

Engineering Procedure

SAEP-1145

12 October 2005

Liquid Penetrant Examination

Non-destructive Testing Standards Committee Members

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1 Scope

- 1.1 This Engineering Procedure establishes the minimum requirements and describes the techniques for performing Liquid Penetrant Testing (PT) of welds and components conducted in accordance with the requirements of the referenced Codes and Standards.
- 1.2 This Engineering Procedure applies to Saudi Aramco NDT personnel and to contracted NDT personnel seconded to Saudi Aramco who perform PT on Company facilities and equipment.
- 1.3 This SAEP does not apply to NDT contractors performing PT for out-of-kingdom vendors or on LSTK projects unless specifically stated in contract or purchasing documents.

Detailed, written, PT procedures meeting the requirements of Appendices I through IV shall be used during all examinations. PT examinations deviating from these written procedures shall be submitted to the Inspection Department, NDT Unit for approval prior to use.

2 Conflicts and Deviations

- 2.1 Any conflicts between this procedure and other Saudi Aramco Engineering Standards (SAES's), Materials System Specifications (SAMSS's), Standard Drawings (SASD's), or industry standards, codes, and forms shall be resolved in writing by the Company or Buyer Representative through the Manager, Inspection Department of Saudi Aramco, Dhahran.
- 2.2 Direct all requests to deviate from this procedure in writing to the Company or Buyer Representative, who shall follow internal company procedure SAEP-302 and forward such requests to the Manager, Saudi Aramco Inspection Department.

3 References

Unless stated otherwise, all Codes and Standards referenced in this Procedure shall be of the latest issue (including revisions, addenda, and supplements) and are considered a part of this Procedure.

3.1 Saudi Aramco References

Saudi Aramco Engineering Procedures

[SAEP-1140](#)

Qualification and Certification of NDT Personnel

[SAEP-1142](#)

*Qualification of Non Saudi Aramco NDT
Personnel*

3.2 Industry Codes And Standards

American Society of Mechanical Engineers

<i>ASME B31.1</i>	<i>Power Piping</i>
<i>ASME B31.3</i>	<i>Process Piping</i>
<i>ASME Section V</i>	<i>Nondestructive Examination</i>
<i>ASME Sect. VIII, Div. 1</i>	<i>Pressure Vessels</i>
<i>ASME SE1209</i>	<i>Standard Test Method, Fluorescent Penetrant Exam./Water Washable</i>
<i>ASME SE1219</i>	<i>Standard Test Method, Fluorescent Penetrant Exam./Solvent Removable</i>
<i>ASME SE1220</i>	<i>Standard Test Method, Visible Penetrant Exam./Solvent Removable</i>

American Welding Society

<i>AWS D1.1</i>	<i>Structural Welding Code - Steel</i>
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American Petroleum Institute

<i>API 510</i>	<i>Pressure Vessel Inspection Code: Maintenance, Inspection, Rating, Repair and Alteration</i>
<i>API 570</i>	<i>Inspection, Repair, Alteration, and Rerating of Inservice Piping Systems</i>
<i>API 620</i>	<i>Design and Construction. of Large Welded Low Pressure Storage Tanks</i>
<i>API 650</i>	<i>Welded Steel Tanks for Oil Storage</i>

4 General Requirements

4.1 Technique

The penetrant processes to be used with this procedure are Water Washable and Solvent Removable. For specific application of penetrant testing processes, refer to the attached technique sheets. Where special circumstances require unique techniques not addressed in the attached technique sheets, contact the Supervisor, NDT Unit, Inspection Department.

4.2 Penetrant System Classification

Penetrant Materials shall meet all the requirements of the applicable Codes listed in paragraph 3.0. Classification of Penetrant Inspection Methods and Types are listed below. Detailed procedures for each method are shown in Appendices I through IV.

4.2.1 Fluorescent Penetrant Inspection

Water-washable (Procedure A-1)
Solvent-removable (Procedure A-3)

4.2.2 Color Contrast (Visible) Penetrant Inspection

Water-washable (Procedure B-1)
Solvent-removable (Procedure B-3)

4.3 Penetrant Material Selection

Penetrant materials used in conjunction with this SAEP shall be approved by the Inspection Department. Appendix V contains a listing, by manufacturer, of the approved penetrant families and groups. This list will be revised independent of this SAEP and it is incumbent on the user of this SAEP to keep informed of changes. Use of penetrant materials not specifically listed in Appendix V requires prior approval of the NDT Unit Supervisor, Inspection Department who maintains the current list of approved materials.

