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DEPARTMENTAL METROLOGY VERIFICATION REGULATION
FOR THE GENERAL ADMINISTRATION OF CIVIL AVIATION OF
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Eddy Current Flaw Detector

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Verification Regulation of Eddy Current Flaw Detector

1 Scope

This Regulation is applicable to the initial verification, subsequent verification and in-use inspection of the probe coil eddy current flaw detector (hereinafter referred to as the eddy current instrument). The verification of other types of eddy current instruments can refer to this Regulation.

2 Normative References

JJF 1001-1998 General Terms in Metrology and Their Definitions

JJF 1002-1998 The Rules for Drafting National Metrological Verification Regulation

GB/T 12604.6-1990 Terminology for Nondestructive Testing - Eddy Current Testing

MH/T 3002.5-1997 Nondestructive Testing in Aircraft - Eddy Current Testing

When using this Regulation, care shall be taken to use the currently valid versions of the above cited documents.

3 Summary

The eddy current instrument is an electronic device that uses the principle of electromagnetic induction to perform non-destructive testing of metal materials and their finished parts, and is widely used in civil aircraft maintenance and inspection.

The eddy current instrument is mainly composed of a power supply, an oscillator, a phase sensitive detector, a phase shifter, an amplifier and a display.

4 Requirements for Metrological Properties

4.1 Excitation source

4.1.1 Output frequency error $\Delta f \leq \pm 10\%$;

4.6 Tilt performance

4.6.1 Change the angle between the axis of the probe coil and the normal of the specimen surface from 0° (vertical) to 20°. At this time, the amount of change displayed by the eddy current instrument shall be no greater than 10% of the full scale.

4.6.2 Keep the probe inclined at an angle of 20°; sweep the 0.5mm-deep artificial defect on the standard specimen; and the amount of change displayed by the eddy current instrument shall be no less than 70% of the amount of change displayed in the vertical state.

5 General Technical Requirements

5.1 Appearance requirements

5.1.1 The appearance of the tested eddy current instrument shall be intact; all parts shall be firm and reliable; the knobs shall be positioned accurately; the adjustment shall be smooth; the switch contact shall be good; the operation shall be flexible; and there shall be no mechanical damage that affects the operation.

5.1.2 The scale of the display panel is clear and there is no trace of damage.

5.2 The entire machine function

5.2.1 Place the tested eddy current instrument in the verification environment for 30min.

5.2.2 Check the battery voltage. If the battery voltage does not meet the requirements of the instructions, charge it first.

5.2.3 Connect the standard probe and matching device with the probe cable to the eddy current instrument to form an eddy current inspection system.

5.2.4 Turn on the power of the eddy current instrument, the instrument shall be able to enter the normal working state, and the display shall be normal. Keep the power on and allow the instrument to warm up for 15 min~20 min.

5.2.5 Adjust each function knob (button) one by one, each function of the eddy current instrument shall be able to change accordingly, indicating normal.

5.3 Display unit

Press the balance button, and the pointer (bright spot) on the display panel shall return to the balance point.

6.1.2.4 Standard specimen (see Appendix A).

Standard specimens include aluminum specimens and steel specimens; and steel specimens are suitable for verifying the "Fe" gear of the eddy current instrument.

6.1.3 Supporting equipment.**6.1.3.1 Standard probe.**

It has passed the comprehensive performance inspection, is not worn and damaged, and can be matched with the eddy current instrument.

6.1.3.2 Load resistance (R).

The rated resistance and non-inductive resistance specified by the manufacturer can also use standard probes.

6.1.3.3 Low temperature test cabinet.

The size can store the eddy current instrument, the temperature shall be controlled at $0^{\circ}\text{C}\pm 5^{\circ}\text{C}$, with a temperature display, to ensure that the instrument is verified in a low temperature state.

6.1.3.4 High temperature test chamber.

The size can store the eddy current instrument, the temperature shall be controlled at $40^{\circ}\text{C}\pm 5^{\circ}\text{C}$, with a temperature display, to ensure that the instrument is verified under high temperature conditions.

6.1.3.5 Non-conductive materials.

PTFE film or other wear-resistant insulating film with a thickness of 0.05mm~0.10mm and a thickness of 0.15mm can be stacked in multiple layers.

