INCREMENTAL CHANGE Release Notification Date: 10/26/2022

SPM 70-32-87 FLUORESCENT INDICATION DIGITAL INSPECTION (FIDI)

DISCLAIMER

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HIGHLIGHTS

HIGHLIGHT REFERENCE	DESCRIPTION OF CHANGE
tk70-32-87-200-801	Technical Change: Added special procedure for the fluorescent indication digital inspection (FIDI).

TASK 70-32-87-200-801

1. General.

A. This document procedure establishes the minimum requirements for digital inspection of non-porous, metal and non-metal components prepared using fluorescent penetrant methods.

B. Refer to TASK 70-32-02-230-001 (70-32-02, Fluorescent Penetrant Inspection) for general requirements and instructions on fluorescent-penetrant inspection process.

CAUTION: PERSONNEL PERFORMING THIS INSPECTION SHOULD RECEIVE PRACTICAL TRAINING IN THE USE OF THIS PROCEDURE AND MUST DEMONSTRATE PROFICIENCY IN USE AND CONTROL OF THE INSPECTION EQUIPMENT, INSPECTION OF HARDWARE, AND EVALUATION OF INDICATIONS BEFORE THE AUTHORITY TO ACCEPT AND REJECT HARDWARE IS DELEGATED.

C. All personnel performing FIDI must be qualified and certified. Refer to TASK 70-32-02-230-001 (70-32-02, Fluorescent Penetrant Inspection) with FIDI additional requirements. Refer to Subtask 70-32-87-230-032 (paragraph 6.D.) for FIDI specific training requirements.

D. All FIDI inspections must be performed to a written procedure and part-specific Techniques that implement all the requirements of applicable process documents. A written Technique approved by a recognized FIDI Level 3 is required. Refer to Subtask 70-32-87-230-033 (paragraph 6.E.).

NOTE: Since the processing procedures are similar for many components, a master written procedure may be utilized that covers the details common to variety of components.

Subtask 70-32-87-230-001

(1) All inspection requirements of applicable process documents apply with the following exceptions when digitally performed.

(a) Interpretation and evaluation may be done by a qualified inspector, by the FIDI equipment or a combination of both. The detailed steps of the interpretation and evaluation process including the responsibilities of both inspector and equipment and the control checks necessary to ensure interpretation and evaluation is being performed accurately must be detailed in the inspection facility work instruction. The combined

wiping (bleedback) on any indications performed by the inspector and FIDI equipment must not exceed two.

(b) FIDI system performance must be checked daily, and results must be comparable to un-aided visible results such as Tool Aerospace Manufacturing (TAM) panels, fluorescent USAF1951 etc. Level of fluorescent penetrant must be comparable.

Subtask 70-32-87-230-002

(2) Inspect 100 percent of the part surface (internal and external) except as noted in applicable process documents. To account for variation in part location and acquisition device position, adjacent Inspectable Image Regions must overlap by a minimum of 10 percent. For a single point of view inspection, all inspected areas of the part must be within the 10 percent band as shown on Figure 1.

Subtask 70-32-87-230-003

(a) If a manipulator is used to move either the acquisition device or the hardware, the relative position must be capable of an error of less than 5 percent of the smallest Inspectable Image Region.

Subtask 70-32-87-230-004

(3) To inspect an indication, the following conditions must be required.

(a) Adequate visual access. Refer to Figure 2.

(b) Ability to confirm that indications are relevant.

(c) Ability to measure relevant indications against the specified limits.

(d) Ability to properly apply and remove the fluorescent penetrant inspection materials within the times required by applicable process documents.

2. Equipment and Facility.

A. The equipment and facility must be approved by the Services Technology Leader of FPI.

B. The facility and equipment must present no hazards to the safety of personnel or property. Procedures must be established so that safe operating conditions exist. A risk assessment study must be conducted for equipment using moving parts and high-risk items must be abated.

C. The evaluation environment must be controlled for temperature, humidity, dust, lighting, access, and noise as required by the process.

D. The following characteristics of the images produced by the FIDI system must be controlled and consistent.

(1) The Inspectable Image Region must be clearly defined and visible to the operator either through cropping or defined boundaries unless the whole image qualifies as an Inspectable Image Region. No interpretation of indications is permitted outside of this region.

(a) The image must be free from any artifact that would affect interpretation and evaluation within the Inspectable Image Region.

Subtask 70-32-87-230-005

(b) For setup purpose only, a color adjustment must be performed using the inspection UV light source and a target which emits a gray color when UV illuminated. This target must be approved by the FPI Services Technology Leader. To perform the color adjustment, the camera white balance function must be used while the aforementioned target is lit with the inspection UV light source. No color adjustment such as white balance is permitted when inspecting production hardware.

E. LED UV-A Light (strobing or continuous) must comply with the requirements of at least ASTM E 3022-18 with the following exceptions.

(1) All the test requirements of ASTM E 3022 performed at 15 inches must instead be performed at the light working distance for the inspection.

(2) There are no restrictions on the beam irradiance profile size. The minimum beam diameter must be listed in the lamp's certification document.

Subtask 70-32-87-230-006

(3) The minimum UV light intensity must be at least 1200 uW/cm2 measured at the maximum working distance over the entire Inspectable Image Region. The maximum UV light intensity must not exceed 10000 uW/cm2 measured at the minimum working distance to avoid fluorescent dye fade out. The white light emission from UV light source must not exceed 2-foot candles (20 lux) at the minimum working distance.

