NIPPON STEEL

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UOE PIPE
P006en_03_202004f

NIPPON STEEL

UOE PIPE

Pipes
& Tubes

NIPPON STEEL CORPORATION

CONTENTS

FEATURES AND ADVANTAGES

COMPANY & UOE PIPE Mill

NIPPON STEEL is one of the biggest UOE pipe suppliers all over the world. We have a pipe mill at KIMITSU in JAPAN. Total capacity is 500 thousand ton per year.
We have been supplying high quality UOE pipe compatible with severe environment application with most-advanced technology.

Volume Production of Quality Materials

The mechanical and chemical properties of UOE pipe – strength, toughness, weldability and corrosion resistance – are largely determined in the phases from steel making to plate rolling. NIPPON STEEL 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 NIPPON STEEL UOE pipe.

Stringent QA/QC Systems

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

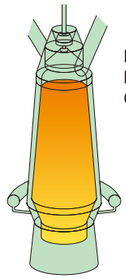
- An advanced tracking and identification system for the stringent control of the entire process flow from steel making to warehousing of finished pipe
- An array of automatic quality control instruments covering the entire process to ensure high reliability in inspections and tests.
- A computer assisted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

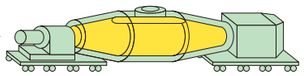
Advanced R & D

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 UOE pipe in response to the changes in service conditions and environmental restrictions, as well as the quality of technical services NIPPON STEEL offers to customers.
- Research for the technical standardization, innovation and automation to ensure high quality on a stable basis.

INTEGRATED PRODUCTION PROCESS


Iron Ore
Limes Tone
Coke
Blast Furnace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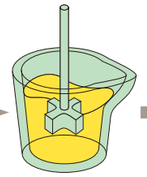
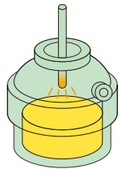

KR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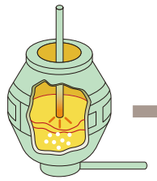
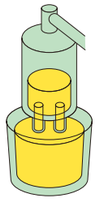
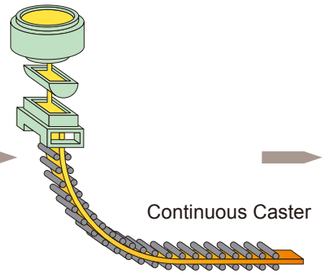

LD Converter


Secondary Refining


Continuous Caster

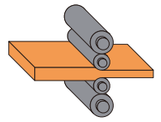


Plate Mill

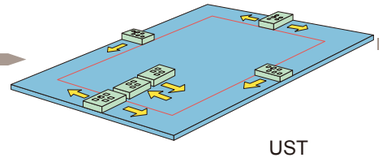
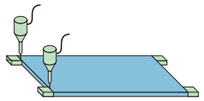
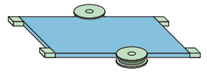
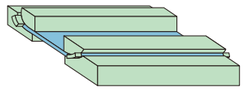

