RUSSIAN MARITIME REGISTER OF SHIPS

HEAD OFFICE

CIRCULAR LETTER **№ 314-52-.651c** dated 07.06.2013г.

Re: Unified Interpretation IACS SC258 (Jan 2013)

"For Application of Regulation 3-11, Part A-1, Chapter II-1 of the SOLAS Convention (Corrosion Protection of Cargo Oil Tanks of Crude Oil Tankers), adopted by Resolution MSC.289 (87) The Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers".

Item of technical supervision:

Corrosion Resistant Steel for Cargo Tanks

Implementation since	As from receipt
Valid: Until	re-edition of ND
Validity period extended till	.
Cancels/amends/adds Circular letter №	- dated -
Number of pages:	1+11
Appendices:	Amendments to the Rules - 11 pages

First Chief Operating Officer Igor A. Baranov

Amends Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships; ND No. 2-020101-040

We hereby inform that since 01.01.2013 Unified Interpretation (UI) IACS SC258 (Jan 2013) "For Application of Regulation 3-11, Part A-1, Chapter II-1 of the SOLAS Convention (Corrosion Protection of Cargo Oil Tanks of Crude Oil Tankers), adopted by Resolution MSC.289 (87) Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers" entered into force.

The UI clarifies and supplements the provisions of IMO Resolution MSC.289(87) as regards the application of approval and testing of Corrosion Resistant Steel for Cargo Tanks in Crude Oil Tankers.

With reference of the aforesaid, the ND No. 2-020101-040 is amended as per Annex to this letter.

It is necessary to do the following:

1.To implement the amendments annexed to this letter to the RS relevant normative documents.

2. The content of this Circular Letter shall be brought to the notice of the RS surveyors, interested organizations and persons in the area of RS Branch Offices' activity.

Person in charge: S.M. Kordonets 314 +7.812.314-07-34

Appendix to the Circular letter No.
№ 314-52 - 651c dated 07.06.2013.

Amendments to
Rules for Technical Supervision during Construction of Ships and Manufacture of Materials and Products for Ships

PART III. TECNHICAL SUPERVISION DURING MANUFACTURE OF MATERIALS

Add a new para 2.6 to read as follows:

«2.6 FOR APPLICATION OF REGULATION 3-11, Part A-1, Chapter II-1 OF THE SOLAS CONVENTION (CORROSION PROTECTION OF CARGO OIL TANKSS OF CRUDE OIL TANKERS), ADOPTED BY RESOLUTION MSC.289 (87) THE PERFORMANCE STANDARD FOR ALTERNATIVE MEANS OF CORROSION PROTECTION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS

2.6.1 This Chapter supplements the provisions of the Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers (hereinafter, PSPC-COT Alt) for Application of Regulation II-1/3-11 (Corrosion Protection of Cargo Oil Tanks of Crude Oil Tankers), adopted by IMO Resolution MSC.289 (82).
The requirements of this Chapter shall be considered alongside with the requirements of PSPC-COT Alt.

2.6.2 Interpretations to 2.1 «General Principles» PSPC-COT Alt
2.6.2.1. Normal and higher strength Corrosion Resistant Steels as defined within this Chapter, is steel whose corrosion resistance performance in the bottom or top of the internal cargo oil tank is tested and approved to satisfy the requirements in this MSC.289 (87) in addition to other relevant requirements for ship material, structure strength and construction. It is not the intention of this document to suggest that Corrosion Resistant Steels be used for corrosion resistant applications in other areas of a vessel.
2.6.2.2. Corrosion Resistant Steels are similar to conventional ship construction steels in terms of chemical composition and mechanical properties.
2.6.2.3. The weldability of Corrosion Resistant Steels is similar to the weldability of conventional ship construction steels and therefore normal shipyard welding requirements in terms of qualification by the approval of welding consumables and welding procedure qualification also apply.

2.6.3 Interpretations to 2.2 «Technical File» PSPC-COT Alt.
2.6.3.1. The shipbuilder shall prepare and submit the Technical File to the Register for verification. If the applicable corrosion protection method varies for different locations, the information required for the technical file is to include each location and corrosion protection method separately. Once verified, one copy of the Technical File is to be placed onboard the ship. The following construction records are to be included in the Technical File:

.1 The copy of the Type Approval Certificate.

.2 Other technical data is to include:
.2.1 Detail of the brand of welding consumables and welding process used;
.2.2 Repair method. Only to be included when specially recommended by the manufacturer of corrosion resistant steel.

.3 Application records

.3.1 Areas of application / location of corrosion resistant steel;
.3.2 Brand of corrosion resistant steel and thickness.

Items 2.6.3.1.3.1 and 2.6.3.1.3.2 above may be substituted by the information given in the hull-related approved drawings. However, each brand of corrosion resistant steel used and its location shall be indicated on the approved drawings, the drawings shall be included in the Technical File.

.4 The test certificates and actual measured values of plate thickness of each corrosion resistant steel, and individual welding conditions need not be included.

2.6.3.2 After the ship enters service, the ship owner or operator shall maintain repair data in the Technical File for review by the Register. The information required shall include each location and corrosion protection method separately. These records shall include:

.1 Where repairs are made in service to the cargo oil tank in which corrosion resistant steel is used, the following information shall be added to the Technical File:

.1.1 Areas of repair work;

.1.2 Repair method (replacement by corrosion resistant steel or coating);

.1.3 Records of the brand of corrosion resistant steel used, plate thickness and welding consumables (brand name and welding method) if corrosion resistant steel is used);

.1.4 Records in accordance with Performance Standard for Protective Coatings for Cargo Oil Tanks (MSC.288 (87)), if coating is used.