(a) In case of strobing light being used for digital interpretation, a flash radiometer must be used. The flash radiometer must be approved by the FPI Services Technology Leader. Refer to Subtask 70-32-87-230-031 (paragraph 6.C.) for details on how to perform energy scaling.

1 The maximum intensity must not exceed 10000 uW/cm2 when scaled to a one second period.

2 The minimum intensity must be at least 1200 uW/cm2. The peak value must be used for minimum intensity.

3 The white light emission from UV light source must not exceed 2-foot candles (20 lux). The peak value must be used for white light emission.

Subtask 70-32-87-230-007

(b) The LED UV-A light must be uniform as defined in ASTM E 3022 over the entire Inspectable Image Region. Uniformity checks must be performed at the minimum working distance using a target approved by the FPI Services Technology Leader.

(c) Reflected light must comply with the intensity and uniformity requirements at the inspection surface. The intensity and uniformity outputs must be maintained throughout the inspection. This requires that the mechanical setup be the same when measuring as when inspecting.

F. Software associated with the image interpretation must be revision controlled and documented in

the Technique. Any changes to the software must be approved by the Services Technology Leader of FPI prior to use on production hardware.

Subtask 70-32-87-230-008

G. If an automated bleed-back system is used, all fluorescent indications must be interpreted after wiping the indication with a solvent applicator. Provisions must be made to prevent flooding of the area with solvent.

Subtask 70-32-87-230-009

(1) A solvent-dampened swab or natural hairbrush must be used to wipe the indications. The applicator must be free from excessive contamination or residual fluorescent penetrant before use. The applicator shape integrity and conformance must be validated to ensure that proper wiping is consistently achieved.

Subtask 70-32-87-230-010

(2) If a manipulator is used to move either the applicator or the hardware, the relative position must be capable of an error less than 5 percent of the applicator's width.

Subtask 70-32-87-230-011

(3) Solvent must be free of excessive contamination that could adversely affect the inspection process.

Subtask 70-32-87-230-012

(4) If a blotter pad is used to wipe extra solvent from the applicator, it must be free of excessive fluorescence, contamination, or solvent.

Subtask 70-32-87-230-013

H. Fluorescent penetrant inspection must be performed in a darkened area with a maximum ambient visible light level of 2-foot candles (20 lux).

3. System Certification.

A. The FIDI system must be approved by the Services Technology Leader of FPI, and the system qualification must be in accordance with this document. The Services Technology Leader of FPI may request additional tests.

B. All reports, test results, images, and data used to qualify the system must be documented and available for review.

C. Since reference values will be established after completed equipment qualification, all tests listed in Table I that do not require comparison to a reference value must be run successfully to validate that the equipment is performing adequately before equipment qualification.

Subtask 70-32-87-230-014

(1) Equipment qualification must include tests that validate the maximum viewing angle where the system is still able to detect the smallest rejectable indication. Refer to Figure 2. This maximum viewing angle must be documented in the qualification package and no inspections requiring a viewing angle exceeding this maximum viewing angle are permitted.

Subtask 70-32-87-230-015

(2) The image must have sufficient resolution to detect the smallest rejectable indication. The image resolution must be measured using the USAF 1951 resolution target. The system must be able to resolve a Group 1 and Element 5. Refer to Subtask 70-32-87-230-030 (paragraph 6.B.). Images of a USAF 1951 resolution target taken in the center and all four corners of the Inspectable Image Region must be archived. This must be performed at the working distance and also at the minimum and maximum distances (also known as near plane and far plane) at which the equipment was qualified. The highest Group and Element that is still resolvable in those images must be noted. These must be used in subsequent system performance checks in accordance with Subtask 70-32-87-230-025 (paragraph 5.B.(3)). This Group and Element number must be clearly indicated in the inspection facility work instructions.

Subtask 70-32-87-230-016

(3) An image of a FIDI Level 3 approved target(s) must be taken and archived. Multiple reference targets are allowed. A reference image technique must be documented for each reference target. The reference image(s) and its associated technique must be used in subsequent system performance checks. Refer to Subtask 70-32-87-230-023 (paragraph 5.B.(1)) to check for the following features.

(a) Intensity level and uniformity
(b) Artifact
(c) Displacement or movement of features
(d) Dimension of features
(e) Sharpness
(f) Color
(g) Depth Of Field

Subtask 70-32-87-230-017

(4) A pixel sample size measurement taken at a typical working distance must be recorded. This measurement must be used as a reference in subsequent system performance checks in accordance with Subtask 70-32-87-230-024 (paragraph 5.B.(2)).

Subtask 70-32-87-230-018

(5) Image intensity must be measured using the inspection UV light source and a target approved by the FPI Services Technology Leader. This measurement must be performed after the color adjustment specified in Subtask 70-32-87-230-005 (paragraph 2.D.(1)(b)). Intensity must be measured as an average of pixel values over the Inspectable Image Region. Automatic intensity adjustment such as automatic gain control or automatic exposure must not be used.

The intensity measurement and the associated image must be archived and must be used as a reference in subsequent system performance checks in accordance with Subtask 70-32-87-230-026 (paragraph 5.B.(5)).

Subtask 70-32-87-230-019

(a) A baseline image must be captured using the working TAM or Penetrant System Monitoring (PSM-5) panel used in the production line. This image must be used as a reference in subsequent system performance checks in accordance with Subtask 70-32-87-230-028 (paragraph 5.H.) verifying that the system is still capable of detecting the same number of indications as seen on the baseline image.

