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UNIFIED INTERPRETATION ON THE APPLICATION OF THE PERFORMANCE STANDARD FOR ALTERNATIVE MEANS OF CORROSION PROTECTION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS (RESOLUTION MSC.289(87))

1 The Maritime Safety Committee, at its ninety-third session (14 to 23 May 2014), with a view to providing specific guidance on the application of the relevant requirements of the *Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers*, as adopted by resolution MSC.289(87), approved the Unified interpretation on the application of the *Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers* (resolution MSC.289(87), prepared by the Sub-Committee on Ship Design and Construction, at its first session (20 to 24 January 2014).

2 Member Governments are invited to use the annexed Unified Interpretations as guidance when applying relevant provisions of the *Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers* and to bring them to the attention of all parties concerned.

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IMO CONVENTIONS EFFECTIVE IMPLEMENTATION

ANNEX

UNIFIED INTERPRETATION ON THE APPLICATION OF THE PERFORMANCE STANDARD FOR ALTERNATIVE MEANS OF CORROSION PROTECTION FOR CARGO OIL TANKS OF CRUDE OIL TANKERS, AS SET OUT IN THE ANNEX TO THE ANNEX OF RESOLUTION MSC.289(87)

Paragraph 2.1 – General principles

1 Normal and higher strength *Corrosion Resistant Steels* as defined within this Unified Interpretation, 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 resolution 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 ship.

2 *Corrosion Resistant Steels* are similar to conventional ship construction steels in terms of chemical composition and mechanical properties.

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.

Paragraph 2.2 – Technical File

1 The shipbuilder is to prepare and submit the Technical File to the Administration 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 on board the ship. The following construction records are to be included in the Technical File:

1.1 The copy of the Type Approval Certificate.

1.2 Other technical data is to include:

(a) Detail of the brand of welding consumables and welding process used.

(b) Repair method. Only to be included when specially recommended by the manufacturer of corrosion resistant steel.

1.3 Application records

(a) Areas of application/location of corrosion resistant steel.

(b) Brand of corrosion resistant steel and thickness.

Note: Items (a) and (b) 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 is to be indicated on the approved drawings, the drawings are to be included in the Technical File.

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

2 After the ship enters service, the shipowner or operator is to maintain repair data in the Technical File for review by the Administration. The information required is to include each location and corrosion protection method separately. These records should include:

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

(a) areas of repair work;

(b) repair method (replacement by corrosion resistant steel or coating);

(c) 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; and

(d) records in accordance with the Performance standard for protective coatings for cargo oil tanks of crude oil tankers (resolution MSC.288(87)), if coating is used.

2.2 Repairs that require records to be maintained as mentioned in paragraph 2.1 above include the following:

(a) replacement by corrosion resistant steel;

(b) 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) and

(c) repairs of pitted parts.(Note 2)

Note 1: Details of coating on repairs to corrosion resistant steel are to 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 is to be as deemed appropriate by the classification society and/or Administration. However, the standard value of the permissible wastage amount is to 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 are to be used. The full depth of the pitting is to 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 of crude oil tankers.

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

Paragraph 3.3 – Special application

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.

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

1.1.1 Permanent means of access which are not integral to the ship's structure include:

- ladders
- rails
- independent platforms
- steps

1.1.2 Appropriate corrosion protection measures are to be adopted for permanent means of access mentioned in paragraph 1.1.1 above.

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.

1.1.4 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 the *Performance standard for protective coatings for cargo oil tanks of crude oil tankers* (resolution MSC.288(87)).

1.1.5 Other corrosion protection measures are to be left to the discretion of the Administration.

1.1.6 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 is not to be impaired.

1.2 Access arrangements integral to the ship's structure

1.2.1 The phrase "Access arrangements that are integral to the ship structure" in paragraph 3.2.2 of the annex to the *Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers* (resolution MSC.289(87)) means access arrangements integral to the ship structure such as the items mentioned below, for access in the cargo oil tanks of crude oil tankers.

