WRITTEN PRACTICE for NDE PERSONNEL QUALIFICATION AND CERTIFICATION
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PR 03.02 rev. 0 approved by Quality Control srl Level III on September 05, 2011

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Attachment B: Training program for MT
Attachment C: Training program for PT
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Attachment G: Training program for UT limited to digital thickness measurement
Attachment H: Training program for UT TOFD
Attachment I: Training program for UT PA
Attachment J: Training program for VT
1.0 SCOPO

Questa procedura stabilisce i requisiti minimi di scolarità, addestramento, esperienza, esame e certificazione del personale responsabile dell’esecuzione di controlli non distruttivi impiegato dalla QUALITY CONTROL SRL (QCsrl)

1.0 SCOPE

This written practice establishes the minimum requirements for education, training, experience, examination and certification of personnel responsible for conducting nondestructive tests while in the employment of QUALITY CONTROL srl (QCsrl)

2.0 ELENCO DELLE ABBREVIAZIONI

QCsrl Quality Control srl
MT Controllo con Particelle Magnetiche
NDT Controlli non distruttivi
PA Phased Array
PT Controllo con Liquidi Penetranti
RAQ Responsabile Qualità QCsrl
RT Controllo radiografico
TOFD Time of Flight Diffraction
UT Controllo ultrasuoni
VT Controllo visivo

2.0 LIST OF ABBREVIATION

QCsrl Quality Control srl
MT Magnetic particle testing
NDT Non-destructive testing
PA Phased Array
PT Liquid Penetrant testing
RAQ QCsrl Quality Manager
RT Radiographic testing
TOFD Time of Flight Diffraction
UT Ultrasonic testing
VT Visual testing

3.0 DOCUMENTI DI RIFERIMENTO

ASNT “Recommended Practice” SNT-TC-1A ed. dal 1992 al 2006
ASME BPVC sezione III – NB-5500

3.0 REFERENCE DOCUMENTS

ASNT Recommended Practice SNT-TC-1A from 1992 to 2006 ed.
ASME BPVC section III – NB-5500

4.0 METODI NDT E TECNICHE

La qualifica e la certificazione del personale NDT in accordo a questo documento è applicabile per ognuno dei seguenti metodi:
PT, MT, RT, UT, VT e per tecniche particolari quali
UT TOFD (Time of Flight Diffraction), UT PA (Phased Array), UT misure di spessore con strumento digitale, e RT Interpretazione Film.

4.0 NDT METHODS AND TECHNIQUES

Qualification and certification of NDT personnel in accordance with this document is applicable to each of the following methods:
PT, MT, RT, UT, VT and for specific techniques as UT TOFD (Time of Flight Diffraction), UT PA (Phased Array), UT Digital thickness measurement, and RT Film Interpretation.

5.0 LIVELLI DI QUALIFICA

Si definiscono tre livelli base di qualifica.
Durante il periodo iniziale di addestramento, qualifica e certificazione un individuo sarà considerato “in addestramento”. Un individuo “in addestramento” lavora con un individuo certificato. L’individuo “in addestramento” non esegue, interpreta, valuta o registra per proprio conto i risultati di qualsiasi controllo.
I tre livelli base di qualifica e le limitazioni sono le seguenti:

(1) NDT - LIVELLO I. Un individuo di livello I NDT sarà qualificato per eseguire in modo corretto specifiche calibrazioni, specifici NDT, e specifiche valutazioni di accettazione o scarto in accordo a istruzioni scritte e per registrare i
risultati. Il livello I NDT riceverà le istruzioni necessarie o la supervisione dal personale QCsrl di livello III NDT o di livello II NDT incaricato.

(2) NDT - LIVELLO II. Un individuo di Livello II NDT sarà qualificato per settare e calibrare l’attrezzatura e per interpretare e valutare I risultati rispetto ai documenti applicabili quali Codici, standard e specifiche. Il Livello II NDT avrà adeguata familiarità con lo scopo e le limitazioni dei metodi per i quali è qualificato ed exercerà le responsabilità assegnategli per l'addestramento e la guida in campo degli apprendisti e per il personale di livello I. Il Livello II NDT sarà capace di organizzare e rapportare i risultati dei controlli non distruttivi. Ogni limitazione alla qualifica sarà indicata nel certificato di qualifica individuale.

(2) NDT - LEVEL II. An NDT Level II individual shall be qualified to set up and calibrate equipment and to interpret and evaluate results with respect to applicable Codes, standard and specifications. The NDT Level II shall be thoroughly familiar with the scope and limitations of the methods for which qualified and shall exercise assigned responsibility for on-the-job training and guidance of trainees and NDT Level I personnel. The NDT Level II shall be able to organize and report the results of non destructive tests. Any qualification limitation shall be indicated in the individual certification.

(3) NDE - LIVELLO III. Un individuo di Livello III NDT sarà capace di sviluppare, qualificare, e approvare procedure; stabilire e approvare le tecniche, interpretare i codici, gli standard, le specifiche, e le procedure; e designare particolari metodi e tecniche NDT e procedure da utilizzare. Il Livello III NDT sarà responsabile per le operazioni NDT per le quali è qualificato e incaricato, e sarà capace di interpretare e valutare i risultati in termini di codici, standards e specifiche esistenti. Il Livello III NDT avrà una sufficiente conoscenza pratica dei materiali, di fabbricazione, e della tecnologia produttiva per stabilire le tecniche e per concorrere a stabilire criteri di accettabilità dove non ve ne siano di esistenti. Il Livello III NDT avrà familiarità con gli altri metodi NDT appropriati, come dimostrato dall’esame Base Livello III. Il Livello III NDT, sarà capace di addestrare ed esaminare gli individui di Livello I e II NDT nei metodi per i quali è certificato.

(3) NDE - LEVEL III. An NDT Level III individual shall be capable of developing, qualifying, and approving procedures; establishing and approving techniques, interpreting codes, standard, specifications, and procedures; and designating the particular NDT methods, techniques and procedures to be used. The NDT Level III shall be responsible for the NDT operations for which qualified and assigned, and shall be capable of interpreting and evaluating results in terms of existing codes, standards and specifications. The NDT Level III shall have sufficient practical background in applicable materials, fabrication, and product technology to establish techniques and to assist in establishing acceptance criteria when none are otherwise available. The NDT Level III shall have familiarity with other appropriate NDT methods, as demonstrated by the Level III Basic examination. The NDT Level III, in the methods in which certified, shall be capable of training and examining NDT Level I and Level II for certification in those method.

6.0 REQUISITI DI SCOLARITA’, ADDESTRAMENTO ED ESPERIENZA PER LA PRIMA QUALIFICA

Il personale candidato alla certificazione negli NDT avrà sufficiente scolarità, addestramento ed esperienza per garantire la qualifica nei metodi NDT in cui è candidato alla certificazione. La documentazione di precedenti certificazioni sarà utilizzata da QCsrl come evidenza della qualifica a livelli equivalenti di qualifica.

6.0 EDUCATION, TRAINING AND EXPERIENCE REQUIREMENTS FOR INITIAL QUALIFICATION

Personnel considered for certification in NDT shall have sufficient education, training and experience to ensure qualification in those NDT methods in which they are being considered for certification. Documentation of prior certification shall be used by QCsrl as evidence of qualification for comparable levels of qualification.
La certificazione precedente sarà valida per dimostrare i requisiti di scolarità, addestramento ed esperienza per la prima qualifica da parte di QC{s}rl.
Per candidarsi alla certificazione, il candidato soddisferà uno dei seguenti criteri per il livello NDT applicabile:

(1) Livelli I e II NDT
La tabella 1 elenca i requisiti di addestramento ed esperienza da considerare da parte di QC{s}rl per la qualifica iniziale al Livello I e Livello II individuali.

(2) Livello III NDT
(a) Avrà una scolarità di minimo quattro anni di università con laurea ingegneristica o scientifica, più un anno aggiuntivo di esperienza secondo i requisiti del livello II NDT in incarichi comparabili a quelli di un livello II NDT nel metodo applicabile o:
(b) Avrà ottenuto un diploma di istituto superiore a indirizzo tecnico o scientifico, più due anni aggiuntivi di esperienza secondo i requisiti del livello II NDT in incarichi comparabili a quelli di un livello II NDT nel metodo applicabile o:
(c) Avrà quattro anni di esperienza secondo i requisiti del livello II NDT in incarichi comparabili a quelli di un livello II NDT nel metodo applicabile.

Prior certification shall be valid to demonstrate education, training and experience requirements for initial qualification by QC{s}rl.
To be considered for certification, a candidate shall satisfy one of the following criteria for the applicable NDT Level:

(1) NDT Levels I and II
Table 1 lists the recommended training and experience factors to be considered by QC{s}rl for initial qualification of Level I and Level II individuals.

(2) NDT Level III
(a) Have graduated from a minimum four year college or university curriculum with a degree in engineering or science, plus one additional year of experience beyond the level II requirements in NDT in an assignment comparable to that of an NDT Level II in the applicable method(s) or:
(b) Have a completed with passing grades at least two years of engineering or science study at a university, college, or technical school, plus two additional years experience beyond the level two requirements in NDT in an assignment at least comparable to that of NDT Level II in the applicable NDT method(s) or:
(c) Have four years experience beyond the level II requirements in NDT in an assignment at least comparable to that of an NDT Level II in the applicable NDT method(s).
7.0 PROGRAMMA DI ADDESTRAMENTO

Il personale candidate per la qualifica iniziale avrà completato un sufficiente addestramento programmato, sia teorico sia pratico per ottenere familiarità con I principi e le tecniche del metodo NDT specificato relative al livello di certificazione desiderato e applicabile al processo da utilizzare e al prodotto da controllare.