Subtask 70-32-87-230-020

(b) UV light uniformity must be measured using the inspection UV light source and a target approved by the FPI Services Technology Leader. This measurement must be performed after the color adjustment specified in Subtask 70-32-87-230-005 (paragraph 2.D.(1)(b)). Uniformity must be measured by taking intensity values in the center and all four corners of the Inspectable Image Region. Automatic intensity adjustment such as automatic gain control or automatic exposure must not be used. The uniformity measurements and the associated image must be archived and must be used as a reference in subsequent system performance checks in accordance with Subtask 70-32-87-230-027 (paragraph 5.C.(2)).

D. AIE Algorithm Qualification. AIE algorithms, if used, must be qualified using known-defect samples, and uniquely identified. The qualification data package must be established and approved by a recognized FIDI Level 3 and the FPI Services Technology Leader. As a minimum the package must contain Part Number information, quantity used, Technique form in accordance with Subtask 70-32-87-230-033 (paragraph 6.E.), test results, and data from a statistical method such as probability of detection (POD). MIL-HDBK-1823A and ASTM E 2862 detail the process for conducting a POD study.

(1) The required True Positive Rate (TPR) of the algorithm must be established by the recognized FIDI Level 3. Rates may be based either upon the TPR of existing inspection, TPR studies or external TPR requirements.

(2) A new algorithm qualification must be required for every new part. The FPI Services Technology Leader may waive this requirement and approve the use of an existing qualified algorithm based on part similarities.

(3) The known-defect samples must be approved by the FPI Services Technology Leader. The known-defect samples must be cleaned after usage and stored to prevent physical damage.

4. Technique.

A. A technique which is capable of consistently producing the desired results and quality level must be established by the recognized FIDI Level 3 and approved by the FPI Services Technology Leader.

B. A qualified and approved algorithm must be used for each technique in accordance with Subtask 70-32-87-230-021 (paragraph 4.D.). The applicable algorithm used must be documented in inspection facility work instructions. Please refer to Subtask 70-32-87-230-033 (paragraph 6.E.) for minimum information required for FIDI inspection plan.

C. A Technique qualification must be conducted, using a set of actual hardware, to validate the performance of the system. A qualification data package, containing a description of the hardware, a complete technique in accordance with Subtask 70-32-87-230-033 (paragraph 6.E.), and all data and images used to qualify the Technique must be submitted for approval. The Technique coverage must be validated in accordance with Subtask 70-32-87-230-002 (paragraph 1.D.(2)), Subtask 70-32-87-230-004 (paragraph 1.D.(3)), and Subtask 70-32-87-230-014 (paragraph 3.C.(1)). In the case of automated bleedback, the performance of the bleedback system must be validated. The qualification data package must be submitted by the recognized FIDI Level 3 and approved by the FPI Services Technology Leader.

Subtask 70-32-87-230-021

D. Please refer to Subtask 70-32-87-230-033 (paragraph 6.E.) for minimum information required for FIDI inspection plan.

Subtask 70-32-87-230-022

E. Modifications to an approved Technique must be approved by a recognized FIDI Level 3 prior to implementation when any of the following parameters are modified within the specified limits from their initial qualified values. The FPI Services Technology Leader approval must be required for any modifications outside these limits.

(1) Any change in Camera Working Distance and or Near Plane - Far Plane of less than ±5 percent is allowed if pixel sample size does not change more than ±1 percent.

(2) Any change in Camera Exposure time, Camera Gain, UV Light Intensity, and UV Light Strobing time is allowed provided that the Image Intensity does not change more than ±5 percent.

F. The FIDI Level 3 may use the provision of Subtask 70-32-87-230-022 (paragraph 4.E.) to derive a new Technique from an approved Technique, provided all other parameters remain unchanged. Please refer to Subtask 70-32-87-230-033 (paragraph 6.E.) for minimum information required for FIDI inspection plan that must be used to document the derived Techniques taking care to keep the original Technique parameters approved by the FPI Services Technology Leader to ensure compliance with Subtask 70-32-87-230-022 (paragraph 4.E.). Images used to verify adequacy of the Technique must be maintained. If a derived Technique for the similar equipment cannot be used with the same parameters as the original approved Technique or cannot be modified in accordance with Subtask 70-32-87-230-022 (paragraph 4.E.), a separate Technique for that equipment must be submitted to the FPI Services Technology Leader.

5. Quality Assurance.

A. This section details the controls necessary to ensure the performance level of the digital inspection equipment. The frequency of the required checks is based upon a facility running

daily production. For facilities operating less frequently, the frequency of daily and weekly checks may be reduced but must be performed prior to use. All other checks must be performed at the same frequency as for full-time operations. Frequencies designate the maximum time between two checks, for example semi-annual checks must not exceed 6 months. These checks must also be performed when a system malfunction is suspected, when replacing an equipment component, when maintenance is performed or if the equipment is moved. Results of all required checks must be documented. When the result of any test falls outside acceptable values, the situation must be corrected prior to use. Table IV in Subtask 70-32-87-230-029 (paragraph 6.A.) lists the frequency and acceptable values for the checks. The step-by-step test procedures must be detailed in the inspection facility work instructions and must be approved by the FPI Services Technology Leader.

B. The following checks are required to ensure the performance of each acquisition device used for inspection of production hardware.

Subtask 70-32-87-230-023

(1) An image of a recognized FIDI Level 3 approved target(s) must be taken and compared to a reference image(s) recorded at system qualification. The current and reference images must appear identical based on the features outlined in Subtask 70-32-87-230-016 (paragraph 3.C.(3)).

