PENETRANT TESTING

Qualification training according to the ISO 9712

PT

PROCESS	SYSTEM	METHOD	LEVEL / TECHNIQUE	SECTOR	CODE	VALID FROM	PREPARED BY
NDT	**ISO 9712**	PT	1, 2, 3	MS	-	**1 / 2023**	**CIESLAR**

INTRODUCTION

Purpose of Penetrant Testing method (PT, sometimes also referenced as FPI) is detection of defects open to the surface on all types of parts and components.

PT qualified personnel has to have knowledge of its **physics principles**, be familiar with overall **requirements of most widely codes and standards**, be able to expand them to new applications and be **able to perform and document testing**.

Training focuses on **gaining knowledge and essential skills** to be further strengthened when collecting experience. Duration and content of the training **depends on the qualification level pursued** as well as the **product or industrial sector selected** (e.g. welding, casting, multisector applications etc.).

Training are designed to prepare participants for all examination parts – **general** (physics principles), **specific** (use of standards and codes), and **practical** (performance of the method) acc. to EN ISO 9712 in the ATG CERT Examination Center.

RECOMMENDED PUBLICATIONS

ATG publications

- PT – Penetrant Testing, Level 1, 2 (ATG handbook)
- PT – Collections of formulas (published by ATG)

Other publications

- Personnel Training Publications: Liquid Penetrant Testing (PT) Programmed Instruction Series (ASNT handbook)
- Level III Study Guide: Liquid Penetrant Testing Method (PT) (ASNT handbook)
- Relevant Discontinuities – Magnetic Particle and Liquid Penetrant Testing (MT & PT) (ASNT handbook)
- Nondestructive Testing Handbook, Third Edition: Volume 2, Liquid Penetrant Testing (ASNT handbook)

SYLLABUS COVERAGE

Training provides theoretical and practical training to understand Penetrant Testing (PT) principles, be familiar with various types of equipment, accessories, and other aids, and handling of tested parts and components to perform safely Penetrant Testing, report (and evaluate for Level 2 and Level 3) results of the testing.

TRAINING DURATION

	SECTOR	LEVEL I	LEVEL II	LEVEL III
MS	Multisector	3 d (24 h)	2 d (16 h)	3 d (24 h)

BODY OF KNOWLEDGE – DISCONTINUITIES OF MATERIALS

Content of this body of knowledge does not have dedicated part of examination, however it can be indirectly included in other examination parts.

	SUBJECT	LEVEL I	LEVEL II	LEVEL III
1	**Types of discontinuities**			
1.1	Differentiation of discontinuities based on their initiation	☐	☑	☑
1.2	Discontinuities of castings	☑	☑	☑
1.3	Discontinuities of forgings	☑	☑	☑
1.4	Discontinuities of welds	☑	☑	☑
1.5	Heat treatment	☑	☑	☑
1.6	Discontinuities initiated during processing and service	☑	☑	☑
1.6.1	Abrasion cracks	☐	☑	☑
1.6.2	Material fatigue	☐	☑	☑
1.6.3	Stress corrosion	☐	☑	☑
1.6.4	Creep	☐	☑	☑

BODY OF KNOWLEDGE – GENERAL PART

	SUBJECT	LEVEL I	LEVEL II	LEVEL III
1	**Physical Principles**			
1.1	Characteristics of liquids	☑	☑	☑
1.1.1	Surface tension	☑	☑	☑
1.1.2	Contact angle, wetting ability	☑	☑	☑
1.1.3	Capillary action	☑	☑	☑
1.1.4	Viscosity	☑	☑	☑
1.2	Emulsification	☑	☑	☑
2	**Testing Process**			
2.1	Test procedure	☑	☑	☑
2.1.1	Surface preparation	☑	☑	☑
2.1.2	Classification of penetrant materials	☑	☑	☑
2.1.3	Penetrant application	☑	☑	☑
2.1.4	Excess penetrant removal	☑	☑	☑
2.1.5	Developing	☑	☑	☑
2.1.6	Evaluation of indications	☐	☑	☑
2.1.7	Post cleaning	☑	☑	☑
3	**Equipment, Penetrant Materials - Controls And Tests**			
3.1	Portable spray cans	☑	☑	☑
3.2	Equipment, penetrant lines	☑	☑	☑
3.3	UV radiation, UV lamps	☑	☑	☑