Il programma di addestramento include esami sufficienti ad assicurare la comprensione della materia. Il programma di addestramento segue le “Topical Outlines for qualification of non-destructive testing personnel” per ciascun test metodo come qui riportato.

<table>
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<tr>
<th>Metodo d’esame</th>
<th>Tecnica</th>
<th>Livello</th>
<th>Addestramento iniziale / Initial Training (Hours)</th>
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<td>A</td>
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<td>Scuola media</td>
<td>Scuola superiore or equivalent</td>
<td>Completion with a passing grade of at least 2 years of engineering or science study at a university, college or technical school</td>
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**TABELLA 1 / TABLE 1**

**Notes:**
- °° = Work Time experience per Level
- °°° for each TOFD and PA technique the training hours and experience period are to be added to the training hours needed for Manual Pulse Echo Technique. The candidate for the certification shall held a valid UT Manual Pulse Echo Technique level II at the moment of the initial training for TOFD and PA Techniques.
- For level III certification, the experience shall consist of time at level I or equivalent. If a person is being qualified directly to Level II with no time at level I, the required experience shall consist of the sum of the times required for level I and level II and the required training shall consist of the sum of the hours required for level I and level II.
- For level III certification, the required experience shall consist of the sum of the times required for level I and level II, and the additional requirements listed in 6.0(2). The required formal training shall consist of the level I and level II training, plus a self-training on the applicable codes used by the company.
- The Italian school education level will be considered as follow:
  - A = 8 Years (Duty school)
  - B = 13 Years (Diploma engineering, Technical High School)
  - C = from 16 Years (University short degree or complete University degree)

7.0 TRAINING PROGRAMS

Personale being considered for initial certification shall complete sufficient organized training, both theoretical and practical to become familiar with principles and practices of the specified NDT method related to the level of certification desired and applicable to the process to be used and the product to be tested. The training program shall include sufficient examinations to ensure understanding of the matter. The training program shall follow the “Topical Outlines for qualification of non-destructive testing personnel” for each test method as shown in
8.0 ESAME

8.1 Gestione e valutazione

Un Livello III NDT ASNT-ACCP, o il Livello II NDT QCsrl è responsabile della gestione e della valutazione degli esami specificati ai paragrafi da 8.3 a 8.8 per il Livelli I e II NDT, o gli altri Livelli III. La gestione e la valutazione dell’esame può essere delegata a un rappresentante qualificato del Livello III NDT e registrata. Un rappresentante qualificato del datore di lavoro può eseguire la gestione e la valutazione dell’esame al Livello III specificata in 8.7.

Per il personale di Livello I e II, il valore composto sarà determinato dalla semplice media dei singoli risultati degli esami generale, specifico e pratico descritti di seguito. Per il personale di Livello III, il valore composto sarà determinato dalla semplice media dei singoli risultati degli esami di base, metodo e specifico descritti di seguito.

L’esame gestito per la qualifica dovrà risultare a un valore composto di almeno 80%, senza che in alcun singolo esame il valore sia inferiore a 70%.

Quando l’esame gestito e valutato per QCsrl da una agenzia esterna e l’agenzia emette solo il risultato di “promosso” o “non promosso”, su un rapporto di certificazione, QCsrl accetta solo un valore minimo di 80 % per quel particolare esame.

E’ responsabilità di RAQ di assicurare che I servizi di esame acquistati all’esterno soddisfino i requisiti di questa Written Practice.

8.2 Capacità visiva

Capacità visiva da vicino. L’esame deve verificare la capacità di vedere con almeno un occhio, al naturale o con strumenti correttivi, almeno il carattere Jaeger numero 1 o equivalente tipo e dimensioni di lettere ad una distanza non inferiore a 30,5 cm, su una carta Jaeger standard. L’abilità di leggere un carattere Ortho-Rater 10 o Times Roman 4,5 o simile è ritenuta accettabile. Questo esame sarà amministrato annualmente, e può essere eseguito dal RAQ o dal livello III o da un Medico.

Differenziazione del contrasto dei colori. L’esame deve dimostrare la capacità di distinguere e differenziare il contrasto fra i colori utilizzati nel metodo e, per le

8.0 EXAMINATION

8.1 Administration and grading

An NDT ASNT-ACCP, or the QCsrl NDT Level III shall be responsible for the administration and grading of examination specified in paragraphs 8.3 through 8.8 for NDT Level I, II or other level III personnel. The administration and grading of examination may be delegated to a qualified representative of the NDT Level III and so recorded. A qualified representative of the employer may perform the actual administration and grading of level III examination specified in 8.7.

For Level I and II personnel, a composite grade shall be determined by simple averaging of the results of the general, specific and practical examination described below. For Level III personnel, the composite grade shall be determined by simple averaging of the results of the basic, method and specific examination described below.

Examination administered for qualification shall result in a passing composite grade of at least 80%, with no individual examination having a passing grade less than 70%.

When an examination is administered and graded for QCsrl by an outside agency and the outside agency issues grades of pass or fail only, on a certified report, than QCsrl shall accept the pass grade as 80 percent for that particular examination.

RAQ is responsible for ensuring that the outside examination services purchased meet the requirements of this Written Practice.

8.2 Vision Examination

Near-Vision Acuity. The examination shall ensure natural or corrected near-distance acuity in at least one eye such that the applicant is capable of reading a minimum of Jaeger number 1 or equivalent type and size letter at a distance of not less than 12 inches (30,5 cm) on a standard Jaeger test chart. The ability to perceive an Ortho-Rater minimum of 10 or Times Roman 4,5 or similar test pattern is also acceptable. This examination shall be administered annually, and it can be assessed by QC Mgr or by the level III or by a Medical staff person.

Colour Contrast Differentiation. The examination shall demonstrate the capability of distinguishing and differentiating contrast among colours used in the

ANSI/ASNT CP-105, 2006 edition and included in attachments B to J of this document.

When training is purchased from outside of QCsrl, the RAQ is responsible for ensuring that such services meet the requirements of this document.
qualifiche RT, differenziare le gradazioni di grigio. Questo esame sarà condotto prima della certificazione iniziale e successivamente con un intervallo di tre anni, con le tavole di Ishihara, o con il test in allegato A. Il test sarà eseguito dal RAQ o dal livello III o da un Medico.

8.3 Generale (Scritto – per Livelli I e II NDT)

L’esame generale è indirizzato sui principi di base del metodo applicabile. La tabella 2 indica il numero minimo di domande richieste per l’esame Generale di Livello I e II.

8.4 Specifico (Scritto – per Livelli I e II NDT)

L’esame specifico sarà indirizzato alle attrezzature, procedure operative e tecniche NDT del metodo applicabile. L’esame specifico include anche le specifiche o i codici e i criteri di accettabilità utilizzati nelle procedure NDT QCsrl. La tabella 2 indica il numero minimo di domande richieste per l’esame Specifico di Livello I e II.

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<th>RT</th>
<th>Film interpreter</th>
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<th>Lev. II</th>
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<th>Digital thickness</th>
<th>Lev. I</th>
<th>Lev. II</th>
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<th>Lev. I</th>
<th>Lev. II</th>
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TABELLA 2 - TABLE 2

Note:
* Il candidato alla certificazione deve possedere un certificato di qualifica per Tecnica UT Manuale Pulse Echo in corso di validità prima dell’inizio del training per le tecniche TOFD e PA.

Notes:
* = The candidate for the certification shall hold a valid UT Manual Pulse Echo Technique level II at the moment of the initial training for TOFD and PA Techniques.

8.5 Pratico (per Livelli I e II NDT)

Il candidato deve dimostrare familiarità e l’abilità operative con le apparecchiature NDT necessarie, registrare e analizzare le informazioni risultanti al grado richiesto.

Sarà eseguito il controllo su almeno un campione componente difettoso e il risultato sarà analizzato dal candidato.

La descrizione del campione, la procedura NDT, inclusi I punti di verifica, e i risultati dell’esame saranno documentati.
Esame pratico Livello I NDT. La capacità è dimostrata eseguendo il controllo NDT applicabile su un campione approvato dal Livello III NDT e valutando i risultati al grado di responsabilità descritto in questo documento. Saranno inclusi nell’esame pratico almeno dieci (10) punti di verifica differenti che richiedano la comprensione delle variabili del controllo e i requisiti procedurali della QCsrI.

NDT Level I Practical examination. Proficiency shall be demonstrated in performing the applicable NDT on one sample approved by the NDT Level III and in evaluating the result to the degree of responsibility as described in this document. At least ten (10) different checkpoints requiring an understanding of test variables and the QCsrI procedural requirements shall be included in this practical examination.

Esame pratico Livello II NDT. La capacità è dimostrata scegliendo ed eseguendo la tecnica NDT all’interno del metodo e interpretando e valutando i risultati su un campione approvato dal Livello III NDT. Saranno inclusi nell’esame pratico almeno dieci (10) punti di verifica differenti che richiedano la comprensione delle variabili del controllo e i requisiti procedurali della QCsrI.

NDT Level II Practical examination. Proficiency shall be demonstrated in selecting and performing the applicable NDT technique within the method and interpreting and evaluating the results on one sample approved by the NDT Level III. At least ten (10) different checkpoints requiring an understanding of NDT variables and the QCsrI procedural requirements shall be included in this practical examination.

