RULES

PUBLICATION 70/P

NON-DESTRUCTIVE TESTING OF HULL AND MACHINERY STEEL FORGINGS

January
2022

Publications P (Additional Rule Requirements) issued by Polski Rejestr Statków complete or extend the Rules and are mandatory where applicable.

GDAŃSK

Publication 70/P – Non-Destructive Testing of Hull and Machinery Steel Forgings – January 2022, based on the IACS Guidelines (Recommendation No. 68 (June 2000)), is an extension of the requirements contained in *Part IX – Materials and Welding* of the *Rules for the Classification and Construction of Sea-going Ships*.

This Publication was approved by PRS Board on 21 December 2021 and enters into force on 1 January 2022.

This Publication also applies to other PRS regulations if it is mentioned there.

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PRS/RP, 12/2021

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1 GENERAL

1.1 This Publication complements the requirements for steel forgings according to the PRS Rules – *Part IX – Materials and Welding, Rules for the Classification and Construction of Sea-going Ships, Publication No. 4/P, Part VI – Machinery Installations and Refrigerating Plants, Rules for the Classification and Construction of Sea-going Ships* and contains general guidance for the non-destructive testing methods, the extent of testing and the minimum recommended quality levels to be complied with unless otherwise approved or specified. The requirements contained herein may be also applied to the testing of austenitic stainless steel and ferritic-austenitic (duplex) stainless steel forgings.

1.2 This *Publication* contains guidelines on surface inspections by visual testing, magnetic particle testing, penetrant testing and ultrasonic testing.

1.3 The requirements contained in this *Publication* may also be applied to such steel forgings as couplings, gears, boilers and pressure vessels provided the materials used, kinds and service stress conditions have been taken into account.

1.4 Forgings shall be testing in the final delivery condition. For specific requirements see paragraphs 3.5 and 4.5.

1.5 Where intermediate inspections have been performed the manufacturer shall submit a documentation of the results upon the request of PRS Surveyor.

1.6 Where a forging is supplied in semi-finished condition, the manufacturer shall take into account the quality level of final finished machined components.

1.7 Where advanced ultrasonic testing methods are applied, e.g. PAUD or TOFD, reference shall be made to Publication No. 80/P for general approach in adopting and application of these advanced methods. Acceptance levels regarding accept/reject criteria should be as per the applicable section in this Publication.

2 PERSONNEL REQUIREMENTS

2.1 Personnel carrying out NDT shall be certified according to ISO 9712 or equivalent national or international standard. Qualifications issued in compliance with other schemes, including employer-based schemes, are subject to PRS acceptance in each particular case.

2.2 The NDT personnel's certificates and competence shall comprise all industrial sectors and techniques being applied by the manufacturer or its subcontractors.

2.3 Certificates shall be made available to PRS for verification, when requested.

2.4 Procedures shall be approved by level 3 personnel for the appropriate NDT method.

2.5 The operator carrying out the NDT and interpreting indications, should as a minimum, be qualified and certified to level 2 in the NDT method(s) concerned. However, operators only undertaking the gathering of data using any NDT method and not performing data interpretation or data analysis may be qualified and certified as appropriate, at level 1.

The operator shall have adequate knowledge of materials, weld, structures or components, NDT equipment and limitations that are sufficient to apply the relevant NDT method for each application appropriately.

3 SURFACE INSPECTIONS

3.1 General

3.1.1 Surface inspections may be carried out by visual testing, magnetic particle testing and penetrant testing, for the purpose of detecting relevant indications and assessing them against accept/reject criteria stated herein.

3.1.2 The testing procedures, apparatus, conditions and test media shall fulfil the requirements specified in the relevant national and international standards, such as EN 13018, EN 10228-2 and EN 10228-1.

3.1.3 Other surface inspection methods, e.g. eddy current testing, may be required by PRS as a supplementary method, e.g. for confirming the presence of indications, or for detecting the presence of undocumented weld repairs. This *Publication* does not include accept/reject criteria for this purpose and is mentioned here for information only.

3.2 Products

3.2.1 Steel forgings covered by this *Publication* shall be subjected to a 100% visual testing of all accessible surfaces by the manufacturer and made available to PRS Surveyor. For series production, the extent of testing shall be specified by PRS in each particular case.

3.2.2 It is noted that PRS Rules does not include every forged component that may be subject to classification (for example, forged slewing rings). In such cases where the particular component or type is not included, either in PRS Rules or this *Publication*, appropriate national or international standards may be applied, to determine the appropriate testing regime and defect acceptance criteria.

3.2.3 Austenitic stainless steel and ferritic-austenitic (duplex) stainless steel forgings acceptance criteria details are included in the appropriate sections for surface and volumetric inspections, however, other acceptance criteria and national or international standards may be applied, upon agreement with PRS.

3.2.4 Where such standards are used or referenced as a basis for accept and reject criteria, the quality level shall provide reasonable equivalence to the allowable criteria stated in the appropriate tables within this *Publication*. The quality levels would normally be the highest or most stringent, to provide reasonable equivalence with this *Publication*.

3.2.5 Surface inspections by penetrant and/or magnetic particle methods generally apply to the following steel forgings:

- all crankshafts,
- propeller shafts, intermediate shafts, thrust shafts and rudder stocks with minimum diameter not less than 100 mm,
- cylinder heads, connecting rods, piston rods and crossheads as per the engine type and size requirements in *Publication No. 4/P*,
- bolts with minimum diameter not less than 50 mm, which are subjected to dynamic stresses such as cylinder cover bolts, coupling bolts for crankshafts, tie rods, crankpin bolts, main bearing bolts and other items as per the engine type and size requirements in *Publication No. 4/P*,
- propeller blade fastening bolts which are subjected to dynamic stresses.

3.3 Zones for Surface Inspections

Where permitted, penetrant or magnetic particle testing, shall be carried out in zones I, II and III (as applicable) as indicated in Figures 1 to 4.

3.4 Surface Condition

The surfaces of forgings to be tested shall be free from scale, dirt, grease or paint that might affect the inspection effectiveness or indications' interpretation.

The tested surface shall be so shot-blasted, sand-blasted or surface-ground that the discontinuity indications can be easily distinguished from the indications of surface irregularity.

3.5 Surface Inspection

3.5.1 Magnetic particle testing shall be carried out with the following exceptions, when liquid penetrant testing will be permitted:
- austenitic and ferritic-austenitic (duplex) stainless steels,
- interpretation of open visual or magnetic particle indications,
- at the instruction of PRS Surveyor.

