2025

Guidelines of Local PWHT for Independent Type C Tank

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CONTENTS

CHAPTER 1 GENERAL

101. Application

1. This guidelines is to apply to local PWHT(post weld heat treatment) performed outside a furnace when the size of the furnace does not allow for the PWHT of complete independent tank, boiler and pressure vessels to be performed at one time.

2. Rules of the Society have the following requirements regarding local PWHT.

(1) Where the heat treatment of a boiler and a pressure vessel cannot be accomplished at one time due to an insufficient size of the furnace, it may be carried out twice or more times, but in this case, care is to be taken to assure that sufficient area between each heat treated section is overlapped in the process of heat treatment.

(2) This provision may also be applied when a structure in sections heat-treated is welded together, in which case the joints between the section are to be heat treated to an entire bend with width of at least six times the plate thickness on each size of the seams.

3. This guideline is to provide requirements on the details necessary for local PWHT while satisfying 2.

4. Where deemed appropriate by the Society, internationally recognized standards considered as equivalent to this Guideline may be applied.

102. Plans and documents for approval

1. In planning local PWHT for independent type C tank, the following plans and documents are to be submitted for the approval of the Society prior to commencement of the work.

(1) Standard Procedure for Local Post Weld Heat Treatment in Annex 1

(2) Local PWHT
- a. Soak Band, Heated Band, Gradient Control Band
- b. Heating rate, Hold temperature and Time, Cooling rate

(3) Thermocouple
- a. Thermocouple type details
- b. Thermocouple wire details
- c. Calibration record of temperature recorder
- d. Welding details for independent C type tank of thermocouples
- e. Layout details for attachment location of thermocouple to independent C type tank
- f. Connection details of thermocouple and temperature recorder

(4) Insulation
- a. Insulation type details
- b. Layout details for independent C type tank of insulation

(5) Heating method
- a. In case where electric resistance heating is applied
  - Power unit details
  - Programmer details
  - Specification of Temperature recorder
  - Connection details for power unit, programmer, electric resistance heating device, thermocouple and temperature recorder
  - Layout details showing electric resistance heating device(ceramic pad heater, etc.) installed for a independent C type tank
- b. In case where high velocity gas combustion is applied
  - Combustion controller details
  - Air blowing system details
  - Ignition system details
  - Connection details for combustion controller, air blowing system, ignition system, thermocouple and temperature recorder
  - Layout details showing high velocity gas combustion installed for a independent C type tank

2. After completing local PWHT for independent type C tank, the following documents are to be submitted for the approval of the Society.

(1) Strip chart record of the entire thermal cycle with the following information
- a. Date(s), time period and location work performed

b. Identification of contractor/personnel performing the work
c. Identification number of the workpiece
d. Temperature and time scales
e. Correspondence between thermocouple numbers on the chart(s) and drawing/sketch
f. Heating rate above specified temperature
g. Hold period temperature and time
h. Cooling rate above specified temperature

(2) If the heat cycle is outside the specified heating rate, hold temperature and time and cooling rate
a. Detailed description of the occurrence
b. Detailed description of corrective actions

(3) If an emergency situation(thermocouple breakage, heating method interruption, etc.) occurs
a. Detailed description of the occurrence
b. Detailed description of corrective actions

(4) Submit after completing items within Standard Procedure for Local Post Weld Heat Treatment, Annex 1, including (1)~(3).

103. Definitions

1. Post Weld Heat Treatment

This is Post-weld heat treatment and its main purpose is to remove residual stress after welding.

2. Local Post Weld Heat Treatment

This refers to cases where post-weld heat treatment is performed locally.

3. Soak Band

It refers to the part where the effect of post-weld heat treatment is to be generated, and is composed of the weldment, heat-affected zone, and part of the base metal adjacent to the weldment, and is composed of metal including the full thickness.

4. Heated Band

It refers to the part that is heated by heating method. In case of applying electric resistance heating, it is the length at which the ceramic pad heating heater is installed.

5. Gradient Control Band

This refers to the part whose purpose is to control the temperature gradient along the length, and is usually the part where insulation is installed.

6. A1 Temperature

The upper boundary of the ferrite-cementite phase field in iron-carbon equilibrium diagram

7. Respirable fiber

Respirable fiber means a fibre that is less than 3 microns wide, more than 5 microns long and has an aspect ratio(length to width ratio) of more than 3:1.

8. Glass wool

An insulating material made by melting waste glass at high temperatures and then pulling it out like fibers

9. Mineral wool

A fibrous material used for insulation, soundproofing, and more. It is made from melted basalt and industrial slag. Sometimes it is called as Rock and slag wool.

10. Refractory ceramic fiber

Amorphous, inorganic, man-made aluminosilicate fibers.