UST

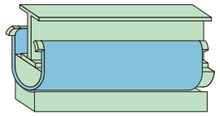

Plate Piling

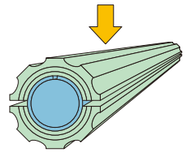
Unpiling

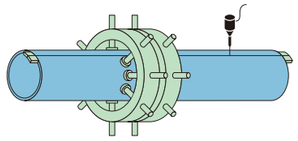

Automatic
Plate Tab Welding

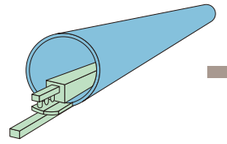

Edge Preparation

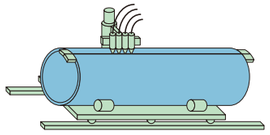

Edge Crimping

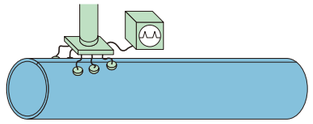

U-ing Press

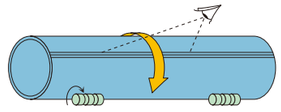

O-ing Press


Tack Welding


Automatic
Inside Welding

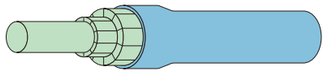

Automatic Outside Welding


1st Ultrasonic Inspection

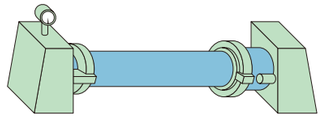

Visual Inspection

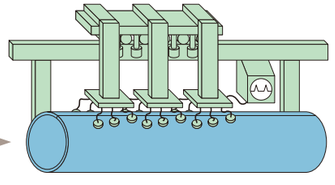
1st X-Ray Radiography

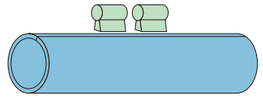
Repair Welding

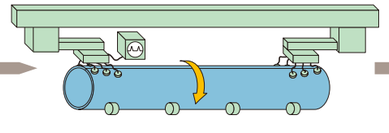

Expansion

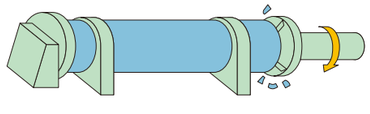

Degreasing


Hydrostatic Test


2nd Ultrasonic Inspection


2nd X-Ray Radiography


Pipe End UST


End Facing

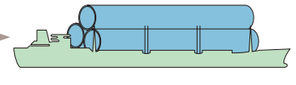
Final Inspection Automatic
Dimensional Measurement
Customer's Inspection

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 UOE pipe, NIPPON STEEL 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 UOE 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

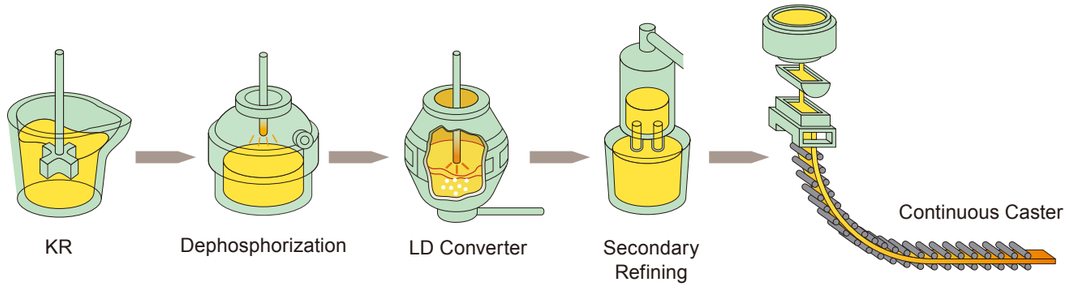
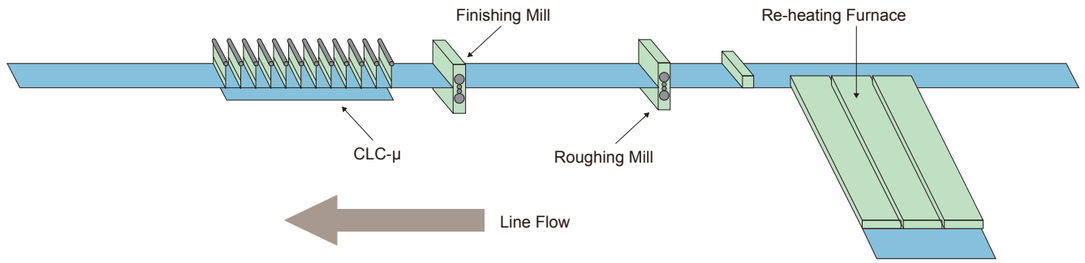


Plate Rolling

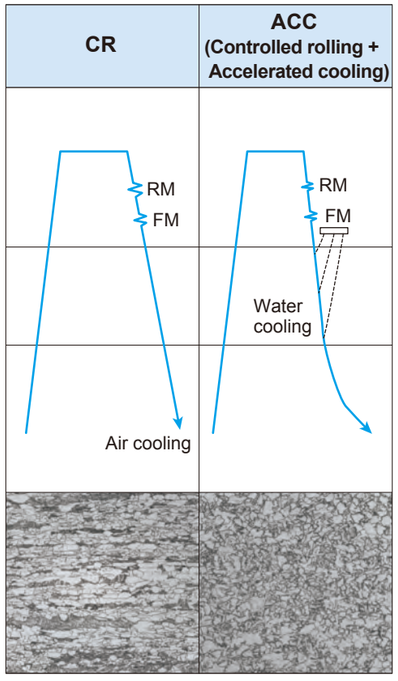
Technical breakthrough in the plate rolling based on NIPPON STEEL's proprietary thermo-mechanical control process (TMCP) impart excellent weldability and toughness to UOE pipe.

1 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.

2 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.



ACC Facility



Pipe Forming, Welding and Finishing

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 GMA 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.