3.5.2 Unless otherwise detailed in the specification, the magnetic particle test shall be performed on a forging in the final machined surface condition and final thermally treated condition.

3.5.3 Unless otherwise agreed, the surface inspection shall be carried out in the presence of PRS Surveyor. The surface inspection shall be carried out before the shrink fitting, where applicable.

3.5.4 For magnetic particle testing, attention shall be paid to the contact between the forging and the clamping devices of stationary magnetization benches in order to avoid local overheating or burning damage in its surface. Prods are not permitted on finished machined items unless they are applied with special protective devices.

3.5.5 When indications are detected as a result of the surface inspection, acceptance or rejection shall be decided by PRS Surveyor in accordance with the requirements specified in subchapter 3.6.

3.6 Acceptance Criteria and Rectification of Defects

3.6.1 Acceptance Criteria for Visual Testing

All forgings shall be free of cracks, crack-like indications, laps, seams, folds or other detrimental indications.

At the request of PRS Surveyor, additional magnetic particle, penetrant and ultrasonic testing may be required for more detailed evaluation of surface irregularities.

The bores of hollow propeller shafts shall be visually tested for imperfections uncovered by the machining operation.

3.6.2 Acceptance Criteria for Magnetic Particle Testing and Penetrant Testing

The following definitions relevant to indications apply:

Linear indication – an indication with a largest dimension three or more times its smallest dimension (i.e. $l \geq 3\ w$).

Non-linear indication – an indication with a largest dimension less than three times its smallest dimension (i.e. $l < 3\ w$).

Aligned indication – a) non-linear indications form an alignment when the distance between indications is less than 2 mm and at least three indications are aligned. An alignment of indications is considered to be a unique indication and its length is equal to the overall length of the alignment. b) linear indications form an alignment when the distance between two indications is smaller than the length of the longest indication.

Open indication – an indication visible after removal of the magnetic particles or that can be detected by the use of penetrant testing.

Non-open indication – an indication that is not visually detectable after removal of the magnetic particles or that cannot be detected by the use penetrant testing.

Relevant indication – an indication that is caused by a condition or type of discontinuity that requires evaluation. Only indications which have any dimension greater than 1.5 mm shall be considered relevant for the categorization of indications.

For the purpose of evaluating indications, the surface shall be divided into reference areas of 225 cm^2. The area shall be taken in the most unfavourable location relative to the indication being evaluated.

The allowable number and size of indications in the reference area is given in Tables 3.6.2-1 and 3.6.2-2. Cracks are not acceptable. Irrespective of the results of non-destructive testing, PRS Surveyor may reject the forging if the total number of indications is excessive.

Table 3.6.2-1
Crankshaft forgings:
Allowable number and size of surface indications in reference area of 225 cm^2

Inspection zone	Max. number of indications	Type of indication	Max. number for each type	Max. dimension [mm]
I (critical fillet area)	0	linear non-linear aligned	0 0 0	– – –
II (important fillet area)	3	linear non-linear aligned	0 3 0	– 3.0 –
III (journal surfaces)	3	linear non-linear aligned	0 3 0	– 5.0 –

Table 3.6.2-2
Steel forgings excluding crankshaft forgings:
Allowable number and size of surface indications in reference area of 225 cm^2

Inspection zone	Max number of indications	Type of indication	Max. number for each type	Max. dimension [mm]
I	3	linear non-linear aligned	0[1)] 3 0[1)]	– 3.0 –
II	10	linear non-linear aligned	3[1)] 7 3[1)]	3.0 5.0 3.0

Note:
1) Linear or aligned indications are not permitted on bolts, which receive a direct fluctuating load, e.g. main bearing bolts, connecting rod bolts, crosshead bearing bolts, cylinder cover bolts.

3.6.3 Rectification of Defects

3.6.3.1 Indications that exceed the requirements of Tables 3.6.2-1 and 3.6.2-2 shall be classed as defects, and shall be repaired or rejected as appropriate.

3.6.3.2 Generally it may be permissible to remove shallow indications by light grinding to a maximum depth of 1.5 mm where it is acceptable according to PRS Rules Part IX.

3.6.3.3 Complete removal of the defect shall be proved by magnetic particle testing or penetrant testing, as appropriate.

3.6.3.4 Repair welding is not permitted for crankshafts or rotating items subjected to torsional fatigue (such as propeller shafts). Repair welding of other forgings shall be subjected to prior approval by PRS in each particular case.

3.6.3.5 Grinding is not permitted in way of finished machined threads.

3.7 Reporting

Test results of surface inspections shall be recorded at least with the following items:

.1 date of testing;
.2 names, signatures and qualification level of inspection personnel;
.3 testing method and testing details, including procedure number;
- for penetrant testing: the penetrant system used and viewing conditions (as appropriate to the penetrant technique and media used);
- for magnetic particle testing: method of magnetizing, test media, magnetic field strength, magnetic flux indicators (where appropriate), and viewing conditions (as appropriate to the magnetizing technique and media used);

.4 type of product;
.5 product number and unique identification;
.6 grade of steel;
.7 heat treatment;
.8 stage of testing;
.9 position (zone) of testing;
.10 surface condition;
.11 test standards used, including reference to the appropriate tables for acceptance purposes;
.12 testing condition;
.13 tests results, including documentation regarding the repair and testing history (as appropriate);
.14 statement on acceptance/non acceptance;
.15 details of weld repair including sketch (where applicable).

4 ULTRASONIC TESTING

4.1 General

4.1.1 Ultrasonic testing in this *Publication* shall be carried out using the contact method with straight beam and/or angle beam technique. Advanced UT methods (such as PAUT or TOFD) shall meet the general requirements of *Publication No. 80/P*.

4.1.2 The testing procedures, apparatus and conditions of ultrasonic testing shall fulfil the requirements specified in the relevant national or international standards (e.g. EN 10228-3, EN 10228-4). Generally, the methods of setting test sensitivity and testing evaluation utilize the DAC

(distance-amplitude correction) or DGS (distance-gain-size) methods. The applied methodology shall use 2 to 4 MHz straight beam (or normal) probes and/or angle beam probes. For near surface testing (up to a depth of 25 mm) twin crystal 0° probe shall be used, plus a 0° probe (usually single crystal beyond a depth of 25 mm) for the remaining volume. The appropriate acceptance criteria tables shall be used, depending on the sensitivity method selected.

4.1.3 Fillet radii shall be tested using 45°, 60° or 70° probes, primarily to determine the presence of any cracks within the radiused areas, and as an additional scan to confirm any indications that may have been detected with 0° probe(s) within this area.

