Spirally welded steel pipes
ArcelorMittal is the world’s number one steel company, present in more than 60 countries. It has led the consolidation of the world steel industry and today ranks as the only truly global steelmaker. ArcelorMittal is the leader in all major global markets, including automotive, construction, household appliances and packaging. The Group leads in R&D and technology, holds sizeable captive supplies of raw materials and operates extensive distribution networks.

Its industrial presence in Europe, Asia, Africa and America gives the Group exposure to all the key steel markets, from emerging to mature. ArcelorMittal will be looking to develop positions in the high-growth Chinese and Indian markets.

ArcelorMittal is listed on the stock-exchanges of Paris, Amsterdam, New York, Brussels, Luxembourg and on the Spanish stock-exchanges of Barcelona, Bilbao, Madrid and Valencia.

Projects Europe
Projects Europe offers complete and customized steel solutions serving three markets:
- Foundation Solutions
- Projects Oil & Gas
- Solar Projects

Projects Europe can be involved from the early stage with an advising role towards the investor, ensuring the best and most efficient steel solution from planning till the actual construction. Projects Europe is your steel ally who goes beyond.

Foundation Solutions
Projects Europe offers foundation solutions for the construction of quays, harbours, locks, breakwaters and to reinforce the banks of rivers or canals. Other applications involve the protection of excavations underwater or on land, and excavation works for bridge abutments, retaining walls and underground car parks.

With the possibility to make pipes up to 2850mm diameter, 65m long (without circumferential welds) and 25.4mm thick, we have a unique position in the world.

Our worldwide presence with stocks of sheet piles, H-bearing piles and pipe piles makes us the preferred partner for our customers to offer tailor-made solutions. The complete range of products goes from hot rolled sheet piles and H-profiles to cold formed sheet piles and foundation pipes.

Head Office
Mannesmannweg 5, 4794 SL Heijningen
The Netherlands
T +31 88 0083 700
F +31 88 0083 800
Production range

Production range

Our strong points are:

• Production is 100% controlled and certified with delivery of 2.2, 3.1 or 3.2 certificates according EN 10204.

• Pipes can be produced with diameters up to 2850mm and wall thicknesses up to 25.4mm (30.0mm for steel grades up to S355).

• We can provide pipes in all requested steel grades due to our worldwide network of coil producers.

• Pipes can be produced with lengths up to 65m without circumferential weld. Longer tubes can be achieved by welding.

• There is a coating facility present on our production site.

• Several specialized welding facilities are placed in line with the spiral mill for executing specific works like welding clutches or other steel parts and making butt welds.

### Weight (kg/m pipe) & Wall thickness (mm & inch)

<table>
<thead>
<tr>
<th>Outside diameter (mm &amp; inch)</th>
<th>Weight (kg/m pipe)</th>
<th>Wall thickness (mm &amp; inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>408</td>
<td>0.47</td>
<td>0.04</td>
</tr>
<tr>
<td>426</td>
<td>0.51</td>
<td>0.05</td>
</tr>
<tr>
<td>444</td>
<td>0.55</td>
<td>0.06</td>
</tr>
<tr>
<td>462</td>
<td>0.59</td>
<td>0.07</td>
</tr>
<tr>
<td>480</td>
<td>0.63</td>
<td>0.08</td>
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<tr>
<td>508</td>
<td>0.67</td>
<td>0.09</td>
</tr>
<tr>
<td>526</td>
<td>0.71</td>
<td>0.10</td>
</tr>
<tr>
<td>544</td>
<td>0.75</td>
<td>0.11</td>
</tr>
<tr>
<td>562</td>
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<tr>
<td>620</td>
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<tr>
<td>640</td>
<td>0.98</td>
<td>0.16</td>
</tr>
<tr>
<td>660</td>
<td>1.00</td>
<td>0.17</td>
</tr>
</tbody>
</table>

### Spiral Mill

Projects Europe’s spiral mill is located on its site in Dintelmond (The Netherlands). This mill is especially designed for the production of spirally welded pipes for foundation purposes.
Production process of spirally welded pipes

Production Process of Spirally Welded Pipes

1. De-coiling
2. Levelling and centring
3. Cutting
4. Edge cutting
5. Bevelling
6. Main drive
7. Three-roll forming
8. Inside welding
9. Inside welding
10. Transversal bevelling and transversal welding
11. Centring
12. Transversal bevelling and transversal welding
13. US testing weld seam
14. Plasma cutting
15. Pipe body testing
The welding process

The Welding Process
The welding of the spirally welded pipes is based on the Double-Sided Submerged Arc Welding (DSAW) process.

