

ISO 9001:2008	Document No. M&C/NDT/125/2004, Rev-II	Version No. 3.0	Effective Date 01/12/2017
Document Title: Specification for portable Digital Ultrasonic Flaw Detector with A-Scan storage			



## RESEARCH DESIGNS & STANDARDS ORGANISATION

Manak Nagar, Lucknow-226011

M&C/NDT/125/2004, Rev-II, January 2017

### SPECIFICATION FOR PORTABLE DIGITAL ULTRASONIC FLAW DETECTOR WITH A-SCAN STORAGE

#### Amendment history:

S. No.	Amendment date	Version	Reasons for Amendment
1.	NA	1.0	First issue specification No M&C/NDT/125/2004.
2.	09.06.2011	2.0	Some typographical mistake has been corrected and addition of clause 3.5 and 3.12. One note has been included at page no. 3 of 3. Approval of Director/M&C available at pp-8 of file No. M&C/NDT/Specs. (Revision/Re-affirmation of 10 nos. of NDT Specifications)
3.	22.05.2017	3.0	Shruti note No. MC/MTG/CME dated 27.4.2015 reference S.No 1/1/0 (M&C) available at pp-8 of file no. M&C/NDT/UTD/Spec. Approval of ED/Wagon. Changed new addition/deletion/rewording of the clause 1.1 to 1.3 & its sub clauses and clause no 14, 15 and note Approval of ED/Wagon (M&C) is available at pp-8, 10, 15 and 17 of file no. M&C/NDT/UTD/Spec. Addition of Note after clause no.13 as per Vigilance cell/RDSO letter no.13/Vig/Policy, dtd. 26.07.2016. Approval of ED/Wagon (M&C) approval available at pp-30 of file no M&C/ NDT / 125/2004, Rev-II, August 2016.

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**1. General:**

- 1.1 Scope:** This standard stipulates the technical and functional requirements for digital portable ultrasonic flaw detector with LCD- TFT screen display for testing axle and other components based on A- scan pulse echo technique in various establishments of Indian Railways. The equipment shall be tropicalised to suit Indian climatic condition.

**2. General requirements:**

- 2.1** The digital ultrasonic flaw detector shall be A-scan pulse echo type with modular design and easily portable. The equipment shall have light weight and suitable to work through both mains and battery operation with LCD-TFT screen display for better visibility in the indirect light. The equipment shall have LEMO and BNC-BNC output. The equipment shall be suitable for testing of locomotive, carriage & wagon axles and other components using suitable probes.
- 2.2** The equipment shall be capable of storing calibration data as well as screen pattern. The equipment shall have suitable port for downloading the complete data set to personal computer. The minimum calibration set storage capacity shall be 100 and A-Scan storage capacity 10000 frames minimum.
- 2.3** The equipment shall be capable of withstanding bumps and vibration as per stipulation of the specification.
- 2.4** The equipment shall be capable to suit Indian climatic condition for damp heat cyclic test.
- 2.5** The equipment shall be packed in a proper container of appropriate material to prevent corrosion, dust ingress and impact during working and in transit.
- 2.6** The equipment shall meet the requirements of specification IS: 12666 latest version in respect of all those characteristics, which have been spelt out in this specification.
- 2.7** The equipment shall be capable of operating in mains through battery as well as separately by battery, when operating with mains, the voltage should be  $230 \pm 10V$ , 50 Hz.
- 2.8** The battery shall be capable for working at least 8 hours continuously without any drop in performance of the equipment.
- 2.9** The equipment shall be tropicalised to suit Indian climatic condition.