4.1.4 For fabricated forgings and weld repairs, weld testing shall be carried out to the appropriate standard, and the acceptance tables contained herein shall not be used as a basis for acceptance criteria of welds.

4.1.5 Construction of DAC curves for normal probes shall be performed using reference blocks containing suitably sized Flat Bottom Holes (FBH) spaced over the inspections thickness. Reference blocks shall be manufactured from similar material, with similar surface condition to that being inspected. Where necessary, allowances shall be made for attenuation losses by performing a transfer correction and adjusting the DAC curve as required. The applied transfer correction (measured in decibels, dB) shall become the new reference sensitivity, to which indications are evaluated against, according to the appropriate table contained herein.

4.2 Products

4.2.1 Ultrasonic testing apply to the following steel forgings:
- all crankshaft,
- propeller shafts, intermediate shafts, thrust shafts and rudder stocks with minimum diameter not less than 200 mm,
- cylinder heads, connecting rods, piston rods and crossheads, coupling bolts and studs as per the engine type and size requirements in *Publication No. 4/P.*

4.2.2 It is noted that PRS Rules does not include every forged component that may be subject to classification (for example, forged slewing rings). In such cases where the particular component or type is not included, either in PRS Rules or this *Publication*, appropriate national or international standards may be applied, to determine the appropriate testing regime and defect acceptance criteria.

4.2.3 Where such standards are used or referenced as a basis for accept and reject criteria, the quality level shall provide reasonable equivalence to the allowable criteria stated in the appropriate tables within this *Publication*. The quality levels would normally be the highest or most stringent, to provide reasonable equivalence with this *Publication*.

4.2.4 Ultrasonic acceptance criteria detailed in Tables 4.5-1, 4.5-2, 4.5-3 and 4.5-4 are intended for C, C-Mn and alloy steel forgings, and do not apply to austenitic stainless steel or ferritic-austenitic (duplex) stainless steel forgings. Acceptance criteria for stainless steel or duplex stainless steel are given in EN 10228-4 standard, and quality levels shall be agreed with PRS. Use of national or international standards is subject to approval of PRS in each particular case.

4.3 Zones for Ultrasonic Testing

Ultrasonic testing shall be carried out in the zones I to III as indicated in Figures 5 to 8. Areas may be upgraded to a higher zone at the discretion of PRS Surveyor.

4.4 Surface Condition

4.4.1 The surfaces of forgings to be tested shall be such that adequate coupling can be established between the probe and the forging and that excessive wear of the probe can be avoided. The surfaces shall be free from scale, dirt, grease, paint or other impurities.

4.4.2 The ultrasonic testing shall be carried out after the steel forgings have been machined to a condition suitable for this type of testing and after the final heat treatment, but prior to the drilling of the oil bores, prior to surface hardening and the machining of bolt threads. Black (or as forged) forgings shall be inspected after removal of the oxide scale using either flame or descaling or shot blasting methods.

4.5 Acceptance Criteria

Acceptance criteria of ultrasonic testing are specified in Tables 4.5-1 to 4.5-4.

Table 4.5-1
Ultrasonic testing acceptance criteria for crankshafts DGS method – normal probes

Type of forging	Zone	Allowable disc shape according to DGS[1)]	Allowable length of indication	Allowable distance between two indications[2)]
Crankshaft	I	$d \leq 1.0$ mm[3)]	Not applicable[4)]	Not applicable
	II	$d \leq 2.0$ mm	≤ 10 mm	≥ 20 mm
	III	$d \leq 4.0$ mm	≤ 15 mm	≥ 20 mm

Notes:
1) DGS – distance-gain-size.
2) In case of accumulations of two or more isolated indications which are subjected to registration the minimum distance between two neighbouring indications shall be at least the length of the larger indication. This also applies to the distance in axial direction as well as to the distance in depth.
Isolated indications with less distances shall be determined as one single indication.
3) For zone 1 testing, probe selection shall take into account the limits of probe beam-path length and depth of beam penetration and shall normally be carried out with a minimum probe frequency of 4 MHz.
4) For zone 1, indications with an echo height greater than a 1.0 mm disc shaped reflector are not acceptable. Indications with an echo height of less than 1.0 mm are acceptable if they are deemed as point reflectors and have no measurable lenght.

Table 4.5-2
Ultrasonic testing acceptance criteria for crankshafts DAC method – normal probes

Type of forging	Zone	Allowable reference level, based of 3.0 FBH [1) 2) 3)]	Allowable length of indication	Allowable distance between two indications[5)]
Crankshaft	I	3.0 mm DAC minus 19 dB	Not applicable[4)]	Not applicable
	II	3.0 mm DAC minus 7 dB	≤ 10.0 mm	≥ 20 mm
	III	3.0 mm DAC + 5 dB	≤ 15.0 mm	≥ 20 mm

Notes:
1) The requirement of a 3 mm FBH is to standardize the DAC reference blocks for clarity and consistency. The dB value for the FBH/DAC setting is equivalent to the disc shaped reflector stated in Table 4.5-1, corresponding to the applicable zone.
2) Other size FBH's may be used for the DAC method (and the dB value adjusted accordingly to provide equivalence with the stated FBH/disc shaped reflector). Where other size FBH's are used, the ultrasonic procedure shall state the equivalence using an appropriate calculation formula.

3) For zone 1 testing, probe selection shall take into account the limits of probe beam-path length and depth of beam penetration and shall normally be carried out with a minimum probe frequency of 4 MHz.
4) For zone 1, indications with an echo height greater than the DAC reference level are not acceptable. Indications with an echo height of less than the DAC reference level are acceptable if they are deemed as point reflectors and have no measurable lenght.
5) In case of accumulations of two or more isolated indications which are subject to registration the minimum distance between two neighbouring indications be at least the length of the larger indication. This also applies to the distance in axial directions as well as to the distance in depth. Isolated indications with less distances shall be determined as one single indication.

Table 4.5-3
Ultrasonic testing acceptance criteria for shafts and machinery components
DGS method – normal probes

Type of forging	Zone	Allowable disc shape according to DGS[1), 2)]	Allowable length of indication	Allowable distance between two indications[3)]
Propeller shaft, intermediate shaft	II	outer: $d \le 2$ mm inner: $d \le 4$ mm	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
Thrust shaft, Rudder stock	III	outer: $d \le 3$ mm inner: $d \le 6$ mm	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
Connecting rod, piston rod, crosshead	II	$d \le 2$ mm	≤ 10 mm	≥ 20 mm
	III	$d \le 4$ mm	≤ 10 mm	≥ 20 mm

Notes:
1) DGS – distance-gain size
2) Outer part means the part beyond one third of the shaft radius from the centre, the inner part means the remaining core area.
3) In case of accumulations of two or more isolated indications which are subject to registration, the minimum distance between two neighbouring indications shall be at least the length of the larger indication. This also applies to the distance in axial directions as well as to the distance in depth. Isolated indications with less distances shall be determined as one single indication.