The principle
Arc welding works by using electric current to produce an electric arc in a gas environment. The arc’s heat brings the metal to fusion point. A key question is how to increase both the concentration and energy intensity of the arc.

DSAW's better penetration makes it possible to achieve higher weld travel speeds without impairing quality, thus improving productivity and lowering costs.

Multi arc welding
The Spiral Mill of ArcelorMittal Projects combines the advantages of DC and AC arc combinations.

Both on the inside and the outside the multi arc principle is used. The first welding pass is done by using a DC arc. Herewith a large and concentrated penetration can be achieved. The second pass is done by using an AC arc. Herewith better deposition rates can be achieved.

The result of the multi arc welding on both sides of the coil is a full penetration weld of a very high quality produced in a cost effective way.

The flexibility of the mill is very high because of the use of this system. A large range of coil thicknesses (between 10 and 25mm) can be transformed in spirally welded pipes in an economic way by choosing the right parameters.
Technical delivery conditions

Technical Delivery Conditions

Pipes for construction purposes are normally produced according to EN 10219 or API 5L - PSL1. The EN 10219 is a European standard giving technical delivery conditions for cold formed, welded pipes for construction works. The API 5L is drawn by the American Petroleum Institute in order to provide standards for pipes suitable for use in conveying gas, water and oil.

Steel grades

Steel grades are built up by symbols and numbers showing the requested properties of the steel:

- An example of a steel grade according to EN 10219:
  - S355J0H

  With: EN 10219: the European standard
  - S: structural steel
  - 355: minimum yield strength [N/mm²]
  - J0: minimum impact energy value of 27 J at 0°C for Charpy testing, others are: JR (27 J at 20°C) and J2 (27 J at -20°C)
  - N or M: normalised rolling or thermomechanical rolling of the feedstock material (coils). Both are rolling processes in which the final deformation is carried out in a certain temperature range.
  - H: hollow sections

- An example of a steel grade according to API 5L-PSL1:
  - X52

  With: API 5L: the standard of the American Petroleum Institute
  - 52: 52000 pounds per square inch = 359 N/mm². This is the yield strength.

Mechanical properties

<table>
<thead>
<tr>
<th>Steel grade according to EN 10219-1</th>
<th>Minimum yield strength $R_{y}$ (N/mm²)</th>
<th>Minimum yield strength $R_{h}$ (16xT≤40mm)</th>
<th>Minimum tensile strength $R_{m}$ (N/mm²)</th>
<th>Minimum elongation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S235JRH (T≤16mm)</td>
<td>235</td>
<td>255</td>
<td>340-470</td>
<td>24</td>
</tr>
<tr>
<td>S275J0H/12H</td>
<td>275</td>
<td>265</td>
<td>410-560</td>
<td>20</td>
</tr>
<tr>
<td>S355J0H/12H</td>
<td>355</td>
<td>345</td>
<td>490-630</td>
<td>20</td>
</tr>
<tr>
<td>S420NH</td>
<td>420</td>
<td>400</td>
<td>500-660</td>
<td>19</td>
</tr>
<tr>
<td>S460NH</td>
<td>460</td>
<td>440</td>
<td>530-720</td>
<td>17</td>
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</table>

<table>
<thead>
<tr>
<th>Steel grade according to API 5L, PSL1</th>
<th>Minimum yield strength $R_{y}$ (N/mm²)</th>
<th>Minimum tensile strength $R_{m}$ (N/mm²)</th>
<th>Minimum elongation (%)</th>
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<tbody>
<tr>
<td>X42</td>
<td>290</td>
<td>415</td>
<td>23</td>
</tr>
<tr>
<td>X46</td>
<td>330</td>
<td>415</td>
<td>22</td>
</tr>
<tr>
<td>X52</td>
<td>360</td>
<td>460</td>
<td>21</td>
</tr>
<tr>
<td>X56</td>
<td>390</td>
<td>490</td>
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<td>X60</td>
<td>415</td>
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<td>X65</td>
<td>450</td>
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<tr>
<td>X70</td>
<td>485</td>
<td>570</td>
<td>17</td>
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Chemical properties

