Technical Specification

"Requirements of workshops performing non-destructive testing on vehicles and their components in the railway maintenance sector"

for the Product Certification Programme NDT RAILWAY

Content

Foreword

The railway system of the European Community has a high level of safety. Making its contribution to this safety level is non-destructive testing (NDT) on components of railway vehicles as part of recurrent maintenance. NDT was identified as one of the activities in the maintenance of railway vehicles (and of wagons especially) to which safety pertains to a particular extent (EU Regulation 779/2019).

In this EU Regulation 779/2019, a certification process was initiated within the European Community, the goal of which is to harmonise the requirements and methods for appraising the capabilities of the entities in charge of maintenance (ECM). This harmonisation includes the entities in charge of maintenance guaranteeing with their maintenance systems that the vehicles for which they are responsible are also in safe operational condition in the future.

For the certification process of ECMs and of maintenance workshops, the European Railway Agency (ERA) has developed certification models (focusing on wagons) in which the significance of non-destructive testing and the necessity of its evaluation are highlighted, but in which no requirements are defined to which non-destructive testing processes must be evaluated or assessed.

There is currently no set of European regulations defining the requirements of workshops carrying out NDT in railway maintenance. This specification describes, for Europe-wide application, the requirements of the organisation and performing of non-destructive testing in railway maintenance, and is based upon "best practices" applied over many years, such as defined in various keeper regulations, national standards (DIN 27201-7) and international standards (EN 16910-1).

Introduction

Safety-related railway components such as wheelset axles, wheels and bogies are rated for endurance strength (EN 13103, EN 13979-1, EN 15827). However, unusual damage during operational use of these components may arise as a consequence of corrosion or wear, or mechanical forces, which has a negative impact on components, fatigue behaviour in particular.

Non-destructive test methods are used to identify early on such unusual damage arising through use, helping to prevent damage. The test techniques deployed as part of railway maintenance are tailored specially to the respective railway-specific components and require special testing equipment, special testing procedures and special test personnel qualifications.

1. Scope

This specification defines general requirements on workshops performing non-destructive testing (NDT) of safety-related components in the railway maintenance sector.

These requirements pertain to:

- Organisation of NDT (see 3.12) in the workshop (see 3.11)
- Qualifications (see 3.10) of test personnel
- Test methods deployed (see 3.9), railway-specific test techniques (see 3.8)
- Test instructions (see 3.3) and reports used
- Practical processes (see 3.3) when performing NDT in the workshop

Implementation of the requirements in this document should guarantee that workshops perform non-destructive testing in a comparable way on a technical level – corresponding to the current high safety standard in the railway maintenance sector.

2. Other relevant rules and standards

Reference is made to the following standards in the application of this document – they and others form the basis of individual NDT methods and the inspection of test medium and test systems. The latest edition of the standard applies in each case.

- EN 15313 Railway applications – In-service wheelset operation requirements – In-service and off-vehicle wheelset maintenance
- EN ISO 9712 Non-destructive testing – Qualification and certification of NDT personnel
- EN 15085-5, Railway applications – Welding of railway vehicles and components – Part 5: Inspection and documentation
- EN ISO 9934-1 Non-destructive testing – Magnetic particle testing – Part 1: General principles
- EN ISO 9934-2 Non-destructive testing – Magnetic particle testing – Part 2: Test equipment
- EN ISO 16810 Non-destructive testing – Ultrasonic testing – Part 1: General principles
- EN 12668-3 Non-destructive testing – Characterisation and verification of ultrasound examination equipment – Part 3: Combined equipment
- EN 13018 Non-destructive testing – Visual inspection – General principles
- EN 13927 Non-destructive testing – Visual inspection – Equipment
- EN 3452-1 Non-destructive testing – Penetrant testing – Part 1: General principles
- EN 3452-3 Non-destructive testing – Penetrant testing – Part 3: Reference test blocks
- EN 15549 Non-destructive testing – Eddy current testing – General principles
- EN 15548-3 Non-destructive testing – Eddy current testing – Part 1: System characteristics and their verification

3. Terms and definitions

3.1 Customer
Organisation commissioning maintenance (and associated non-destructive testing) in the workshop. The organisation can be the manufacturer/keeper of vehicles, the railway undertaking or ECM.