4.4 Restriction in Use of Penetrant Materials

4.4.1 Fluorescent penetrant examination shall never follow a color contrast examination.

4.4.2 Intermixing of penetrant materials from different manufacturers is not permitted. Manufacturer's recommendation for compatible penetrant systems shall be followed. The only exception is if the systems used are qualified effective to the satisfaction of the Inspection Department and approval is given in writing prior to use.

4.5 Control of Penetrant Materials

Content of penetrant materials is necessary when testing nickel based alloys, austenitic stainless steels, and titanium. Control shall be based on the manufacturer's batch certification which shall include, as a minimum, the manufacturer's name, batch, number, and chemical contaminant content as determined in accordance with ASME Section V, paragraph T-641. Only

penetrant materials having a batch number printed on the container and traceable to a valid manufacturer's batch certification on file shall be used.

4.6 Personnel Qualification

4.6.1 Saudi Aramco personnel performing penetrant testing shall be qualified and certified to the requirements of [SAEP-1140](#). Individuals performing interpretation of the results of the examination shall be certified to a minimum PT Level II.

4.6.2 Contractor personnel performing penetrant testing shall be qualified and certified to [SAEP-1142](#). Individuals performing interpretation of the results of the examination shall be certified to a minimum PT Level II.

4.7 Surface Preparation

4.7.1 In general, satisfactory results will be obtained when the surface to be inspected is in the as-welded condition. Surface preparation by grinding, machining, or other methods may be used when surface conditions could mask indications of discontinuities. Caution must be exercised to avoid smearing the metal and possibly masking discontinuities. In the event that a mechanical method of cleaning (e.g., grinding, machining, wire brushing and sanding) is necessary, it may be necessary to acid etch the surface prior to penetrant examination. Refer to ASME SEC V, Article 24, SE-165.

4.7.2 Welds or areas to be examined, and 1 inch on either side of the weld or area, shall be dry and free of all dirt, grease, lint, scale, welding spatter, welding flux, paint, oil and any other material that could obscure surface openings or otherwise interfere with the examination.

4.7.3 Detergents, organic solvents, descaling solutions and other paint removers may be used as cleaning agents. Ultrasonic and degreasing methods may also be used to clean surfaces prior to examination.

4.7.4 Penetrant testing of previously painted welds or components shall not be performed until all paint has been completely removed.

4.8 Drying

Following pre-cleaning, evaporation time of cleaners shall be 5 minutes minimum. Where indications of retained moisture exist, the evaporation time shall be increased until no evidence of moisture in the area of test can be detected.

5 Examination

- 5.1 The minimum and maximum temperatures of the penetrant and surface to be tested depends on the type of penetrant used. The permissible test surface temperature for Penetrant Testing is 50° to 125°F (10° to 52°C). Other temperature limitations and times may be used only after approval of an Inspection Department PT Level III.
- 5.2 Penetrant may be applied by dipping, brushing or spraying. Filters shall be used on the upstream side of the air inlet when using compressed air to apply penetrant.
- 5.3 The length of time the penetrant must remain on the part to allow proper penetration shall be as recommended by the penetrant manufacturer. Table 1 provides a guide for dwell times for a variety of material, their forms, and types of discontinuities. If manufacturer's recommendations are not available, Table 1 shall be used.

Table 1 - Recommended Dwell Times

Material	Form	Type of Discontinuity	Dwell Times (min.) for Methods A-1, A-3, B-1, B-3	
			Penetrant	Developer
Aluminum, Magnesium, Steel, Brass and Bronze, Titanium and High Temperature Alloys	Castings and Welds	Cold Shuts, Porosity, Lack of Fusion, Cracks (all forms)	10	7
	Wrought Extrusions, forgings, plate	Laps, Cracks (all forms)	20	7
Carbide-tipped tools		Lack of Fusion, Porosity, Cracks	10	7
Plastics	all forms	cracks	10	7
Glass	all forms	cracks	10	7
Ceramic	all forms	cracks	10	7

Note: Select dwell times carefully. Although Table 1 lists various recommended dwell times, some circumstances may exist where the required dwell times are significantly greater. For example, one manufacturer recommends a dwell time of 240 minutes for detection of stress corrosion cracking. Where dwell times exceed 20 minutes, additional penetrant must be applied at least every 20 minutes or as needed to keep the surface wet. If the penetrant is allowed to dry during the examination the part must be recleaned and the entire examination repeated.

