MARILLOY S-400 Pipes, 1%Cr Steel for Cargo Oil and Water Ballast Pipes

Nippon Steel Corporation
Overview

1. Features of Mariloy

2. Why Mariloy is good

3. Investigation result of Mariloy
Overview

1. Features of Mariloy

2. Why Mariloy is good

3. Investigation result of Mariloy
Features of MARILLOY S-400 Pipes

1. Chemical composition: 1% Cr

2. Manufacturing processes: SML, ERW, UO

3. Available length: up to 15 m
   (SML: 5.5 or 6.0m, ERW: 9-12m, UO: 9-15m)

4. Corrosion Resistance:
   Better pitting corrosion and erosion resistance than 1% Cr cast steel in cargo oil and water ballast pipes environment

5. Workability:
   enough for expanding, bending. Plates for fittings (elbows, reducers) can be supplied.

6. Weldability:
   Good weldability owing to chemical composition of low carbon
# Mechanical Properties of MARILLOY S-400 Pipes

<table>
<thead>
<tr>
<th>Tensile Test</th>
<th>UO (JIS G 3457 STPY400 basis)</th>
<th>ERW (JIS G 3454 STPG410 basis)</th>
<th>SML (JIS G 3454 STPG410 basis)</th>
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<tbody>
<tr>
<td>Specification</td>
<td>Example</td>
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<tr>
<td>Tensile Strength</td>
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<td>400MPa, min</td>
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<td>(16mm, max)</td>
<td>19%, min</td>
<td>23%, min</td>
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<td>(16mm, over)</td>
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<td>t/D: 8%, over</td>
<td>2/3D, max</td>
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**Standard Size of MARILLOYS S-400 Pipes**

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<th>Wall Thickness (mm)</th>
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- **SML**: Minimum lot is 4 tons for standard size.
- **ERW**: Minimum lot is 5 tons. Standard size only. Length is limited to be 9 to 12m.
- **UO**: Minimum lot is 5 tons. Length can be 9 to 15m.
Overview

1. Features of Mariloy

2. Why Mariloy is good

3. Investigation result of Mariloy
**Why Mariloy is good?**

**Present:** Long carbon steel pipe coated with tar epoxy resin paint on the inner surface of the pipe.

**Proposal:** Long Mariloy S-400 pipe without a coating on the inner surface of the pipe.
Why Mariloy is good?

Merit for ship-builders:
As no flange, no coating on the inner surface in fabrication and maintenance

1) Cost and time can be reduced

2) Ecological

3) Reliability

Merit for ship-owners
1) Maintenance free
you will be able to use pipes for over 30 years
(our estimation)
Supply Records of MARILOY S-400 Pipes
of course “NO LEAK”

- Total 40,286 tons
- Total 146 tankers
Users of MARILLOY S-400 Pipes

1. Ship-building Companies

- IHI MARINE UNITED,
- SUMITOMO HEAVY INDUSTRIES,
- UNIVERSAL SHIPBUILDING CO. ,
- NAMURA SHIPBUILDING CO. ,
- MITSUBISHI HEAVY INDUSTRIES (JPN)
- HYUNDAI HEAVY INDUSTRIES,
- DAEWOO SHIPBUILDING(KOR),
- NACKS, OTHERS(CHINA),
- KEPPEL, JYURONG,(SINGAPORE)
Users of MARILOY S-400 Pipes

2. Ship-owners

Japan:

NIPPON YUSEN K.K, KYOEI TANKER CO.,
TOKYO KISEN CO., IINO KAIUN KAISYA,
NISSHO KISEN CO., MITSUI O.S.K. LINES,
SHINWA KAIUN KAISYA, TAIHEIYO KAIUN CO., IDEMITSUI

Oversea Countries:

PULTAMINA, NAVIX, GROVAL TRANSPORT ENTERPRISE,
WORLD WIDE, ONASSIS, GLAFKI MARITIME COMPANY,
FORMOSA, FRONTLINE, SINYCALIERO, SUN ENNTH,
SOPONATA, DYNACOM TANKERS, DSD SHIPPING,
PREDEUS SHIPPIG, NANFUNK, PETRONAS
Overview

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Investigation of Mariloy Pipes used in a tanker for a Long Time
Investigated Tanker and Operating Conditions

1. Tanker
   Tanker Name: TOHZAN (ex-COSMO ASTREA) / Kyoei Tanker
   Building Date: November 1992
   DWT: 230,000
   Mariloy Pipe: UO/341 tons, BR/43 tons, ERW/15 tons

2. Operating Conditions
   9 times a year, between Middle East and Japan
   [Middle East to Japan] Cargo oil pipe and tank = filled with crude oil
       Water Ballast Pipe = empty, however, wet
   [Japan to Middle East] Cargo oil pipe and tank = empty, however, wet
       Water Ballast Pipe = filled with sea water

3. Investigation Time
   After 2.5, 7.5, 12.5 and 15 years
Inspection After 2.5, 7.5, 12.5 and 15-Years Services

Main cargo oil pipe: pump room to No.4 oil tank about 100 m in length of 750Ax19mmt UO pipes
Water ballast pipe: pump room to No.4 oil tank about 100 m in length of 650Ax17mmt UO pipes
Inspection Method

Wall thickness of pipes were continuously measured by using ultrasonic testers.

