

SPD0025ERN
PROCESS DESIGN MANUAL
AIR COOLED HEAT EXCHANGER

REV. : [3](#)

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**SAMSUNG
ENGINEERING**

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Appendix A. Air Cooled Heat Exchanger, (Form No.C-6330-202AA4 (Metric unit))

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1. SCOPE

This manual covers the basic design considerations of air cooled heat exchangers. Furthermore, the engineering flow diagram for air cooled heat exchangers are described.

2. FORMAT

Design data of air cooled heat exchanger shall be written on the Form No.C-6330-202AA4 (Metric unit).

3. ENGINEERING FLOW

3.1 General

- (1) The AFC (Air Fin Cooler) engineering flow diagram attached hereto has been decided on at AFC discussions based on the present technical level to meet the transfer of AFC engineering services. Refer to Fig. 3-1.
- (2) Critical service flows such as drawing distribution flows are not covered therein since they are the same as those in general services.
- (3) On the flow sheet, main routes are indicated by using thick lines (rare cases by using dotted lines) and relative routes by using fine lines. Refer to Fig. 3-1.

3.2 Related Design Manuals

The design manuals and reference information shown below are reviewed at AFC discussions to utilize them effectively in AFC engineering services.

3.2.1 Process Engineering

- (1) Manifold type selection standard
- (2) AFC design program
- (3) AFC temperature control system
- (4) AFC solidification preventive measure

Regarding these manuals, the documents are not included in this manual, but separately registered in process engineering department.

3.2.2 Mechanical Engineering

- (1) Data sheet: Air cooled heat exchanger (mechanical ; Form No. C-6330-202AA4)
- (2) Air cooled heat exchanger design and fabrication standards
- (3) General specification for air cooled heat exchanger

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- (4) AFC header strength calculation method
- (5) AFC tube bundle vibration due to air flow
- (6) Noise of air cooled heat exchanger

4. SELECTION OF MANIFOLDS

4.1 Introduction

Selection of manifold types can be made by using computer program which has been prepared as a tool for flow distribution calculation in the case of large air cooled heat exchangers. Manifold types selected shall be shown on the P & I diagram by following this manual (in which symbols are set forth).

4.2 Types of Manifold Patterns

4.2.1 Basic Patterns

Manifold patterns can be classified into the types shown in Fig. 4-1.

Selection shall be made from among them and the symbol of the selected type shall be shown on the P & I diagram.

Other engineering firms also use symbols for manifold patterns.

4.2.2 Optional Patterns

The basic patterns of manifolds are four in number as shown in Fig. 4-1. In addition to these, the following arrangements are available as optional patterns if necessary:

Type W.....With water injection

Type B.....With block valves

In cases where an optional pattern is used, the letter "W" or "B" must be added to the symbol as follows: Type-TW and type-MUB.

The optional patterns are as shown in Fig. 4-2.

4.3 Guide to Selection of Manifold Types

Matters to be considered in the selection of manifold types are as enumerated below.

- (1) The order of the flow distribution efficiencies of these types are as follows: T, MU, U and S.
- (2) In the case of single phase flows, type S or U can serve the purpose sufficiently.
- (3) In the case of two-phase flows and mixed phase flows, type T or MU should be used to ensure

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the evenness of the flow in each pass.

- (4) Water injection shall be practicable in each pass if it is required from the process operation standpoint and/or if there is a possibility of sludge accumulation in the air cooled heat exchangers.
- (5) Block valves shall be provided on each pass if there is a possibility of failure due to erosion and/or corrosion or scale formation resulting in plugging.
- (6) The ratio of header cross sectional area to total branch-cross sectional area shall not exceed 1.0;

$$A \text{ Branch} / B \text{ Header} = 1.0$$

Value 0.7 – 0.8 can be regarded as a standard value.

- (7) Actual header arrangement shall be as shown in Fig. 4-3. Refer to Reference (4).

4.4 Recommendable manifold Type for Each Process

Manifold types selected for actual air fin coolers based on the above guide are as shown below for reference.