- Stiffeners and girders with increased depth for walkways

1.2.2 Appropriate corrosion protection measures are to be adopted for access arrangement given in paragraph 1.2.1. If coating is applied, the provisions of the Performance standard for protective coatings for cargo oil tanks (resolution MSC.288(87)) are to 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 of crude oil tankers, is to be used.

1.3 Supporting members, etc.

1.3.1 It 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 paragraph 1.1.4.

1.4 Work attachments

1.4.1 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 figure 3.3.1.

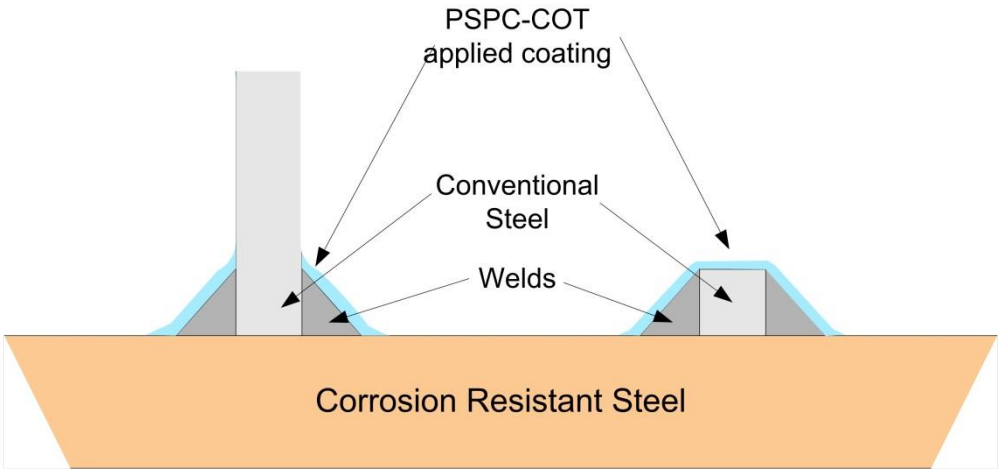

Figure 3.3.1 Range of coating when work attachments are welded to corrosion resistant steel

Paragraph 3.2 – Area of application

1 Structural members in the COT that require protection measures against corrosion are specified in the Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers (resolution MSC.289(87).

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).

3 Acceptable combinations of corrosion protection methods are shown in table 1.

Table 1 – 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.			

4 If different corrosion protection methods (coating and corrosion resistant steel) are selected for either (a) or (b), the selected procedure for each member is to comply with the relevant performance standards.

5 Where corrosion resistant steel is used it is to be type approved by the Administration.

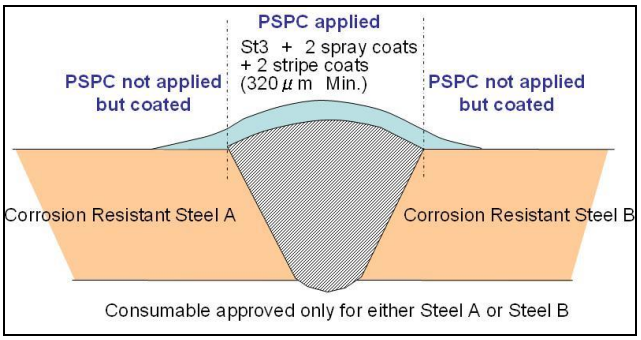

Figure 3.4.1

6 Where different brands of corrosion resistant steels are used in the same structural member, see figure 3.4.1, the weld joining the two different steels is to be coated. Coating is to be in accordance with the *Performance standard for protective coatings for cargo oil tanks of crude oil tankers* (resolution 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.

