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QUALITY CONTROL PROCEDURE FOR BACK PURGING OF PIPE WELDING

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FADHILI SULFUR RECOVERY UNIT
QUALITY CONTROL PROCEDURE FOR
BACK PURGING OF PIPE WELDING

1. SCOPE

This procedure defines the purging method during the welding of material of ASME P.No.5 and higher in accordance with international code and Saudi Aramco standards in Fadhili Sulfur Recovery Unit.

2. PURPOSE

This quality procedure describes the minimum quality requirements to ensure that back purging of ASME P.No.-5 and higher materials are performed in accordance with applicable Saudi Aramco specifications and international codes.

3. DEFINITIONS

PROJECT	: Fadhili Gas Plant Sulphur Recovery Unit- Package-3
COMPANY	: Saudi Aramco (SA)
CONTRACTOR	: Petrofac Saudi Arabia International Limited (PSAL)
SUB-CONTRACTOR	: Nasser S Al Hajri Corporation (NSH)
SAES	: Saudi Aramco Engineering Standard
SAEP	: Saudi Aramco Engineering Procedure
SAMSS	: Saudi Aramco Material System Specification
ITP	: Inspection and Test Plan
WPS	: Welding Procedure Specification

4. REFERENCES

SAES-W- 011	: Welding Requirements for On- Plot Piping
SAES-W-016	: Welding of Special-Resistance Materials
Applicable ITP	: Inspection and Test plan
Schedule "Q"	: Quality Requirements
ASME SEC.IX	: Welding and Brazing Qualifications
ASME B31.3	: Process Piping
AWS A5.32	: Specification for welding shielding gases
AWS D10.4	: Recommended practices for welding austenitic chromium – nickel stainless Steel piping and tubing
AWS D10.11	: Recommended practices for root pass welding of pipe without backing
PFI-ES-43	: Standard for protection of Austenitic Stainless Steel & Nickel Alloy Materials
NSH-PSAL-FSRU-PQP-QC-0001	: Project Quality Plan
NSH-PSAL-FSRU-PRO-PI-0006	: Welding Consumables Handling and Storage Procedure

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5. RESPONSIBILITIES

- 5.1 Project Manager** shall be the responsible for the overall implementation of the company safety & quality plan and ensure efficient execution of work in accordance with project specification and this procedure.
- 5.2 QC Manager** shall be responsible for ensuring all activities are carried out as per the project quality plan, project specifications, and this procedure. He shall ensure inspections, testing, and examinations are carried out as per the approved ITP.
- 5.3 Piping Manager** shall be responsible for ensuring all back purging activities are carried out as per this procedure. He shall have close coordinating with project quality control department. He shall co-ordinate with personnel at field, plan work schedule allocate job to piping superintendents.
- 5.4 Piping Superintendent** shall plan the daily work schedule; the job to concerned Supervisors and controlling piping works in the field. He shall be responsible for implementation of this procedure.
- 5.5 Piping Supervisor** shall be the responsible to ensure the safe and efficient working environment to monitor plant and equipment requirements and to ensure that productivity and quality are maintained by their subordinates. They are also responsible for ensuring that the proper back purging material is being used.
- 5.6 QC Supervisor** shall arrange and supervises all QC activities ensuring that all inspections are performed in timely manner and documented. Before starting new activity tool box shall be conducted. He shall ensure this procedure is understood and implemented by all personnel.
- 5.7 Piping Inspector** shall be responsible for inspection and testing of all piping activities such as material receiving, piping internal cleaning, fit up, alignment, dimensional check etc...
- 5.8 Welding Foreman** shall be responsible for arranging and checking all welding related tools and equipment for welder and welding activity. He shall ensure the back purging materials are available, used, and removed from the piping.
- 5.9 Welding Inspector** shall be responsible for inspection and testing of all piping welding activities. He shall check all back purging joints with calibrated oxygen analyser and make sure oxygen level is in acceptable limit as per the procedure. He shall also confirm and log back purge dams were removed from the piping after the completion of welding.

6. GENERAL REQUIREMENTS

- 6.1** An inert backing gas shall be used for GTAW or GMAW root passes on single-sided groove welds for materials of ASME P-No. 5 and higher.

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- 6.2 For P-No. 5 and higher materials, any back purging shall be maintained until at least 10 mm of the weld deposit thickness has been completed.
- 6.3 The use of nitrogen as a backing gas for austenitic stainless steels is prohibited
- 6.4 Purging gas shall conform to AWS A5.32 specification for welding shielding gases.
- 6.5 Purging gas and flow rate shall be as per approved WPS. Gas purity, moisture , and dew point gas shall be as per the AWS 5.32
- 6.6 Back purging oxygen level shall be as per the below table.