11. Continuous filament fiber

A fiber which has no defined length and is made up of straight filaments. ⚓

CHAPTER 2 Local PWHT

Section 1 Maximum Temperature

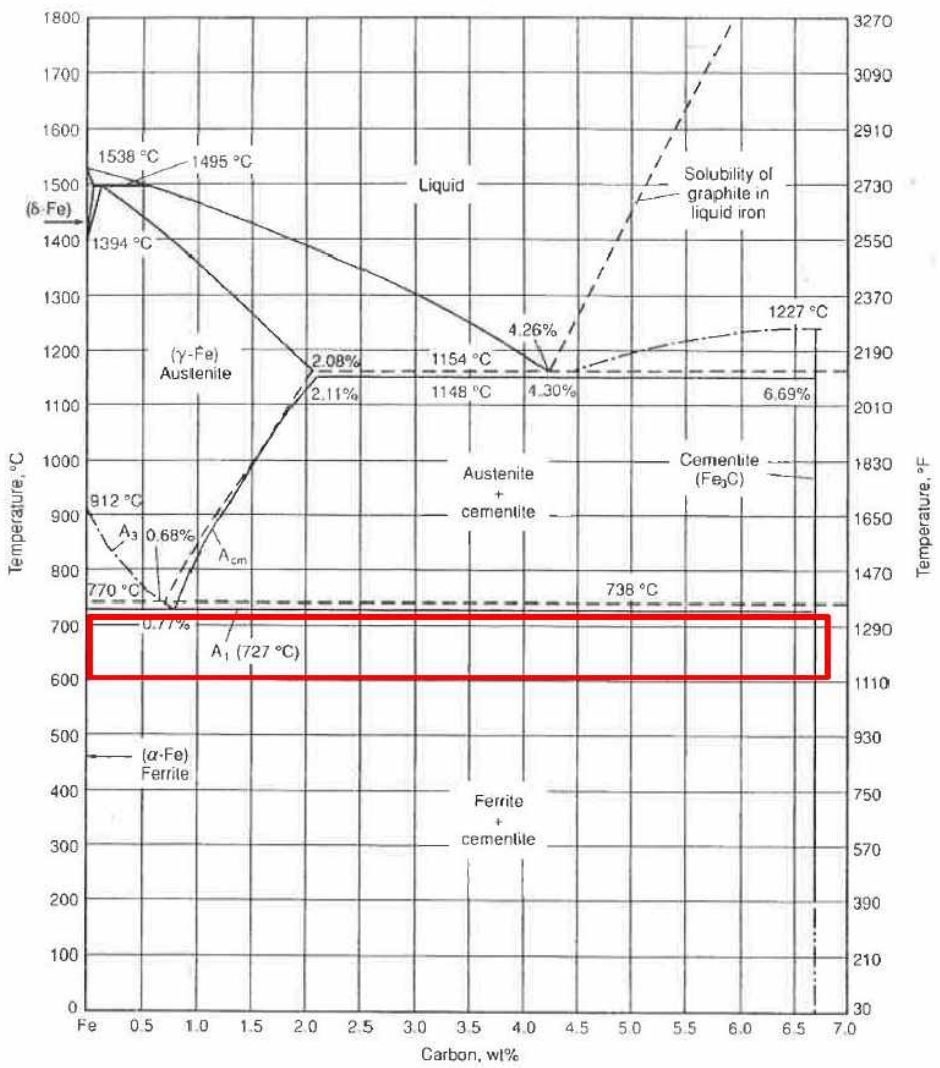


Figure 1. Phase diagram of carbon steel, carbon-manganese steel

1. The IGC Code requires post-weld heat treatment for independent type C tank of carbon-manganese steel when the design temperature is less than -10°C. This means that the materials subject to local PWHT are carbon-manganese steel.
2. In Table 6.2 of the IGC Code and Table 7.2 of the IGF Code, the carbon content is stipulated to be a maximum of 0.16%, which indicates that carbon manganese steel is hypoeutectoid steel.
3. Carbon manganese steel have various phase depending on the carbon content and temperature as shown in Figure 1. From local PWHT perspective, what is important to consider is the A_1 temperature, which is the temperature at which the austenite phase begins to form when the steel is heated.
4. When the temperature of the steel exceeds A_1 and then cools, the austenite phase change to proeutectoid ferrite, pearlite, martensite, and bainite depending on the cooling rate, which can cause many changes in mechanical properties, etc. From the perspective of PWHT, appropriately reducing the residual stress in the weld zone without changing the steel phase is a method to restore the

structural integrity of the tank without affecting the mechanical properties, etc. This principle is equally applicable to local PWHT.

5. Based on this background, it is recommended to maintain the maximum temperature that occurs during local PWHT below the A_1 temperature.

6. Even when performing local PWHT at temperature exceeding A_1, if all mechanical properties required by the Classification Society can be satisfied it can be considered to be applied as the maximum heating temperature for local PWHT.

Section 2 Local Heating

1. In order to perform local PWHT, it is necessary to understand the following terms that distinguish the heated area as shown in Figure 2.

2. Soak Band : Soak Band consists of the weld, heat-affected zone and part of the base metal adjacent to the weld, and is composed of metal covering the entire thickness. The temperature of Soak Band is to be controlled to be greater than the minimum required heating temperature and less than the maximum allowable heating temperature.

3. Heated Band : The heated band consists of the surface area over which the heat source is applied to achieve the required temperature in the soak band and limit induced stresses in the vicinity of the weld. It should consist of the soak band plus any adjacent base metal necessary to both control the temperature and to limit induced stress within the soak band

4. Gradient Control Band : The gradient control band consists of the surface area over which insulation is placed. It should encompass the soak band, heated band, and sufficient adjacent base metal such that the maximum permissible axial temperature gradient within the heated band is not exceeded.

5. This guideline suggests using the equation for Soak Band, Heated Band, Gradient Control Band and Axial Temperature Gradients in Table 1.

Table 1 Recommended equation for Soak Band, Heated Band, and Gradient Control Band

Zone	Equation
Soak Band	$5t$
Heated Band	$Soak\ Band + 4\sqrt{Rt}$
Gradient Control Band	$Heated\ Band + 4\sqrt{Rt}$
Axial Temperature Gradient	The axial temperature gradient during PWHT be controlled such that the temperature at a edge of the heated band be no less than one half the temperature at the edge of the soak band during heating, holding and cooling.

