KOBELCO CRANES NORTH AMERICA, INC.
*Reliability is the History of Quality*

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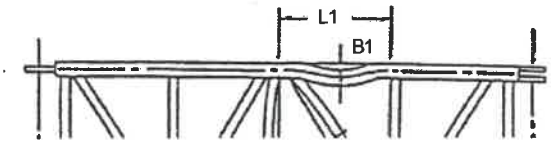
# KOBELCO CRANES NORTH AMERICA SERVICE INFORMATION

CLASSIFICATION 1.☐Improvement 2.☐Trouble Shooting 3.☒**Technical Information** 4.☐Parts Information

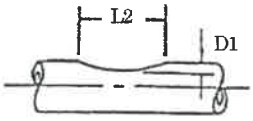
## Subject: Boom Repairing Memorandum

This material is to inform Useable limitations and Countermeasure against for damaged boom section for field engineer and/or inspector using purpose.

1. Useable Limitations.
   1) Main Chord.
      a. Bending. (B1)
         Within 3mm + (L1/2000)mm.

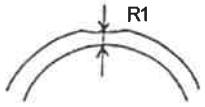



      b. Denting. (D1 / L2 / W1)
         Within 0.8mm / Within 30mm / Within 30mm.
         *D1 should not exceed 1% of pipe diameter.

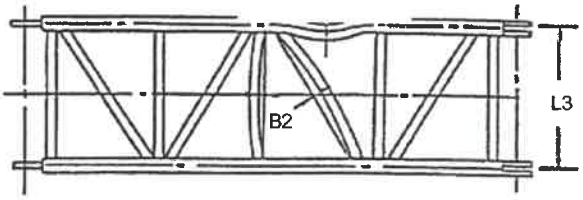




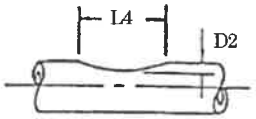
      c. Rubbing.
         Within 10% of thickness of pipe.

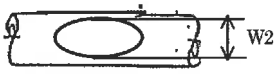



   2) Lacing Pipe.
      a. Bending. (B2)
         Within 2mm + (L3/2000)mm.

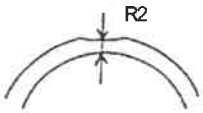



      b. Denting. (D2 / L4 / W2)
         Within 1.0mm / Within 15mm / Within 15mm.
         *D2 should not exceed 1% of pipe diameter.

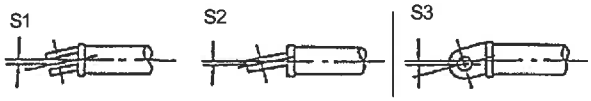


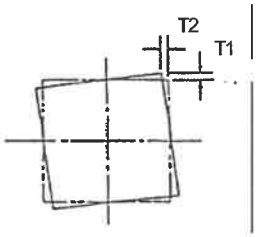

      c. Rubbing. (R2)
         Within 10% of thickness of pipe.



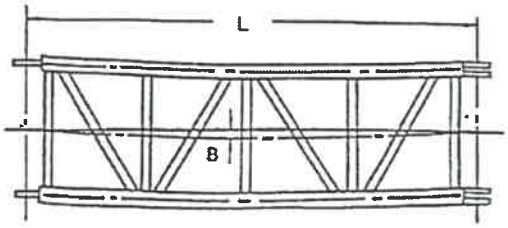
3) Connector.
   a. Slanting. (S1, S2 and S3)
      Within 0.8mm.




4) Boom.
   a. Twisting. (T1 and T2)
      Within 5mm.




   b. Bending. (B)
      Within 3mm + (L/2000)mm.




2. Countermeasures.
If the damaged part is out of useable limitation, you must follow instruction below.

1) Main Chord.
   a. Bending - - - > Replace boom section.
   b. Denting - - - > Replace boom section.
   c. Rubbing - - - > Replace boom section.

2) Lacing Pipe.
   a. Bending - - - > Replace damaged lacing pipe.
   b. Denting - - - > Replace damaged lacing pipe.
   c. Rubbing - - -> Replace damaged lacing pipe.

Remarks: Limit of replaceable lacing pipe is 30 % for number of equipped lacings on one surface of boom section.

3) Connector.
   a. Slanting - - - > Replace boom section.

4) Boom.
   a. Twisting - - - > Replace boom section.
   b. Bending - - - > Replace boom section.

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*NOTE*

*The welder for boom repair must be certified to the AWS 6GR standard.*

*The repair welding part shall be required certification of magnetic flux test (MT) result.*

*Kobelco Cranes North America Inc.*

**KOBELCO CRANES NORTH AMERICA** January 1, 2005

# PRODUCT SUPPORT BULLETIN 002

## Boom Repair Procedures.

Lattice boom crane sections are occasionally damaged, often through handling when the crane is being disassembled or transported. The crane's boom must be in excellent condition for the machine to perform as it is designed. Therefore, it is the obligation of everyone involved in the cranes usage and maintenance to insure that the boom assembly is free from damage or defect.

Attached are our published instructions on boom inspection and repair. These instructions provide specific criteria for inspecting the condition of the boom assembly as well as instructions for repairing the boom if it is found to be damaged.

Boom repair welding can be done by a local, certified welder arranged either by dealer or customer. This welder should be certified to the AWS 6GR standard. In any case, the workmanship and liability for these repairs must be accepted by the welder and customer. Kobelco will accept no responsibility for the repair beyond the materials it has provided.

Kobelco Cranes will supply boom lacing through our Parts Department. We offer bulk lacing as well as specific pieces.

If you have any question or concern, please do not hesitate to contact us.

Scott Emmans
Manager
Service & Parts Operations

# 1. INTRODUCTION

## 1.1 GENERAL

Kobe Steel Ltd. provides a worldwide boom repair service using certified welders. We recommend that certified welders do boom repairs whenever possible. Contact your local KOBELCO Dealer to arrange for the services of a welder.

This procedure is provided as a guide to aid users in the proper repair of lattice boom sections when our welders are not available.

### IMPORTANT

Repairs made by other than a certified welder are responsibility of the organization or person performing the repair. Kobe Steel Ltd. and its authorized dealers assume no liability for claims resulting from failures traceable to such repairs.

These instructions pertain to repair of laced bases, inserts, masts and jib sections. Instructions apply to both tubular and angle chord booms.

For repairs other than replacing lacing, as covered herein, contact the local KOBELCO Dealer Service Department.

Repairable Conditions Which Must Be Corrected:

- Broken, bent, kinked or missing lacings.
- Cracks in welds or braces other than chord members.

The inspection and Repair Procedures for Lattice Boom Sections cover the identification, inspection and repair of boom and jib sections manufactured by Kobe Steel Ltd., which has experienced certain specific types of damage.
The supporting lattice work and main chords on crane boom attachments must meet the requirements criteria for main chords, i.e. straightness, dents, dimples, corrosion, or abrasion.

## 1.2 WARNINGS, CAUTIONS AND NOTES

WARNINGS, CAUTIONS and NOTES are used throughout this manual to emphasize important and critical instructions. For the purpose of this manual, WARNINGS, CAUTIONS and NOTES are defined as follows:

**WARNING** — An operating procedure, practice, etc., which, if not correctly followed, could result in personal injury, or loss of life.

CAUTION — An operating procedure, practice, etc., which, if not strictly observed, could result in damage to, or destruction of, equipment.

NOTE — An operating procedure, condition, etc., which is essential to highlight.

## 1.3 BOOM MATERIALS

KOBELCO booms are made of various high quality materials. To insure that replacement material is of the proper strength and size, it should be obtained from authorized KOBELCO dealers.

Individually coped lacings are recommended to be and can be obtained from any KOBELCO dealer by giving the part number and serial number of the boom section to be repaired, along with the machine model and serial number. Physical location of the lacings to be replaced can be identified by referring to the Appendix at the rear of this manual.

Bulk lacing material may be obtained from any

KOBELCO dealer by giving the part number and serial number of the boom section to be repaired, along with the machine model and serial number.

For a clear description of the required lacings, please refer to the Appendix.

NOTE

Typical boom marking showing the boom part number and serial number is shown in Fig. 1–1.

## IDENTIFICATION CODE

Factory Code Markings

◈ , ◈ T , ◎ , H

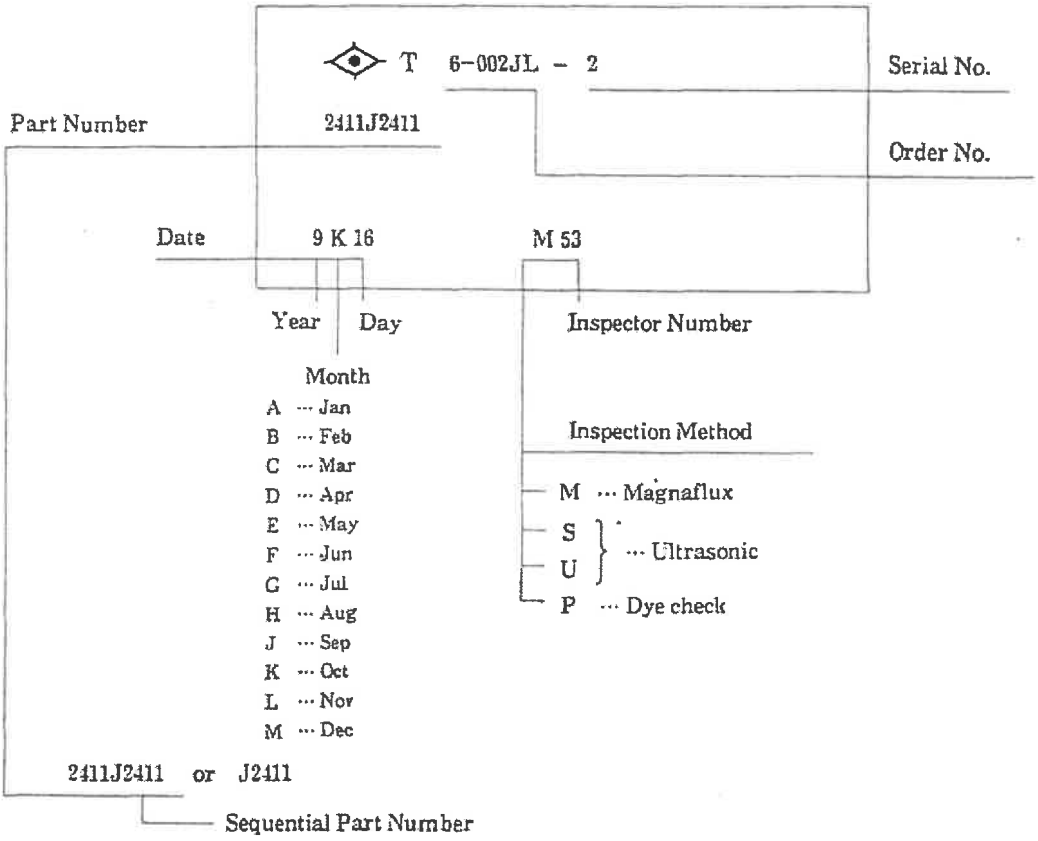
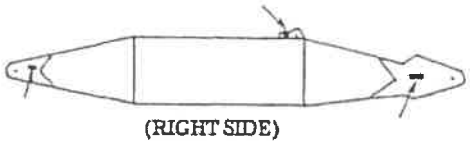



Fig. 1–1

For the location of the markings, refer to the Appendix on page A–2.



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Book code No.
S5 G008 01E

KOBELCO

# SHOP MANUAL

## GENERAL (8)
## BOOM SECTION REPAIR

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KOBE STEEL, LTD.

| Revision | Applicable Machine | Date of Issue | Book Code No. |
|---|---|---|---|
| 1st Edition | ALL | 1991, 03 | S5GO0801E Ⓥ |
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# 2. BOOM SECTION REPAIR

## 2.1 WELDING MATERIALS

Welding electrodes to be used must be high quality, dry and low-hydrogen type-Approved electrodes are AWS E-7018 and JIS D 5016.
Recommended electrode sizes are 2.4mm(3/32" ) diameter or 3.2mm(1/8" ) diameter.

### NOTE

Do not use electrodes larger than 3.2mm(1/8" ) diameter, as the thin lacing walls make it extremely difficult to prevent burn through when using large electrodes.