5.4 Excess Penetrant Removal

- 5.4.1 After the specified dwell time has elapsed, remaining surface penetrant shall be removed. Care should be taken to minimize removal of penetrant from discontinuities. **FLUSHING THE SURFACE WITH SOLVENT IS PROHIBITED.**

5.4.2 SOLVENT REMOVABLE - Remove excess penetrant by wiping the surface with clean lint free material, until most traces of penetrant have been removed. Then lightly moisten a lint-free material with solvent and wipe the surface until all remaining traces of excess penetrant have been removed. FLUSHING THE SURFACE WITH SOLVENT IS PROHIBITED.

5.4.3 WATER WASHABLE: Excess penetrant can be removed by a coarse water spray. Pressure shall not exceed 50 psi and water temperature shall not exceed 110°F. A nozzle specifically designed for penetrant testing (droplet sprayer) should be used in lieu of the typical garden nozzles.

5.5 Drying After Penetrant Removal

5.5.1 When drying the surface after excess penetrant removal, ensure that the shortest amount of time possible occurs between the penetrant removal and developer application steps, but not to exceed 30 minutes.

5.5.2 SOLVENT REMOVABLE: Surfaces may be dried by normal evaporation, blotting, wiping.

5.5.3 WATER WASHABLE: Surfaces may be dried by blotting or circulating air.

5.5.4 HEATING - Surfaces may be dried with hot air provided surface temperatures do not exceed the standard surface temperatures of this SAEP.

5.6 Developing

5.6.1 When using color contrast penetrant only a wet developer shall be used. Wet or dry developers may be used with fluorescent penetrant.

5.6.2 Dry Powder Developers may be applied to the surface by brushing, powderbulb, hand applicator or other means making sure the entire surface is dusted evenly.

5.6.3 Wet Developers must be thoroughly agitated prior to application.

5.6.3.1 Nonaqueous (solvent based) Developer shall be applied only to a dry surface. Drying shall be by normal evaporation. Flooding of the surface being examined with nonaqueous developers is prohibited as it can flush the penetrant from within the discontinuities.

5.6.3.2 Aqueous (water based) Developer may be applied to either a wet or dry surface and may be applied by dipping, spraying, tank dipping, etc. Drying time may be accelerated with warm air provided surface temperature does not exceed the standard temperatures as stated in this SAEP.

5.6.4 Developers should be applied lightly. It is permissible to add additional developer to aide in interpretation, if necessary. If it is necessary to remove developer which was determined to be excessive, the test shall be restarted at the pre-cleaning step.

5.7 Lighting Requirements

5.7.1 Color Contrast Penetrant Testing

Visible penetrant indications can be examined in either natural or artificial white light. Adequate illumination is required to ensure no loss of sensitivity of the examination. It is recommended that, wherever possible, white light intensity levels be maintained at 100 ftc (1076 lux) or greater. The minimum permissible light intensity at the examination site is 32.5 ftc (350 lux).

5.7.2 Fluorescent Penetrant Testing

5.7.2.1 A minimum ultraviolet (UV) light intensity of 3000 $\mu\text{W}/\text{cm}^2$ is required for field inspections in areas of ambient white light which exceed 2 ftc (22 lux) as measured at the examination surface. A minimum value of 1000 $\mu\text{W}/\text{cm}^2$ is required for work in a darkened area of 2 ftc (22 lux) or less. UV light utilization requirements are performed in accordance with Appendix VI.

5.7.2.2 Fluorescent Penetrant Testing is to be performed in a darkened area. Ambient light (natural or artificial white light) shall not exceed 2 ftc (22 lux). With the specific approval of the Inspection Department, special "Day-light" black lights may be used in areas where ambient light cannot be reduced to 2 ftc (22 lux). Even with a "Day Light" ultraviolet light, the site ambient lighting shall be reduced as much as possible.

5.7.2.3 Visual inspection of the filter lens is mandatory prior to switching the light on. Lights with broken, cracked or chipped filters shall be repaired or replaced. Eye damage may result if unfiltered UV light is used.

