A03

ARTICLE 14

ARTICLE 14
EXAMINATION SYSTEM QUALIFICATION

T-1410 SCOPE

The provisions of this Article for qualifying nondestructive examination (NDE) systems are mandatory when specifically invoked by the referencing Code Section. The Manufacturer, examination organization, owner, or other user of this Article is responsible for qualifying the examination technique, equipment, and written procedure in conformance with this Article. The referencing Code Section shall be consulted for the following specific detailed requirements:

(a) personnel certification requirements or prerequisites for qualification under the requirements of this Article

(b) examination planning, including the extent of examination

(c) acceptance criteria for evaluating flaws identified during examination

(d) level of rigor required for qualification

(e) examination sensitivity, such as probability of detection and sizing accuracy

(f) records, and record retention requirements

T-1420 GENERAL REQUIREMENTS

T-1421 The Qualification Process

The qualification process, as set forth in this Article, involves the evaluation of general, technical, and performance-based evidence presented within the documented technical justification, and when required, a blind or non-blind performance demonstration.

T-1422 Technical Justification

The technical justification is a written report providing a detailed explanation of the written examination procedure, the underlying theory of the examination method, and any laboratory experiments or field examinations that support the capabilities of the examination method.

The technical justification provides the technical basis and rationale for the qualification, including:

(a) mathematical modeling

(b) field experience

(c) test hierarchy ranking

(d) anticipated degradation mechanism

(e) NDE response by morphology and/or product form

T-1423 Performance Demonstration

The performance demonstration establishes the ability of a specific examination system to achieve a satisfactory probability of detection (POD), by application of the examination system on flawed test specimens. The demonstration test results are used to plot the POD curve and determine the false call probability (FCP) for establishing confidence limitations.

(a) The test specimens shall replicate the object to be examined to the greatest extent practical. Simplified test specimens representative of an actual field situation may be used. The use of specimens with known, identified flaws is preferred, and may be essential for the most rigorous qualification process. A hierarchy of test specimen flaws may be used to minimize qualifications when technically justified (i.e., demonstrations on more challenging degradation mechanisms may satisfy qualification requirements for less challenging mechanisms).

(b) When they sufficiently replicate the object to be tested, performance demonstrations of a limited scope may be used to minimize the costs involved, and facilitate specimen availability. The technical justification must support any limitations to the scope of performance demonstrations.

(c) Personnel qualification shall be based upon blind testing, except where specifically exempted by the referencing Code Section.

(d) The level of rigor applied to the performance demonstration may vary from a simple demonstration on a few flaws, to an extensive test using hundreds of flaws. The level of rigor may also vary between qualifications for the written procedure and examination personnel. More rigorous procedure qualifications can be beneficial for the following reasons:

(1) improved pass-fail rates for personnel;

(2) reduced scope for blind personnel qualification testing;

(3) better understanding of the correlation between the procedure and the damage mechanisms of interest;

(4) more reliable written procedures.

T-1424 Levels of Rigor

Qualification is performed at one of three levels of rigor. The referencing Code Section shall invoke the required level of rigor, to verify the examination system capability to detect and size typical flaws for the damage mechanisms of interest, depending upon their locations and characteristics. When not otherwise specified, the level of rigor shall be set by agreement between the interested parties. The three levels of rigor are:

(a) Low Rigor (Technical Justification only): The requirement for this level of rigor is a satisfactory technical justification report. No performance demonstrations are required for qualification of the examination system.

(b) Intermediate Rigor, (Limited Performance Demonstration): The requirements for this level of rigor are a satisfactory technical justification report, and the successful performance of a demonstration test (blind or non-blind) on a limited number of test specimens. The referencing Code Section shall establish the scope of demonstration requirements, and sets acceptable POD and FCP scores for qualification. When not otherwise specified, the qualification criteria shall be set by agreement between the interested parties.