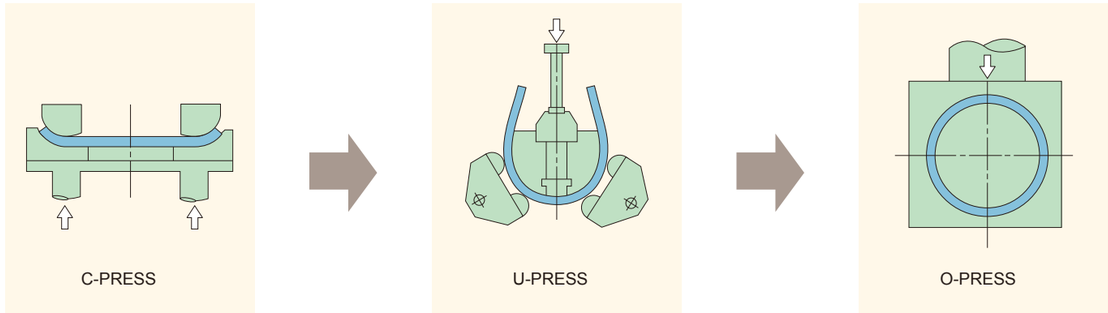
Tab GMA welding robot

Edge miller

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



U-ing press

Continuous tack 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 GMA 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.

O-ing Press

Welding

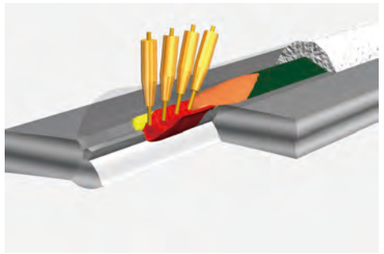


Image of outside welding

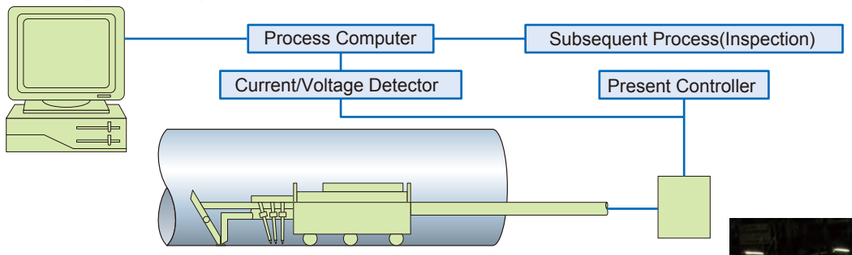
Inside and Outside Welding

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.

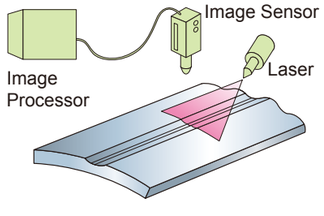
Configuration of Automatic Welding(Inside) System

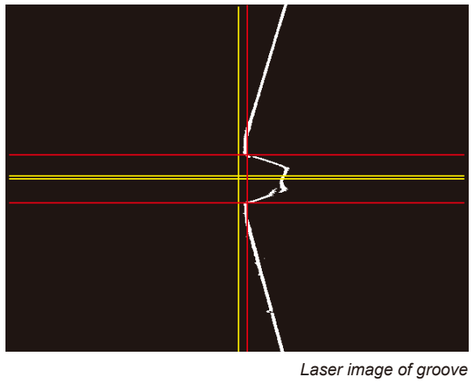


Inside welding remote monitor at control center

Inside welding

Seam Tracking Control System (Outside Welding)





Laser image of groove

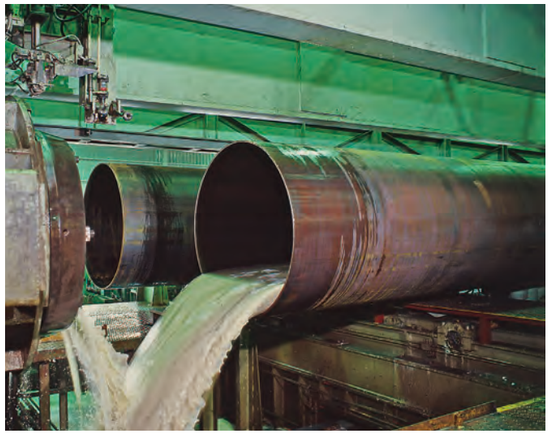
UO Pipe Inspection and Testing

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. NIPPON STEEL 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 60 MPa(8702psi) at KIMITSU.