**3. Technical Requirement:**

**Functional Parameters:**

The technical requirements of the equipment shall be as under:

- 3.1 Test mode:** The equipment shall be capable for working in single crystal (T+R) mode and double crystal (T/R) mode.
- 3.2 Frequency range:** The equipment shall have one broad band amplifier in the frequency range from 1 MHz to 6MHz.
- 3.3 Test range:** The equipment shall cover from 50 mm to 5 meter. The range shall be adjustable in 2 mm steps or less.
- 3.4 Trace delay:** The equipment shall have trace delay facility of minimum 3 meter length in steel in steps of 2 mm or less.
- 3.5 Gain/ Amplification:** The equipment shall have minimum 120dB total gain (including internal gain). The operable gain shall be 80 dB. It shall be provided with suitable gain control steps. The gain step shall cover 0.5 dB, 1 dB, 2 dB and 6 dB in the equipment.
- 3.6 Suppression/ Reject:** The equipment shall have reject facility or suppression of vertical signals from 0 to 80% (Minimum) of the screen height in 1% increment without affecting the desired signals.
- 3.7 Monitor gate:** The equipment shall be provided with two monitor gate expandable to cover entire horizontal screen displayed range. The level (height) of the gate shall be adjustable to 5% to 99%.

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- f. Sensitivity:**  
The equipment shall be capable of giving at least 40% of full screen height signal (echo) from an artificial defect of 5 mm deep saw cut in a 2.5 meter (approx.) long coach axle. The cut shall be at a distance of 60-100 mm in journal from axle end. In scanning of this axle from far end, the reserve gain shall be at least 30 dB from cut in journal irrespective the type of axle while picking up the above defect.
- g. Sweep drift:**  
Sweep drift shall not be more than  $\pm 1\%$  between room temperature and at 55°C temperature. To check sweep drift, the equipment shall be kept for 2 hrs. at 55°C.
- h. Vertical drift**  
Vertical drift shall not be more than  $\pm 3$  dB between room temperature and at 55°C temperature. To check vertical drift, the equipment shall be kept for 2 hrs at 55°C.
- i. Alarm:**  
The equipment shall be provided with audible alarm and LED glow for signals exceeding pre-set threshold value.
- j. Signal to noise ratio:**  
Signal to noise ratio shall not be more than 10% of full screen height at 500 mm range on 23mm perspex of block VI as per IS:4904 latest with 0°, 2.0/2.5 MHz/20mm diameter single crystal probe with 5 full echoes & 6<sup>th</sup> appearing echo.
- k. Trace Pattern.**  
The trace on the screen shall be free from bow, kinks and under shoots. It shall be horizontal and free from tilts etc.
- l. Bump Test.**  
The equipment shall withstand 40 g, 4000  $\pm$  10 bumps as per IS: 9000 (Part VII, Sec-2).
- m. Resistance to vibration.**  
The equipment shall give normal performance after being subjected to 1g, 10 to 100 Hz vibrations for 30 minutes as per IS: 9000 (Part-VIII) clause 6.1, 6.2 & 6.3.
- n. Tropicalisation and Humidity Test.**  
The equipment shall be tropicalised to suit Indian climate for damp heat cyclic test as per IS: 9000 (Part-V, Sec-2).
- Note:** "One unit within a period of 06 months shall be subjected to Bump, resistance to Vibration & Tropicalisation test. From the date of completion of these tests, another unit selected from the lot offered for the inspection after a period of six month shall be kept for above mentioned tests. Also various type of Ultrasonic apparatus viz SRT, DRT, Axle Tester, Weld Tester etc. having similar type of Ultrasonic Flaw Detector shall be treated as one lot. However, any new developmental unit shall be subjected for above tests at the time of its approval."
- 3.15 Trigonometrical function:**  
The equipment shall have arrangement for sound path, surface distance and flaw depth display in mm for angle beam testing. It should also be capable of calculating and displaying echo to echo measurements.
- 3.16 Back Light display:**  
The equipment shall have back light facility for working in night.
- 3.17 Distance amplitude correction curve:**  
The equipment shall have 10- point DAC auto plotting facility. DAC shall work as flaw monitor gate with LED glow and alarm.
- 3.18 Locking facility:**  
The equipment shall have locking facility for setting data through external key.