Table 4.5-4
Ultrasonic testing acceptance criteria for shafts and machinery components
DAC method – normal probes

Type of forging	Zone	DAC reference level, based on 3.0 mm FBH [1), 2)]	Allowable length of indication	Allowable distance between two indications[3)]
Propeller shaft, intermediate shaft	II	outer: DAC minus 7 dB inner: DAC + 5 dB	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
Thrust shaft, Rudder stock	III	outer: +0 DAC inner: DAC + 12 dB	≤ 10 mm ≤ 15 mm	≥ 20 mm ≥ 20 mm
Connecting rod, piston rod, crosshead	II	DAC minus 7 dB	≤ 10 mm	≥ 20 mm
	III	DAC + 5 dB	≤ 10 mm	≥ 20 mm

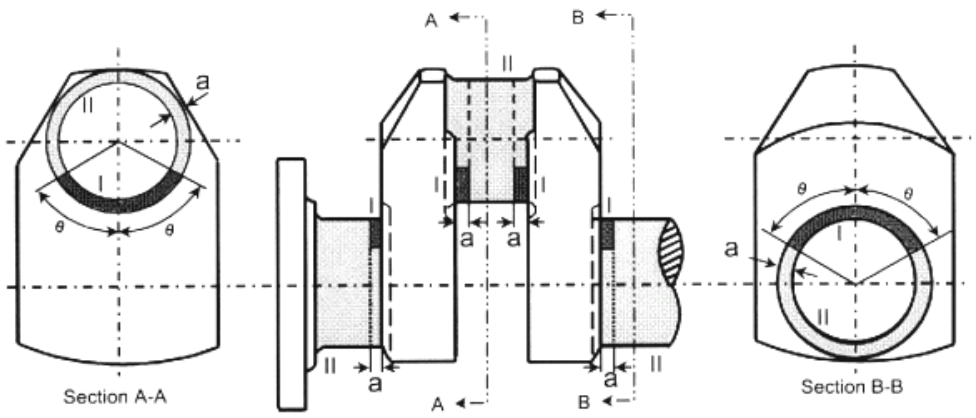
Notes:
1) The requirement of a 3 mm FBH is to standardize the DAC reference blocks for clarity and consistency. The dB value for the FBH/DAC setting is equivalent to the disc shaped reflector stated in Table 4.5-1, corresponding to the applicable zone.
2) Other size FBH's may be used for the DAC method (and the dB value adjusted accordingly to provide equivalence with the stated FBH/disc shaped reflector). Where other size FBH's are used, the ultrasonic procedure shall state the equivalence using an appropriate calculation formula.
3) In case of accumulations of two or more isolated indications which are subject to registration, the minimum distance between two neighbouring indications shall be at least the length of the larger indication. This also applies to the distance in axial directions as well as to the distance in depth. Isolated indications with less distances shall be determined as one single indication.

4.6 Reporting

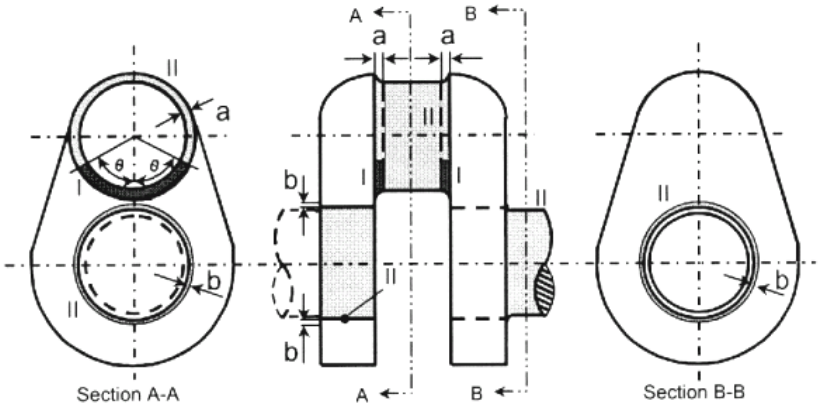
Test results of ultrasonic testing shall be recorded at least with the following items:

.1 date of testing;
.2 names, signatures and qualification level of inspection personnel;
.3 testing method, including procedure number, and details of the following items:
- equipment used (instrument, probes, including any adaptions to probes for curved surfaces, calibration and reference blocks
- technique(s) used to set test sensitivity (including sensitivity method, specific reference blocks, reflector size, transfer correction)
- maximum scanning rate (mm/s)
- details of any testing restrictions

.4 type of product;
.5 product number and unique identification;
.6 grade of steel;
.7 heat treatment;
.8 stage of testing;
.9 position (zone) of testing;
.10 surface condition;
.11 test standards used, including reference to the appropriate tables for acceptance purposes;
.12 testing condition;
.13 tests results, including documentation regarding the repair and testing history (as appropriate);
.14 statement on acceptance/non acceptance;
.15 details of weld repair including sketch (where applicable).



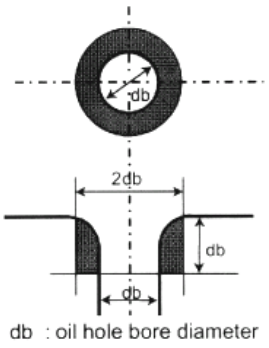
(a) Solid crankshaft



(b) Semi built-up crankshaft

Notes:

1. When the crankpin or journal has oil holes, the circumferential surfaces of the oil holes shall be treated as Zone I. (See the figure on the right.)



db : oil hole bore diameter

2. In the above figures, θ, a, b mean:

   $\theta = 60º$

   $a = 1.5r$

   $b = 0.05d$ (circumferential surfaces of shrinkage fit)

   where r – fillet radius, d – journal diameter.

