SARA SAE PRIVATE LIMITED

Management System Document Control Cover Sheet

Document Title	Ref. No.	Revision No.
Procedure for Magnetic Particle Testing	**SSE-QAD-MT-1/97**	**7**

	Name	Position	Signature	Date
Review &Approved by	VARUN SHARMA	ASNT NDT LEVEL III RT, UT, MT, PT. File No 188262		25/05/2019
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Revision No.	Effective Date	Description / Summary of Revision
0	10/11/2012	Initial Issue
1	10.02.2009	Change of name of company “Sara Sae” to “NOV Sara “
2	21.10.2011	Change of name of company “NOV Sara” to “SARA SAE”
3	10.11.2012	Clauses identified with “line on left ” amended
4.	25.04.2014	Compliances with FMC Doc. No. Q01114.
5.	08.11.2015	Compliances with FMC Doc. No. Q01114 Rev. AA, API 6A, API 16A, API 16C
6.	05.06.2017	Compliance with TechnipFMC Doc. No. Q01114 Rev. AB.
7.	25.05.2019	Compliance with Client procedure. Complete formatting edited.

1.0 PURPOSE:

1.1 The purpose of this procedure is to establish the requirements for magnetic particle inspection of ferromagnetic materials.

1.2 This procedure provides a system of general conditions and specific instructions as an aid to qualified personnel required to perform magnet particle inspection, using A.C /HWDC Electromagnets.

2.0 SCOPE:

2.1 This procedure gives the methods, techniques, quality, and reporting requirements necessary for the magnetic particle inspection of ferromagnetic materials.

2.2 This procedure covers the magnetic particle inspection of ferromagnetic materials in forgings and fusion welded butt joints in plate and pipe welds, using the magnetic flow technique with A.C /HWDC. Electromagnet yokes. All welds examined shall include 13mm of adjacent base metal on both sides of weld. Prods are not permitted on well fluid surface or sealing surface. DC Yokes and permanent magnets are not permitted.

2.3 The test shall be carried out by continuous wet visible, wet fluorescent and dry magnetic particle method with white contrast paint.

2.4 This procedure covers requirement of PSL 3, all accessible wetted surface and all accessible sealing surfaces of each finished part shall be magnetic Particle inspected after final heat treatment and final machining operations. All magnetic Particle Examination shall use the wet Fluorescent Method. Duplex and super Duplex materials are not suitable for MPT.

2.5 This procedure is applicable to casting components, forging components as well as welded joints for equipment's to be designed, manufactured and tested as per API 6A and other applicable Codes.

2.6 Duplex and Super Duplex Stainless Steels may exhibit ferromagnetic properties but shall not be considered ferromagnetic. Liquid penetrant shall be used for examination of these materials

3.0 REFERENCE STANDARDS:

The latest edition of the Standards and References cited were utilized in the current release of this inspection method. Changes to these Standards and References determined to affect the quality of the products and services of the project shall be cause for revision to this document.

3.1 ASTM E-709 - 15.

3.2 ASME Sec. V Article 7: 2017: ASME BPVC Non-destructive Testing: Magnetic Particle Examination

3.3 API 1104 - Welding of Pipelines and Related Facilities.

3.4 ASME Vlll - Rules for the Construction of Pressure Vessels. Division 1.

3.5 ASMEB31-3 - Chemical Plant and Petroleum Refinery Piping.

3.6 AWSD1.1 - Structural Welding Code.

3.7 SARA SAE Quality Assurance Manual
3.8 SDP-22-004 Personal Certification
3.9 SDP-27-009 Control of Non-Conforming Products
3.10 American Petroleum Institute (API)
3.11 Specification 6A "Specification for Well Head and Christmas Tree Equipment"
3.12 Specification 7K "Specification for "Drilling Well services"
3.13 Specification 11E "Specification for Pumping Units"
3.14 Specification 16A "Specification for Drill through Equipment"
3.15 Specification 16C "Specification for Choke and kill system"
3.16 Specification 16D "Specification for Control System for Drilling Well Control equipment"
3.17 SNT–TC–1A: 2016: Recommended guidelines for qualification and certification of NDT Personnel.
3.18 Cameron Specification No. X – 008061 Rev. 16

4.0 RESPONSIBILITIES:

4.1 The President/Manager QA shall be responsible for ensuring that the necessary resources are available for the requirements of this procedure to be carried out.