Inside of pipes were visually inspected and the depth of pitting was measured using depth gauge.
Inspection result for cargo oil pipes
Inside of Cargo Oil Pipe
After 2.5 Years
Inside of Cargo Oil Pipe
After 7.5 Years
Inside of Cargo Oil Pipe
After 12.5 Years
Inside of Cargo Oil Pipe
After 15 Years
Pit with Maximum Depth (5mm) After 15 years - Service
Pit with Maximum Depth(5mm) After 15 Years-Service
The corrosion product is close to that usually observed in cargo oil carbon pipes and tanks, except the existence of Cr. The good corrosion resistance of Mariloy pipe may come from Cr-containing oil coat.
Comparison of Corrosion Rate of Mariloy with 1% Cr Cast Steel in Cargo Oil Pipe

If the corrosion rate of Mariloy is the same as that of 1%Cr cast steel, the corrosion depth of Mariloy is less than 7mm even after 30-years service.
Inspection result for water ballast pipes
Inside of Water Ballast Pipe After 7.5 and 12.5 Years

After 7.5 years (Water ballast pipe in pump room)
About a half of surface was covered with rust and the other half was covered with mill scale.

After 12.5 years (Water ballast pipe in cargo oil tank)
The surface was fully covered with rust. Dark spots were wet portion.
Inside of Water Ballast Pipe After 15 Years
Inside of Water Ballast Pipe After 15 Years
Inside of Water Ballast Pipe After 15 Years

Before Hammering

After Hammering

There is no pit under the rust; General Corrosion

Ultrasonic measurement of wall thickness: max. 3.2mm loss
Investigation of a water ballast pipe removed after 15 years service

Appearance
Inside of water ballast pipe after shot blasting
Conclusions of Investigation

1. Cr-containing oil coating may give Mariloy good corrosion resistance to cargo oil environment.

Inspection after 15 years service showed that Mariloy pipe could be used without painting over 30 years in cargo oil pipe environment.
2. There is no pit in the inside of water ballast pipe, though all surfaces rusted. That means that general corrosion occurred.

As the maximum loss in wall thickness is 3.2mm maximum after 15 years, Mariloy can be used without painting over 30 years also in water ballast pipe environment.
REVIEW

1. Features of Mariloy

2. Why Mariloy is good

3. Investigation result of Mariloy
Conclusions

1. **Good Corrosion Resistance**
   
   Inspection after 15-years service showed that Mariloy S-400 pipe could be used without painting over 30 years in cargo oil pipe and in water ballast pipe environments.

2. **Merit of Using Mariloy S-400 Pipe**
   
   Using Mariloy S-400 gives you an economical and ecological solution;
   
   vs carbon steel pipe with painting: reduction in the fabrication and maintenance cost and time, and solution to regulation of harmful paints.
Fabricating
Fittings of Mariloy Pipes

45° Elbow        90° Elbow        Reducer

Fittings of Mariloy are produced by BENKAN  JPN  .
Induction Bends

Sketch of HF induction Bending Machine

DAI-ICHI HIGH FREQUENCY CO., LTD.
Welding Materials for MARILOY Pipes

<table>
<thead>
<tr>
<th>Type</th>
<th>Brand Name</th>
<th>Diameter (mm)</th>
<th>Shield Gas</th>
<th>Chemical Composition (%)</th>
<th>Mechanical Properties of Weld Joint</th>
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<tbody>
<tr>
<td>Shielded Metal Arc Welding Rod</td>
<td>RS-55</td>
<td>3.2, 4.0, 5.0, 6.0</td>
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<td>0.05, 0.53, 0.57, - , 1.00</td>
<td>500, 590, 28, 220 (at 0°C)</td>
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<td>Flux-cored Welding Rod</td>
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<td>0.06, 0.34, 1.07, 0.23, 1.09</td>
<td>462, 550, 28, 192 (at 0°C)</td>
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Weldability of Mariloy is almost the same as ordinary carbon steels. There is no need for pre-heating and post welding heat treatment. The welding consumables for Mariloy are produced by Niipon Steel & Sumikin Welding Co., Ltd.
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<tr>
<th>Sleeve Joint</th>
<th>Recommendation</th>
<th>Acceptable Combination</th>
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<tr>
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<td>Flange Joint</td>
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- **Welding materials for Mariloy**
- **Welding materials for carbon steel**
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<th>Dresser Joint</th>
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![Joint-3 with Paint](image.png)
Joint-4

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Conclusions

1. **Good Corrosion Resistance**
   Inspection after 15-years service showed that Mariloy S-400 pipe could be used without painting over 30 years in cargo oil pipe and in water ballast pipe environments.

2. **Merit of Using Mariloy S-400 Pipe**
   Using Mariloy S-400 gives you an economical and ecological solution;
   \textit{vs carbon steel pipe with painting:} reduction in the fabrication and maintenance cost and time, and solution to regulation of harmful paints.