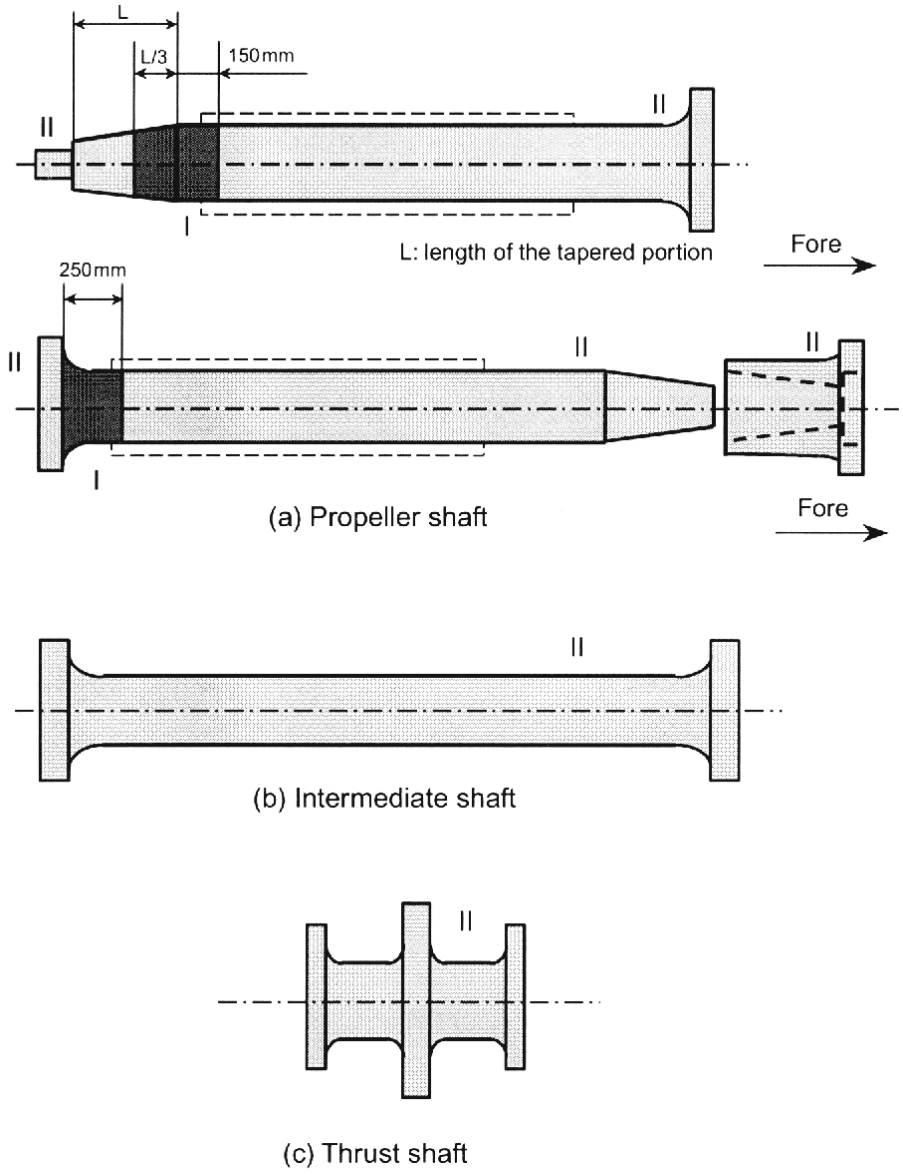
3. Identification of the zones (similar in Figs. 1 through 4).

– Zone I

– Zone II

– Zone III

Fig. 1 – Zones for magnetic particle / liquid penetrant testing on crankshafts



Note:

For propeller shaft, intermediate shafts and thrust shafts, all areas with stress raisers such as radial holes, slots and keyways shall be treated as Zone I.

Fig. 2 – Zones for magnetic particle / liquid penetrant testing on shafts

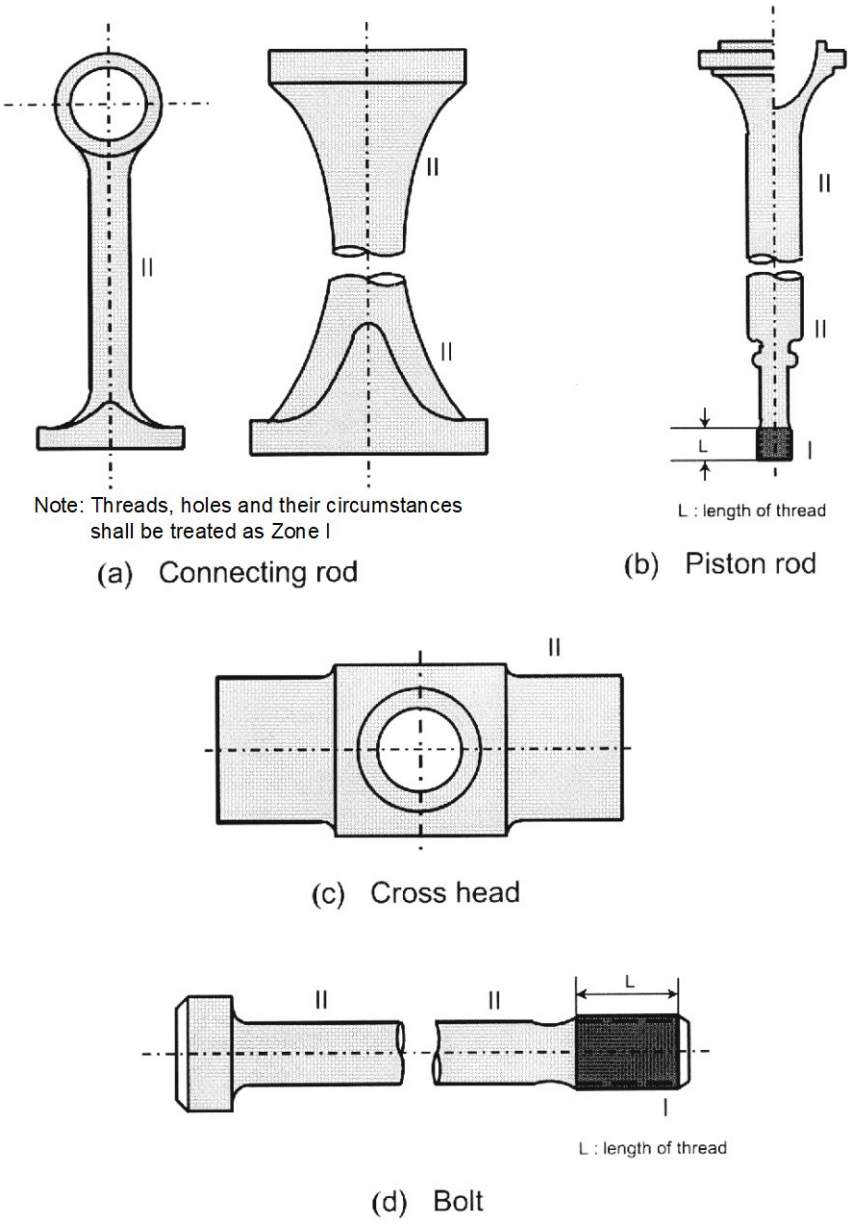


Fig. 3 – Zones for magnetic particle / liquid penetrant testing on machinery components