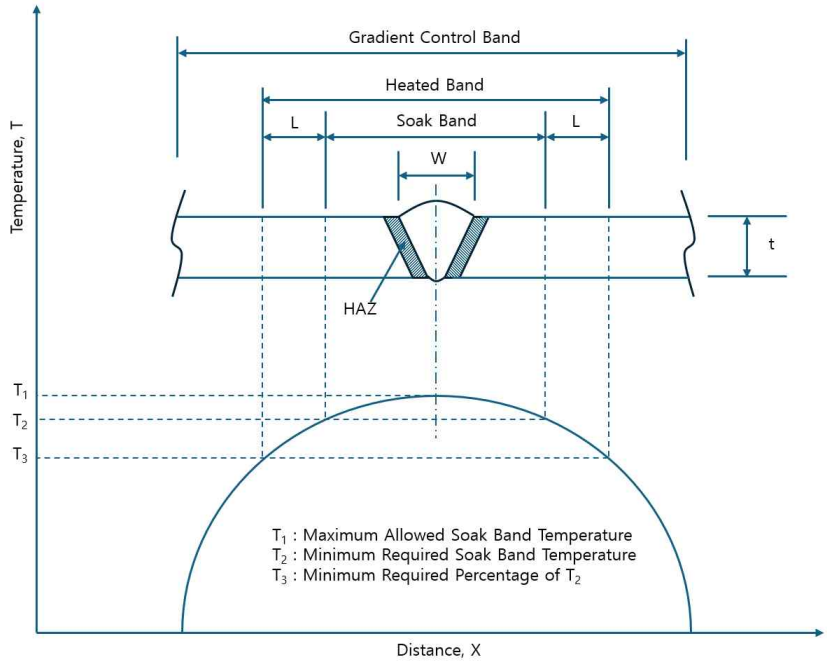


Figure 2 Basic Terminology of Local PWHT

Section 3 Thermal Cycles

1. The thermal cycle for local PWHT consists of 3 steps such as heating, holding and cooling as shown in Figure 3.
2. The heating stage is an step to the holding stage, and it is important to maintain an appropriate heating rate so that the temperature gradient within the structure is maintained within an appropriate value. Excessive heating rates can cause problems such as deformation of the structure.
3. Reduction of residual stress within weld line of independent C type tank is accomplished during holding time. It is important to manage the maximum temperature of the holding stage below the A1 temperature so as not to cause phase transformation of the steel.
4. The cooling stage is an intermediate step from the holding stage to room temperature and it is necessary to maintain an appropriate cooling rate. It is a factor that generates a temperature gradient within the structure, just like the heating rate and an excessive cooling rate can cause problems such as deformation of the structure.
5. This guideline suggests using the maximum heating rate, minimum holding temperature and minimum holding time, and maximum cooling rate in Table 2.

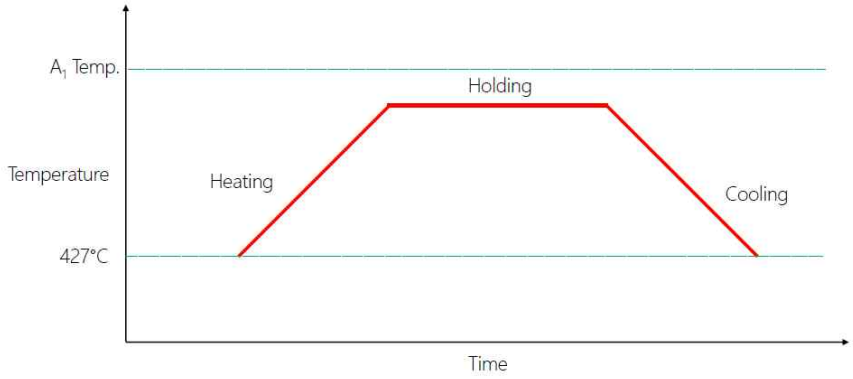


Figure 3 Basic thermal cycle of Local PWHT

Table 2 Thermal cycle for Local PWHT

Items		Contents	
Maximum heating rate		The following equation applies above 427°C : $[\frac{5,555}{t}-17.8][^\circ c/hr]$ (t in mm) Minimum : 37.8°C/hr, Maximum : 204.4°C/hr	
Holding	Minimum Temperature	595°C	
	Maximum Temperature	727°C	
	Minimum Time	$t \leq 50mm$	$50mm < t \leq 125mm$
		$\frac{t}{25}hr$ Minimum : 0.25hr	$2hr + 0.25hr \times \frac{t-50}{25}$
Maximum cooling rate		The following equation applies above 427°C : $[\frac{6,945}{t}-17.8][^\circ c/hr]$(t in mm) Minimum : 37.8°C/hr, Maximum : 260°C/hr	

CHAPTER 3 MEASUREMENTS OF TEMPERATURE

Section 1 Thermocouple

1. The temperature range that occurs in local PWHT of independent C type tank is 400°C to 750°C.
2. A thermocouple that can operate properly in this temperature range should be considered. Table 3 shows the specification of Type J, E, K and Type K, and the upper limit temperature is higher than the temperature range that occurs in local PWHTof independent C type tank.

Table 3 Specification of thermocouple for local PWHT

Type	Nominal Composition	Normal Upper Temperature Limit
J	Iron-Constantan	760°C
E	Nickel/chromium-Constantan	900°C
K	Chromel-Alumel	1260°C
N	Nicrosil-Nisil	1260°C

3. It is generally recommended to use a K type thermocouple.
4. An appropriate welding machine is to be used to attach the thermocouple to the tank. It is recommended to sue a capacitance discharge type welding machine.
5. Thermocouple wire, temperature recorder, etc. is to be installed to properly record the temperature.