4.2 Operations Management/NDT Level III shall be responsible for ensuring that the requirements of this procedure are fully implemented at all times.

4.3 Employees involved in the implementation of this procedure shall be responsible for adherence to the requirements stated within

5.0 EXAMINATIONCOVERAGE:

5.1 Areas of the component to be examined shall be as specified by customer, applicable engineering specification or agreed quality plan with customer.
5.2 All examination shall be conducted with minimum 10% overlap for assuring 100% coverage of the required area.

6.0 PERSONAL REQUIREMENTS:

6.1 All non-destructive testing personnel performing examination in accordance with this procedure are qualified in accordance with SARA Written Practice (SES -26 - 743), which meets or exceeds the requirement of ASNT recommended practice SNT–TC–1A - 2016.
6.2 Personnel performing specific calibrations and examinations to evaluate for acceptance or rejection in accordance with this specification and recording results shall be qualified and certified to at least Level I.
6.3 Personnel interpreting and evaluating results of examinations with respect to applicable codes and standards shall be qualified and certified to at least Level II
6.4 All NDE Level I, NDE Level II or NDE Level III certification of personnel shall be valid and current as per Written Practice Number:SES -26 – 743latest revision.

7.0 EQUIPMENT:

The equipment may be stationary, portable, or a hand held yoke. The magnetizing equipment shall be equipped with a power source capable of delivering the required

current levels necessary to produce the magnetic field. Either alternating current (AC) or half wave rectified direct current.(HWDC) shall be used.

7.1 Accessories: Following accessories shall be used with above mentioned magnetic particle testing equipment:

7.1.1 Calibrated Ultraviolet Light intensity measuring instrument (Measuring Unit: Micro watt/ cm2).

7.1.2 Calibrated visible light level measuring instrument (Measuring Unit: Lux).

7.1.3 Calibrated residual field measuring instrument. (Measuring Unit: Gauss).

7.2 Calibration / verification of equipment and accessories shall be performed in accordance with below intervals of E- 709 and whenever maintenance is performed which affects the function of the equipment.

TABLE 1 Required Verification Intervals

Item	Maximum Time Between Verification[A]
Lighting:[B]	
Visible light intensity	Weekly
Ambient light intensity	Weekly
Black light intensity	Daily
Battery powered black light intensity check	Before and after each use
Black light integrity	Weekly
System Performance:[B]	Daily
Wet particle concentration	8 hours, or every shift change
Wet particle contamination:[B]	1 week
Water break test	Daily
Equipment calibration check:[B]	
Ammeter accuracy	6 months
Timer control	6 months
Quick break	6 months
Yoke dead weight check	6 months
Black and white light meters	6 months
Gaussmeter or Field Indicator accuracy	6 months

7.3 When the electromagnetic yoke will lift the weight as follows at maximum leg spacing, it is considered verified to have the necessary power required to perform the examination. The verification interval for the dead weight check on electromagnetic yoke is every six months and after any repairs that could affect its operation.

7.4 The dead weight test shall be performed using 10 pound (4.5 kg) weight for AC yokes with leg spacing of 2 to 4 inch.

7.5 The dead weight test shall be performed for DC yoke using 30 pound (13.5 kg) weight with the legs spaced at 2 inch to 4 inch or a 50 pound (23.0) weight with legs spaced at 4 inch to 6 inch.

7.6 A streaker or other identification means shall be provided as evidence that verification has been performed in the past six months to preclude conducting the verification test each time it is used. If for any reason, a verification sticker or other identification of verification is not provided, then yoke shall be re-verified.

8.0 Examination Medium:

The magnetic particle examination shall use any of the below Magnetic particles. Particles manufactured by MAGNAFLUX (Table 1) shall be used.:

8.1 Fluorescent Magnetic Particle:

8.1.1 Visible Ambient Light Level — Examine fluorescent penetrant indications under black light in a darkened area. Visible ambient light should not exceed 2 ft candles (20 Lx).