Electrodes must be purchased in 10 pound (approx. 4.5kgs) hermetically sealed containers and maintained in their "as manufactured" condition until used. Once opened, these electrodes must be warmed up to 300℃(572° F) to 350℃(662° F), and kept in a weld rod holding oven for one hour, after that the electrodes must be kept at 100 ℃(212° F) to 150 ℃(302° F) until used.
No more than a two hour supply be exposed to the atmosphere at any one time.

All welding shall be done with direct current reverse polarity (DCRP) or alternate current (AC). Welding equipment must be capable of delivering 200 amperes minimum.

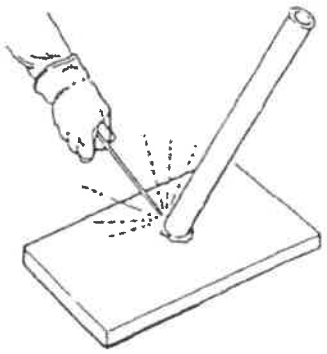
## 2.2 WELDER QUALIFICATION

Boom sections on a mobile crane are constructed from special alloy and heat treated steels requiring exact fit-up and welding skills.

Only an experienced, skilled and fully qualified welder may repair booms.

Practice before boom welding is very desirable. Since lacing material is for the most part, thin wall, high tensile strength material, a very delicate touch and a high degree of skill are required to produce the weld joint between the heavier chord member walls and thin wall lacing material. It is recommended that damaged lacing material removed from the boom section to be repaired be used for welding practice. Weld the removed lacing material to 10mm(0.4" ) thick plate to obtain "feel" for the welding and proper welding machine settings (see Fig.2-1).

Step 1. Weld removed portion of damaged lacing to 10mm(0.4" ) thick plate.



Step 2. Cut off lacing

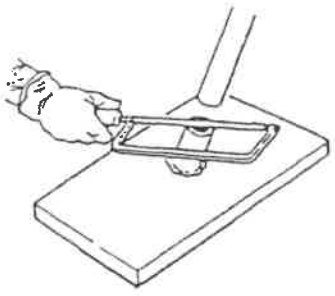


Fig. 2-1 Practicing Welding Technique
(to be continued)

Step 3. Do it again until settings and techniques are correct.

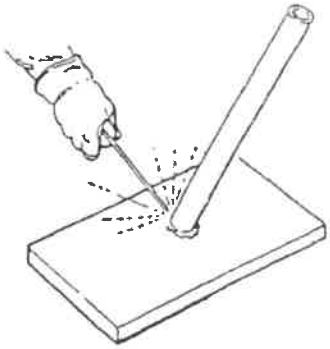


Fig. 2–1 Practicing Welding Technique (continued)

## 2.3 EXTENT OF REPAIR

No welding shall be done on the corner structural members (referred to as chords) except to attach lacing members (see Fig.2–2). No chord shall be replaced in whole or in part.

Heat shall not be used to straighten chords or lacings.

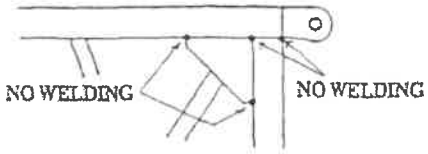



Fig. 2–2

The extent of repair in a factory authorized by Kobe Steel Shall be limited to the lacings shown in the classification of A and B in Table 2–1.

A: Number (%) of repairable lacings, which can not be used, on one side of the top, bottom and sides (four sides) of the boom section.

B: Number of repairable lacings, which are gathered to the chord (marked with ○ in Fig.2 –3) and which cannot be used, of the two sides of the boom section.

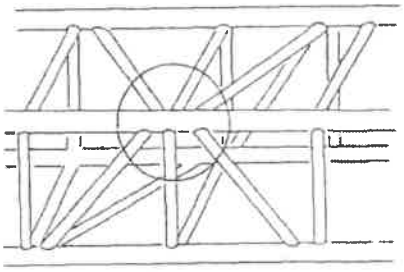


Fig. 2–3

Table 2–1. Extent of Boom Repair

| Contents of Repair | | | Authorized Factory | KOBELCO Factory |
|---|---|---|---|---|
| Repair and replacement of chord | | | Not approved | Not approved |
| Lacings | Boom, under 50tons of crane capacity | A | Less than 30% | Less than 40% |
| | | B | Less than 3 lacings | Less than 5 lacings |
| | Boom, more than 50tons to under 100tons of crane capacity | A | Less than 20% | Less than 30% |
| | | B | Less than 2 lacings | Less than 4 lacings |
| | Boom, more than 100tons to under 200tons of crane capacity | A | Less than 10% | Less than 20% |
| | | B | One lacing only | Less than 3 lacings |
| | Boom, more than 200tons of crane capacity | A | Not approved | Less than 10% |
| | | B | Not approved | Not approved |
| Repair and replacement of diaphragm | | | Not approved | Approved |
| Replacement of clevis | | | Not approved | Approved |

NOTE: Total number of repaired lacings in repairs of several times shall not exceed the above standard.

To insure structural integrity of the boom section, after repair, the chords shall meet the overall straightness requirements of Table 2-2 on page 2-3. In addition, the individual chords and lacings shall meet the requirements of Table 2-3 on page 2-5. as measured between any two adjoining panel points (see Fig.2-4).

These dimensions can be checked with a tightline or straightedge, and shall be checked in two directions, 90 degrees apart.

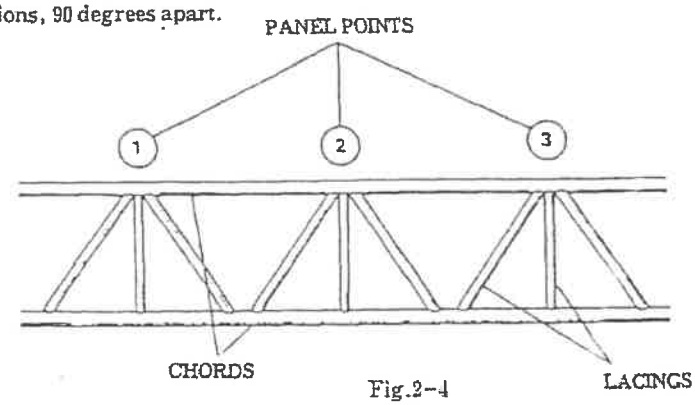
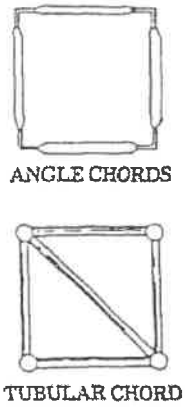



Fig.2-4

All bent lacings must be replaced, since they pull the chords out of true alignment and can cause deflections in the chords which can contribute to failure of the boom/jib section.




Smooth sweep bends in lacings may be straightened by jacking them back into alignment, taking extreme care not to kink or further damage bent lacings. If a lacing cannot be straighten within $b_2 = 2mm + (\ell_2/2000)mm$ (where, $b_2$: amount of lacing bend, $\ell_2$: sectional width of boom), it must be removed and replaced. Lacing with a uniform bend/curvature not in excess of a ratio of 30mm in 1 meter (1 inch in 36 in.) may be straightened. Bend/curvature in excess of this amount requires replacement of lacings.

Angular distortion(twist), $d_1$, shall be no more than 1.5mm(1/16 in.) for a 3 meters (10 ft.) section or 3.0mm(1/8 in.) for longer sections (see Fig.2-5).

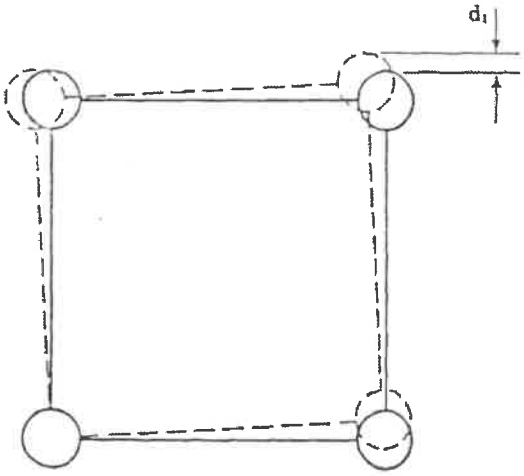



Fig. 2-5 Angular Distortion (Twist)

Table 2-2. Overall Main Chord Straightness

| Chord Length | Maximum Deviation over Length of Chord |
|---|---|
| 3 meters(10 ft.) or less | 5mm (0.20 in.) |
| Over 3 meters(10 ft.) upto and including 9 meter(30 ft.) | 6mm (0.24 in.) |
| Over 9 meters(30 ft.) upto and including 15 meter(45 ft.) | 10mm (0.40 in.) |

Dents or dimples in tubular chords shall not exceed those dimensions shown in Fig.2-6 and Table 2-4 on page 2-6. There shall be no more than 2 dents between panel points (see Fig.2-4) and defects shall be at least 150mm(6 inches) apart.

Corrosion or abrasion damage to chords shall not exceed the depth shown in Table 2-5 on page 2-12 and illustrated as dimension $d_5$ in Fig.2-7. Corrosion or abrasion which is not deeper than the values of the last column of Table 2-5 can be disregarded.

The sum of the greatest dimensions of all corrosion or abrasion defects between panel points (see Fig.2-4 on page 2-3) shall not exceed those values shown in Table 2-5. An example of this dimension is shown as $d_3$ in Fig.2-7.

## 2.4 TUBULAR BOOM LACING REPAIR PROCEDURE

Once a full and detailed inspection of the entire boom has been performed, and those lacing members that need to be replaced or straightened have been identified, the lacing replacement procedure for tubular chord boom is as follows:

1. If at all posible, replace only one lacing at a time and complete the repair before removing another so as to maintain the original chord alignment. If there is extensive damage and more than one lacing must be replaced at one time, extreme care must be used to hold the chord in alignment, both vertically and horizontally, during replacement. All damaged lacings must be replaced with tubing of equivalent material and properties, size and wall thickness as original.

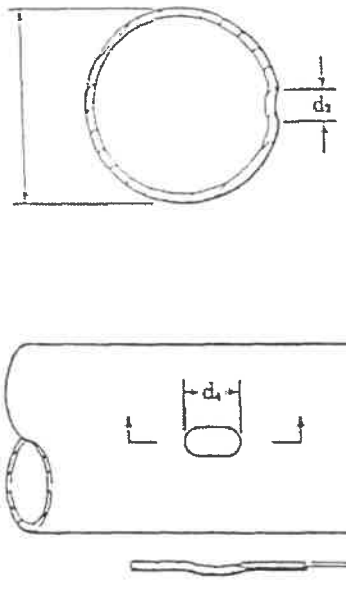



Fig. 2-6 Dents or Dimples

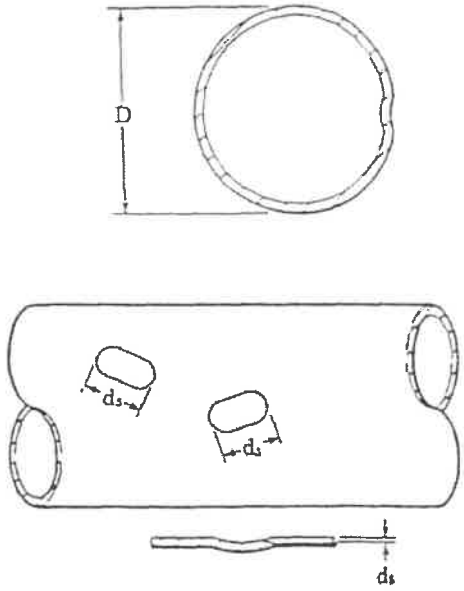



Fig. 2-7 Corrosion or Abrasion

Table 2–3. Main Chord Straightness between Panel Points

| TUBE DIAMETER OR SHORTER LEG OF ANGLE LESS THAN | | MAXIMUM DEVIATION BETWEEN PANEL POINTS | |
|---|---|---|---|
| mm | (Inches) | mm | (Inches) |
| 50 | (2) | 1.6 | (0.062) |
| 60 | (2.25) | 1.7 | (0.068) |
| 70 | (2.75) | 2.0 | (0.080) |
| 75 | (3) | 2.2 | (0.086) |
| 80 | (3.25) | 2.3 | (0.092) |
| 90 | (3.5) | 2.5 | (0.089) |
| 95 | (3.75) | 2.6 | (0.10) |
| 100 | (4.5) | 2.8 | (0.11) |
| 110 | (4.25) | 2.9 | (0.12) |
| 115 | (4.75) | 3.1 | (0.12) |
| 120 | (5) | 3.2 | (0.13) |
| 130 | (5.5) | 3.4 | (0.13) |
| 140 | (6) | 3.7 | (0.14) |
| 150 | (6.5) | 4.0 | (0.16) |
| 165 | (7) | 4.3 | (0.17) |
| 180 | (7.5) | 4.6 | (0.18) |
| 190 | (8) | 4.9 | (0.19) |
| 200 | (8.5) | 5.2 | (0.20) |
| 215 | (9) | 5.5 | (0.21) |
| 230 | (9.5) | 5.8 | (0.23) |
| 240 | (10) | 6.1 | (0.24) |
| 255 | | 6.4 | (0.25) |

NOTE: For an explanation of this table please refer to page 2–3.