3.2 Service provider
External organisation performing NDT on behalf of the workshop as part of maintenance work on railways vehicles and their components.

3.3 Test instructions
Written description of the exact process to be followed when testing is to an existing standard, regulation, specification or procedure (EN ISO 9712).

3.4 Test area
The test area is the component surface area to be subjected to NDT.

3.5 Test authorisation
Declaration, issued in writing by the customer and based upon the scope of qualification, authorising the person to carry out the tasks defined (EN ISO 9712).

3.6 Test surface
The test surface is the surface area of the component on which a probe (or the like) is moved to inspect a specific test area.

3.7 Test system
Collective term for the equipment, tools, measuring aids, inspection/reference blocks, and ambient conditions, necessary for proper NDT.

3.8 Test technique
Special type of NDT method application (EN ISO 9712).

3.9 Test methods
Application of a physical principle in non-destructive testing (EN ISO 9712).

3.10 Qualification
Verification of physical suitability, knowledge, skills, training and experience necessary to properly perform NDT tasks (EN ISO 9712).

3.11 Workshop
Organisation carrying out maintenance of railway vehicles and their components, and also applying NDT in this context.

3.12 Non-destructive testing (NDT)

Grouping of test methods (for which test personnel is qualified in accordance with EN ISO 9712) performed without damaging the components under test and used to inspect these components for potential operation-related damage as part of railway maintenance.

4. General requirements on workshops

Workshops performing non-destructive testing as part of railway maintenance must satisfy the following organisational prerequisites.

4.1 Maintenance management system

A workshop must have a railway-specific maintenance system defining for the components undergoing NDT the test methods, test intervals (recurring inspection), test times (event-dependent testing) and test scope in relation to the maintenance level.

The maintenance system must guarantee that the customer's order information relevant to NDT is checked, confirmed and implemented in the workshop in the manner stipulated.

4.2 NDT personnel

A workshop must have personnel qualified for planning, carrying out and overseeing NDT processes. The requirements of test personnel are described in Sections 5.1 and 5.2 of this specification.

A workshop must appoint one or more test supervisors to oversee NDT personnel, the test processes and the measurement and test equipment. The requirements of test supervisors are described in Section 5.3 of this specification.

A workshop must have expertise management for NDT personnel which regulates the necessary qualifications, authorisation, continual training and regular monitoring of skills.

A workshop must have a procedure for specifying and documenting signatures from NDT test personnel used to sign documents relevant to NDT (such as test reports). Signatures can be written, electronic or with an individual stamp.

4.3 Test instructions and test reports

A workshop must have written test instructions for all tests on railway components performed as part of NDT. The requirements of these test instructions are described in Section 7.1 of this specification.

Workshop test instructions must be approved by the customer prior to tests starting.

For all tests performed as part of NDT, a workshop must have a system in place (in writing or on a computer) for the documentation of test conditions and test results (test report). The requirements of this documentation are described in Section 7.2 of this specification.

A workshop must have a process in place for the regular checking and, if necessary, revision of test instructions and test reports.

A workshop must ensure that NDT personnel has access to the test instructions and test reports.

4.4 Test and measurement equipment

A workshop must have test and measurement equipment with which deterioration potentially occurring during railway operations can be verified with appropriate sensitivity in line with the requirements in NDT test instructions and the compliance with the necessary test conditions can be checked.

A workshop must have procedures in place which guarantee that test/measurement equipment and auxiliary materials used for NDT are checked regularly as regards functionality and accuracy at defined time intervals by internal/external entities and that these inspections are documented. The findings of accuracy testing on test and measurement equipment must be used as input into how NDT work is performed. The relevant requirements are described in Section 6.2 of this specification.