(c) High Rigor, (Full Performance Demonstration): The requirements for this level of rigor are a satisfactory technical justification report, and the successful performance of blind demonstration tests. The referencing Code Section shall establish the scope of demonstration requirements, and sets acceptable POD and FCP scores for qualification. When not otherwise specified, the qualification criteria shall be set by agreement between the interested parties. A sufficient number of test specimens shall be evaluated to effectively estimate sizing error distributions, and determine an accurate POD for specific degradation mechanisms or flaw types and sizes. A high rigor performance demonstration is generally required to support a Probabilistic Risk Assessment.

T-1425 Planning a Qualification Demonstration

The recommended steps for planning and completing the qualification demonstration, as applicable, are:

(a) Assemble all necessary input information concerning the component, defect types, damage mechanism of interest, and objectives for the examination and qualification of the examination system.

(b) Review the written procedure to verify its suitability for the intended application.

(c) Develop the technical justification for the examination method to be used.

(d) Determine the required level of rigor for the performance demonstration.

(e) Develop performance demonstration criteria using the applicable references.

(f) Conduct the performance demonstration.

(g) Conduct the personnel qualifications.

(h) Compile, document, and evaluate the results.

(i) Determine qualification status, based upon a final evaluation.

T-1430 EQUIPMENT

The equipment used for the performance demonstration of an examination system shall be as specified in the written procedure and the technical justification. After qualification of the examination system, the use of different examination equipment may require requalification (see T-1443).

T-1440 APPLICATION REQUIREMENTS

T-1441 Technical Justification Report

Prior to qualification of any examination system, regardless of the level of rigor, a technical justification report shall be prepared and receive approval by a Level III certified for the specific method to be applied. The technical justification report shall be reviewed and accepted by the owner of the object of interest and, where applicable, to the Jurisdiction, Authorized Inspection Agency (AIA), independent third party, examination vendor, or other involved party. Acceptance of this report by the involved parties is the minimum requirement for qualification of an examination system at the lowest level of rigor. The technical justification report shall address the following minimum topics:

T-1441.1 Description of Component/Flaws to be Examined. The component design, range of sizes, fabrication flaw history, and any anticipated damage mechanisms (for in-service evaluations) for the object of interest shall be analyzed to determine the scope of the examinations, the types and sizes of critical flaws to be detected, and the probable location of flaws. The

scope of the written procedure shall define the limits for application of the procedure (e.g., materials, thickness, diameter, product form, accessibility, examination limitations, etc.).

(a) The flaws of interest to be detected; their expected locations, threshold detection size, critical flaw size, orientation, and shape shall be determined, serving as a guideline for development of the written procedure. Critical flaw sizes (calculated from fracture mechanics analysis) and crack growth rates are important considerations for determining flaw recording and evaluation criteria. The minimum recordable flaw size must be smaller than the critical flaw size, and include consideration of the estimated or observed crack growth rates and the observed quality of workmanship during fabrication. Flaw evaluation must be based upon precluding the formation of critically sized flaws prior to the next inspection, or for the estimated remaining life of the object during normal operations.

(b) Object or technique geometry, environmental conditions, examination limitations, and metallurgical conditions may limit the accessibility for evaluating the object. Examination procedure or equipment modifications may be required to gain access to the area of interest to be examined.

(c) The acceptance criteria for the demonstration shall be provided.

(d) Additional issues to consider for inclusion in the technical justification may include:

(1) historical effectiveness of procedure;

(2) documentation for prior demonstrations;

(3) extent of prior round robin tests;

(4) observed flaw detection rates, probability of detection, and false call rates;

(5) acceptable rejection/acceptance rates; and

(6) sizing accuracy.

T-1441.2 Overview of Examination System. A general description of the examination system, with sufficient detail to distinguish it from other systems, shall be included within the technical justification report. The description shall include, as applicable, sizing techniques, recording thresholds, and techniques to be used for interpreting indications. If a combination of equipment is used, the applicable conditions for specific equipment combinations shall be adequately described.

T-1441.3 Description of Influential Parameters. The influence of inspection parameters on the examination system shall be considered, including equipment selection, sensitivities, instrument settings, data analysis, and personnel qualifications. The justification for parameter selections shall be based upon the flaws of interest, and include an explanation of why the selected parameters will be effective for the particular examination and expected flaws.