Subtask 70-32-87-230-024

(2) A pixel sample size measurement must be taken at the same working distance used in Subtask 70-32-87-230-017 (paragraph 3.C.(4)) and compared to the reference value recorded at system qualification.

Subtask 70-32-87-230-025

(3) Image resolution must be checked using a USAF 1951 resolution target specified in Subtask 70-32-87-230-030 (paragraph 6.B.). That check must be performed in the same conditions as the ones used in Subtask 70-32-87-230-015 (paragraph 3.C.(2)). The Group and Element that must be resolved must be the same as measured at system qualification.

(4) Color adjustment must be checked using a UV target specified in Subtask 70-32-87-230-005 (paragraph 2.D.(1)(b)). The check must be performed at the working distance and using the UV light source used for inspection. The measurement must be performed using an average of each individual color channel (Red, Green, and Blue).

Subtask 70-32-87-230-026

(5) Image intensity must be measured in the same conditions used in Subtask 70-32-87-230-018 (paragraph 3.C.(5)), and compared to the value recorded at system qualification. This measurement must be performed after the color adjustment check.

(6) If a manipulator is used to either move the acquisition device or the hardware, the acquisition device position must be verified in accordance with Subtask 70-32-87-230-003 (paragraph 1.D.(2)(a)).

(7) If special equipment (such as mirrors) is used, each component must be checked for cleanliness individually.

C. The following checks are required to ensure the acceptable performance of all UV light sources. If reflected light is used, each mirror must be checked individually.

(1) All UV light sources must be checked for intensity in accordance with Subtask 70-32-87-230-006 (paragraph 2.E.(3)). UV light reflectors and filters must be checked for cleanliness and integrity. Damaged or dirty reflectors or filters must be replaced or corrected as appropriate.

Subtask 70-32-87-230-027

(2) All UV light sources must be checked for uniformity in accordance with Subtask 70-32-87-230-007 (paragraph 2.E.(3)(b)) and Subtask 70-32-87-230-020 (paragraph 3.C.(5)(b)).

(3) The white light emission from all UV light sources must be measured in accordance with Subtask 70-32-87-230-006 (paragraph 2.E.(3)).

D. The following checks are required to ensure the performance of all bleedback systems.

(1) The applicator shape integrity and conformance must be validated in accordance with Subtask 70-32-87-230-009 (paragraph 2.G.(1)) to ensure that it has not suffered any damage. Damaged applicators must be replaced. The applicator must be free from excessive contamination or residual fluorescent penetrant before usage. The applicator must be inspected using an ultraviolet light source. If evidence of excess fluorescence is present, the applicator must be cleaned or replaced.

(2) If a manipulator is used to move either the applicator or the hardware, the applicator position must be verified as specified in Subtask 70-32-87-230-010 (paragraph 2.G.(2)).

(3) The system must ensure complete wetting of the applicator. The solvent must be clean and free of excessive fluorescence or other contamination in accordance with Subtask 70-32-87-230-011 (paragraph 2.G.(3)).

(4) Blotter pads, where used, must be free of excessive fluorescence, contamination, or solvent in accordance with Subtask 70-32-87-230-012 (paragraph 2.G.(4)).

(5) The performance of the bleedback system must be verified, ensuring cleaning without flooding the area with solvent in accordance with Subtask 70-32-87-230-008 (paragraph 2.G.).

E. If used, any fixture or component touching the production hardware must be checked for cleanliness and wear. The fixture must be inspected using an ultraviolet light source. If evidence of excessive fluorescence penetrant is present, cleaning is required. If excessive wear is observed, the fixture must be repaired or replaced.

F. The inspection area must be checked for cleanliness, free from excessive fluorescent contamination and clutter.

G. Fluorescent penetrant inspection must be performed in a darkened area as in accordance with Subtask 70-32-87-230-013 (paragraph 2.H.).

Subtask 70-32-87-230-028

H. A check must be performed to ensure the overall performance of the equipment using the working TAM or PSM-5 panel used in the production line. The result must be compared with the baseline result of that panel in accordance with Subtask 70-32-87-230-019 (paragraph 3.C.(5)(a)).

NOTE: For inspector interpretation, all quality assurance provisions from applicable process documents must apply in accordance with Subtask 70-32-87-230-001 (paragraph 1.D.(1)).

6. Process Qualification Requirements.

Subtask 70-32-87-230-029

A. This section defines the system performance validation checks that must be performed at the designated minimum frequency shown in Table IV along with the expected values of those tests.

Table IV. Performance Checks Frequency and Values

Test Name	Paragraph	Frequency	Value
Reference image	6.B.(1)	Daily	Visual comparison
Special equipment cleanliness	5.B.(7)	Daily	Free from excessive contamination
UV light intensity	5.C.(1)	Daily	Minimum of 1200 uW/cm2 Maximum of 10000 uW/cm2
UV white light emission	5.C.(3)	Daily	2 foot-candles (20 lux) maximum at minimum working distance
Applicator integrity	5.D.(1)	Daily	Shape integrity and free from excessive contamination
Applicator position	5.D.(2)	Daily	Error in position less than 5% of applicator width
Solvent	5.D.(3)	Daily	Sufficient supply and free from excessive contamination
Blotter pad	5.D.(4)	Daily	Free from excessive contamination
Bleed back overall performance	5.D.(5)	Daily	Proper cleaning and avoid flooding
Fixture cleanliness	5.E.	Daily	Free from excessive contamination and wear
System Validation	5.H.	Each Shift	Same number of indications as the baseline image
Work area cleanliness	5.F.	Weekly	Free from excessive contamination
Ambient visible light	5.G.	Weekly	2 foot-candles (20 lux) maximum
Pixel sample size	5.B.(2)	Semi-annually	±5 % maximum from reference value
Resolution target	5.B.(3)	Semi-annually	Resolve same Group and Element number as at system qualification
Color adjustment	5.B.(4)	Semi-annually	±5% maximum from reference value
Image intensity	5.B.(5)	Semi-annually	±5% maximum from reference value
Acquisition device position	5.B.(6)	Semi-annually	Error in position less than 5% of smallest Inspectable Image Region
UV light uniformity	5.C.(2)	Semi-annually	±5% maximum from reference value

Subtask 70-32-87-230-030

B. USAF 1951 Resolution Test Chart.

(1) The information contained herein is intended for guidance only.

