

Data sheet: A8.1

## Hot rolled strip for line pipe (sweet service)

### Steel Strip for API 5L Line Pipe

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#### General description

ArcelorMittal South Africa produces and markets steel strip for the production of line pipe in accordance with the American Petroleum Institute (API) Specification 5L (44<sup>th</sup> edition 2008). This specification provides a standard for the manufacturing and supply of line pipe for the conveyance of oil, water and gas in the oil, and gas for sweet (i.e. 'non-sour') service. This data sheet describes the materials suitable for API 5L as produced by ArcelorMittal South Africa.

The following steel specifications suitable for API 5L line pipe are available:

- API 5L L245/Gr B PSL1
- API 5L L290/X42 PSL1
- API 5L L290M/X42M PSL2
- API 5L L290/X42 PSL1
- API 5L L360M/X52M PSL2
- API 5L L390/X56 PSL 1 - (acceptable on enquiry only)
- API 5L L415/X60 PSL 1 - (acceptable on enquiry only)
- API 5L L450/X65 PSL 1 - (acceptable on enquiry only)

(Other qualities on enquiry)

#### Steel making

Steel for the production of line pipe is manufactured through either the electric arc furnace (EAF) or basic oxygen furnace (BOF) route and is continuously cast. Steel for pipes operating under non-sour conditions is normally restricted to a maximum sulphur content of 0,010%. For pipe applications where high toughness and improved cleanliness is required, the steel may be calcium treated for inclusion shape modification. Casting parameters are carefully controlled for homogeneity of composition, uniformity of structure and improved surface quality.

The API 5L grades are micro-alloyed with niobium and/or vanadium for grain refinement and precipitation strengthening. These high strength low alloy (HSLA) grades offer higher toughness and their low carbon equivalent content improved weldability and formability.

The API 5L grades are normally fully killed and aluminium treated to ensure a fine grain steel.

#### Hot rolling

The steel is thermo-mechanically controlled rolled on a seven stand continuous hot strip mill. Parameters such as reheat, finishing and coiling temperature are closely monitored and controlled to achieve the optimum combination of mechanical properties. Other parameters critically controlled during hot rolling include strip profile, dimensions, shape and surface.

For further information, contact:

ArcelorMittal South Africa Limited, PO Box 2, Vanderbijlpark 1900. Toll free number 0800 005043

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### Chemical composition

The API 5L specification sets the chemical composition limits very wide, offering both the steel producer and pipe manufacturer scope to apply specific manufacturing techniques to obtain the desired mechanical properties in the final product.

Table 1. Chemical composition (ladle analysis, percent) as specified in API 5L

Grade	C max	Mn max	P max	S max	Si Max	Nb	V	Ti	CE <sub>IW</sub> <sup>4</sup>	CE <sub>Pcm</sub> <sup>5</sup>
L245/Gr B PSL1	0,26	1,20	0,030	0,030		2	2	2		
L290/X42 PSL1	0,26	1,30	0,030	0,030		2	2	2		
L290M/X42M PSL2	0,22	1,30	0,025	0,015	0,45	0,05	0,05	0,05	0,43	0,25
L360/X52 PSL1	0,26	1,40	0,030	0,030		2	2	2		
L360M/X52M PSL2	0,22	1,40	0,025	0,015	0,45	0,05	0,05	0,05	0,43	0,25
L390/X56 PSL1	0,26	1,40	0,030	0,030		2	2	2		
L415/X60 PSL1	0,26	1,40	0,030	0,030		2	2	2		
L450/X65 PSL1	0,26	1,45	0,030	0,030		2	2	2		

#### Notes:

1. For each reduction of 0,01% below the specified maximum concentration for carbon, an increase of 0,05% above the specified maximum concentration for manganese is permissible up to a maximum of 1,65% for grades L245/BX42, L320/X46 and L360/X52 and to a maximum of 1,75% for grades L390/X56, L415/X60 and L450/65.
2. The sum of the Nb, V and Ti concentrations shall be ≤ 0,15%
3. Unless otherwise agreed, 0,50% max. Cu, 0,50% max. Ni, 0,50% max. Cr and 0,15% max. Mo
4. Based on product analysis. CE<sub>IW</sub> limits apply if %C > 0,12%
5. Based on product analysis. CE<sub>Pcm</sub> limits apply if %C ≤ 0,12%

### Mechanical properties

ArcelorMittal South Africa supplies strip with mechanical properties conforming to those specified for the final product. The onus rests with the pipe manufacturer to prove that the pipe conforms to the specification requirements after forming, welding and heat treatment. The mechanical property requirements indicated in the table below apply to the formed pipe.

