
96 x 144	4411	96 x 240	9801
96 x 240	7351		
96 x 288	8821		
1 1/4" (51.0 Lbs./Sq. Ft.)		1 5/8" (66.36 Lbs./Sq. Ft.)	
48 x 96	1634		
48 x 120	2042	96 x 192	8494
48 x 144	2450		
48 x 240	4084		
60 x 120	2552	1 3/4" (71.47 Lbs./Sq. Ft.)	
60 x 240	5105		
		48 x 96	2287
72 x 120	3063	48 x 120	2859
72 x 144	3675		
72 x 240	6126	60 x 120	3573
72 x 384	9801	60 x 240	7147
96 x 144	4901	72 x 240	8576
96 x 240	8168		
96 x 288	9801	96 x 192	9148
		96 x 240	11435

Cont'd

STEEL PLATES WEIGHT CHART

Thickness Size in Inches	Billing Weight per Plate Lbs.	Thickness Size in Inches	Billing Weight per Plate Lbs.
2" (81.68 Lbs./Sq. Ft.)		3" (122.5 Lbs./Sq. Ft.)	
48 x 96	2614	48 x 96	3920
48 x 120	3267	48 x 120	4901
		48 x 144	5881
60 x 120	4084	60 x 120	6126
60 x 240	8168		
		72 x 120	7351
72 x 144	5881	72 x 144	8821
72 x 192	7841		
72 x 240	9801	96 x 120	9801
		96 x 144	11761
96 x 144	7841		
96 x 192	10455		
96 x 240	13068		
2¼" (91.89 Lbs./Sq. Ft.)		3¼" (132.78 Lbs./Sq. Ft.)	
48 x 96	2940	96 x 96	8494
		96 x 120	10618
96 x 144	8821		
96 x 192	11761		
2½" (102.1 Lbs./Sq. Ft.)		3½" (142.8 Lbs./Sq. Ft.)	
48 x 96	3267	48 x 96	4574
48 x 120	4084	48 x 120	5717
		60 x 120	7147
72 x 144	7351		
72 x 240	12252	72 x 120	8576
84 x 240	14293	96 x 108	10291
96 x 120	8168	96 x 120	11435
96 x 144	9801		
2¾" (112.3 Lbs./Sq. Ft.)		3¾" (153.14 Lbs./Sq. Ft.)	
60 x 120	5615	48 x 96	4901
96 x 120	8984	72 x 144	11026
96 x 144	10781		

Cont'd

STEEL PLATES WEIGHT CHART

Thickness Size in Inches	Billing Weight per Plate Lbs.	Thickness Size in Inches	Billing Weight per Plate Lbs.
4" (163.35 Lbs./Sq. Ft.)		5½" (224.61 Lbs./Sq. Ft.)	
48 x 96	5227	60 x 120	11231
48 x 120	6534		
48 x 144	7841		
		6" (245.03 Lbs./Sq. Ft.)	
60 x 120	8168	48 x 96	7841
		48 x 120	9801
72 x 120	9801	48 x 144	11761
4¼" (173.56 Lbs./Sq. Ft.)		7" (285.87 Lbs./Sq. Ft.)	
72 x 144	12497	48 x 96	9148
		48 x 120	11435
96 x 96	11108	48 x 144	13722
4½" (183.77 Lbs./Sq. Ft.)		60 x 120	14280
48 x 120	7351		
48 x 144	8821		
		8" (326.71 Lbs./Sq. Ft.)	
60 x 120	9189	48 x 96	10455
		48 x 120	13068
5" (204.19 Lbs./Sq. Ft.)		60 x 120	16335
48 x 96	6534		
48 x 120	8168		
		10" (408.38 Lbs./Sq. Ft.)	
60 x 120	10210	48 x 96	13068