Esame pratico Livello II RT interpretazione films. La capacità è dimostrata nella lettura di films e nella valutazione dei risultati di almeno dieci films campione approvati dal Livello III NDT. Saranno inclusi nell’esame pratico almeno dieci (10) punti di verifica differenti che richiedano la comprensione delle variabili del controllo RT e i requisiti procedurali della QCsrI.

RT level II films interpretation, Practical examination. Proficiency shall be demonstrated in film reading and results evaluation on at least ten sample films approved by the NDT level III. At least ten (10) different checkpoints requiring an understanding of RT variables and the QCsrI procedural requirements shall be included in this practical examination.

Esame pratico misura di spessore con strumenti digitali. La capacità è dimostrata misurando e valutando i risultati di almeno due campioni di materiale differente approvati dal livello III NDT. Saranno inclusi nell’esame pratico almeno dieci (10) punti di verifica differenti che richiedano la comprensione delle variabili del controllo UT e i requisiti procedurali della QCsrI.

UT level II digital thickness measurement, Practical examination. Proficiency shall be demonstrated in measuring at least two specimens of different materials approved by the NDT level III and results evaluation. At least ten (10) different check points requiring an understanding of UT variables and the QCsrI procedural requirements shall be included in this practical examination.

8.6 Criteri aggiuntivi per gli esami scritti

Tutti gli esami scritti per Livelli I, II e III saranno a libro-chiuso eccetto i dati necessari quali grafici, tabelle, specifiche, procedure, codici, eccetera, che possono essere forniti per l’esame. Le domande che utilizzano tale materiale di riferimento richiedono la comprensione dell’informazione invece della mera localizzazione della risposta appropriata.

Tutte le domande utilizzate per l’esame di Livello I e Livello II sono approvate dal responsabile di Livello III o dal Livello III esterno incaricato per l’esame.

Tutte le domande utilizzate per l’esame di Livello III saranno prestate da un livello III esterno incaricato per l’esame.

8.6 Additional written, examination criteria

All Level I, II and III written examination shall be closed-book except that necessary data such graphs, tables, specifications, procedures, codes, etc., may be provided with or in the examination. Questions utilizing such reference material shall require an understanding of the information rather than merely locating the appropriate answer.

All questions used for Level I and Level II examinations shall be approved by the responsible Level III or by the outside Level III appointed for examination.

All questions used for Level III examination shall be prepared by the outside Level III appointed for examination.
8.7 Esami di Livello III NDT

Il numero minimo di domande richieste per l’esame di livello III sono specificate di seguito:

Esame di Base (solo uno è richiesto quando sono eseguiti più esami di metodo). Il numero minimo di domande da eseguire è il seguente:
(a) Quindici (15) domande relative alla comprensione del documento SNT-TC-1A.
(b) Venti (20) domande relative ai materiali applicabili, alla fabbricazione e alle tecnologie di prodotto.
(c) Venti (20) domande simili a quelle pubblicate per i Livelli II di altri appropriati metodi NDT.

Esame di metodo (per ogni metodo).
(a) Trenta (30) domande relative ai fondamentali e ai principi che sono simili a quelle pubblicate da ASNT per Livelli III in ogni metodo.
(b) Quindici (15) domande all’applicazione e alla definizione di tecniche e principi procedurali che sono simili a quelle pubblicate da ASNT per Livelli III in ogni metodo.
(c) Venti (20) domande relative alla capacità di interpretare codici, standards e specifiche relative al metodo.

Esame specifico (per ogni metodo).
(a) Venti (20) domande relative a specifiche, apparecchiature, tecniche e procedure applicabili al prodotto e ai metodi impiegati da QCslr e alla gestione della Written Practice QCslr.
(b) QCslr può evitare l’esame specifico se il candidato possiede un certificato ASNT-ACCP NDT Level III valido nel metodo e se esiste una evidenza di esperienza documentata, incluso la preparazione di procedure NDT in accordo a codici, standards, o specifiche e la valutazione dei risultati dei controlli.

Una approvazione valida di un certificato ASNT-ACCP NDT Livello III soddisfà i criteri di esame di Base e di Metodo descritti precedentemente per ogni metodo applicabile.

8.8 Riesame

Il personale che non raggiunge il grado di valutazione richiesto attenderà almeno trenta (30) giorni o riceverà l’addestramento aggiuntivo definito dal Livello III prima del riesame.

9.0 CERTIFICAZIONE

La certificazione di tutti i livelli NDT della QCslr è responsabilità del Direttore Generale della QCslr.

8.7 NDT Levels III Examinations

The minimum number of questions required for Level III examination shall be as follows:

Basic examination (required only once when more than one method examination is taken). The minimum number of questions which shall be given is as follows:
(a) Fifteen (15) questions relating to understanding the SNT-TC-1A document.
(b) Twenty (20) questions relating to applicable materials, fabrication and product technology.
(c) Twenty (20) questions that are similar to published Level II questions for other appropriate NDT methods.

Method examination (for each method).
(a) Thirty (30) questions relating to fundamentals and principles that are similar to published ASNT Level III questions for each method.
(b) Fifteen (15) questions relating to application and establishment of techniques and procedures principles that are similar to published ASNT Level III questions for each method.
(c) Twenty (20) questions relating to capability for interpreting codes, standards and specifications relating to the method.

Specific examination (for each method).
(a) Twenty (20) questions relating to specifications, equipment, techniques and procedures applicable to the QCslr product and methods employed and to the administration of the QCslr Written Practice.
(b) QCslr may delete the specific examination if the candidate has a valid ASNT-ACCP NDT Level III certificate in the method and if documented evidence of experience exists, including the preparation of NDT procedures to codes, standards, or specifications and the evaluation of tests results.

A valid endorsement on an ASNT-ACCP NDT Level III certificate fulfills the examination criteria of basic and method examination above described for each applicable method.

8.8 Re-examinations

Personnel failing to attain the required grades shall wait at least thirty (30) days or receive additional training as determined by the Level III before re-examination.

9.0 CERTIFICATION

Certification of all levels of QCslr NDT personnel is the responsibility of QCslr General Manager.
La certificazione del personale NDT è basata sulla dimostrazione della qualifica in accordo ai paragrafi 6, 7 e 8 di questo documento.

Un’agenzia esterna può essere incaricata di fornire il servizio di livello NDT. In tale circostanza, la responsabilità della certificazione del personale QCsrl sarà mantenuta dal Direttore Generale della QCsrl. I documenti di certificazione del personale sono mantenuti in archivio per un periodo di tre anni dopo il termine, e includeranno i seguenti dati:
- Nome dell’individuo certificato;
- Livello e metodo NDT certificato;
- Scolarità ed esperienza dell’individuo certificato;
- Dichiarazione indicante il completamento soddisfacente dell’addestramento in accordo a questo documento;
- Risultati dell’esame di capacità visiva per il corrente periodo di certificazione.
- Copia dell’esame corrente o evidenza del soddisfacente completamento degli esami.
- Altre evidenze appropriate di qualità soddisfacenti quando tali qualifiche sono utilizzate in alternative agli esami richiesti al paragrafo 8 di questo documento (es. certificati ASNT o ACCP)
- Grado composto o idonea evidenza delle valutazioni.
- Firma del livello III che ha verificato la qualifica del candidato alla certificazione
- Data della certificazione e/o ricertificazione e la data di assegnazione agli NDT.
- Data di scadenza del certificato
- Firma del Direttore Generale QCsrl.

Il personale qualificato per esame e certificate secondo precedenti revisioni della Written Practice che fanno riferimento a differenti edizioni della SNT-TC-1A, sono considerati qualificati in accordo all’ultima revisione quando la ricertificazione è basata sulla continuità operativa. Tutti i riesami e i nuovi esami saranno in accordo all’ultima revisione della Written Practice.

Personnel qualified by examination and certified to the previous Written Practice which used different editions of SNT-TC-1A, are considered to be qualified to the latest revision when re-certification is based on continuing satisfactory performance. All re-examination and new examinations shall be in accordance with the latest revision of the Written Practice.

Certification of NDT personnel shall be based on demonstration of satisfactory qualification in accordance with paragraphs 6, 7 and 8 of this document.

An outside agency may be engaged to provide NDT Level III services. In such instances, the responsibility of the certification of the QCsrl employees shall be retained by QCsrl General Manager.

Personnel certification records shall be maintained on file for a period of three years after termination, and shall include the following data:
- Name of certified individual;
- Level of certification and NDT method;
- Educational background and experience of certified individuals;
- Statement indicating satisfactory completion of training in accordance with this document;
- Results of the vision examination for the current certification period.
- Current examination copy(ies) or evidence of successful completion of examinations.
- Other suitable evidence of satisfactory qualifications when such qualifications are used in lieu of examinations prescribed in paragraph 8 of this document (eg. ASNT or ACCP certificates)
- Composite grade(s) or suitable evidence of grades.
- Signature of the level III that verified the qualification of the candidate for certification
- Date of certification and/or recertification and the date of assignments to NDT.
- Certificates expiration date
- Signature of QCsrl General Manager.

10.0 VALUTAZIONE TECNICA PRATICA

Il personale NDT può essere riesaminato in ogni momento a discrezione del proprio responsabile o del Livello III e avere la propria certificazione estesa o revocata.

