About Jindal Steel & Power Ltd

Jindal Steel and Power Limited (JSPL) is one of India’s primary & integrated steel producers with a significant presence in sectors like mining, power generation and infrastructure. With an annual turnover of over US$ 3.5 billion, JSPL is a part of the US$ 18 billion diversified O. P. Jindal Group and is consistently tapping new opportunities by increasing production capacity, diversifying investments, and leveraging its core capabilities to venture into new businesses. The company has committed investments exceeding US$ 30 billion in the future and has several business initiatives running simultaneously across continents.

From the widest flat products to a whole range of long products, JSPL has a product portfolio that caters to the varied needs in the steel market. The company also has the distinction of producing the world’s longest 121 meter rails and large size parallel flange beams for the first time in India.

JSPL operates the largest coal-based sponge iron plant in the world and has an installed capacity of 3 MTPA of crude steel at Raigarh, Chhattisgarh.

The company has an installed capacity of:

- 0.8 MTPA Rail and Universal Beam Mill at Raigarh, Chhattisgarh
- 0.6 MTPA Wire Rod Mill and 1.0 MTPA TMT Rebar mill at Patratu, Jharkhand
- 0.6 MTPA Medium and Light Structural Mill and 1.0 MTPA Plate Mill at Raigarh, Chhattisgarh and
- 1.5 MTPA Plate Mill producing up to 5 meter wide plates at Angul, Odisha

The company aims for a fast-paced growth so as to contribute substantially to India’s long term prosperity.

An enterprising spirit and the ability to discern future trends have been the driving force behind the company’s remarkable growth story. The company has scaled new heights with the combined force of innovation, adaptation of new technologies and the collective skills of its 15,000 strong, committed workforce.
The newly commissioned plate mill from Siemens VAI, at Angul, Odisha produces plates up to a width of 5 meter. It is equipped with latest equipments and technologies like TMCR, MULPIC cooling, On-line & Off-line normalizing, Quenching, Tempering, Shearing Units & On-line ultrasonic flaw detection system.

The Angul Plate Mill features the world class processes and ultra-modern facilities like:

- A state-of-the-art plate mill with total production capacity of 1.5MTPA with steel refining and rolling processes as exclusive to this mill
- Hydraulic Automatic Gauge Control, Continuous Variable Crown, Anti Bending System, Plan View Rolling & Online Gamma Thickness Gauge
- Electric Arc Furnace, Ladle Refining Furnace, Vacuum Degassing
- 300mm Vertical Caster with Soft reduction in Six segments followed by Pile cooling
- 4HI Reversible Powerful Mill with 10,000 tonnes of roll separating force
- MULPIC (Accelerated cooling and Direct Quenching)
- 100% Full body and Edges, Online Ultrasonic testing
- Furnace Normalized, Austenitized, Quenched & Tempered, Thermo Mechanical Control Processed
- Widest dimensional range

JSPL adheres to stringent international standards and the steel grades are manufactured under various specifications like IS, ASTM, EN, JIS, API etc. The Angul Plate Mill is fully equipped with inspection facilities right from the steel making stage to finished plate stage.

It is also equipped with the walking beam type reheating furnace which ensures excellent surface quality and high pressure de-scaler. The slabs in this furnace are re-heated to a temperature ranging from 1100-1250°C based on grades and then rolled in a 4 Hi-reversing Mill to produce plates with excellent surface quality.

The Angul mill is also equipped with Level 2 Automation; Thickness and Width controlling system coupled with Heavy duty Leveller which assures close dimensional tolerances and an increased level of flatness control during plate production.

Our Plate Mill is capable of producing value added grades and products meeting all specialized and latest industry requirements.

