SEMMPF3-015
Inspecting castings by magnetic particle testing methods

Overview
This standard identifies the competencies you need to carry out magnetic particle tests on ferromagnetic castings produced from sand or ceramic moulds, dies or investment shells, in accordance with approved procedures/techniques. The castings inspected will be circular, square or irregular in shape and will have projections and internal cavities. The profiles will be curved and tapered. The testing will generally take place after the castings have received a provisional visual examination and have been fettled.

You will be required to prepare the castings for the magnetic particle testing activities and to check that the equipment complies with the specification requirements, is safe to use and is fit for purpose. You must ensure that the ambient conditions are satisfactory for the tests to proceed and you will set up the equipment according to the non-destructive testing (NDT) instructions and requirements. You will carry out the specified tests using the correct procedures/techniques and you will observe and record the test indications. You will complete the tests by preparing/completing a NDT test report, containing the required test information and data along with your interpretation of the test indications. You will be expected to mark up the castings to show where there are any indications of surface defects. The completed inspection report, along with the castings, will be passed to the appropriate person, in accordance with procedures.

Your responsibilities will require you to comply with organisational policy and procedures for the magnetic particle testing activities undertaken and to report any problems with the equipment in use that you cannot personally resolve, or are outside your permitted authority, to the relevant people. You will be expected to work with a minimum of supervision, taking personal responsibility for your actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide a good understanding of your work and will provide an informed approach to the inspection of castings using magnetic particle testing. You will have a working knowledge of the principles of magnetic particle testing, including the methods of generating magnetic fields. You will understand the different types of equipment, their advantages, limitations and care and the methods of calibration and performance checks.

You will have a detailed knowledge of testing practice, and will understand why this method has significant limitations on its flaw detecting capabilities. Your knowledge will include an appreciation of hazards and safe working practice and you will understand the risks posed by casting defects and the consequences of component failure. The importance of compiling accurate and legible reports will also be a key issue in complying with this standard.
You will understand the safety precautions required when carrying out the magnetic particle testing activities and when using the associated tools and equipment. You will be required to demonstrate safe working practices throughout and will understand the responsibility you owe to yourself and others in the workplace.
Performance criteria

You must be able to:

P1 work safely at all times, complying with health and safety, environmental and other relevant regulations, directives and guidelines
P2 follow the correct procedure/technique for the product or equipment being inspected
P3 use the correct equipment to carry out the inspection
P4 identify and confirm the inspection checks to be made and acceptance criteria to be used
P5 carry out all required inspections as specified
P6 identify any defects/flaws or variations from the specification
P7 record the results of the inspection in the appropriate format
P8 deal promptly and effectively with problems within your control and report those that cannot be solved
Inspecting castings by magnetic particle testing methods

Knowledge and understanding

You need to know and understand:

K1 the specific safety precautions to be taken when carrying out magnetic particle inspection activities on castings
K2 the hazards associated with carrying out the magnetic particle inspection activities (such as electrical, mechanical, toxic and fire) and how they can be minimised
K3 what type of personal protective equipment (PPE) is used and how to obtain it
K4 the COSHH regulations relating to materials used during the magnetic particle inspection process
K5 how to obtain the necessary job instructions and testing procedures/techniques and how to interpret the information
K6 the reasons why it is important to test castings using non-destructive testing methods
K7 why castings need to be tested by a range of different non-destructive testing methods (such as magnetic particle, penetrant flaw detection, ultrasonic and radiography)
K8 the various types of magnetic particle detection equipment used (to include portable and fixed machines)
K9 the various components that make up the equipment (such as contact prods and heads, rigid and flexible coils, permanent magnets, electromagnets)
K10 the basic concepts of magnetic particle testing (including creating the magnetic field, magnetisation of the casting, the use of a magnetic flux, disruption of the flux by discontinuities/flaws in the castings and imaging of the disruption by the magnetic media)
K11 how to check that the testing equipment is within current calibration dates
K12 the type of checks that can be carried out on the equipment (such as sensitivity assessment, functional tests, operation of flux indicators and field strength meters, ammeters and quality of detecting medium)
K13 the different detecting mediums that are used (to include inks and powders), methods of applying them and their removal on completion of the testing
K14 how to set up the equipment parameters for the testing activities undertaken (to include selection of magnetising technique, field strength, direction of current flow, calculation of magnetising current required and flux density required)
K15 the preparations that need to be carried out on the casting test area (such as degreasing, grinding, filling, polishing and other mechanical operations and, where appropriate, the application of contrast aid paint)
K16 how to carry out the testing activities (including the application of the magnetic field, application of the detecting media, viewing conditions required such as ambient light or ultraviolet (UV), identification of the displayed defects, defect transfer techniques such as magnetic rubber and photographic)