.2 Repairs that require records to be maintained as mentioned in 2.6.3.2.1 above include the following:

.2.1 Replacement by corrosion resistant steel;

.2.2 Application of coating on members in which corrosion resistant steel is used (including cases where corrosion resistant steel is replaced with conventional steel and coating) (Note 1)

.2.3 Repairs of pitted parts. (Note 2)

Note 1: Details of coating on repairs to corrosion resistant steel shall be recorded in the Corrosion Resistant Steel Technical File. In such cases, duplicates of these coating records do not need to be included in the Coating Technical File.

Note 2: The wastage limit of the pitted part or area shall be as deemed appropriate by the Classification Society and/or Register. However, the standard value of the permissible wastage amount shall be taken as about 40% of the original thickness. In this case weld repairs are required. Only welding consumables approved for the relevant corrosion resistant steel shall be used. The full depth of the pitting shall be filled up by the weld metal. If non-approved welding consumables are used, an appropriate area around the repaired part is to be coated suitably after the repairs in accordance with the IMO Performance Standard for Protective Coatings for Cargo Oil Tanks. MSC.215(87)

.3 Plate thickness records during periodical surveys need not be recorded in the Technical File.

2.6.4 Interpretations to 3.3 “Special Application” PSPC-COT Alt.

2.6.4.1 Where other items of structure, such as appurtenances, are not clearly identified, the application of the PSPC-COT Alt to these items is described here.

2.6.4.1.1 Means of access, to be used for ship inspections, which are not integral to the ship structure.

.1 Permanent means of access which are not integral to the ship's structure include:
Ladders;
Rails;
Independent platforms;
Steps.
.2 Appropriate corrosion protection measures are to be adopted for permanent means of access mentioned in 2.6.4.1.1.1
.3 When corrosion resistant steel is used, in principle, a corrosion resistant steel of the same brand as used in the main structure is to be used for the means of access and the attachments..
.4 When conventional steel is used, and is welded to corrosion resistant steel, corrosion protection measures for the attachment and weld are recommended to be in accordance with Performance Standard for Protective Coatings for Cargo Oil Tanks MSC.288 (87)).
.5 Other corrosion protection measures are to be left to the discretion of the Register.
.6 Where other corrosion protection measures other than those stated above, for example cathodic protection are used, the performance of the corrosion resistant steel of the surrounding structure shall not be impaired.

2.6.4.1.2 Access arrangements integral to the ship's structure.

.1 The phrase "Access arrangements that are integral to the ship structure" in 3.2.2 of the Annex to Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks (MSC.291(87)) means access arrangements integral to the ship structure such as the items mentioned below, for access in the cargo oil tanks.
Stiffeners and girders with increased depth for walkways
.2 Appropriate corrosion protection measures are to be adopted for access arrangement given in 2.6.4.1.2.1. If coating is applied, the provisions of Performance Standard for Protective Coatings for Cargo Oil Tanks (MSC.288 (87)) shall be followed. If corrosion resistant steel is used on the above arrangements, in principle, corrosion resistant steel of the same brand/type as that used in the cargo oil tanks, is to be used.
2.6.4.1.3 Supporting members, etc.
.1 is recommended that pipes and supporting members for measuring equipment or outfitting items that are not strength members of the hull be protected either by coating or by use of corrosion resistant steel in accordance with the provisions of 2.6.4.1.1.4
2.6.4.1.4 Work Attachments
.1 In the case of attachments (conventional steel) used only during construction work such as hanging pieces, if welding consumables which are not indicated on the Type Approval Certificate of the corrosion resistant steel are used, it is recommended that the welded part is coated in accordance with Fig. 2.6.4.1.4.1

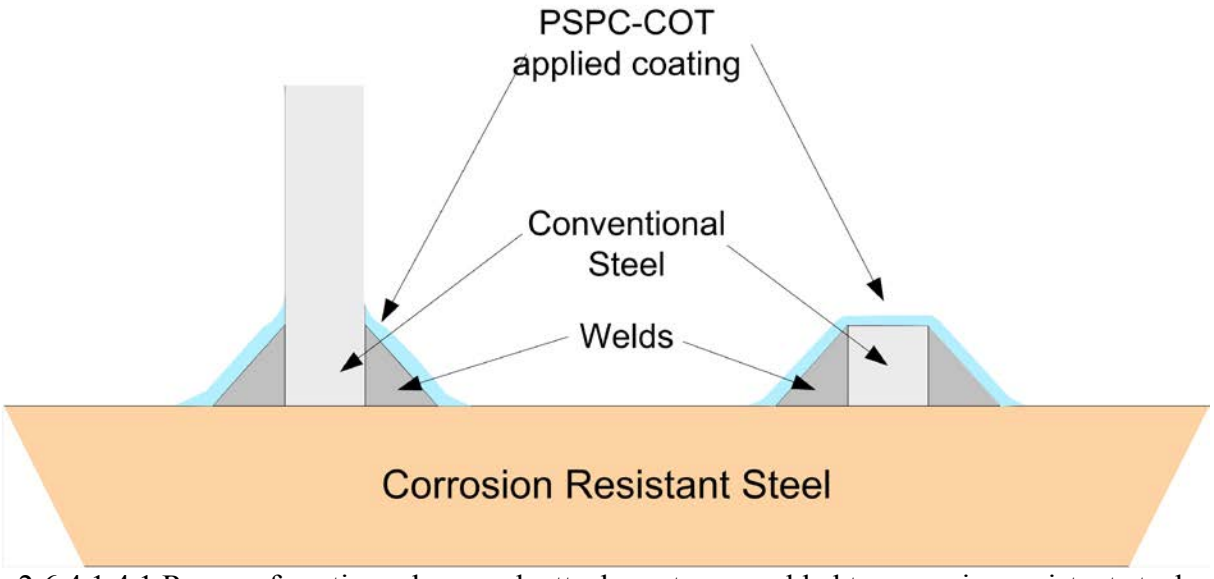

Fig. 2.6.4.1.4.1 Range of coating when work attachments are welded to corrosion resistant steel