Table 2–4. Dents or Dimples

| D TUBE DIAMETER | | $d_2$ DENT WIDTH | | $d_3$ DENT DEPTH | | $d_4$ DENT LENGTH | |
|---|---|---|---|---|---|---|---|
| mm | (Inches) | mm | (Inches) | mm | (Inches) | mm | (Inches) |
| 25 | (1) | 2.8 | (0.111) | See Note 2 below | | 4.6 | (0.182) |
| 30 | (1.25) | 3.5 | (0.139) | | | 5.8 | (0.227) |
| 40 | (1.5) | 4.2 | (0.167) | | | 6.9 | (0.237) |
| 45 | (1.75) | 4.9 | (0.194) | | | 8.1 | (0.318) |
| 50 | (2) | 5.6 | (0.222) | | | 9.2 | (0.364) |
| 60 | (2.25) | 6.4 | (0.250) | | | 10 | (0.409) |
| 65 | (2.5) | 7.1 | (0.278) | | | 12 | (0.455) |
| 70 | (2.75) | 7.8 | (0.306) | | | 13 | (0.500) |
| 75 | (3) | 8.5 | (0.333) | | | 14 | (0.545) |
| 85 | (3.25) | 9.2 | (0.361) | | | 15 | (0.591) |
| 90 | (3.5) | 9.9 | (0.389) | | | 16 | (0.636) |
| 95 | (3.75) | 11 | (0.417) | | | 17 | (0.682) |
| 100 | (4) | 11 | (0.444) | | | 18 | (0.727) |
| 110 | (4.25) | 12 | (0.472) | | | 20 | (0.773) |
| 115 | (4.5) | 13 | (0.500) | | | 21 | (0.818) |
| 120 | (4.75) | 13 | (0.528) | | | 22 | (0.864) |
| 130 | (5) | 14 | (0.556) | | | 23 | (0.909) |
| 140 | (5.5) | 16 | (0.611) | | | 25 | (1.00) |
| 155 | (6) | 17 | (0.667) | | | 28 | (1.09) |
| 165 | (6.5) | 18 | (0.722) | | | 30 | (1.18) |
| 180 | (7) | 20 | (0.778) | | | 32 | (1.27) |
| 190 | (7.5) | 21 | (0.833) | | | 35 | (1.36) |
| 200 | (8) | 23 | (0.889) | | | 37 | (1.45) |
| 215 | (8.5) | 24 | (0.944) | | | 39 | (1.55) |
| 230 | (9) | 25 | (1.00) | | | 42 | (1.64) |
| 240 | (9.5) | 27 | (1.06) | | | 44 | (1.73) |
| 255 | (10) | 28 | (1.11) | | | 46 | (1.82) |

NOTE: 1. For explanation of this table, refer to page 2–4.

2. $d_3$ should be less than one third thickness of tubular chord.

2. Tubular lacings to be replaced should be cut off mechanically, preferably with a hacksaw or disc grinder, directly above the fillet weld attaching it to the chord, leaving the original weld on the chord member.

Grind or file the remaining weld bead flush with the cord, using extreme care not to notch the chord or nick it in any way (see Fig.2-8).

NOTE

Lacings may be removed from heavier booms by careful use of the arc-air torch, slightly above the attaching fillet weld, again using extreme care not to damage the chord member in any way.

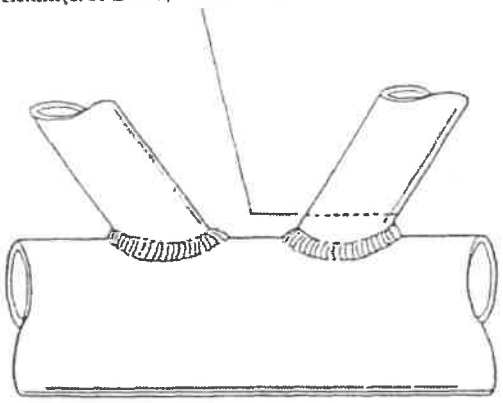



Fig. 2-8 Cutting Off Damaged Tubular Lacings

3. Remove the remaining material. Grind marks should be parallel to the chord to minimize the possibility of damaging the chord (see Fig. 2-9).

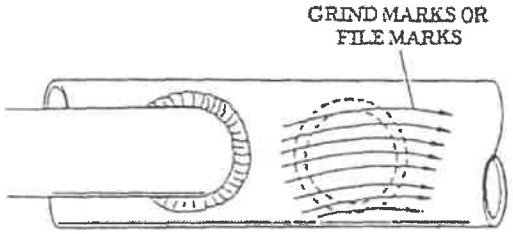



Fig. 2-9 Removing Remaining Material

NOTE

Due to the location of the lacing being removed in Fig.2-9, disc grinding the remoaining 1.5 mm(1/16 inch) of weld is difficult, if grind marks are to be kept longitudinal to the cord. Therefore, a large file should be used to remove the remaining 1.5mm(1/16 inch) weld. If no other member interferes with grinding, a fine grit disc grinder should be used. Note the direction of the grind marks in Fig.2-9.

NOTE

A smooth gouge free surface, as far as possible, is required on the chord before a replacement lacing is fitted into place.
Use emery cloth or a buff to polish the chord after grinding or filing.

4. When using bulk replocement lacings, cut the lacing to the proper length which will be 12mm(1/2 inch) longer than is actually required so as to leave sufficient material for contour fitting (see Fig.2-10 on page 2-8).

A. Hold a length of bulk lacing in proper a lignment with another undamaged lacing of the same length as the lacing to be replaced.

B. Cut at the points and at the angle shown in Fig.2-10.

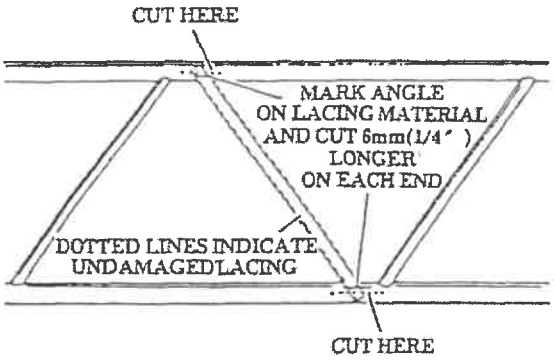



Fig. 2–10 Cutting Replacement Lacing

5. Cope the lacing as shown in Fig.2–11. Carefully contour fit the ends of the replacement lacing so that it fits within 1.2mm(3/64 inch) for the boom tip and base or within 0.8mm(1/32 inch) for the boom insert all around the join and a slight drive fit is required to aligh the lacing in its proper location (see Fig.2–11). This fitting is very important as excessive opening will result in greater weld metal deposit, excessive heat buildup which can materially weaken the joint and also result in very undesirable distortion and locked up stresses. Weld sizes required to attach the lacings to the chords can be determined by looking at the previous welds on the other unaffected joint on the boom. These will usually be from 3mm(1/8 inch) to 5mm(3/16 inch) leg size. It is extremely important that this fit and weld size be maintained so as not to induce a imbalance of weld shrinkage and locked up stresses.

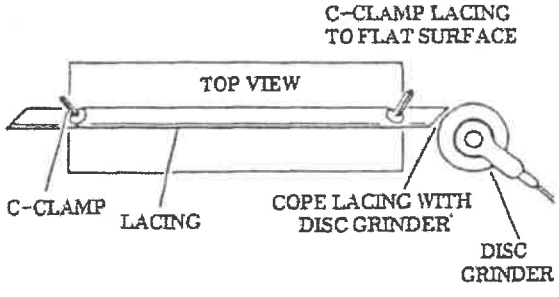



Fig. 2–11 Coping Lacing With Disc Grinder

NOTE

It is very important that the centerlines of the copes on each end of the replacement lacing be in the same plane (not twisted), to assure a good fit on both chords.

6. New lacings shall be installed in alignment with adjacent lacings. Accomplish this alignment by placing two straightedges on existing lacings, one on each side of the lacing being replaced. Clamp the straightedges firmly against existing lacings, bring the replacement lacing against the straightedges, and hold in this position while welding is performed (see Fig. 2–12).

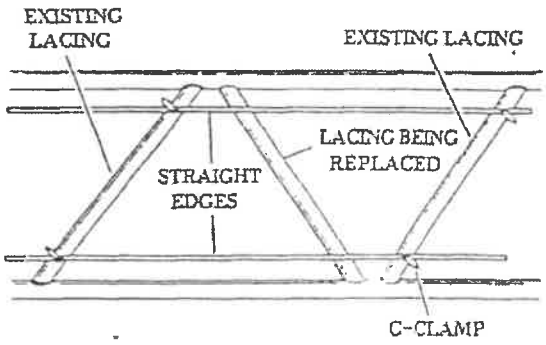



Fig. 2–12 Aligning Replacement Lacing

7. Welding must be performed in a dry, still atmosphere away from the wind, rain, and other adverse elements. If it is necessary to perform the weld outside a building, a suitable wind break or enclosure must be constructed over the area to be repaired.

All welding should be done in the flat or downhand position. The boom section should be rolled or turned to allow the welding to be done in this position.

Be sure that all grease, oil, water, and other contaminants are removed from the weld area.

Heat must be applied to the weld area very cautiously to bring the material within the recommended temperature range for welding. Use a temperature measuring device to determine maximum temperature.

The boom chords and lacings should be preheated to between 50 ℃(122° F) and 100℃(212° F) before starting to weld. Interpress temperature is to be no more than 200℃(392° F). Welding should never be performed on material colder than 20℃(68 ° F).

Each lacing weld should be performed in two distinct steps. Extreme care and skill are required for the proper overlap at the start and stop of the weld joints, or weld passes, so as not leave any unfilled craters, which are subject to crater cracks and weakening of the joint (see Fig.2–13). Do not weave the electrode while welding.

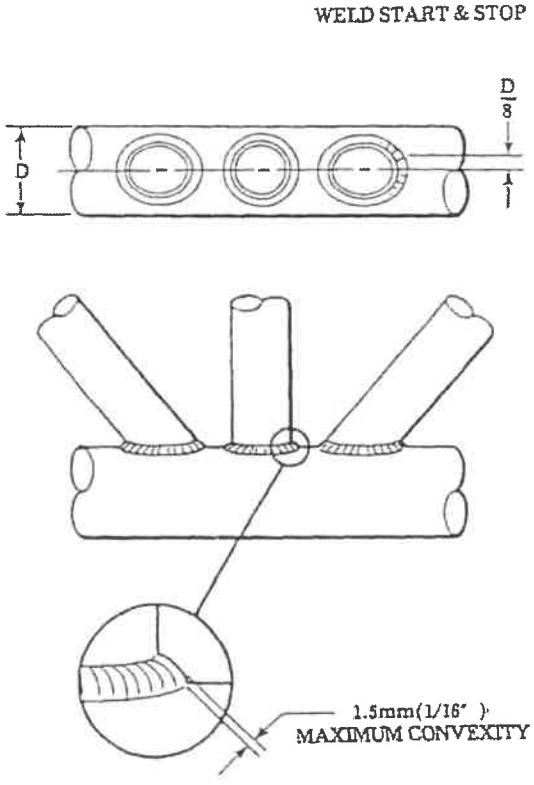



Fig. 2–13 Welding Lacings to Tubular Chord

Inspect completed welds as specified in the topic, Inspection, later in this section.

## 2.5 ANGLE CHORD BOOM LACING REPAIR PROCEDURE

Replacement of lacing in an angle chord boom section is similar in most respects to the procedure for lacing replacements in tubular chord boom sections. Only the differences will be discussed here.

Therefore, be sure to read the procedure for replacement of tubular boom lacings as well as this procedure. The major difference in the procedures is that the ends of the lacings must be crimped or flattened to permit proper fit–up with the edge of the angle chords (see Fig. 2–14).

