

## ARTICLE 9

T-910	Scope.....	164
T-920	General .....	164
T-921	Basic Requirements and Terms Used.....	164
T-922	Personnel Requirements.....	164
T-923	Procedure .....	164
T-930	Equipment.....	165
T-940	Miscellaneous Requirements.....	165
T-941	Procedure Requirements .....	165
T-942	Physical Requirements.....	165
T-950	Technique.....	165
T-951	Applications .....	165
T-952	Direct Visual Examination .....	165
T-953	Remote Visual Examination.....	166
T-954	Translucent Visual Examination .....	166
T-980	Evaluation.....	166
T-990	Documentation.....	166
T-991	Report of Examination .....	166
T-992	Performance Documentation .....	166
T-993	Record Maintenance.....	166
<b>Table</b>		
T-923	Requirements of a Visual Examination Procedure .....	164
<b>Mandatory Appendix</b>		
Appendix I	Glossary of Terms for Visual Examination .....	167
I-910	Scope.....	167
I-920	General .....	167

# ARTICLE 9

## VISUAL EXAMINATION

**01 T-910 SCOPE**

(a) This Article contains methods and requirements for visual examination applicable when specified by a referencing Code Section. Specific visual examination procedures required for every type of examination are not included in this Article, because there are many applications where visual examinations are required. Some examples of these applications include nondestructive examinations, leak testing, in-service examinations and fabrication procedures.

(b) The requirements of Article 1, General Requirements, apply when visual examination, in accordance with Article 9, is required by a referencing Code Section.

(c) Definitions of terms for visual examination appear in Article 1, Appendix I – Glossary of Terms in Nondestructive Examination, and Article 9, Appendix I.

**TABLE T-923  
REQUIREMENTS OF A VISUAL EXAMINATION  
PROCEDURE**

Requirement (As Applicable)	Essential Variable	Non-Essential Variable
Technique used	X	
Surface Conditions	X	
Surface preparation/cleaning		X
Method or Tool(s) required for Surface Preparation		X
Direct or Indirect Viewing method	X	
Special Illumination	X	
Equipment to be used		X
Sequence of performing examination		X
Data to be documented		X
Report Forms to be Completed		X
Personnel Qualifications	X	
Procedure Qualification Reference	X	

**01**

**T-920 GENERAL**

**01 T-921 Performance**

Visual examination to this Article, when required by the referencing Code Sections, shall be performed to a written procedure prepared by the user.

**01 T-922 Personnel Requirements**

The user of this Article shall be responsible for assigning qualified personnel to perform visual examinations to the requirements of this Article. At the option of the manufacturer, he may maintain one certification for each product, or several separate signed records based on the area or type of work, or both combined. Where impractical to use specialized visual examination personnel, knowledgeable and trained personnel, having limited qualifications, may be used to perform specific examinations, and to sign the report forms. Personnel performing examinations shall be qualified in accordance with requirements of the referencing Code Section.

**T-923 Procedure**

**01**

**T-923.1 Requirements.** Visual examinations shall be performed in accordance with a written procedure, which shall, as a minimum, contain the requirements listed in Table T-923. The written procedure shall establish a single value or range of values, for each requirement.

**T-923.2 Procedure Qualification.** When procedure qualification is specified, a change of a requirement in Table T-923 identified as an essential variable from the specified value, or range of values, shall require requalification of the written procedure. Where a range is specified for an essential variable, the bounding values of the range shall be qualified by demonstration. A change of a requirement identified as a nonessential variable from the specified value, or range of values, does not require requalification of the written procedure. All changes of essential or nonessential variables from the value, or range of values specified by the written

procedure shall require revision of, or an addendum to, the written procedure.

### 01 T-930 EQUIPMENT

Equipment used for visual examination techniques, for example, direct, remote, or translucent, shall have the capabilities as specified in the procedure. Capabilities include, but are not limited to viewing, magnifying, identifying, measuring, and/or recording observations in accordance with requirements of the referencing Code Section.

### 01 T-940 MISCELLANEOUS REQUIREMENTS

#### 01 T-941 Procedure Requirements

The procedure shall contain or reference a report of what was used to demonstrate that the examination procedure was adequate. In general, a fine line  $\frac{1}{32}$  in. (0.8 mm) or less in width, an artificial imperfection or a simulated condition, located on the surface or a similar surface to that to be examined, may be considered as a method for procedure demonstration. The condition or artificial imperfection should be in the least discernable location on the area surface to be examined to validate the procedure.

NOTE: T-941.3 is a non-essential variable (See Table T-923).

01 **T-941.1** Visual examination shall be performed in accordance with a written procedure.

**T-941.2** A written procedure, when required in accordance with T-150, shall include at least the following:

- (a) how visual examination is to be performed;
- (b) type of surface condition and criteria for surface cleaning;
- (c) cleaning instructions or reference to cleaning procedures;
- (d) method or tool for surface preparation, if any;
- (e) whether direct or remote viewing is used;
- (f) special illumination, instruments, or equipment to be used, if any;
- (g) sequence of performing examination, when applicable;
- (h) data to be tabulated, if any;
- (i) report forms or general statement to be completed.

**T-941.3** In some instances it is preferable to relate the procedure to a specific component or surface such as the internal examination of a weld many feet from the open end of a tube or tubes of several sizes, but

procedures may be in a general form applicable without adaptation to a variety of unlisted products or situations, thereby reducing the number of written procedures required.