FLOOR PLATES WEIGHT REFERENCE CHART

Algoma 50 Floor Plates

Thickness Size in mm inches ()	Theoretical Weight per Plate Lbs.	Thickness Size in mm inches ()	Theoretical Weight per Plate Lbs.
2 mm (.079) 3.52 lbs./sq.ft.		6 mm (.236) 9.94 lbs./sq.ft.	
36 x 96	84	60 x 144	596
48 x 96	112	60 x 240	994
48 x 120	140	72 x 240	1192
48 x 144	169		
2.8 mm (.110) 4.79 lbs./sq.ft.		8 mm (.315) 13.16 lbs./sq.ft.	
36 x 96	115	48 x 96	421
48 x 96	153	48 x 240	1052
48 x 120	192	60 x 120	658
		60 x 240	1316
		72 x 240	1579
3.2 mm (.126) 5.45 lbs./sq.ft.		10 mm (.394) 16.39 lbs./sq.ft.	
36 x 96	131	48 x 96	524
36 x 120	164	48 x 240	1311
48 x 96	174	60 x 240	1639
48 x 120	218	72 x 240	1967
48 x 144	261		
60 x 120	272		
4.8 mm (.189) 8.02 lbs./sq.ft.		12 mm (.472) 19.58 lbs./sq.ft.	
48 x 96	256	48 x 96	626
48 x 120	320	48 x 240	1566
48 x 240	641	60 x 240	1958
60 x 120	401	72 x 240	2350
60 x 240	802		
6 mm (.236) 9.94 lbs./sq.ft.		<div> THICKNESS IS MEASURED EXCLUSIVE OF PROJECTIONS </div>	
48 x 96	318		
48 x 120	397		
48 x 144	477		
48 x 240	794		

FLATNESS TOLERANCES – RECTANGULAR SHEARED CARBON STEEL PLATES

Flatness denotes the deviation of the top or bottom surface from a horizontal line when the plate is resting on a flat surface. This table shows flatness tolerances when measured in the length and width direction. See notes 1 to 5 inclusive.

Specified Thickness inches	Specified Weights, lbs. per sq. ft.	Flatness tolerances for specified widths, inches			
		To 36, excl.	36 to 48, excl.	48 to 60, excl.	60 to 72, excl.
To ¼, excl.	To 10.2, excl.	9/16	¾	15/16	1¼
¼ to ⅜, excl.	10.2 to 15.3, excl.	½	⅝	¾	15/16
⅜ to ½, excl.	15.3 to 20.4, excl.	½	9/16	⅝	⅝
½ to ¾, excl.	20.4 to 30.6, excl.	7/16	½	9/16	⅝
¾ to 1, excl.	30.6 to 40.8, excl.	7/16	½	9/16	⅝
1 to 2, excl.	40.8 to 81.6, excl.	¾	½	½	9/16
2 to 4, excl.	81.6 to 163.2, excl.	5/16	¾	7/16	½
4 to 6, excl.	163.2 to 244.8, excl.	¾	7/16	½	½

Specified Thickness inches	Specified Weights, lbs. per sq. ft.	Flatness tolerances for specified widths, inches				
		72 to 84, excl.	84 to 96, excl.	96 to 108, excl.	108 to 120, excl.	120 to 144, excl.
To ¼, excl.	To 10.2, excl.	1⅝	1½	1⅝	1¾	1⅞
¼ to ⅜, excl.	10.2 to 15.3, excl.	1⅝	1¼	1⅜	1½	1⅝
⅜ to ½, excl.	15.3 to 20.4, excl.	¾	7/8	1	1⅝	1¼
½ to ¾, excl.	20.4 to 30.6, excl.	⅝	¾	1	1	1⅝
¾ to 1, excl.	30.6 to 40.8, excl.	⅝	⅝	¾	7/8	1
1 to 2, excl.	40.8 to 81.6, excl.	9/16	⅝	⅝	⅝	11/16
2 to 4, excl.	81.6 to 163.2, excl.	½	½	½	9/16	⅝
4 to 6, excl.	163.2 to 244.8, excl.	9/16	9/16	⅝	¾	7/8