<table>
<thead>
<tr>
<th>Steel grade according to EN 10219-1</th>
<th>C max.</th>
<th>Mn max.</th>
<th>P max.</th>
<th>S max.</th>
<th>Si max.</th>
<th>N max.</th>
<th>CEV max.</th>
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<tbody>
<tr>
<td>S235JRH</td>
<td>0.17</td>
<td>1.40</td>
<td>0.045</td>
<td>0.045</td>
<td>-</td>
<td>0.009</td>
<td>0.35</td>
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<tr>
<td>S275J0H/J2H</td>
<td>0.20</td>
<td>1.50</td>
<td>0.040</td>
<td>0.040</td>
<td>-</td>
<td>0.009</td>
<td>0.40</td>
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<tr>
<td>S355J0H/J2H</td>
<td>0.22</td>
<td>1.60</td>
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<td>0.040</td>
<td>0.55</td>
<td>0.009</td>
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<td>S420MH</td>
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<td>0.035</td>
<td>0.50</td>
<td>0.020</td>
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<td>0.035</td>
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<table>
<thead>
<tr>
<th>Steel grade according to API 5L, PSL1</th>
<th>C max.</th>
<th>Mn max.</th>
<th>P max.</th>
<th>S max.</th>
<th>Ti+V+Nb max.</th>
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<tr>
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<td>0.26</td>
<td>1.30</td>
<td>0.030</td>
<td>0.030</td>
<td>0.15</td>
</tr>
<tr>
<td>X46</td>
<td>0.26</td>
<td>1.40</td>
<td>0.030</td>
<td>0.030</td>
<td>0.15</td>
</tr>
<tr>
<td>X52</td>
<td>0.26</td>
<td>1.40</td>
<td>0.030</td>
<td>0.030</td>
<td>0.15</td>
</tr>
<tr>
<td>X56</td>
<td>0.26</td>
<td>1.40</td>
<td>0.030</td>
<td>0.030</td>
<td>0.15</td>
</tr>
<tr>
<td>X60</td>
<td>0.26</td>
<td>1.45</td>
<td>0.030</td>
<td>0.030</td>
<td>0.15</td>
</tr>
<tr>
<td>X65</td>
<td>0.26</td>
<td>1.45</td>
<td>0.030</td>
<td>0.030</td>
<td>0.15</td>
</tr>
<tr>
<td>X70</td>
<td>0.26</td>
<td>1.65</td>
<td>0.030</td>
<td>0.030</td>
<td>0.15</td>
</tr>
</tbody>
</table>

Geometric tolerances

<table>
<thead>
<tr>
<th>Standard</th>
<th>Outside diameter $D$</th>
<th>Wall thickness $T$</th>
<th>Straightness</th>
<th>Out-of-roundness</th>
<th>Mass</th>
<th>Maximum weld bead height</th>
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</thead>
<tbody>
<tr>
<td>EN 10219-2</td>
<td>max. +/- 10.0 mm</td>
<td>max. +/- 2.0 mm</td>
<td>0.0% of total length</td>
<td>+/- 2%</td>
<td>+/- 6%</td>
<td></td>
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</tbody>
</table>
Combined walls

A combined wall is the retaining wall solution with a high horizontal or vertical bearing capacity required. A combined wall consists of primary elements with intermediate sheet piles (secondary elements) that can be either horizontal or vertical. The intermediate sheet piles ensure that the pipes remain in place during the construction process.

The following formulas can be helpful for the design of combined walls:

\[ I_{\text{prim}} = \frac{\pi \left(D^4 - (D - 2t)^4\right)}{64} \]
\[ W_{\text{prim}} = \frac{I_{\text{prim}}}{b} \]
\[ W = \frac{I}{0.5 \cdot D} \]
\[ \sigma = \frac{M}{W} \]

With:
- \( D \): Outside pipe diameter [cm]
- \( b \): System width [m]: pipe diameter [m] + width of sheet piles [m] + 0.05 m
- \( I \): Moment of inertia of combined wall [cm\(^4\)/m]
- \( W \): Section modulus of combined wall [cm\(^3\)/m]
- \( M \): Bending moment [Nm]
- \( \sigma \): Maximum steel stress due to bending moment [N/mm\(^2\)]