(2) The common USAF 1951 target format consists of six groups in three layers of patterns. The largest two groups, forming the first layer, are located on the outer sides. The smaller layers consist of repeating progressively smaller pairs toward the center. Each group consists of six elements, numbered from 1 to 6. Within the same layer, the odd-numbered groups appear contiguously from 1 through 6 from the upper right corner. The first element of the even-numbered groups is at the lower right of the layer, with the remaining 2 through 6, at the left.

(3) Groups and Elements are more restrictive as their number goes up, so the achievable Group and Element numbers should be equal or higher than the ones specified. Going a full group (column) over or under represents a 2X change. Going an element over or under represents a 12 percent change from the previous value.

Table V. Number of Line Pairs for each mm in USAF Resolving Power Test Target 1951

	Group Numbers											
Element	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	0.250	0.500	1.00	2.00	4.00	8.00	16.00	32.0	64.0	128.0	256.0	512.0
2	0.281	0.561	1.12	2.24	4.49	8.98	17.96	35.9	71.8	143.7	287.4	574.7
3	0.315	0.630	1.26	2.52	5.04	10.08	20.16	40.3	80.6	161.3	322.5	645.1
4	0.354	0.707	1.41	2.83	5.66	11.31	22.63	45.3	90.5	181.0	362.0	724.1
5	0.397	0.794	1.59	3.17	6.35	12.70	25.40	50.8	101.6	203.2	406.4	812.7

6	0.445	0.891	1.78	3.56	7.13	14.25	28.51	57.0	114.0	228.1	456.1	912.3

Table VI. Width of 1 Line in Micrometers in USAF Resolving Power Test Target 1951

	Group Numbers											
Element	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	2000.00	1000.00	500.00	250.00	125.00	62.50	31.25	15.63	7.81	3.91	1.95	0.98
2	1781.80	890.90	445.45	222.72	111.36	55.68	27.84	13.92	6.96	3.48	1.74	0.87
3	1587.40	793.70	396.85	198.43	99.21	49.61	24.80	12.40	6.20	3.10	1.55	0.78
4	1414.21	707.11	353.55	176.78	88.39	44.19	22.10	11.05	5.52	2.76	1.38	0.69
5	1259.92	629.96	314.98	157.49	78.75	39.37	19.69	9.84	4.92	2.46	1.23	0.62
6	1122.46	561.23	280.62	140.31	70.15	35.08	17.54	8.77	4.38	2.19	1.10	0.55

(4) Groups and Elements are more restrictive as their number goes up, so the achievable Group and Element numbers should be equal or higher than the ones specified. Going a full group (column) over or under represents a 2X change. Going an element over or under represents a 12 percent change from the previous value.

Subtask 70-32-87-230-031

C. Pulse Energy vs Continuous Energy.

(1) The information contained herein is intended for compliance.

(2) To compare energy contained in a pulsed light vs a continuous light, one must consider the power emitted by the light and also the period of time that the light was on. Continuous light is represented by a 1000 ms (1 sec) measurement. Figure 4 shows that a 200 ms pulse of light at a power of 10000 W has the same amount of energy as a continuous light at a power of 2000 W. In order to compare how a pulsed light measures up to a continuous light, use the following formula.

Equivalent continuous power of pulsed light = (power of pulsed light * pulse time(ms))/(1000(ms))

Subtask 70-32-87-230-032

D. FIDI Specific Training Requirements.

(1) Training must be complied to the requirements of NAS 410, EN4179 or any equivalent standard as recognized by the Airworthiness Authority of the personnel.

(2) Personnel must not be certifying to FIDI without a current NAS 410, EN4179 or any equivalent standard as recognized by the Airworthiness Authority of the personnel, certification of the same level. The Penetrant Testing and FIDI certification may be performed concurrently.

(3) Additional training requirements as shown in Table I, Table II, and Table III must be met.

Table I. Minimum Additional FIDI Formal Training Hours for Level 1 and Level 2

Level 1 PT to Level 1 FIDI	Level 2 PT to Level 2 FIDI
16h	16h

Table II. Minimum Additional FIDI Experience Hours for Level 1 and Level 2

Level 1 PT to Level 1 FIDI	Level 2 PT to Level 2 FIDI
20h	40h

Table III. Minimum Additional FIDI Formal Training and Experience for Level 3

Formal Training	Practical Process Experience
40h	80h

(4) As a minimum this list should be covered in a formal training plan for FIDI. Previous FPI certification to the same level is assumed.