If new test and measurement equipment is used by a workshop, it must be proven as part of a validation process that the results attained with this test and measurement equipment are no worse than those attained with conventional methods.

4.5 Communication and archiving of test results

A workshop must have a process in place for archiving test reports, associated test instructions and documents specific to testers (such as eyesight tests, qualification certificates and skill checks). This process must also regulate the archiving duration – which must correspond to the timeframe specified in maintenance management.

A workshop must have a process in place for the sharing the documentation of test results and test conditions (test reports in paper or electronic form) with the customer. Protection must be in place to prevent this information from being changed.

A workshop must have a process in place for the documentation of NDT testing performed in the course of maintenance on the component in question or in record sheets.

4.6 Use of external NDT service providers

If a workshop commissions an external service company to carry out NDT, the workshop must ensure that this service provider and its personnel satisfy the requirements in this guideline.

5. Requirements on test personnel qualifications

Workshops performing non-destructive testing as part of railway maintenance must satisfy the following requirements made of test personnel qualifications.

5.1 Qualification levels of test personnel

NDT personnel must be qualified to EN ISO 9712. NDT personnel can assume the following functions depending on qualification level.

Level 1 personnel:
Implementation and documentation of NDT tests based on the specifications in a test instruction document. Certified level 1 testers are authorised to assess test results, provided this is included in the activity description or test instruction document.

Level 2 personnel:
Implementation and supervision of tests. For supervision of tests by level 2 personnel, the guidelines and restrictions specified in EN ISO 9712 are applicable. Certified level 2 personnel may, amongst others:

a. Assume all level 1 and 2 activities, instruct and oversee level 1 and 2 personnel.
b. Select test techniques and delineate application areas for NDT.
c. Create NDT test instructions and supervise NDT tests
d. Set up NDT test systems and check the settings.
e. Interpret and assess NDT test results based on regulations
f. Assume the activities of a test supervisor for the method for which qualifications are in place.

Level 3 personnel:
Assume professional responsibility for the entire testing process. Certified level 3 personnel work to the guidelines of EN ISO 9712 and may (not exhaustive):

a. Perform and supervise NDT activities on all levels, instruct and oversee personnel on all levels.
b. Select test methods and techniques and delineate application areas for NDT.
c. Generate, validate and approve NDT test instructions.
d. Generate, validate and approve NDT procedures.
e. Design and interpret NDT standards
f. Assume the activities of a test supervisor for the method for which qualifications are in place.

5.2 Qualifications in the railway maintenance sector

NDT personnel of the relevant levels who perform testing activities on railway vehicles and their components must:

a. Be qualified in the railway maintenance sector to EN ISO 9712.
b. Renew these qualifications every 5 years
c. Keep the qualifications up to date through verifiable yearly activity in the respective process.

For countries in which there is no industrial railway maintenance sector for NDT or individual NDT processes, the following are stipulated in place of Section 5.2a:

a. Certification in the relevant test process in the multi-sector.
b. Regular and documented in-house NDT training (theoretical and practical) on railway components.
c. Professional NDT experience in the field of railway maintenance, where the experience times in ISO 9712 for certification are used as the basis in the respective process and at the relevant level.

Special national regulations as well as normative requirements (such as EN 15085-5) for the qualification, certification and deployment of test personnel can/must be included by a workshop as required.

Qualification and training certificates must be archived (see Section 4.5).

5.3 Roles of the test supervisor

The test supervisor appointed by a workshop (see Sections 4.2 and 5.1) is responsible for:

a. Regular internal training of test personnel
b. Proper application of test instructions (see Section 7.1).
c. Checking all documentation of test conditions and test results in the test reports and correct interpretation of the test results.
d. Checking test and measurement equipment and test conditions.
e. Annual monitoring of tester skills and knowledge as regards the content of test instructions and other documents with a relevance to NDT.
f. Instructing testers in new testing tasks.
g. Regularly checking test instructions and test reports as regards usability (such as when maintenance conditions may have changed).