8.1.2 Black Light Intensity - The black light intensity at the examination surface shall be not less than 1000 µW/cm2 when measured with a suitable black light meter.

8.1.3 Black Light Warm-up - Allow the black light to warm up for a minimum of 5 min prior to its use or measurement of the intensity of the ultraviolet light emitted.

8.1.4 Dark Area Eye Adaptation - It is recommended that the inspector be in the darkened area for at least 5 min prior to examining parts using black light so that his eyes will adapt to dark viewing.

8.1.5 Photo chromatic or permanently tinted lenses shall not be worn during examination.

8.1.6 The ultraviolet light source intensity shall be measured at the start of each magnetic particle examination, at the beginning of shift, at maximum interval of 8 hours of continuous magnetic particle examination, when the work location is changed or when the light is extinguished and re-lighted.

8.1.7 Unacceptable intensity readings will result in re – inspection of all parts examined since the last acceptable intensity reading.

8.2 Dry Particle:

Visible dry magnetic powders are to be applied by dusting directly onto the surface of the part being examined. Reuse of the dry particle powder is not permitted under this procedure.

8.2.1 The area under inspection shall be illuminated by daylight or artificial light from either a normal tungsten filament lamp or a fluorescent tube, to a level of illumination not less than 100 FTC (1076 Lux) so as to enable a proper evaluation to be made of the indications revealed. The viewing conditions shall be such that no glare will be experienced during inspection of the component.

8.2.2 Unacceptable intensity readings will result in re – inspection of all parts examined since the last acceptable intensity reading.

8.3 Wet Particle Systems:

The dry or paste concentrate particles are to be suspended in a vehicle such as water or light petroleum distillate. The manufacturer supplied the pre-mixed wet particles in right concentration with suspending in light petroleum distillate in aerosol cans. The wet particles always applied on the best surface by spraying.

Table-1.

Type of Particle	Color	Manufacturer	Model	Particle Size Unit: u
Wet Visible Type	Black ink	Magnaflux	7HF	Less than 45 u
	White Contrast	Magnaflaux	WCP-2	Less than 45 u
Wet Fluorescent Type	Yellow Green	Magnaflaux	14HF	Less than 45 u
Dry Powder	Red	Magnaflaux	8A	Less than 180 u

9.0 Wet Particle System:

9.1 Wet Bath Concentration Check:

9.1.1 The bath concentration shall be checked at least once every 8 hours of operation when magnetic particle testing is being performed and at any other time deemed necessary by the operator

9.1.2 Turn on the bath circulation pump and mechanically agitate the bath. Flush the hose and allow the pump to agitate the bath for a minimum of 30 minutes.

9.1.3 Bath concentration shall be determined by settling volume through the use of an pear-shaped centrifuge tube as specified in ASTM E-709 with a 1-mL stem (0.05 mL division) for fluorescence particles and 1.5-mL stem (0.1 mL division) for visible particles. The settling time shall be 30 minutes for aqueous suspension (water suspension) and 60 minutes for non aqueous suspension (oil suspension). The volume setting out at the bottom of the tube is indicative of the particle concentration in the bath.

9.1.4 If the bath concentration is low in particle content, add the sufficient amount of particle materials to obtain desired concentration; if the suspension is high in the material add sufficient water to obtained desired concentration.

9.1.5 If the settled particle appears to be loose agglomerates rather than a solid layer, take a second sample. If still agglomerated, the particles may have bacome magnetized; and shall be replaced.

9.1.6 The allowable settling volume of suspended fluorescent particles shall be between 0.1 ml to 0.4 ml. If the bath concentration found more than 0.4 ml add additional liquid and recheck the concentration as above. If the bath concentration found less than 0.1 ml then add some particles and recheck the bath concentration again.

9.1.7 Visible Magnetic particles, having good contrast with backing examination surface, can also be used in place of Fluorescence Magnetic Particles with ferromagnetic suspension as shallow in following table. Fluorescence Visible Magnetic Particles suspended in water or kerosene with the concentration of 1.2 mL to 2.4 mL per 100 mL of bath sample, measured with pear shaped centrifuge tube, shall be used.

