
	<b>AAC SPECIFICATION</b>	<b>999018</b>
	<b>NON-DESTRUCTIVE TESTING OF COMPRESSOR ROTORS (IMPELLERS AND SHAFTS)</b>	<b>ISSUE 2</b>
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## 1 SCOPE

This code of practice details the methods and criteria for the NDT of compressor rotors and shall be read in conjunction with AAC Code of Practice 999/0 "Non-destructive testing".

## 2 TECHNICAL REQUIREMENTS TO BE SPECIFIED BY THE PURCHASER

The following requirements shall be specified on every invitation to tender, contract or order.

The reference number, issue, date and title of this specification.

Any additional examinations (see Clause 4.7).

## 3 DEFINITIONS

For the purpose of this code of practice the following definitions shall apply.

APPROVED : Approved by the Engineer in writing.

SAQCC : South African Qualification and Certification Committee (for non-destructive testing).

VISUAL TESTING : Inspection conducted by the unaided eye.

## 4 REQUIREMENTS

### 4.1 MACHINED ITEMS

Items which require machining shall be tested after casting, forging or rolling and again tested after final machining.

### 4.2 CALIBRATION OF TEST EQUIPMENT


NDT equipment shall be calibrated in accordance with the requirements of ASME Section V unless otherwise directed by this specification.

### 4.3 TEST REPORTS

NDT shall be reported using a format which includes the following:

- Contract number, job number or order number
- Reference to this document
- Component identification
- Area, section or welds examined and extent of testing
- Material examined and section thickness or component size
- Applicable test specifications and procedure

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- Applicable acceptance criteria or code
- Test equipment and relevant consumables
- Defects detected in the course of the testing, their dimensions, location and disposition
- Name of test technician and qualification
- Name and signature of the supplier/manufacturer
- Date, time and location of testing
- The completed NDT checklist.

The report shall be forwarded to the Engineer.

#### 4.4 GENERAL CONDITIONS

Details of bent or damaged vanes, corrosion, erosion, surface defects, score marks, gouge marks, or wear shall be included in the test report.

#### 4.5 SPECIFIC NDT REPORTS

In addition to the requirements of Clause 4.3 the following information shall be included in reports for the specific NDT methods:

##### **Magnetic particle testing**

Equipment used, indicating medium, AC field strength, method of verification of field intensity, field direction and surface condition.

##### **Ultrasonic testing**

Probe type, probe diameters, frequency, and measured probe angles Calibration blocks used. Method of establishing test sensitivity. Defect sizing method Applicable scanning techniques and patterns. Couplant used and surface condition.

#### 4.6 MAGNETIC PARTICLE TESTING


**Magnetic yoke:** shall be a suitable AC hand yoke with sufficient magnetic field strength.

**Magnetic indicating medium:** shall be a suitable dry iron oxide powder (dry magnetic particle) or a suitable non-water based iron oxide suspension (wet magnetic particle) used in conjunction with an ultra-violet light.

**Surface condition:** of the area under test shall be free from grease, oil, paint and any other foreign matter which may interfere with the testing process.

**Testing of riveted impellers:** shall be performed twice on all accessible surfaces, under good lighting conditions, using either dry or wet magnetic particles and a suitable magnetic flux density. The direction of the flux for the second test shall be at right angles to that of the first.

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**Acceptance/rejection criteria**

Any concentration of magnetic particles at a flux anomaly indicating surface cracks, laps, folds, gross porosity, pitting or any near surface defect on any of the rivets, front plate or back plate, shall be cause for rejection.

**Testing of welded impellers:** shall be performed twice on all accessible surfaces, using wet magnetic particles, an ultra-violet light and a suitable magnetic flux density. The direction of the flux for the second test shall be at right angles to that of the first.

**Acceptance/rejection criteria**

Any concentration of magnetic particles at a flux anomaly indicating surface cracks, laps, folds, gross porosity, pitting or any near surface defect or welding defect on the impeller shall be cause for rejection.

**Testing of rotor shafts:** shall be performed twice on all accessible surfaces, using wet magnetic particles, an ultra-violet light and a suitable magnetic flux density. The direction of the flux for the second test shall be at right angles to that of the first.

**Acceptance/rejection criteria**

Any concentration of magnetic particles at a flux anomaly indicating surface cracks, laps, folds, gross porosity, or any near surface defect shall be cause for rejection.

