UO PIPE

NIPPON STEEL & SUMITOMO METAL

http://www.nssmc.com/
FEATURES AND ADVANTAGES

COMPANY & UOE PIPE Mill

Nippon Steel & Sumitomo Metal Corporation (NSSMC) is one of the biggest UO pipe suppliers all over the world. We have 2 (two) pipe mills at KIMITSU and KASHIMA in JAPAN. Total capacity is 1 Million ton per year.
We have been supplying high quality UO pipe compatible with severe environment application with most advanced technology.

Volume Production of Quality Materials

The mechanical and chemical properties of UO pipe – strength, toughness, weldability and corrosion resistance – are largely determined in the phases from steel making to plate rolling. NSSMC has a world-class system for the volume of production of high quality steels.

Advanced Production Facilities Backed by Expertise and Long Experience

Fully automated mill equipment and the largest pipe making technology – especially in the area of welding - ensure the high and stable quality of NSSMC UO pipe.

Stringent QA/QC Systems

Every UO pipe is produced under a special quality assurance system comprised of:

- An advanced tracking and identification system for the stringent control of the entire process flow from steel making to warehousing of finished pipe
- An array of automatic quality control instruments covering the entire process to ensure high reliability in inspections and tests.
- A computer assisted quality control and production specification system for high efficiency in process control.
- Certified inspection staff for nondestructive, visual and dimensional inspections

Advanced R & D

Research and development are being made in constant pursuit of technical innovations in all areas of pipe production: steel making, plate rolling, pipe fabrication, inspection and surface treatment. The results of these R&D efforts are led forward to the production line and reflected in the plant engineering. Concerned emphasis is placed on

- Research aimed at improving the performance and mechanical properties of UO pipe in response to the changes in service conditions and environmental restrictions, as well as the quality of technical services NSSMC offers to customers.
- Research for the technical standardization, innovation and automation to ensure high quality on a stable basis.

Notice: While every effort has been made to ensure the accuracy of the information contained within this publication, the use of the information is at the reader’s risk and no warranty is implied or expressed by Nippon Steel & Sumitomo Metal Corporation with respect to the use of the information contained herein. The information in this publication is subject to change or modification without notice. Please contact the Nippon Steel & Sumitomo Metal Corporation office for the latest information.

The names of our products and services shown in this publication are trademarks or registered trademarks of Nippon Steel & Sumitomo Metal Corporation或者 its affiliated companies. Other product or service names shown may be trademarks or registered trademarks of their respective owners.
INTEGRATED PRODUCTION PROCESS

Blast Furnace → Torpedo Car → KR → Diphosphorization → LD Converter → Secondary Refining → Continuous Caster → Plate Mill → UST

Plate Piling → Automatic Plate Tab Welding → Edge Preparation → Edge Crimping → U-ing Press → O-ing Press → Tack Welding → Automatic Inside Welding

Automatic Outside Welding → 1st Ultrasonic Inspection → 1st X-Ray Radiography or Fluoroscopy → Repair Welding

Expansion → Degreasing → Hydrostatic Test → 2nd Ultrasonic Inspection → X-Ray Radiographic Inspection

End Facing → Final Inspection

Automatic Dimensional Measurement → Marking

Products: Varnish, Coating

Shipping
MANUFACTURING PROCESS
Steel making, Secondary Refining and Continuous Casting

Volume production of High-Purity Steel
For improvement of the mechanical properties of UO pipe, NSSMC has developed and established the following techniques that permit volume production of high-purity steel.
1) Pre-treatment and Secondary Refining Process
   1) Reduction and shape – control of nonmetallic inclusions
   2) Reduction of impurities, phosphorus, sulfur, oxygen, nitrogen and hydrogen
   3) Reduction of easy-to-segregate elements, carbon and phosphorus
2) Continuous casting
   1) Prevention of steel reoxidation and nitrogen absorption
   2) Vertical-bending type continuous casting machine

Reduction of Center Segregation in Continuous Casting
New techniques have also been developed to reduce center segregation in the continuous casting process in order to obtain UO pipe with improved sour environment resistance in particular.
1) Soft reduction of slab through the use of divided roll segments in the final stage of solidification
2) Reduced roll pitch and rigid roll segment to suppress slab bulging

CR (Controlled Rolling) Process
The CR process refines the steel by controlling various thermo-mechanical factors such as slab reheating temperature, rolling temperature and rolling reduction.

