SPECIFICATION FOR GENERAL REQUIREMENTS OF POST WELD HEAT TREATMENT (STRESS RELIVING)

Rev	Reason of Change	Date	Made By	Reviewed By	Approved By	Status
0	Initial release	16-08-2011	KKM	USR	KCR	Obsolete
1	Section added for Temperature uniformity/ calibration of furnace.	20-10-2011	JG	JMS	KKD	Obsolete
2	Rewritten with full details	15-05-2017	R Thapa	AS	KKD	Obsolete
3	Addition of API-16C requirement	10-09-2023	Karan sharma	HU Hidayat Ullah	JG	Released

SARA-SAE PVT. LTD. DEHRADUN

1.0 PURPOSE

1.1 It is the purpose of this specification to list in a concise form the Post weld Heat Treatment of equipment's manufactured for Oilfield as per API-6A,16A,16C.

1.2 This material specification is intended to aid the PPC / Product Manager/ Purchasing department in out sourcing and the vendor to comply the requirements of heat treatment of a material which needs to meet its intended use, and the quality control department in the inspection and release of incoming material.

1.3 Welds may be locally post weld heat treated as defined in this procedure.

2.0 SCOPE

2.1 This specification covers requirements of pre heat and post weld heat treatment of alloy steels used for API-6A,16A & 16C equipments.

3.0 GENERAL REQUIREMENTS

3.1 FURNCAE HEATING

3.1.1 Spacing: Material to be heat treated should be racked / stacked such to allow circulation of heating and quenching media, to ensure all surfaces of the product are exposed to heating media and to minimize warpage during heating & quenching.

3.1.2 Carburization and Nitriding - The heating media in furnaces used for heating material shall be controlled to preclude carburization & nitriding.

3.1.3 Temperature Uniformity / Calibration of Furnace - The design and construction of the furnace (heat treatment equipment) shall be such that the temperature at any point in the furnace working zone or work load shall comply requirements of API 6A or AMSH – 6875 & AMS2750E.

3.2 PREHEATING, INTERPASS TEMPERATURE MAINTAINING AND INTERMEDIATE HEAT TREATMENT:

Preheat for welding or thermal cutting, interpass temperature maintaining and Intermediate heat treatment may be done using a resistance system, linear burner, oxygen torch burner or other suitable system, which does not harm the base material or any weld metal already applied, and does not introduce into the welding area foreign material which is harmful to the weld.

The Preheat temp. and interpass temp. and Intermediate heat treatment detail shall be limited by the code requirements and shall be indicated clearly in the welding procedure specification WPS.

Temperature measurements shall be made near the weld (5 cm from the weld centerline max.) by suitable temperature indicating crayons or optical or electrical pyrometers.

3.3 LOCAL HEATING

3.3.1 Local PWHT may be conducted for items that cannot be placed in furnace. This shall be performed by an induction or resistance system, peculiar for- each wall thickness involved.

3.3.2 Number and location of thermocouples shall be as defined below or as per product specification whichever is applicable.

3.3.3 The distribution of thermocouples shall be sketched and attached with the PWHT Report.

3.3.4 Thermocouples shall be in direct contact with the heat-treated material to assure that the thermocouples show the exact temperature of the wall.

3.3.5 Local post weld heat treatment shall consist of heating a circumferential band around the weld at a temperature within the range specified in the qualified WPS. The minimum width of

SARA-SAE PVT. LTD. DEHRADUN

the controlled band at each side of weld on the face of the greatest weld width shall be the thickness of the weld or 50 mm (2") from the weld edge, whichever is less. Heating by direct flame impingement on the material shall not be permitted.

3.3.6 The post weld heat treatment of the material shall be in the same temperature range as that specified on the WPS or purchase order. Allowable range for the post weld heat treatment on the WPS shall be nominal temperature range ± 13.9°C (+ 25°F).

3.3.7 Maximum holding time shall not exceed Five times (5X) the minimum holding time. In all case, holding time shall not start until parts or materials have reached specified heat treatment temperature. The 5X rule does not apply to the separate QTC (e.g. ER 5").

3.4 THERMOCOUPLES, THERMAL INSULATION AND RECORDING INSTRUMENTS:

3.4.1 THERMOCOUPLES:

3.4.1.1 All thermocouples shall be checked to ensure "K" type is used.

3.4.1.2 Thermocouples, and thermocouple wires, shall be purchased to standard limits of error of not more than 0.75 percent in the range of 270°C or 1200°C. This requirement shall be so stated in the purchase requisition. Thermocouple wire for capacitor discharge applications shall be covered with high temperature (1200°C) insulation.

3.4.1.3 Thermocouple wire less than 1m in length shall not be used, and care shall be taken to ensure that the thermocouple conductor wires do not touch each other, or metallic components.

3.4.1.4 Indicated temperatures for each thermocouple shall be indicated on a recorded chart with increments of 10 ºC as a number or color.

3.4.1.5 Thermocouples shall be attached by means of the direct wire discharge method in order to avoid errors introduced by direct heating sources. The conductor wires shall be fixed to the work piece no further than 5 mm apart.

3.4.1.6 To enhance the mechanical strength of the Thermocouple hot-Junction, chloride-free high temperature cement shall be applied to the hot junction.