Hydrostatic test

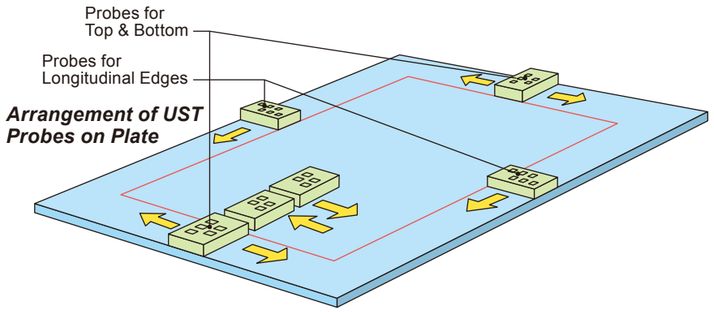
Inside cleaning

Nondestructive Examinations

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

Automatic plate UST

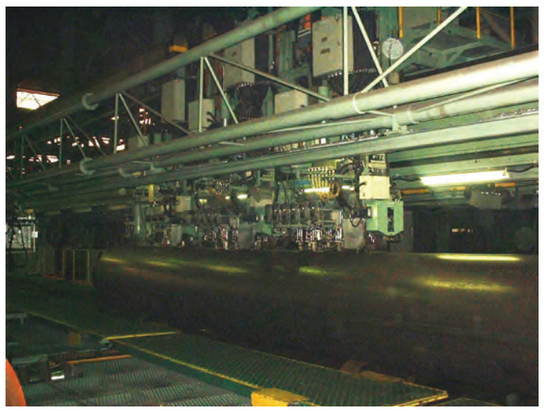
The entire surface of each plate is scanned by multi-channel UST with a self sensitivity assurance system and a self-calibration function. Plate edges are carefully checked by double-probe mechanism. And all judgments are done automatically by a computer controlled system.



Arrangement of UST Probes on Plate

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.



Automatic UST of welds

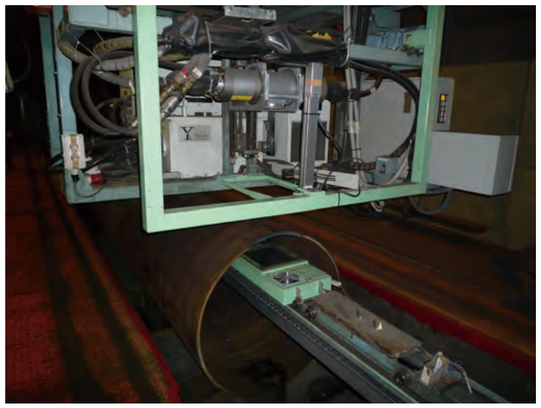
X-ray Radiography

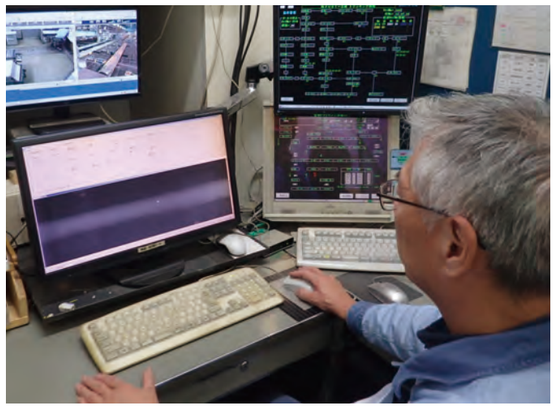
The X-ray radiographic examinations system features a small focus, high-performance X-ray tube and digital radiographic technique(computed radiography) to produce highly sensitive radiographs. X-ray Images is easily to judge through the monitor in all cases.

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.