2.6.5 Interpretations to 3.4 «Area of Application» PSPC-COT Alt.

2.6.5.1 Structural members in the COT that require protection measures against corrosion are specified in MSC.289 (87) The Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks of Crude Oil Tankers. MSC.289 (87).
2.6.5.2. Different methods of corrosion protection (coating and corrosion resistant steel) may be adopted for (a) and (b) above. Moreover, a combination of different corrosion protection methods may be used for each of the structural members within the areas identified by (a) and (b).
2.6.5.3. Acceptable combinations of corrosion protection methods are shown in Table 2.6.5.3 .

Table 2.6.5.3 Acceptable combinations of corrosion protection methods

Member		Lower surface of strength deck (a)	Upper surface of inner bottom plating (b)
Corrosion protection method	Case 1	Corrosion resistant steel – Brand A*	Corrosion resistant steel – Brand B*
	Case 2	Coating	Corrosion resistant steel – Brand B*
	Case 3	Corrosion resistant steel – Brand A*	Coating
	Case 4	Corrosion resistant steel – Brand C*	Corrosion resistant steel – Brand C*
*Corrosion Resistant Steel and coating may be used on the same member.			

2.6.5.4. If different corrosion protection methods (coating and corrosion resistant steel) are selected for either (a) or (b), the selected procedure for each member shall comply with the relevant performance standards.
2.6.5.5. Where corrosion resistant steel is used it shall be type approved by the Register (steel shall be supplied by the RS recognized manufacturers). Welding technology and welding materials shall be approved by RS.

Fig. 2.6.5.5

2.6.5.6. Where different brands of corrosion resistant steels are used in the same structural member, see Figure 2.6.5.5, the weld joining the two different steels shall be coated. Coating shall be in accordance with Performance Standard for Protective Coatings for Cargo Oil Tanks (MSC.288 (87)). However, coating of the weld is not required if the welding consumable used to produce the weld has been subject to the necessary corrosion tests. In such a case, a type approval certificate is required for the both steel brands in association with the welding consumable used.
2.6.5.7. When corrosion resistant steel and conventional steel are used together in an area where corrosion protection is necessary, see Figure 2.6.5.7, the conventional steel and the weld shall be coated in accordance with Performance Standard for Protective Coatings for Cargo Oil Tanks (MSC.288 (87)).

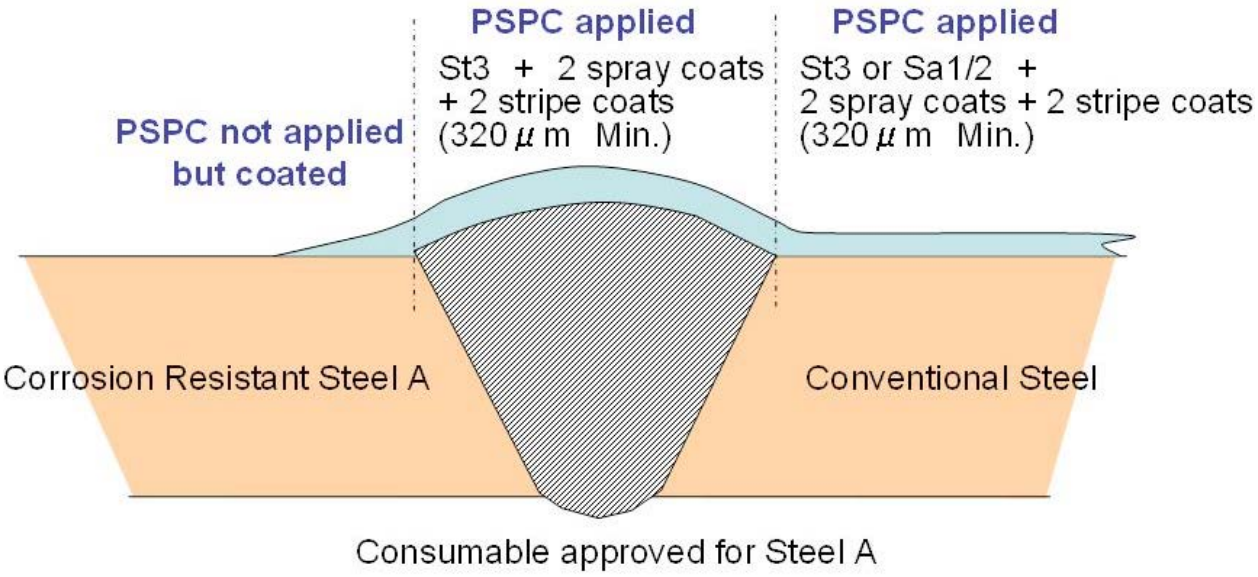

Fig. 2.6.5.7

2.6.5.8. Where the welding consumable used is different from that indicated on the Type Approval Certificate of corrosion resistant steel, in singular cases agreed by RS the weld shall be coated in accordance with Performance Standard for Protective Coatings for COT (MSC.288 (87)), see Figure 2.6.5.8.