9.1.8 Examination with wet visible magnetic particle testing technique shall be limited to as welded joints with surface preparation with wire brush or welded joints with surface preparation with grinding process.

9.1.9 For magnetic particle examination of components with PSL 3 / 3G and PSL 4 only continuous wet fluorescent magnetic particle examination technique shall be used.

9.2 Wet Bath Contamination:

9.2.1 The bath shall checked daily for contaminants such as dirt, scale, oil, lint, or other material which can reduce the performance of magnetic particle examination.

9.2.2 The liquid vehicle shall be examined with a black light. The liquid will have a little fluorescence. Its colour can be compared with a freshly made-up sample. If used sample is noticeably more fluorescent than the comparison standard, the bath shall be replaced.

9.2.3 The graduated portion of the centrifuge tube shall be examined under an ultraviolet light for striation, bands, difference in colour or appearance. Bands or striation may indicate contamination. If the total volume of contaminates, including bands or striations exceeds 30% of the volume of magnetic particles, or if the liquid is noticeably fluorescent, the bath shall be replaced.

9.3 WATER BREAK CHECK:

9.3.1 When water is used as vehicle in ferromagnetic suspension, water break check shall be performed daily as per Paragraph 20.7.5 of ASTM E 709.

9.3.2 The water break check shall be performed by flooding a part, similar in surface finish to those under examination, with suspension, and then noting the appearance of the surface of the part after the flooding is stopped. If the film of suspension is continuous and even all over the part, sufficient wetting agent is present. If the film of suspension breaks, exposing bare surfaces of the part, and the suspension forms many separate droplets on the surface, more wetting agent is needed or the part has not been sufficiently cleaned. When using the fluorescent method, this check shall be performed independently under both black light and visible light.

10.0 GENERAL EXAMINATION REQUIREMENTS:

10.1 Surface Conditioning:

10.1.1 Satisfactory results are generally obtained when the surface are in the as-welded, as-rolled, as-cast or as-forged condition.

10.1.2 However surface preparation by grinding or machining may be necessary where the surface irregularities could mask indications due to discontinuities.

10.1.3 Extraneous Matter. Prior to magnetic particle examination, the surface to be examined and all adjacent areas within at least one inch must be dry and free of all dirt, grease, lint, scale, welding flux and spatter, oil or other extraneous matter that could interfere with the examination.

10.1.4 Cleaning. Cleaning of surfaces is accomplished using detergents, organic solvents, descaling solutions, paints removers, vapour degreasing, sand or grit blasting or ultrasonic cleaning methods. These and /or other methods must have no detrimental effect on the component or the MPT consumables.

10.1.5 The temperature at the examination surface shall be below 135 Deg. F.

10.1.6 Thin, nonconductive coatings (such as paint) in the order of 0.02 to 0.05 mm (1 or 2 mils) will not normally interfere with the formation of indications, but they must be removed at all points where electrical contact is to be made for direct magnetization

10.1.7 If a nonconductive coating/plating is left on the area to be examined that has a thickness greater than 0.05 mm (2 mils), it must be demonstrated that discontinuities can be detected through the maximum thickness applied. The results of this demonstration must be documented and retained on file. The NDT Level III shall retain the results of this demonstration.

10.1.8 Where a rust preventative oil has been applied, thorough cleaning is necessary for performance of the examination.

10.1.9 Before magnetic particle examination is conducted, a check of the examination surface shall be conducted to locate any surface discontinuity openings which may not attract and hold magnetic particles because of their width.

10.2 Magnetic Field Strength:

10.2.1 Suitable means of establishing the necessary magnetic flux shall be either by passing a current through the material with contact electrodes, or by inducing a field in the part with coils or central conductors, using one or more of the techniques. The use of hand held prods to achieve magnetization is not allowed on wetted or sealing surfaces. The use of such prods is not permitted without prior written agreement with clients.

10.2.2 Sufficient magnetic field strength can be established by:

10.2.2.1 Known Discontinuities – Experiments with similar/identical parts having known discontinuities in all areas of interest.

10.2.2.2 Artificial Discontinuities – Verification of indications derived from AS 5371 shims is an effective means of verifying field strength when using the continuous method.