(a) Procedure requirements, including essential variables to be addressed, may be found in the Mandatory Appendix associated with the examination method, or in the referencing Code Section.

(b) Personnel certification requirements, in addition to method specific Level II or III certification, may be advisable under some conditions. When using established techniques for a low rigor application (e.g., for examination of more readily detected damage mechanisms, or where less critical components are involved) a method specific Level II or III certification is adequate. When an intermediate or high rigor application is required, additional personnel requirements shall be considered and, if required, so specified. This may include quantitative risk based criteria for the selection of components to be examined, or completion of a blind performance demonstration. For examination techniques performed by a team of examiners, the specific qualification requirements for each team member shall be addressed.

T-1441.4 Description of Examination Techniques. A justification for the effectiveness of the selected examination technique used in the written procedure for detecting flaws of interest shall be included. The sensitivity settings for recording flaws, flaw orientation, critical flaw size, anticipated degradation mechanism (for in-service applications), and the influence of metallurgical and geometric affects shall be addressed in the justification. A description of the method for distinguishing between relevant and non-relevant indications, justification for sensitivity settings, and the criteria for characterizing and sizing flaws shall be included.

T-1441.5 Optional Topics for Technical Justification. The following topics may be addressed within the technical justification to improve the understanding of the techniques to be applied.

(a) Description of Examination Modeling. A description of the examination modeling used to develop the procedure, plot indications, predict flaw responses, design mockups, show coverage, and qualify written procedures may be included. Models are required to be validated before use. The referencing Code Section shall establish the criteria for validating models. When not otherwise specified, the modeling validation criteria shall be set by agreement between the interested parties. Models can be used with qualified written procedures to demonstrate the anticipated effectiveness of procedure revisions when parameters such as geometry, angle,

size, and access limitations are changed. The written procedure may be qualified or requalified using a minimum number of mockups with adequate justification.

(b) Description of Procedure Experience. Prior experience with a written procedure may be included in the technical justification, and used to support revisions to the procedure. Documentation of similar demonstrations relevant to the proposed examination may be included. Experimental evidence to show the effect of applicable variables may also be cited and considered when developing the written procedure.

T-1442 Performance Demonstration

Examination systems requiring qualification at intermediate or high levels of rigor shall also pass a performance demonstration. The specimen test set and pass/fail criteria to be used in the performance demonstration shall be determined by the owner of the object; and, where applicable, shall be acceptable to the Jurisdiction, Authorized Inspection Agency, independent third party, examination vendor, inspection agency, or other involved party.

(a) The procedure shall be demonstrated by performing an examination of an object or mockup. The examiner conducting the demonstration shall not have been involved in developing the procedure. The completed report forms provide documentation of the demonstration. Qualification of the procedure is only valid when applying the same essential variables recorded during the demonstration. Changes to essential variables require requalification of the procedure. Editorial changes to the procedure, or changes to nonessential variables, do not require requalification of the procedure.

(b) The demonstration of the written procedure may use blind or non-blind certified personnel. Blind performance demonstrations qualify the complete examination system (i.e., the equipment, the written procedure, and the examiner). Non-blind demonstrations only qualify the procedure and the equipment. All recordable indications shall be sized and located. The detection records shall note whether indications are located correctly. Depth, height, and length sizing capabilities are only qualified by a blind performance demonstration.

(c) Demonstrations can be performed by a non-blind demonstration using a few flaws, a demonstration mandated by the referencing Code Section, reiterative blind testing, a combination of multiple small specimen demonstrations; or using a rigorous, statistically based demonstration based on binomial distributions with reduced, one-sided confidence limits. Acceptable demonstration methodologies shall be described in the technical justification for that procedure.

(d) An individual or organization shall be designated as the administrator of the demonstration process. The roles of the administrator include:

(1) reviewing the technical justification;

(2) reviewing the procedure and its scope of applicability;

(3) ensuring that all essential variables are included in the procedure and demonstration;

(4) assembling the test specimens;

(5) grading the demonstrations;

(6) developing the protocol;

(7) maintaining security of the samples; and

(8) maintaining the demonstration records.