**T-941.4** The procedure shall contain or reference a report of what was used to demonstrate that the examination procedure was adequate. In general, a fine line  $\frac{1}{32}$  in. (0.8 mm) or less in width, or some other artificial flaw located on the surface or a similar surface to that to be examined, may be considered a test method for this demonstration. The line or artificial flaw should be in the least discernible location on the area examined, to prove the procedure.

**T-941.5** Substituting one equipment manufacturer's equipment for another, or changes in the details of test arrangement, will not require requalification.

### T-942 Physical Requirements

Personnel shall have an annual vision test to assure natural or corrected near distance acuity such that they are capable of reading standard J-1 letters on standard Jaeger test type charts for near vision. Equivalent near vision tests are acceptable.

### T-950 TECHNIQUE

#### T-951 Applications

Visual examination is generally used to determine such things as the surface condition of the part, alignment of mating surfaces, shape, or evidence of leaking. In addition, visual examination is used to determine a composite material's (translucent laminate) subsurface conditions.

### T-952 Direct Visual Examination

Direct visual examination may usually be made when access is sufficient to place the eye within 24 in. (610 mm) of the surface to be examined and at an angle not less than 30 deg. to the surface to be examined. Mirrors may be used to improve the angle of vision, and aids such as a magnifying lens may be used to assist examinations. Illumination (natural or supplemental white light) for the specific part, component, vessel, or section thereof being examined is required. The minimum light intensity at the examination surface/site shall be 100 footcandles (1000 lux). The light source, technique used, and light level verification is required to be demonstrated one time, documented, and maintained on file. Personnel shall have an annual vision

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test to assure natural or corrected near distance acuity such that they are capable of reading standard J-1 letters on standard Jaeger test type charts for near vision. Equivalent near vision tests are acceptable.

### **T-953 Remote Visual Examination**

In some cases, remote visual examination may have to be substituted for direct examination. Remote visual examination may use visual aids such as mirrors, telescopes, borescopes, fiber optics, cameras, or other suitable instruments. Such systems shall have a resolution capability at least equivalent to that obtainable by direct visual observation.

### **01 T-954 Translucent Visual Examination**

Translucent visual examination is a supplement of direct visual examination. The method of translucent visual examination uses the aid of artificial lighting, which can be contained in an illuminator that produces directional lighting. The illuminator shall provide light of an intensity that will illuminate and diffuse the light evenly through the area or region under examination. The ambient lighting must be so arranged that there are no surface glares or reflections from the surface under examination and shall be less than the light applied through the area or region under examination. The artificial light source shall have sufficient intensity to permit "candling" any translucent laminate thickness variations.

### **T-980 EVALUATION**

**T-980.1** All examinations shall be evaluated in terms of the acceptance standards of the referencing Code Section.

**T-980.2** An examination checklist shall be used to plan visual examination and to verify that the required visual observations were performed. This checklist establishes minimum examination requirements and does not indicate the maximum examination which the Manufacturer may perform in process. **01**

### **T-990 DOCUMENTATION 01**

#### **T-991 Report of Examination 01**

**T-991.1** A written report of the examination shall contain the following information:

- (a) the date of the examination;
- (b) procedure identification and revision used;
- (c) technique used;
- (d) results of the examination;
- (e) examination personnel identity, and, when required by the referencing Code Section, qualification level;
- (f) identification of the part or component examined.

**T-991.2** Even though dimensions, etc., were recorded in the process of visual examination to aid in the evaluation, there need not be documentation of each viewing or each dimensional check. Documentation shall include all observation and dimensional checks specified by the referencing Code Section.

#### **T-992 Performance Documentation 01**

Documentation of performance demonstration shall be completed when required by the referencing Code Section.

#### **T-993 Record Maintenance 01**

Records shall be maintained as required by the referencing Code Section.

# ARTICLE 9

## MANDATORY APPENDIX

### APPENDIX I — GLOSSARY OF TERMS FOR VISUAL EXAMINATION

#### I-910 SCOPE

This Mandatory Appendix is used for the purpose of establishing standard terms and definitions of terms related to Visual Examination which appear in Article 9.

#### 01 I-920 GENERAL

(a) Article 30, SE-1316, Section 9, provides the definition of *footcandle (fc)*.

(b) Definitions of terms for visual examination and other methods appear in Article 1, Mandatory Appendix I, Glossary of Terms for Nondestructive Examination.

(c) The following Code terms are used in conjunction with Article 9:

*artificial flaw* — an intentional imperfection placed on the surface of a material to depict a representative flaw condition

*auxiliary lighting* — an artificial light source used as a visual aid to improve viewing conditions and visual perception

*candling* — see *translucent visual examination*

*direct visual examination* — a visual examination technique performed by eye and without any visual

aids (excluding light source, mirrors, and/or corrective lenses)

*enhanced visual examination* — a visual examination technique using visual aids to improve the viewing capability, e.g., magnifying aids, borescopes, video probes, fiber optics, etc.

*lux (Lx)* — a unit of illumination equal to the direct illumination on a surface that is everywhere one meter from a uniform point source of one candle intensity or equal to one lumen per square meter

*remote visual examination* — a visual examination technique used with visual aids for conditions where the area to be examined is inaccessible for direct visual examination

*surface glare* — reflections of artificial light that interfere with visual examination

*translucent laminate* — a series of glass reinforced layers, bonded together, and having capabilities of transmitting light

*translucent visual examination* — a technique using artificial lighting intensity to permit viewing of translucent laminate thickness variations (also called candling)

*visual examination* — a nondestructive examination method used to evaluate an item by observation, such as: the correct assembly, surface conditions, or cleanliness of materials, parts, and components used in the fabrication and construction of ASME Code vessels and hardware