	SUBJECT	LEVEL I	LEVEL II	LEVEL III
3.4	Reference test blocks	☑	☑	☑
3.5	Type testing and bath testing	☐	☑	☑
3.6	Process control testing	☑	☑	☑
3.6.1	Performing of process control testing	☐	☐	☑
3.7	Safety data sheet	☑	☑	☑
4	**Evaluation of Liquid Penetrant Testing Indications**			
4.1	Inspection	☑	☑	☑
4.2	Interpretation	☐	☑	☑
4.3	Classification + ASTM E 433 Standard reference photographs for liquid penetrant inspection	☐	☑	☑
4.4	Evaluation	☐	☑	☑
4.5	Dividing of indications according to their essential features	☑	☑	☑
4.6	Evaluation of penetrant indications according to standards	☐	☑	☑
4.6.1	Pressure equipment	☐	☐	☑
4.6.2	Castings	☐	☑	☑
4.6.3	Forgings	☐	☑	☑
4.6.4	Tubes and pipes	☐	☐	☑
4.6.5	Aerospace	☐	☑	☑

BODY OF KNOWLEDGE – SPECIFIC PART

The content of specific part is modified according to product sector which is covered by training. Multisector includes standards from all sectors. Level of detail paid to particular documents depends on the level of the training (Level I, Level II or III).

	STANDARD	LEVEL I	LEVEL II	LEVEL III
1	**General methodology**			
EN ISO 3452-1	Non-destructive testing. Penetrant testing. General principles	☑	☑	☑
EN ISO 3452-2	Non-destructive testing. Penetrant testing. Testing of penetrant materials	☑	☑	☑
EN ISO 3452-3	Non-destructive testing. Penetrant testing. Reference test blocks	☑	☑	☑
EN ISO 3452-4	Non-destructive testing. Penetrant testing. Equipment	☐	☑	☑
EN ISO 3452-5	Non-destructive testing. Penetrant testing. Penetrant testing at temperatures higher than 50 degrees C	☐	☐	☑
EN ISO 3452-6	Non-destructive testing. Penetrant testing. Penetrant testing at temperatures lower than 10 degrees C	☐	☐	☑
EN ISO 3059	Non-destructive testing. Penetrant testing and magnetic particle testing. Viewing conditions	☑	☑	☑
QP-AMS-2644	Qualified Products List of Products Qualified Under SAE Aerospace Material Specification AMS 2644 - Inspection Material, Penetrant	☐	☑	☑
ASTM E 433	Standard Reference Photographs for Liquid Penetrant Inspection	☐	☑	☑
ASTM E 1417	Standard Practice for Liquid Penetrant Testing	☐	☐	☑
EN ISO 12706	Non-destructive testing -- Penetrant testing -- Vocabulary	☑	☑	☑

	STANDARD	LEVEL I	LEVEL II	LEVEL III
EN ISO 3452-2	Non-destructive testing. Penetrant testing. Testing of penetrant materials	☑	☑	☑
2	**Castings**			
EN 1371-1	Founding. Liquid penetrant testing. Sand, gravity die and low pressure die castings	☐	☑	☑
EN 1371-2	Founding. Liquid penetrant inspection. Investment castings	☐	☑	☑
3	**Welds**			
EN ISO 23277	Non-destructive testing of welds. Penetrant testing of welds. Acceptance levels	☐	☑	☑
EN ISO 17635	Non-destructive testing of welds. General rules for metallic materials	☐	☐	☑
EN ISO 6520-1	Welding and allied processes. Classification of geometric imperfections in metallic materials. Fusion welding	☐	☑	☑
EN 13445-5	Unfired pressure vessels – Part 5: Inspection and testing	☐	☐	☑
ASME BPV Code Section V/ Art. 1		☐	☐	☑
ASME BPV Code Section V/ Art. 6		☐	☐	☑
ASME BPV Code Section VIII, Div.1, App8		☐	☐	☑
3	**Pipings And Formings**			
EN 13480-5	Metallic industrial piping - Part 5: Inspection and testing	☐	☑	☑
EN 10228-2	Non-destructive testing of steel forgings. Penetrant testing	☐	☑	☑