For straightforward applications, the administrator may be a department within the owner's organization. For complex demonstrations, or when Code or user requirements dictate, it may be appropriate to use a disinterested third party.

T-1443 Examination System Re-qualification

The original qualification applies only to the system and essential variables described in the technical justification report and the written procedure. If essential variables are changed, requalification is required. Requalification may be accomplished by one of the following means:

(a) The characteristics of the new equipment can be compared to the qualified equipment. If they are essentially identical, the new equipment can be substituted, except when the referencing construction Code invokes more stringent requirements for substituting equipment.

(b) New equipment may be requalified by conducting another complete examination qualification. A hierarchical approach should be used to qualify the new equipment by conducting the demonstration on the most difficult test specimens. Then there is no need to requalify the equipment on the entire set of test specimens.

(c) Modeling may be used to requalify a procedure when proper justification supports such an approach.

T-1450 CONDUCT OF QUALIFICATION DEMONSTRATION

T-1451 Protocol Document

A protocol document shall be prepared to ensure continuity and uniformity from qualification-to-qualification. The protocol document forms the basis for third

party oversight, and sets the essential variables to be qualified, ensuring portability of the qualification. The protocol document commonly takes the form of a written procedure and associated checklist, documenting the process followed during qualification. This document is developed collectively with the involvement of all the affected parties (i.e., the owner, and, when applicable, the Jurisdiction, AIA, independent third party, examination vendor, or other involved party).

A key element of the protocol document is the Pass/Fail criteria. An alternative evaluation criteria that may be applied is an "achieved level of performance criteria". For this criteria, an examiner demonstrates the technique, including sizing capabilities, and the qualification is based on the detection range the examiner achieves during the demonstration. Examiners qualified under these criteria are permitted to conduct examinations within their qualified capabilities.

T-1452 Individual Qualification

The performance demonstration requirements found in T-1440 qualify the examination system (i.e. equipment, written procedure, and personnel) as a unit. As an alternative, a two-stage qualification process may also be applied. The first stage of this process involves a performance demonstration to qualify the system procedure/equipment. The procedure/equipment qualification requires several qualified examiners to evaluate the specimen set, with the results meeting predetermined requirements more stringent than personnel pass/fail requirements. After the procedure/equipment has been qualified, individual examiners using the qualified procedure/equipment combination need only to perform a limited performance demonstration.

The principal incentive for adopting this form of test is to reduce costs in personnel qualification of a widely used procedure. The procedure/equipment may be qualified/developed in a non-blind fashion but the personnel shall take blind tests. This two-step process also precludes the possibility of an examiner attempting to pass a demonstration test with inadequate procedures or equipment.

T-1460 CALIBRATION

Calibration of equipment shall be in accordance with the written procedure used to conduct the performance demonstration.

T-1470 EXAMINATION

The performance demonstration shall be conducted in accordance with the written procedure, using the techniques and equipment described in the technical justification. Supplemental information for conducting various modes of performance demonstrations is provided in the following paragraphs

T-1471 Intermediate Rigor Detection Test

The objective of an intermediate rigor performance demonstration test is to reveal inadequate procedures and examiners. Following are typical options for flaws in specimen test sets used for intermediate rigor performance demonstrations:

(a) Specimens should accurately represent the component to be examined to the greatest extent possible, with at least 10 flaws or grading units as a minimum. A POD of 80% with a false call rate less than 20% is required for acceptable performance.

(b) Less than 10 flaws or grading units are used, but they shall be used in a blind fashion. The flaws are reused in an iterative, blind, and random process. This is an economic way to increase the sample set size. Eighty percent of the flaws are required to be detected. The false call rate should be less than 20%.

(c) Between 5 and 15 flaws or grading units are used with at least the same number of unflawed grading units. A POD of 80% with a false call rate less than 20% is required for acceptable performance.

(d) Sample set size shall be sufficient to ensure that most examiners with an unacceptable POD will have difficulty passing the demonstration, while most examiners with an acceptable POD will be able to pass the demonstration.