5. DESIGN PROGRAM

Thermal rating of air fin coolers is usually conducted by the vendor, but their results must be checked for confirmation; especially those for critical services must be carefully checked. The matters to be checked are as shown below.

- (1) Pressure drops and heat transfer coefficients in critical services.
- (2) Maximum velocities in condensers
Even in the case of H₂S-NH₃ free service if the vapor velocity exceeds 100 ft/s ([30.48 m/s](#)), measures, such as the use of ferrules (tube inserts) must be considered for the prevention-of erosion. Crude overhead condenser is the case.
- (3) Flow velocities in tubes in H₂S-NH₃-H₂O services such as those in hydrosulfurization units.
In such cases, the flow velocities in the tubes shall be limited to under 20 ft/s ([6.10 m/s](#)).
- (4) Flow arrangements in condensers
When condensers are designed for a multi-pass-multi-layer type, care shall be taken not to assign the vapor to the upper layer and the liquid to the lower layer.
- (5) Allowable pressure drops provided for high viscosity-high fouling services
If such services are involved, a sufficient allowable pressure drop must be provided.
A flow velocity (in tubes) of over 3 ft/s ([0.91 m/s](#)) is desired.

6. AFC TEMPERATURE CONTROL TYPES

6.1 Purposes of Temperature Control

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First of all temperature control is required as a part of the process operation.
Besides this, temperature controls are used for the following purposes:

- (1) Reduction in the operating manpower
- (2) Reduction in the power consumption
- (3) Increase in the life of the driving equipment (by reduction in the driving load)
- (4) Reduction in noise in low load operation and other merits

Hence, economics studies should be conducted and proper temperature controls should be selected and used even for such air fin coolers as product rundown coolers which can be operated without any temperature control.

6.2 Types of Temperature Controls

Temperature control can be conducted by the following means in the case of air fin coolers:

- (1) Variation in the fan blade pitch
- (2) Variation in the RPM of the fan
- (3) Variation in the louver opening
- (4) Process fluid bypass

These control can be designed for the following types:

- (1) Manual
- (2) HC (Hand Control)
- (3) Local mounted TC
- (4) Board mounted TC

The above are summarized in Table 6-1.

Air fin cooler temperatures can be controlled by switching on or off their fans, but this means is not taken up herein.

6.3 Selection of Temperature Controls

In actual jobs, temperature controls must be selected with consideration given to various factors, such as process requirements, the owner's policies and costs.

Since selection criteria cannot be explained briefly, herein, the features of each control type are discussed and the instances of their applications are shown. Also, their costs are shown for reference.

6.3.1 Features of Each Temperature Control

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(1) Fan pitch control

- This temperature control is superior in response characteristics indicating responsibility and controllability.
Generally, temperature control can be done by this means with such high accuracy as about $\pm 1.0^{\circ}\text{C}$.
- In cold weather and in low load operation, a large power saving can be afforded, compared with the design value.
- Usually two fans are provided for one bundle and temperature control is done by using one of them.
- Hot air circulation can be conducted by holding the blades at the negative angle.

(2) Fan RPM Control

- The following three types of motor RPM control are commercialized:
 - (a) Two-speed motor: manual switch turned on or off according to the atmospheric temperature.
 - (b) Thyristor cycle conversion: expensive at present.
 - (c) Stepless speed variation motor: unsuitable for continuous services.
- In some cases, two-speed motors are used in combination with automatic fans and louvers
- Drivers(for instance, steam turbines and hydraulic motors) other than electric motors can be used for fan RPM control comparatively easily.

(3) Louver control

- Even if the louver board angle is slightly changed, the air rate will vary largely as shown in Fig. 6-1 owing to the characteristics of louvers.
Hence, louver control is unsuitable for services where the operating conditions are largely variable.
- Reduction in the power consumption in low load operation and in cold weather are smaller than those in the case of fan pitch control.
- In cases where steam coils are provided, usually louvers are used.
- In cases where hot air circulation is to be conducted, louvers must be provided.
- The louvers can serve for the protection of the air fin coolers against such bad weather as strong winds and snowfall.
- Generally, temperature control can be done with such accuracy as $\pm 5.0^{\circ}\text{C}$.