- Notes:*
- Flatness Tolerances for Length.* The longer dimension specified is the length, and flatness variation along the length should not exceed the tabular amount for the specified width in plates up to 12 feet in length, or in any 12 feet of longer plates.
 - The flatness variation across the width* should not exceed the tabular amount for the specified width.
 - When the longer dimension is under 36 inches, the variation in flatness along the length and across the width should not exceed ¼ inch in each direction. When the longer dimension is from 36 to 72 inches, incl., the flatness variation should not exceed 75 per cent of the tabular amount for the specified width, but in no case less than ¼ inch.
 - The tolerances given in the above table apply to plates which have a minimum specified tensile strength not over 60,000 psi or compatible chemistry or hardness. For plates specified to a higher minimum tensile strength or compatible chemistry or hardness, the limits given in the table are increased to 1½ times the amounts in the above table.
 - The above table and notes cover the flatness tolerances of circular and sketch plates, based on the maximum dimensions.

FLATNESS TOLERANCES – ALLOY STEEL – HOT ROLLED OR THERMALLY TREATED

Rectangular Sheared Plates, Universal Mill Plates,
and Circular and Sketch Plates

Specified Thickness inches	Specified Weights, lbs. per sq. ft.	Flatness tolerances for specified widths, inches				
		To 36, excl.	36 to 48, excl.	48 to 60, excl.	60 to 72, excl.	72 to 84, excl.
To ¼, excl.	To 10.2, excl.	13/16	1 1/8	1 3/8	1 7/8	2
¼ to ⅜, excl.	10.2 to 15.3, excl.	¾	1 5/16	1 1/8	1 7/8	1 3/4
⅜ to ½, excl.	15.3 to 20.4, excl.	¾	7/8	1 5/16	1 5/16	1 7/8
½ to ¾, excl.	20.4 to 30.6, excl.	5/8	¾	1 3/16	7/8	1
¾ to 1, excl.	30.6 to 40.8, excl.	5/8	¾	7/8	7/8	1 5/16
1 to 2, excl.	40.8 to 81.6, excl.	9/16	5/8	¾	1 3/16	7/8
2 to 4, excl.	81.6 to 163.2, excl.	1/2	9/16	1 1/16	¾	¾
4 to 6, excl.	163.2 to 244.8, excl.	9/16	1 1/16	¾	¾	7/8
6 to 8, excl.	244.8 to 326.4, excl.	5/8	¾	¾	1 5/16	1
8 to 10, excl.	326.4 to 418. , excl.	¾	1 3/16	1 5/16	1	1 1/8
10 to 12, excl.	418. to 489.6, excl.	¾	1 5/16	1 1/8	1 1/4	1 5/16
12 to 15, excl.	489.6 to 612. , excl.	7/8	1	1 3/16	1 5/16	1 3/8

Specified Thickness inches	Specified Weights, lbs. per sq. ft.	Flatness tolerances for specified widths, inches					
		84 to 96, excl.	96 to 108, excl.	108 to 120, excl.	120 to 144, excl.	144 to 168, excl.	168 and Over
To ¼, excl.	To 10.2, excl.	2 1/4	2 3/8	2 5/8	2 3/4	—	—
¼ to ⅜, excl.	10.2 to 15.3, excl.	1 7/8	2	2 1/4	2 3/8	—	—
⅜ to ½, excl.	15.3 to 20.4, excl.	1 5/16	1 1/2	1 5/8	1 7/8	2 3/4	3 1/8
½ to ¾, excl.	20.4 to 30.6, excl.	1 1/8	1 1/4	1 3/8	1 7/8	2 1/4	3
¾ to 1, excl.	30.6 to 40.8, excl.	1	1 1/8	1 1/16	1 1/2	2	2 5/8
1 to 2, excl.	40.8 to 81.6, excl.	1 5/16	1	1	1	1 7/8	2 1/4
2 to 4, excl.	81.6 to 163.2, excl.	¾	¾	7/8	1	1 1/4	1 5/8
4 to 6, excl.	163.2 to 244.8, excl.	7/8	1 5/16	1 1/8	1 1/4	1 1/4	1 1/2
6 to 8, excl.	244.8 to 326.4, excl.	1 1/8	1 1/4	1 5/16	1 1/2	1 1/2	1 1/2
8 to 10, excl.	326.4 to 418. , excl.	1 1/4	1 5/16	1 3/8	1 1/2	1 1/2	1 1/2
10 to 12, excl.	418. to 489.6, excl.	1 3/8	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2
12 to 15, excl.	489.6 to 612. , excl.	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2

Notes: 1. *Flatness Tolerances for Length.* The longer dimension specified is considered the length, and variations from a flat surface along the length should not exceed the tabular amount for the specified width in plates up to 12 feet in length, or in any 12 feet of longer plates.