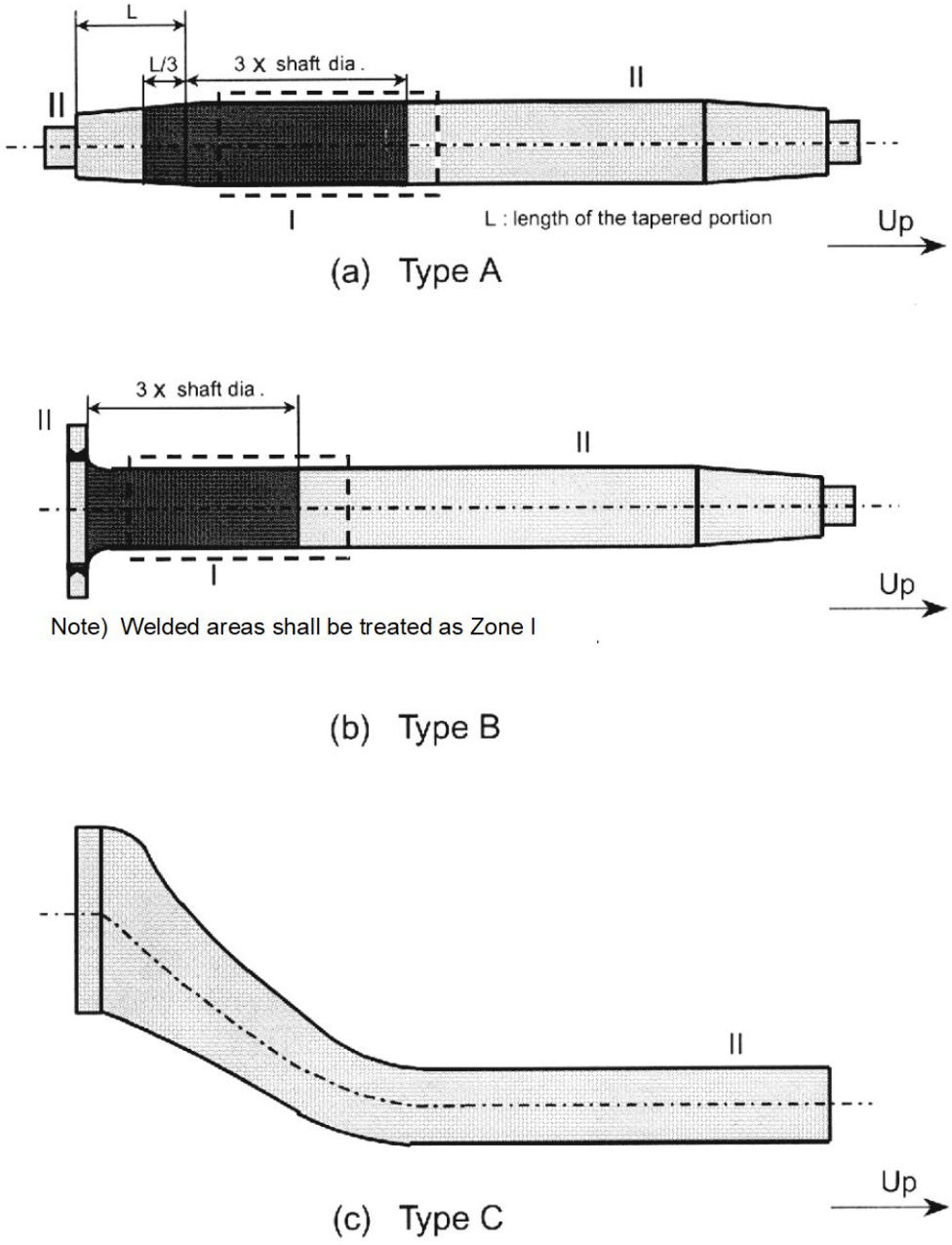
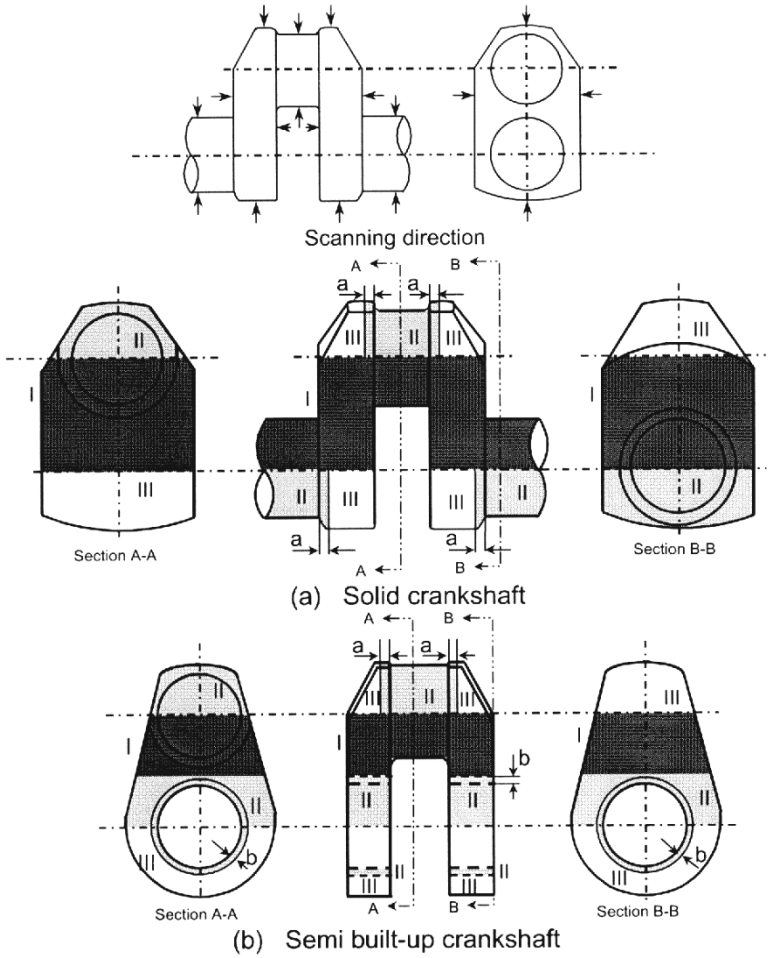