10.2.2.3 Hall-effect Meter

10.2.2.4 Using Empirical Formulas

10.2.2.5 Note: The pie gage may be used in conjunction with the formulas in this procedure and are typically for field direction only.

10.2.2.6 The field strength of an electromagnetic yoke is verified when the dead weight test is performed as described in Paragraph 5.6. The field/magnetic flux indicator may be used when deemed necessary by the technician to verify the field strength in the area of examination. This verification shall be performed daily prior to use.

10.3 Direction of Magnetization:

10.3.1 To ensure the most effective detection of discontinuities, it is necessary to examine each area at least twice, with lines of flux in one case approximately perpendicular to the lines of flux in the other.

10.4 Magnetizing Method

10.4.1 Perform the inspection using the continuous method; that is, bathing the part with the examination medium to provide an abundant source of suspended particles on the surface of the part and terminating the bath application immediately prior to cutting off the magnetizing current. Proper sequencing of the operation is essential to indication formation and retention.

11.0 INSPECTION TECHNIQUES:

The electromagnetic yoke shall be placed on each area two times for magnetic particle examination such that the yoke placement on the same area shall be perpendicular to yoke placement for first case in the same area. Alternating or direct current electromagnetic yokes, shall be used to create a longitudinal field between the poles.

12.0 STEPS FOR OPERATION:

Magnetization shall be perform on each area at least twice, with lines of magnetic flux during second magnetization shall be approximately perpendicular to first magnetization. For this purpose, the electromagnetic yoke shall be placed on each area two times for magnetic particle examination such that the yoke placement on the same area shall be perpendicular to yoke placement for first case in the same area.

13.0 DEMAGNETIZATION:

13.1 The component shall be demagnetized after completion of magnetic particle examination and after interpretation and evaluation of test results.

13.2 The demagnetization shall be performed using electromagnetic yoke. The yoke shall be put in AC mode and place its pole on the part. Then move the yoke around the area and slowly withdraw the yoke away from part when AC is flowing through it. It is recommended that yoke should withdraw up to 3 foot distance for demagnetization whenever possible.

13.3 After demagnetizing the residual magnetism shall be checked in the forging. The forging showing residual magnetization more than 3 gauss shall be demagnetized again. The forging showing residual magnetic field less than or equal to 3 gauss are acceptable for residual magnetic field.

14.0 POST CLEANING

14.1 After completion of interpretation and evaluation of indication, reporting and demagnetization, the examination surface shall be cleaned for removal of all residual magnetic particles and liquid from examination surface.

14.2 Post cleaning shall be performed with dray rag, hand wire brush, solvent cleaning or with detergent and water.

15.0 OVERHEATING AND ARC BURNS

15.1 Care shall be taken to prevent local overheating, arcing, or burning the surface being inspected, particularly on high carbon or alloy steels where hard spots or cracks could be produced by improper magnetizing techniques. Arc strikes shall be ground out and re-inspected

16.0 EVALUATION OF INDICATIONS:

16.1 All indications shall be investigated to the extent that the Inspector can evaluate such indications in terms of the applicable acceptance criteria.

16.2 Indications shall be clearly marked for identification and disposition.

16.3 Relevant indications are those which result from mechanical discontinuities.

16.4 Relevant Indication - An indication with the major dimension greater than 1/16" (1.5mm).

16.5 Such indications shall include the following:-

- **16.5.1** Cracks.
- **16.5.2** Linear indications – those indications in which the length is equal to, or greater than three (3)times the width.
- **16.5.3** Rounded indications or indications which are circular or elliptical with the length less than three (3)times the width.

16.6 Non-relevant indications include:-

- **16.6.1** Localized surface imperfections, such as may occur from machining marks or surface conditions. These are not relevant to the detection of unacceptable discontinuities and shall not be reported.

16.7 Any questionable or doubtful indications shall be retested to verify whether or not actual discontinuities are present.

16.8 As a guide, this can be achieved by using either a fluorescent tube of 8OW at a distance of approximately 1m or a tungsten filament pearl lamp of 100W at a distance of approximately 0.2m.