- 5.7.2.4 The UV light must be allowed to warm-up a minimum of 5 minutes prior to use. In the event power is lost, many lights require 20 minutes before they will restart. Regardless, if the power is lost, an additional warm-up time of 10 minutes is required to assure proper performance of the UV light. Output shall be checked with a calibrated UV light meter. Refer to Appendix VI.
- 5.7.2.5 The inspector should be in the darkened examination area for at least 5 minutes prior to examination to allow the eyes to adapt to the dark viewing.

5.8 Interpretation

- 5.8.1 Final interpretation shall be made within 7 to 30 minutes of applying the developer. For wet developer, timing shall begin once the developer is dry and for dry developer, timing shall begin immediately after application. To aid in interpretation, formation of indications shall be closely observed during application of the developer. This may assist in characterizing and determining the extent of the indication.

5.8.2 Color Contrast Penetrants

Indications with a light pink color may indicate excessive penetrant removal. Inadequate penetrant removal may leave a pinkish splotchy background which will make interpretation difficult. If interpretation of the indication is difficult for any reason, the examination shall be repeated from the beginning. Recleaning is then required.

5.8.3 Fluorescent Penetrants

The examiner shall not use photosensitive glasses or lenses and shall be in the darkened area for a minimum of 5 min. prior to evaluation.

6 Evaluation

- 6.1 All indications shall be evaluated in accordance with the referencing Code or Specification. Sample acceptance criteria for specific codes are listed in Appendix VII. Any conflicts between this document and the applicable Code Section shall be resolved by an Inspection Department PT Level III.
 - 6.2 Any indication which is believed to be nonrelevant shall be regarded as relevant until reexamined to verify whether or not an actual discontinuity is present. Machining marks, surface roughness, mechanical conditions and other surface conditions could cause or produce false indications.
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- 6.3 Broad areas of pigmentation which could mask indications of discontinuities are unacceptable and require corrective action by cleaning or other suitable means of surface preparation as described herein. The area must then be retested.
- 6.4 Interpretation of indications found and determined to be rejectable shall be based on the apparent size of the indication. Linear indications are those having a length greater than three times the width. Rounded indications are those that have a circular or elliptical shape with the length equal to or less than three times the width.
- 6.5 All examinations shall be reported on the Saudi Aramco form 4719 (Appendix VIII).

7 Post Cleaning

Post cleaning shall be performed on all components that have been PT tested. Suitable cleaning techniques include machine wash, vapor degreasing, solvent soak and ultrasonic cleaning. Caution should be exercised to remove all developer prior to vapor degreasing as vapor degreasing can bake the developer on parts.

8 Safety

- 8.1 Penetrant materials are highly volatile, relatively toxic and the liquid may cause skin irritation. Use adequate ventilation at all times and avoid prolonged skin contact.
- 8.2 Penetrant materials shall not be heated above 130°F (54°C) or exposed to open flames.
- 8.3 The inspector shall be responsible for compliance with applicable safety rules in the use of liquid penetrant materials.
- 8.4 Keep aerosol cans containing penetrant materials out of direct sunlight and storage areas in excess of 130°F (54°C); as excessive heat may cause aerosol cans to explode.

Revision Summary

12 October 2005	Revised the "Next Planned Update". Reaffirmed the contents of the document, and reissued with minor changes.
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Appendix I - Procedure A-1

Water Washable Fluorescent Penetrant Examination

Temperature Limits	50° to 125°F (10° to 52°C)	
Surface Conditioning Prior to Penetrant Inspection	As welded, cast, rolled, forged condition unless otherwise instructed.	
Pre-clean	Approved solvent cleaner. Allow to dry minimum 5 minutes prior to proceeding with the test.	
Penetrant Materials	PENETRANT	DEVELOPER
(Appendix V)	Water Washable Fluorescent	Dry Developer Aqueous Developer Non-Aqueous Developer
Penetrant Application	Depending on whether penetrant is supplied in bulk containers or aerosol cans, application can be by dipping, brushing, flooding, or spraying.	
Penetrant Dwell Time	10 to 20 minutes depending on defect sought per Table 1.	
Excess Penetrant Removal	Removal with a coarse water sprayed on the surface of the part. Water pressure not to exceed 50 psi and should be applied with a droplet type sprayer specifically designed for penetrant removal. Caution must be taken not to over wash the part or area under test. The test surface must be dry prior to the application of Nonaqueous and Dry Developers.	
Developer Application	Standard Saudi Aramco Developer is Non-Aqueous in an aerosol can. Spray at 25cm to 30cm (10" to 12") from the surface. If Aqueous (water based) developer is used, flood the surface and allow to dry.	
Inspection Lighting	UV Light - 1000 $\mu\text{W}/\text{cm}^2$ - 3000 $\mu\text{W}/\text{cm}^2$ White Light - Maximum = 2 ftc	
Post Cleaning	Wipe surface clean with dry cloth. Flush surface with an approved solvent cleaner. Wipe as required with a clean cloth and/or absorbent paper towel.	