Intermediate Sheet Piles: double AZ18

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Thickness (mm)</th>
<th>M60% (kg/m²)</th>
<th>M100% (kg/m²)</th>
<th>I (cm(^4)/m)</th>
<th>W (cm(^3)/m)</th>
<th>M60% (kg/m²)</th>
<th>M100% (kg/m²)</th>
<th>I (cm(^4)/m)</th>
<th>W (cm(^3)/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2850</td>
<td>107</td>
<td>149.492</td>
<td>3.279</td>
<td>182.315</td>
<td>2.885</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>266</td>
<td>100</td>
<td>142.815</td>
<td>2.885</td>
<td>182.315</td>
<td>2.885</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>210</td>
<td>50</td>
<td>78.017</td>
<td>1.572</td>
<td>111.315</td>
<td>1.685</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>180</td>
<td>44</td>
<td>64.017</td>
<td>1.343</td>
<td>97.315</td>
<td>1.445</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>39</td>
<td>50.517</td>
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<td>77.315</td>
<td>1.225</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>140</td>
<td>34</td>
<td>37.017</td>
<td>0.888</td>
<td>59.315</td>
<td>0.945</td>
<td></td>
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<td></td>
<td></td>
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</table>

Intermediate Sheet Piles: triple PU18

<table>
<thead>
<tr>
<th>Diameter (mm)</th>
<th>Thickness (mm)</th>
<th>M60% (kg/m²)</th>
<th>M100% (kg/m²)</th>
<th>I (cm(^4)/m)</th>
<th>W (cm(^3)/m)</th>
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</thead>
<tbody>
<tr>
<td>2850</td>
<td>107</td>
<td>149.492</td>
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<td>160</td>
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<td>50.517</td>
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<td>34</td>
<td>37.017</td>
<td>0.888</td>
<td>59.315</td>
<td>0.945</td>
</tr>
</tbody>
</table>

Advantages C6:
- Less weight than C9, therefore more economical
- Easy to weld
Coating

The classical protection for steel tubes is surface coating. The European standard EN ISO 12944 deals with protection by paint systems and its various parts cover all the features that are important in achieving adequate corrosion protection.

In certain situations where there is no oxygen (deep below surface level) steel tubes may not corrode. When water and oxygen are both available, corrosion takes place by an electrochemical process. Coating systems are used to protect against corrosion as well as for decoration, but before a coating system is applied it is essential that the steel surface is properly blasted.

Surface Preparation

The most commonly used preparation grades are, according to the ISO 8501-1 standard: ISO Sa 2.5: very thorough blast cleaning ISO Sa 3: blast cleaning to visually clean steel.

Coating Systems

In the following, some paint systems are proposed for different environments according to the classification of EN ISO 12944.

Atmospheric exposure

Steel tubes can be partly exposed to the atmosphere, for example when used as pillars for bridges or in permanent retaining combiwalls. In such applications, polyurethane finishes provide an aesthetical and functional look. They combine gloss and color retention and are easy to apply and maintain.

Proposal (EN ISO 12944 - table A4, corrosivity category C4)

- Zinc silicate epoxy primer (50µm)
- Recoatable epoxy intermediate coating (140µm)
- Aliphatic polyurethane topcoat (40µm)

Nominal dry film thickness of the system: 230µm

Freshwater immersion

Freshwater immersion is usually less corrosive than in marine conditions, but there can be aesthetic considerations. For convenience here, a system has been chosen which is capable of performing well both above and below water.

Proposal (EN ISO 12944 - table A8, corrosivity category Im 1)

- 2 coats of polyamide cured epoxy coating (150 + 150µm)

Nominal dry film thickness of the system: 300µm

Seawater immersion

Structures continuously or partially immersed in seawater require careful attention. For long-term performance in immersion there should be no compromise on quality. The application must be properly carried out and inspected and, of course, the coating system must be of high quality.

Proposal 1 (EN ISO 12944 - table A8, corrosivity category Im 2)

- Polyamide cured epoxy primer (50µm)
- 2 coats of polyamide cured coal tar epoxy coating (200 + 200µm)

Nominal dry film thickness of the system: 450µm

Proposal 2 (EN ISO 12944 - table A8, corrosivity category Im 2)

- Polyamide cured epoxy primer (50µm)
- Glassflake reinforced polyamide cured epoxy coating (400µm)

Nominal dry film thickness of the system: 450µm

All coating systems can be provided by ArcelorMittal Projects for its entire production range.
Logistics and services

Delivery Procedure:
ArcelorMittal Projects deals with all logistics starting with the acceptance and storage of base materials until tailor-made deliveries on the job site worldwide.