La pratica esecutiva dei Livelli I e II sarà valutata dal Livello III QCsrl applicando il controllo NDT su un prodotto QCsrl con discontinuità o su un campione con discontinuità e documentando come descritto nel paragrafo 8.5 di questo documento. La valutazione tecnica pratica sarà effettuata in almeno un metodo ogni anno.

10.0 TECHNICAL PERFORMANCE EVALUATION

NDT Personnel may be re-examined any time at the discretion of their responsible or Level III and have their certificates extended or revoked.

The technical performance of Level I and Level II personnel will be evaluated by the QCsrl Level III on the NDT performed on QCsrl flawed products or flawed specimen and documented as described in section 8.5 of this document.

The technical performance evaluation shall be performed at least for one method each year.
11.0 SOSPENSIONE DELL’ATTIVITÀ

In caso di sospensione dell’attività per un periodo maggiore di sei mesi la certificazione si considera scaduta e il personale NDT riceverà un addestramento aggiuntivo per quanto ritenuto appropriato dal Livello III, esaminato come descritto al paragrafo 8.4 e 8.5 e ricertificato.

12.0 RICERTIFICAZIONE

Tutti i livelli del personale NDT saranno ricertificati periodicamente secondo uno dei seguenti criteri:

(a) Evidenza della continuità tecnica pratica soddisfacente;
(b) Riesame nelle parti di esame ritenute necessarie dal Livello III QCsr1.

Gli intervalli di certificazione sono:
(a) Livello I e II - 3 anni
(b) Livello III - 5 anni

13.0 TERMINE

La certificazione è ritenuta revocata quando termina l’impiego presso QCsr1. I Livelli I, II o III i cui certificate sono terminati saranno certificate al precedente livello NDT da QCsr1 sulla base di esami, come descritto al paragrafo 8, a condizione che tutti i seguenti criteri sono soddisfatti:
- il dipendente ha prova della precedente certificazione
- il dipendente è ricertificato entro sei mesi dal termine,
- prima dell’esame di certificazione, il dipendente che non soddisfa i requisiti precedenti riceverà un addestramento aggiuntivo secondo quanto ritenuto appropriato dal Livello III.

14.0 RIPRISTINO

Un Livello I, II o III la cui certificazione è terminata può essere ripristinata al precedente livello NDT, senza nuovi esami, a condizione che siano soddisfatti tutti i seguenti requisiti:
- QCsr1 ha mantenuto la documentazione della precedente certificazione come da paragrafo 9 di questo documento
- la certificazione dell’individuo non è scaduta
- l’individuo è ripristinato entro sei mesi dal termine

11.0 INTERRUPTED SERVICE

In case of interrupted service for a period longer than six months certification is considered expired and NDT personnel shall receive additional training as deemed appropriate by the Level III, examined as described at paragraph 8.4 and 8.5 and re-certified.

12.0 RECERTIFICATION

All levels of NDT personnel shall be recertified periodically in accordance with one of the following criteria:
(a) Evidence of continuing satisfactory technical performance;
(b) Re-examination in those portion of the examinations deemed necessary by the QCsr1 Level III.

The recertification intervals are:
(a) Levels I and II - 3 years
(b) Level III - 5 years

13.0 TERMINATION

The certification shall be deemed revoked when the employment by QCsr1 is terminated. Level I, II or III whose certification has been terminated will be certified to the former NDT level by QCsr1 based on examination, as described in paragraph 8, provided all of the following condition are met:
- the employer has proof of prior certification
- the employee is being re-certified within six months of termination,
- prior to being examined for certification, employees not meeting the above requirements shall receive additional training as deemed appropriate by the Level III.

14.0 REINSTATEMENT

A Level I, II or III whose certification has been terminated may be reinstated to the former NDT level, without a new examination, provided all of the following conditions are met:
- QCsr1 has maintained the personnel certification records as per paragraph 9 of this document
- the employee’s certification did not expire during termination
- the employee is being reinstated within six months of termination
ALLEGATO A - ATTACHMENT A

Test dei colori e delle tonalità di grigio - Colours and shades of grey test
Magnetic Particle Testing Level I Topical Outline

1.0 Principles of Magnets and Magnetic Fields
   1.1 Theory of magnetic fields
      1.1.1 Earth’s magnetic field
      1.1.2 Magnetic fields around magnetized materials
   1.2 Theory of magnetism
      1.2.1 Magnetic poles
      1.2.2 Law of magnetism
      1.2.3 Materials influenced by magnetic fields
         a. Ferromagnetic
         b. Paramagnetic
      1.2.4 Magnetic characteristics of nonferrous materials
   1.3 Terminology associated with magnetic particle testing

2.0 Characteristics of Magnetic Fields
   2.1 Bar magnet
   2.2 Ring magnet

3.0 Effect of Discontinuities of Materials
   3.1 Surface cracks
   3.2 Scratches
   3.3 Subsurface defects

4.0 Magnetization by Means of Electric Current
   4.1 Circular field
      4.1.1 Field around a straight conductor
      4.1.2 Right-hand rule
      4.1.3 Field in parts through which current flows
         a. Long, solid, cylindrical, regular parts
         b. Irregularly-shaped parts
         c. Tubular parts
         d. Parts containing machined holes, slots, etc.
      4.1.4 Methods of inducing current flow in parts
         a. Contact plates
         b. Prods
      4.1.5 Discontinuities commonly discovered by circular fields
   4.2 Longitudinal field
      4.2.1 Field produced by current flow in a coil
      4.2.2 Field direction in a current-carrying coil
      4.2.3 Field strength in a current-carrying coil
      4.2.4 Discontinuities commonly discovered by longitudinal fields
      4.2.5 Advantages of longitudinal magnetization
      4.2.6 Disadvantages of longitudinal magnetization

5.0 Selecting the Proper Method of Magnetization
   5.1 Alloy, shape, and condition of part
   5.2 Type of magnetizing current
   5.3 Direction of magnetic field
   5.4 Sequence of operations
   5.5 Value of flux density

6.0 Inspection Materials
   6.1 Wet particles
   6.2 Dry particles

7.0 Principles of Demagnetization
   7.1 Residual magnetism
   7.2 Reasons for requiring demagnetization
   7.3 Longitudinal and circular residual fields
   7.4 Basic principles of demagnetization
   7.5 Retentivity and coercive force
   7.6 Methods of demagnetization
8.0 Magnetic Particle Testing Equipment
   8.1 Equipment-selection considerations
      8.1.1 Type of magnetizing current
      8.1.2 Location and nature of test
      8.1.3 Test materials used
      8.1.4 Purpose of test
      8.1.5 Area inspected
   8.2 Manual inspection equipment
   8.3 Medium- and heavy-duty equipment
   8.4 Stationary equipment
   8.5 Mechanized inspection equipment
      8.5.1 Semiautomatic inspection equipment
      8.5.2 Single-purpose semiautomatic equipment
      8.5.3 Multipurpose semiautomatic equipment
      8.5.4 Fully automatic equipment

9.0 Types of Discontinuities Detected by Magnetic Particle Testing
   9.1 Inclusions
   9.2 Blowholes
   9.3 Porosity
   9.4 Flakes
   9.5 Cracks
   9.6 Pipes
   9.7 Laminations
   9.8 Laps
   9.9 Forging bursts
   9.10 Voids

10.0 Magnetic Particle Test Indications and Interpretations
   10.1 Indications of nonmetallic inclusions
   10.2 Indications of surface seams
   10.3 Indications of cracks
   10.4 Indications of laminations
   10.5 Indications of laps
   10.6 Indications of bursts and flakes
   10.7 Indications of porosity
   10.8 Nonrelevant indications

Magnetic Particle Testing Level II Topical Outline

1.0 Principles
   1.1 Theory
      1.1.1 Flux patterns
      1.1.2 Frequency and voltage factors
      1.1.3 Current calculations
      1.1.4 Surface flux strength
      1.1.5 Subsurface effects
   1.2 Magnets and magnetism
      1.2.1 Distance factors vs. strength of flux
      1.2.2 Internal and external flux patterns
      1.2.3 Phenomenon action at the discontinuity
      1.2.4 Heat effects on magnetism
      1.2.5 Material hardness vs. magnetic retention

2.0 Flux Fields
   2.1 Direct current
      2.1.1 Depth of penetration factors
      2.1.2 Source of current
   2.2 Direct pulsating current
      2.2.1 Similarity to direct current
      2.2.2 Advantages
      2.2.3 Typical fields
   2.4 Alternating current
      2.4.1 Cyclic effects
      2.4.2 Surface strength characteristics
      2.4.3 Safety precautions
      2.4.4 Voltage and current factors
      2.4.5 Source of current
3.0 Effects of Discontinuities on Materials
   3.1 Design factors
      3.1.1 Mechanical properties
      3.1.2 Part use
   3.2 Relationship to load-carrying ability

4.0 Magnetization by Means of Electric Current
   4.1 Circular techniques
      4.1.1 Current calculations
      4.1.2 Depth-factor considerations
      4.1.3 Precautions B safety and overheating
      4.1.4 Contact prods and yokes
         a. Requirements for prods and yokes
         b. Current-carrying capabilities
      4.1.5 Discontinuities commonly detected
   4.2 Longitudinal technique
      4.2.1 Principles of induced flux fields
      4.2.2 Geometry of part to be inspected
      4.2.3 Shapes and sizes of coils
      4.2.4 Use of coils and cables
         a. Strength of field
         b. Current directional flow vs. flux field
         c. Shapes, sizes, and current capacities
      4.2.5 Current calculations
         a. Formulas
         b. Types of current required
         c. Current demand
      4.2.6 Discontinuities commonly detected