Appendix II - Procedure A-3

Solvent-Removable Fluorescent Penetrant Examination

Temperature Limit	50° to 125°F (10° to 52°C)	
Surface Conditioning Prior to Penetrant Inspection	As welded, cast, rolled, forged condition unless otherwise instructed.	
Preclean	Approved solvent cleaner. Allow to dry minimum 5 minutes prior to proceeding with the test.	
Penetrant Materials (Appendix V)	PENETRANT	DEVELOPER
	Solvent Removable Fluorescent	Dry Developer Aqueous Developer Non-Aqueous Developer
Penetrant Application	Depending on whether penetrant is supplied in bulk containers or aerosol cans, application can be by dipping, brushing, flooding, or spraying.	
Penetrant Dwell Time	10 to 20 minutes depending on defect sought per Table 1.	
Excess Penetrant Removal	Remove penetrant with a dry, clean, lint free cloth or paper towel, followed by moistened clean, lint free, white cloth or paper towel. For final removal of excess penetrant use a dry, lint free white cloth or paper towel.	
Developer Application	Standard Saudi Aramco Developer is Non-Aqueous in an aerosol can. Spray at 25cm to 30cm (10" to 12") from the surface. If Aqueous (water based) developer is used, flood the surface and allow to dry.	
Inspection Lighting	Black Light - $1000 \mu\text{W}/\text{cm}^2$ - $3000 \mu\text{W}/\text{cm}^2$ White Light - Maximum = 2 ftc	
Post Cleaning	Wipe surface clean with dry cloth. Flush surface with an approved solvent cleaner. Wipe as required with a clean cloth and/or absorbent paper towel.	

Appendix III - Procedure B-1

Water Washable Color Contrast (Visible Dye) Penetrant Examination

Temperature Limits	50° to 125°F (10° to 50°C)	
Surface Conditioning Prior to Penetrant Inspection	As welded, cast, rolled, forged condition unless otherwise instructed.	
Preclean	Approved solvent cleaner. Allow to dry minimum 5 minutes prior to proceeding with the test.	
Penetrant Materials (Appendix V)	PENETRANT	DEVELOPER
	Water Washable Visible	Dry Developer Aqueous Developer Non-Aqueous Developer
Penetrant Application	Depending on whether penetrant is supplied in bulk containers or aerosol cans, application can be by dipping, brushing, flooding, or spraying.	
Penetrant Dwell Time	10 to 20 minutes depending on defect sought per Table 1.	
Excess Penetrant Removal	Removal with a coarse water sprayed on the surface to be examined. Water pressure not to exceed 50 psi and should be applied with a droplet type sprayer specifically designed for penetrant removal. Caution must be taken not to over wash the part or area under test. The test surface must be dry prior to the application of Nonaqueous and Dry Developers.	
Developer Application	Standard Saudi Aramco Developer is Non-Aqueous in an aerosol can. Spray at 25cm to 30cm (10" to 12") from the surface. If Aqueous (water based) developer is used, flood the surface and allow to dry.	
Inspection Lighting	White Light – Min 32.5 ftc (350 lux). Recommended 100 ftc (1076 lux)	
Post Cleaning	Wipe surface clean with dry cloth. Flush surface with an approved solvent cleaner. Wipe as required with a clean cloth and/or absorbent paper towel.	

