

# LQ-130 AND LQ-140

## VERY HIGH STRENGTH STEELS PLATE STEEL



### Construction Equipment Crane booms



**LQ-130 AND LQ-140** are quenched and tempered, 130 or 140 ksi minimum yield strength, general structural plate product currently available to 5 in. and 2 in. thick respectively. (Refer thicker plates to Cleveland-Cliffs Plate offices).



## LQ-130 AND LQ-140

### Chemical Composition Requirements

(maximums unless a range is shown)

Element	Composition %
Carbon (C)	0.12 – 0.18
Manganese (Mn)	1.55
Phosphorus (P)	0.015
Sulfur (S)*	0.003*
Silicon (Si)	0.15 – 0.55
Molybdenum (Mo)	0.70
Chromium (Cr)	0.70
Nickel (Ni)	1.50
Vanadium (V)	0.08
Niobium (Nb, Cb)	0.04
Boron (B)	0.005

\* Includes FINELINE® calcium treated for sulfide shape control

### Tensile Requirements

	LQ-130	LQ 140
Yield strength (minimum)	130 ksi*	140 ksi
Ultimate tensile strength (minimum)	For information only	
Elongation (minimum)	12%	12%

\* 120 ksi min. for over 2.0 in.

### Charpy V-Notch Impact Properties

Longitudinal @ -40°F	25 ft-lbs. minimum average
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### Size Availability +

	Width	Length
3/16 to 1/2 in. incl.	To 96 in.	To 500 in.
LQ-130: Over 1/2 to 5 in. incl.	To 130 in.	To 540 in.
LQ-140: Over 1/2 to 2 in. incl.	To 130 in.	To 540 in.

+ Refer other sizes to Cleveland-Cliffs Plate offices.

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## Flatness

This product will be supplied to 1/2 the permissible variation in the ASTM A6 Table A1.14 for high strength steels.

## Formability

Cold forming should be performed at shop temperatures over +60°F using practices that include grinding of plate edges, conditioning of dies, use of adequate lubrication and applying the load in a smooth, steady manner. Bend punch radius to plate thickness ratio should be greater

than 3 for bending perpendicular to the direction of rolling and 4 for bending parallel to the rolling direction for plates up to 0.5 in. thick. Check with Cleveland-Cliffs Plate offices for guidelines on thicker plate.

## Welding Guidelines for LQ-130 and LQ-140

LQ-130 and LQ-140 may be welded using any conventional welding process provided low hydrogen welding practice is followed (weld metal diffusible hydrogen level  $\leq 5$  ml/100g,  $\leq 3$  ml/100g preferred). All weld edges should be clean and free from rust, oil, grease, etc. with proper joint fit-up. Specific recommendations are as follows:

The information given above is based on general welding metallurgy principles, AWS D1.1:2004 (Annex XI, Tables XI-1 and XI-2), and available data on similar steels. It is subject to revision without notice and is intended only as a starting guideline.

### THERMAL LIMITATIONS

#### SUGGESTED MAXIMUM HEAT INPUT

Section Thickness Range		Welding Process	
(in)	(mm)	SMAW	GMAW/FCAW
3/8 – 5/8	9.5 – 15.9	40 kJ/in	35 kJ/in
5/8 – 7/8	15.9 – 22.2	45 kJ/in	40 kJ/in
7/8 – 1-3/8	22.2 – 34.9	45 kJ/in	45 kJ/in
1-3/8 - 3	34.9 - 101	50 kJ/in	50 kJ/in

### CONSUMABLES

Conservative approach – Use undermatching consumables with the lowest strength electrode permitted by design. Use softer electrodes for the root pass and higher strength electrodes for filler passes.

Weld matched to plate strength – Employ matching consumables although availability of suitable electrodes is limited. This approach carries increased risk of problems with cracking, distortion, and higher residual stresses. Fabricator should be aware that weld metal strength and toughness would vary with consumable supplier and product. Qualification of the joint and process is strongly recommended.

#### SUGGESTED MINIMUM PREHEAT/INTERPASS TEMPERATURE

Section Thickness Range		Minimum Preheat/Interpass Temperature*	
(in)	(mm)	(°F)	( C )
$\leq 5/8$	$\leq 15.9$	75 - 150	25 - 65
5/8 – 7/8	15.9 - 22.2	125 - 200	50 - 95
7/8 – 1-3/8	22.2 – 34.9	200 - 275	95 - 135
$> 1-3/8$	$> 34.9$	225 - 300	105 - 150

\* Measure preheat/interpass temperature approximately 3" from the joint face.

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## Process/Governing Standard

	<b>SMAW/ AWS 5.5</b>	<b>SAW/ AWS 5.23</b>	<b>GMAW/ AWS 5.28</b>	<b>FCAW/ AWS 5.29</b>
	(140 ksi)*	(140 ksi)*	(140 ksi)*	(140 ksi)*
	(130 ksi)*	(130 ksi)*	(130 ksi)*	(130 ksi)*
Consumable	E 12018	F12A4-EX	E110S-X	E 12XT-X
	E 11018	F11A4-EX	E100S-X	E 11XT-X
		F10A4-EX		E 10XT-X

\* Note: Although consumables delivering tensile strengths exceeding 120 ksi are not generally included in these AWS specifications, some are available. Contact your welding supplier or Cleveland-Cliffs Plate offices for further details.

It is important to note this grade of steel may be susceptible to cracking in the heat-affected zone of welds during post-weld heat treatment (stress relief). Therefore, Cleveland-Cliffs Plate metallurgists recommend careful consideration be given to this phenomenon by competent welding engineers before stress relieving is applied to weldments of this grade. Also, it is not recommended for service at temperatures lower than -50°F or higher than 800°F.

## Information

Contact John Kross at 610.383.2306 or [John.Kross@clevelandcliffs.com](mailto:John.Kross@clevelandcliffs.com)

### About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials and direct reduced iron to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest steel supplier to the automotive industry in North America. Headquartered in Cleveland, Ohio, Cleveland-Cliffs employs approximately 25,000 people across its mining, steel and downstream manufacturing operations in the United States and Canada.



### CLEVELAND-CLIFFS INC.

200 Public Square  
Suite 3300  
Cleveland, OH 44114-2315  
844.STEEL99 | 844.783.3599  
[clevelandcliffs.com](http://clevelandcliffs.com)

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