5.0 Selecting the Proper Method of Magnetization
   5.1 Alloy, shape, and condition of part
   5.2 Type of magnetizing current
   5.3 Direction of magnetic field
   5.4 Sequence of operations
   5.5 Value of flux density

6.0 Demagnetization Procedures
   6.1 Need for demagnetization of parts
   6.2 Current, frequency, and field orientation
   6.3 Heat factors and precautions
   6.4 Need for collapsing flux fields

7.0 Equipment
   7.1 Portable type
      7.1.1 Reason for portable equipment
      7.1.2 Capabilities of portable equipment
      7.1.3 Similarity to stationary equipment
   7.2 Stationary type
      7.2.1 Capability of handling large and heavy parts
      7.2.2 Flexibility in use
      7.2.3 Need for stationary equipment
      7.2.4 Use of accessories and attachments
   7.3 Automatic type
      7.3.1 Requirements for automation
      7.3.2 Sequential operations
      7.3.3 Control and operation factors
      7.3.4 Alarm and rejection mechanisms
   7.4 Multidirectional units
      7.4.1 Capability
      7.4.2 Control and operation factors
      7.4.3 Applications
   7.5 Liquids and powders
      7.5.1 Liquid requirements as a particle vehicle
      7.5.2 Safety precautions
      7.5.3 Temperature needs
      7.5.4 Powder and paste contents
      7.5.5 Mixing procedures
      7.5.6 Need for accurate proportions
7.6 Ultraviolet radiation type
  7.6.1 Ultraviolet radiation and fluorescence
  7.6.2 Visible light and black light comparisons
  7.6.3 Requirements in the testing cycle
  7.6.4 Techniques in use

7.7 Light-sensitive instruments
  7.7.1 Need for instrumentation
  7.7.2 Light characteristics

8.0 Types of Discontinuities
  8.1 In castings
  8.2 In ingots
  8.3 In wrought sections and parts
  8.4 In welds

9.0 Evaluation Techniques
  9.1 Use of standards – e.g. ASTM E1444, E709
    9.1.1 Need for standards and references
    9.1.2 Comparison of known with unknown
    9.1.3 Specifications and certifications
    9.1.4 Comparison techniques
  9.2 Defect appraisal
    9.2.1 History of part
    9.2.2 Manufacturing process
    9.2.3 Possible causes of defect
    9.2.4 Use of part
    9.2.5 Acceptance and rejection criteria
    9.2.6 Use of tolerances

10.0 Quality Control of Equipment and Processes
  10.1 Malfunctioning of equipment
  10.2 Proper magnetic particles and bath liquid
  10.3 Bath concentration
    10.3.1 Settling test
    10.3.2 Other bath-strength tests
  10.4 Tests for Ultraviolet radiation intensity
1.0 Introduction
1.1 Brief history of nondestructive testing and liquid penetrant testing
1.2 Purpose of liquid penetrant testing
1.3 Basic principles of liquid penetrant testing
1.4 Types of liquid penetrants commercially available
1.5 Method of personnel qualification

2.0 Liquid Penetrant Processing
2.1 Preparation of parts
2.2 Adequate lighting
2.3 Application of penetrant to parts
2.4 Removal of surface penetrant
2.5 Developer application and drying
2.6 Inspection and evaluation
2.7 Postcleaning

3.0 Various Penetrant Testing Methods
3.1 Current ASTM and ASME standard methods - ASTM E165, E1208, 1209, 1210, E1417.
3.2 Characteristics of each method
3.3 General applications of each method

4.0 Liquid Penetrant Testing Equipment
4.1 Liquid penetrant testing units
4.2 Lighting for liquid penetrant testing equipment and light meters
4.3 Materials for liquid penetrant testing
4.4. Precautions in liquid penetrant inspection

1.0 Review
1.1 Basic principles
1.2 Process of various methods
1.3 Equipment

2.0 Selection of the Appropriate Penetrant Testing Method
2.1 Advantages of various methods
2.2 Disadvantages of various methods

3.0 Inspection and Evaluation of Indications
3.1 General
3.1.1 Discontinuities inherent in various materials
3.1.2 Reason for indications
3.1.3 Appearance of indications
3.1.4 Time for indications to appear
3.1.5 Persistence of indications
3.1.6 Effects of temperature and lighting (white to UV)
3.1.7 Effects of metal smearing operations (shot peening, machining, etc.)
3.1.8 Preferred sequence for penetrant inspection
3.1.9 Part preparation (precleaning, stripping, etc.)
3.2 Factors affecting indications
3.2.1 Pre-cleaning
3.2.2 Penetrant used
3.2.3 Prior processing
3.2.4 Technique used
3.3 Indications from cracks
3.3.1 Cracks occurring during solidification
3.3.2 Cracks occurring during processing
3.3.3 Cracks occurring during service
3.4 Indications from porosity

3.5 Indications from specific material forms
   3.5.1 Forgings
   3.5.2 Castings
   3.5.3 Plate
   3.5.4 Welds
   3.5.5 Extrusions

3.6 Evaluation of indications
   3.6.1 True indications
   3.6.2 False indications
   3.6.3 Relevant indications
   3.6.4 Nonrelevant indications
   3.6.5 Process Control
       a. Controlling process variables
       b. Testing and maintenance materials

4.0 Inspection Procedures and Standards
   4.1 Inspection procedures (minimum requirements)
   4.2 Standards/codes
       4.2.1 Applicable methods/processes
       4.2.2 Acceptance criteria
Radiographic Testing Level I Topical Outline

Radiographic Equipment Operating and Emergency Instructions Course

Note: It is recommended that the trainee receive instruction in this course prior to performing work in radiography.

1.0 Personnel Monitoring
   1.1 Wearing of monitoring badges
   1.2 Reading of pocket dosimeters
   1.3 Recording of daily dosimeter readings
   1.4 “Off-scale” dosimeter-action required
   1.5 Permissible exposure limits

2.0 Survey Instruments
   2.1 Types of radiation instruments
   2.2 Reading and interpreting meter indications
   2.3 Calibration frequency
   2.4 Calibration expiration-action
   2.5 Battery check-importance

3.0 Leak Testing of Sealed Radioactive Sources
   3.1 Requirements for leak testing
   3.2 Purpose of leak testing
   3.3 Performance of leak testing

4.0 Radiation Survey Reports
   4.1 Requirements for completion
   4.2 Description of report format

5.0 Radiographic Work Practices
   5.1 Establishment of restricted areas
   5.2 Posting and surveillance of restricted areas
   5.3 Use of time, distance, and shielding to reduce personnel radiation exposure
   5.4 Applicable regulatory requirements for surveys, posting, and control of radiation and high-radiation areas

6.0 Exposure Devices
   6.1 Daily inspection and maintenance
   6.2* Radiation exposure limits for gamma-ray exposure devices
   6.3 Labeling
   6.4 Use
   6.5 Use of collimators to reduce personnel exposure
   6.6.* Use of “source changers” for gamma-ray sources

7.0 Emergency Procedures
   7.1* Vehicle accidents with radioactive sealed sources
   7.2* Fire involving sealed sources
   7.3* “Source out” - failure to return to safe shielded conditions
   7.4* Emergency call list

8.0 Storage and Shipment of Exposed Devices and Sources
   8.1* Vehicle storage
   8.2* Storage vault - permanent
   8.3* Shipping instructions - sources
   8.4* Receiving instructions - radioactive material

9.0 State and Federal Regulations
   9.1 Nuclear Regulatory Commission (NRC) and agreement states - authority
   9.2 License reciprocity
   9.3* Radioactive materials license requirements for industrial radiography
   9.4 Qualification requirements for radiography personnel
   9.5 Regulations for the control of radiation (state or NRC as applicable)
Basic Radiographic Physics Course

1.0 Introduction
1.1 History and discovery of radioactive materials
1.2 Definition of industrial radiography
1.3 Radiation protection - why?
1.4 Basic math review: exponents, square root, etc.