(4) Process fluid bypass control

- If the system is well designed, temperature control can be done by this means with high accuracy.
- Since a part of the process fluid will be cooled to a temperature lower than required for process operation, if the process fluid is prone to solidify, this

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control cannot be used.

- In many cases, AFC temperature control is required when solidification-prone fluids are cooled.

Hence, there are few instances where this control is used.

6.3.2 Instances of Temperature Controls Actually Used

Instances of temperature controls actually used chiefly in refineries are summarized according to the classifications of services in Table 6-2.

6.3.3 Comparison of Costs of Temperature Controls

The cost of each control shown in Table 6-1 is estimated and shown in Tables 6-3 and 6-4 is for reference.

Table 6-3 shows the costs of the temperature controls used on HVGO coolers (35,000 BPSD vacuum flasher) in example 1 and Table 6-4 shows those on main fractionator overhead condensers (80,000 BPSD topping unit) in example 2. In these cases, bypass controls cannot be used.

The figures given in the tables are only a part of those in actual applications.

Judging from them, fan pitch controls are inexpensive and the merits of local mounted temperature controls are largest.

Note:

The costs of the air fin coolers were estimated on the basis "Delivery after installation at the jobsite".

Those of the controls were estimated by Instrumentation department: the installation costs are included.

Both the estimates were conducted in January to February, 1978.

7. PROTECTION AGAINST PLUGGING

7.1 Measures for Prevention of Plugging

In cases where high pour point or solidifying point fluids are to be cooled in air fin coolers, plugging preventive measures may be required.

When the tube skin temperature decreases nearly to the pour or solidifying point of the (high pour or solidifying point) fluid, the viscosity of the fluid increase accordingly.

As a result, the pressure drop will increase and it will become impracticable to pump the fluid.

In the case of fluids containing water, when the temperature has fallen below the freezing point,

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hydrates will form, causing plugging or ice will form, causing erosion.

Hence, plugging preventive measures must be provided for air coolers which are intended to handle such fluids and for those which are not to be operated all the time.

For this, some criteria should be established, but strictly speaking as they must be worked out for each individual plant with consideration given to the properties of the fluid to be handled, operation modes planned, and geographical conditions involved, universal criteria cannot be set up herein.

However, the following points could be used as a general guide to the adoption of preventive measures.

- Where the design minimum ambient temperature is no higher than 5°C from the pour or solidifying point. (mini. amb. temp. – pour point: $\leq 5^{\circ}\text{C}$)
- Where the design minimum ambient temperature is no higher than 0°C if water or fluids containing water are to be handled.
- Where the air coolers are not to be operated normally.
- Where fractions heavier than reduced crude (or heavy gas oil in some cases) are to be air cooled. (This depends on the types of crudes.)
- Where fluids of a relatively high solidifying point such as benzene, p-xylene, amine solution and caustic are to be handled.

After it has been decided that preventive measures should be provided, one or more measures must be selected from among those shown in Para. 7.2.

7.2 Examples of Solidification Preventive Measures

solidification preventive measures available are as enumerated below.

- Arrange the piping as shown in Fig. 7-1.
- Provide steam coils under the air fin coolers: divide them into the sections of the air fin coolers and provide a valve and steam trap for each section as shown in Fig. 7-2.
- Provide louvers. In many cases, louvers are used in combination with steam coils. Combination of louvers and variable pitch fans is considered in some cases to enable hot air circulation.
- Provide block valves and a flushing connection for each air fin cooler tube bundle. Refer to Fig. 7-3.
- Provide drains to remove all liquid in the air fin coolers completely after shut-down.
- Use bare tubes on the outlet side of the bundle to raise the tube temperature.