Table-1

SL#	Material	Oxygen Level (%)
1	Low Alloy Steel	Below 1 %
2	Stainless Steel Alloys	Below 0.05%
3	Nickel Alloys	Below 0.05%

- △ 6.7 An oxygen analyzer shall be used to determine the oxygen content inside the pipe during purging. If more than 20 joints are to be welded at the same time then minimum of 10% of the total joints shall be analyzed. Out of 10% joints to be analyzed, two joints shall be at the extremes and one in the middle. The below formula is used to achieve the required purging time

$$PT = (V/PGFR) \times 4$$

Where

PT=Purging time, hr

V = volume of pipe section to be purged, ft³

PGFR = purging gas flow rate, ft³/hr

6 shall be used instead of 4 in equation for welding special corrosion-resistance materials as per SAES-W-016

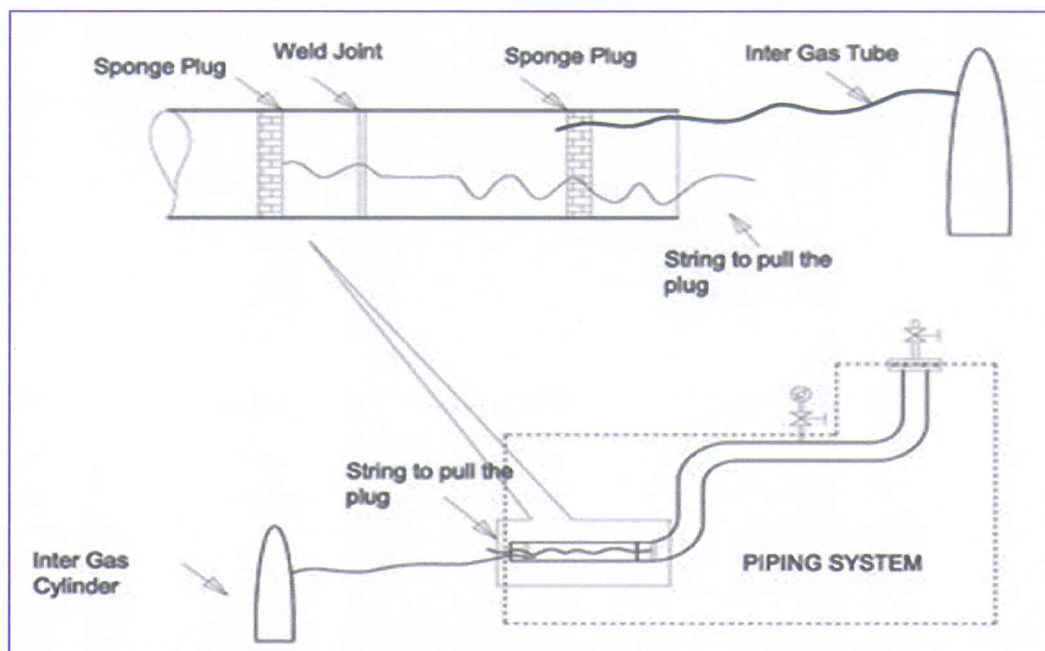
- 6.8 Soluble paper and purge foam/Sponge shall be used as purge dams in all accessible pipes in both fabrication and erection.
- 6.9 If purge dams are to be used but cannot be retrieved after welding, then the proprietary dissolvable (water soluble) dams shall be used. In addition, water soluble “low chloride” glues (Elmer’s glue) or proprietary water soluble adhesive tape shall be applied to purge dams. Masking tape shall not be used for holding water soluble purge dams.
- 6.10 Purge dams shall be located far enough from the joint to prevent burning, melting, or other damages to dams from heat of welding, usually 150-300mm. whenever preheating is used, this distance shall be increased to keep the metal temperature at dam no higher than 150°C.
- 6.11 Masking tape used for masking the joint from outside shall be heat resistant (e.g. Self-Adhesive Aluminum Tape) and free of lead and chloride.

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7. PROCEDURE

- 7.1 Purging dams shall be slightly bigger diameter than the pipe inside diameter and placed at ends of pipe string for small loops.
- 7.2 Purging requires entrance and exit opening through which the purging gas can enter and leave the weld joint area at controlled rate.
- 7.3 Precaution shall be taken to ensure that all leaks path are blocked and that branch pipes and other areas where air may be entrapped are well vented.
- 7.4 Precaution shall be taken to prevent the purging gas from escaping through the root opening at the weld groove itself. This is done by wrapping a single layer of masking tape around the outside of the joint. The tape shall not touch the groove face, and it shall not leave any residue after removal.
- 7.5 Install purge dams, string and purging gas hose as shown in below figure-1.

Figure-1



- 7.6 Purging gas shall be introduced slowly to the bottom of chamber and it is vented at the top, purging time shall be as per the equation $PT = (V/PGFR) \times 4$, hr.
- 7.7 Higher flow rate as per the approved WPS shall be maintained in order to displace the air in the pipe.

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- 7.8 This high flow rate shall be maintained until the gas inside the pipe reaches an acceptable low oxygen level as per the Table-1.
- 7.9 Purge gas flow rate shall be reduced as per the approved WPS so that the purge maintains a slight positive pressure on the inside of the pipe.
- 7.10 A “visual inspection windows” shall be left open for inspection to verify acceptable root pass condition.
- 7.11 Purging gas flow rate shall be reduced as the root is closed to prevent blowout of weld metal.
- 7.12 Purging dam verification shall be done during the fit-up and weld visual inspection.
- 7.13 Purging dam shall be removed after the welding with help of string attached to purging dam as shown in figure-1
- 7.14 Water soluble purging dam shall not be used on pneumatic test medium piping.
-  7.15 Installation and removal of purging dam shall be recorded on ‘Purge Dam Removal Log Sheet’ (NSH-PSAL-FSRU-FM-PI-0032)

8. DOCUMENTATION

- 8.1 Welding foreman shall prepare ‘Purge Dam Removal Log Sheet’ and welding inspector shall check and document the Log

9. ATTACHMENTS

Attachment #1 : Purge Dam Removal Log Sheet (NSH-PSAL-FSRU-FM-PI-0032)

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