<table>
<thead>
<tr>
<th>CONTINUOUS CASTER SLAB</th>
<th>FINISH PLATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thickness - 150 mm - 300 mm</td>
<td>Thickness - 5 mm - 150 mm</td>
</tr>
<tr>
<td>Width - 1000 mm - 2300 mm</td>
<td>Width - 900 mm - 5000 mm</td>
</tr>
<tr>
<td>Length - 2600 mm - 4800 mm</td>
<td>Length - 3000 mm - 24000 mm</td>
</tr>
<tr>
<td>Weight - 4.6 - 30 MT (Max.)</td>
<td>Weight - 30 MT (Max.)</td>
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</tbody>
</table>
What makes our Angul Plate Mill Unique

Features
- Scale Free Heat Treated Plates
- Online Direct Quenched Plates
- Ultrasonic Testing Machine online top down 102 probes
- Residual Stress Free Plates
- Customized Plates: Grades, Thickness, Width, Length
- Ultra Wide 5000mm Plates
- ½ ASTM Tolerances
- Metallurgical Process: DRI, EAF, LF, Vacuum Degassing, Vertical mould continuous Caster with Soft Reduction, Plate Rolling, Heat Treatment
- TMCP, MULPIC (ACC/DQ)
- Product and Strength Range: Thickness-5-150mm, Width- 900-5000mm Length- 3000-24000mm, YS-235-1800 Mpa
- Advanced OCTOPUS testing software

Technology Used
- 5 Meter Wide Plate Mill : M/s Siemens VAI UK
- 280 MT/hr Reheating Furnace: M/s Fives Stein France
- Roll Shop: M/s TENOVA Pomini Italy
- Online Ultrasonic Testing M/c : M/s G E Inspection Technologies Germany
- Detailed Engineering for Civil, Structural & Infrastructure by: M/s MECON India
- Robotic Universal Testing M/c: M/s Zwick Roell, Germany
- Impact Testing M/c & Hardness Testers: M/s Zwick Roell, Germany

Capacity
- Phase I - 1.5 Million Tonnes per annum
- Phase II - 2.0 Million Tonnes per annum
- Width of Plate to be Rolled : 900mm to 5000mm
- Maximum despatchable length - 24 Meters
- Thickness of plate - 5 mm to 150mm

Why JSPL Plates are Better than Others

From the raw material to the final product delivered to the customers, JSPL assures consistent quality at every step. Its strong quality assurance and control systems are equipped with state-of-the-art modern testing facilities and conform to stringent quality standards. Ultra clean steel owing to in-house iron ore, coal mines, better grain orientation and strength/structural integrity for plates & sheets on account of cross rolling.

Wide Application
High end special steel grade plates such as High Strength Low Alloy (HSLA), Boiler & Pressure Vessel and API, are used in all structures, Boilers, Line Pipes, Automobiles, Ship Building, Wind Mills, Yellow Goods, Wagon Manufacturing, Defense & other Engineering applications.

Leading Technology
- Automatic gauge control
- Work roll bending and Shifting equipment
- Smart crown facility
- Plan view rolling
- Profile and flatness gauges
- Thermo-mechanical controlled rolling & MULPIC (Multi purpose interrupted cooling) process
- Double side trim shear
- Heat treatment facility
- On-line Ultrasonic flaw detection system

Benefits
- Accurate dimensions
- Increases profile and flatness control range
- Better flatness
- Proper cross section and shape to ensure plate rectangularity
- Ensuring premium quality in plates
- For producing high-tensile steel plates with high and good weldability for all major structural applications.
- For trimming plates with tighter tolerances
- Center sitting
- Sampling & cut to length plates
- For normalizing, austenitising, quenching and tempering
- Automatic inspection and evaluation of the full body of the plates

Compliance with Standards/ Customer Requirements

With strict adherence to various national and international standards/specifications like EN, DNV, BS, ASTM, API, JIS, ABS, IS etc; JSPL Plate Mill is capable of producing value added plate products to meet critical and the latest industry requirements.
Process Flow