16.9 If any indications are believed to be non-relevant on the basis that they are not associated with a surface rupture (i.e. magnetic permeability variations ,non metallic stringers) , they shall be examined by LPT methods , or removed and re-inspected, to confirm their non-relevancy.

17.0 ACCEPTANCE STANDARDS

17.1 The acceptance standards for the interpretation of items inspected shall be Client requirements or the Contract Document.

17.2 If no Client requirements or Contract Document are available the international specification relevant to the work scope shall be used.

17.3 Annexure A& B shall be referred for all acceptance criteria.

18.0 REPORTING

18.1 As a minimum following information shall be documented in report:
18.2 Name of customer.
18.3 Identification of items examined (part number, serial number, drawing number, purchase order number, heat number, lot number as applicable).
18.4 Procedure number and revision, acceptance criteria.
18.5 Area examined or location of magnetic particle examination.
18.6 Forging material and forging thickness at examination surface.
18.7 Magnetic Particle Examination technique, type of equipment used, type of current and amount of current used, type of magnetic particles (wet, fluorescent as per this procedure), type of vehicle, method of application of magnetic particle suspension, bath concentration, coil turns etc.
18.8 Interpretation and evaluation of all relevant indications and their locations.
18.9 Lighting equipment (Artificial lighting, if used)
18.10 Demagnetizing technique.
18.11 Post-examination Cleaning.
18.12 The inspector's signature and level of certification.
18.13 The names and employers of any witnesses to the examination.

19.0 Safety:

S/N#	Safety Requirements	Remarks
1.	Electrical Safety	a. The cables used with ultraviolet lamp as well as electromagnetic yoke must be shock proof with proper connectors. The connecters shall be connected to electric plug having proper earthling for preventing shock.
2.	Personnel Safety	a. The incandescent lamp whenever used must be used in glass envelop having shielding on top side for preventing glare in operator's eyes. b. The ultraviolet lamp must always use with filter. The filter shall have any crack. c. The ultraviolet lamp must always face down. d. Avoid direct contact on ultraviolet light on eyes and skin. e. Hand gloves for preventing direct contact of hand skin with ferromagnetic material or test surface. f. Nose mask for preventing air bon parting entering in inertia of operator. g. Wear safety shoes and safety helmet. h. Wear safety belt during working at height.
3.	Fire Safety	a. Pre-mixed bath samples or oil vehicle for wet ferromagnetic particle suspension are flammable. They must be stored in dry and cooled place having storage temperature range specified by the manufacturer. b. Material Safety Data Sheet specified by the pre-mixed ferromagnetic suspension bath material manufacturer must be followed. c. Pre-mixed ferromagnetic bath suspension or oil based wet suspension must be protected from welding arc, grinding spark etc. which can cause fire.

Annexure A

Details of interpretation and evaluation for Magnetic Particle Examination as per API 6A Specification:

Following criteria shall be applied when drawing / purchase order specification / job specification requires Magnetic Particle examination as per API 6A Specification:

1.0 Interpretation of indications observed during Magnetic Particle Examination:

1.1 An indication is the evidence of a mechanical imperfection. An indication of an imperfection may be larger than the imperfection that caused it, however the size of the indication is the basis for acceptance evaluation.

1.2 Only indications with major dimensions greater than 1.5 mm shall be considered relevant.

1.3 A linear relevant indication is one having length (major dimension) equal to or greater than three times the width (minor dimension).

1.4 A rounded indication is one of circular or elliptical shape with the length (major dimension) less than three times the width (minor dimension).

1.5 If indications are believed to be non-relevant, they shall be examined by liquid penetrant surface NDE methods in accordance with ASTM E165, or removed and re-inspected, to prove their non-relevancy.

2. Acceptance Criteria:

Sr. No.	Job Description	Acceptance Criteria Details
2.1	Material – Surface NDE: Magnetic Particle Examination (Paragraph 7.4.2.2.8 for PSL 2, Paragraph 7.4.2.3.8 for PSL 3/3G and Paragraph 7.4.2.4.8 PSL 4)	For PSL 3 / 3G, magnetic particle examination shall be performed by wet fluorescent technique. The following acceptance criteria shall apply: a. No relevant linear indication. b. No relevant rounded indication with a major dimension equal to or greater than 5 mm. c. No more than 10 relevant indications in any continuous 40 cm^2 area. d. Four or more relevant indications in a line separated by less than 1.6 mm edge to edge are unacceptable. e. No relevant indications in pressure contact sealing surface.