T-1472 High Rigor Detection Tests

The following guidelines describe the methodology for constructing POD performance demonstration tests for examination system qualification. In order to construct any of the detection tests mentioned in this appendix, the following information must be assembled:

(a) The type of material and flaws the procedure is supposed to detect.

(b) The size of the critical flaw for this application.

(c) The minimum acceptable POD that inspection should achieve for critical flaws. (Call this POD_{min}.)

(d) The maximum acceptable false call probability that the inspection should display. (Call this FCP_{max}.)

(e) The level of confidence that the test is supposed to provide. (The most widely applied level of confidence being 95%).

T-1472.1 Standard Binomial Detection Test. The examiner is subjected to a blind demonstration. The flawed grading units contain critical flaws (i.e., flaws near the critical flaw size) so that a POD calculated from this data estimates the POD for critical flaws. After the examination, the POD and FCP scores are calculated by comparing the number of detections classified as flaws to the number of flawed or blank grading units examined. In other words:

$$\text{POD Score} = \frac{\text{\# of flawed grading units as flaws}}{\text{Total \# of flawed grading units examined}} \quad (1)$$

$$\text{FCP Score} = \frac{\text{\# of blank grading units classified as flaws}}{\text{Total \# of blank grading units examined}} \quad (2)$$

The POD and FCP are supported by tolerance bands called "α bounds" to describe the statistical uncertainty in the test. (In the case of POD a lower α bound is used, while for FCP, an upper α bound is used). The examiner's score is acceptable if the lower bound on POD score is above POD_{min} , and the upper bound on FCP score is below FCP_{max}.

The α bounds are calculated using standard binomial formulas, shown below.

Where:

D = Number of detections recorded

N = Number of grading units that contain flaws (for POD calculations) or that are blank (for FCP calculations)

P_{upper} = upper α bound

P_{lower} = lower α bound

$$\alpha = \beta(P_{lower};\ D,\ N - D + 1) \quad (3)$$

$$\alpha = 1 - \beta(P_{upper};\ D + 1,\ N - D) \quad (4)$$

where $\beta(z;\ c_1,c_2)$ is a beta distribution with parameters c_1 and c_2. The design of a statistically significant sample set for this test is based on the above binomial formulas.

A POD of 95% with a 90% confidence implies that there is a 90% probability that 95% is an underestimate of the true detection probability. In other words, the confidence level, α describes how reliable the qualification test must be. If 10 flaws are in the test, then on the basis of 2 misses, there is a 90% confidence that the true inspection reliability is greater than 55%. If 95% confidence is desired, then the true inspection reliability is greater than 33.8%. If all 10 flaws were detected, then the POD would be 79%. To obtain a 90% POD at a 95% confidence level requires a minimum of 29 flaws out of 29 flaws to be detected.

TABLE T-1472.1 TOTAL NUMBER OF SAMPLES FOR A GIVEN NUMBER OF MISSES AT A SPECIFIED CONFIDENCE LEVEL AND POD

Level of Confidence	Number of Misses	Probability of Detection		
		90%	95%	99%
90%	0	22	45	230
	1	38	77	388
	2	52	105	531
	3	65	132	667
	4	78	158	798
	5	91	184	926
	10	152	306	1,000+
	20	267	538	1,000+
95%	0	29	59	299
	1	46	93	473
	2	61	124	628
	3	76	153	773
	4	89	181	913
	5	103	208	1,000+
	10	167	336	1,000+
	20	286	577	1,000+
99%	0	44	89	458
	1	64	130	662
	2	81	165	838
	3	97	198	1,000+
	4	113	229	1,000+
	5	127	259	1,000+
	10	197	398	1,000+
	20	325	656	1,000+

Table T-1472.1 shows the relationship between smallest number of flaws, confidence level, probability of detection, and misses by calculating the formula above for various scenarios. It can be used to develop the size of the test set. The user is free to select the actual number of flawed and blank locations (i.e., the sample size) employed in the test. The user's choice for sample size will be governed by two competing costs, (1) the cost of constructing test specimens, and (2) the cost of failing a "good" examiner. If the user chooses to perform a large test, the confidence bounds associated with the POD scores will be small, so a "good" examiner will have an excellent chance for passing the test. However, if an abbreviated test is given, the confidence bounds will be large, and even a good examiner will frequently fail a test.