2.0 Fundamental Properties of Matter
2.1 Elements and atoms
2.2 Molecules and compounds
2.3 Atomic particles - properties of protons, electrons, and neutrons
2.4 Atomic structure
2.5 Atomic number and weight
2.6 Isotope vs. radioisotope

3.0 Radioactive Materials
3.1 Production
3.1.1 Neutron activation
3.1.2 Nuclear fission
3.2 Stable vs. unstable (radioactive) atoms
3.3 Curie - the unit of activity
3.4 Half-life of radioactive materials
3.5 Plotting of radioactive decay
3.6 Specific activity - curies/gram

4.0 Types of Radiation
4.1 Particulate radiation - properties: alpha, beta, neutron
4.2 Electromagnetic radiation - X-ray, gamma-ray
4.3 X-ray production
4.4 Gamma-ray production
4.5 Gamma-ray energy
4.6 Energy characteristics of common radioisotope sources
4.7 Energy characteristics of X-ray machines

5.0 Interaction of Radiation with Matter
5.1 Ionization
5.2 Radiation interaction with matter
5.2.1 Photoelectric effect
5.2.2 Compton scattering
5.2.3 Pair production
5.3 Unit of radiation exposure - the roentgen
5.4 Emissivity of commonly used radiographic sources
5.5 Emissivity of X-ray exposure devices
5.6 Attenuation of electromagnetic radiation - shielding
5.7 Half-value layers; tenth-value layers
5.8 Inverse-square law

6.0 Biological Effects of Radiation
6.1 "Natural" background radiation
6.2 Unit of radiation dose - rem
6.3 Difference between radiation and contamination
6.4 Allowable personnel-exposure limits and the banking concept
6.5 Theory of allowable dose
6.6 Radiation damage - repair concept
6.7 Symptoms of radiation injury
6.8 Acute radiation exposure and somatic injury
6.9 Personnel monitoring for tracking exposure
6.10 Organ radiosensitivity

9.6* Department of Transportation regulations for radiographic-source shipment
9.7 Regulatory requirements for X-ray machines (state and federal as applicable)
*) Topics may be deleted if the radiography is limited to X-ray exposure devices.
7.0 Radiation Detection

7.1 Pocket dosimeter
7.2 Difference between dose and dose rate
7.3 Survey instruments
7.3.1 Geiger-Müller tube
7.3.2 Ionization chambers
7.3.3 Scintillation chambers, counters
7.4 Film badge - radiation detector
7.5 TLDs (theroluminescent dosimeters)
7.6 Calibration

8.0 Exposure Devices and Radiation Sources

8.1 Radioisotope sources
8.1.1 Sealed-source design and fabrication
8.1.2 Gamma ray sources
8.1.3 Beta and bremsstrahlung sources
8.1.4 Neutron sources
8.2 Radioisotope exposure device characteristics
8.3 Electronic radiation sources - 500 keV and less, low-energy

8.3.1 Generator - high-voltage rectifiers
8.3.2 X-ray tube design and fabrication
8.3.3 X-ray control circuits
8.3.4 Accelerating potential
8.3.5 Target material and configuration
8.3.6 Heat dissipation
8.3.7 Duty cycle
8.3.8 Beam filtration

8.4* Electronic radiation sources - medium- and high-energy

8.4.1* Resonance transformer
8.4.2* Van de Graaff accelerator
8.4.3* Linac
8.4.4* Betatron
8.4.5* Roentgen output
8.4.6* Equipment design and fabrication
8.4.7* Beam filtration

8.5* Fluoroscopic radiation sources

8.5.1* Fluoroscopic equipment design
8.5.2* Direct-viewing screens
8.4.3* Image amplification
8.4.4* Special X-ray tube considerations and duty cycle
8.4.5* Screen unsharpness
8.4.6* Screen conversion efficiency

9.0 Special Radiographic Sources and Techniques

9.1* Flash radiography
9.2* Stereo radiography
9.3* In-motion radiography
9.4* Autoradiography

*) Topics may be deleted if the radiography is limited to X-ray exposure devices.

Radiographic Technique Course

1.0 Introduction

1.1 Process of radiography
1.2 Types of electromagnetic radiation sources
1.3 Electromagnetic spectrum
1.4 Penetrating ability or “quality” of X-rays and gamma rays
1.5 Spectrum of X-ray tube source
1.6 Spectrum of gamma-radioisotope source
1.7 X-ray tube - change of mA or kVp effect on “quality” and intensity

2.0 Basic Principles of Radiography

2.1 Geometric exposure principles

2.1.1 “Shadow” formation and distortion
2.1.2 Shadow enlargement calculation
2.1.3 Shadow sharpness
2.1.4 Geometric unsharpness
2.1.5 Finding discontinuity depth
2.2 Radiographic screens
   2.2.1 Lead intensifying screens
   2.2.2 Fluorescent intensifying screens
   2.2.3 Intensifying factors
   2.2.4 Importance of screen-to-film contact
   2.2.5 Importance of screen cleanliness and care
   2.2.6 Techniques for cleaning screens
2.3 Radiographic cassettes
2.4 Composition of industrial radiographic film
2.5 The "heel effect" with X-ray tubes

3.0 Radiographs
   3.1 Formation of the latent image on film
   3.2 Inherent unsharpness
   3.3 Arithmetic of radiographic exposure
      3.3.1 Milliamperage - distance-time relationship
      3.3.2 Reciprocity law
      3.3.3 Photographic density
      3.3.4 X-ray exposure charts - material thickness, kV, and exposure
      3.3.5 Gamma-ray exposure chart
      3.3.6 Inverse-square-law considerations
      3.3.7 Calculation of exposure time for gamma- and X-ray sources
      3.4 Characteristic Hurter and Driffield (H&D) curve
   3.5 Film speed and class descriptions
   3.6 Selection of film for particular purpose

4.0 Radiographic Image Quality
   4.1 Radiographic sensitivity
   4.2 Radiographic contrast
   4.3 Film contrast
   4.4 Subject contrast
   4.5 Definition
   4.6 Film graininess and screen mottle effects
   4.7 Penetrameters or image-quality indicators

5.0 Film Handling, Loading, and Processing
   5.1 Safe light and darkroom practices
   5.2 Loading bench and cleanliness
   5.3 Opening of film boxes and packets
   5.4 Loading of film and sealing cassettes
   5.5 Handling techniques for "green film"
   5.6 Elements of manual film processing

6.0 Exposure Techniques - Radiography
   6.1 Single-wall radiography
   6.2 Double-wall radiography
   6.2.1 Viewing two walls simultaneously
   6.2.2 Offset double-wall exposure single-wall viewing
   6.2.3 Elliptical techniques
   6.3 Panoramic radiography
   6.4 Use of multiple-film loading
   6.5 Specimen configuration

7.0 Fluoroscopic Techniques
   7.1 Dark adaptation and eye sensitivity
   7.2 Special scattered radiation techniques
   7.3 Personnel protection
   7.4 Sensitivity
   7.5 Limitations
   7.6 Direct screen viewing
   7.7 Indirect and remote screen viewing
Radiographic Testing Level II Topical Outline
Film Quality and Manufacturing Processes Course

1.0 Review of Basic Radiographic Principles
   1.1 Interaction of radiation with matter
   1.2 Math review
   1.3 Exposure calculations
   1.4 Geometric exposure principles
   1.5 Radiographic-image quality parameters

2.0 Darkroom Facilities, Techniques, and Processing
   2.1 Facilities and equipment
      2.1.1 Automatic film processor vs. manual processing
      2.1.2 Safe lights
      2.1.3 Viewer lights
      2.1.4 Loading bench
      2.1.5 Miscellaneous equipment
   2.2 Film loading
      2.2.1 General rules for handling unprocessed film
      2.2.2 Types of film packaging
      2.2.3 Cassette-loading techniques for sheet and roll
   2.3 Protection of radiographic film in storage
      2.4 Processing of film - manual
         2.4.1 Developer and replenishment
         2.4.2 Stop bath
         2.4.3 Fixer and replenishment
         2.4.4 Washing
         2.4.5 Prevention of water spots
         2.4.6 Drying
   2.5 Automatic film processing
   2.6 Film filing and storage
      2.6.1 Retention-life measurements
      2.6.2 Long-term storage
      2.6.3 Filing and separation techniques
   2.7 Unsatisfactory radiographs - causes and cures
      2.7.1 High film density
      2.7.2 Insufficient film density
      2.7.3 High contrast
      2.7.4 Low contrast
      2.7.5 Poor definition
      2.7.6 Fog
      2.7.7 Light leaks
      2.7.8 Artifacts
   2.8 Film density
      2.8.1 Step-wedge comparison film
      2.8.2 Densitometers

3.0 Indications, Discontinuities, and Defects
   3.1 Indications
   3.2 Discontinuities
      3.2.1 Inherent
      3.2.2 Processing
      3.2.3 Service
   3.3 Defects

4.0 Manufacturing Processes and Associated Discontinuities
   4.1 Casting processes and associated discontinuities
      4.1.1 Ingots, blooms, and billets
      4.1.2 Sand casting
      4.1.3 Centrifugal casting
      4.1.4 Investment casting
   4.2 Wrought processes and associated discontinuities
      4.2.1 Forgings
      4.2.2 Rolled products
      4.2.3 Extruded products
   4.3 Welding processes and associated discontinuities
      4.3.1 Submerged arc welding (SAW)
      4.3.2 Shielded metal arc welding (SMAW)
4.3.3 Gas metal arc welding (GMAW)
4.3.4 Flux cored arc welding (FCAW)
4.3.5 Gas tungsten arc welding (GTAW)
4.3.6 Resistance welding
4.3.7 Special welding processes - electron beam, electroslag, electrogas, etc.