7.3 Special Solidification Preventive Measures

Special constructions as shown below are used to conduct hot air circulation in closed systems in cases where high solidifying point fluids, such as benzene ([Freezing Point](#) +5.5°C) and p-xylene ([Freezing Point](#) +13.3°C) are to be cooled.

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Refer to Fig. 7-4.

8. REFERENCE

- (1) API 661 air cooled heat exchanger for general refinery services
- (2) JPI-7R-51-77 construction of air cooled heat exchanger (for petroleum industries)
- (3) Sasakura Engineering Co.'s reports
- (4) Hydrocarbon processing Vol. 46, No. 2 (1967)

Table 6-1. Air Fin Cooler Controls

	Fan Pitch Control	Fan Control	Louver Control	Process Fluid Bypass Control
Manual				
HC				
TC Local Mounted				
TC Board Mounted				
Note	All fans are controlled in some cases.	Two speed motors are used.	In cases where steam coils are provided normally louvers are used.	This type of control is conceivable, but there is no actual instance where it is used as far as our investigation is concerned.

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Table 6-2 Summary of Air Fin Cooler Control Types Actually Used

NO	Service	Fluid	Fan pitch control	Control type	Fan RPM control	Control type	Number of Fans Controlled	Louver Provided	Control type	Steam Coil Provided	Note
1	Top main fraction condenser	Hydrocarbon vapor	Yes	TC (L)	No	-	Half	No	-	No	TC at air temp.
2	"	"	Yes	HC	No	-	All	No	-	No	
3	"	"	Yes	TC (L)	No	-	Half	No	-	No	
4	"	"	Yes	TC (B)	No	-	Half	No	-	No	
5	"	"	No	-	No	-	-	No	-	No	
6	"	"	No	-	No	-	-	No	-	No	
7	"	"	Yes	TC (L)	No	-	-	No	-	No	
8	Kerosene cooler	Hydrocarbon liquid	Yes	TC (L)	No	-	Half	No	-	No	
9	"	"	Yes	TC (L)	No	-	Half	No	-	No	
10	LVGO cooler	"	Yes	TC (L)	No	-	Half	No	-	No	
11	"	"	No	-	No	-	-	Yes	TC (L)	No	Temp. measurement at trim cooler outlet
12	"	"	No	-	No	-	-	No	-	No	
13	HGO cooler	"	Yes	TC (L)	No	-	-	Yes	Man'l	Yes	
14	"	"	No	-	No	-	-	Yes	TC (L)	Yes	
15	"	"	No	-	No	-	-	Yes	TC (L)	Yes	
16	"	"	Yes	-	No	-	Half	No	-	No	
17	LVGO cooler	"	Yes	TC (L)	No	-	Half	No	-	Yes	
18	"	"	Yes	TC (L)	No	-	-	Yes	Man'l	Yes	
19	LVGO reflux cooler	"	No	-	No	-	-	Yes	TC (L)	Yes	
20	"	"	Yes	TC (L)	No	-	-	Yes	Man'l	Yes	
21	LVGO reflux cooler	"	No	-	No	-	-	Yes	Man'l	Yes	
22	"	"	No	-	No	-	-	Yes	HC	Yes	
23	"	"	Yes	TC (L)	No	-	Half	No	-	Yes	
24	"	"	No	-	No	-	-	-	TC (L)	No	
25	MVGO cooler	"	No	-	No	-	-	Yes	TC (L)	Yes	
26	MVGO reflux cooler	"	No	-	No	-	-	Yes	TC (L)	Yes	
27	HVGO cooler	"	No	-	No	-	-	Yes	TC (L)	Yes	
28	"	"	Yes	TC (L)	No	-	-	Yes	Man'l	Yes	
29	"	"	Yes	TC (L)	No	-	Half	Yes	Man'l	Yes	
30	HVGO reflux cooler	"	No	-	No	-	-	Yes	TC (L)	Yes	
31	"	"	No	-	No	-	-	Yes	TC (L)	Yes	
32	"	"	Yes	TC (B)	No	-	All	Yes	Man'l	Yes	
33	"	"	Yes	TC (L)	No	-	Half	No	-	Yes	
34	"	"	No	-	No	-	-	Yes	TC (B)	Yes	