Full length X-lay radiographic examination system

Pipe-end X-ray radiographic examination system

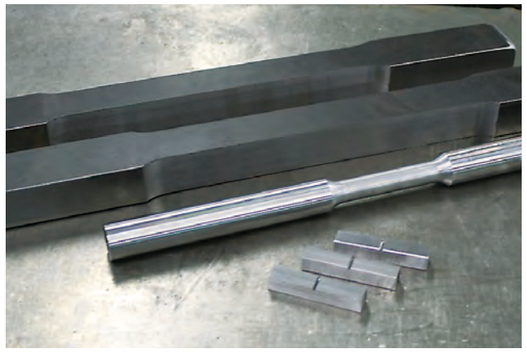




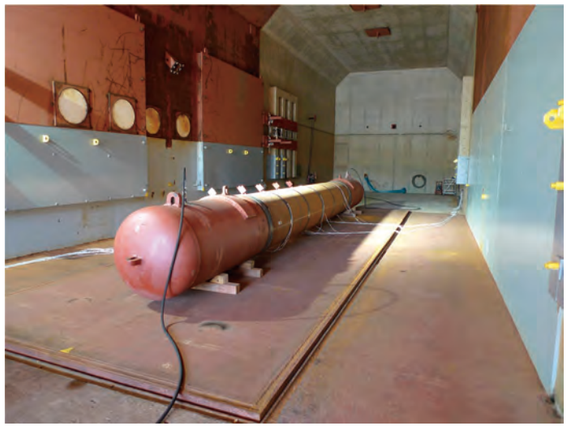
computed radiography

Physical Testing

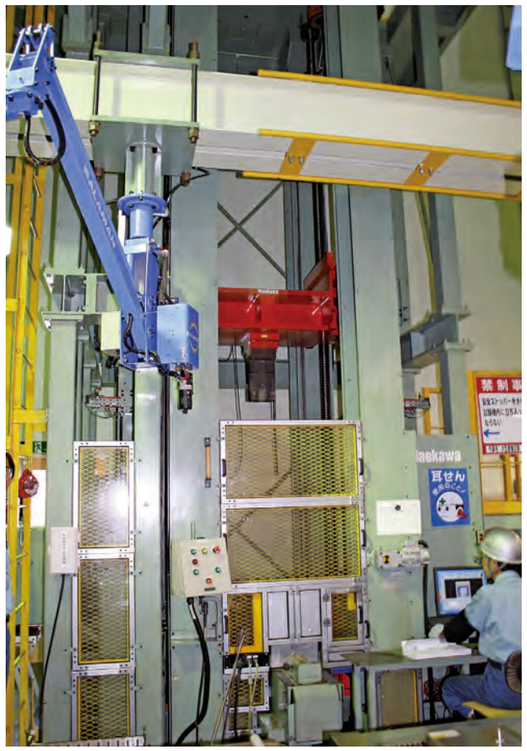
In addition to in-line testing, random samples of pipe are subjected to a rigorous program of off-line testing for mechanical properties of base metal and weld metal. In some case, HIC resistance and fracture properties are checked by using actual pipe. These comprehensive testing procedures assure users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



Tensile & Charpy Test Specimen



Burst Test [HASAKI]



Drop Weight Tear Test

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 UOE 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.

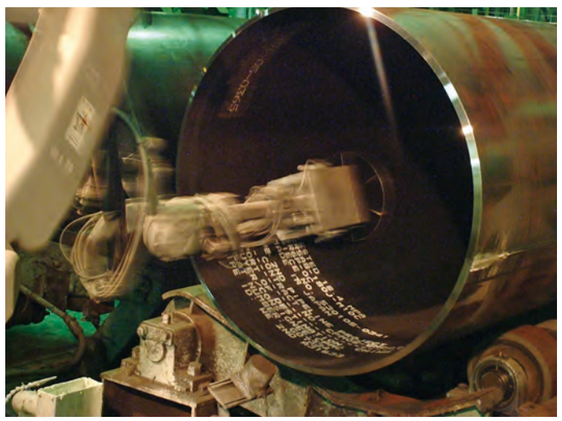
Storage Contorol:
Radio data transceivers are used for storage control.This storage control system provides in real time the address of each pipe and the image of each pipe pile at the storage yard.

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 UOE pipe mill.

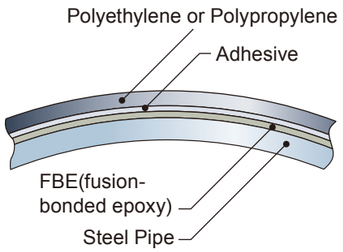
Data Analysis:
All data are fed to an off-line data analysis system, where they are precisely analyzed to find optimum process parameters, and the results of the analysis are reflected in subsequent production specifications.