5.0 Radiological Safety Principles Review
5.1 Controlling personnel exposure
5.2 Time, distance, shielding concepts
5.3 ALARA (as low as reasonably achievable) concept
5.4 Radiation-detection equipment
5.5 Exposure-device operating characteristics

Radiographic Evaluation and Interpretation Course

1.0 Radiographic Viewing
1.1 Film-illuminator requirements
1.2 Background lighting
1.3 Multiple-composite viewing
1.4 Penetrameter placement
1.5 Personnel dark adaptation and visual acuity
1.6 Film identification
1.7 Location markers
1.8 Film-density measurement
1.9 Film artifacts

2.0 Application Techniques
2.1 Multiple-film techniques
   2.2.1 Thickness-variation parameters
   2.2.2 Film speed
   2.2.3 Film latitude
2.2 Enlargement and projection
2.3 Geometrical relationships
   2.3.1 Geometrical unsharpness
   2.3.2 Penetrameter sensitivity
   2.3.3 Source-to-film distance
   2.3.4 Focal-spot size
2.4 Triangulation methods for discontinuity location
2.5 Localized magnification
2.6 Film-handling techniques

3.0 Evaluation of Castings
3.1 Casting-method review
3.2 Casting discontinuities
3.3 Origin and typical orientation of discontinuities
3.4 Radiographic appearance
3.5 Casting codes/standards - applicable acceptance criteria
3.6 Reference radiographs

4.0 Evaluation of Weldments
4.1 Welding-method review
4.2 Welding discontinuities
4.3 Origin and typical orientation of discontinuities
4.4 Radiographic appearance
4.5 Welding codes/standards - applicable acceptance criteria
4.6 Reference radiographs or pictograms

5.0 Standards, Codes, and Procedures for Radiography
5.1 ASTM standards
5.2 Acceptable radiographic techniques and setups
5.3 Applicable employer procedures
5.4 Procedure for radiograph parameter verification
5.5 Radiographic reports
Limited Certification For Radiographic Film Interpretation
Topical Outlines
Radiographic Technique Course

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1.1 Process of radiography
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1.2 Protection of radiographic film in storage

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1.3.3 Fixer and replenishment

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1.3.5 Prevention of water spots

1.3.6 Drying

1.4 Automatic film processing

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1.5.2 Long-term storage

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1.6.6 Fog

1.6.7 Light leaks

1.6.8 Artifacts

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1.7.1 Step-wedge comparison film

1.7.2 Densitometers

2.0 Indications, Discontinuities, and Defects

2.1 Indications

2.2 Discontinuities

2.2.1 Inherent

2.2.2 Processing

2.2.3 Service

2.3 Defects

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   1.7 Location markers
   1.8 Film-density measurement
   1.9 Film artifacts

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      2.1.1 Thickness-variation parameters
      2.1.2 Film speed
      2.1.3 Film latitude
   2.2 Enlargement and projection
   2.3 Geometrical relationships
      2.3.1 Geometrical unsharpness
      2.3.2 Penetrameter sensitivity
      2.3.3 Source-to-film distance
      2.3.4 Focal-spot size
   2.4 Triangulation methods for discontinuity location
   2.5 Localized magnification
   2.6 Film-handling techniques

3.0 Evaluation of Castings
   3.1 Casting-method review
   3.2 Casting discontinuities
   3.3 Origin and typical orientation of discontinuities
   3.4 Radiographic appearance
   3.5 Casting codes/standards – applicable acceptance criteria
   3.6 Reference radiographs

4.0 Evaluation of Weldments
   4.1 Welding-method review
   4.2 Welding discontinuities
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   4.4 Radiographic appearance
   4.5 Welding codes/standards – applicable acceptance criteria
   4.6 Reference radiographs or pietograms

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   5.1 Acceptable radiographic techniques and setups
   5.2 Applicable employer procedures
   5.3 Procedure for radiograph parameter verification
   5.4 Radiographic reports
Programma di addestramento per UT - Training program for UT

Ultrasonic Testing Level I Topical Outline
Basic Ultrasonic Course

Note: It is recommended that the trainee receive instruction in this course prior to performing work in ultrasonics.

1.0 Introduction
1.1 Definition of ultrasonics
1.2 History of ultrasonic testing
1.3 Applications of ultrasonic energy
1.4 Basic math review
1.5 Responsibilities of levels of certification

2.0 Basic Principles of Acoustics
2.1 Nature of sound waves
2.2 Modes of sound-wave generation
2.3 Velocity, frequency, and wavelength of sound waves
2.4 Attenuation of sound waves
2.5 Acoustic impedance
2.6 Reflection
2.7 Refraction and mode-conversion
2.8 Snell’s law and critical angles
2.9 Fresnel and Fraunhofer effects

3.0 Equipment
3.1 Basic pulse-echo instrumentation (A-, B-, C-scan and computerized systems)
  3.1.1 Electronics - time base, pulser, receiver, and various monitor displays
  3.1.2 Control functions
  3.1.3 Calibration
    a. Basic instrument calibration
    b. Calibration blocks (types and use)
3.2 Digital thickness instrumentation
3.3 Transducer operation and theory
  3.3.1 Piezoelectric effect
  3.3.2 Types of transducer elements
  3.3.3 Frequency (transducer elements -thickness relationships)
  3.3.4 Near field and far field
  3.3.5 Beam spread
  3.3.6 Construction, materials, and shapes
  3.3.7 Types (straight, angle, dual, etc.)
  3.3.8 Beam-intensity characteristics
  3.3.9 Sensitivity, resolution, and damping
  3.3.10 Mechanical vibration into part
  3.3.11 Other type of transducers (Laser UT, EMAT, etc.)
3.4 Couplants
  3.4.1 Purpose and principles
  3.4.2 Materials and their efficiency

4.0 Basic Testing Methods
4.1 Contact
4.2 Immersion
4.3 Air coupling
Ultrasonic Technique Course

1.0 Testing Methods
1.1 Contact
   1.1.1 Straight-beam
   1.1.2 Angle-beam
   1.1.3 Surface-wave and plate waves
   1.1.4 Pulse-echo transmission
   1.1.5 Multiple transducer
   1.1.6 Curved surfaces
      a. Flat entry surfaces
      b. Cylindrical and tubular shapes

1.2 Immersion
   1.2.1 Transducer in water
   1.2.2 Water column, wheels, etc.
   1.2.3 Submerged test part
   1.2.4 Sound-beam path B transducer to part
   1.2.5 Focused transducers
   1.2.6 Curved surfaces
   1.2.7 Plate Waves
   1.2.8 Pulse-echo and through-transmission

1.3 Comparison of contact and immersion methods

2.0 Calibration (Electronic and Functional)
2.1 Equipment
   2.1.1 Monitor displays (amplitude, sweep, etc.)
   2.1.2 Recorders
   2.1.3 Alarms
   2.1.4 Automatic and semiautomatic systems
   2.1.5 Electronic distance/amplitude correction
   2.1.6 Transducers

2.2 Calibration of equipment electronics
   2.2.1 Variable effects
   2.2.2 Transmission accuracy
   2.2.3 Calibration requirements
   2.2.4 Calibration reflectors

2.3 Inspection calibration
   2.3.1 Comparison with reference blocks
   2.3.2 Pulse-echo variables
   2.3.3 Reference for planned tests (straight-beam, angle-beam, etc.)
   2.3.4 Transmission factors
   2.3.5 Transducer
   2.3.6 Couplants
   2.3.7 Materials

3.0 Straight-Beam Examination to Specific Procedures
3.1 Selection of parameters
3.2 Test standards
3.3 Evaluation of results
3.4 Test reports

4.0 Angle-Beam Examination to Specific Procedures
4.1 Selection of parameters
4.2 Test standards
4.3 Evaluation of results
4.4 Test reports
Ultrasonic Testing Level II Topical Outline

Ultrasound Evaluation Course

1.0 Review of Ultrasonic Technique Course
   1.1 Principles of ultrasonics
   1.2 Equipment
      1.2.1 A-Scan
      1.2.2 B-Scan
      1.2.3 C-Scan
      1.2.4 Computerized systems
   1.3 Testing techniques
   1.4 Calibration
      1.4.1 Straight-beam
      1.4.2 Angle-beam
      1.4.3 Resonance
      1.4.4 Special applications

2.0 Evaluation of Base-Material Product Forms
   2.1 Ingots
      2.1.1 Process review
      2.1.2 Types, origin, and typical orientation of discontinuities
      2.1.3 Response of discontinuities to ultrasound
      2.1.4 Applicable codes/standards
   2.2 Plate and sheet
      2.2.1 Rolling process
      2.2.2 Types, origin, and typical orientation of discontinuities
      2.2.3 Response of discontinuities to ultrasound
      2.2.4 Applicable codes/standards
   2.3 Bar and rod
      2.3.1 Forming process
      2.3.2 Types, origin, and typical orientation of discontinuities
      2.3.3 Response of discontinuities to ultrasound
      2.3.4 Applicable codes/standards
   2.4 Pipe and tubular products
      2.4.1 Manufacturing process
      2.4.2 Types, origin, and typical orientation of discontinuities
      2.4.3 Response of discontinuities to ultrasound
      2.4.4 Applicable codes/standards
   2.5 Forgings
      2.5.1 Process review
      2.5.2 Types, origin, and typical orientation of discontinuities
      2.5.3 Response of discontinuities to ultrasound
      2.5.4 Applicable codes/standards
   2.6 Castings
      2.6.1 Process review
      2.6.2 Types, origin, and typical orientation of discontinuities
      2.6.3 Response of ultrasound to discontinuities
      2.6.4 Applicable codes/standards
   2.7 Composite structures
      2.7.1 Process review
      2.7.2 Types, origin, and typical orientation of discontinuities
      2.7.3 Response of ultrasound to discontinuities
      2.7.4 Applicable codes/standards
   2.8 Other product forms as applicable B rubber, glass, etc.