6.2 Verification items and verification methods**6.2.1 The verification items are shown in Table 1.**

The comprehensive performance verification of the eddy current instrument is to connect a standard probe to the eddy current instrument; make the standard probe move at a normal and uniform speed; and keep a certain angle between the probe coil axis and the sample surface. And move on the standard specimen according to the set trajectory; so that verify the sensitivity, signal-to-noise ratio, lift-off effect, edge effect and tilt performance of the eddy current instrument.

In the following verification, for the eddy current meter with variable frequency, shall select the high, medium and low points in the usual frequency range for verification respectively. For the eddy current meter with fixed frequency, the commonly used gears (Fe, NFe) shall be verified, respectively. But for frequency points exceeding 3MHz, the 6.2.7.1d) and 6.2.7.5 verification items shall not be required.

When reading the amount of change displayed by the eddy current instrument, for the instrument displayed on the impedance plane, the vertical component shall be read.

6.2.7.1 Sensitivity verification.

- a) Place the probe on the part of the standard specimen without artificial defects (i.e.: the specimen substrate); keep the probe coil axis perpendicular to the specimen surface; and the distance between the center of the coil and the edge of the specimen and artificial defects is no less than 10mm. Set the frequency and phase of the eddy current instrument; adjust the gain of the eddy current instrument to the maximum. If the electrical noise is too large at this time, the gain shall be appropriately reduced until no obvious electrical noise appears.
- b) Reduce the gain by 6dB. The instrument displayed on the impedance plane shall adjust the phase; adjust the lift-off signal to the horizontal direction; adjust the instrument; move the probe at a normal speed to sweep the 0.5mm deep artificial defect on the specimen; and record the amount of change $H_i (i = 1, 2, 3)$; measure 3 times; take the average value of H and fill it in Table D6 of Appendix D.
- c) For the eddy current instrument whose gain cannot be adjusted quantitatively, after adjusting the instrument according to a), move the probe at a normal speed to scan the 0.2mm deep artificial defect on the standard specimen; and record the amount of change displayed by the eddy current instrument $H_i (i = 1, 2, 3)$; measure 3 times; take the average value of H and fill it in Table D6 of Appendix D.
- d) Put a layer of insulating material of 0.15mm between the standard specimen and the probe; re-adjust the instrument; repeat the verification of a), b), and c) above. Record the amount of change $Y_i (i = 1, 2, 3)$ displayed by the eddy current instrument when the insulating material is filled; measure 3 times; take the average value of Y and fill it in Table D6 of Appendix D.
- e) Calculate the ratio of H to Y and fill it in Table D6 of Appendix D.

in 6.2.7.1 and fill it in Table D10 of Appendix D.

6.2.7.6 Alarm performance inspection.

- a) In the state of 6.2.7.1a), adjust the gain of the eddy current instrument to make the sensitivity meet the requirements of 4.2.1 or 4.2.2; and adjust the alarm threshold to be lower than 5% of the displayed value of the instrument when the probe scans through the artificial defect; and then move the probe at a normal speed to scan the artificial defects on the standard specimen; and the alarm light and sound shall give an alarm.
- b) Change the alarm threshold to be higher than 5% of the value displayed by the instrument when the probe scans through the artificial defect; and then move the probe at a normal speed to scan the artificial defect on the standard specimen. The alarm light and sound shall not give an alarm; fill the inspection results in the Table D1 of Appendix D.

6.2.7.7 Low temperature test.

After placing the eddy current instrument in a low temperature test chamber at $0^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for 30min; repeat the operation in 6.2.7.1; fill in the results in Table D6 of Appendix D.

6.2.7.8 High temperature test.

After placing the eddy current instrument in a high temperature test chamber at $40^{\circ}\text{C}\pm 5^{\circ}\text{C}$ for 30min; repeat the operation in 6.2.7.1; fill in the results in Table D6 of Appendix D.

6.3 Processing of verification results

The eddy current instrument that has passed the verification shall be issued with a certificate of qualification; the unqualified eddy current instrument shall be issued a notice of unqualified verification, and the unqualified items shall be indicated.

6.4 Verification cycle

The verification period of the eddy current instrument can be determined according to the specific usage, but the longest period shall not exceed 12 months.

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