**4.7 ULTRASONIC TESTING**

**A pulse echo ultrasonic flaw detector:** with suppression set at zero with no pulse energy employed shall be used.

**Probes:** shall be as follows:

**For rivet testing:** a 5 MHz, 6 mm diameter twin crystal type.

**For shaft testing:** 4 MHz and 2MHz frequencies of 24 mm diameter.

**Couplant:** shall be grease or oil based.


**Calibration blocks:** shall be either the V1 and V2 block or the 1 to 8 mm step wedge as relevant to the application.

**Calibration:** shall be as follows:

**For rivet testing:** calibrate on the V1 and V2 blocks or the 1 to 8 mm step wedge, with the suppression set at zero and no pulse energy employed, for the length of the rivets to be tested.

**Note:** Rivets differ in length from the inner to the outer rows.

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**For shaft testing:** calibrate for full scale reflection on the V1 block using multiple echoes, with the suppression set at zero and no pulse energy employed, for the length or diameter of the shaft to be tested.

**Note:** For the length range calibration a suitable 0,5 or 1,0 m rod may be used.

**Sensitivity:** shall be as follows:

**For rivet testing:** a 100% backwall echo shall be raised on a defect free area of the plate adjacent to the rivets to be tested.

**For shaft testing:** with the range calibration completed for the length or diameter, a 100% backwall echo shall be raised on a defect free area of the shaft to be tested.

**Testing of loose and fixed rivets:** shall be performed with the flaw detector calibrated and using a 5 MHz, 6 mm diameter twin crystal probe. The probe shall be placed on the rivet under test and then the probe moved to the plate adjacent to the rivet.

**Acceptance/rejection criteria**

Any flaw pulse indication in excess of 5% screen height shall be cause for rejection. Any attenuation of the backwall echo shall be verified.

**Note:** Loose rivets are the cheesehead and countersunk types.

Fixed rivets are those which are an integral part of the vane.

**Testing of shaft diameter:** shall be performed with the flaw detector calibrated for the relevant diameter on a V1 block and using a 24 mm diameter, 4 MHz probe. With the range calibration completed a 100% backwall echo on the diameter under test shall be raised. All accessible areas through 360° on the circumference shall be scanned.

**Acceptance/rejection criteria**


Any defect echo greater than 5% and less than 20% of the calibrated or attenuated back wall echo recorded shall be provided in the test report (see Clause 4.3). The amplitude and location of the defect shall be stated in the report.

A defect equal to or greater than 20% of the calibrated or attenuated back wall echo at any locality shall be cause for rejection unless otherwise approved.

**Testing of shaft length:** shall be performed with the flaw detector calibrated for the relevant length on a V1 calibration block (multiple echoes) or 0,5 m or 1,0 m calibration rods, using a 24 mm diameter, 4 MHz probe and also a 24 mm diameter, 2 MHz probe. A 100% backwall, plus 6 dB for scanning, shall be raised. The shaft shall be scanned from both ends.

- Note:**
1. The length or configuration of the rotor shaft under test may also necessitate the use of a 24 mm diameter, 1 MHz probe.
  2. Testing shall commence with a 4 MHz probe to check material condition

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(attenuation and coarse grain structure).

**Acceptance/rejection criteria**

Any defect echo greater than 5% and less than 20% of the calibrated or attenuated back wall echo recorded shall be provided in the test report (see Clause 4.3). The amplitude and location of the defect shall be stated in the report.


A defect equal to or greater than 20% of the calibrated or attenuated back wall echo at any locality shall be cause for rejection unless otherwise approved.

**5 QUALITY ASSURANCE PROVISIONS**

Personnel conducting NDT to the requirements of this specification shall be qualified to level 2 for the category of forgings as determined by the SAQCC.

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**APPENDIX A : RELATED DOCUMENTS**

Unless otherwise stated the latest issue of the following document shall be deemed to form part of this specification.

ASME Section V : Non-destructive testing

**APPENDIX B : RECORD OF AMENDMENTS**


Issue 2 : Removed AAC, ENGINEER & NDT From point 3

Page break before Test reports

4.5: Magnetic particle testing: added commas, changed according to what was specified

Put Appendix A & B on one page

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**APPENDIX C : NDT CHECKLIST**

Approved NDT agent Name:	Address:
Approved quality assurance representative Name: Order No: Region: Shaft No:	Address:
Compress shafts Component description: Component No: Material: Specification No:	
Compressor impellers Component description: Component No: Material: Specification No:	
Raw Material Material description: Cast No: Material: Specification No:	