If a workshop appoints more than one test supervisor (differentiated by test method for example), the respective responsibilities of the test supervisors must be clearly delineated.

5.4 Authorisation of test personnel

A workshop must authorise in writing the test personnel for performing non-destructive testing. This authorisation must include:

a. The NDT tasks and areas of responsibility to be fulfilled
b. Qualifications (test method, qualification level, amount of experience, physical suitability) required for performing NDT.
c. The necessary amount of experience in the railway maintenance sector (the industrial experience times in EN ISO 9712, Section 7.3, are used as the basis).
d. For test supervisors, a declaration from workshop management that the test supervisor is authorised to manage and oversee test processes and test personnel and its supervisory test function enables it to make technical decisions independently.
e. Name and signature of those authorising and authorised.

Authorisation applies conditionally on verification of annual activity in every test method applied and is subject to physical suitability (eyesight test).

6. Requirements on the test methods and techniques used

Workshops performing non-destructive testing as part of railway maintenance must satisfy the following requirements on test methods and techniques used.

6.1 Requirements on the test methods used

For the following NDT methods, EN ISO 9712 stipulates qualification in the railway maintenance sector. These test methods are also used typically as part of railway maintenance:

- Magnetic particle testing (MT)
- Ultrasonic testing (UT)
- Visual inspection (VT)
- Penetrant testing (PT)
- Eddy current testing (ET)

The test methods are applied on the basis of the following process standards:

- Magnetic particle testing to EN ISO 9934-1 (General principles).
  In conjunction with EN ISO 9934-2 (Reference blocks for checking test equipment).
- Ultrasound testing to EN 16810 (General principles)
  in conjunction with EN 12668-3 (Verification of examination equipment).
- Visual inspection to EN 13018 (General principles)
  in conjunction with EN 13927 (Equipment for visual inspection).
- Penetrant testing to EN ISO 3452-1 (General principles)
  in conjunction with EN ISO 3452-3 (Reference test blocks for checking test medium).
- Eddy current testing to EN ISO 15549 (General principles)
  in conjunction with EN ISO 15548-3 (System characteristics and verification).

If NDT test methods other than the aforementioned are used, it must be verified by the workshop as part of a validation process that the results attained with these test methods (detectability of deterioration occurring, verification sensitivity, …) correspond as a minimum

to the results of the aforementioned test methods and that test personnel is qualified for these methods as stipulated in Section 5.2.

Provided compelling technical reasons (such as accessibility) do not otherwise give rise to conflicts, priority should be given to the test method with the highest level of verification sensitivity in the event different test methods can fundamentally be applied.

6.2 Requirements on test techniques used

A workshop must use NDT techniques which satisfy the detectability requirements for potentially occurring deterioration in railway operations, verification sensitivity and requirements of test instructions used.

Test techniques used must be technically efficient. Techniques which are unnecessarily protracted and technically inefficient lower the attention span of the tester over time and increase the probability of faults occurring in the test procedure.

NOTE: For example, the magnetic particle testing of a wheelset axle or wheel with a hand unit is not technically efficient compared to the use of a coil all around the component.

Priority should be given to the technique with the highest level of verification sensitivity and higher level of technical efficiency in the event different test techniques can fundamentally be applied.

A workshop must have a test and measurement equipment management system in place which guarantees that NDT techniques used are regularly checked in a traceable manner at defined time intervals by internal/external entities as regards functionality and accuracy and that this check is documented (see 4.4).

All test and measurement devices, sensors, reference/test blocks used for non-destructive testing must be checked regularly:

a. Test and measurement devices used for NDT must be calibrated regularly by a calibration laboratory. The calibration traceability must be verified. Calibrations must be renewed after three years at the latest.
b. Calibration results (such as measurement uncertainty) must be factored into performing NDT work.
c. The functionality of test devices must be checked once a week as a minimum.
d. Sensors and probes must be checked daily and before each use.
e. Reference/test blocks must be visually inspected at least every year.
f. The checks must be documented.