Section 2 Installation Location

1. There are two aims to locate thermocouple in independent C type tank. One is control and the second is monitoring.
2. The location for control thermocouple is to be based upon the characteristic of heat sources, location of heat sources and the tank being heated.
3. The control thermocouple is to assure that proper heat is applied to zones to achieve the required temperature in these zone.
4. Monitoring thermocouple is to be located to ensure that all of the parameters to control the local heating operation is being achieved. Thermocouples is to be placed to measure the maximum and minimum expected temperature and to calculate the axial temperature gradient. To achieve this purpose, thermocouple is to be installed at the weld centerline, the edge of soak band and at the edge of heated band to determine the axial thermal gradient. It is necessary, if possible, to place thermocouple on the surface opposite to that of the heat source for one sided heating, to ensure that the required temperature is achieved throughout the thickness.
5. Thermocouple at centerline of weld is to ensure that the maximum temperature is not exceeded since this presents a likely location for such an occurrence. Thermocouple at edge of the soak band is to determine if the minimum temperature have been achieved throughout the soak band. Thermocouple at edge of the heated band is to determine if the maximum allowed temperature drop(maximum axial temperature gradient) has been exceeded.
6. When applying 1 ~ 5, the thermocouple location is to be selected while considering the following.
   (1) Due to natural convection heat flow, the 12:00 position in a circumferential weld seam can be significantly hotter than the 6:00 position.
   (2) Increase the number of circumferential control zones a the piping diameter increases.
   (3) Use a method for determining the minimum required heated band width which attempt to account for the convection and other heat losses.

(4) Control the 12:00 position to the high side for the allowable temperature range.
(5) Use additional outside insulation layers at the 6:00 position.
(6) Utilize an eccentric heater layout (wider heater at the 6:00 versus 12:00 position) and
(7) Insulate the inner surface.

7. This guideline recommends that thermocouple be positioned as shown in Figure 4. If deemed necessary by the inspector, thermocouples may be added at appropriate locations, referring to 6.

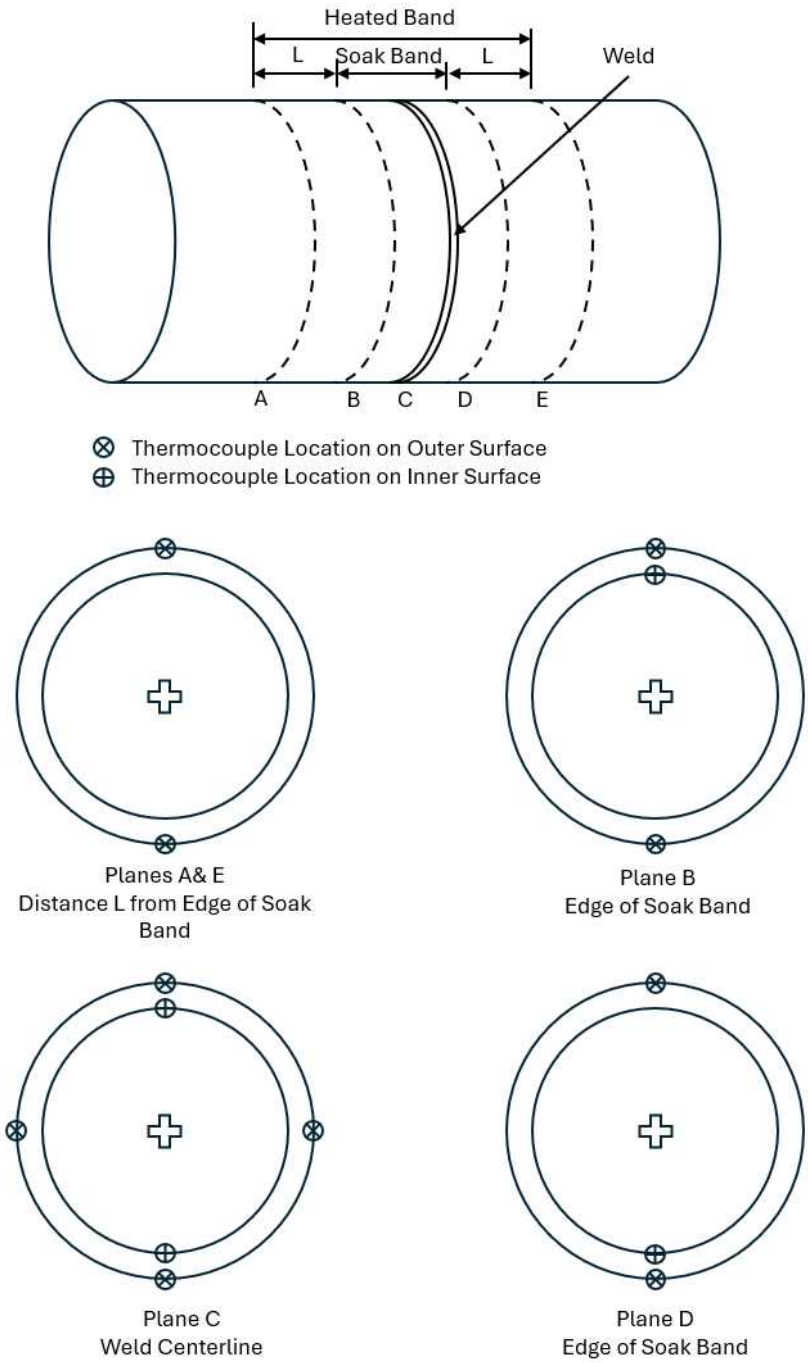


Figure 4 Recommended thermal location of local PWHT for independent C type Tank

CHAPTER 4 INSULATION

1. Insulation are materials used for the purpose of heat insulation or heat blocking. Insulation are generally classified by material, and Table 4 shows the information.