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Sr. No.	Job Description	Acceptance Criteria Details
2.2	Weld – Surface NDE: Magnetic Particle examination PSL 2 and PSL 3 / 3G (Paragraph 7.4.2.2.12 (b) for PSL 2 and 7.4.2.3.11 for PSL 3 /3G)	Examination shall include a minimum of 13 mm of adjacent base metal on both sides of the weld. For PSL 3 / 3G, magnetic particle examination shall be performed by wet fluorescent technique. The following acceptance criteria shall apply: a. No relevant linear indication. b. No rounded indication greater than 3 mm for welds whose depth is 16 mm or less or no rounded indication greater than 5 mm for welds whose depth is greater than 16 mm. ***c. No more than 10 relevant indications in any continuous 40 cm^2 area.*** d. Four or more relevant indications in a line separated by less than 1.6 mm edge to edge are unacceptable. e. No relevant indications in pressure contact sealing surface.
2.3	Repair Weld PSL 2 and PSL 3 / 3G (Paragraph 7.4.2.2.13 for PSL 2 and PSL 3 /3G)	Examination shall include a minimum of 13 mm of adjacent base metal on all sides of the weld. Surface preparation for welding shall be examined prior to welding to ensure defect removal to acceptable level method and acceptance criteria shall be as per raw 2.2 above. The following acceptance criteria shall apply: a. No relevant linear indication. b. No rounded indication greater than 3 mm for welds whose depth is 16 mm or less or no rounded indication greater than 5 mm for welds whose depth is greater than 16 mm. ***c. No more than 10 relevant indications in any continuous 40 cm^2 area.*** d. Four or more relevant indications in a line separated by less than 1.6 mm edge to edge are unacceptable. e. No relevant indications in pressure contact sealing surface.

ANNEXURE B: Details of interpretation and evaluation for Magnetic Particle Examination as per API 16A Specification:

Following criteria shall be applied when drawing / purchase order specification / job specification requires Magnetic Particle examination as per API 16A Specification:

1.0 Interpretation of indications observed during Magnetic Particle Examination:

1.1 An indication is the evidence of a mechanical imperfection. An indication of an imperfection may be larger than the imperfection that caused it, however the size of the indication is the basis for acceptance evaluation.
1.2 Only indications with major dimensions greater than 1.5 mm shall be considered relevant.
1.3 A linear relevant indication is one having length (major dimension) equal to or greater than three times the width (minor dimension).
1.4 A rounded indication is one of circular or elliptical shape with the length (major dimension) less than three times the width (minor dimension).
1.5 If indications are believed to be non-relevant, they shall be examined by liquid penetrant surface NDE methods in accordance with ASTM E165, or removed and re-inspected, to prove their non-relevancy.

2.0 Acceptance Criteria:

Sr. No.	Job Description	Acceptance Criteria Details
2.1	Equipment and Parts – surface other than pressure contact (metal to metal) sealing surface. (Paragraph 7.5.1.9.5.3)	a. No Relevant Linear indication. b. No relevant rounded indication with a major dimension equal to or greater than 5 mm. c. No more than 10 relevant indications in any continuous 40 cm^2 area. d. Four or more relevant indications in a line separated by less than 1.6 mm (edge to edge) are unacceptable.
2.2	Equipment and Parts –pressure contact (metal to metal) sealing surface. (Paragraph 7.5.1.9.5.4)	a. There shall be no relevant indication in the pressure contact (metal to metal) sealing surface.