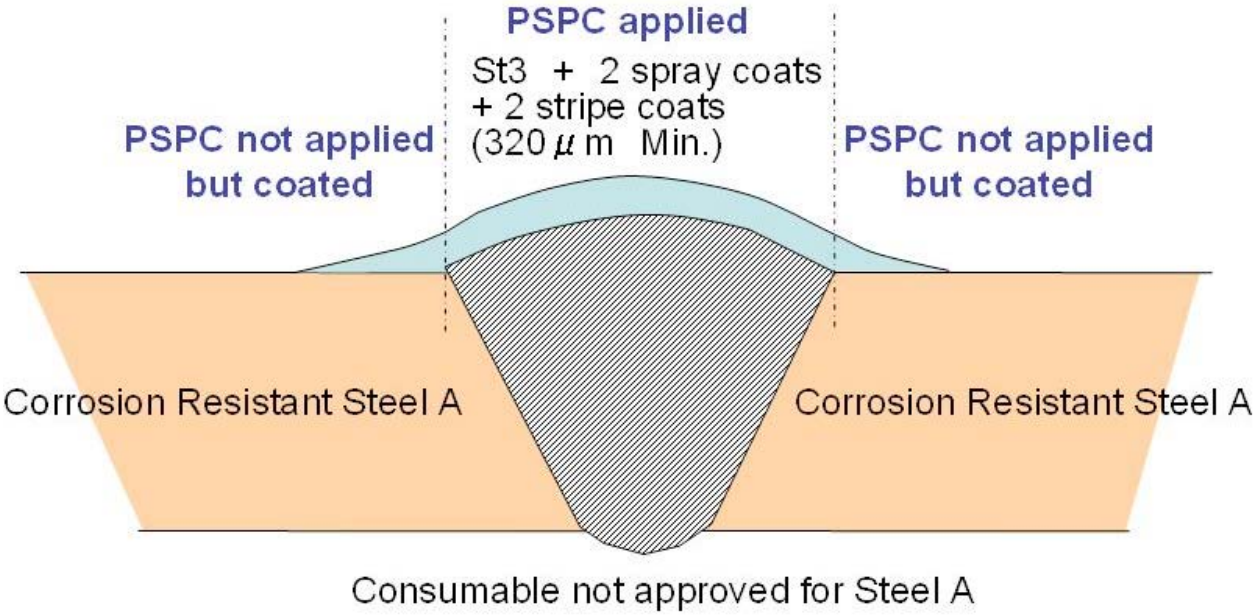

Fig. 2.6.5.8

2.6.6 Interpretations to 4 «Approval» PSPC-COT Alt.

2.6.6.1. Approval procedure

2.6.6.1.1 The steel must be approved and graded accordingly.

2.6.6.1.2 The approval procedure for corrosion testing of corrosion resistant steel is described in the Annex to Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks MSC.288 (87)).

2.6.6.1.3 The Register's approval is not needed for the testing laboratory where a surveyor of the Register is present at specified stages to witness the approval tests.

2.6.6.1.4 In the case where the Register is not present at specified stages to witness the approval tests, the testing laboratory shall be approved.

2.6.6.1.5 Where the scope of approval changes, for example for additions to the applicable welding consumables, the effects of these changes shall be subjected to corrosion resistance tests for the welded joints, specified in the Annex to Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks MSC.288 (87)).

2.6.6.2 Recognition Certificate for Manufacture Certificate (СПИ) for corrosion resistant steel shall be issued as per 2.1.

2.6.7 Interpretation to 5 «Inspection and Verification Requirements» PSPC-COT Alt.

2.6.7.1. General requirements
.1 The general requirements are as follows:

.1.1 Corrosion resistant steel type approved by the Register shall be used;
.1.2 Welding consumables used shall be the Brand specified on approved by RS documentations.
.1.3 Welding work shall be implemented according to the approved welding procedure;
.1.4 The correct use of corrosion resistant steel is verified by engineering review and survey.
.1.5 The shipbuilder shall prepare a Technical File after the construction work has been completed, and submit it to the Register for verification;
.1.6 The Technical File shall be maintained onboard the ship.
.2 If any of the items in 2.6.7.1.1.1 – 2.6.7.1.1.6 above are not complied with, the Register notifies the shipbuilder immediately who confirms the corrective action to be followed and its completion. A Cargo Ship Safety Construction Certificate shall not be issued until all required corrective actions have been closed to the satisfaction of the Register.

2.6.7.2 Procedure applicable to new ships.
2.6.7.2.1. Product inspection shall be carried out as part of material certification. The control range of the chemical composition is determined as follows:
.1 The manufacturer shall supply data relating to the control of applicable chemical elements that the manufacturer has intentionally added or is controlling to improve corrosion resistance. Upper and lower limits for all such elements and any relationship between these elements shall be disclosed. The manufacturer is to obtain the Register’s approval for these additions and the relationships.
.2 The effect of variation of each element is to be assessed by using sufficient corrosion tests to determine the effects of variation with variations of other elements used to enhance corrosion resistance.
.3 The corrosion resistance test shall be conducted in accordance with Appendix of Annex 3 to Performance Standard for the Alternative Means of Corrosion Protection for Cargo Oil Tanks MSC.289 (87)).

2.6.7.2.2 Survey during the construction stage
.1 The Register's surveyor shall verify that corrosion resistant steel has been used correctly at the appropriate locations.
.2 The verification in 2.6.7.2.2.1 shall be implemented periodically, and the frequency shall be determined on assessment of quality control feedback of each shipyard. However, if some deficiency is found, the shipyard shall formulate the necessary remedial action with regard to both the deficient location and counter measures to be taken to improve inspection methods.