3.0 Evaluation of Weldments
   3.1 Welding processes
   3.2 Weld geometries
   3.3 Welding discontinuities
   3.4 Origin and typical orientation of discontinuities
   3.5 Response of discontinuities to ultrasound
   3.6 Applicable codes/standards

4.0 Evaluation of Bonded Structures
   4.1 Manufacturing processes
   4.2 Types of discontinuities
   4.3 Origin and typical orientation of discontinuities
   4.4 Response of discontinuities to ultrasound
   4.5 Applicable codes/standards
5.0 Discontinuity Detection

5.1 Sensitivity to reflections
   5.1.1 Size, type, and location of discontinuities
   5.1.2 Techniques used in detection
   5.1.3 Wave characteristics
   5.1.4 Material and velocity

5.2 Resolution
   5.2.1 Standard reference comparisons
   5.2.2 History of part
   5.2.3 Probability of type of discontinuity
   5.2.4 Degrees of operator discrimination
   5.2.5 Effects of ultrasonic frequency
   5.2.6 Damping effects
   5.3 Determination of discontinuity size
   5.3.1 Various monitor displays and meter indications
   5.3.2 Transducer movement vs. display
   5.3.3 Two-dimensional testing techniques
   5.3.4 Signal patterns

5.4 Location of discontinuity
   5.4.1 Various monitor displays
   5.4.2 Amplitude and linear time
   5.4.3 Search technique

6.0 Evaluation

6.1 Comparison procedures
   6.1.1 Standards and references
   6.1.2 Amplitude, area, and distance relationship
   6.1.3 Application of results of other NDT methods

6.2 Object appraisal
   6.2.1 History of part
   6.2.2 Intended use of part
   6.2.3 Existing and applicable code interpretation
   6.2.4 Type of discontinuity and location
Limited Certification for Ultrasonic Digital Thickness Measurement Topical Outline

1.0 Principles/Theory
   1.1 General
   1.2 Principles of acoustics
       1.2.1 Nature of sound waves
       1.2.2 Modes of sound wave generation
       1.2.3 Velocity, frequency and wavelength of sound waves
       1.2.4 Attenuation/scattering of sound waves

2.0 Equipment/Materials
   2.1 Equipment
       2.1.1 Pulse-echo instrumentation
           2.1.1.1 Pulse generation
           2.1.1.2 Signal detection
           2.1.1.3 Display and recording methods, A-scan, B-scan, C-scan and digital
           2.1.1.4 Sensitivity and resolution
       2.1.2 Digital thickness instrumentation
       2.1.3 Transducer operation and theory
           2.1.3.1 Piezoelectric effect
           2.1.3.2 Frequency (crystal-thickness relationships)
           2.1.3.3 Types (straight, angle, single, dual, etc.)
   2.2 Materials
       2.2.1 Couplants
           2.2.1.1 Purpose and principles
       2.2.2 Calibration blocks
       2.2.3 Cables/Connectors
       2.2.4 Test specimen

3.0 Techniques/Calibrations – Contact Straight Beam

4.0 Variables Affecting Test Results
   4.1 Instrument performance variations
   4.2 Transducer performance variations
   4.3 Test specimen variations
       4.3.1 Surface condition
       4.3.2 Part geometry
       4.3.3 Material structure

5.0 Procedure/Specification Applications/Thickness Measurement
Ultrasonic Testing Level II TOFD Technique Topical Outline

1.0 Review of Ultrasonic Technique Course
   1.1 Principles of ultrasonics review
   1.2 TOFD techniques introduction
      1.2.1 Theoretical basis
      1.2.2 Signal presentations
      1.2.3 Wave types
   1.3 Equipments
      1.3.1 Hardware
      1.3.2 Software
      1.3.3 Search Unit
      1.3.4 Wedges
      1.3.5 Scanner and encoder
   1.4 Processing, Display and Analysis of Time-of-Flight Data
      1.4.1 Simple forms of display
      1.4.2 Two-dimensional display
      1.4.3 Analysis of A-scan data
      1.4.4 Signal recognition
      1.4.5 Measurement of flaws

2.0 Application on Welds
   2.1 Type of joint
      2.1.1 Geometry
      2.1.2 Orientation
      2.1.3 Scanning plan
      2.1.4 Calibration blocks
      2.1.5 Calibration method
   2.2 Flaws determination
      2.2.1 Flaw type
      2.2.2 Flaw identification and determination
   2.3 Codes and standards
      2.3.1 ASME codes
      2.3.2 Code Case 2235
      2.3.3 Other international standards
      2.3.4 Applicable codes/standards
Ultrasonic Testing Level II PA Technique Topical Outline

1.0 Review of Ultrasonic Technique Course
   1.1 Principles of ultrasonics review
   1.2 PA techniques introduction
      1.2.1 Theoretical basis
      1.2.2 Wave types
      1.2.3 Search unit structure
      1.2.4 Fixed angle electronic scan
      1.2.5 Sectorial Scan
      1.2.6 Beam Focusing
   1.3 Equipments
      1.3.1 Hardware
      1.3.2 Software
      1.3.3 Search Units
      1.3.4 Wedges
      1.3.5 Scanner and encoder
   1.4 Processing, Display and Analysis of Phased Array Data
      1.4.1 Sampling data
      1.4.2 Two-dimensional display
      1.4.3 Analysis of A-scan data
      1.4.4 Measurement of flaws

2.0 Application on Welds
   2.1 Type of joint
      2.1.1 Geometry
      2.1.2 Orientation
      2.1.3 Scanning plan
      2.1.4 Calibration blocks
   2.2 Flaws determination
      2.2.1 Flaw type
      2.2.2 Flaw identification and determination
   2.3 Codes and standards
      2.3.1 ASME codes
      2.3.2 Code Case 2235
      2.3.3 Other international standards
      2.3.4 Applicable codes/standards
ALLEGATO J - ATTACHMENT J

Visual Testing Level I Topical Outline

Note: The guidelines listed below should be implemented using equipment and procedures relevant to the employer’s industry. No times are given for a specific subject; this should be specified in the employer’s written practice. Based upon the employer’s product, not all of the referenced subcategories need apply.

1.0 Introduction
   1.1 Definition of visual testing
   1.2 History of visual testing
   1.3 Overview of visual testing applications

2.0 Definitions
   Standard terms and their meanings in the employer’s industry

3.0 Fundamentals
   3.1 Vision
   3.2 Lighting
   3.3 Material attributes
   3.4 Environmental factors
   3.5 Visual perception
   3.6 Direct and indirect methods

4.0 Equipment (as applicable)
   4.1 Mirrors
   4.2 Magnifiers
   4.3 Borescopes
   4.4 Fiberscopes
   4.5 Closed-circuit television
   4.6 Remote visual inspection systems
   4.7 Light sources and special lighting
   4.8 Gages (welding, go/no-go, etc.) templates, scales, micrometers, calipers, special tools, etc.
   4.9 Automated systems
   4.10 Computer-enhanced systems

5.0 Employer-Defined Applications
   (Includes a description of inherent, processing and service discontinuities.)
   5.1 Mineral-based material
   5.2 Metallic materials, including welds
   5.3 Organic-based materials
   5.4 Other materials (employer-defined)

6.0 Visual Testing to Specific Procedures
   6.1 Selection of parameters
      6.1.1 Inspection objectives
      6.1.2 Inspection checkpoints
      6.1.3 Sampling plans
      6.1.4 Inspection patterns
      6.1.5 Documented procedures
   6.2 Test standards/calibration
   6.3 Classification of indications per acceptance criteria
   6.4 Reports and documentation

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Visual Testing Level II Topical Outline

The guidelines listed below should be implemented using equipment and procedures relevant to the employer’s industry. The employer should tailor the program to the company’s particular application area. Discontinuity cause, appearance, and how to best visually detect and identify these discontinuities should be emphasized. No times are given for a specific subject; this should be specified in the employer’s written practice. Depending upon the employer’s product, not all the referenced subcategories need apply.

1.0 Review of Level I
   1.1 Definitions
   1.2 Fundamentals of visual testing
   1.3 Equipment
   1.4 Applications

2.0 Vision
   2.1 The eye
   2.2 Vision limitations
   2.3 Disorders
   2.4 Employer’s vision examination methods

3.0 Lighting
   3.1 Fundamentals of light
   3.2 Lighting measurements
   3.3 Recommended lighting levels
   3.4 Lighting techniques for inspection

4.0 Material Attributes
   4.1 Cleanness
   4.2 Color
   4.3 Condition
   4.4 Shape
   4.5 Size
   4.6 Temperature
   4.7 Texture
   4.8 Type

5.0 Environmental and Physiological Factors
   5.1 Atmosphere
   5.2 Cleanness
   5.3 Comfort
   5.4 Distance
   5.5 Elevation
   5.6 Fatigue
   5.7 Health
   5.8 Humidity
   5.9 Mental attitude
   5.10 Position
   5.11 Safety
   5.12 Temperature

6.0 Visual Perception
   6.1 What your eyes see
   6.2 What your mind sees
   6.3 What others perceive
   6.4 What the designer, engineer, etc., wants you to see
7.0 Equipment
   7.1 Automated systems
   7.2 Borescopes
   7.3 Closed-circuit television
   7.4 Computer-based systems
   7.5 Fiberscopes
   7.6 Gages, micrometers, calipers, templates, scales, etc.
   7.7 Imaging systems
   7.8 Light sources and special lighting
   7.9 Magnifiers
   7.10 Mirrors
   7.11 Special optical systems
   7.12 Standard lighting
   7.13 Remote visual inspection systems

8.0 Employer-Defined Applications
   8.1 Mineral-based material
   8.2 Metallic materials (including welds)
   8.3 Organic-based materials
   8.4 Other materials and products (employer-defined)

9.0 Acceptance/Rejection Criteria
   9.1 Subjective basis (qualitative)
   9.2 Objective basis (quantitative)
   9.3 Evaluation of results per acceptance criteria

10.0 Recording and Reports
    10.1 Subjective method
    10.2 Objective method
    10.3 Recording methods