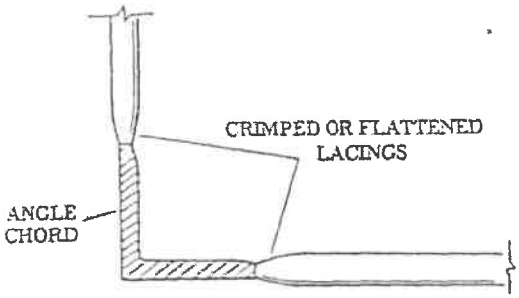



Fig. 2–14 Fit–up of Lacings to chord

Proceed in the following sequence.

1. Cut the lacing to be replaced off about 6mm(1/4 inch) above the weld, using a hacksaw, carbon arc torch, or disc grinder (see Fig.2–8 on page 2–7 and Fig.2–15 on page 2–10).

2. Disc grind the remaining lacing and weld material away until the angle is returned to its original shape (see Fig. 2–9 on page 2–7 and Fig. 2 –15).

3. Lacing ends must be flattened by pounding into the approximate shape shown in Fig.2–16 on page 2–10.

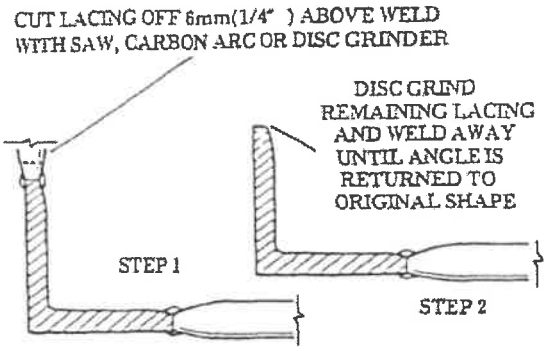



Fig. 2–15 Removing Damaged Lacing

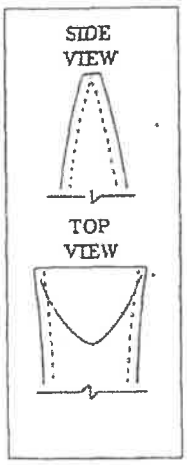



Fig. 2–16 Approximate Shape of Lacing Ends

4. When forming lacing ends with a hammer, the lacing will have a tendency to move backward. A holding device similar to the one shown in Fig.2–17 should be used to hold the lacing in place. This will make it easier to obtain the desired shape of the lacing end. Be sure that both ends of the lacing are flattened in the same plane (not twisted).

5. Determine the length of replacement lacings and the correct angle at which they should be cut by placing a length of lacing material against a lacing of identical construction in the boom section to be repaired. Mark the correct length and angle of cut needed and saw cut the lacing approximately 3mm (1/8 inch) longer than required.

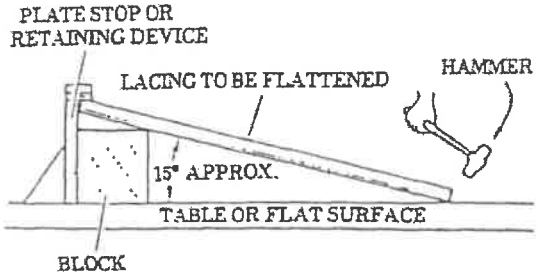



Fig. 2–17 Shaping Lacing Ends

6. Flatten the lacing ends as previously described, and check for correct fit in the position it will occupy in the boom section to be repaired. If necessary, grind the lacing end to the correct length and reshape the end which was ground off.

7. Make sure the lacing is placed in the exact position from which the damaged lacing was removed. Then tack weld the lacing to the chord angle on the side.

8. Weld the lacing in place, using the materials and techniques previously described in this manual (see Fig.2–18).

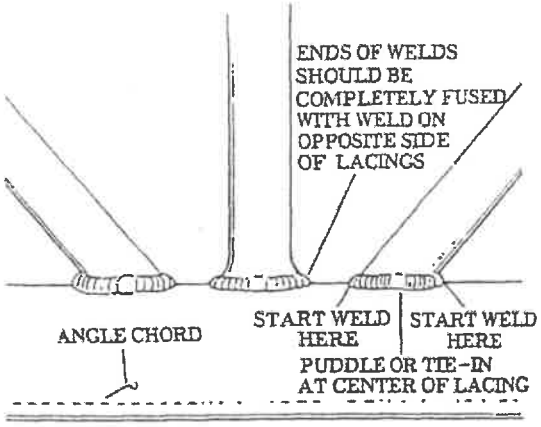



Fig. 2–18 Welding Lacings to Angle Cord

**CAUTION**

The "PUDDLE" or "TIE–IN" should not be concave. It must equal or exceed the contour of the rest of the weld.

## 2.6 INSPECTION

After welding repairs have been completed, a full visual inspection shall be made to assure that all craters are full, that there is no undercut around any of the weld, and that proper contours have been accomplished.

In addition, magnetic particle inspection or penetration inspection should be made.

Any defective weld shall be ground out and rewelded.

A full detailed report shall be made of the repair, including a serial number, its location, the date, the welder, and the circumstances under which the repair was made. This report should be forwarded to Kobe Steel regional office with photographs showing the damage before the repair.

Table 2–5. Corrosion or Abrasion(Tubular Chords)

| D TUBE DIAMETER | | $d_3$ SUM OF GREATEST PANEL POINTS | | $d_4$ MAXIMUM DEPTH ALLOWABLE | | DISREGARD UNLESS DEEPER THAN | |
|---|---|---|---|---|---|---|---|
| mm | (Inches) | mm | (Inches) | mm | (Inches) | mm | (Inches) |
| 25 | (1) | 6.4 | (0.25) | 0.2 | (0.008) | 0.08 | (0.003) |
| 30 | (1.25) | 7.9 | (0.31) | 0.2 | (0.009) | 0.10 | (0.004) |
| 40 | (1.5) | 9.5 | (0.38) | 0.3 | (0.011) | 0.11 | (0.005) |
| 45 | (1.75) | 11 | (0.44) | 0.3 | (0.013) | 0.13 | (0.005) |
| 50 | (2) | 13 | (0.5) | 0.4 | (0.015) | 0.15 | (0.006) |
| 60 | (2.25) | 14 | (0.56) | 0.4 | (0.017) | 0.17 | (0.007) |
| 65 | (2.5) | 16 | (0.62) | 0.5 | (0.019) | 0.19 | (0.008) |
| 70 | (2.75) | 17 | (0.69) | 0.5 | (0.021) | 0.21 | (0.008) |
| 75 | (3) | 19 | (0.75) | 0.6 | (0.023) | 0.23 | (0.009) |
| 80 | (3.25) | 21 | (0.81) | 0.6 | (0.024) | 0.25 | (0.010) |
| 90 | (3.5) | 22 | (0.88) | 0.7 | (0.026) | 0.27 | (0.011) |
| 95 | (3.75) | 24 | (0.94) | 0.7 | (0.028) | 0.29 | (0.011) |
| 100 | (4) | 25 | (1) | 0.8 | (0.030) | 0.30 | (0.012) |
| 110 | (4.25) | 27 | (1.06) | 0.8 | (0.032) | 0.32 | (0.013) |
| 115 | (4.5) | 29 | (1.12) | 0.9 | (0.034) | 0.34 | (0.014) |
| 120 | (4.75) | 30 | (1.19) | 0.9 | (0.036) | 0.36 | (0.014) |
| 130 | (5) | 32 | (1.25) | 1.0 | (0.038) | 0.38 | (0.015) |
| 140 | (5.5) | 35 | (1.38) | 1.0 | (0.041) | 0.42 | (0.017) |
| 150 | (6) | 38 | (1.5) | 1.1 | (0.045) | 0.46 | (0.018) |
| 165 | (6.5) | 41 | (1.62) | 1.2 | (0.049) | 0.50 | (0.020) |
| 180 | (7) | 44 | (1.75) | 1.3 | (0.053) | 0.53 | (0.021) |
| 190 | (7.5) | 48 | (1.88) | 1.4 | (0.056) | 0.57 | (0.023) |
| 200 | (8) | 51 | (2) | 1.5 | (0.060) | 0.61 | (0.024) |
| 215 | (8.5) | 54 | (2.12) | 1.6 | (0.064) | 0.65 | (0.026) |
| 230 | (9) | 57 | (2.25) | 1.7 | (0.068) | 0.69 | (0.027) |
| 240 | (9.5) | 60 | (2.38) | 1.8 | (0.071) | 0.72 | (0.029) |
| 250 | (10) | 64 | (2.5) | 1.9 | (0.075) | 0.76 | (0.030) |

For explanation of this table refer to page 2–4.

# Paint/Coating Inspection & Testing

General

1. Requirements
   A. Subcontractor and Sub Equipment Supplier shall grant Contractor's inspector free access to inspect all work performed by Subcontractor and their Suppliers.
   B. Subcontractor shall not initiate blasting and/or painting operations until the Contractor inspector has been notified.
   C. The following steps shall be subject to inspection by Contractor's representative:
      - Following surface preparation and immediately prior to the coating application.
      - Following the application and curing of each coat.
      - After final inspection and sign-off, in accordance with the specified requirements.
2. The Subcontractor shall furnish the necessary testing and inspection instruments, properly calibrated and maintained. Such equipment shall be available for use by Contractor in conducting surveillance of the work.
3. Prior to using compressed air, the quality of the air downstream of the separator shall be tested in accordance with ASTM D 4285. The test shall be performed at the beginning of each shift and at not less than 4-hour intervals. The test also shall be made after any interruption of the air compressor operation or as required by Contractor. The air shall be used only if the blotter test indicates no visible contamination, oil, or moisture. If contaminants are evident, the equipment deficiencies shall be corrected and the air stream shall be retested. Separators shall be bled continuously. All lines shall be tested individually prior to use. Surfaces, which are determined to have been blasted or blown down with contaminated air, must be cleaned of that contamination and re-blasted with clean air and abrasive.
4. Any defects disclosed by inspection shall be reinspected after correction.

Surface Preparation Inspection

1. The temperature, dew point, and relative humidity shall be determined with a sling psychrometer or an equal following procedures in ASTM E 337. Readings are required at the start of work and every four (4) hours and at the completion of the work, or at other time intervals approved in writing by Contractor. Alternatively, continuous monitoring shall be performed using systems established and/or accepted by the Contractor.
2. Degree of blast cleaned surfaces shall be determined by comparison to SSPC Visual Standard VIS 1 or to NACE Visual Standard #1. The profile depth shall be verified with a Kean-Tator Profile Comparator or Testex Press-O-Film in accordance with ASTM D-4417.

3. A grease-free chalk shall be used to mark local areas for re-blasting which do not meet specified standards.
4. Shot and grit used for abrasive cleaning shall be tested after use for the presence of oil by immersing in water and checking for oil flotation. Tests shall be made at the start of blasting, every four (4) hours thereafter, and at the end of blasting. If oil is evident, contaminated abrasive shall be replaced with clean abrasive and retested before proceeding. All steel blasted since the last satisfactory test shall be inspected and all contaminated steel shall be re-blasted.
5. Testing for soluble salts shall be conducted prior to commencing abrasive blasting. Extraction and assessment of the soluble salts shall be done in accordance with ISO 8501-6 and ISO 8502-9 or SSPC Guide 15, Section 4.6 and SSPC Guide 15, Section 5.3. Six samples per 2000 m2 shall be taken for immersion surfaces and 4 samples per 2000 m2 shall be taken for atmospheric surfaces. Acceptable average conductivity for immersion surfaces shall correspond to ≤ 20 mg/m2 and maximum conductivity shall correspond to ≤ 30 mg/m2. Acceptable average conductivity for atmospheric surfaces shall correspond to ≤ 30 mg/m2 maximum conductivity shall correspond to ≤ 40 mg/m2. Surfaces not in compliance with these limits shall be steam cleaned or fresh water washed and re-tested until the requirements are met.