Any supplementary requirements should be negotiated prior to ordering.

Table 3. Mechanical properties as specified by API 5L

Grade	Yield strength (MPa)	Tensile strength (MPa)	YS/TS Ratio Maximum
L245/Gr B PSL1	245 min	415 min	-
L290/X42 PSL1	290 min	415 min	-
L290M/X42M PSL2	290 - 495	415 - 760	0,93
L360/X52PSL1	360 min	460 min	-
L360M/X52MPSL2	360 - 530	460 - 760	0,93
L390/X56 PSL1	390 min	490 min	-
L415/X60 PSL1	415 min	520 min	-
L450/X65 PSL1	450 min	535 min	-

#### Note:

1. The minimum elongation(e) is determined by the following formula:  $e = 1\ 940 \frac{A}{A_0}^{0,2}$

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Where

e = minimum elongation in 200 mm gauge length

A = cross sectional area of tensile test specimen in square millimetres

U = specified minimum tensile strength in megapascals

### Dimensions

For more detail on available dimensions, refer to the data sheet: Hot Strip Mill Product Dimensions (file reference A1.1).

Table 4. Available dimensions

Grade	Thickness (mm)																
	4	4.2	4.4	4.6	4.8	5	6	7	8	9	10	11	12	13	14	15	16
Grade B	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
X42 PSL1	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800	1800
X42 PSL2	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1800	1800			
X52 PSL1	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1800	1800	1680	1570	1470
X52 PSL2	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1800	1500			
X56 PSL1	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1670	1540	1400		
X56 PSL2	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1670	1540			
X60 PSL1	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1500	1400			
X60 PSL2	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1800	1500	1400			
X65 PSL1	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1640	1500	1390			
X65 PSL2	1645	1670	1720	1730	1780	1800	1800	1800	1800	1800	1800	1640	1500				

Notes:

1. Widths indicated are maximum mill edge widths. For side trimmed material please subtract 50 mm from these values.
2. For thicknesses exceeding 6,0 mm, material is supplied mill edge only.
3. Minimum width 920 mm.
4. Other dimensions on enquiry.

### Dimensional tolerances

API 5L specifies dimensional tolerances on finished pipe only: therefore ArcelorMittal South Africa produces steel grades to API 5L to tolerances as specified by ASTM A568M / A635M

### Edge Condition

Please note that surface quality and freedom from edger lines on the first 20mm wide on the edges of coils cannot be guaranteed.

### Weldability

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The API 5L range of line pipe steels is readily weldable by means of the usual metal arc processes as well as resistance welding process. The most widely used processes are longitudinal high frequency resistance welding and spiral submerged arc welding. With regard to arc welding processes, acceptable results can be obtained if specific attention is given to ensure:

- a. Correct wire and flux combinations to ensure matching tensile strength.
- b. Acceptable welding parameters such as heat input and preheat (where applicable).

When welding hot rolled strip, reference should be made to BS 5135: 1984 'Specification for the arc welding of carbon and carbon manganese steels'.

Resistance welding processes require sufficient fusion, good weld bead profile and adequate heat treatment of the weld area to ensure acceptable results.

The carbon equivalent value should be calculated from the values of the chemical composition indicated on the test certificates for the strip concerned.

The formula to be used is: 
$$CE = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

### Certification

All material described in this data sheet is supplied with test and analysis certificates.

### Supply conditions

All material described in this data sheet is supplied in terms of price lists 110, 120 and ArcelorMittal South Africa's General Conditions of Sale.

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