Fig. 4 – Zones for magnetic particle/liquid penetrant testing on rudder stocks



Notes:

1. In the above figures, *a*, *b* mean:

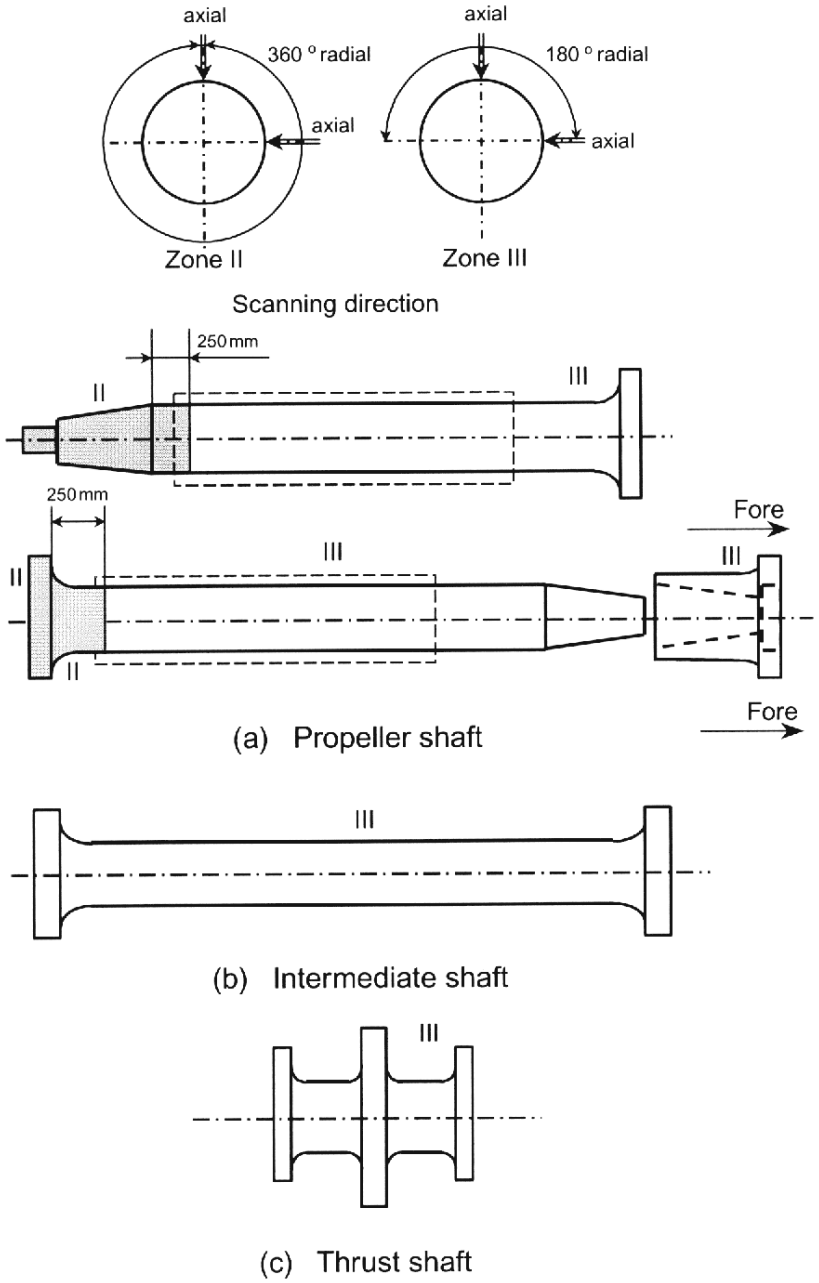
   $a = 0.1d$ or 25 mm, whichever greater,

   $b = 0.05d$ or 25 mm, whichever greater (circumstances of shrinkage fit)

   where *d* – pin or journal diameter.
2. Core areas of crank pins and/or journals within a radius of $0.25d$ between the webs may generally be coordinated to Zone II.
3. Identification of the Zones (similar in Figs. 5 through 8).

– Zone I
– Zone II
– Zone III

Fig. 5 – Zones for ultrasonic testing on crankshafts



Notes:
1. For hollow shafts, 360° radial scanning applies to Zone III.
2. Circumferences of the bolt holes in the flanges shall be treated as Zone II.