ACC (Accelerated Cooling)
This on-line cooling technique is designed for use immediately after the CR process to refine grain size and better control the transformation temperature.
Steps Preliminary to Forming

Tab Plate Affixing
A tab plate is precisely affixed to each corner of the plate for pipe by means of a dedicated MAG welding robot to permit quality welding beyond the pipe ends.

Edge Preparation
Shaving tools or milling cutter accurately machines both longitudinal edges of the plate, producing a weld preparation suitable for the Submerged Arc Welding process, which follows pipe forming. The design of the weld preparation is governed by the pipe size and wall thickness.

Forming Plate into Circular Shape

“UO Forming”
The edge-planed plate is automatically fed through the crimping press, U-ing press and O-ing press and is deformed into the shape of an almost closed circle which is then ready for welding.

Continuous Tack Welding
To ensure sound welds by internal and external Submerged Arc Welding (SAW), the continuous tack welder welds the gap along the full length of pipe from the outside by means of CO₂ Welding process. This tack welding eliminates many causes of weld defects, including burn-through and weld-cracks in subsequent welding, because unlike other commonly used tack-welding operations the seam in the pipe is completely welded.
**Welding**

**Inside and Outside Welding**
The tack welded pipe is welded on the inside and outside by the multi-electrode SAW method. The SAW machine used in this operation is capable of performing all welding operations automatically from receipt of the tack welded pipe and the seam alignment to delivery of the welded pipe.

It also has many other features including a welding condition controller which can accurately control the welding process parameters to preset values.

All these add up to highly reliable, quality welds.

**Automatic Supply of Moisture-Free Flux**
The flux used in SAW is supplied through an automatic circulation system of totally closed type. Hence, a continuous flow of high-quality, moisture-free flux is maintained.

**Mechanical Expansion**
The final diameter and straightness of the pipe is obtained by mechanically expanding the pipe. This corrects any deformations such as out-of-roundness or bending that might have occurred during welding process.

As pipe is expanded from inside, uniform diameters are obtained to facilitate field welding. Simultaneously, residual stress is reduced by expansion. NSSMC uses a mechanical expander for greater accuracy of dimensions.

**Hydrostatic Testing**
All pipes are subjected to automatic hydrostatic testing after mechanical expansion. Testing can be carried out up to a maximum pressure of 44.1MPa (6450psi) and 48.0MPa (6960psi) at KIMITSU and KASHIMA respectively.

**UO Pipe Inspection and Testing**

**Inside cleaning**

**Hydrostatic test [KIMITSU]**

**Mechanical expansion [KASHIMA]**

**Inside welding [KIMITSU]**

**Laser image of groove**

**Image Processor**

**Image Sensor**

**Laser**

**Seam Tracking Control System (Outside Welding)**

**Image of outside welding**

**Inside welding remote monitor at control center [KIMITSU]**

**Configuration of Automatic Welding (Inside) System**

**Process Computer**

**Current/Voltage Detector**

**Present Controller**

**Subsequent Process (Inspection)**
Nondestructive Examinations

All pipes are subjected to a series of stringent nondestructive examinations such as ultrasonic testing, X-ray radiography, X-ray fluoroscopy (KIMITSU only) and magnetic particle testing. NDEs are carried out by qualified inspectors.

**Automatic plate UST**
The entire surface of each plate is scanned by multi-channel UST with a self-sensitivity assurance system and a self-calibration function. Plate edges are carefully checked by double-probe mechanism. And all judgments are done automatically by a computer controlled system.

**Automatic UST of Welds**
Welds are ultrasonically tested by multi-channel UST. Featuring probe self-diagnosis and hydrostatic coupling functions, and AGC functions designed to maintain system sensitivity, the UST system enables stable and accurate examinations.

**X-ray Fluoroscopy [KIMITSU only]**
The X-ray fluoroscopic examination system consists of a small focus, high performance X-ray tube and special dynamic image processor and offers highly sensitive pictures.

**X-ray Radiography**
The X-ray radiographic examinations system features a small focus, high-performance X-ray tube and special mechanism that allows the radiographic file to be brought into direct contact with the pipe being inspected to produce highly sensitive radiographs. The exposed films are processed in a fully-automatic manner – feature that provides quality pictures in all cases. The computed radiography technique is introduced at KASHIMA. X-ray Image is easily to judge through the monitor in all cases. The result of judgment of each radiographic is fed into the system from an input terminal for computer-aided total judgment of the quality of each pipe.
Physical Testing

In addition to in-line testing, random samples of pipe are subjected to a rigorous program of off-line testing for mechanical properties of base metal and weld metal. In some case, HIC resistance and fracture properties are checked by using actual pipe. These comprehensive testing procedures assure users of highest quality products that conform to exceed the specification.