Coating Inspection

1. Surface temperature and humidity readings shall be taken prior to application of each coat. The work shall not proceed if the ambient temperature parameters are outside the requirements of this Specification. The substrate temperature shall be at least 6°C above the dew point temperature.
2. The dry film thickness shall be tested with a Mikro-test FIM gauge or an accepted equivalent. The testing method shall be in accordance with SSPC PA-2.
3. After the application of each coat the surfaces shall be visually inspected and repaired. The following defects are not permitted:

| | | |
|---|---|---|
| Pinholes | Orange-Peel | Dry Spray |
| Blisters | Mud-Cracking | Contaminants |
| Bubbling | Runs and Sags | Mechanical Damage |
| Fisheyes | Holidays | Unmatched colors |
| Incomplete Cure | Abrasive Inclusions | Lack of Adhesion |
| Over-Spray | Lack of Hardness | Drips |
| Runs | Sagging | Powdering |

# Jotamastic 90

## Product description

This is a two component polyamine cured epoxy mastic coating. It is a surface tolerant, abrasion resistant, high solids, high build product. This product is tintable in a wide range of colours in Jotun's Multicolor Industry (MCI) system. Specially designed for areas where optimum surface preparation is not possible or required. Provides long lasting protection in environments with high corrosivity. Can be used as primer, mid coat, finish coat or as single coat system in atmospheric and immersed environments. Suitable for properly prepared carbon steel, galvanised steel, stainless steel, aluminium, concrete and a range of aged coating surfaces. It can be applied at sub zero surface temperatures.

### Scope

The Application Guide offers product details and recommended practices for the use of the product.

The data and information provided are not definite requirements. They are guidelines to assist with efficient and safe use, and optimum service of the product. Adherence to the guidelines does not relieve the applicator of responsibility for ensuring that the work meets specification requirements.
Jotuns liability is in accordance with general product liability rules.

The Application Guide (AG) must be read in conjunction with the relevant specification, Technical Data Sheet (TDS) and Safety Data Sheet (SDS) for all the products used as part of the coating system.

### Projects specified to the requirements in Performance Standard for Protective Coatings (PSPC)

For application and repair / maintenance requirements according to IMO MSC.215 (82) for dedicated Sea Water Ballast Tanks (WBT), and/or to IMO MSC.288 (87) for Cargo Oil Tanks of Crude Oil Tankers (COT) reference is made to the PSPC Appendix in this document.

### Referred standards

Reference is generally made to ISO Standards. When using standards from other regions it is recommended to reference only one corresponding standard for the substrate being treated.

## Surface preparation

The required quality of surface preparation can vary depending on the area of use, expected durability and if applicable, project specification.

When preparing new surfaces, maintaining already coated surfaces or aged coatings it is necessary to remove all contamination that can interfere with coating adhesion, and prepare a sound substrate for the subsequent product.

Inspect the surface for hydrocarbon and other contamination and if present, remove with an alkaline detergent. Agitate the surface to activate the cleaner and before it dries, wash the treated area using fresh water.
Paint solvents (thinners) shall not be used for general degreasing or preparation of the surface for painting due to the risk of spreading dissolved hydrocarbon contamination. Paint thinners can be used to treat small localized areas of contamination such as marks from marker pens. Use clean, white cotton cloths that are turned and replaced often. Do not bundle used solvent saturated cloths. Place used cloths into water.

#### Process sequence

Surface preparation and coating should normally be commenced only after all welding, degreasing, removal of sharp edges, weld spatter and treatment of welds is complete. It is important that all hot work is completed before coating commences.

### Soluble salts removal

Soluble salts have a negative impact on the coating systems performance, especially when immersed. Jotun's general recommendations for maximum soluble salts (sampled and measured as per ISO 8502-6 and -9) content on a surface are:
For areas exposed to (ISO 12944-2):
C1-C4: 200 mg/m²
C5: 100 mg/m²
Im1-Im3: 80 mg/m²

## Carbon steel

### Initial rust grade

The steel shall preferably be Rust Grade A or B (ISO 8501-1). It is technically possible to apply the coating to rust grades C and D, but it is practically challenging to ensure specified film thickness on such a rough surface, hence risk of reduced lifetime of the coating system. When steel of Rust Grade C or D is coated, the frequency of inspection and testing should be increased. For steel with Rust Grades C or D, contact your nearest Jotun office for advice.

### Metal finishing

For areas in corrosivity category C1 to C4 (ISO 12944-2) all irregularities, burrs, slivers, slag and spatter on welds, sharp edges and corners shall conform to minimum grade P2 (ISO 8501-3) Table 1, or as specified. For areas in corrosivity category C5 the requirement is conformance to grade P3 (ISO 8501-3) Table 1. Defective welds shall be replaced and treated to an acceptable finish before painting. Temporary welds and brackets shall be ground to a flat finish after removal from the parent metal.

### Pitting repair

Pittings in steel can be difficult to cover fully with most coatings. In some areas it is practically feasible to use filler to fill pittings. This should then be done either after the initial surface preparation or after application of first coat.

## Abrasive blast cleaning

### Cleanliness

After pre-treatment is complete, the surface shall be dry abrasive blast cleaned to Sa 2 (ISO 8501-1) using abrasive media suitable to achieve a sharp and angular surface profile.

### Surface profile

Recommended surface profile 30-85 µm, grade Fine to Medium G (ISO 8503-2).

### Abrasive media quality

The selected abrasive must be compatible with both the surface to be blast cleaned and the specified coating system. The abrasive shall meet specifications as per relevant parts of ISO 11124 (Specification for metallic blast-cleaning abrasives), or ISO 11126 (Specification for non-metallic blast-cleaning abrasives). It should be sampled and tested as per relevant parts of ISO 11125 (metallic abrasives) or ISO 11127 (non-metallic abrasives). Dry storage of abrasive and shelter for blasting pots is necessary to prevent equipment becoming clogged with damp abrasive.

All abrasive blast media used should be new and not recirculated, with the exception of steel grit. If this is utilized the circulation process must include a cleaning process.

### Compressed air quality

The supply of clean air to blasting pots must be secured to avoid contamination of abrasive and thereby of blast cleaned surfaces. Compressors must be fitted with sufficient traps for oil and water. It is also recommended to fit two water separators at the blasting machine to ensure a supply of moisture-free air to the abrasive chamber.

### Dust contamination

At the completion of abrasive blasting the prepared surface shall be cleaned to remove residues of corrosion products and abrasive media, and inspected for surface particulate contamination. Maximum contamination level is rating 2 (ISO 8502-3) as per Figure 1. Dust size no greater than class 2.

## Hand and Power Tool Cleaning

### Power tool cleaning

Surfaces to be coated shall be prepared by mechanical preparation methods to minimum St 2 (ISO 8501-1). Suitable methods are disc grinding, hand sanding or hand wire brushing. If power wire brushing is used, care should be taken not to polish the metal surface, as this can reduce adhesion of the coating. The surface should appear rough and mat.
Overlapping zones to intact coating shall have all leading edges feathered back by sanding methods to remove all sharp leading edges and establish a smooth transition from the exposed substrate to the surrounding coating. Consecutive layers of coating shall be feathered to expose each layer and new coating shall always overlap to an abraded existing layer. Abrade intact coatings around the damaged areas for a minimum 100 mm to ensure a mat, rough surface profile, suitable for over coating.

### Water jetting

High pressure water jetting surface preparation refers to ISO 8501-4, for substrates previously coated either with a full coating system (surface DC A, DC B, DC C) or shop primer (surface DP I and DP Z). The surface definition for existing coating (DC) refers to the degree of coating breakdown according to ISO 4628.
It is important before considering water jetting, to ensure that the specified coating system is compatible with the existing coating system. High pressure water jetting does not remove mill scale or create surface roughness, and is only useful for surfaces with an initial roughness suitable for the subsequent coat.
Optimum performance is achieved with preparation grade Wa 2½ (ISO 8501-4). Minimum preparation grade is Wa 1. For DP I and DP Z surface Wa 2 is accepted.
Maximum accepted grade of flash rust for any preparation is M (ISO 8501-4).
Alternatively minimum approved preparation grade is SSPC-SP WJ-2/ NACE WJ-2, Very thorough cleaning. Maximum accepted flash rust grade is Moderate (M).

## Galvanised steel

### Abrasive blast cleaning

The galvanised finish shall be smooth as is consistent for a protective coating and shall have no sharp fins, sharp edges, dross or zinc ash on the surface. If present, remove by mechanical cleaning methods.
After removal of excess zinc and surface defects the area to be coated shall be degreased to ISO 12944-4, Part 6.2.4 Alkaline Cleaning. The galvanised surface shall be sweep blast-cleaned with the nozzle angle at 45-60° from perpendicular at reduced nozzle pressure to create a sharp and angular surface profile using approved non-metallic abrasive media. As a guide, a surface profile 25-55 µm, grade Fine to Medium; Ry5 (ISO 8503-2) should be achieved.

### Hand and Power Tool Cleaning

After removal of excess zinc and surface defects the area to be coated shall be degreased with an alkaline detergent, washed by Low-Pressure Water Cleaning (LPWC) to a grade corresponding to the description of Wa 1 (ISO 8501-4) or higher standard and the surface abraded using mechanical or hand sanding methods using non-metallic abrasives or bonded fibre abrasive pads to remove all polish and to impart a scratch pattern to the surface. Do not use high speed rotational sanders.

## Aluminium

### Abrasive blast cleaning

After pre-treatment of welds, sharp edges, removal of weld spatter and other surface contamination the surface shall be degreased using an alkaline detergent which is agitated with non-metallic brushes followed by rinsing using clean fresh water. The surface shall then be dry abrasive blast cleaned with an approved non-metallic abrasive media to create a sharp and angular surface profile. As a guide, a surface profile between 25-55 µm, grade Fine to Medium G; Ry5 (ISO 8503-2) should be achieved.

### Hand and Power Tool Cleaning

After pre-treatment of welds, sharp edges, removal of weld spatter and other surface contamination the surface shall be degreased using an alkaline detergent which is agitated with non-metallic brushes and then fresh water rinsed. The cleaned surface shall be then hand or machine abraded with non-metallic abrasives or bonded fibre machine or hand abrasive pads to remove all surface polish and to impart a scratch pattern to the surface. Do not use high speed rotational sanders.

## Stainless steel

### Abrasive blast cleaning

After pre-treatment of welds, sharp edges, removal of weld spatter and other surface contamination the surface shall be degreased with an alkaline detergent, followed by rinsing using clean fresh water and dry abrasive blast cleaned to create a sharp and angular surface profile using approved non-metallic abrasive media. As a guide, a surface profile between 45-75 µm, grade Fine to Medium, Ry5 (ISO 8503-2) should be achieved.

### Hand and Power Tool Cleaning

After pre-treatment of welds, sharp edges, removal of weld spatter and other surface contamination the surface shall be degreased with an alkaline detergent, followed by rinsing using clean fresh water and hand or machine abraded with non-metallic abrasives or bonded fibre machine or hand abrasive pads to remove all polish and to impart a scratch pattern to the surface. Do not use high speed rotational sanders.

## Concrete

Concrete should be a minimum of 28 days old, applying any coating before this time will greatly increase the chance of the coating de-bonding. The moisture content of the concrete should be checked prior to the application of the coating and should not be greater than 5%. Concrete substrates should be mechanically prepared to leave a clean, sound and dry base on which a coating system can be applied.
Clean – Free of oils, grease, dust, dirt, chemicals, loose coating, curing compounds, form release oils, sealers or hardeners.
Sound – Concrete that has unsound areas (voids, hollow spots, and friable surface) may have to be removed, replaced or repaired with materials that are compatible with the selected coating system.
Dry – It is important to address dryness because most coatings require a dry surface for proper adhesion. Moisture contained within the concrete that moves towards the surface through the pores of the concrete may prevent adequate coating adhesion.
Dry abrasive blast cleaning to SSPC-SP 13/NACE No. 6. Where the concrete has become contaminated with oils, grease, or fuels, water emulsifiable degreasers-cleaners may be used to remove these contaminants. It is important to only clean an area that can be fully washed down after degreasing before any of the cleaner can dry on the surface.
Ultra high pressure water jetting can be used to remove laitance and reveal blowholes and imperfections. Ensure concrete is dry before coating application.

### Blast cleaning

Dry abrasive blast cleaning to SSPC-SP 13/NACE No. 6. All prepared surfaces should then have all "blow holes" and other surface defects filled with suitable filler that is compatible with the primer and finish coat system to ensure that the coating can be applied over a smooth and regular substrate.

### Diamond disc grinding

Diamond grind the surface to remove all laitance and expose the aggregates.

## Coated surfaces

### Verification of existing coatings including primers

When the surface is an existing coating, verify with technical data sheet and application guide of the involved products, both over coatability and the given maximum over coating interval.