6.3 Reference blocks, reference flaw sizes and allowable limits

If reference blocks typical for railways are used for the sensitivity adjustment of test systems and to check test medium, the properties of these reference blocks (material, heat treatment

condition, main dimensions, …) must be comparable with those of the railway components to be tested.

The sizes and positions of reference flaws in these reference blocks, in conjunction with the procedure for sensitivity adjustment, must guarantee detectability of deterioration occurring in railway operations and the verification sensitivity necessary.

The following standards make reference to the sizes of reference flaws in these reference blocks and, in conjunction with these, the permissibility criteria for the respective test:

- Standards for new builds, such as EN 13261, EN 13262 and EN 15085-5
- Maintenance standards, such as EN 15313, EN 16910-1, DIN 27201-7, EN 15085-5

7. Requirements on documents used

Workshops performing non-destructive testing as part of railway maintenance must satisfy the following requirements pertaining to documents and drawings relevant to testing.

7.1 Test instructions

All NDT on railway vehicles and their components must be carried out on the basis of written test instructions. Test instructions must contain at minimum the following information:

a. Specifications on application area and scope of the test instruction
b. Information on the component (ID number, type, main dimensions...)
c. Information concerning the test time
d. Information on the requirements on test personnel (testers, test supervisors)
e. Information on the test area
f. Information on the test system
g. Information concerning monitoring of the test system – carried out at least once before and after testing
h. Information concerning preparation of the component for the test (e.g. cleaning, testable and non-testable areas, surface condition)
i. Information on carrying out the test (e.g. specific settings for the test systems, sequence of tests, sequence of inspection of the component surface)
j. Information concerning assessment of the test results (observation, recording and acceptance levels)
k. Information concerning the reports to be used
l. Instructions for the handling and marking of components which have exceeded acceptance levels during testing.
m. Information concerning the individuals who created the test instructions, reviewed and approved them where relevant

Before NDT is commenced, test instructions must be validated and approved technically by a level 3 person certified in the railway sector (see 5.1) and be authorised by the customer (see 3.1).

7.2 Test reports

Test conditions under which NDT is performed as well as NDT results must be documented in written or electronic test reports. Test reports must contain the following as a minimum:

a. Specification of test instructions used (including revision and edition levels).
b. Unique identification of the component tested.
c. Unique identification of the test devices, probes, tools, reference blocks and measuring devices used.
d. Documentation of the specific test conditions (test media, lighting, radiation, field strength, sensitivity settings, etc.)
e. Documentation of the specific test scope
f. Non-ambiguous documentation and evaluation of test results.
g. Conclusion on the status of railway components following the test (compliant / non-compliant).
h. Location and date of test
i. Name and signature of tester
j. Name and signature of test supervisor

8. Requirements on the practical performance of non-destructive testing

Workshops performing NDT as part of railway maintenance must satisfy the following requirements as regards test procedures in practical testing:

a. To carry out NDT, it is necessary for test personnel to have the general knowledge required for performance of the NDT work as well as specialist knowledge of the operational loading of the railway components to be tested and the types and locations of potential deterioration.
b. The test instructions and test reports necessary for conducting a test must be available at the test location of test personnel.
c. The procedure in a test must satisfy the requirements and flowchart of the respective test instruction.
d. Conformance with the procedure- and component-specific requirements for ambient conditions (room facilities, temperature, illumination level, irradiation level, accessibility, …) is a requirement when tests are carried out.
e. The railway-specific test systems specified in the test instruction (test devices, tools, test equipment, probes, magnetisation equipment, reference blocks and test blocks, …) must be used when tests are performed.
f. Only test and measurement equipment which is functional and regularly monitored and calibrated may be used when tests are performed.
g. Test equipment, test devices and references blocks must be kept/stored in a manner which does not impact functionality.
h. The preparation of a surface or test surface on the component to be tested must permit verification of imperfections without restriction by the surface condition. If a component needs to be cleaned, the component may not be negatively impacted as regards

operational characteristics, nor may the cleaning method compromise meeting of the test objective.