Table 4 Classification of insulation and its characteristics by material

Insulation Classification	Material	Strong/Weak point
Inorganic	Glass, minerals, metals, carbon, etc are used.	Resistant to heat Excellent joint construction High moisture absorption
Organic	Using chemically synthesized materials. Expanded polystyrene, expanded polyurethane, expanded vinyl chloride, and other plastic called Styrofoam are used.	Low hygroscopicity Weak to heat

2. The most important factor in selecting an insulation in local PWHT is the maximum temperature that occurs in the Soak Band, which can reach up to 730°C. Insulation that can operate without problems at this maximum temperature should be given priority. From this perspective, inorganic insulation should be considered for local PWHT.
3. Table 5 shows the classification of insulation which can be used for local PWHT and its characteristics including potential for respirable fibers, maximum usage temperature, crystalline transformation temperature and thermal conductivity.
4. Insulation materials are closely related to the Gradient control Band in local PWHT. They should satisfy the requirement that the axial temperature gradient should be controlled so that the edge temperature of the heated band is more than half of the edge temperature of the Soak Band during heating, maintenance, and cooling.
5. Insulation is to function appropriately with heating method to satisfy the maximum heating rate and maximum cooling rate.
6. Insulation not included in Table 5 is applicable to local PWHT if it shows proper performance.

Table 5 Classification of Insulation and its characteristic

Insulation Type	Potential for Respirable Fibers	Maximum usage Temperature	Crystalline Transformation Temperature	Thermal Conductivity
Glass Wool	Present to manufacturing process and if transformation to crystalline state with subsequent fracture into smaller size.	450°C	Above maximum usage temperature	〉Mineral wool and RCF
Mineral wool	Present due to manufacturing process and if transformation to crystalline state with subsequent fracture into smaller size.	650°C	725°C~825°C	〈Glass wool; 〉RCF
Refractory Ceramic Fiber(RCF)	Present due to manufacturing process and if transformation to crystalline state with subsequent fracture into smaller size.	1093°C	1000°C	〈Glass wool; 〈mineral wool
Continuous Filament Fiber	Manufacturing process allows production of nonrespirable fibers. Respirable fibers can be present if transformation to crystalline state with subsequent fracture into smaller size.	1100°C	1000°C	Depends upon composition

CHAPTER 5 HEATING METHOD

Section 1 Electric Resistance Heating

1. In local PWHT, electric resistance heating is achieved using ceramic pad heating heaters. Ceramic pads as shown in Figure 5 can be applied to pipe weld circumferences and various shapes of parts or structures, and can also be easily applied to independent C type tank. Figure 6 shows an example of applying ceramic pad heating heaters to perform electric resistance heating.
2. Ceramic pad heaters is connected to the low voltage heat treatment equipment that supplies power and the programmer that control the heat treatment cycle.
3. When selecting a ceramic pad heater, a low voltage heat treatment equipment and a programmer, the following conditions is to be satisfied.
   (1) Maximum and minimum temperature required in the Soak Band and Heater Band and related time
   (2) Axial temperature gradient conditions required in the Gradient Control Band : The edge temperature of Heated Band is to be controlled to be more than half of the edge temperature of Soak Band during heating, holding and cooling
   (3) Maximum heating rate and maximum cooling rate
4. When considering the above conditions, it is common to assume that insulation is applied to independent C type Tank. If insulation cannot be applied due to field condition, etc. a ceramic pad heater, a low voltage heat treatment equipment and a programmer should be selected considering that there is no insulation effect.
5. The accessories(triple cable set, connectors, etc.) required to connect the low voltage treatment equipment and the ceramic pad heater are to be appropriately selected.
6. A temperature recorder is to be installed to record the temperature.

Figure 5 Ceramic pad heater

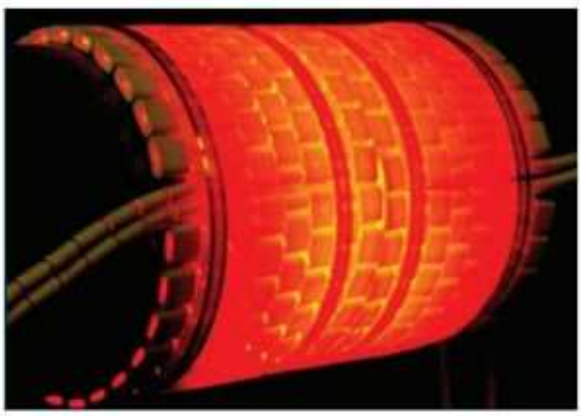


Figure 6 Application of electric resistance heating

Section 2 High Velocity Gas Combustion

1. High velocity gas combustion method is a process that uses a high-velocity stream of hot gases to heat materials. It burns a mixture of fuel and air at high temperature in a combustion chamber. The combustion produces a high-velocity stream of hot gases, which are expelled through a nozzle at high pressure and temperature. Figure 7 shows this. These gases penetrate deep into the material being heated, transferring heat efficiently.
2. As shown in Figure 8, Local PWHT can be performed by heating the inside of pressure vessels using high velocity gas combustion method.
3. When selecting high velocity gas combustion method, the following conditions is to be satisfied. If necessary, simultaneous application with Electric resistance heating may be considered.
   (1) Maximum and minimum temperature required in the Soak Band and Heater Band and related time
   (2) Axial temperature gradient conditions required in the Gradient Control Band : The edge temperature of Heated Band is to be controlled to be more than half of the edge temperature of Soak Band during heating, holding and cooling
   (3) Maximum heating rate and maximum cooling rate
4. When sections are to be heated, insulated bulkhead are erected to limit the area being heated.
5. Bulkheads are typically erected beyond each edge of the required soak band at a distance based upon the heated band width requirements.
6. Insulation is installed on the hot face of each bulkhead and on the external surface of the pressure vessel shell opposite the heat chamber, typically extending past the bulkheads a distance based upon gradient control band requirements.
7. The systems necessary to implement high velocity gas combustion, such as combustion controller, air blowing systems, and ignition systems, are to be appropriately selected.
8. A temperature recorder is to be installed to record the temperature.