7 When corrosion resistant steel and conventional steel are used together in an area where corrosion protection is necessary, see figure 3.4.2, the conventional steel and the weld is to be coated in accordance with the *Performance standard for protective coatings for cargo oil tanks of crude oil tankers* (resolution MSC.288(87)),

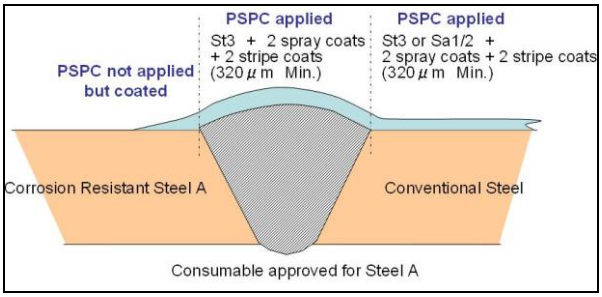

Figure 3.4.2

8 Where the welding consumable used is different from that indicated on the Type Approval Certificate of corrosion resistant steel, the weld is to be coated in accordance with the *Performance standard for protective coatings for cargo oil tanks of crude oil tankers* (resolution MSC.288(87)), see figure 3.4.3.

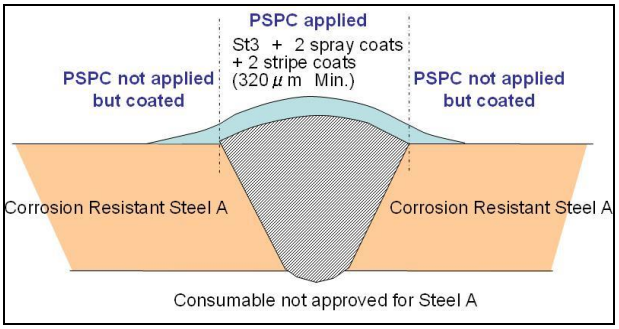

Figure 3.4.3

Paragraph 4 – Approval

1 Approval procedure

1.1 The steel must be approved and graded accordingly.

1.2 The approval procedure for corrosion testing of corrosion resistant steel is described in the annex to the *Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers* (resolution MSC.289(87)).

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

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

1.5 Where the scope of approval changes, for example for additions to the applicable welding consumables, the effects of these changes are to be subjected to corrosion resistance tests for the welded joints specified in the annex to the *Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers* (resolution MSC.289(87)).

2 Type Approval Certificate

2.1 The Type Approval Certificate for approved corrosion resistant steel is to include the following items:

(a) brand name, manufacturer and certificate number;

(b) steel grade and area of application designation;

(c) chemical composition range (including additive and/or controlling element percentages to improve corrosion resistance);

(d) maximum thickness;

(e) steelmaking process;

(f) casting process;

(g) delivery condition;

(h) brand of welding consumables and welding method; and

(i) period of validity of approval.

2.2 The Type Approval Certificate is valid for a maximum period of 5 years from the date of approval. When the renewal of approval is carried out, the period of validity will be a maximum period of 5 years from the next day after the expiry date of the previous validity.

Paragraph 5 – Inspection and verification requirements

1 General requirements

1.1 The general requirements are as follows:

(a) Corrosion resistant steel type approved by the Administration is to be used.

(b) Welding consumables used are to be the Brand specified on the type approval certificate.

(c) Welding work is to be implemented according to the approved welding procedure.

(d) The correct use of corrosion resistant steel is verified by engineering review and survey.

(e) The shipbuilder is to prepare a Technical File after the construction work has been completed, and submit it to the Administration for verification.

(f) The Technical File is to be maintained on board the ship.

1.2 If any of the items in 1.1(a) to 1.1(f) above are not complied with, the Administration notifies the shipbuilder immediately who confirms the corrective action to be followed and its completion. A SOLAS Safety Construction Certificate should not be issued until all required corrective actions have been closed to the satisfaction of the Administration.

2 Procedure applicable to new ships

2.1. Product inspection is to be carried out as part of material certification. The control range of the chemical composition is determined as follows:

2.1.1 The manufacturer is to 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 are to be disclosed. The manufacturer is to obtain the Administration's approval for these additions and the relationships.

2.1.2 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.

2.1.3 The corrosion resistance test is to be conducted in accordance with the appendix to annex 3 to the *Performance standard for the alternative means of corrosion protection for cargo oil tanks of crude oil tankers* (resolution MSC.289(87)).