i. The setting/adjustment and measuring of the test system (test medium sensitivities, field strengths, distance/sensitivity adjustments, transfer corrections, …) must correspond to the railway-specific procedures defined in the test instructions.
j. A test must guarantee full reading of the test areas (e.g. by appropriate selection of test sections and sufficient overlapping of magnetisation areas, search coil test tracks, probes and search coil effective widths).
k. Testing must be performed at an appropriate test speed (movement of probes for UT and ET) and inspection speed (MT, PT and VT) such that displays can be located reliably and can be differentiated from those which are not relevant.
l. NDT personnel must be capable of correctly differentiating and interpreting component-specific and flaw-specific test signals and displays for railway components under test.
m. Test procedure must be technically efficient. Test procedures which are unnecessarily protracted and technically inefficient lower the attention span of the tester over time and increase the probability of fault occurrences in the test cycle.
n. The working conditions, including occupational safety conditions, at the site where testing is performed much be such that the full attention of the tester remains focused on the test process for the duration of the test.
o. Test conditions, test results and identification of railway components tested must be documented correctly and in full in the test report provided.
p. The assessment of displays on the basis of monitoring, registration and permissibility criteria for the test instructions applied must be complete and correct.
q. Once testing is complete, the test devices must be calibrated correctly (e.g. amplification values) with subsequent checking of the test conditions (e.g. magnetisation conditions).
r. The marking of tested components and the handling of components with impermissible test results must be in accordance with the test instruction used.

References:

- Regulation (EU) No. 779/2019 of the Commission "… system of certification of entities in charge of maintenance of wagons ..."
- EN 15313 Railway applications – In-service wheelset operation requirements – In-service and off-vehicle wheelset maintenance
- EN 13103 Railway applications – Wheelsets and bogies – Non-powered axles – Design method
- DIN EN 13979-1 Railway applications – Wheelsets and bogies – Monobloc wheels – Technical approval procedure – Part 1: Forged and rolled wheels
- DIN EN 15827, Railway applications – Requirements for bogies and running gears
- EN 13261 Railway applications – Wheelsets and bogies – Wheelset axles – Product requirements
- EN 13262 Railway applications – Wheelsets and bogies – Wheelsets – Product requirements;
- DIN 27201-7 Condition of railway vehicles – Basic principles and production technologies – Part 7: Non-destructive testing
- EN 16910-1 Railway applications – Rolling stock – Requirements for non-destructive testing on running gear in railway maintenance – Part 1: Wheelsets
- DIN EN 15085-5, Railway applications – Welding of railway vehicles and components – Part 5: Inspection and documentation
- EN ISO 9712 Non-destructive testing – Qualification and certification of NDT personnel
- EN ISO 9934-1 Non-destructive testing – Magnetic particle testing – Part 1: General principles
- EN ISO 9934-2 Non-destructive testing – Magnetic particle testing – Part 2: Test equipment
- EN ISO 16810 Non-destructive testing – Ultrasonic testing – Part 1: General principles
- EN 12668-3 Non-destructive testing – Characterisation and verification of ultrasound examination equipment – Part 3: Combined equipment
- EN 13018 Non-destructive testing – Visual inspection – General principles
- EN 13927 Non-destructive testing – Visual inspection – Equipment
- EN 3452-1 Non-destructive testing – Penetrant testing – Part 1: General principles
- EN 3452-3 Non-destructive testing – Penetrant testing – Part 3: Reference test blocks
- EN 15549 Non-destructive testing – Eddy current testing – General principles
- EN 15548-3 Non-destructive testing – Eddy current testing – Part 1: System characteristics and their verification