



AMENDMENT -- NOTIFICATION

AA 085 01 04 REV.01

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1.0 TITLE: Title of the standard is changed as below:

**"ULTRASONIC EXAMINATION, ACCEPTANCE STANDARDS AND CLASSIFICATION
OF CARBON, LOW ALLOY AND MARTENSITIC STEEL CASTINGS"**

(Change is underlined)

2.0 Cl.1: SCOPE: Scope of the standard is modified as below:

"This standard details the ultrasonic testing procedure, acceptance standards and classification of carbon, low alloy and martensitic steel castings."

3.0 Cl.4: This clause is modified as below:

PERSONNEL REQUIREMENT:

Personnel performing non-destructive examination and evaluation shall be qualified to the recommended practice SNT-TC-1A or any other recognised practice.

REF:
Cl.8.7 of MOM of WG(NDT)

AMD. NO.
01

APPROVED
WG(NDT)

ISSUED
Corp.R&D

DATE
June '93

CUM.SR.NO.
A 1274



CORPORATE STANDARD

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ULTRASONIC EXAMINATION, ACCEPTANCE STANDARD AND CLASSIFICATION OF STEEL CASTINGS

1. SCOPE:

This standard details the ultrasonic testing procedure, acceptance standard and classification of steel castings.

2. STAGE OF EXAMINATION:

Ultrasonic examination shall be generally carried out after heat treatment of the casting and rough machining, if called for in the order. Ultrasonic examination shall be repeated after weld rectification, if any.

3. SURFACE PREPARATION:

Smooth "as cast" surface, free from adhered or fused sand and irregularities is adequate for ultrasonic examination. Loose scales and excessive surface irregularities such as that caused by removal of runner and riser shall be ground off. While grinding care shall be taken to avoid surface undulations which would interfere with probe contact. To improve coupling efficiency of as cast surfaces or to remove rust or paint, shot-blasting or sand-blasting may be carried out. Rough machined surfaces should have a minimum surface finish of 6.2 microns.

4. OPERATING PERSONNEL:

The operator performing the ultrasonic test shall be conversant with the ultrasonic techniques and the equipment.

5. EQUIPMENT CHARACTERISTICS:

5.1 Frequency Range:

The equipment shall be capable of operating over a frequency range of at least 0.5 to 12 MHz.

5.2 CRT Screen Presentation:

"A" scope presentation shall be used. The trace shall be well defined, easy to read and associated with permanent graticule scale marking for both range and amplitude.

5.3 Linearity Of Amplification:

The amplifier shall be linear within ± 2 dB upto at least 1/2 full screen height and any deviation above this should be known to the operator. Supression affects linearity and the effect of suppression over full range should be recorded.

Revisions: Cl. 3.14 of the minutes of meeting of WG(NDT)

Approved: INTERPLANT
STANDARDIZATION COMMITTEE -WG(NDT)

Rev. No.	Rev. Date	Revised:	Prepared	Issued	Date
01	June '88	Corp (R&D)	Corp (R&D)	CORP. RAD	Sept, '79

**5.4 Linearity Of Time Base:**

The time base shall be linear as far as possible and non-linearity should not exceed 1% of the full scale graticule reading.

5.5 Resolution:

The resolution of probe and flaw detection apparatus shall be such as to show separately the indications from two or more nearby reflecting surfaces separated by twice the wave length.

5.6 Sensitivity Of The Equipment:

The sensitivity of the equipment shall be checked with the longitudinal wave probes used, by placing the probe on the metallised surface of the plastic insert of IS:4904/IIW test block. The minimum number of multiple echoes from the plastic insert at full gain setting shall be as given below:

<u>Frequency range, MHz</u>	<u>Number of multiple echoes</u>
1	5
2	4
4 to 6	2

6. COUPLANT:

To ensure adequate transmission of ultrasonic energy between probe and casting, a suitable couplant having good wetting characteristic shall be used. Oil, glycerine or Polycell paste may be used. For better adoption of cast surfaces, a thin protective plastic cover over the longitudinal probe is recommended.

7. TESTABILITY OF CASTINGS:

The testability of a casting is expressed as the minimum equivalent flaw size discernible with sufficient accuracy. The echo height of largest allowable equivalent flaw at the back wall distance shall be at least 8 dB above grass level. The testability can be determined on a parallel wall area of the casting using either a DGS diagram or a test block containing the appropriate flat bottomed hole. The surface quality of the test block should correspond to that of the casting. Sufficient testability is proved when the following condition is fulfilled.

Type of probe

Discernible defect size 8dB
above noise level, mm

2-4 MHz Normal beam probe
(Tested from one side)

3 or (Largest size allowable)

**8. TESTING PROCEDURE:****8.1 Selection Of Probes:**

For all ultrasonic examinations, the highest frequency compatible with the size, metallurgical condition and thickness of the casting shall be used.

8.2 Testing Technique:

While selecting testing technique the following factors must be taken into account.

- (i) Type, orientation, position and incidence of defects likely to be encountered in the casting under consideration.
- (ii) Thickness and profile of the section.
- (iii) Structural condition.