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Table 6-3 Air Fin Cooler Temperature Control System Cost 1

As of February, 1978

	Fan Pitch	Fan RPM	Louver	Bypass	Note
Manual	AFC 17,000,000 Instr. 43,000 Total 17,043,000	AFC 16,950,000 Instr. 43,000 Total 16,993,000	AFC 17,380,000 Instr. 43,000 Total 17,423,000		The instrument cost includes only Th.
HC	AFC 17,300,000 Instr. 555,000 Total 17,855,000		AFC 17,660,000 Instr. 555,000 Total 18,215,000	AFC 16,600,000 Instr. 999,000 Total 17,599,000	The instrument cost includes Th, TI, HC(board to I/P) and HC (I/P to controller).
Local TC	AFC 17,300,000 Instr. 389,000 Total 17,689,000		AFC 17,660,000 Instr. 389,000 Total 18,049,000	AFC 16,660,000 Instr. 833,000 Total 17,433,000	The instrument cost includes TI, local TC and IC (I/P to controller).
Board TC	AFC 17,300,000 Instr. 905,000 Total 18,205,000		AFC 17,660,000 Instr. 905,000 Total 18,565,000	AFC 16,660,000 Instr. 1,349,000 Total 17,949,000	The instrument cost includes Th, TIC (T/C to board), TIC(board to I/P) and, TIC(I/P to controller).
Note	Variable pitch fans are 1/2 of the total.	Two speed motors are 1/2 of the total	If steam coils are provided, the cost will increase Y1,750,000 G/O motors are included in the cost of AFC.	The instrument cost includes control valves(4"). It does not include the piping cost. AFC is provided with no controls.	TI desk is not included. The size of the work is about that for an FCC unit

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Table 6-4 Air Fin Cooler Temperature Control System Cost 2

As of February, 1978

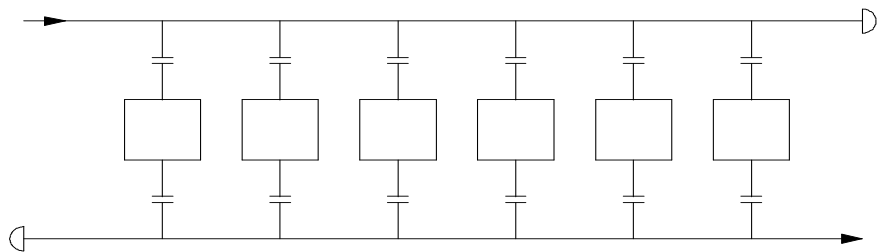
	Fan Pitch		Fan RPM		Louver		Bypass	Note
Manual	AFC	122,400,000	AFC	122,620,000	AFC	125,580,000		The instrument cost includes only Th.
	Instr.	43,000	Instr.	43,000	Instr.	43,000		
	Total	122,443,000	Total	122,663,000	Total	125,623,000		
HC	AFC	122,200,000			AFC	127,200,000		The instrument cost includes Th, TI, HC(board to I/P) and HC (I/P to controller).
	Instr.	870,000			Instr.	870,000		
	Total	125,070,000			Total	128,070,000		
Local TC	AFC	124,200,000			AFC	127,200,000		The instrument cost includes TI, local TC and TC (I/P to controller).
	Instr.	704,000			Instr.	704,000		
	Total	124,404,000			Total	127,904,000		
Board TC	AFC	124,200,000			AFC	127,200,000		The instrument cost includes Th, TIC (T/C to board to I/P) and TIC(I/P to controller).
	Instr.	1,220,000			Instr.	1,220,000		
	Total	125,420,000			Total	128,420,000		
Note	Variable pitch fans are 1/2 of the total.		Two speed motors are 1/2 of the total		G/O motors are included in the cost of AFC.		Since AFC is used as a condenser, bypass control cannot be used.	The size of the work is about that for an FCC unit.