Figure 7 High velocity gas combustion method

Figure 8 Application example of high velocity gas combustion method

CHAPTER 6 Examples

Section 1 Application of Electric Resistance Heating

1. Cases where local PWHT is expected to be applied in independent C type tank were selected as shown in Table 6, and the required factors to apply local PWHT in these cases were calculated.
2. The shell thickness was considered to be from 40mm to 50mm, and the inner radius was considered to be from 4,000mm to 5,000mm.
3. Local PWHT can be applied to conditions not included in Table 6, and the necessary factors can be calculated using this Guideline.

Table 6 Condition of example

Case	Thickness[mm]	Inner Radius[mm]
1	50	4000
2	50	5000
3	45	4000
4	45	5000
5	40	4000
6	40	5000

4. Using the formulas in Table 1 and Table 2 for the conditions in Table 6, Soak Band, Heated Band, Gradient Control Band and Thermal cycle(Heating rate, Minimum Holding Temperature, Minimum Holding Time, Cooling Rate) are calculated as in Table 7.

Table 7 Calculated parameters of Local PWHT for Condition in Table 6

Case	Soak Band [mm]	Heated Band [mm]	Gradient Control Band [mm]	Thermal Cycle				
				Heating rate	Holding			Cooling rate
					Minimum Temperature [°C]	Maximum Temperature [°C]	Minimum Time [Hour]	
1	250	2,038	3,827	93.3°C/hr	595	727	2	121.1°C/hr
2	250	2,250	4,250	93.3°C/hr	595	727	2	121.1°C/hr
3	225	1,922	3,619	105.6°C/hr	595	727	1.8	136.5°C/hr
4	225	2,122	4,020	105.6°C/hr	595	727	1.8	136.5°C/hr
5	200	1,800	3,400	121.1°C/hr	595	727	1.6	155.8°C/hr
6	200	1,989	3,778	121.1°C/hr	595	727	1.6	155.8°C/hr

5. The concept of implementing local PWHT in independent C type tank considering the necessary factors in Table 7 is shown in Figure 9. The center of the Electric Resistance Heater should be located on the welding line, ad its length should be installed to include Soak Band and Heated Band.
6. The insulation length shall be installed to include the Gradient Control Band and satisfy the required Thermal Gradient(The edge temperature of Heated Band during heating, holding and cooling is to be greater than half edge temperature of Soak Band) along the shell length.
7. If possible, insulation should be installed on the inside of the shell to satisfy the required thermal gradient along the length of the shell.

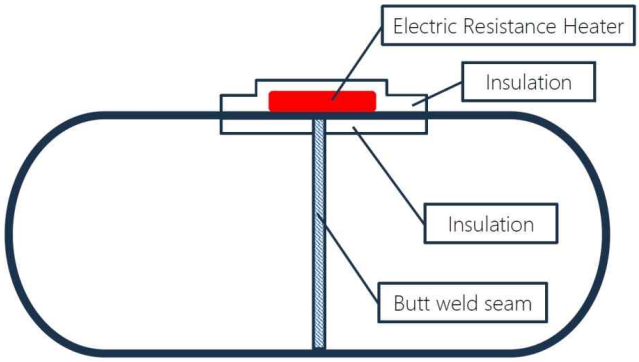


Figure 9 Example of application of electric resistance heater for Local PWHT

Section 2 Application of Electric Resistance Heating and High Velocity Gas Combustion

1. Examples of the simultaneous application of electric resistance heating and High Velocity Gas Combustion in independent C type tank considered in Section 1 is presented.
2. Using the formulas in Table 1 and Table 2 for the conditions in Table 6, Soak Band, Heated Band, Gradient Control Band and Thermal cycle(Heating rate, Minimum Holding Temperature, Minimum Holding Time, Cooling Rate) are calculated as in Table 7.
3. The concept of implementing local PWHT in independent C type tank considering the necessary factors in Table 7 is shown in Figure 10. The center of the Electric Resistance Heater should be located on the weld line, and its length should be installed to include at least the Soak Band. The extension of the length of the Electric Resistance Heater to include the Heated Band is determined based on whether the temperature condition required at the Heated Band can be satisfied by the High Velocity Gas Combustion.
4. The length of insulation outside the tank shall be installed to include the Gradient Control Band so as to satisfy the required thermal gradient(the edge temperature of Heated Band during heating, holding and cooling is to be more than half the edge temperature of the Soak Band) along the shell length
5. Install a bulkhead inside the tank and install insulation toward the outside of the bulkhead compartment to ensure that the temperature in the bulkhead compartment is maintained for a certain period of time.
6. Do not install insulation inside the shell where the Electric Resistance Heater is installed.
7. A hole for installing a gas burner is to be appropriately considered in the bulkhead compartment.