Appendix IV - Procedure B-3

Solvent-Removable Color Contrast (Visible Dye) Penetrant Examination

Temperature Limits	50° to 125°F (10° to 52°C)	
Surface Conditioning Prior to Penetrant Inspection	As welded, cast, rolled, forged condition unless otherwise instructed.	
Preclean	Approved solvent cleaner. Allow to dry minimum 5 minutes prior to proceeding with the test.	
Penetrant Materials (Appendix V)	PENETRANT	DEVELOPER
	Solvent Removable Visible	Dry Developer Aqueous Developer Non-Aqueous Developer
Penetrant Application	Depending on whether penetrant is supplied in bulk containers or aerosol cans, application can be by dipping, brushing, flooding, spraying or by rag.	
Penetrant Dwell Time	10 to 20 minutes depending on defect sought per Table 1.	
Excess Penetrant Removal	Removal with a dry, clean, lint free cloth or paper towel, followed by moistened clean, lint free, white cloth or paper towel with final removal to assure sufficient removal with a dry, lint free white cloth or paper towel.	
Developer Application	Standard Saudi Aramco Developer is Non-Aqueous in an aerosol can. Spray at 25cm to 30cm (10" to 12") from the surface. If Aqueous (water based) developer is used, flood the surface and allow to dry.	
Inspection Lighting	White Light – Min 32.5 ftc (350 lux), recommended 100 ftc (1076 lux)	
Post Cleaning	Wipe surface clean with dry cloth. Flush surface with an approved solvent cleaner. Wipe as required with a clean cloth and/or absorbent paper towel.	

Appendix V - Approved Penetrant Materials

Permissible Penetrant, Removers and Developers

The following manufacturers and their product designations are only examples of typical product combinations. The user is not limited from selecting other manufacturers and their products.

Water Washable, Fluorescent Penetrant System - Procedure A-1

Manufacturer	Penetrant	Remover	Developer
Sherwin	HM-440, HM-430	Water	D-100, D-100NF
Ardrox	P133D, P134D, P135D	Water	9D1B
Magnaflux	ZL-60C	Water	SKD-LT or ZP-9F

Solvent-Removable, Fluorescent Penetrant System - Procedure A-3

Manufacturer	Penetrant	Remover	Developer
Sherwin	RC-50, RC-65	DR-60, DR-61	D-100, D-100NF
Ardrox	985-P12, 985-P13	9PR50	9D1B
Magnaflux	ZL-27A	SKC-NF	SKD-LT or ZP-9F

Water Washable, Color Contrast Penetrant System - Procedure B-1

Manufacturer	Penetrant	Remover	Developer
Sherwin	DP-51	Water	D-100, D-100NF
Ardrox	906/303A	Water	9D1B
Magnaflux	SKL-WP	Water	SKD-NF, SKD-S, ZP-9B
Turco	DY-CHEK WW-1A	Water	DY-CHEK NAD

Solvent-Removable, Color Contrast Penetrant System - Procedure B-3

Manufacturer	Penetrant	Remover	Developer
Sherwin	DP-40	DR-60, DR-61	D-100, D-100NF
Ardrox	996/P300A	9PR50	9D1B
Magnaflux	SKL-HF	SKC-NF, SKC-S	SKD-NF, SKD-S, ZP-9B
Turco	DY-CHEK	DY-CHEK REMOVER #3	DY-CHEK NAD

Note: The latest list of approved materials shall be held by the Supervisor, NDT Unit, Dhahran.
Phone 874-6605.

Appendix VI - Ultraviolet Light Utilization Requirements

- 1 Examinations requiring the use of ultraviolet light shall be conducted in a darkened area of 22 lux (lx) [2 foot candles (ftc)] or less of white light intensity as measured at the surface to be tested. Every attempt shall be made to darken the area as much as possible prior to conducting a fluorescent penetrant examination through the use of a blanket, hood, or portable booth.
- 2 The ultraviolet light intensity at the examination surface shall be measured:
 - 2.1 At least every 4 hours.
 - 2.2 Whenever the work location is changed.
 - 2.3 After changing a component of the unit such as a filter or bulb.
 - 2.4 After a UV light unit failure.
- 3 The ultraviolet light intensity shall be determined using a UVP Model J-221 Long Wave UV Meter, Spectroline DSE-100X, DME-365, or equivalent. The light meters shall be calibrated every 6 months and bear an authentic seal which presents the date calibration was accomplished and the next due date.
- 4 A minimum of 3000 $\mu\text{W}/\text{cm}^2$ is required for field inspections in areas of ambient white light which exceed 2 ftc as measured at the examination surface. A minimum value of 1000 $\mu\text{W}/\text{cm}^2$ is required for work in a darkened area of 2 ftc or less.
- 5 Ultraviolet light intensity shall be measured at the examination surface prior to the fluorescent PT examination. The light sensor shall be placed on the surface to be tested. The black light should be centered perpendicular (90°) to the light sensor at a distance of 15 inches (38.1 cm). The light should be placed to achieve the highest intensity light meter reading. The reading shall be recorded on the PT Inspection Report and the Light Intensity Log Sheet.
- 6 A UV Light Intensity Log Sheet shall be kept with the UV light unit at all times and the UV light unit intensity monitored for fading trends (decreased output) before each usage.