Automatic pipe marking

Coating

External Coating



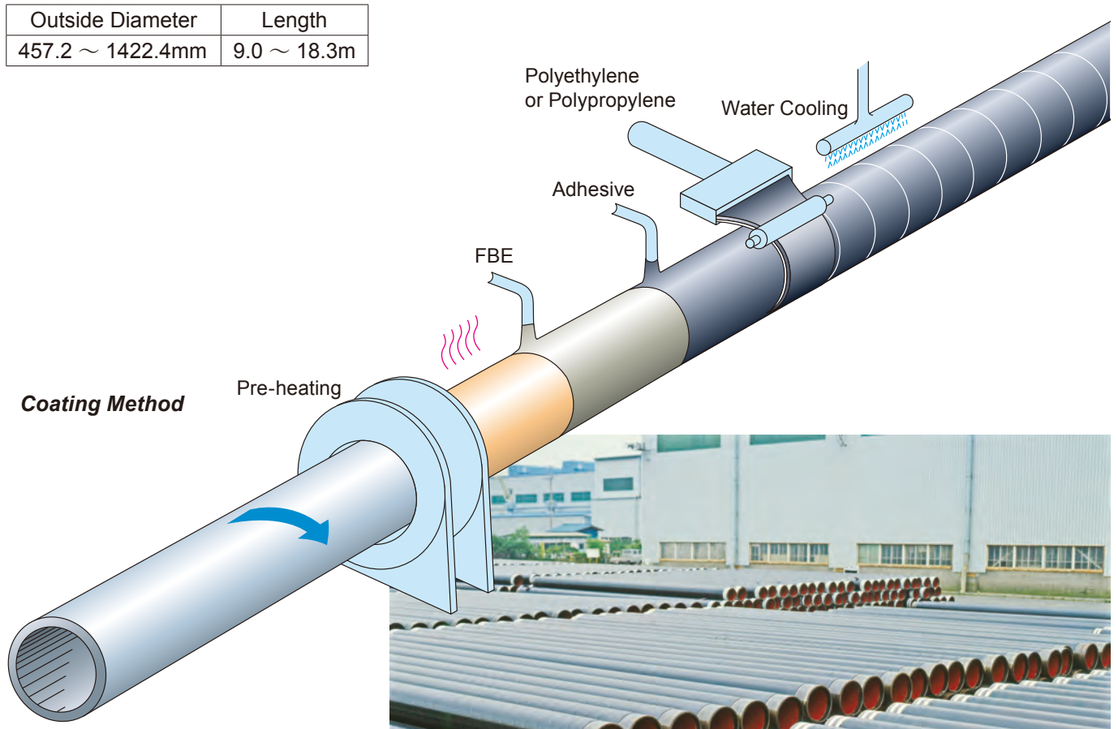
The external coating of UOE pipe is applied by extrusion of polyethylene or polypropylene resins using T-dies. NIPPON STEEL started production of external coating UOE pipe in 1974, the first example in Japan. Since then, external coated large-diameter pipe has been finding widening application as oil 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 or polypropylene layer. It exhibits good adhesion to the base metal and is excellent also in electric isulating properties, weathering resistance and resistance to chemicals.