Sr. No.	Job Description	Acceptance Criteria Details
2.3	Weld – Surface NDE: Magnetic Particle examination (Paragraph 7.5.1.13.2 a)	Examination shall include a minimum of 13 mm of adjacent base metal on both sides of the weld. The following acceptance criteria shall apply: a. No Relevant Linear indication. b. No rounded indication greater than 3 mm for welds whose depth is 16 mm or less or no rounded indication greater than 5 mm for welds whose depth is greater than 16 mm. c. No more than 10 relevant indications in any continuous 40 cm^2 area. d. Four or more relevant indications in a line separated by less than 1.6 mm (edge to edge) are unacceptable. e. There shall be no relevant indications in the pressure contact sealing surfaces.
2.4	Defect removal area prior to weld repair (Paragraph 7.5.1.14)	Surfaces of ground-out area for repair welds shall be examined prior to welding to ensure defect removal using the acceptance criteria of fabrication weld (sr. no. 2.3 above).
2.5	Repair weld (Paragraph 7.5.1.14)	Examination shall include a minimum of 13 mm of adjacent base metal on all sides of the weld. The following acceptance criteria shall apply: a. No Relevant Linear indication. b. No rounded indication greater than 3 mm for welds whose depth is 16 mm or less or no rounded indication greater than 5 mm for welds whose depth is greater than 16 mm. c. No more than 10 relevant indications in any continuous 40 cm^2 area. d. Four or more relevant indications in a line separated by less than 1.6 mm (edge to edge) are unacceptable. e. There shall be no relevant indications in the pressure contact sealing surfaces.

ANNEXURE C: Details of interpretation and evaluation for Magnetic Particle Examination as per API 16C Specification:

Following criteria shall be applied when drawing / purchase order specification / job specification requires Magnetic Particle examination as per API 16C Specification:

1.0 Interpretation of indications observed during Magnetic Particle Examination:

1.1 An indication is the evidence of a mechanical imperfection. An indication of an imperfection may be larger than the imperfection that caused it, however the size of the indication is the basis for acceptance evaluation.
1.2 Only indications with major dimensions greater than 1.5 mm shall be considered relevant.
1.3 A linear relevant indication is one having length (major dimension) equal to or greater than three times the width (minor dimension).
1.4 A rounded indication is one of circular or elliptical shape with the length (major dimension) less than three times the width (minor dimension).
1.5 If indications are believed to be non-relevant, they shall be examined by liquid penetrant surface NDE methods in accordance with ASTM E165, or removed and re-inspected, to prove their non-relevancy.

2.0 Acceptance Criteria:

Sr. No.	Job Description	Acceptance Criteria Details
2.1	Material (Paragraph 7.4.6.9.2.5)	Following acceptance criteria shall be applied: a. No Relevant Linear indication. b. No relevant rounded indication with a major dimension equal to or greater than 4.8 mm. c. No more than ten relevant indications in any continues 152.4 mm (6 Inch) square area. d. Four or more relevant indications in a line separated by less than 1.6 mm (edge to edge) are unacceptable. e. No relevant indication in pressure contact sealing surface.
2.2	Weld – Surface NDE: Magnetic Particle examination (Paragraph 7.4.6.11.3.3 and 7.4.6.9.2)	Examination shall include a minimum of 13 mm of adjacent base metal on both sides of the weld. Following acceptance criteria shall be applied: a. No Relevant Linear indication. b. No rounded indication greater than 3.2 mm for weld whose depth is 15.9 mm or less and 4.8 mm for weld whose depth is greater than 15.9 mm. ***c. No more than ten relevant indications in any continues 152.4 mm (6 Inch) square area.*** d. Four or more relevant indications in a line separated by less than 1.6 mm (edge to edge) are unacceptable. e. No relevant indication in pressure contact sealing surface.
2.3	Defect removal area	Surfaces prepared for repair welding shall be examined prior to

	prior to weld repair (Paragraph 7.4.6.12)	welding to ensure defect removal of acceptable levels.
2.4	Repair weld (Paragraph 7.4.6.12.)	Examination shall include a minimum of 13 mm of adjacent base metal on all sides of the weld. The following acceptance criteria shall apply: Following acceptance criteria shall be applied: a. No Relevant Linear indication. b. No rounded indication greater than 3.2 mm for weld whose depth is 15.9 mm or less and 4.8 mm for weld whose depth is greater than 15.9 mm. ***c. No more than ten relevant indications in any continues 152.4 mm (6 Inch) square area.*** d. Four or more relevant indications in a line separated by less than 1.6 mm (edge to edge) are unacceptable. e. No relevant indication in pressure contact sealing surface.