- DRI
- Electric Arc Furnace
- Slabs Yard
- Walking Beam Reheating Furnace
- Hot Paint Marker
- High Pressure Descaling
- Inspection Bed (Plate Turnover Device)
- Online Ultrasonic Testing
- Cooling Bed 1 (Thickness <= 50 mm)
- Cooling Bed 3 (Thickness >50 mm)
- Trolley Mounted UT Machine
- Inspection Bed
- Gas Cutting
- Double side trim shear & Slitting Shear
- Painting & Stamping
- Divide shear
- Paint Marking & Stamping
- Hot Leveller
- MULPIC
- Vacuum Degassing/RH Degassing
- Slab Casting
- Ladle Refining Furnace
- 4 Hi Reversing Mill
- Sampling & Testing
- Packing & Dispatch
- Gas Cutting
- Double side trim shear & Slitting Shear
- Painting & Stamping
- Hot Leveller
- MULPIC

*Offline Heat treatment facilities available: Normalising, Quenching & Tempering*
Process Flow of Angul Plate Mill

Digital Reheating Furnace
The double row walking beam type digital furnace with a capacity of 280MT/hr is equipped with side burners having an independent on/off control for each burner, reducing the excess scale formation. The furnace is split into different control zones for uniform heat transfer through homogeneous heat & elimination of hot spots. The world’s longest furnace 57 meter provided by Fives Stein further enhances soaking & improves the quality of heavy plates.

Rolling Mill
The 4 Hi reversible rolling mill along with cross rolling facilities has a roll separating force of 10,000 tonnes. This force helps in high shape factor rolling and thus reduces the internal discontinuities. The rolling mill is supported by high speed automatic gauge control, work roll anti bending and shifting equipment, smart crown facility, plan view rolling, profile & flatness gauges.

Thermo-Mechanical Controlled Rolling and Accelerated Cooling
The thermo mechanical control process is a new generation rolling process for producing fine grain steel by rolling the steel plates in re-crystallization and non-recrystallization region of austenite and for some applications in the dual phase region of austenite & ferrite and then using high rate (accelerated) cooling. Apart from the latest rolling, the mill also has Multi Purpose Interrupted Cooling (MULPIC) with features of Accelerated Cooling, Direct Quenching (DQ) & Quenching with Self Tempering (QST) facilities. A wide range of alloy design can be adapted for devising the rolling & cooling processes for achieving the desired properties. The combination of controlled rolling and accelerated cooling helps in producing high tensile steel plates with lower carbon equivalent with targeted properties, microstructures and excellent surface finish.

Hot Leveller
The hot leveller, with a capacity of 4,000 tonnes, provides excellent flatness and residual stress-free plates. Residual stress free plates are achieved by performing bending reversals, wherein, the plates are passed through a number of rolls separated by distance. The levelling force and the roll gap setting through hydraulic gauge control are calculated based on the strength, thickness, temperature etc. A plastification ratio of up to 80% can be offered depending on the tensile strength and thickness. The unit has automatic gauge control and shape system to ensure a high level of flatness. Residual stress free plates can be produced with most powerful leveller with a capacity of levelling heavy plates up to 100mm thickness.

Shearing Units
The online shearing units in the mill can shear plates of up to 50 mm thickness. The mill is equipped with heavy duty shear for plate shearing. With the help of double side trim shear, plates are supplied in trimmed and ready-to-use condition with tighter tolerance. Slitting shear on the other hand is used for central slitting where as dividing shear helps in sampling and final cut to length of plates.

Ultrasonic Testing
The ultrasonic testing unit is on-line test equipment supplied by GE for automatic inspection and evaluation of the full body of the plates. The 102 probes ensure accurate examination of all flaws. As a result, on-line inspection of up to 50 mm covering 100% of the plate body and edges is done. Indications are recorded and evaluated to ensure precise monitoring of the internal quality of plates. The accuracy of this machine is such that a flat bottom hole of 2 mm diameter can be detected which supersedes any international standards so far in the Ultrasonic flaw detection. For thickness beyond 50mm, Ultrasonic testing shall be performed through trolley mounted multiprobe testing machine.

Heat Treatment
The mill is equipped with heat treatment facility with normalizing, austenising, quenching and tempering furnaces for achieving the desired texture of the steel plates. The plates are shot blasted before heat treatment and an inert atmosphere is maintained in the furnaces with indirect radiant type heating ensuring no scale formation on the surface of the plate.