2.6.7.3. Procedure applicable to ships in service.

2.6.7.3.1 If the repair method is described in the Technical File, repairs is to be carried out in accordance with the said method.
2.6.7.3.2 If corrosion resistant steel or coated member is to be replaced, the same corrosion protection method to the one used during construction is recommended.
2.6.7.3.3 If corrosion resistant steel is to be used during repairs, use of the corrosion resistant steel of the same brand as that used during construction is recommended.
2.6.7.3.4 If conventional steel is used in a corrosion resistant steel member that shall be replaced, coating shall be applied to the conventional steel. In this case, it is required that the coating complies with 3.4.3 of the Performance Standard for Protective Coatings for Crude Oil Tanks (MSC.288 (87)), see Figure 2.6.5.7.
2.6.7.3.5 The application of welding consumables to be used is to be confirmed through the approved by RS documentation of the relevant corrosion resistant steel (brands of the welding consumables).
2.6.7.3.6 If the welding consumables specified in approved by RS documentation for the corrosion resistant steel cannot be used, the weld shall be coated, see Figure 2.6.5.8. In this case, it is required that the coating complies with 3.4.3 of the Performance Standard for Protective Coatings for Crude Oil Tanks (MSC.288 (87)).

2.6.7.4. Welding Considerations

2.6.7.4.1 Welding workmanship standards accepted for conventional steel may be used.
2.6.7.4.2 An approved welding procedure shall be used for welding work as appropriate to the grades (excluding subscripts related to corrosion resistance), welding consumables, welding position and plate thickness, etc., of the corrosion resistant steel to be used.

2.6.8 Interpritation to PSPC-COT Alt Appendix - Test Procedures for Qualification of Corrosion Resistant Steel for Cargo Tanks in Crude Oil Tankers.

2.6.8.1. Test on simulated upper deck conditions
.1 Test condition:
.1.1 The chemical composition of the conventional shipbuilding steel used for test purposes (Table 1 in the Annex to the Performance Standard for Alternative Means of Corrosion Protection for Cargo Oil Tanks (MSC.289 (87))) shall be based on ladle analysis given in the mill certificate. Steel complying with a national standard that meets the requirements of Table 1 is also acceptable (Appendix to MSC.289 (87)). The chemical composition shall meet the requirements on Recognition Certificate for Manufacture Certificate (СПИ).
.1.2 All the base material specimens shall be located in one tank. Figure 2 in the Annex to MSC.289 (87) only shows locations of 20 specimens. The tank can be designed to hold 25 or more specimens; alternatively specimens can be added and removed as necessary so that the appropriate time periods are achieved within the total timescale of 98 days.
.1.3 Since certain factors such as control and measurement of temperature and size of chamber may affect the corrosion rate achieved, it shall be confirmed that the corrosion rate of conventional steel in the conditions and equipment of the test, satisfies the rate criteria, before carrying out corrosion test for evaluation of corrosion resistant steel.
.1.4 To remove specimens, the chamber shall be purged with 100% nitrogen gas while the specimens are in the high temperature region until the specimens are dry.
.1.5 The cycling pattern of specimen temperature and temperature of distilled water shall be controlled such that each cycle is as identical as possible throughout the whole corrosion test period. These temperatures must be recorded. See Figure 2.6.8.1.1.5

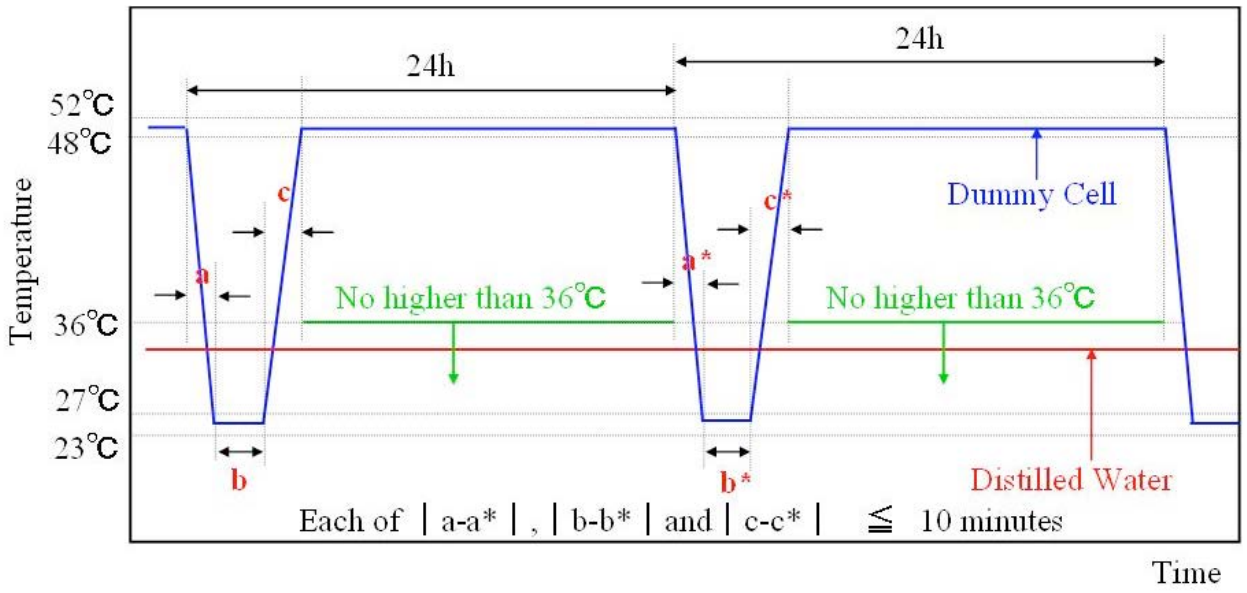

Figure 2.6.8.1.1.5 - Schematic view of temperature controlling accuracy of specimens and distilled water during corrosion test

.1.6 The transition time, a, a*, c and c* in figure 2.6.8.1.1.5 is the time from when the cooling and heating commences until the lower or upper temperature is reached, see Figure 2.6.8.1.1.6. The transition of each cycle shall be as identical as possible throughout the whole corrosion test period.