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4. Standard parameters:
  - 4.1 Size of the equipment:  
The size of the equipment shall not exceed 250mmx200mmx75mm (W x H x D).
  - 4.2 Weight:  
The weight of the equipment shall not exceed 3.0 Kg with battery and without accessories.
  - 4.3 Screen Display Size:  
The equipment shall have minimum 120 mm x 90mm screen display size.
  - 4.4 PC connectivity:  
The equipment shall have suitable port and transfer software to connect with PC.
  - 4.5 Printer connectivity:  
The equipment shall have suitable port arrangement to connect it to printer.
  - 4.6 Update Rate:  
The equipment shall have update rate of 50/60 Hz.
  - 4.7 Battery level indicator:  
The equipment shall have facility of battery level indicator to show its charging condition.
5. Power Supply:
  - 5.1 The equipment shall be capable of operating in main through battery as well as separately by re-chargeable Ni MH / Li - ion or any other alkaline battery of 15 V max. The battery shall be detachable from UFD without need of any tool and can be charged without need of main equipment.
  - 5.2 The battery shall be capable for working minimum 8 hours continuously per full charge.
  - 5.3 Automatic cut-off switch shall be provided to protect against deep discharge of battery below the workable voltage.
  - 5.4 Automatic cut-off for battery and battery charger shall be provided to protect the battery from over charge.
  - 5.5 Automatic cut-off circuit to be provided built-in to protect against over loading of equipment.
  - 5.6 Necessary guide lines for proper maintenance and long life of battery shall be provided with the equipment.
  - 5.7 The charger shall be provided with an indicator to show the full charge condition of the battery.
- Note: Firm has to provide the declaration regarding various features of the power supply like type of battery, its optimum voltage in full charge condition, provision of cut-off switches/circuit for clause 5.1 to 5.7.
6. Alphanumeric Labelling:
 

The equipment shall have alphanumeric labelling facility for entering the following data through a detachable alphanumeric QWERTY Key board with back space and space bar to key in following data

  - a. Date and time (Real time display)
  - b. Operator name/code (Min 12 alphanumeric character)
  - c. Railway/workshop (Min 12 alphanumeric character)
  - d. Type of axle/wheel No. (Min 12 alphanumeric character)
  - e. Location of defect (Min 12 alphanumeric character)
- 6.1 Railway's/Workshop, Operator name /code, Type of axle/wheel and Axle/wheel No. once saved shall have automatic copying facility to next frame and these details can be editible, if required.

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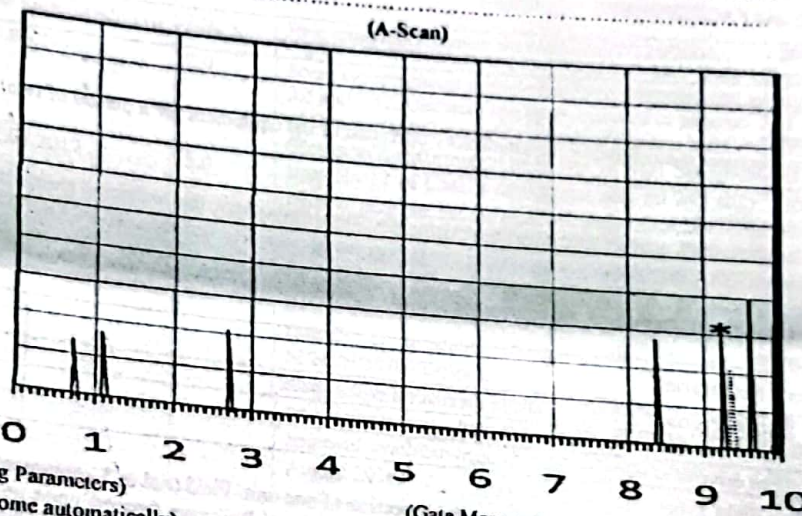
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- 6.2 All probe locations during testing of each axle/ wheel, the screen pattern along with testing data details, date & time, Workshop Name/Code, Operator Name/Code and Axle/wheel No. etc shall be displayed in the following format.

### ULTRASONIC TESTING REPORT

Date and Time (Real time recording) .....  
 UFD Model (shall come automatically) Sr.No (shall come automatically) .....  
 Railway/ Workshop: .....  
 Type of axle/wheel ..... Axle/wheel No .....  
 Operator Name/Code: .....  
 Defect Location: .....  
 Test Result: (Pass/Fail/other) .....  
 If other, then Remarks .....  
 Frame no: .....