Marking and Traceability
Equipped with Hot paint marker, Cold paint marking & Stamper in impact unique and permanent identification. This ensures traceability right from the heat making stage to the finished product.
The plate mill is a metallurgical tool that enables us to produce a wide range of high-quality plate products using different rolling techniques & heat treatment processes. Depending on the application, rolling techniques like As-Rolled, Normalized Rolled, Thermo-Mechanical Controlled process are adopted. These plates can further be processed in heat treatment (Normalizing and Quenching & Tempering) for improving the mechanical properties suitable for the applications. Figure 1 shows the metallurgical principles followed for producing different range of plate products.

As Rolled

As rolled is a rolling procedure in which the final deformation is carried out in the austenitic region. General grades of steel plates are processed using this technique. With the advent of high-powered mills, even the as-rolled products offer good properties.

Normalized Rolled

Normalized rolling is a rolling procedure in which the final deformation is carried out above the Ar3, i.e., in the austenitic region equivalent to the normalizing temperature range. Normalized Rolled plate products are used as a substitute for Furnace Normalized steel plates. The normalized rolled products offer similar properties that of furnace normalized plates with improved mechanical properties like ductility, impact toughness etc. The mechanical properties are further retained even after normalizing of these plates.

Thermo-Mechanical Control Process

Thermo mechanical control process (TMCP) is a new generation rolling process for producing fine-grain steel by rolling the steel plates in recrystallization and non-recrystallization region of austenite and for some applications in the dual phase region of austenite & ferrite and then using high rate (accelerated) cooling. A wide range of TMCP plates can be processed by controlling the rolling and the cooling strategies like air cooling & accelerated cooling. The steel slabs are first homogenized in the reheating furnace for dissolution of micro-alloys and to form a homogenized coarse austenite with a defined drop-out temperature.

The rolling is split into two phases, one in the recrystallized austenite and another in the non-recrystallized austenite. In between the two phases the intermediate plate stock is allowed to oscillate in the roller table prior to achieving the recrystallization stop temperature. The final deformation & rolling sequences are given in the non-recrystallized phase for achieving favorable properties. The thermo-mechanical rolling is followed with accelerated cooling or air cooling depending on the service property requirements. TMCP plate helps in achieving high strength, high toughness with lower carbon equivalent.

Thermo-Mechanical Controlled Rolling with Direct Quenching & Self Tempering

A combination of thermo-mechanical controlled rolling and a very high rate of cooling is known as direct quenching. Direct quenching is an online cooling technique (MULPIC) that helps in achieving very high cooling rates to substitute quenched and tempered steel plates.

Depending on critical applications, the unit also has advanced mathematical models for performing quenching as well as self-tempering. The self-tempering helps in improving ductility and impact toughness.

Furnace Normalized

Furnace Normalizing is a heat treatment procedure adopted to improve the mechanical properties of rolled steel plates. The principle of furnace normalizing is heating the steel plates above Ar3 temperature (Approx 910°C), soaking at that temperature and then allowing it to cool in still air. This process helps in reducing the internal stresses, the microstructural banding, and further helps in refining the grains to produce fine grains and homogeneous microstructures. The normalized plates offer improved ductility, fine-grained microstructures, and excellent impact toughness. The process is carried out in a closed roller hearth furnace with advanced temperature controls for thinner plates and in baffle-hearth furnace for thicker plates.

Quenching (Hardening) and Tempering

Quenching is a heat treatment process of heating the steel plates above Ar3 (Approx 910°C), soaking for a stipulated duration at a very high rate of cooling. The quenched steel plates are very hard, low on ductility & toughness. The steel plates are further heat treated in a furnace in a wide range of temperature viz. 150°C to 700°C to produce steel plates with desired properties. The tempering is done to improve the ductility, impact toughness and achieving desired hardness.
JSPL Heavy Plates are finding wide application across verticals due to its ultra wide range and grades produced using state-of-the-art technology.