2.2 Survey during the construction stage

2.2.1 The Administration's surveyor is to verify that corrosion resistant steel has been used correctly at the appropriate locations.

2.2.2 The verification in 2.2.1 is to be implemented periodically, and the frequency is to be determined on assessment of quality control feedback of each shipyard. However, if some deficiency is found, the shipyard is to formulate the necessary remedial action with regard to both the deficient location and counter measures to be taken to improve inspection methods.

3 Procedure applicable to ships in service

3.1 If the repair method is described in the Technical File, repairs are to be carried out in accordance with the said method.

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.

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.

3.4 If conventional steel is used in a corrosion resistant steel member that is to be replaced, coating is to be applied to the conventional steel. In this case, it is required that the coating complies with paragraph 3.4.3 of the *Performance standard for protective coatings for crude oil tanks of crude oil tankers* (resolution MSC.288(87)), see figure 3.4.2.

3.5 The application of welding consumables to be used is to be confirmed through the latest Type Approval Certificate of the relevant corrosion resistant steel to ensure conformity (brands of the welding consumables are indicated on the Type Approval Certificate).

3.6 If the welding consumables specified in the Type Approval Certificate for the corrosion resistant steel cannot be used, the weld is to be coated, see figure 3.4.3. In this case, it is required that the coating complies with paragraph 3.4.3 of the *Performance standard for protective coatings for cargo oil tanks of crude oil tankers* (resolution MSC.288(87)).

4 Welding Considerations

4.1 Welding workmanship standards accepted for conventional steel may be used.

4.2 An approved welding procedure is to 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.

Appendix – Test procedures for qualification of corrosion resistant steel for cargo tanks in crude oil tankers

1 Test on simulated upper deck conditions

1.1 Test condition

(a) 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 of crude oil tankers* (resolution MSC.289(87))) is to 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.

(b) All the base material specimens should be located in one tank. Figure 2 in the annex to the *Performance Standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers* (resolution 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.

(c) Since certain factors such as control and measurement of temperature and size of chamber may affect the corrosion rate achieved, it should 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.

(d) To remove specimens, the chamber is to be purged with 100% nitrogen gas while the specimens are in the high temperature region until the specimens are dry.

(e) The cycling pattern of specimen temperature and temperature of distilled water should be controlled such that each cycle is as identical as possible throughout the whole corrosion test period. These temperatures must be recorded. See figure App 1.

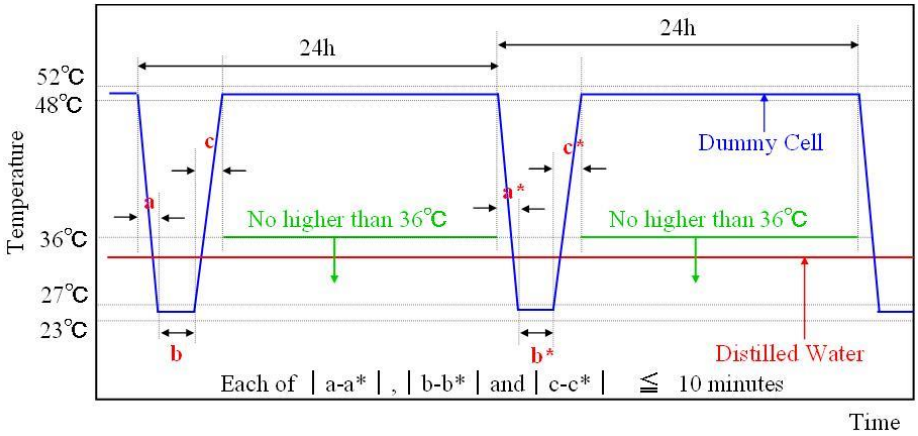

Figure App 1 – Schematic view of temperature controlling accuracy of specimens and distilled water during corrosion test

(f) The transition time, a, a*, c and c* in figure App 1 is the time from when the cooling and heating commences until the lower or upper temperature is reached, see figure App 2. The transition of each cycle is to be as identical as possible throughout the whole corrosion test period.