### Over coating

High pressure water jetting surface preparation refers to ISO 8501-4, for substrates previously coated either with a full coating system (surface DC A, DC B, DC C) or shop primer (surface DP I and DP Z). The surface definition for existing coating (DC) refers to the degree of coating breakdown according to ISO 4628.
It is important before considering water jetting, to ensure that the specified coating system is compatible with the existing coating system. High pressure water jetting does not remove mill scale or create surface roughness, and is only useful for surfaces with an initial roughness suitable for the subsequent coat.

### Shop primers

Shop primers are accepted as temporary protection of steel plates and profiles. Refer to the technical data sheet for the generic types accepted. Certain standards require pre-approval of the shop primer as part of a complete system. Contact your nearest Jotun office for specific system compatibility. Before being overcoated the shop primer must be fully cured, clean, dust free, dry and undamaged. Inorganic zinc shop primers must be free of zinc salts (white rust).
Corroded and damaged areas must be blast cleaned to minimum Sa 1 (ISO 8501-1).

# Application

## Acceptable environmental conditions - before and during application

Before application, test the atmospheric conditions in the vicinity of the substrate for the dew formation according to ISO 8502-4.

**Standard grade**

| | | |
|---|---|---|
| Air temperature | 5 - 60 | °C |
| Substrate temperature | 5 - 60 | °C |
| Relative Humidity (RH) | 10 - 85 | % |

**Winter grade**

| | | |
|---|---|---|
| Air temperature | -5 - 40 | °C |
| Substrate temperature | -5 - 60 | °C |
| Relative Humidity (RH) | 10 - 85 | % |

The following restrictions must be observed:

- Only apply the coating when the substrate temperature is at least 3 °C (5 °F) above the dew point
- Do not apply the coating if the substrate is wet or likely to become wet
- Do not apply the coating if the weather is clearly deteriorating or unfavourable for application or curing
- Do not apply the coating in high wind conditions

# Product mixing

## Product mixing ratio (by volume)

**STANDARD GRADE**

| | |
|---|---|
| Jotamastic 90 Comp A | 3.5 part(s) |
| Jotamastic 90 Standard Comp B | 1 part(s) |

**WINTER GRADE**

| | |
|---|---|
| Jotamastic 90 Comp A | 3.5 part(s) |
| Jotamastic 90 Wintergrade Comp B | 1 part(s) |

### Product mixing

Independent on substrate temperature the minimum temperature of the mixed base and curing agent is 10 °C. Lower temperature may require additional thinner to reach correct application viscosity. Additional thinner gives lower sag resistance and slower curing. If addition of thinner is required, this shall be done after mixing of the two components.

### Induction time and Pot life

| Paint temperature | 23 °C |
|---|---|
| **Standard grade** | |
| Pot life | 2 h |
| **Winter grade** | |
| Pot life | 45 min |

The temperature of base and curing agent is recommended to be 18 °C or higher when the product is mixed.

## Thinner/Cleaning solvent

Thinner: Jotun Thinner No. 17

Thinning is not normally required. Consult the local representative for advice during application in extreme conditions. Do not thin more than allowed by local environmental legislation.

## Application data

## Spray application

### Airless Spray Equipment

| | |
|---|---|
| Pump ratio (minimum) : | 42:1 |
| Pressure at nozzle (minimum) : | 150 bar/2100 psi |
| Nozzle tip (inch/1000) : | 19-25 |
| Nozzle output (litres/minute) : | 1.5-2.6 |
| Filters (mesh) : | 70 |

Several factors influence, and need to be observed to maintain the recommended pressure at the nozzle. Among factors causing pressure drop are:
- extended hoses or hose bundles
- extended hose whip-end line
- small internal diameter hoses
- high paint viscosity
- large spray nozzle size
- inadequate air capacity from compressor
- incorrect or clogged filters

# Film thickness per coat

**Typical recommended specification range**

**STANDARD GRADE**

| | | | | |
|---|---|---|---|---|
| Dry film thickness | 100 | - | 300 | µm |
| Wet film thickness | 125 | - | 375 | µm |
| Theoretical spreading rate | 8 | - | 2.7 | m²/l |

**WINTER GRADE**

| | | | | |
|---|---|---|---|---|
| Dry film thickness | 100 | - | 300 | µm |
| Wet film thickness | 125 | - | 375 | µm |

Theoretical spreading rate 8 - 2.7 m²/l

This product can be applied up to 50 % higher than maximum specified film thickness without loss of technical properties.

## Film thickness measurement

### Wet film thickness (WFT) measurement and calculation

To ensure correct film thickness, it is recommended to measure the wet film thickness continuously during application using a painter's wet film comb (ISO 2808 Method 1A). The measurements should be done as soon as possible after application.
Fast drying paints may give incorrect (too low) readings resulting in excessive dry film thickness. For multi layer physically drying (resoluble) coating systems the wet film thickness comb may give too high readings resulting in too low dry film thickness of the intermediate and top coats.
Use a wet-to-dry film calculation table (available on the Jotun Web site) to calculate the required wet film thickness per coat.

### Dry film thickness (DFT) measurement

When the coating has cured to hard dry state the dry film thickness can be checked to SSPC PA 2 or equivalent standard using statistical sampling to verify the actual dry film thickness. Measurement and control of the WFT and DFT on welds is done by measuring adjacent to and no further than 15 mm from the weld.

### Ventilation

Sufficient ventilation is very important to ensure proper drying/curing of the film.

### Coating loss

The consumption of paint should be controlled carefully, with thorough planning and a practical approach to reducing loss. Application of liquid coatings will result in some material loss. Understanding the ways that coating can be lost during the application process, and making appropriate changes, can help reducing material loss.
Some of the factors that can influence the loss of coating material are:
- type of spray gun/unit used
- air pressure used for airless pump or for atomization
- orifice size of the spray tip or nozzle
- fan width of the spray tip or nozzle
- the amount of thinner added
- the distance between spray gun and substrate
- the profile or surface roughness of the substrate. Higher profiles will lead to a higher "dead volume"
- the shape of the substrate target
- environmental conditions such as wind and air temperature

# Drying and Curing time

| Substrate temperature | -5 °C | 0 °C | 5 °C | 10 °C | 23 °C | 40 °C |
|---|---|---|---|---|---|---|
| **STANDARD GRADE** | | | | | | |
| Surface (touch) dry | | | 20 h | 12 h | 4 h | 1.5 h |
| Walk-on-dry | | | 40 h | 20 h | 6 h | 3 h |
| Dry to over coat, minimum | | | 30 h | 10 h | 3 h | 1.5 h |
| Dried/cured for service | | | 28 d | 14 d | 7 d | 2 d |
| **WINTER GRADE** | | | | | | |
| Surface (touch) dry | 24 h | 18 h | 12 h | 8 h | 3.5 h | |
| Walk-on-dry | 72 h | 30 h | 20 h | 12 h | 4 h | |
| Dry to over coat, minimum | 54 h | 20 h | 10 h | 6 h | 2 h | |

| | | | | | |
|---|---|---|---|---|---|
| Dried/cured for service | 21 d | 14 d | 10 d | 5 d | 3 d |

Drying and curing times are determined under controlled temperatures and relative humidity below 85 %, and at average of the DFT range for the product.

Surface (touch) dry: The state of drying when slight pressure with a finger does not leave an imprint or reveal tackiness.

Walk-on-dry: Minimum time before the coating can tolerate normal foot traffic without permanent marks, imprints or other physical damage.

Dry to over coat, minimum: The recommended shortest time before the next coat can be applied.

Dried/cured for service: Minimum time before the coating can be permanently exposed to the intended environment/medium.

# Maximum over coating intervals

Maximum time before thorough surface preparation is required. The surface must be clean and dry and suitable for over coating. Inspect the surface for chalking and other contamination and if present, remove with an alkaline detergent. Agitate the surface to activate the cleaner and before it dries, wash the treated area by low-pressure water cleaning using fresh water.

If maximum over coating interval is exceeded the surface should in addition be carefully roughened to ensure good inter coat adhesion.

The referred intervals relate specifically to over coating with Jotun Performance Coating products.

## Areas for atmospheric exposure

| **Average temperature during drying/curing** | **-5 °C** | **0 °C** | **5 °C** | **10 °C** | **23 °C** | **40 °C** |
|---|---|---|---|---|---|---|
| **Standard grade** | | | | | | |
| Itself | | | extended | extended | extended | extended |
| acrylic | | | 10 d | 10 d | 7 d | 5 d |
| epoxy | | | 3 mth | 3 mth | 3 mth | 2 mth |
| epoxy Passive Fire Protection | | | 30 d | 30 d | 30 d | 21 d |
| polyurethane | | | 3 mth | 3 mth | 3 mth | 2 mth |
| polysiloxane | | | 3 mth | 3 mth | 3 mth | 2 mth |
| epoxy mastic | | | extended | extended | extended | extended |
| **Winter grade** | | | | | | |
| Itself | 3 mth | 3 mth | 3 mth | 3 mth | 3 mth | 2 mth |
| acrylic | 14 d | 10 d | 7 d | 7 d | 5 d | 1 d |
| epoxy | 3 mth | 3 mth | 3 mth | 3 mth | 3 mth | 2 mth |
| epoxy Passive Fire Protection | | | 21 d | 21 d | 14 d | |
| polyurethane | 14 d | 10 d | 10 d | 10 d | 7 d | 5 d |
| polysiloxane | 14 d | 10 d | 10 d | 10 d | 7 d | 5 d |
| epoxy mastic | 3 mth | 3 mth | 3 mth | 3 mth | 3 mth | 2 mth |

## Areas for immersed exposure

| Average temperature during drying/curing | -5 °C | 0 °C | 5 °C | 10 °C | 23 °C | 40 °C |
|---|---|---|---|---|---|---|
| **Standard grade** | | | | | | |
| Itself | | | 21 d | 18 d | 14 d | 14 d |
| epoxy | | | 14 d | 14 d | 7 d | 7 d |
| vinyl epoxy | | | 14 d | 14 d | 7 d | 7 d |
| epoxy mastic | | | 21 d | 18 d | 14 d | 14 d |
| **Winter grade** | | | | | | |
| Itself | 1 mth | 21 d | 21 d | 18 d | 14 d | 14 d |
| epoxy | 1 mth | 21 d | 21 d | 18 d | 14 d | 14 d |
| vinyl epoxy | 14 d | 14 d | 14 d | 14 d | 7 d | 5 d |
| epoxy mastic | 1 mth | 21 d | 21 d | 18 d | 14 d | 14 d |

## Other conditions that can affect drying / curing / over coating

### Adding anti-skid to the coating system

Anti skid aggregate should only be added in the final coat, and should not be used in single coat systems. Spread the aggregate evenly on the surface before half of time to Surface dry. Use Jotun Anti-skid, medium particle size (400 - 600 µm) for coatings applied in 150 to 400 µm DFT. The recommended usage is 2.5 - 3.3 kg per 10 litres of paint.

### Repair of coating system

**Damages to the coating layers:**
Prepare the area through sandpapering or grinding, followed by thorough cleaning/vacuuming. When the surface is clean and dry the coating may be over coated by itself or by another product, ref. original specification.
Always observe the maximum over coating intervals. If the maximum over coating interval is exceeded the surface should be carefully roughened in order to ensure good intercoat adhesion.

**Damages exposing bare substrate:**
Remove all rust, loose paint, grease or other contaminants by spot blasting, mechanical grinding, water and/or solvent washing. Feather edges and roughen the overlap zone of surrounding intact coating. Apply the coating system specified for repair.

**Areas with too low DFT:**
Roughen the surface, vacuum and apply new coating according to specification.

**Areas with too high DFT:**
Areas with DFT above maximum specified for isolated areas shall be ground down to acceptable thickness, or down to bare steel and recoated.

### Repair of damaged areas

Sags and runs can be caused by too high wet film thickness, too much thinner added or the spray gun used too close to the surface.
Repair by using a paint brush to smooth the film when still wet.
Sand down to a rough, even surface and re-coat if the coating is cured.
Orange peel can be caused by poor flow/levelling properties of the paint, poor atomization of the paint, thinner evaporating too fast or the spray gun held too close to the surface.
This can be rectified by abrading the surface and applying an additional coat after having adjusted the application properties or the application technique.
Dry spray can be caused by poor atomization of the paint, spray gun held too far from the surface, high air temperature, thinner evaporating too fast or coating applied in windy conditions.