Appendix VI (Con't)

Ultraviolet (Uv) Light Intensity Log

UV LIGHT MFG: _____ UV LIGHT MODEL #: _____

UV LIGHT S/N: _____ LOCATION: _____

[illegible]

NOTES:

- Ambient white light 2 ftc or less.
- If UV meter reads lower than 1000 $\mu\text{W}/\text{cm}^2$, clean the filter and reflector as required and re-measure. If still below 1000 $\mu\text{W}/\text{cm}^2$, replace bulb.
- UV light intensity should be minimum 1000 $\mu\text{W}/\text{cm}^2$ @ 15 inches in a darkened area and 3000 $\mu\text{W}/\text{cm}^2$ @ 15 inches in all other areas.

Appendix VII – Example Liquid Penetrant Testing Acceptance Criteria

Code	Rejection Criteria
API STD 1104	- Linear Indications Indications > 1/16" (1.6 mm) shall be considered as relevant. Relevant indications are rejectable if: Evaluated as crater cracks or star cracks and >5/32" (4 mm) in length. Evaluated as cracks other than crater cracks or star cracks. Evaluated as IF and >1" (25.4 mm) in total length in a continuous 12" (305 mm) weld or >8% of the weld length. - Rounded Indications. For evaluation, the maximum dimension of rounded indications shall be considered. Indications are rejectable defects if: Individual indication >1/8" (3.2 mm) or 25% of the thickness of the thinner member, whichever is less. Distribution of scattered rounded indications exceed the concentration of API STD 1104, Figures 18 or 19. Clustered rounded indications >1/2" (12.7 mm) are present. Combined length of clustered indications > 1/2" in any 12" (305 mm) of weld. Any individual indication in a cluster >1/16" (1.6 mm).
ANSI/ASME B31.1 & ANSI/ASME B31.3	Indications > 1/16" (1.6 mm) shall be considered as relevant - Linear Indication: Any Crack or linear indication - Rounded Indications Indications with dimensions > 3/16" (4.8 mm) Four or more rounded indication in a line separated by 1/16" (1.6 mm) or less edge to edge. Ten or more rounded indication in any 6 in² (3870 mm²) of surface with the major dimension of this area not to exceed 6 in. (150 mm).
ASME SEC VIII, Div 1	Indications > 1/16" (1.6 mm) shall be considered as relevant The following Indications shall be rejectable: - Relevant linear indication > 1/16" (1.6 mm) - Relevant rounded indications > 3/16" (4.8 mm) - Four or more rounded indications in a line separated by 1/16" (1.6 mm) or less (edge to edge).
AWS D1.1	Acceptance/Rejection criteria is dependent on service condition. Refer to the relevant project engineer or the Inspection Department.

Note: The examiner must verify actual acceptance criteria per the applicable code or purchase specifications.

II

Appendix VIII – Liquid Penetrant Examination Request & Report Form

Log No.	B.I. No.	J.O. No.	Plant No.	Plant Name	Contractor			
Location/Kilometer Reference		Saudi Aramco Rep.	Unit	Requested by:		Phone:	Date:	
Technician Level		Code / Acceptance Criteria		Material Type	Material Form		Sch. / Thickness	
Liquid Penetrant System: A-1 _____ A-3 _____ B-1 _____ B-3 _____		Penetrant Mfg	Penetrant Batch No.	Penetrant P/N	Remover P/N.	Developer P/N.		
Surface Temperature	White Light Intensity	UV Light Intensity	UV Light Model No.	UV Meter Model No.	Material Form			
Surface Condition / Part Description								
Item No.	Drawing No.	Equipment P/N Line Reference	Weld No.	Welder Symbol	Exam Results		REPAIR LOCATION	DEFECT TYPE & SIZE
					ACC	REJ		
Interpretation by: (print) _____			Badge No.		Signature:		Date:	
PT Level II / PT Level III								

NOTES:

1. All blanks are to be filled in or marked N/A (not applicable).
2. Examination performed by Level I require a sign-off by Level II or Level III.