In fact, with a binomial test such as this, there is a smallest sample size that can be used. If a sample

size smaller than the smallest sample size is used, it is impossible to ever pass the test, because the confidence bounds are so wide. With the smallest sample size, the examiner has to obtain a perfect score (i.e., $POD = 1$, or $FCP = 0$) to pass. The smallest sample size depends upon the detection threshold and the confidence level chosen for the test. For example, as the minimum acceptable POD is set closer to unity, the minimum sample size becomes larger. Table T-1472.1 presents the minimal sample size for various confidence levels, and POD/FCP thresholds.

As one can see from this table, quite a large sample set is required if high detection thresholds are required for the inspection. If exceptionally high detection thresholds are required, the standard binomial test described in this appendix may not be the most efficient testing strategy.

As a general rule, the test should include as many blank as flawed location, but this proportion may be altered depending upon which threshold (POD or FCP) is more stringent.

As developed in this section, the standard binomial test examines POD for one flaw size only, the critical flaw size. It is possible to include more flaw sizes in the test. Each included flaw size would contain the minimum number of flaws required by Table T-1472.1. For example, a 90% detection rate at a 90% confidence level for four different flaw size intervals would require 22 flaws in each size interval if no misses are allowed for a total of 88 flaws.

T-1472.2 Two-Stage Detection Test. The basic component of the two-stage demonstration test is the Standard Binomial Detection Test described in T-1472.1. The two-stage test applies the standard binomial test to personnel qualification, but applies a more stringent test for procedure qualification. The two-stage test is intended to eliminate inadequate procedures from the qualification process, preserving resources. The motivating objective for a two-stage test is to construct the first stage to eliminate a procedure whose pass rate is unacceptably low. (A procedure's pass rate is the proportion of trained examiners that would pass the personnel test when using this procedure).

A two-stage test is ideally suited for an examination scenario where many examiners will be using a few standardized procedures, which may differ substantially in performance. If only one procedure is available, or if each examiner applies a separate own customized procedure, two-stage testing is not advantageous.

In order to construct a two-stage detection test, the same information that must be assembled for the standard binomial test is required, with the addition of a target pass rate, R_{pass}, for personnel. The target pass-rate is the pass-rate that the user considers acceptable.

The procedure qualification (1st stage) portion of the test requires that M procedure-trained examiners each pass a standard binomial detection test. The standard binomial detection test, constructed in accordance with T-1472.1, will be used for personnel qualification. The key difference is that more that one examiner is used for procedure qualification. It is important that the procedure test be conducted with examiners that are representative of the field population (and not experts). A "procedure-trained" examiner should be one that has received the standard training required for the procedure.

After the procedure has passed its test, then individual examiners are allowed to be qualified in the second stage, using the same standard binomial test. The binomial test is constructed so that critical flaws are detected with a POD of at least POD_{min} and false calls are no more than FCP_{max} with a level of confidence of α. The number of examiners (M) used in the first stage is chosen to assure the desired pass-rate at 80% confidence (i.e. the user can be 80% sure that the actual pass-rate will be above the target value). The formula for determining the proper M is:

$$M = \frac{\log(1 - 0.80)}{\log(R_{pass})} \tag{5}$$

The table below provides the M associated with various target pass rates.

The user is completely free to choose the number of examiners (M) employed in the first stage of qualification. As one can see from the above table, the larger that M is made, the more stringent the procedure portion of the test becomes, but the higher the pass-rate becomes on the second stage of the test. In fact, for high M, the user might eliminate the second stage of the test entirely.

TABLE T-1472.2 REQUIRED NUMBER OF FIRST STAGE EXAMINERS vs. TARGET PASS RATE

Target Pass Rate (R_{pass})	Number of First Stage Examiners (M)
50	3
60	4
70	5
80	8
90	15
95	32

T-1472.3 Iterative Detection Test. This detection test is useful when the test specimens are extremely costly or limited. It is constructed in the same manner as the standard binomial test from T-1472.1, however the test presents the applicant with the same set of specimens more than once to obtain the desired sample size.