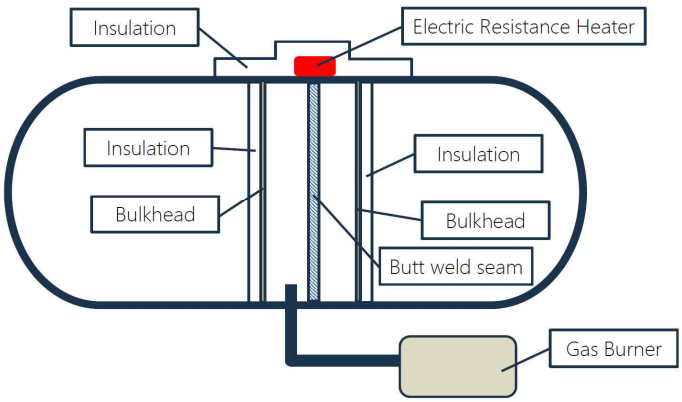


Figure 10 Example of application of Electric Resistance Heater and High Velocity Gas Combustion for Local PWHT

CHAPTER 7 REFERENCES

1. For detailed technical specifications on local PWHT, Standards in Table 8 may be refered.

Table 8 List of Standards for Local PWHT

Num.	Standards
1	AWS(American Welding Society) D10.10/10.10M, Recommended Practices for Local Heating of Welds in Piping and Tubing
2	WRC(Welding Research Council) Bulletin 452, Recommended Practices for Local Heating of Welds in Pressure Vessels
3	ASME BPVC(Boiler and Pressure Vessel Code) Section VIII(Rules for Construction of Pressure Vessels), Division 1
4	ASME BPVC(Boiler and Pressure Vessel Code) Section VIII(Rules for Construction of Pressure Vessels), Division 2
5	ASME BPVC(Boiler and Pressure Vessel Code) Section III(Ruels for Construction of Nuclear Facility Components), Subsection NB-Class 1 component
6	ASME B31.1, Power Piping
7	ASME B31.3, Process Piping
8	BS 2633, Specification for Class 1 arc welding of ferritic steel pipework for carrying fluids
9	BS 5500, Specification for unfired pressure vessels
10	AS 1210, Pressure Vessels

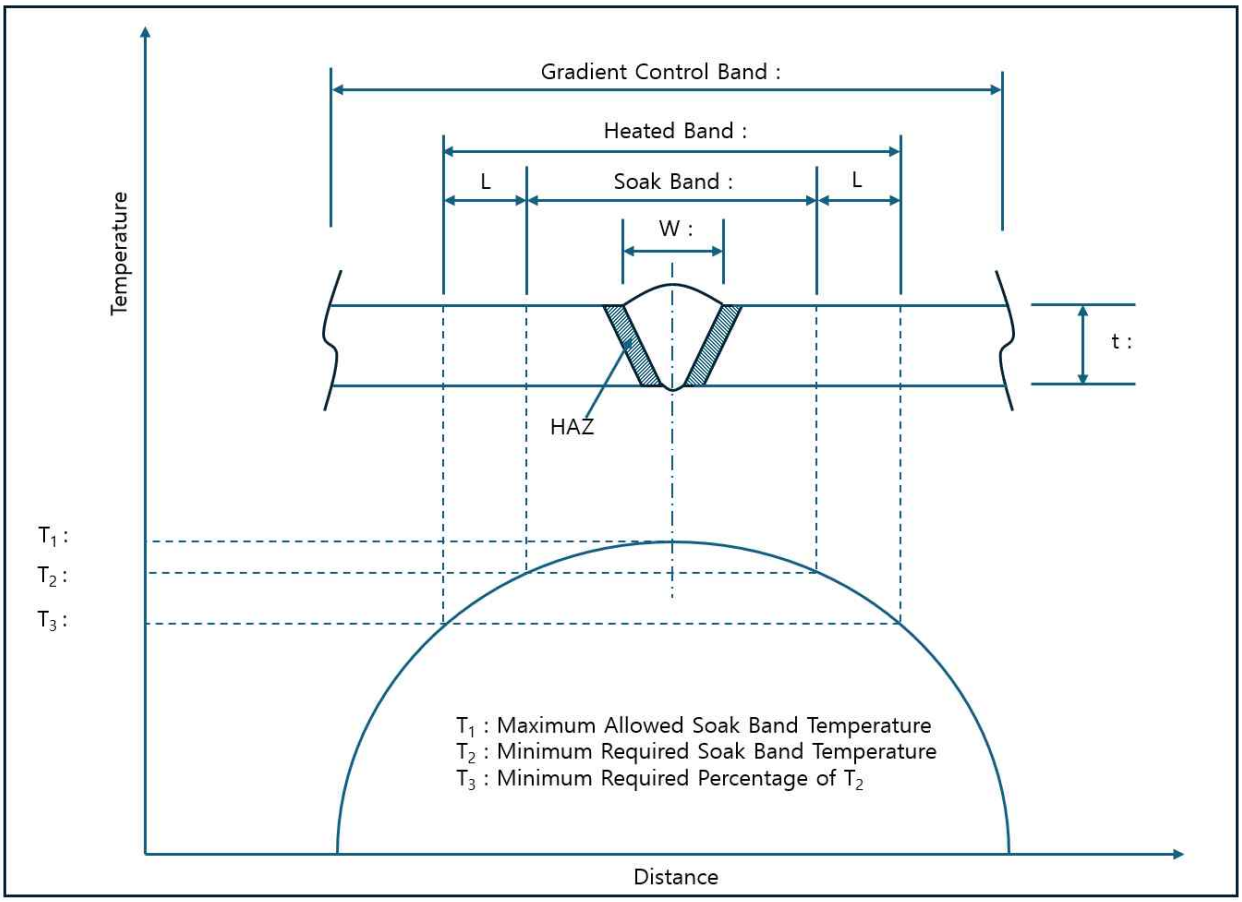
ANNEX 1 STANDARD PROCEDURE FOR LOCAL POST WELD HEAT TREATMENT

1. General			
Procedure No.		Revision No.	
Governing Codes & Standards			
Tank Identificaion Number			
Tank Dimension			
Material Specification			
Heating Method		☐ Electric Resistance Heating ☐ High Velocity Gas Combustion ☐ Other :	
Thermocouple Layout Drawing Number			
Heating Layout Drawing Number			
Insulation Layout Drawing Number			