2. *Flatness Tolerances for Width.* The flatness variation across the width should not exceed the tabular amount for the specified width.

3. When the longer dimension is under 36 inches, the variation should not exceed 3/8 in. When the longer dimension is from 36 to 72 inches inclusive, the variation should not exceed 75 per cent of the tabular amount for the specified width.

4. The above table and notes cover the tolerances for flatness of circular and sketch plates, based on the maximum dimensions of those plates.

Permissible Variations in Width and Length for Sheared Plates 1½ in. and Under in Thickness

Specified Dimensions, in.		Variation over Specified Width and Length* for Thicknesses, in., and Equivalent Weights, lb/ft². Given			
Length	Width	To ¾, excl		¾ to ½, excl	
		To 15.3, excl		15.3 to 25.5, excl	
		Width	Length	Width	Length
To 120, excl	To 60, excl	⅜	½	⅞ ₁₆	⅝
	60 to 84, excl	⅞ ₁₆	⅝	½	⅞ ₁₆
	84 to 108, excl	½	¾	⅝	⅞
	108 and over	⅝	⅞	¾	1
120 to 240, excl	To 60, excl	⅜	¾	½	⅞
	60 to 84, excl	½	¾	⅝	⅞
	84 to 108, excl	⅞ ₁₆	⅞	⅞ ₁₆	⅞ ₁₆
	108 and over	⅝	1	¾	1⅞
240 to 360, excl	To 60, excl	⅜	1	½	1⅞
	60 to 84, excl	½	1	⅝	1⅞
	84 to 108, excl	⅞ ₁₆	1	⅞ ₁₆	1⅞
	108 and over	⅞ ₁₆	1⅞	⅞	1¼
360 to 480, excl	To 60, excl	⅞ ₁₆	1⅞	½	1¼
	60 to 84, excl	½	1¼	⅝	1⅝
	84 to 108, excl	⅞ ₁₆	1¼	¾	1⅝
	108 and over	¾	1⅝	⅞	1½

Specified Dimensions, in.		Variation over Specified Width and Length* for Thicknesses, in., and Equivalent Weights, lb/ft². Given			
Length	Width	¾ to 1, excl		1 to 2, incl†	
		25.5 to 40.8, excl		40.8 to 81.7, incl	
		Width	Length	Width	Length
To 120, excl	To 60, excl	½	¾	⅝	1
	60 to 84, excl	⅝	⅞	¾	1
	84 to 108, excl	¾	1	1	1⅞
	108 and over	⅞	1⅞	1⅞	1¼
120 to 240, excl	To 60, excl	⅝	1	¾	1⅞
	60 to 84, excl	¾	1	⅞	1¼
	84 to 108, excl	⅞ ₁₆	1⅞	1	1¾
	108 and over	⅞	1¼	1⅞	1⅝
240 to 360, excl	To 60, excl	⅝	1¼	¾	1½
	60 to 84, excl	¾	1¼	⅞	1½
	84 to 108, excl	⅞	1⅝	1	1½
	108 and over	1	1⅝	1¼	1¾
360 to 480, excl	To 60, excl	⅝	1⅝	¾	1⅝
	60 to 84, excl	¾	1½	⅞	1⅝
	84 to 108, excl	⅞	1½	1	1⅞
	108 and over	1	1⅝	1¼	1⅞

* Permissible variation under specified width and length, ¼ in.
† Permissible variations in length apply also to Universal Mill plates up to 12 in. in width for thicknesses over 2 to 2½ in. incl. except for alloy steel up to 2 in. thick.