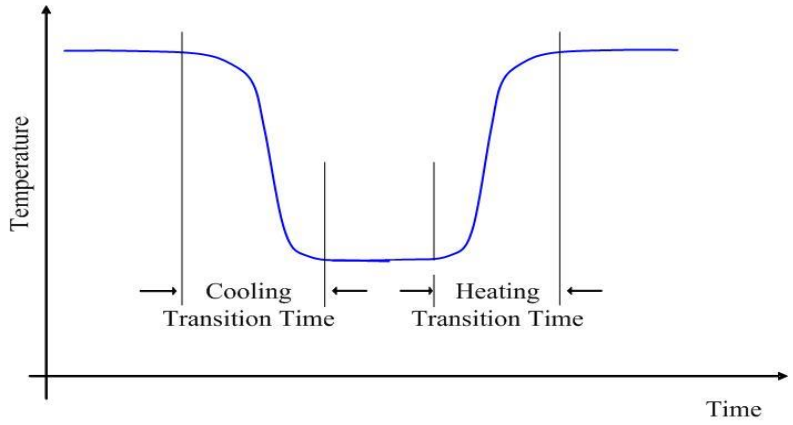

Figure App 2 – Transition time definition

(g) The temperature of both the specimens and the water is to be continuously recorded throughout the test.

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

(i) Base material is to be prepared such that the surface to be tested is to be taken from a position within 2 mm of one rolled surface. This surface is to be ground to bare steel and polished to 600 grit finish.

(j) For welded samples, a test assembly is to 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 is to be welded using the process and consumable to be approved for use with the base material. The surface to be tested is to be selected such that the width of weld metal, excluding heat affected zone, is to be between 10 and 20 mm. This surface is to be ground to bare steel and polished to 600 grit finish.

(k) Specimens are to be weighed to an accuracy of ± 1 mg.

(l) Where the calculated corrosion loss of conventional steel is less than 0.05 mm/year, the concentration of H_2S may be increased in the simulated cargo oil tank gas. All tests will be carried out at this increased level.

(m) At least 3 values of individual weight loss of conventional steel should be in the range of maximum X and minimum Y measured in grams.

$X = (0.11 \times S \times D)/10$

$Y = (0.05 \times S \times D)/10$

Where

S = surface area (cm^2)

D = density (g/cm^3)

2 Test on simulated inner bottom conditions

2.1 Test condition

(a) The conventional steel used should also meet the requirements of table 1 in the annex to the *Performance standard for alternative means of corrosion protection for cargo oil tanks of crude oil tankers* (resolution MSC.289(87)) and interpretations 1.1 (a) above.

(b) Base material is to be prepared such that one surface is to be taken from a position within 2 mm of one rolled surface. All surfaces are to be ground to bare steel and polished to 600 grit finish.

(c) For welded samples, a test assembly is to be made from the same steel cast as the base material test in (e) but may be from a plate of different thickness. The assembly is to be welded using the process and consumable to be approved for use with the base material. The surface to be tested is to be selected such that the width of weld metal, excluding heat affected zone, is to be between 10 and 20 mm. This surface is to be ground to bare steel and polished to 600 grit finish.

(d) Specimens are to be weighed to an accuracy of ± 1 mg.

(e) 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.).

3 Interpretation of weld discontinuity

3.1 Preparation of samples after corrosion test

(a) All five samples are to be prepared as follows.

(b) Two full thickness specimens approximately 20 mm long x 5 mm wide are to be sectioned with their principle axis perpendicular to the weld fusion line. Each specimen is to be located such that the weld fusion line is located approximately at its mid length. See figure App 3.