Sand down to a rough even surface and re-coat.
Pinholes can be caused by entrapped solvents in the film or by incorrect application technique. Pinholes can be repaired as per procedure for damages to the coating layer or to the substrate, ref. above.

### Coating film continuity

When required by the specification, the coating shall be tested for film discontinuity according to ASTM D 5162, test method A or B as appropriate for the actual dry film thickness.
All recorded defects shall be repaired by best practical means.

# Performance Standard for Protective Coatings (PSPC)

**PSPC Appendix (COT)**
**Application requirements particular for coating according to Performance Standard for Protective Coatings (PSPC) of cargo oil tanks of crude oil tankers to IMO Resolution MSC.288(87)**

**Job specification**
There shall be a minimum of two stripe coats and two spray coats, except that the second stripe coat, by way of welded seams only, may be reduced in scope where it is proven that the NDFT (nominal total dry film thickness) can be met by the coats applied in order to avoid unnecessary over thickness. Any reduction in scope of the second stripe coat shall be fully detailed in the CTF.

**NDFT (nominal total dry film thickness)**
NDFT 320 µm with 90/10 rule. (Minimum 90 % of all DFT measurements shall be greater than or equal to the NDFT and none of the remaining 10 % measurements shall be below 0.9 x NDFT).

Maximum DFT 2000 µm is acceptable for isolated spots only, and should not extend to more than 1% of the total tank area.

**PRIMARY SURFACE PREPARATION**

**Blasting and surface profile:**
Cleanliness minimum Sa 2½ (ISO 8501-1)
Surface profile 30-75 µm (ISO 8503-2)

Blasting shall not be carried out when:
- the relative humidity is above 85 %
- the surface temperature of steel is less than 3 °C above the dew point

**Water soluble salts limit equivalent to NaCl**
Maximum 50 mg/m² of sodium chloride (ISO 8502-6/9)

**SECONDARY SURFACE PREPARATION**

**Steel condition**
For steel preparation, PSPC makes reference to grade P2 (ISO 8501-3). All sharp edges are to be rounded to a radius of minimum 2 mm, subject to a three-pass grinding, or treated with an alternative process giving an edge profile that results in a dry film thickness retention corresponding to or better than a three pass grinding. Sharp edges mean all edges except natural rounded/rolled edges of sections.

**Surface treatment**
Cleanliness minimum Sa 2½ (ISO 8501-1) on damaged shop primer and welds.

**Surface treatment after erection**

**Cargo oil tanks (COT), IMO Resolution MSC.288 (87)**
Erection joints minimum St 3 or Sa 2½ (ISO 8501-1) where practicable.

For inner bottom:
- Damages up to 20 % of the area to be coated to be treated to minimum St 3
- Contiguous damages over 25 m² or over 20 % of the area to be coated, Sa 2½ shall be applied

For underdeck:
- Damages up to 3 % of area to be coated to be treated to minimum St 3
- Contiguous damages over 25 m² or over 3 % of the area to be coated, Sa 2½ shall be applied
- Coating in overlap shall be feathered

**Profile requirements**
In case of full or partial blasting surface profile 30-75 µm (ISO 8503-2).

**Dust**
Dust quantity rating 1 for dust size class 3 or larger (ISO 8202-3).
Lower dust size classes to be removed if visible without magnification on the surface to be coated.

**Water soluble salts limit equivalent to NaCl after blasting/ grinding**
Maximum 50 mg/m² of sodium chloride (ISO 8502-6/9).

**Contamination**
No oil contamination.
Inspect the surface for contaminations and if present, remove with an alkaline detergent. Agitate the surface to activate the cleaner and before it dries, wash the treated area by Low-Pressure Water Cleaning (LPWC) to Wa 1 (ISO 8501-4) using fresh water.

**Ventilation**
Sufficient ventilation must be provided to remove the solvent evaporating from the coating. When mixed, this product requires exchange of 56 m³ air per litre paint in order to dilute the evaporating solvent to a safe concentration in the tank (i.e. less than 10 % of the Lower Explosion Limit, LEL). The solvent gas concentration in the tank must at all times be kept below this level, hence sufficient ventilation must be maintained during the whole application and drying periods.

**Environmental conditions**
Coating shall be applied under controlled humidity and surface conditions, in accordance with the manufacturer's specifications. In addition, coating shall not be applied when:
- the relative humidity is above 85 %
- the surface temperature is less than 3 °C above the dew point
- the surface is wet or is likely to become wet

**Testing of coating**
Destructive testing should be avoided.
Dry film thickness shall be measured after each coat for quality control purposes. The total dry film thickness shall be documented after completion of the final coat, using appropriate thickness gauges.

**Repair and maintenance procedures relevant to coating according to Performance Standard for Protective Coatings (PSPC) of cargo oil tanks of crude oil tankers to IMO Resolution MSC.288(87)**

**Superficial damages not exposing bare substrate:**
Prepare the area through sandpapering or grinding, followed by thorough cleaning/vacuuming. When the surface is dry and clean the coating may be over coated by itself or by another product, ref. original specification. Always observe the minimum and maximum over coating intervals. If the maximum over coating interval is exceeded the surface should be carefully roughened in order to ensure good intercoat adhesion.

**Damages exposing bare substrate:**
Choise of surface preparation and application methods shall be made in conjunction with Jotun and the actual Classification Society, following the guielines in:

MSC.1/Circ. 1399 (COT)
- Chapter 4.1 for coating condition assessment
- Chapter 5 for coating maintenance
- Chapter 6 for coating repair

# Quality assurance

The following information is the minimum required. The specification may have additional requirements.

- Confirm that all welding and other metal work has been completed before commencing pre-treatment and surface preparation
- Confirm that installed ventilation is balanced and has the capacity to deliver and maintain the RAQ
- Confirm that the required surface preparation standard has been achieved and is held prior to coating application
- Confirm that the climatic conditions are within recommendations in the AG, and are held during the application
- Confirm that the required number of stripe coats have been applied
- Confirm that each coat meets the DFT requirements in the specification
- Confirm that the coating has not been adversely affected by rain or other factors during curing
- Observe that adequate coverage has been achieved on corners, crevices, edges and surfaces where the spray gun cannot be positioned so that its spray impinges on the surface at 90° angle
- Observe that the coating is free from defects, discontinuities, insects, abrasive media and other contamination
- Observe that the coating is free from misses, sags, runs, wrinkles, fat edges, mud cracking, blistering, obvious pinholes, excessive dry spray, heavy brush marks and excessive film build
- Observe that the uniformity and colour are satisfactory

All noted defects shall be fully repaired to conform to the coating specification.

## Caution

This product is for professional use only. The applicators and operators shall be trained, experienced and have the capability and equipment to mix/stir and apply the coatings correctly and according to Jotun's technical documentation. Applicators and operators shall use appropriate personal protection equipment when using this product. This guideline is given based on the current knowledge of the product. Any suggested deviation to suit the site conditions shall be forwarded to the responsible Jotun representative for approval before commencing the work.
For further advice please contact your local Jotun office.

## Health and safety

Please observe the precautionary notices displayed on the container. Use under well ventilated conditions. Do not inhale spray mist. Avoid skin contact. Spillage on the skin should immediately be removed with suitable cleanser, soap and water. Eyes should be well flushed with water and medical attention sought immediately.

## Accuracy of information

Always refer to and use the current (last issued) version of the TDS, SDS and if available, the AG for this product. Always refer to and use the current (last issued) version of all International and Local Authority Standards referred to in the TDS, AG & SDS for this product.

## Colour variation

When applicable, products primarily meant for use as primers or antifoulings may have slight colour variations from batch to batch. Such products and epoxy based products used as a finish coat may chalk when exposed to sunlight and weathering.

Colour and gloss retention on topcoats/finish coats may vary depending on type of colour, exposure environment such as temperature, UV intensity etc., application quality and generic type of paint. Contact your local Jotun office for further information.

## Reference to related documents

The Application Guide (AG) must be read in conjunction with the relevant specification, Technical Data Sheet (TDS) and Safety Data Sheet (SDS) for all the products used as part of the coating system.

When applicable, refer to the separate application procedure for Jotun products that are approved to classification societies such as PSPC, IMO etc.

# Symbols and abbreviations

min = minutes
h = hours
d = days
°C = degree Celsius
° = unit of angle

TDS = Technical Data Sheet
AG = Application Guide
SDS = Safety Data Sheet
VOC = Volatile Organic Compound
MCI = Jotun Multi Colour Industry (tinted colour)

µm = microns = micrometres
g/l = grams per litre
g/kg = grams per kilogram
m²/l = square metres per litre
mg/m² = milligrams per square metre
psi = unit of pressure, pounds/inch²
Bar = unit of pressure
RH = Relative humidity (% RH)
UV = Ultraviolet
DFT = dry film thickness
WFT = wet film thickness

RAQ = Required air quantity
PPE = Personal Protective Equipment
EU = European Union
UK = United Kingdom
EPA = Environmental Protection Agency
ISO = International Standards Organisation
ASTM = American Society of Testing and Materials
AS/NZS = Australian/New Zealand Standards
NACE = National Association of Corrosion Engineers
SSPC = The Society for Protective Coatings
PSPC = Performance Standard for Protective Coatings
IMO = International Maritime Organization
ASFP = Association for Specialist Fire Protection

# Disclaimer

The information in this document is given to the best of Jotun's knowledge, based on laboratory testing and practical experience. Jotun's products are considered as semi-finished goods and as such, products are often used under conditions beyond Jotun's control. Jotun cannot guarantee anything but the quality of the product itself. Minor product variations may be implemented in order to comply with local requirements. Jotun reserves the right to change the given data without further notice.

Users should always consult Jotun for specific guidance on the general suitability of this product for their needs and specific application practices.

If there is any inconsistency between different language issues of this document, the English (United Kingdom) version will prevail.

# Hardtop AX

## Product description

This is a two component chemically curing aliphatic acrylic polyurethane coating. It has a high gloss finish with very good gloss retention. It has good chemical resistance. It is a high solids product. This product contains no solvents on the Hazardous Air Pollutants (HAPs) list. Minor amounts of such solvents may come in through tinting of some colours. To be used as topcoat in atmospheric environments.

### Scope

The Application Guide offers product details and recommended practices for the use of the product.

The data and information provided are not definite requirements. They are guidelines to assist with efficient and safe use, and optimum service of the product. Adherence to the guidelines does not relieve the applicator of responsibility for ensuring that the work meets specification requirements.
Jotuns liability is in accordance with general product liability rules.

The Application Guide (AG) must be read in conjunction with the relevant specification, Technical Data Sheet (TDS) and Safety Data Sheet (SDS) for all the products used as part of the coating system.

### Referred standards

Reference is generally made to ISO Standards. When using standards from other regions it is recommended to reference only one corresponding standard for the substrate being treated.

## Surface preparation

The required quality of surface preparation can vary depending on the area of use, expected durability and if applicable, project specification.

When preparing new surfaces, maintaining already coated surfaces or aged coatings it is necessary to remove all contamination that can interfere with coating adhesion, and prepare a sound substrate for the subsequent product.
Inspect the surface for hydrocarbon and other contamination and if present, remove with an alkaline detergent. Agitate the surface to activate the cleaner and before it dries, wash the treated area using fresh water.
Paint solvents (thinners) shall not be used for general degreasing or preparation of the surface for painting due to the risk of spreading dissolved hydrocarbon contamination. Paint thinners can be used to treat small localized areas of contamination such as marks from marker pens. Use clean, white cotton cloths that are turned and replaced often. Do not bundle used solvent saturated cloths. Place used cloths into water.

#### Process sequence

Surface preparation and coating should normally be commenced only after all welding, degreasing, removal of sharp edges, weld spatter and treatment of welds is complete. It is important that all hot work is completed before coating commences.

### Coated surfaces

#### Verification of existing coatings including primers

When the surface is an existing coating, verify with technical data sheet and application guide of the involved products, both over coatability and the given maximum over coating interval.

#### Organic primers/intermediates

The surface of previous coats shall be free from contamination by water, hydrocarbon based products, wax, mud, mortar droppings and loose, chalked and flaking coating.
Inspect the surface for hydrocarbon and other contamination and if present, remove with an alkaline emulsifying detergent. Agitate the surface to activate the cleaner and before it dries, wash the treated area by low-pressure waterjetting method to Wa 1 (ISO 8501-4) using fresh water. Surfaces not contaminated with hydrocarbon deposits shall be washed to Wa 1 (ISO 8501-4) using fresh water to reduce surface chlorides.
When applied on coatings past maximum over coating interval light abrading may be required to achieve proper intercoat adhesion.