(a) Digital Images (Level 3)
- 1 Grayscale vs color
- 2 Image formation
- 3 Pixel sample size
- 4 Contrast
- 5 Resolution

(b) Camera (Level 3)
- 1 Gain
- 2 White balance
- 3 Exposure time
- 4 Triggering mode

(c) Lenses (Level 3)
- 1 Aperture
- 2 Focus ring
- 3 Focus plane or working distance
- 4 Depth of field

(d) Lightning (Level 3)
- 1 White light
- 2 UV light
- 3 Lightning configuration (Brightfield, Darkfield)
- 4 Uniformity

5 Intensity
6 Filters

(e) Machine Vision algorithm (Level 3)
1 General algorithm (Level 1, 2, and 3)
2 Operation (Level 1, 2, and 3)
3 Performance checks (Level 1, 2, and 3)
4 Technique parameter impact (Level 1, 2, and 3)
5 Calibration (Level 1, 2, and 3)
6 P-Spec (Level 1, 2, and 3)
7 Troubleshooting (Level 1, 2, and 3)
8 Accept and Reject process (Level 2 and 3)
9 Data storage and retrieval (Level 2 and 3)

(f) AIE topics (Level 3)
1 General algorithm (Level 1, 2, and 3)
2 Operation (Level 1, 2, and 3)
3 Performance checks (Level 1, 2, and 3)
4 Technique parameter impact (Level 1, 2, and 3)
5 Calibration (Level 1, 2, and 3)

Subtask 70-32-87-230-033

E. The information contained herein is intended for guidance to establish forms with minimum information for a FIDI inspection plan. Forms must be submitted by the recognized FIDI Level 3 and approved by the FPI Services Technology Leader.

(1) FIDI Technique form must include the minimum information below.
(a) NDT facility name and address
(b) Part number and name
(c) Type and class of penetrant
(d) Type of developer
(e) Type of solvent
(f) Equipment model and serial number
(g) Software revision number(s)
(h) Name of qualified algorithm used
(i) Camera model number*
(j) Camera exposure time*
(k) Camera gain*
(l) Lens focal length*
(m) Working distance*
(n) Near plane distance*
(o) Pixel sampled size*
(p) Fixture I.D.*
(q) UV Light model number*
(r) UV Light strobing time*
(s) UV Light intensity*
(t) Image intensity*
(u) Evaluation algorithm identifier*
(v) Revision history page
(w) Image for each point of view
* These parameters must be provided for each point of view if applicable.

(2) Reference image technique form must include the minimum information below.
(a) NDT facility name and address
(b) Equipment model and serial number
(c) Software revision number(s)
(d) Camera model number
(e) Camera exposure time
(f) Camera gain
(g) Lens focal length
(h) Lens aperture
(i) Working distance
(j) UV Light model number
(k) UV Light strobing time
(l) UV Light intensity
(m) Revision history page
(n) Image for each reference target
(o) UV Light intensity
(p) Revision history page
(q) Image for each reference target

(3) Resolution image technique form must include the minimum information below.
(a) NDT Facility name and address
(b) Equipment model and serial number
(c) Software revision number(s)
(d) Camera model number

(e) Camera exposure time
(f) Camera gain
(g) Lens focal length
(h) Lens aperture
(i) Working distance
(j) UV Light model number
(k) UV Light strobing time
(l) UV Light intensity
(m) Target location (Center, Top Left, Top Right, Bottom Left, Bottom Right)
(n) Group/Element resolved
(o) Revision history page
(p) Image for each location