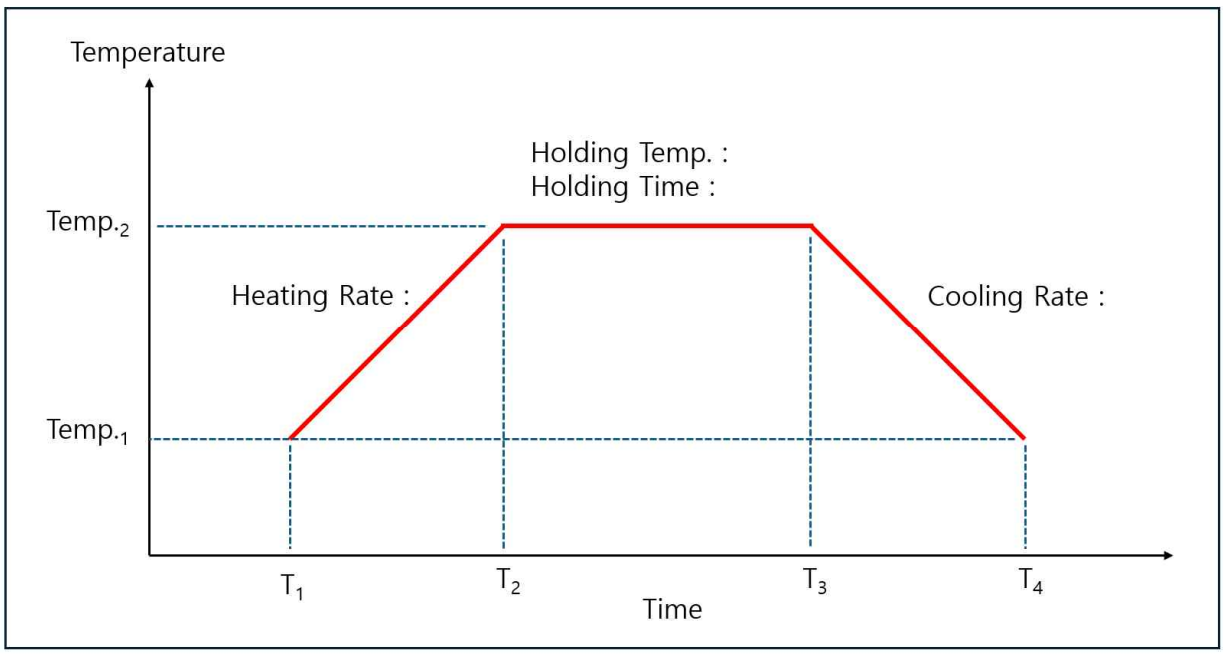
2. Step			
2-1. Match proceudre/drawings of workpiece, including verification of workpiece identification number. Check the appropriateness of specified thermal cycle to the material and application			
Sign		Date	
2-2. Install and test power/control equipment including power supplies, temperature controllers, and temperature recorders.			
Sign		Date	
2-3. Check validity of calibration data on temperature recorders.			
Sign		Date	
2-4. Install thermocouples (including spares) per drawings.			
Sign		Date	
2-5. Verify specified placement of thermocouples.			
Sign		Date	
2-6. Install heat source and insulation per drawing.			
Sign		Date	
2-7. Verify specified placement of heat source and insulation before the start of heating.			
Sign		Date	
2-8. Install and connect thermocouple extension wire.			
Sign		Date	
2-9. Check operation of all thermocouples. Check for reversal of thermocouple polarity.			
Sign		Date	
2-10. Install and connect power cables. Check operation of all heat sources.			
Sign		Date	
2-11. Obtain approval to begin the heating operation.			
Sign		Date	
2-12. Perform periodic checks during heating including equipment operation(recorder and power supplies) and adherence to specified heating rate.			

Sign		Date	
2-12-1. If a deviation occurs during heating, follow approved corrective action			
Sign		Date	
2-13. Verify the start of the hold period. e.g. all soak band thermocouple are within the required temperature range.			
Sign		Date	
2-14. Perform periodic check to required hold temperature range.			
Sign		Date	
2-14-1. If a deviation occurs during the hold period, follow approved corrective action.			
Sign		Date	
2-15. Verify completion of the hold period, e.g., all soak band thermocouple remained within the required temperature range for the minimum required time.			
Sign		Date	
2-16. Perform periodic check during cooling period and adherence to specified cooling rate.			
Sign		Date	
2-17. Deactivate power/control equipment after the temperature is below that where cooling rate control is required.			
Sign		Date	
2-18. Remove all equipment after the temperature is safe for personnel. Cut thermocouple wires and mark locations of attached thermocouples for light filing/grinding.			
Sign		Date	
2-19. Note any deviation such as heating rate, hold time and temperature or cooling rate that occurred during thermal cycle.			
☐ Occurred :		☐ None	
Sign		Date	
2-20. Complete and submit to user's/owner's representative appropriate documentation.			
Sign		Date	

3. Recommendation for Soak Band, Heated Band and Gradient Control Band	
Thickness[mm]	
Inner Radius[mm]	
Soak Band[mm]	
Heating Band[mm]	
Gradient Control Band[mm]	



4. Target Thermal Cycle	
Heating Rate:	
Hold Temperature Range:	
Minimum Hold Time:	
Cooling Rate:	



5. Thermocouple	
Thermocouple Type	
Thermocouple wire	
Number of thermocouple	
Location of thermocouple	
Thermocouple welding	☐ Capacitance discharge welding ☐ Other :

6. Heating	
Power unit	
Programmer	
Temperature recorder	

7. Documentation	
Recording on the complete temperature cycle of heating, holding and cooling	
Valid calibration certificate of temperature recorder	
Temperature chart per every thermocouple	
Any discrepancy	

Guidelines of Local PWHT for Independent Type C Tank

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