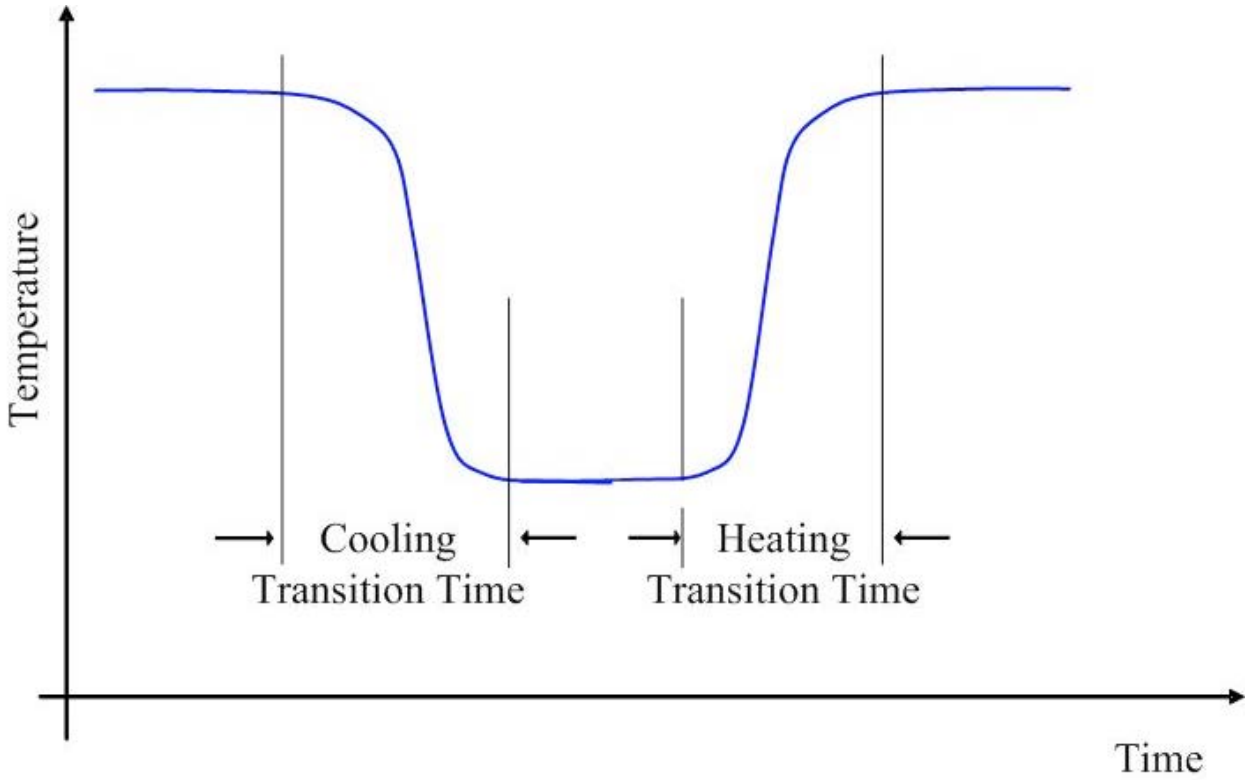

Figure 2.6.8.1.1.6 - Transition time definition

.1.7 The temperature of both the specimens and the water shall be continuously recorded throughout the test.

.1.8 Welded specimens may be tested with the parent material tests or tested separately against 5 conventional steel specimens.

.1.9 Base material shall be prepared such that the surface to be tested shall be taken from a position within 2 mm of one rolled surface. This surface shall be ground to bare steel and polished to 600 grit finish.
.1.10 For welded samples, a test assembly shall be made from the same steel cast as the base material test in (i) but may be from a plate of different thickness. The assembly shall be welded using the process and consumable to be approved for use with the base material. The surface to be tested shall be selected such that the width of weld metal, excluding heat affected zone, shall be between 10 and 20 mm. This surface shall be ground to bare steel and polished to 600 grit finish.
.1.11 Specimens are to be weighed to an accuracy of ± 1 mg.
.1.12 Where the calculated corrosion loss of conventional steel is less than 0.05 mm/year, the concentration of H2S may be increased in the simulated cargo oil tank gas. All tests will be carried out at this increased level.
.1.13 At least 3 values of individual weight loss of conventional steel shall be in the range of maximum X and minimum Y measured in grams.