An experienced team is at our clients’ service to arrange road, rail or water transport all over the world, all additional activities such as loading and unloading facilities, custom clearance, local taxes, etc. included.

Transport by truck:
ArcelorMittal Projects has a close cooperation with specialized companies to ensure in-time deliveries with lengths up to 40m.

Transport by rail:
Delivery of lengths up to 32m can be done in most European countries. For longer items, a specific study needs to be done before executing.

Transport over water:
Both our site in Dintelmond and Moerdijk are directly connected to deep water in the port of Rotterdam area. The loading berths are equipped with cranes with lifting capacities over 120 tons. Hereafter long and heavy pipes can be transported directly after production to our clients without additional transshipments.

Deliveries made by ArcelorMittal Projects are in accordance with Incoterms 2010.

Below you will find some examples of these terms.

All modes of transport:
- EXW Ex Works (named place of delivery)
- FCA Free Carrier (named place of delivery)
- CPT Carriage Paid To (named place of destination)
- CIP Carriage and Insurance Paid to (named place of destination)
- DAT Delivered At Terminal (named terminal at port or place of destination)
- DAP Delivered At Place (named place of destination)
- DDP Delivered Duty Paid (named place of destination)

Sea and inland waterway transport:
- FAS Free Alongside Ship (named port of shipment)
- FOB Free On Board (named port of shipment)
- CFR Cost and Freight (named port of destination)
- CIF Cost, Insurance and Freight (named port of destination)

ArcelorMittal Projects can arrange all necessary export documents such as EX1, EUR1, certificates of origin, etc.

Services:
ArcelorMittal Projects delivers the entire range of steel foundation products to its customers, and offers a total solution to its customers in civil engineering.

In order to do so, ArcelorMittal Projects relies on 3 plans:

1. Extensive product range:
   - Spiral welded pipe mill: unique state-of-the-art pipe producing mill with production specifications ranging from:
     - thickness 10-25.4 mm (30.0mm for steel grades up to S355)
     - 914mm-2850mm diameter
     - Steel grades up to X80
     - Capacity to produce pipes up to 65m length without circumferential weld.
   - Large stock of steel pipes:
     - Newly produced, high-quality pipes from overrollings, mainly meant for gas transportation or water transmission pipelines.
     - Used pipes, formerly used as water or gas pipe lines.
   - Other pipes: If the customer’s requirement is beyond our production range, we will rely on our worldwide network of pipe producers, in order to find a technically and economically optimized solution for our customers.

2. Fabrication of end products:
   - Construction of:
     - Piles for combiwalls (welding of clutches and welding pipes to required lengths), box piles, special sheet piles, MV piles, walings and struts for supporting sheet pile walls...
   - Sealing of interlocks with: Beltan® Plus, Arcoseal™, Roxan® Plus, Akila® or by welding.
   - Coating: when end products need to be treated we can provide all requirements.

3. Technical support:
   - With our team of engineers we are able to find the most suitable solution for our customers’ projects by providing feasibility studies, dimensioning of entire structures, elaboration of anchorage or struttying systems, calculation of vertical load-bearing capacity...
   - We can also provide driving plans.
Quality control

1. Certification

Projects Europe has been certified for many years for the production of spirally welded steel pipes. Our production facility is certified to produce spirally welded pipes according to customer requirements e.g.: EN 10219. Projects Europe has the right to issue 3.1. certificates with their products. 3.2. certificates can be issued when the production is controlled by a notified third party.

2. The quality process

Our quality management system is certified according to EN ISO 9001 (Lloyds Register Quality Assurance) to ensure a completely controlled process from purchasing the coils until delivery of the final goods to our clients. Furthermore, we hold a certification to produce under the CE MARK and the German DIN 18800 - 7 (Groover Eignungs Nachweis).

Being a certified mill for spirally welded steel pipes the following quality conditions are guaranteed:

- Internal procedures for production of spirally welded pipes and implementation of them in the production process
- Conformity of our procedures to EN 10219
- Methodology for testing and inspection in order to deliver quality products:
  - Purchase of base material with certificates of conformity as per the clients detail
  - Welding procedures and welders qualifications
  - Control on dimensioning
  - Visual inspection
  - Non-destructive inspection: the welds are 100% UT tested
- Methodology for storage of end products
- Methodology for transport

ISO 9001 : 2008
EN 10219-1:2006
EN1090-1
EN 10219-1:2006