All parts of the casting surface where a contact probe can be used, shall be tested by overlapping scans (20 - 25 mm) with normal beam probes, irrespective of casting geometry and availability of reference back echo. Normal beam probe of minimum 2 MHz frequency shall be used but shall be augmented by a thorough shear wave examination of location where the manufacturing method of the casting gives rise to features which may cause internal planar defects due to risers, chills, fillets, brackets, bosses and changes in section thickness. When examining areas of the casting which are to be further machined, a double crystal probe shall be used to reveal defects very near to the surface. This type of probes may also be used for the examination of thin sections and weld repaired areas, to determine depth of flaws, etc. Smaller diameter probes may be used for more critical examination of suspected areas. Testing shall be carried out from both sides of the wall wherever possible to assess the loss in wall thickness.

9. EQUIPMENT CALIBRATION:**9.1 Depth Range:**

The depth range of the equipment shall be adjusted for normal and shear wave probes using known thickness of the casting or standard calibration block. When latter is used, velocity difference, if any, should be taken into account.

9.2 Sensitivity:

The scanning sensitivity of the apparatus shall be adjusted using either DGS diagram or standard test block with flat bottomed hole so that maximum acceptable equivalent defect will give an indication height of 75% screen height +8 dB. When test block is used for sensitivity calibration, distance amplitude curve shall be plotted on CRT screen to facilitate



correct defect size assessment. While estimating the size of defect, compensation shall also be made for difference in surface condition and attenuation in the test block and casting.

10. SIGNIFICANT ULTRASONIC INDICATIONS:

The following ultrasonic indications are significant and must be considered during testing of castings:

- (a) All defect echoes beyond the acceptance level.
- (b) All echo indications which suggest crack like planer defects perpendicular to/approximately perpendicular to the test surface.
- (c) Loss of back echoes occurring not due to the casting geometry. (If loss of back echo cannot be attributed to the presence of a defect inspite of examining with different transducers, then such loss shall not exceed 75%).

11. ACCEPTANCE STANDARD:

The casting wall is divided into four zones as shown below:

- Zone 1: Middle 1/3 wall thickness
- Zone 2: Outer 1/3 wall thickness but not less than 16mm
- Zone 3: Inner 1/3 wall thickness but not less than 16mm
- Zone 4: 16 mm from surface of zone 2 if machined and 16 mm from surface of zone 3 whether machined or unmachined.
- Zone 5: Fabrication weld zone. Volume of casting representing weld preparation length plus further 25 mm length of casting.

The castings are categorised into three levels according to the size distribution and number of defects permissible.

Ultrasonic indications exceeding those shown in the table below as well as cracks, hot tears and cold shuts are unacceptable.



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DEFECT PARAMETER	CLASSIFICATION LEVEL	ZONE 1	ZONE 2 & 3	ZONE 4
A. Equivalent flaw dia. As fraction of wall thickness in mm				
	W*	3	3	3
	I	1/5 WT**	1/8 WT	1/16 WT
	II	1/5 WT	1/8 WT	1/16 WT
	III	1/4 WT	1/6 WT	1/12 WT
B. Decrease of back-echo in percentage associated with the defect				
	W*	Not allowed	Not allowed	Not allowed
	I	90	75	"
	II	90	75	"
	III	95	85	"
C. Thickness of defect as percentage of wall thickness				
	W*	5	5	5
	I	15	10	5
	II	15	10	5
	III	20	15	10
D. Length of defect in mm (See Note below)				
	W*	3	3	3
	I	100	75	12
	II	120	100	50
	III	150	120	75
E. Area of individual defect in cm				
	W*	120	10	0.25
	I	150	20	0.50
	II	200	30	10
	III			
F. Accumulated area of defect in 1000 cm area				
	W*	200 cm	10 cm	2.5 cm
	I	300 cm	40 cm	5 cm
	II	400 cm	60 cm	10 cm
	III			
G. Minimum distance between defects 'X' (See Fig. 1)				
	W*	6L+	6L+	6L+
	I	4L	4L	6L
	II	4L	4L	6L
	III	4L	4L	6L



* W = Fabrication Weld Zone : 75 mm length from the edges shall constitute the fabrication weld zone which excludes the excess machining allowance. In the case of unacceptable defects beyond 30 mm from the edge, they may be referred to BHEL for further evaluation with respect to actual weld preparation.

** WT = Wall thickness

L+ = Length of defects

Note (For item D):

Close by defects will be treated as a single defect if the distance between the extremities of the adjacent defects is less than the length of the longest defect. The total length of the defect shall be considered as the length of the flaws plus the distance in between.

Minimum Distance Between Defects 'X' (For item G)

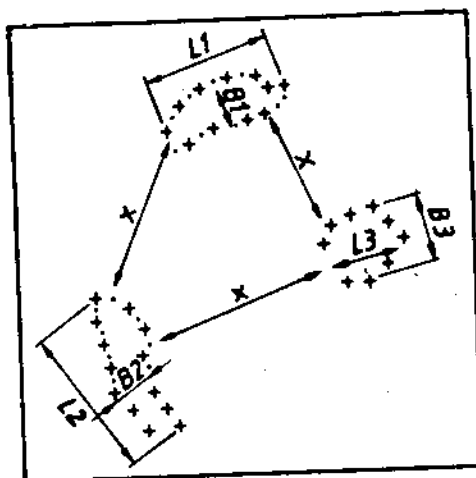


Fig - 1

L = Length of defect
B = Breadth of defect
X = Minimum distance between defects