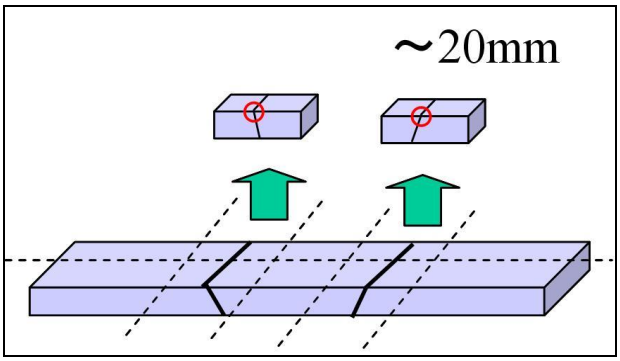

Figure App 3 – Sectioning plan

(c) The specimens are to be mounted in resin to allow polishing of the cross section. The specimens are to be etched in Nital after polishing to reveal the fusion boundary.

(d) A photomicrograph is to be taken at a magnification of approximately 100 X.

3.2 Evaluation of depth step

(a) 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 App 4.

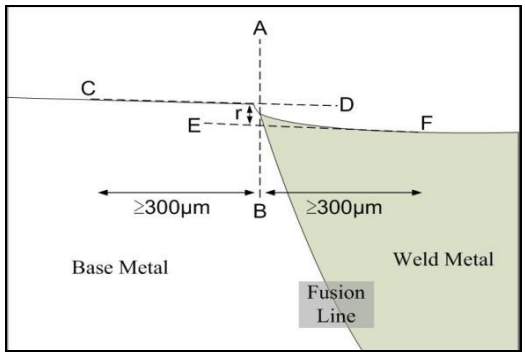

Figure App 4 – Determination of corrosion depth on photomicrograph

(b) Construct two parallel lines C-D and E-F one representing the higher level, the other the lower level. Each line is to be constructed over a distance of ≥ 300 µm from line A-B on the base metal and weld metal side, respectively.

(c) Measure the distance r mm between the intersection point at line A-B and each average surface line on the photomicrograph.

(d) 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 should be neglected for this sample.

(e) Calculate the depth of discontinuous step R in µm from the actual photomicrograph magnification M as follows:

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

3.3 Evaluation of step angle

(a) Evaluation for angle of step is unnecessary if the depth of step calculated on both samples see paragraph 3.2, are not greater than 30 µm or if either step exceeds 50 µm for a single specimen. Otherwise the angle of step is to be calculated as follows.

(b) Produce a photomicrograph at a magnification of approximately 250 X, see figure App 5.

(c) Draw an average surface line C-D for base metal part and E-F for weld metal part.

(d) 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.

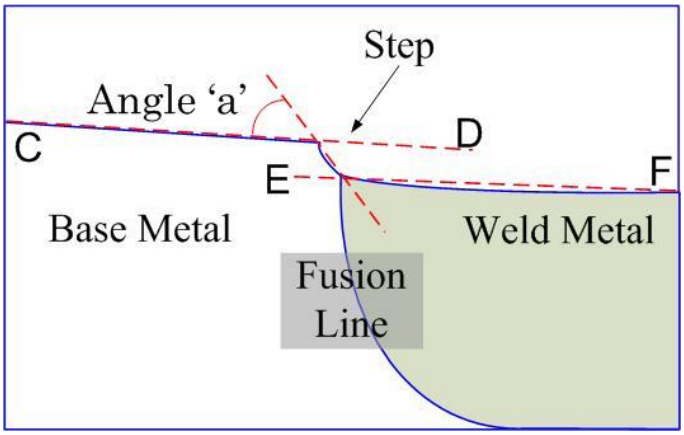

Figure App 5 – Calculation of step angle

(e) Measure the angle "a" in degrees given by the line C-D and the connected line described in paragraph d, see figure App 2.

3.4 Acceptance criteria

(a) 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.

(b) 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.

(c) If either of the conditions described in paragraphs a or b above are not in compliance, the sample is considered to contain a "*discontinuous surface*" and fails the test.

(d) Welds should be evaluated as "*without discontinuous surface*" when all 5 corrosion test samples are considered acceptable.