3.4.1.7 The Thermocouple to thermocouple extension cable junction shall be kept clear from the heated zone.

3.4.2 THERMAL INSULATION:

3.4.2.1 Thermal insulation such as nonflammable paper, nonflammable blankets, mineral wool blocks, or ceramic fiber blankets shall be wrapped around the outside of the heated area.

3.4.2.2 The insulation shall extend a minimum distance of 300 mm beyond the outer-most edges of the heated band.

3.4.2.3 Where ever possible, pipes/vessels open ends shall be blanked off before heat treatment commences.

3.4.2.4 The insulation shall be bound with black annealed iron wire.

3.4.2.5 The total insulation covering will be such to provide minimum heat loss.

3.4.2.6 Temperature crayons shall be used to ensure that the temperature do not exceed 300°C at any nearest point beyond insulation covering.

3.4.3 RECORDING INSTRUMENTS:

3.4.3.1 Multiple-point, temperature-indicating recorders shall be used. Recorders shall be calibrated in accordance with the manufacturer's standard service instructions at least once every 3 months.

3.4.3.2 For those cases in which four or more recording thermocouples are required, the

SARA-SAE PVT. LTD. DEHRADUN

PWHT may be accepted if not more than one recording channel is lost, provided that:

a. The holding temperature has been achieved and maintained for at least one-half hour before the channel was lost.
b. The heating equipment and the control system continue to function properly.
c. The PWHT chart is noted regarding the recording malfunction and proper heating function and signed by the PWHT supervisor, the welding engineer or the client representative.

3.4.4 Chart speed preferably be (9 inch per hour).

4.0 PREPARATION FOR HEAT TREATMENT

4.1 The materials and welds shall be free of machining fluids or debris, inspection residues such as couplants liquid penetrants and magnetic particles examination fluids and particles and other contaminants which, when heated, may be detrimental to the base or weld material.

4.2 The components, or their parts, shall be supported, in such a way to avoid permanent deformations and maintaining their straightness, roundness, concentricity and geometrical shape.

5.0 POST WELD HEAT TREATMENT PWHT PARAMETERS

5.1 The typical details of HT cycle for carbon steel & Alloy steel if not provided in designated WPS shall be in general is as under:

a. **Heating from Ambient to 300°C:** unrestricted
b. **Heating from** 300°C to 625°C for carbon steel: 150^{0}C/Hour Max
c. **Soaking Period:** 1 hour per inch of maximum through thickness. One hour minimum.
d. **Rate of cooling to 300°C:** 150°C (150°C/Hour)
e. **300°C to Ambient:** To Cool in still Air.

6.0 INTERRUPTED POST WELD HEAT TREATMENTS

6.1 Interrupted post weld heat treatment is defined as decreasing below the minimum specified holding temperature or exceeding the maximum specified cooling rate and may be caused by loss of power, equipment malfunction, or operator error.

6.2 For welds in which the post weld heat treatment temperature has dropped below the minimum holding temperature without exceeding the specified cooling rate, actions should be initiated to restart the heat treatment as soon as possible.

7.0 PERSONNEL'S QUALIFICATION

7.1 Heat Treatment operator shall have at least one year of field experience in the heat treatment work described in this Procedure.

8.0 REPORT / DOCUMENTATION

A Time-Temperature Record Chart shall be provided for each heat treatment operation. Each chart is to show:

(a) Item Identification Number
(b) Number of Thermocouples
(c) Time and Date Started
(d) Chart Speed (inches/hr.)

SARA-SAE PVT. LTD. DEHRADUN

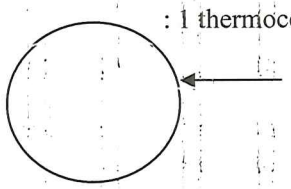
(e) Heating / cooling Rates, Soak Temperature & Soak Time
(f) The Approval signature of welding supervisor
(g) PWHT Charts, Thermocouple/Temp recording devices/Instruments calibration certificates

APPENDIX – 1

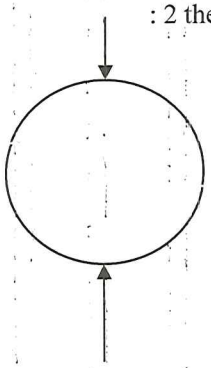
THERMOCOUPLE LOCATIONS (LOCAL PWHT)

All thermocouples are to be attached on the centre of the weld.

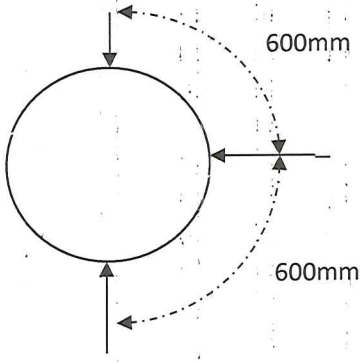
1) D ≤ 6" : 1 thermocouple – 9 O' clock (CENTRE)



2) 6" < D < 16" : 2 thermocouple (TOP & BOTTOM)



3) D ≥ 16" : 3 or more thermocouples
(Every 600mm from each other or in ¼ of
The outer circumference, whichever
Distance is the smallest)



4) Thermocouple can be placed as per the client's requirement or at a regular interval of 0.5m on plate type joints.

SARA SAE PVT. LTD. DEHRADUN