# Application

## Acceptable environmental conditions - before and during application

Before application, test the atmospheric conditions in the vicinity of the substrate for the dew formation according to ISO 8502-4.

| | | |
|---|---|---|
| Air temperature | 0 - 50 | °C |
| Substrate temperature | 0 - 60 | °C |
| Relative Humidity (RH) | 10 - 85 | % |

The following restrictions must be observed:

- Only apply the coating when the substrate temperature is at least 3 °C (5 °F) above the dew point
- Do not apply the coating if the substrate is wet or likely to become wet
- Do not apply the coating if the weather is clearly deteriorating or unfavourable for application or curing
- Do not apply the coating in high wind conditions

# Product mixing

## Product mixing ratio (by volume)

| | |
|---|---|
| Hardtop AX Comp A | 4 part(s) |
| Hardtop AX Comp B | 1 part(s) |

### Product mixing

The coating shall be mixed with an air powered mechanical paint mixing tool that is clean and fit for purpose.
Mix complete units only.

### Induction time and Pot life

| **Paint temperature** | **23 °C** |
|---|---|
| Pot life | 2 h |

The temperature of base and curing agent is recommended to be 18 °C or higher when the product is mixed.

## Thinner/Cleaning solvent

Thinner: Jotun Thinner No. 26 / Jotun Thinner No. 10

Jotun Thinner No. 10 can be used where aromatic solvents are accepted.

## Application data

## Spray application

### Airless Spray Equipment

| | |
|---|---|
| Pump ratio (minimum) : | 32:1 |
| Pressure at nozzle (minimum) : | 150 bar/2100 psi |
| Nozzle tip (inch/1000) : | 13-19 |
| Nozzle output (litres/minute) : | 0.7-1.5 |
| Filters (mesh) : | 70-100 |

Several factors influence, and need to be observed to maintain the recommended pressure at the nozzle. Among factors causing pressure drop are:
- extended hoses or hose bundles
- extended hose whip-end line
- small internal diameter hoses
- high paint viscosity
- large spray nozzle size
- inadequate air capacity from compressor
- incorrect or clogged filters

### Air Spray Equipment

| | |
|---|---|
| Pressure pot : | Pressure 1.6 bar |
| Pressure at nozzle (minimum) : | Gravity gun: 3.2 bar / Pressure pot: 3.2 bar |
| Nozzle tip: | Gravity gun: 1.6-1.8 (mm) / Pressure pot: 1.4-1.6 (mm) |

Thinning: Min. 10 % (pressure pot) / max. 15 % (gravity gun)
Viscosity after thinning (DIN Cup No. 4): 24 ± 2 sec (pressure pot) / 20 ± 2 sec (gravity gun)

Application to be made in one wet coat to achieve the specified DFT.

# Film thickness per coat

**Typical recommended specification range**

| | | | | |
|---|---|---|---|---|
| Dry film thickness | 50 | - | 100 | µm |
| Wet film thickness | 80 | - | 160 | µm |
| Theoretical spreading rate | 13 | - | 6.3 | m²/l |

Bright colours may need film thickness in the high end of the recommended specification range to achieve opacity.

Can be applied up to 25 % higher than maximum specified film thickness without loss of technical properties.

## Film thickness measurement

### Wet film thickness (WFT) measurement and calculation

To ensure correct film thickness, it is recommended to measure the wet film thickness continuously during application using a painter's wet film comb (ISO 2808 Method 1A). The measurements should be done as soon as possible after application.
Fast drying paints may give incorrect (too low) readings resulting in excessive dry film thickness. For multi layer physically drying (resoluble) coating systems the wet film thickness comb may give too high readings resulting in too low dry film thickness of the intermediate and top coats.
Use a wet-to-dry film calculation table (available on the Jotun Web site) to calculate the required wet film thickness per coat.

### Dry film thickness (DFT) measurement

When the coating has cured to hard dry state the dry film thickness can be checked to SSPC PA 2 or equivalent standard using statistical sampling to verify the actual dry film thickness. Measurement and control of the WFT and DFT on welds is done by measuring adjacent to and no further than 15 cm from the weld.

### Ventilation

Sufficient ventilation is very important to ensure proper drying/curing of the film.

### Coating loss

The consumption of paint should be controlled carefully, with thorough planning and a practical approach to reducing loss. Application of liquid coatings will result in some material loss. Understanding the ways that coating can be lost during the application process, and making appropriate changes, can help reducing material loss.
Some of the factors that can influence the loss of coating material are:
- type of spray gun/unit used
- air pressure used for airless pump or for atomization
- orifice size of the spray tip or nozzle
- fan width of the spray tip or nozzle
- the amount of thinner added
- the distance between spray gun and substrate
- the profile or surface roughness of the substrate. Higher profiles will lead to a higher "dead volume"
- the shape of the substrate target
- environmental conditions such as wind and air temperature

# Drying and Curing time

| Substrate temperature | 0 °C | 5 °C | 10 °C | 23 °C | 40 °C |
|---|---|---|---|---|---|
| Surface (touch) dry | 4 h | 3 h | 2 h | 1 h | 1 h |
| Walk-on-dry | 40 h | 24 h | 16 h | 8 h | 4 h |
| Dry to over coat, minimum | 24 h | 18 h | 10 h | 5 h | 3 h |
| Dried/cured for service | 20 d | 14 d | 10 d | 5 d | 3 d |

Drying and curing times are determined under controlled temperatures and relative humidity below 85 %, and at average of the DFT range for the product.

Surface (touch) dry: The state of drying when slight pressure with a finger does not leave an imprint or reveal tackiness.

Walk-on-dry: Minimum time before the coating can tolerate normal foot traffic without permanent marks, imprints or other physical damage.

Dry to over coat, minimum: The recommended shortest time before the next coat can be applied.

Dried/cured for service: Minimum time before the coating can be permanently exposed to the intended environment/medium.

# Maximum over coating intervals

Maximum time before thorough surface preparation is required. The surface must be clean and dry and suitable for over coating. Inspect the surface for chalking and other contamination and if present, remove with an alkaline detergent. Agitate the surface to activate the cleaner and before it dries, wash the treated area by low-pressure water jetting to Wa 1 (ISO 8501-4) using fresh water.

If maximum over coating interval is exceeded the surface should in addition be carefully roughened to ensure good inter coat adhesion.

## Areas for atmospheric exposure

| Average temperature during drying/curing | 0 °C | 5 °C | 10 °C | 23 °C | 40 °C |
|---|---|---|---|---|---|
| Itself | extended | extended | extended | extended | extended |

## Other conditions that can affect drying / curing / over coating

### Adding anti-skid to the coating system

Anti skid aggregate should only be added in the final coat, and should not be used in single coat systems. Spread the aggregate evenly on the surface before half of time to Surface dry. Use Jotun Anti-skid, fine particle size (180 - 250 µm), for coatings applied in 50 to 150 µm DFT. The recommended usage is 1.5 - 2.0 kg per 10 litres of paint.

### Water contamination

If the wet coating is exposed to relative humidity above 85% or to moisture before the coating is at least Walk-on-dry, then blushing may occur. Blushing will cause fading of bright colours, and will affect the gloss. Provided the coating is fully dried/cured the protective properties will not be affected.
All affected areas should be lightly sanded, cleaned and recoated.

### Repair of coating system

**Damages to the coating layers:**
Prepare the area through sandpapering or grinding, followed by thorough cleaning/vacuuming. When the surface is clean and dry the coating may be over coated by itself or by another product, ref. original specification.
Always observe the maximum over coating intervals. If the maximum over coating interval is exceeded the surface should be carefully roughened in order to ensure good intercoat adhesion.

**Damages exposing bare substrate:**
Remove all rust, loose paint, grease or other contaminants by spot blasting, mechanical grinding, water and/or solvent washing. Feather edges and roughen the overlap zone of surrounding intact coating. Apply the coating system specified for repair.

### Coating film continuity

When required by the specification, the coating shall be tested for film discontinuity according to ASTM D 5162, test method A or B as appropriate for the actual dry film thickness.
All recorded defects shall be repaired by best practical means.

# Quality assurance

The following information is the minimum required. The specification may have additional requirements.

- Confirm that all welding and other metal work has been completed before commencing pre-treatment and surface preparation
- Confirm that installed ventilation is balanced and has the capacity to deliver and maintain the RAQ
- Confirm that the required surface preparation standard has been achieved and is held prior to coating application
- Confirm that the climatic conditions are within recommendations in the AG, and are held during the application
- Confirm that the required number of stripe coats have been applied
- Confirm that each coat meets the DFT requirements in the specification
- Confirm that the coating has not been adversely affected by rain or other factors during curing
- Observe that adequate coverage has been achieved on corners, crevices, edges and surfaces where the spray gun cannot be positioned so that its spray impinges on the surface at 90° angle
- Observe that the coating is free from defects, discontinuities, insects, abrasive media and other contamination
- Observe that the coating is free from misses, sags, runs, wrinkles, fat edges, mud cracking, blistering, obvious pinholes, excessive dry spray, heavy brush marks and excessive film build
- Observe that the uniformity and colour are satisfactory

All noted defects shall be fully repaired to conform to the coating specification.

## Caution

This product is for professional use only. The applicators and operators shall be trained, experienced and have the capability and equipment to mix/stir and apply the coatings correctly and according to Jotun's technical documentation. Applicators and operators shall use appropriate personal protection equipment when using this product. This guideline is given based on the current knowledge of the product. Any suggested deviation to suit the site conditions shall be forwarded to the responsible Jotun representative for approval before commencing the work.
For further advice please contact your local Jotun office.

## Health and safety

Please observe the precautionary notices displayed on the container. Use under well ventilated conditions. Do not inhale spray mist. Avoid skin contact. Spillage on the skin should immediately be removed with suitable cleanser, soap and water. Eyes should be well flushed with water and medical attention sought immediately.

## Accuracy of information

Always refer to and use the current (last issued) version of the TDS, SDS and if available, the AG for this product. Always refer to and use the current (last issued) version of all International and Local Authority Standards referred to in the TDS, AG & SDS for this product.

## Colour variation

Some coatings used as the final coat may fade and chalk in time when exposed to sunlight and weathering effects. Coatings designed for high temperature service can undergo colour changes without affecting performance. Some slight colour variation can occur from batch to batch. When long term colour and gloss retention is required, please seek advice from your local Jotun office for assistance in selection of the most suitable top coat for the exposure conditions and durability requirements.

## Reference to related documents

The Application Guide (AG) must be read in conjunction with the relevant specification, Technical Data Sheet (TDS) and Safety Data Sheet (SDS) for all the products used as part of the coating system.

When applicable, refer to the separate application procedure for Jotun products that are approved to classification societies such as PSPC, IMO etc.

# Symbols and abbreviations

min = minutes
h = hours
TDS = Technical Data Sheet
AG = Application Guide

d = days
°C = degree Celsius
° = unit of angle
µm = microns = micrometres
g/l = grams per litre
g/kg = grams per kilogram
m²/l = square metres per litre
mg/m² = milligrams per square metre
psi = unit of pressure, pounds/inch²
Bar = unit of pressure
RH = Relative humidity (% RH)
UV = Ultraviolet
DFT = dry film thickness
WFT = wet film thickness

SDS = Safety Data Sheet
VOC = Volatile Organic Compound
MCI = Jotun Multi Colour Industry (tinted colour)
RAQ = Required air quantity
PPE = Personal Protective Equipment
EU = European Union
UK = United Kingdom
EPA = Environmental Protection Agency
ISO = International Standards Organisation
ASTM = American Society of Testing and Materials
AS/NZS = Australian/New Zealand Standards
NACE = National Association of Corrosion Engineers
SSPC = The Society for Protective Coatings
PSPC = Performance Standard for Protective Coatings
IMO = International Maritime Organization
ASFP = Association for Specialist Fire Protection

# Disclaimer

The information in this document is given to the best of Jotun's knowledge, based on laboratory testing and practical experience. Jotun's products are considered as semi-finished goods and as such, products are often used under conditions beyond Jotun's control. Jotun cannot guarantee anything but the quality of the product itself. Minor product variations may be implemented in order to comply with local requirements. Jotun reserves the right to change the given data without further notice.

Users should always consult Jotun for specific guidance on the general suitability of this product for their needs and specific application practices.

If there is any inconsistency between different language issues of this document, the English (United Kingdom) version will prevail.