(Testing Parameters)  
 (shall come automatically)

Gain: \_\_\_\_\_ dB  
 Range: \_\_\_\_\_ mm  
 Velocity: \_\_\_\_\_ m/sec  
 Reject: \_\_\_\_\_ %  
 Delay: \_\_\_\_\_ mm  
 Probe Zero:  
 Mode: (Single/Double)  
 Probe Angle: \_\_\_\_\_ °  
 Thickness: \_\_\_\_\_ mm

(Gate Measure)

(shall come automatically)  
 Gate 1 (Status): ON/OFF  
 Gate 2 (Status): ON/OFF  
 Gate 1 (Echo height): \_\_\_\_\_ %  
 Gate 1 (Beam path): \_\_\_\_\_ mm  
 Gate 1 (Surface Distance): \_\_\_\_\_ mm  
 Gate 1 (Depth): \_\_\_\_\_ mm  
 Gate 2 (Echo height): \_\_\_\_\_ %  
 Gate 2 (Beam Depth): \_\_\_\_\_ mm  
 Gate 2 (Surface Distance): \_\_\_\_\_ mm  
 Gate 2 (Depth): \_\_\_\_\_ mm

Observation/Remarks (If Any): \_\_\_\_\_

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#### 7. Co-axial Cable:

Co-axial cable used for the probes shall be flexible, oil proof, durable good quality and strength to withstand with service condition. The junction of the cable and the probe shall be suitably protected to avoid snapping of the cable in operation at the junction. The diameter of the cable shall be 6 mm and impedance 50 ohms. The length of the cable shall be 2 to 2.5 metre.

#### 8. Equipment Cover:

The equipment shall be provided with a cover to protect the equipment from dust, grease, oil etc. and to accommodate the unit. The cover shall be provided with shoulder strap.

#### 9. Carrying Case:

The carrying case shall be of moulded reinforced fibre-glass luggage type and shall accommodate the equipment, battery, co-axial cable, probes etc. The case shall be provided with locking facility.

#### 10. Technical Literature:

One set of operating instructions with day to day maintenance and minor trouble shooting tips, IXX, DONTS and FAQs etc.

#### 11. Training:

The supplier shall train two operators per equipment in operation and minor troubleshooting of the equipment for two days.

#### 12. Warranty:

The manufacturer shall warranty for satisfactory operation of the equipment for a period of two years from the date of commissioning of the equipment.

#### 13. Service facility:

13.1 The supplier shall provide and ensure servicing facilities throughout the warranty period of the equipment. After the warranty period is over, the supplier should give service support for ANVC for which payment shall be claimed separately.

13.2 The manufacturer shall check the equipment at every 6 months during warranty period free of cost.

#### 14. Accessories:

Standard Accessories		
i)	Normal probe (2.5 MHz, 20 mm diameter Single Crystal)	Qty.
ii)	BNC cable of 2 to 2.5 meter length	02 nos
iii)	Pen drive of atleast 16GB	05 nos
		02 nos

#### 15. Extensive Field Trial:

Once equipment is developed after satisfactory inspection of one unit, Field trial of 5 equipments shall be conducted on atleast two different workshops/ sheds of Zonal Railways (spaced quite apart) for testing of atleast 100 nos of axle/Armatures shafts/wheels etc. per equipment. The satisfactory performance of all 5 equipments shall be considered for necessary approval.

#### Note:

1. This specification is property of RDSO. Its reproduction, copying wholly or partially or assigning new number, for any purpose by Railways or any other agency is not permitted.
2. RDSO reserve the right to modify this specification time to time based on the requirements and experience gained.
3. Any features and technical requirements mentioned in the above specification are changed/modified by the manufacturer against approved model, the same shall be brought into the notice of M&C Directorate/RDSO Lucknow. Approval of the same shall be taken by the manufacturer.
4. All the provisions contained in RDSO's ISO procedures laid down in Document No. QO-D-7.1-11 dated 19/07/2016 (titled "Vendor-Changes in approved status") and subsequent versions/amendments thereof, shall be binding and applicable on the successful vendor/vendors in the contracts floated by Railways to maintain quality of products supplied to Railways.

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Prepared By: <i>Chandra</i>	Checked By: <i>Chandra</i>	Printed: 02.06.2017
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