

ULTRASONIC INSPECTION PROCEDURE

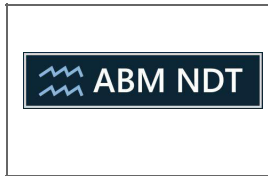
Reference: PROC/GEN/UT/10228-3:2016 Issue:01 | Date of Issue: 15/03/2018



**Procedure For The Ultrasonic Testing
Of Ferritic Or Martensitic
Steel Bar to BS EN 10228-3:2016**

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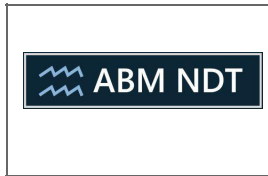
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1. Scope

This procedure covers the ultrasonic inspection of round steel bar products using the longitudinal wave manual pulse-echo technique for on-site and in-house use.

This procedure follows practices laid down in BS EN 10228-3: 2016.

The procedure only covers the testing of ferritic or martensitic steel solid round, square and rectangular bar products.

This procedure is only to be used for the inspection of newly manufactured wrought bar products and does not cover in-service inspection or items which have been subject to any repair work

This procedure does not cover bar stock which has been extensively machined (i.e. into components) except where turning has taken place to improve surface condition.

This procedure only covers solid bar products and is not applicable to bar which has been bored or is hollow.

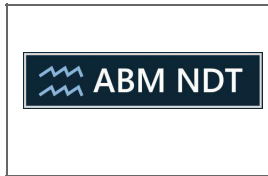
This procedure does not cover the testing of closed die forgings or turbine rotor and generator forgings.

This procedure shall be carried out once all heat treatment operations have been completed and at least 48 hours after the final heat treatment operation has been completed.

2. References

This procedure makes reference to the following documents:-

- | | |
|----------------------------|---|
| BS EN 10228-3:2016 | Non-destructive testing of steel forgings - Pt 3: Ultrasonic testing of ferritic or martensitic steel forgings. |
| BS EN ISO 9712:2012 | Non-destructive Testing. Qualification and certification of NDT personnel. |
| BS EN ISO 2400:2012 | Non-Destructive testing - Ultrasonic Examination - Specification for calibration block No. 1 |
| BS EN 12668-1:2010 | Non-destructive testing - Characterization and verification of ultrasonic examination equipment - Part 1: Instruments |
| BS EN 12668-2:2010 | Non-destructive testing - Characterization and verification of ultrasonic examination equipment - Part 2: Probes |



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- BS EN 12668-3:2013** Non-destructive testing - Characterization and verification of ultrasonic examination equipment - Part 3: Combined equipment
BS EN 1330-1:2014 Non-destructive testing - Terminology - List of general terms
BS EN 1330-4:2010 Non-destructive testing - Terminology - Terms used in ultrasonic testing
BS EN ISO 16811:2014 Non-destructive testing - Ultrasonic testing - Sensitivity And Range Setting

3. Definitions & Abbreviations

As well as the terms defined in BS EN 1330-1 and BS EN 1330-4 this procedure uses the following definitions:

PCN	Personnel certification in Non-destructive testing
COSHH	Control of substances hazardous to health
PPE	Personal protective equipment
FBH	Flat-bottom hole
FSH	Full screen height
DAC	Distance-amplitude correction

Point Discontinuity: As the probe is moved, the A-scan display shows a single sharp indication rising smoothly in amplitude to a maximum then falling smoothly to zero and/or an indication with dimensions equal or less than the -6dB beam width.

Extended Discontinuity: As the probe is moved, the A-scan display shows a single sharp indication rising smoothly in amplitude to a maximum then falling smoothly to zero and/or an indication with dimensions greater than the -6dB beam width.

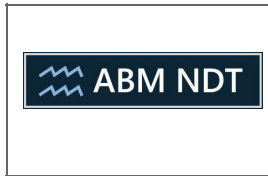
Isolated Discontinuity: The distance d , between points corresponding to the maxima of the indications of adjacent discontinuities exceeds 40mm.