Applications

- High strength and toughness
- Good weldability
- Corrosion and fatigue resistance
- Tight dimensional tolerances

Grades

- IS 2062 E250 to E450
- EN 10025 S235 to S450
- ASTM A36, A283/285, A588
- With strict adherence to various national and international standards and specifications like IS, EN, DNV, BS, ASTM, JIS, LRS, ABS etc., JSPL Plate Mill is capable to produce value added plate products to meet specialized and latest industrial requirements.

Dimensions

- Plates Thickness: 5 mm - 150 mm
- Width: 900 mm - 5000 mm
- Length: 3000 mm - 24000 mm
- Max. weight: 30 MT per plate
- *Dimensional Tolerances as per relevant standards and customized specification

Mechanical Properties

- JSPL manufactures plates for bridges, dams, civil structures and for industrial fabrication work

Delivery Conditions

- As rolled
- Normalised rolled
- Thermo-mechanically controlled process
- Quenched and Tempered

Construction / General Engineering
JSPL manufactures hot rolled plates and coils for the ship building industry which can endure adverse loading conditions, face corrosive environment and low temperature conditions to give the required mechanical properties of:

- High strength
- Low temperature toughness
- High corrosion resistance
- Excellent fatigue properties
- Tight dimensional tolerances
- Excellent weldability with Low carbon equivalent

**Dimensions**

- Thickness: 5 mm - 90 mm
- Width: 900 mm - 5000 mm
- Length: 3000 mm - 24000 mm
- Max. Weight: 30 MT per plate

*Dimensional Tolerances as per relevant standards / customized specification

**Delivery Conditions**

- As rolled
- Normalised rolled
- Thermo-mechanically controlled rolled
- Furnace Normalised
- Quenched and Tempered
- Reference Standards: ASTM, IRS, ABS, DNV, GL, NKK, LR, BV etc.

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JSPL manufactures plates for windmills subjected to high wind speeds and buckling loads due to blades rotation.

**Mechanical Properties**

- High strength and toughness
- Good weldability, formability
- Corrosion and fatigue resistance
- Weld bead bend test on demand
- Through thickness properties.

**Applications**

- Tower
- Supporting structure for generator

**Grades**

- EN 10025 S355 JR/JO/J2/K2, EN 10025 460 NL/ML, EN 10025 690 QL

**Dimensions**

- Thickness: 5 mm - 80 mm
- Width: 900 mm - 5000 mm
- Length: 6000 mm - 24000 mm
- Weight: 30 MT per plate

*Dimensional Tolerances as per relevant standards

**Delivery Conditions**

- As rolled
- Normalised
- Thermo-mechanically controlled
- Quenched and Tempered
JSPL manufactures hot rolled plates as per international standards especially API grade steel for making line pipes for transportation of oil, gas and for offshore applications.

**Mechanical Properties**
- High strength and toughness
- Low temperature toughness
- Corrosion and fatigue resistance
- Wear and abrasion resistance
- Tight dimensional tolerances

**Applications**
- Offshore Structures
- Oil and Gas Line Pipes

**Grades**
- EN10225 S355+N, EN10225 S355+M, EN10225 S3420+M, EN10225 S460+M
- API 2H-S02, API 2W-S02, API 2W-60

**Dimensions**
- Thickness: 5 mm - 100 mm
- Width: 1500 mm - 5000 mm
- Length: 3000 mm - 24000 mm
- Max. weight: 30 MT per plate

*Dimensional Tolerances as per relevant standards / customized Impact tested & Stringent UT as per requirements

**Delivery Conditions**
- Thermo mechanically controlled process
- Normalised
- Quenched and Tempered
- Through thickness test (Z-Test)
- Drop weight tear test (DWTT) and CTOD test
- Impact tested & Stringent UT as per requirements

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**Line Pipes and Offshore Platforms**

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**Mechanical Properties**
- High strength and toughness
- Low temperature toughness
- Corrosion and fatigue resistance
- Wear and abrasion resistance
- Tight dimensional tolerances