Fig. 6 – Zones for ultrasonic testing on shafts

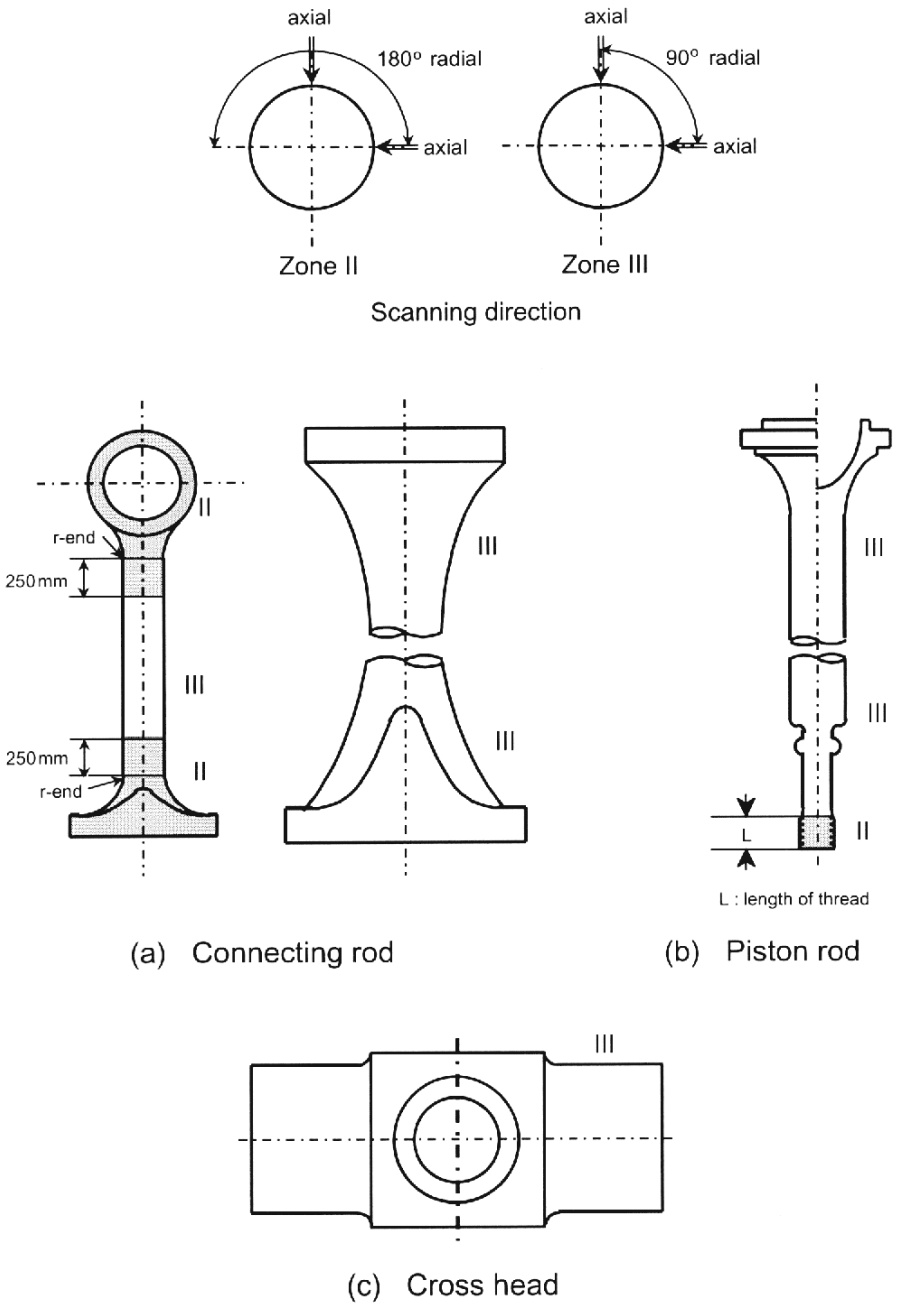


Fig. 7 – Zones for ultrasonic testing on machinery components

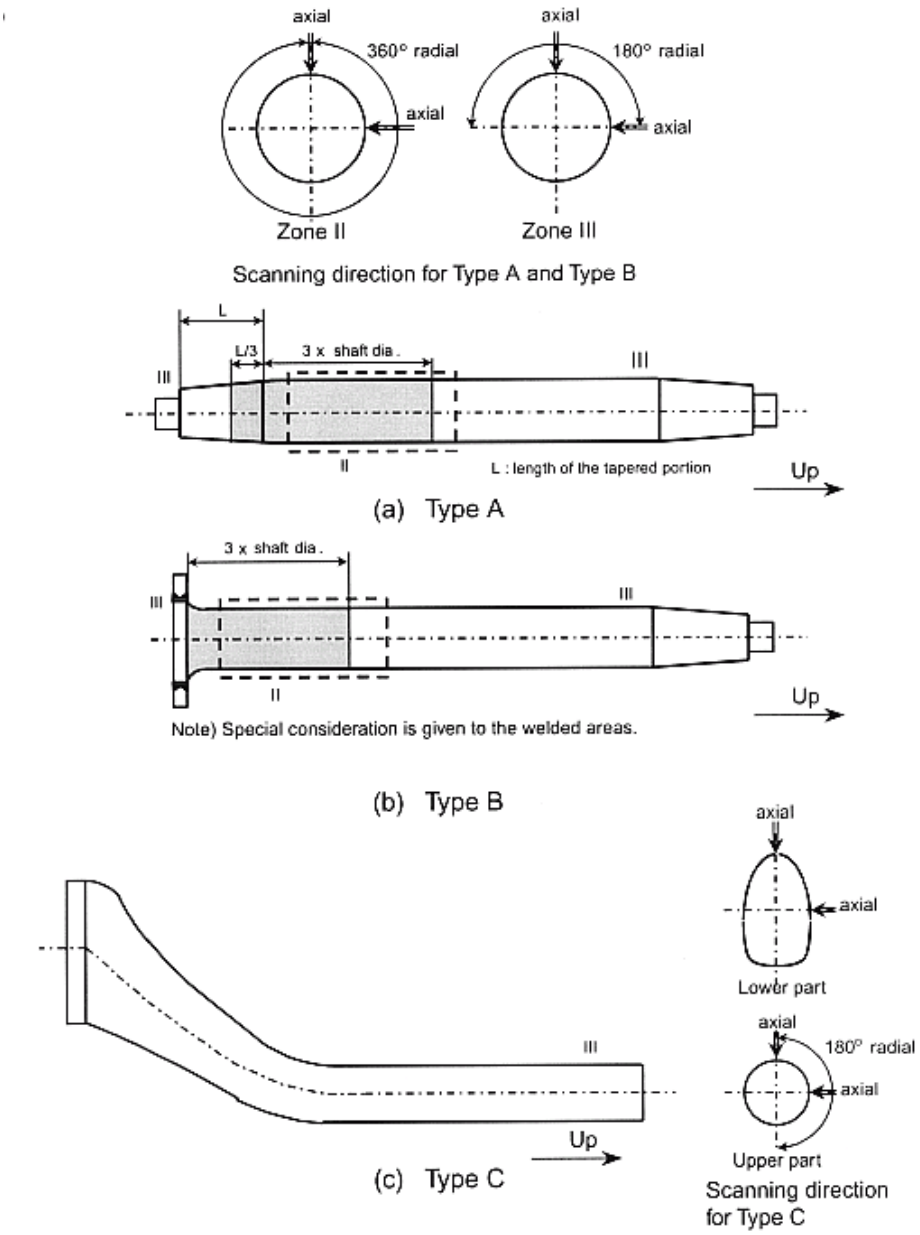


Fig. 8 – Zones for ultrasonic testing on rudder stocks

List of amendments effective as of 1 January 2022

Item	*Title/Subject*	*Source*
1.1, 1.7	General	IACS Rec. 68 (Rev. 1 Apr 2021)
2	Personnel Requirements	IACS Rec. 68 (Rev. 1 Apr 2021)
3.1.1, 3.1.3 3.2, 3.3, 3.5.1, 3.5.2	Surface Inspections	IACS Rec. 68 (Rev. 1 Apr 2021)
3.6.1, 3.6.2, 3.6.3	Acceptance Criteria and Rectification of Defects	IACS Rec. 68 (Rev. 1 Apr 2021)
3.7, 4.6	Reporting	IACS Rec. 68 (Rev. 1 Apr 2021)
4.1, 4.2 4.4.2	Ultrasonic Testing	IACS Rec. 68 (Rev. 1 Apr 2021)
4.5 Tables 4.5-1, 4.5-2, 4.5-3, 4.5-4	Acceptance Criteria	IACS Rec. 68 (Rev. 1 Apr 2021)