Available Size

Outside Diameter	Length
457.2 ～ 1422.4mm	9.0 ～ 18.3m

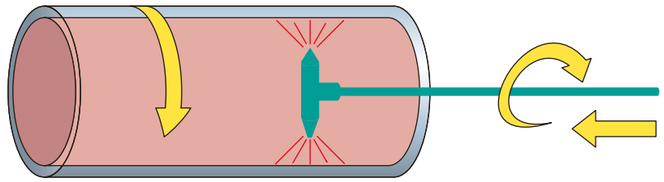
Coating Method



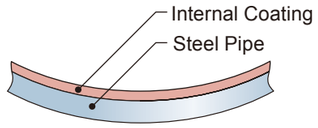
Internal Coating

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

Coating Method

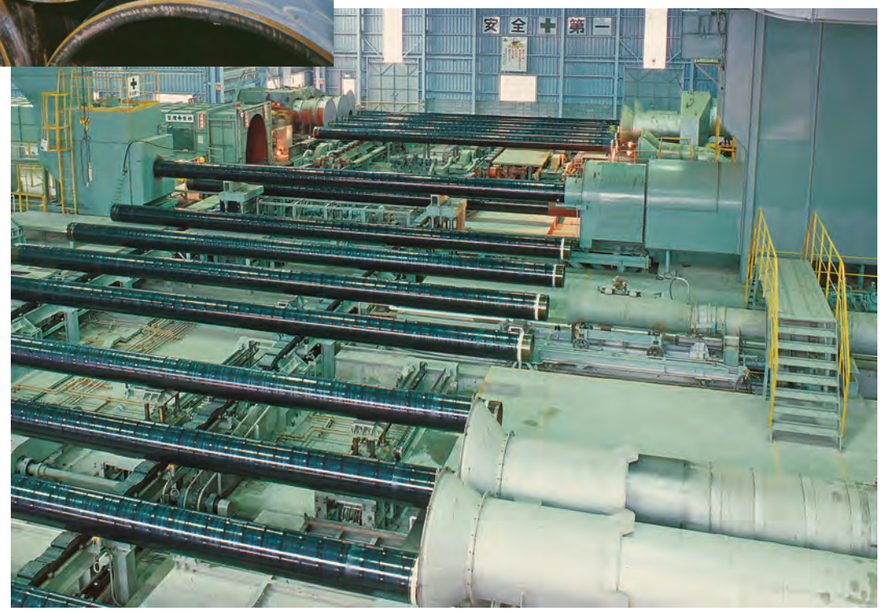


Liquid epoxy resin pipe



Available Size

Outside Diameter	Length
457.2 ～ 1422.4mm	9.0 ～ 18.3m



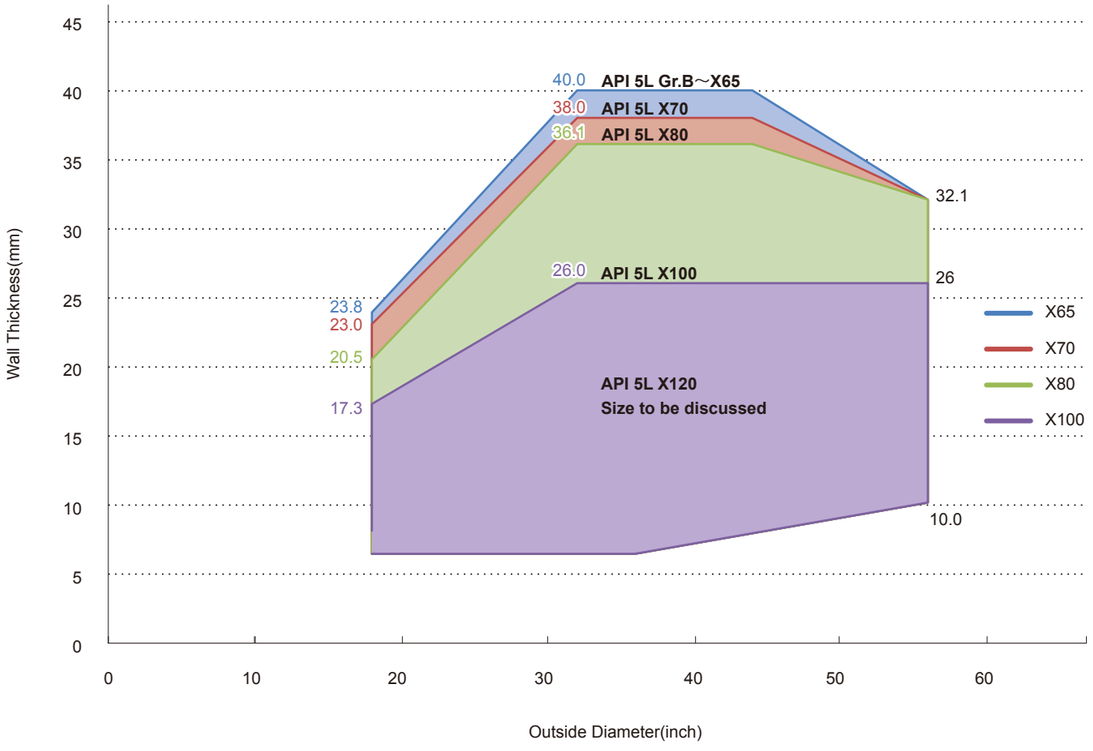
Liquid epoxy resin mill

SIZE RANGE OF UOE PIPE

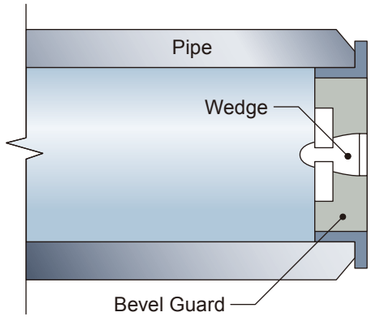
NIPPON STEEL UOE pipe mills produces pipe with outside diameters from 18 inch to 56 inch. The equipment to produce such pipes reflects NIPPON STEEL's intent to meet the great demand for larger and heavier steel pipe.

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

Length:
NIPPON STEEL UOE pipe mill can produce pipes with lengths up to 60feet. 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

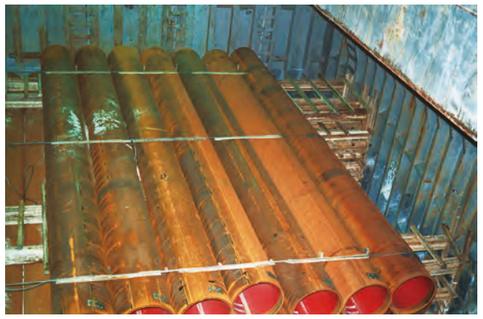


Special consideration and attention are given to the handling and storage of UOE pipe.Improper handling or storage results in damage such as scratches, deformation, fatigue cracks and so on.