**Applications**
- Offshore Structures
- Oil and Gas Line Pipes

**Grades**
- EN10225 S355+N, EN10225 S355+M, EN10225 S3420+M, EN10225 S460+M
- API 2H-S02, API 2W-S02, API 2W-60

**Dimensions**
- Thickness: 5 mm - 100 mm
- Width: 1500 mm - 5000 mm
- Length: 3000 mm - 24000 mm
- Max. weight: 30 MT per plate

*Dimensional Tolerances as per relevant standards / customized Impact tested & Stringent UT as per requirements

**Delivery Conditions**
- Thermo mechanically controlled process
- Normalised
- Quenched and Tempered
- Through thickness test (Z-Test)
- Drop weight tear test (DWTT) and CTOD test
- Impact tested & Stringent UT as per requirements

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**Inspection & Testing Facility**
JSPL assures its customers of superior quality plates. Rigorous quality assurance plan and state-of-the-art testing facility ensures compliance to all national and international specifications.

Our Laboratory and Testing Facilities are equipped with:
- Robotic Universal Testing Machine 1200kN
- Automatic Impact Testing Machine 750J
- 1000kN Capacity Bend Testing Machine
- Drop Weight Tear Testing (DWTT-100,000 J capacity)
- Multi Probe UT Scanning Device
- Metallurgical Microscope & Image Analyser
- HIC/NACE Testing Facilities
- Simulation Furnace
- Vicker and Rockwell Hardness Testing Machine
- Spectrometer
- Through Thickness Testing (Z-Test)
- Weld Bead Bend Test

Mechanical testing such as Tensile test, Impact test, Bend test, Hardness test, Chemical analysis, Microstructure examination/Grain Size determination are done in accordance with the standard specifications as per order. JSPL produces steel plates under proper metallurgical quality control and product inspection at each stage.
Our Plate-cum-Coil Mill at Raigarh (Chattisgarh) produces plates up to 3500mm wide and coils up to 2500 mm wide in various steel grades as per Indian and International standards. JSPL Plates & Coils are of premium quality in terms of dimensional adherence & internal soundness owing to its clean raw material, sound steel refining facilities and an efficient rolling mill. JSPL produces plates and coils complying to IS 2062 specifications up to E450 grade besides a wide range of international standards and steel grades as per EN, DIN, JIS, ASTM, API etc. The mill is approved by various certifying agencies such as LRS, DNV, ABS, GL, BV, IRS and NKK for shipbuilding steel; AD2000, PED, LR and IBR for boiler quality and CE marking for export. Beside these this mill is also accredited with - ISO 9001:2008, ISO 14001:2004, OHSAS 18001 and NABL certification for chemical and mechanical lab.

Product Dimensions

<table>
<thead>
<tr>
<th>DISCRETE PLATES</th>
<th>HOT ROLLED COILS</th>
</tr>
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<tbody>
<tr>
<td>Thickness: 5 mm - 120 mm</td>
<td>Thickness: 5 mm-25 mm</td>
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<tr>
<td>Width: 1500 mm - 3500 mm</td>
<td>Width: 1500 mm-2500 mm</td>
</tr>
<tr>
<td>Length: 3000 mm - 13500 mm</td>
<td>Coil ID/OD: 700 mm/2000 mm</td>
</tr>
<tr>
<td>Weight: 24 MT (Max.)</td>
<td>Coil Weight: 25 MT (Max.)</td>
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</tbody>
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<table>
<thead>
<tr>
<th>FURNACE NORMALISED/ONLINE NORMALISED PLATES</th>
<th>CUT TO LENGTH PLATES</th>
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<tbody>
<tr>
<td>Thickness: 5 to 80 mm</td>
<td>Thickness: 5 mm-25 mm</td>
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<tr>
<td>Width: 1500 mm-2500 mm</td>
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</tr>
<tr>
<td>Length: 6000 mm-12500 mm</td>
<td>Length: 3000 mm - 13500 mm</td>
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</tbody>
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Grades

Family of grades produced

- Low strength plain carbon, standard structural and boiler steel
- High strength plain carbon, solution hardened steel
- Precipitation hardened HSLA steel
- Control-rolled “Line Pipe” grade steel
- Corrosion/Heat resistant steel
- Low alloy steel
- Cu bearing grades