Computer System for Quality and Production Control

Tracking System

Data Collation Between Plate Mill and Pipe Mill:
It is possible to completely eliminate the risk of unwanted plates entering the UO pipe mill by collating the output data of plate information with computer tracking system.

In-Line Tracking:
By tracking electrical signals generated upon passage of the pipe through each process, the movement of each pipe can be accurately tracked.

Automatic Marking:
All finished pipes are automatically marked with such information as measured weight and length in accordance with the marking specifications each customer designates.

Storage Control:
Radio data transceivers are used for storage control. This storage control system provides in real time the address of each pipe and the image of each pipe pile at the storage yard.

Production Specifications and Quality Analysis System

Production Specification:
A sophisticated on-line production specification system is in operation, in which production conditions or process parameters are fed directly to visual displays (CRT) installed in each process for the effective elimination of human errors.

On-Line Quality Control:
An advanced on-line quality control system is in service which enables real-time feedforward and feedback of the quality-related data of each pipe measured between processes in the UO pipe mill.

Data Analysis:
All data are fed to an off-line data analysis system, where they are precisely analyzed to find optimum process parameters, and the results of the analysis are reflected in subsequent production specifications.
External Polyethylene Coating

The external polyethylene coating of UO pipe is applied by extrusion of polyethylene resins using T-dies. NSSMC started production of polyethylene-coating UO pipe in 1974, the first example in Japan. Since then, polyethylene coated large-diameter pipe has been finding widening application as oil and natural gas line pipe and is today highly reputed among third-party institutions.

The Coating is of Three-Layer Construction

Primer layer, adhesive layer and polyethylene layer. It exhibits good adhesion to the base metal and is excellent also in electric insulating properties, weathering resistance and resistance to chemicals.

Available Size

<table>
<thead>
<tr>
<th>Outside Diameter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIMITSU</td>
<td>400 – 1625.6mm</td>
</tr>
<tr>
<td>KASHIMA</td>
<td>508 – 1524.0mm</td>
</tr>
</tbody>
</table>

Internal Coating

Internal-coating UO pipe is also available from NSSMC. This type of UO pipe is enjoying welding acceptance for use in such applications as require both high corrosion resistance and improved transport efficiency of fluids.

Coating Method

Liquid epoxy resin pipe

Available Size

<table>
<thead>
<tr>
<th>Outside Diameter</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>KIMITSU</td>
<td>400 – 1422.4mm</td>
</tr>
<tr>
<td>KASHIMA</td>
<td>508 – 1524.0mm</td>
</tr>
</tbody>
</table>
SIZE RANGE OF UO PIPE

NSSMC UO pipe mills produces pipe with outside diameters from 18 inch to 60 inch. The equipment to produce such pipes reflects NSSMC’s intent to meet the great demand for larger and heavier steel pipe.

Wall Thickness
Submarine pipelines require pipe of greater strength and toughness. To produce pipe with wall thickness up to 1.57 inch. NSSMC has installed very large crimping press, U-ing press and expander.

Length
NSSMC UO pipe mill can produce pipes with lengths up to 60 feet. The long pipes reduce the number of weld joints and inspections necessary at the site, thus leading to faster construction and lower costs.

HANDLING AND STORAGE

Special consideration and attention are given to the handling and storage of UO pipe. Improper handling or storage results in damage such as scratches, deformation, fatigue cracks and so on.

End Protection:
The ends of UO pipes are protected by steel bevel guards. The bevel guard is fitted so as not slip off in transit, but can be easily removed and refitted wherever necessary.

Handling:
Pipe-handling crane hooks are cushioned and specially designed to prevent pipe-end damage. Also, all handling equipment and practices are designed to avoid excessive stresses on the pipe.

Storage:
In the pipe mill, all pipes are placed neatly on dunnage in level and drained storage so that they will be safe from permanent deformation such as out-of-roundness.

Similar safety precautions are also used for marine transport. In order to prevent pipe damage such as deformation and fatigue cracking, stowing is performed strictly in accordance with NSSMC’s own standards which are more rigorous than API RP5LW.
FACILITIES AND LOCATIONS

- UO Pipe Mill
- ERW Pipe Mill
- Seamless Pipe Mill
- Research Center

MEMO

Hikari  Amagasaki  Kashima  Hachioji  Kimitsu  Futtsu  Nagoya  Wakayama

[Map of Japan showing locations]