Less than 10 flaws are used, but they are used in a blind fashion. The flaws are reused in an iterative, blind, and random process. This is an economic way to increase the sample set size. The flawed and unflawed grading units are examined several times until the desired sample size and corresponding confidence level is reached. The specimens must be indistinguishable from each other so that each examination is independent and the test team cannot recognize the specimen or the flaws. The number of unflawed grading units must at least equal or exceed the number of flawed grading units. Table T-1472.1 may be used to determine the flaw sample size, misses, and POD for a given confidence level.

T-1480 EVALUATION

The owner, and, when applicable, the Jurisdiction, AIA, independent third party, examination vendor, or other user shall evaluate the technical justification report, and the results of the performance demonstration submitted by the administrator, to determine the acceptability of the system. The evaluation shall be based upon the criteria established within the protocol document.

T-1490 DOCUMENTATION AND RECORDS

Documentation of the performance demonstration shall include the following:

(a) The technical justification document

(b) NDE procedures, including the essential variables applied

(c) Description of the equipment used, including the calibration records

(d) Description of the specimens used to perform the demonstration

(e) Certification of acceptable completion of the performance demonstration. The certification may be issued separately for the equipment/procedure and the individual.

ARTICLE 14
MANDATORY APPENDIX I

APPENDIX I — GLOSSARY OF TERMS FOR EXAMINATION SYSTEM QUALIFICATION

I-1410 SCOPE

This Mandatory Appendix is used for the purpose of establishing standard terms and definition of terms, which appear in Article 14, Examination System Qualification.

I-1420 GENERAL REQUIREMENTS

(a) Paragraph I-1430 provides a list of terms and definitions, which are used in conjunction with Article 14, Examination System Qualification, and are Code specific.

(b) Terms and definitions associated with specific examination techniques and systems are addressed in the Mandatory Appendix applicable to those examination methods. Other terms and definitions used within the referencing Code of Construction are specific to that Code application.

I-1430 REQUIREMENTS

The following Code terms are used in conjunction with this Article:

(a) Blind Demonstration. A performance demonstration, where the examiner is presented with both flawed and non-flawed specimens which are visually indistinguishable, with the objective of proving the capability of an examination system to correctly detect and size flaw locations.

(b) Detection. When a specimen or grading unit is correctly interpreted as being flawed.

(c) Essential Variables. A change in the examination system, which will affect the system's ability to perform in a satisfactory manner.

(d) Examination System. The personnel, procedures, and equipment collectively applied by a given examination technique to evaluate the flaw characteristics of an object of interest.

(e) False Call. When a specimen or grading unit is incorrectly interpreted as being flawed or unflawed.

(f) False Call Probability (FCP). The percentage resulting from dividing the number of false calls by the number of specimens or grading units examined.

(g) Grading Unit. A prepared specimen, or designated interval (e.g., length) within a specimen, having known flaw characteristics, which is used to evaluate the performance of an examination system through demonstration.

(h) Level of Rigor. The level of confidence to which a given examination system must be demonstrated, based upon factors such as user needs, damage mechanism, and level of risk. There are three levels of rigor: low, intermediate, and high (see T-1424).

(i) Non-Blind Demonstration. A performance demonstration where the examiner is presented with test pieces containing clearly identifiable flaw locations of known sizes, with the objective of proving the capability of an examination system to correctly detect and size flaw locations.

(j) Nonessential Variables. A change in the examination system, which will not affect the system's ability to perform in a satisfactory manner.

(k) Performance Demonstration. A demonstration of the capabilities of an examination system to accurately evaluate a specimen with known flaw characteristics in an environment simulating field conditions.

(l) Probability of Detection (POD). The percentage resulting from dividing the number of detections by the number of flawed specimens or grading units examined. POD indicates the probability that an examination system will detect a given flaw.

(m) Qualification. Successful documentation of an examination system's ability to demonstrate established qualification objectives at the required level of rigor, in compliance with the requirements of this Article.