

SPECIAL TYPE HEAT EXCHANGERS**JGS 210-120-1-67E**

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1. SCOPE

This standard practice provides the guidelines for the design of Special type heat exchangers in refineries, petrochemical plants and similar plants. Shell and Tube heat exchanger (JGS 210-120-1-24E), air cooled heat exchangers (JGS 210-120-1-25E) are outside the scope of this practice.

2. WORK PROCEDURE

2.1 Input to the Design

2.1.1 Process Conditions

The data to be used for the design of Special type heat exchangers, such as the flow rate, temperature, pressure and so on will be obtained from, but not limited to, the following documents ;

- Process Flow Diagram (PFD), including material and heat balances
- Basic Engineering Design Data (BEDD)
- Piping & Instrument Diagram (P&ID)
- Plot plan
- Piping material specification
- Material Selection Basis

2.1.2 Input Data

The following is a summary of input data to be prepared.

(1) Operational data

- Service Name
- Item number
- Operating conditions and physical properties

		Required data	Notes
Fluid name		Yes	
Flow rate	(W : kg/h)	Yes	
Operating pressure	(P : kg/cm ² G)	Yes	
Terminal temperature	(T : °C)	Yes	
Vapor	Thermal conductivity (Kv : Kcal/m·h °C)	Yes	To be specified if fluid is vapor or two-phase flow.
	Density (ρ_v : kg/m ³)	Yes	
	Viscosity (μ_v : c.p)	Yes	
	Enthalpy (Hv : Kcal/kg)	Yes	
	Specific heat (Cpv : Kcal/kg °C)	Yes	
	Dew point (Td : °C)	(Yes)	
Liquid	Thermal conductivity (Kl : Kcal/m·h °C)	Yes	To be specified if fluid is liquid or two-phase flow.
	Density (ρ_l : kg/m ³)	Yes	
	Viscosity (μ_l : c.p)	Yes	
	Enthalpy (Hl : Kcal/kg)	Yes	
	Specific heat (Cpl : Kcal/kg °C)	Yes	
	Bubble point (Tb : °C)	(Yes)	
Latent heat of vaporization (λ : Kcal/kg)		(Yes)	To be prepared if phase changes.
Heat duty * (Q : Kcal/h)		Yes	
Fouling factor (γ : m ² ·h°C/Kcal)		Yes	

* $Q = (W\Delta H)_{HOT} = (W\Delta H)_{COLD}$ shall be confirmed.

(2) Construction data

- Installation : horizontal, vertical, inclined
- Design pressure
- Design temperature
- Short term design conditions, if specified.
- Materials
- Corrosion allowance

- Code requirement
- Nozzle rating and facing
- (3) Design requirements
 - Allowable pressure drop
 - Allowable velocity, if specified.

2.2 Output from the Design

Special type Heat Exchanger data sheet by vendor should be checked by process engineer.

2.3 Work Steps

The heat exchanger design will be conducted according to the following work steps, as a guideline.

- (1) Prepare verification procedure based on this JGS and client's standard.
- (2) Select heat exchanger type.
- (3) Prepare the data sheets.
- (4) Check the vendor's output
- (5) Reflect the result on P & ID and other related documents.

2.4 Computer Programs

Following computer programs are available to select and design special heat exchangers.

- (A) HTRI (Heat Transfer Research Institute)
 - Rating of liquid-phase plate heat exchangers.
- (B) HTFS (Heat Transfer and Fluid Flow Service)
 - (1) HEAd Heat exchanger advisor program for guidance on optimised equipment selection using HTFS expertise and industrial know-how
 - (2) APLE A single package for design, rating and performance simulation of gasketed plate and frame heat exchangers
 - (3) PFIN The only quality program available for 'first-shot' thermal design of a multistream plate-fin heat exchanger
 - (4) MuSE2 Performance simulation of multistream plate-fin heat exchangers
 - (5) MuLE2 Layer by layer performance simulation of a multistream plate-fin exchanger
 - (6) MuSC Performance simulation of a multistream plate-fin heat exchanger with crossflow
- (C) JAPETS-he
 - Design/Rating of Double Pipe Heat Exchanger and BFT.

3. DESIGN

3.1 Selection

The following factors play critical roles in the choice between Shell and Tube Heat Exchanger and other Special Type Heat Exchanger.

- (1) Capital and operating costs
- (2) Maintenance requirements
- (3) Weight and Space limitation
- (4) Temperature approach
- (5) Pressure and temperature levels

A computer program for HTFS (HEAd = Heat Exchanger Advisor program) is available to select the most suitable type of heat exchanger.

3.2 Features of Each Special H/E

3.2.1 Double Pipe Heat Exchanger (D/P HE)

(A) Profile and Structure

Double Pipe Heat Exchangers are designed in a hairpin shape.

Standard designs are available for pressures up to 300 kg/cm²G on tubeside and 30 kg/cm²G on shellside, and special designs can be fabricated for higher pressures.

Fig. 3.2.1 Double Pipe HE

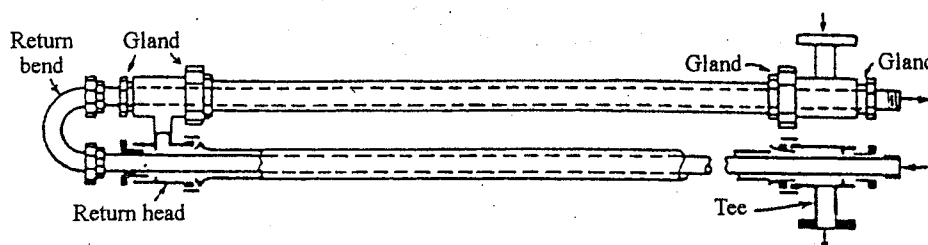


Table 3.2.1 Double Pipe

Outer Pipe Nominal Dia.	Inner Pipe Nominal Dia.
1"	1/2"
1-1/2"	3/4"
2"	3/4"
2"	1"
2-1/2"	1-1/2"
3"	1-1/2"
3"	2"
4"	1-1/2"
4"	2"
4"	2-1/2"

(B) Advantages ⁽¹⁾

- (1) Countercurrent flow will result in lower surface area requirements for services having a temperature cross.
- (2) Big flexibility on design enables to select the most suitable size, construction and cost.
- (3) Simple construction leads to ease of cleaning and inspection.

(C) Disadvantage ⁽¹⁾

- (1) As preliminary evaluation, $UA = 22,500 \text{ kcal}/(\text{hr}^\circ\text{C}) (= Q/\text{LMTD})$ may be the upper economical limit.
- (2) Tubes can not be removed during maintenance.

3.2.2 Brown Fin Tube Heat Exchanger (BFT)

(A) Profile and Structure

The use of longitudinal finned tubes will result in a compact heat exchanger for shellside fluids having a low heat transfer coefficient.

BFT is classified into the following two types.