$X = (0{,}11 \times S \times D)/10$

$X = (0{,}05 \times S \times D)/10$

Where:
S = surface area (cm2)
D = density (g/cm3)

2.6.8.1.2. Test on simulated inner bottom conditions
.1 Test condition
.1.1 The conventional steel used shall also meet the requirements of Table 1 in the Annex to MSC.289 (87)) and 2.6.8.1.1 (a).
.1.2 Base material shall be prepared such that one surface shall be taken from a position within 2 mm of one rolled surface. All surfaces shall be ground to bare steel and polished to 600 grit finish.
.1.3 For welded samples, a test assembly shall be made from the same steel cast as the base material test in 2.6.8.1.2 (e) but may be from a plate of different thickness. The assembly shall be welded using the process and consumable to be approved for use with the base material. The surface to be tested shall be selected such that the width of weld metal, excluding heat affected zone, shall be between 10 and 20 mm. This surface shall be ground to bare steel and polished to 600 grit finishes...
.1.4 Specimens shall be weighed to an accuracy of ± 1 mg.
.1.5 One specimen that has a corrosion rate deviating from the average corrosion rate by more than +25% may be eliminated from the results, provided that the cause of the accelerated corrosion is demonstrated to be due to localized corrosion around the hanging hole and/or stamp (e.g. crevice corrosion, pitting corrosion, etc.).

2.6.8.3. Interpretation of weld discontinuity

2.6.8.3.1 Preparation of samples after corrosion test
.1 All five samples shall be prepared as follows.
.1.1 Two full thickness specimens approximately 20 mm long x 5 mm wide shall be sectioned with their principle axis perpendicular to the weld fusion line. Each specimen shall be located such that the weld fusion line is located approximately at its mid length. See Figure 2.6.8.3.1 (b).

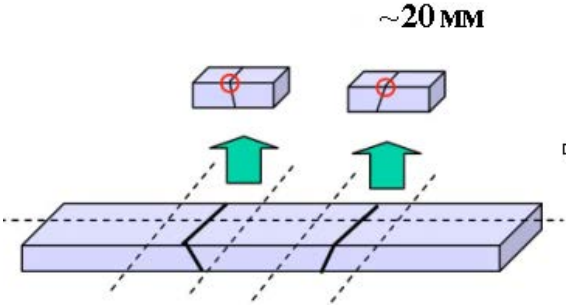

Figure 2.6.8.3.1.1.1 - Sectioning plan

.1.2 The specimens shall be mounted in resin to allow polishing of the cross section. The specimens shall be etched in Nital after polishing to reveal the fusion boundary.
.1.3 A photomicrograph shall be taken at a magnification of approximately 100 X.

2.6.8.3.2 Evaluation of depth step
.1 On the photomicrograph, construct a line A–B, perpendicular to the corrosion surface through the point where fusion line and the surface cross. (See Figure 4.6.8.3.2.1)