*** * * FOR ALL**

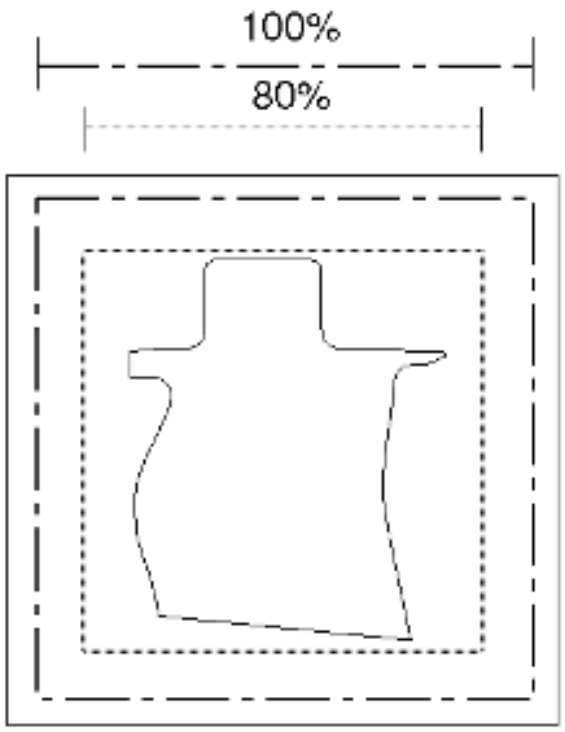


Figure 1 Coverage Example

*** * * FOR ALL**

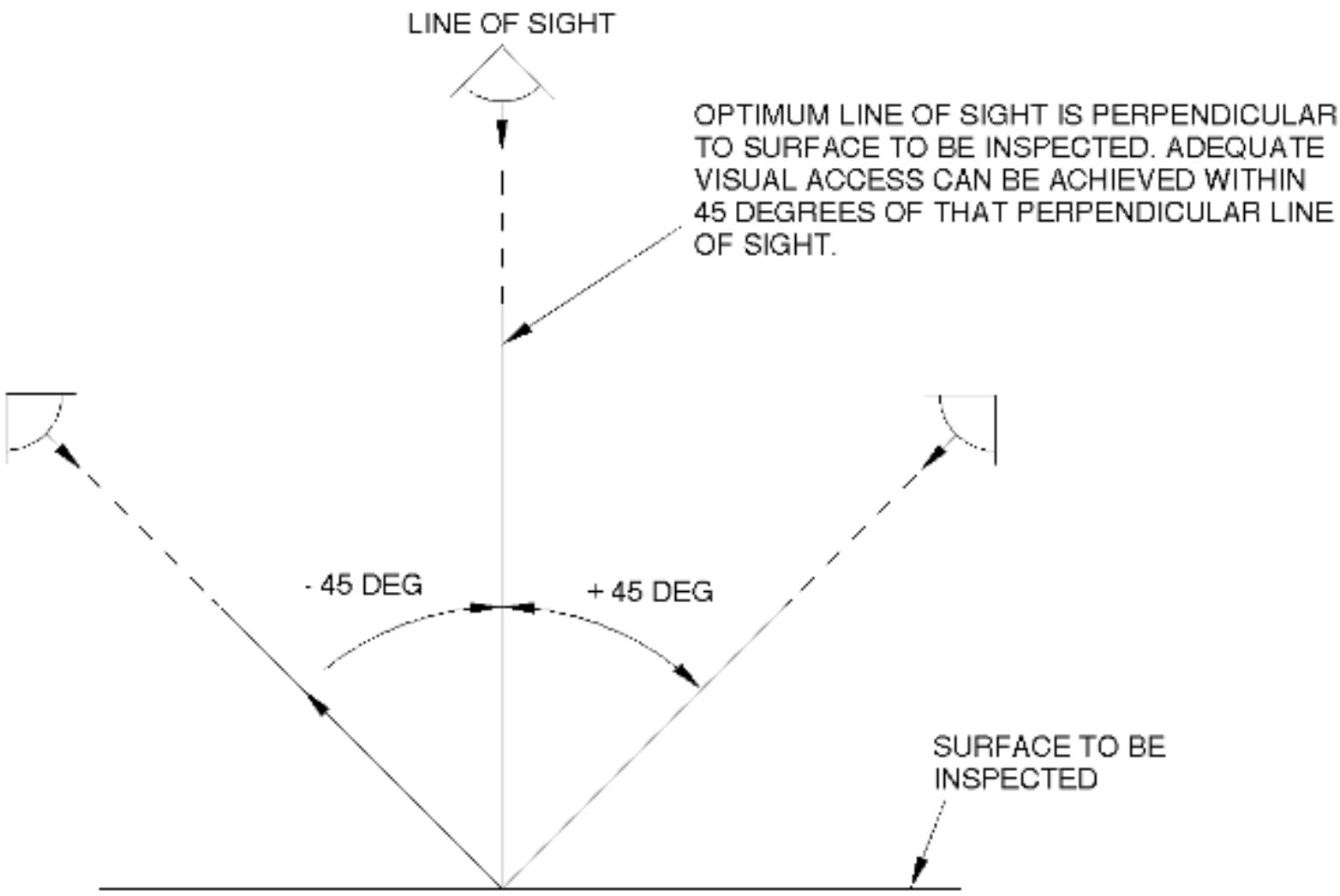
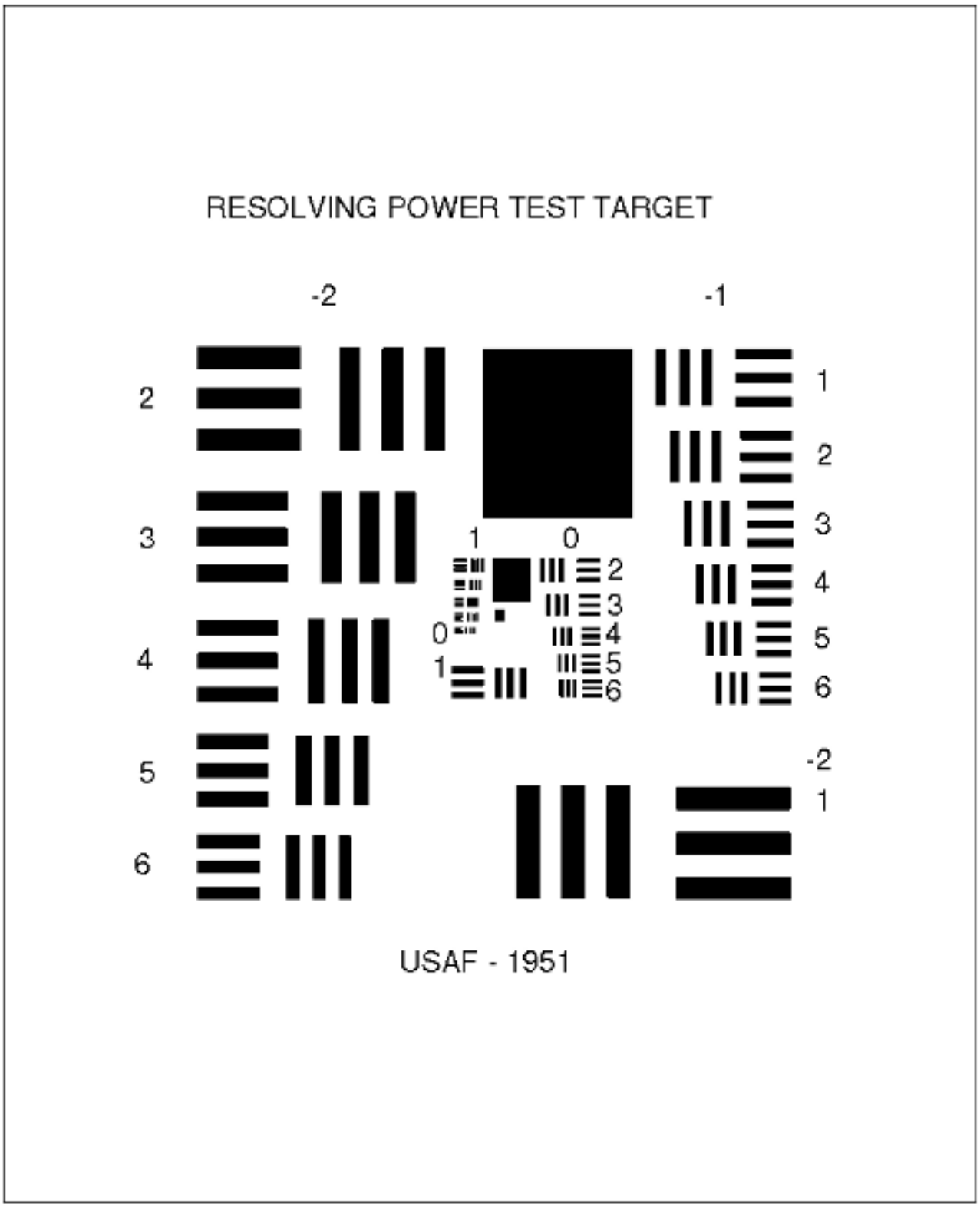