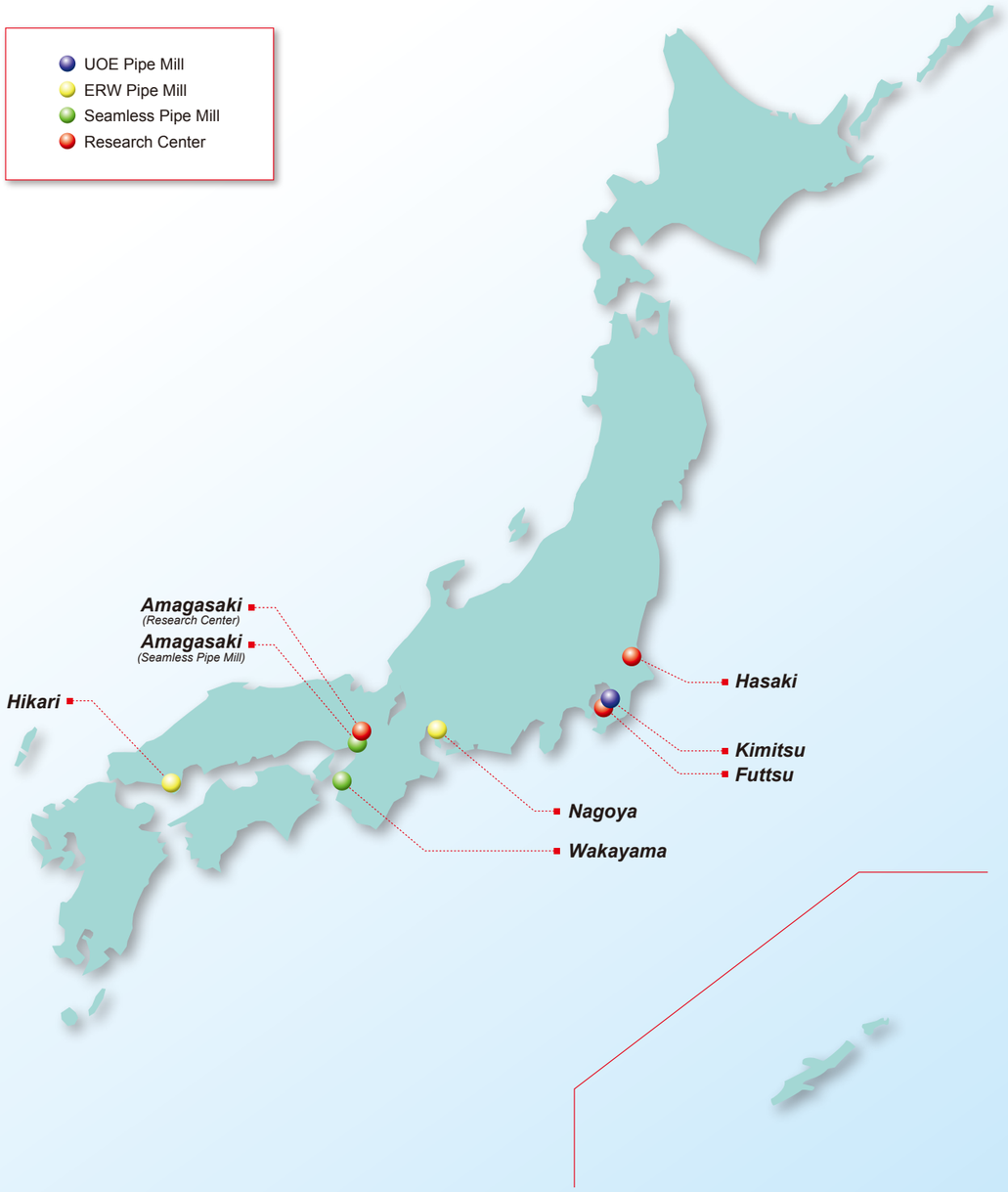
End Protection:
The ends of UOE pipes are protected by steel bevel guards.The bevel guard is fitted so as not slip off in transit, but can be easily removed and refitted wherever necessary.

Handling:
Pipe-handling crane hooks are cushioned and specially designed to prevent pipe-end damege.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 damege such as deformation and fatigue cracking,stowing is performed strictly in accordance with NIPPON STEEL's own standards which are more rigorous than API RP5LW.



FACILITIES AND LOCATIONS



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