Grouped Discontinuities: The distance d , between points corresponding to the maxima of the indications of adjacent discontinuities is less than or equal to 40mm.

4. Safety

All consumables used shall have accompanying COSHH data sheets and shall be disposed of in a way that is non-injurious to site personnel or to the environment.

Personnel working to this procedure shall at all times wear mandatory PPE; overalls, safety boots, hard hat, high visibility clothing, safety eyewear.



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5. Personnel Qualifications

All personnel following this procedure must be currently certified by PCN (or ISO 9712 equivalent body) to a minimum of Level 2 covering the ultrasonic testing of forgings and wrought products.

All personnel shall also hold a valid eyesight certificate (meeting the requirements of ISO 9712 Section 7.4) obtained within the last 12 months.

Documentation relating to ultrasonic operators working on-site for the steel supplier/end user shall be kept on file at the administration offices for review purposes.

6. Identification And Datum Points

All bars tested shall be permanently stamped/engraved at one end with an identifying cast number and where more than one bar from the same cast is to be tested, each bar shall be uniquely numbered by stamping/with indelible ink at the same end for identification purposes.

The end of the bar marked with the cast number shall be used as the datum point for reporting purposes.

7. Surface Finish

See appendix B for further information.

Machined condition

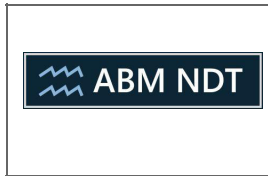
In the machined condition, for testing to class 1 a surface finish of roughness $Ra \leq 25 \mu\text{m}$ shall be achieved, for classes 2 and 3 a surface finish of roughness $Ra \leq 12.5 \mu\text{m}$ shall be achieved and for testing to class 4, surface finish of roughness $Ra \leq 6.3 \mu\text{m}$ shall be achieved. Surface comparator blocks shall be acceptable in determining surface roughness level.

If the forging has been subject to heat treatment after machining then only classes 1,2 and 3 can be achieved.

As forged condition

When forgings are supplied in the as forged condition they shall be considered acceptable providing the specified surface finish for the quality class can be achieved. Normally only quality class 1 shall be applicable to an as forged surface. Where it is not practical to perform a comprehensive test, shot/sand blasting or surface grinding shall be employed to improve surface condition and ensure that acoustic coupling can be maintained.

Regardless of surface condition, all surfaces to be examined shall be clean and free from paint, scale, dry couplant, surface irregularities or any other substance that could reduce coupling efficiency, hinder the free movement of the probe or cause errors in interpretation.



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Unsatisfactory surface finish shall be categorised as a non-conformance to procedure as per section 15.

8. Extent of Inspection

All bars tested in accordance with this procedure shall be examined using the longitudinal wave manual pulse-echo technique on:

- In the case of square/rectangular bars: 100% of two perpendicular faces parallel to the direction of rolling.
- In the case of round bars: At least 180° of the cylindrical surface of the bar along full length.

If near surface testing has been specified by customer the the above tests shall be repeated using twin crystal (dual element) probes.

This procedure does not cover the examination of the bar in the longitudinal direction nor does this procedure cover the examination of the bar using angle (shearwave) probes.

This procedure only covers solid round, square and rectangular bar stock and is not applicable to bar stock which has been bored.

9. Equipment Specification

The following equipment is required in order to carry out this procedure:

An ultrasonic flaw detector with an A-scan presentation which meets the requirements of BS EN 12668-1.

A calibration block No. 1 manufactured in accordance with BS EN ISO 2400.

A set of reference blocks as described in BS EN 10228-3:2016 part 7.4 which cover the section thickness of the bars to be examined and of the relevant FBH diameter (See appendix C).

Reference test blocks shall be manufactured out of the same (or acoustically similar) material as the items under test and shall also have a comparable surface finish to the items under test.

Although not recommended, BS EN 10228-3 states that reflector sizes different to those detailed in Table 5 (appendix C) may be used as long as the test sensitivity is corrected accordingly.

Both single and combined double probes may be used with diameter of 10-40mm and a nominal frequency range of 1-6 MHz (See appendix D). All probes used shall comply with the