Figure 2 Required Viewing Angle

*** * * FOR ALL**



6037899-00

Figure 3 Required Viewing Angle

*** * * FOR ALL**

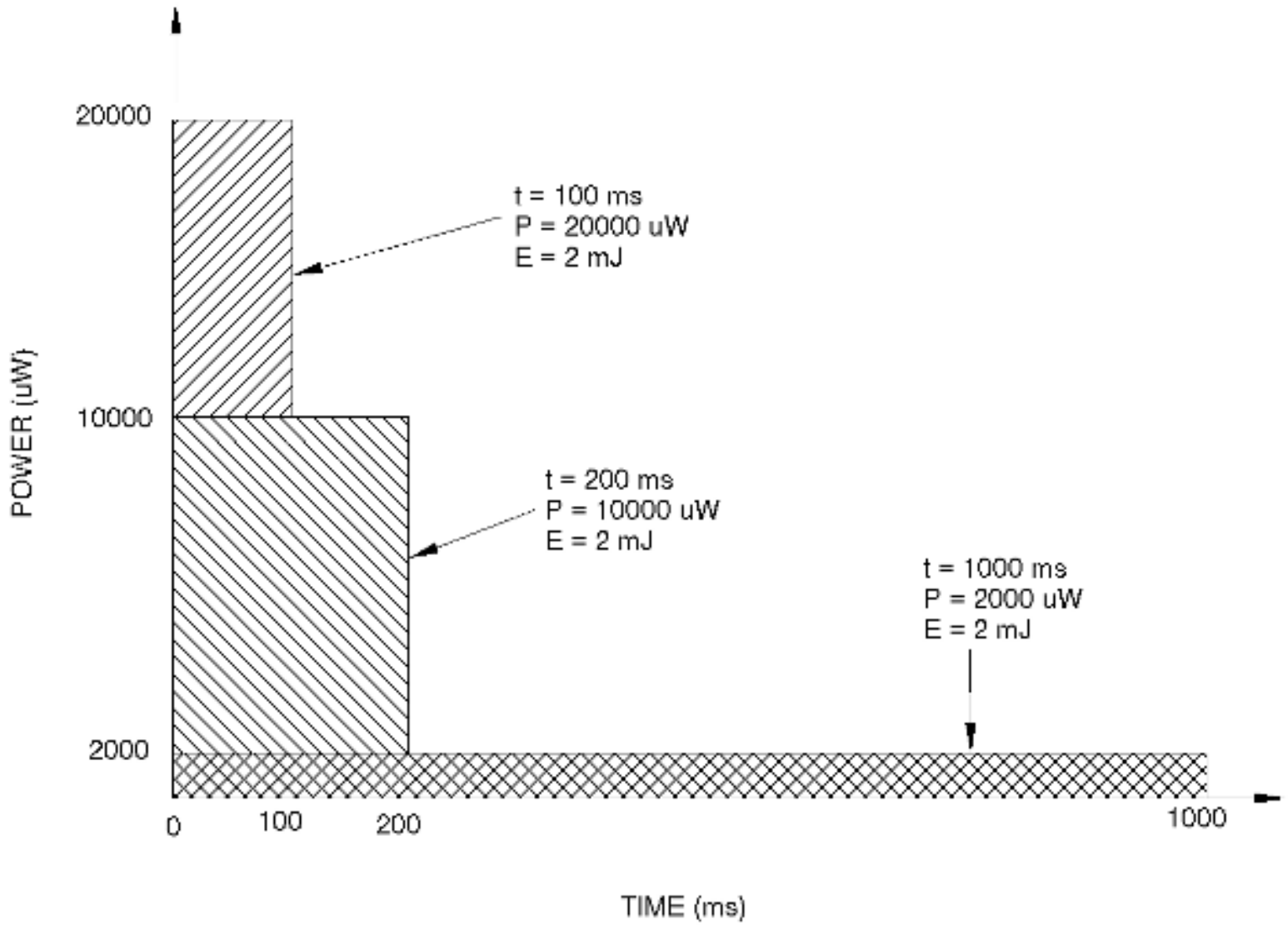


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Figure 4 Energy Equivalence Between Pulses of Different Duration

GE Designated: - CONFIDENTIAL Subject to the restrictions on the media