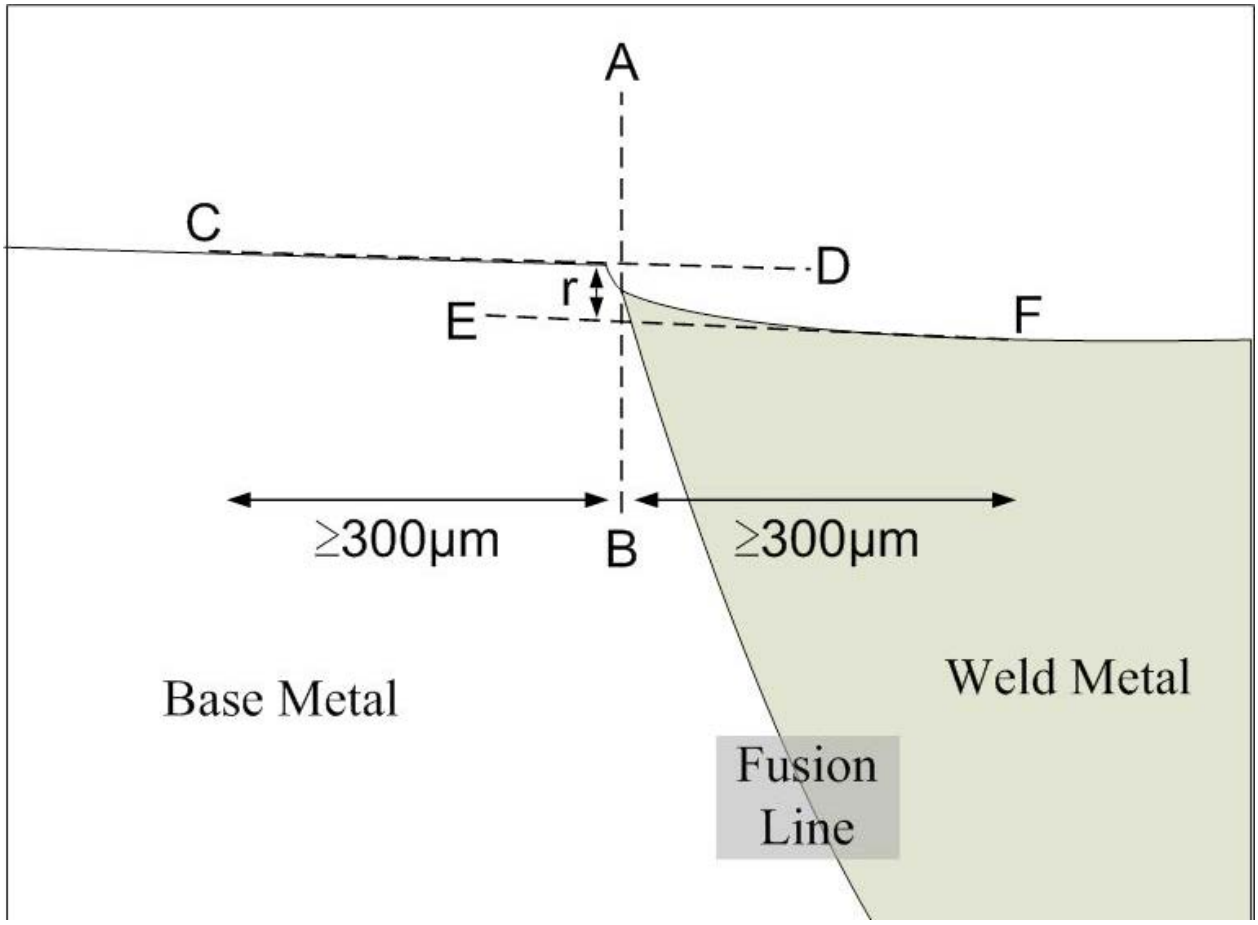

Figure 2.6.8.3.2.1 - Determination of corrosion depth on photomicrograph

.2 Construct two parallel lines C-D and E-F one representing the higher level, the other the lower level. Each line shall be constructed over a distance of ≥ 300 μm from line A-B on the base metal and weld metal side, respectively.
.3 Measure the distance r mm between the intersection point at line A-B and each average surface line on the photomicrograph.
.4 If the intersection point at line A-B and average surface line of welded metal part is above that of base metal part, then the existence of step shall be neglected for this sample..

.5 Calculate the depth of discontinuous step R in μm from the actual photomicrograph magnification M as follows:

$$R(\mu m) = \frac{r\,(mm) \times 1000}{M} \qquad (2.6.8.3.2.5)$$

2.6.8.3.3 Evaluation of step angle

.1 Evaluation for angle of step is unnecessary if the depth of step calculated on both samples (see 2.6.8.3.2), are not greater than 30 μm or if either step exceeds 50 μm for a single specimen. Otherwise the angle of step shall be calculated as follows.
.1.1 Produce a photomicrograph at a magnification of approximately 250 X, (see Figure 2.6.8.3.3.1.1).
.1.2 Draw an average surface line C-D for base metal part and E-F for weld metal part.
.1.3 Find the closest intersection point with the step of the base metal surface profile and the constructed line C-D and the closest intersection point with the step for weld metal constructed line E-F respectively, and connect those two intersection points.

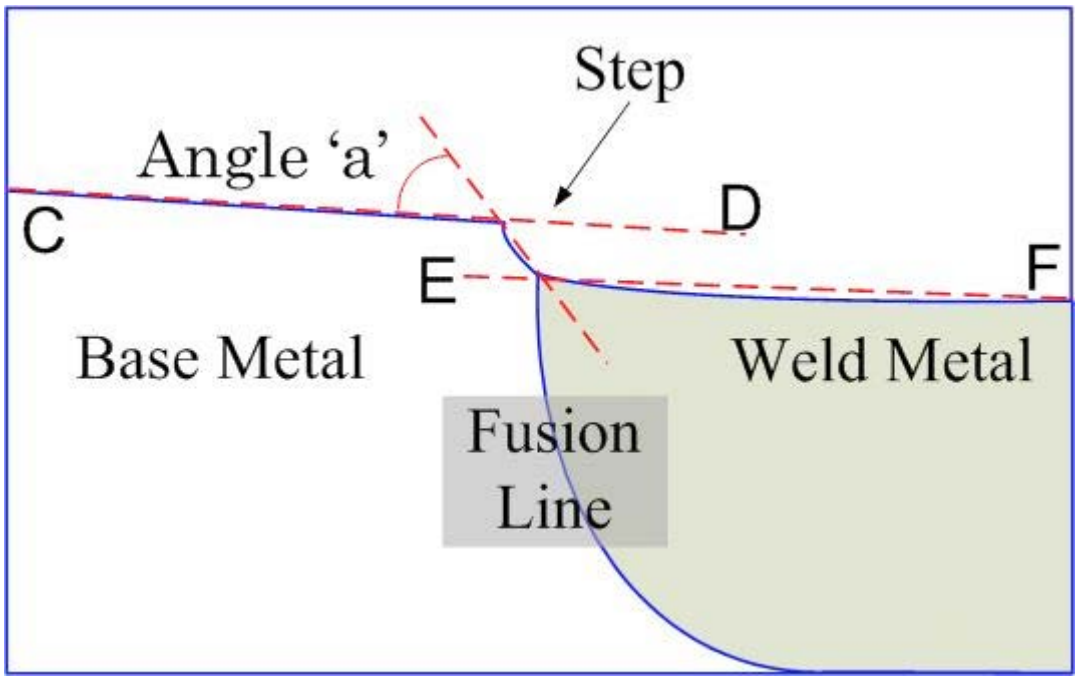

Figure 2.6.8.3.3.1.1 - Calculation of step angle

.1.4 Measure the angle 'a' in degrees given by the line C-D and the connected line described in 2.6.8.3.3.1.3 (see Figure 2.6.8.3.3.1.1).

2.6.9 Acceptance Criteria

2.6.9.1 If the depth of both steps are less than or equal to 30 μm then the measurement of angle is unnecessary, and the sample is considered to be acceptable.
2.6.9.2 If the depth of steps on both photomicrographs are less than or equal to 50 μm and in addition if both the measured angles are less than or equal to 15 degrees, then the sample is considered to be acceptable.
2.6.9.3 If either of the conditions described in s (a) or (b) above are not in compliance, the sample is considered to contain a "discontinuous surface" and fails the test.
2.6.9.4 Welds shall be evaluated as "without discontinuous surface" when all 5 corrosion test samples are considered acceptable".