BODY OF KNOWLEDGE – PRACTICAL PART

In the practical part of the training the trainees practice working with instructions and procedures as well as knowledge gained from the standards discussed in the specific part. Training and examination specimens are representative for given product sectors.

	SUBEJCT	LEVEL I	LEVEL II	LEVEL III
1	**General**			
1.1	Overview of penetrant means	☑	☑	☑
1.2	Process control testing	☑	☑	☑
1.2.1	Visible light measurement	☑	☑	☑
1.2.2	UV-A measurement	☑	☑	☑
1.2.3	Ambient white light and emitted white light measurement (FPI)	☑	☑	☑
1.2.4	Process control testing documentation	☑	☑	☑
1.3	Using and cleaning of reference blocks	☐	☑	☑
2	**Visible Color Penetrant Testing According To An Instruction And Reporting**			
2.1	Spraying, excess penetrant removal by solvent, wet non aqueous developer	☑	☑	☑
2.2	Spraying, excess penetrant removal by water, wet non aqueous developer	☑	☑	☑
2.3	Brushing, excess penetrant removal by solvent, wet non aqueous developer	☑	☑	☑
2.4	Brushing, excess penetrant removal by water, wet non aqueous developer	☑	☑	☑
3	**Fluorescent Penetrant Testing According To An Instruction And Reporting**			

	SUBEJCT	LEVEL I	LEVEL II	LEVEL III
3.1	Spraying, excess penetrant removal by solvent, wet non aqueous developer	☑	☑	☑
3.2	Brushing, excess penetrant removal by solvent, wet non aqueous developer	☑	☑	☑
3.3	Using of penetrant line, including dry oven	☑	☑	☑
3.4	Immersion, excess penetrant removal by water + dry powder, or aqueous or wet non aqueous developer	☑	☑	☑

BODY OF KNOWLEDGE – DOCUMENTATION

In the practical part of the training the trainees practice dealing with process documentation from reporting results to reports, drafting instructions and procedures.

	SUBEJCT	LEVEL I	LEVEL II	LEVEL III
1	**Test Report**			
1.1	Purpose	☑	☑	☑
1.2	Tested part	☑	☑	☑
1.3	Testing conditions	☑	☑	☑
1.4	Reporting findings	☑	☑	☑
1.5	Evaluation	☐	☑	☑
2	**Written Instruction**			
2.1	Validity range	☐	☑	☑
2.2	Personnel requirements	☐	☑	☑
2.3	Inspection range and area of interest	☐	☑	☑
2.4	Equipment and accessories	☐	☑	☑
2.5	Testing parameters and their verification	☐	☑	☑
2.6	Evaluation, acceptance criteria	☐	☑	☑
2.7	Reporting	☐	☑	☑
2.8	Post-testing activity	☐	☑	☑
3	**Written Procedure**			
3.1	Validity range	☐	☐	☑
3.2	Personnel requirements	☐	☐	☑
3.3	Inspection range and scheduled plan	☐	☐	☑
3.4	Equipment, accessories and control activities	☐	☐	☑
3.5	Setting of parameters	☐	☐	☑
3.6	Testing parameters	☐	☐	☑
3.7	Evaluation, acceptance criteria	☐	☐	☑
3.8	Documentation	☐	☐	☑
3.9	Post-testing activity	☐	☐	☑