K17 the types of defects/flaws that are detectable using magnetic particle detection methods (such as sub-surface connected blowholes/shrinkage, inclusions, cracks, hot tears, cold shut, mis-runs, scab, oxide fold, and mould-metal reactions)

K18 how to recognise defects/flaws in the castings from the displayed indications and how to identify false indication of effects and their cause

K19 the level of defects/flaws that are acceptable in the castings; the influence of the defects/flaws on the service/performance of the casting

K20 the system of quality control within the company and who is responsible for it

K21 why it is critical that records of magnetic particle inspections on the castings are accurate, comprehensive and maintained legibly

K22 the person that you need to pass the inspected castings and inspection records to

K23 the extent of your own responsibility and whom you should report to if you have problems that you cannot resolve
Additional Information

Scope/range related to performance criteria

You must be able to:

1. carry out all of the following during the magnetic particle inspection activities:
   1.1 obtain the required magnetic particle testing equipment, and check it is correctly calibrated and in a safe condition
   1.2 use appropriate personal protective equipment (PPE)
   1.3 comply with job instructions/techniques, NDT testing inspection specifications, relevant COSHH sheets and risk assessment documentation
   1.4 follow the defined testing procedures and apply safe working practices and procedures at all times
   1.5 leave the work area in a safe condition on completion of the activities

2. check and confirm that the ambient conditions for testing are satisfactory, to include all of the following:
   2.1 temperature
   2.2 humidity
   2.3 free from vibration
   2.4 free from pollutants

3. prepare the castings for testing, to include all of the following:
   3.1 identifying and marking the test areas
   3.2 removing any contaminants from the test area (such as by degreasing)
   3.3 preparing the test surface to the specified finish (such as by grinding or polishing)

4. check that the specified equipment is fit for purpose and safe to use, by checking all of the following:
   4.1 condition and security of electrical connections
   4.2 operation of all mechanical functions
   4.3 function of powder/ink application
   4.4 correct operation of all safety devices

5. carry out the specified tests, in accordance with instructions, to include all of the following:
   5.1 setting the equipment parameters to the appropriate levels
   5.2 magnetising the casting
5.3 applying the detecting medium (ink or powder) correctly
5.4 using magnetic flux indicators
5.5 observing defect indications under correct lighting conditions (ambient light or ultraviolet (UV))
5.6 recording conclusions of observations
5.7 demagnetising and cleaning the casting on completion of the test

6 identify five of the following casting surface defects/flaws:
   6.1 inclusions
   6.2 cold shut
   6.3 scab
   6.4 mould metal reaction
   6.5 cracks
   6.6 mis-run
   6.7 oxide fold
   6.8 sub-surface connected blowholes/shrinkage
   6.9 hot tears
   6.10 other defects/flaws (specify)

7 follow the correct procedure to deal with castings which fall into all of the following categories:
   7.1 castings which meet the specification
   7.2 castings with identified defects/flaws
   7.3 castings requiring further investigation
   7.4 castings requiring other inspection methods

8 complete the inspection activities, to include carrying out all of the following:
   8.1 marking up defective castings with all relevant information
   8.2 recording all the required details of the inspection in the appropriate format
   8.3 handing over the castings and inspection details to the appropriate people
# SEMMPF3-015
Inspecting castings by magnetic particle testing methods

<table>
<thead>
<tr>
<th><strong>Developed by</strong></th>
<th>SEMTA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Version number</strong></td>
<td>2</td>
</tr>
<tr>
<td><strong>Date approved</strong></td>
<td>February 2013</td>
</tr>
<tr>
<td><strong>Indicative review date</strong></td>
<td>February 2018</td>
</tr>
<tr>
<td><strong>Validity</strong></td>
<td>Current</td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>Original</td>
</tr>
<tr>
<td><strong>Originating organisation</strong></td>
<td>SEMTA</td>
</tr>
<tr>
<td><strong>Original URN</strong></td>
<td>MPF3.15</td>
</tr>
<tr>
<td><strong>Relevant occupations</strong></td>
<td>Engineering and manufacturing technologies; Manufacturing technologies; Process, Plant and Machine Operatives; Process Operatives</td>
</tr>
<tr>
<td><strong>Suite</strong></td>
<td>Materials Processing and Finishing Suite 3</td>
</tr>
<tr>
<td><strong>Key words</strong></td>
<td>Engineering; manufacturing; processing; inspection; ferromagnetic casting; magnetic partial; testing; procedure; method; equipment</td>
</tr>
</tbody>
</table>