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Fig. 4-1 Basic Patterns of Manifold

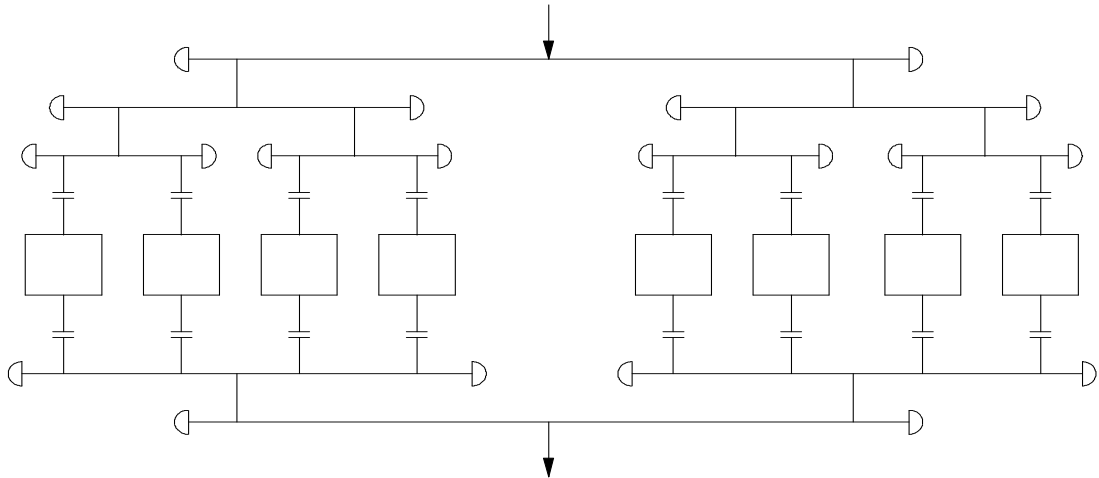
(a) S-Type

This pattern is so-called S-flow type.



(b) I-Type

This pattern is so-called "Tournament type" in which the piping arrangement is symmetrical.

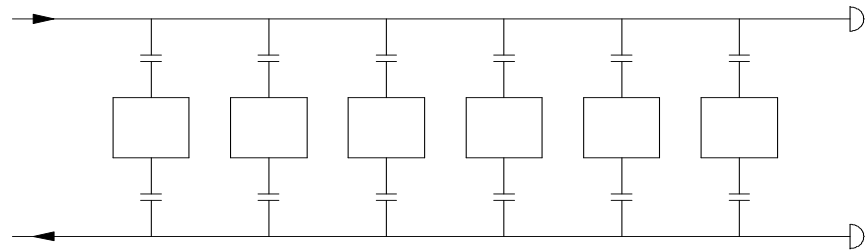


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Fig. 4-1 Basic Patterns of Manifold (concluded)

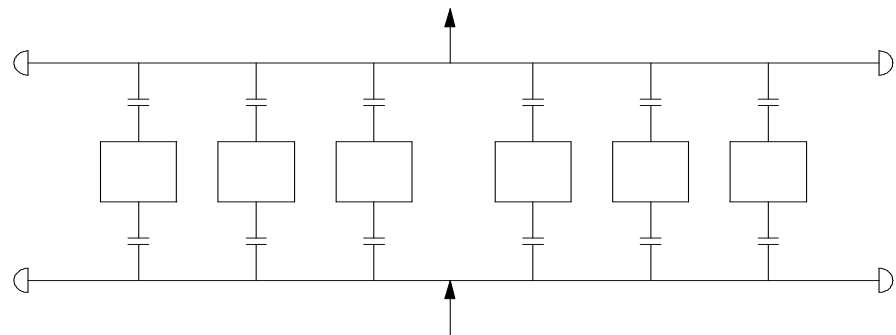
(c) U-Type

This pattern is so-called "U-flow type".



(d) Mu-Type

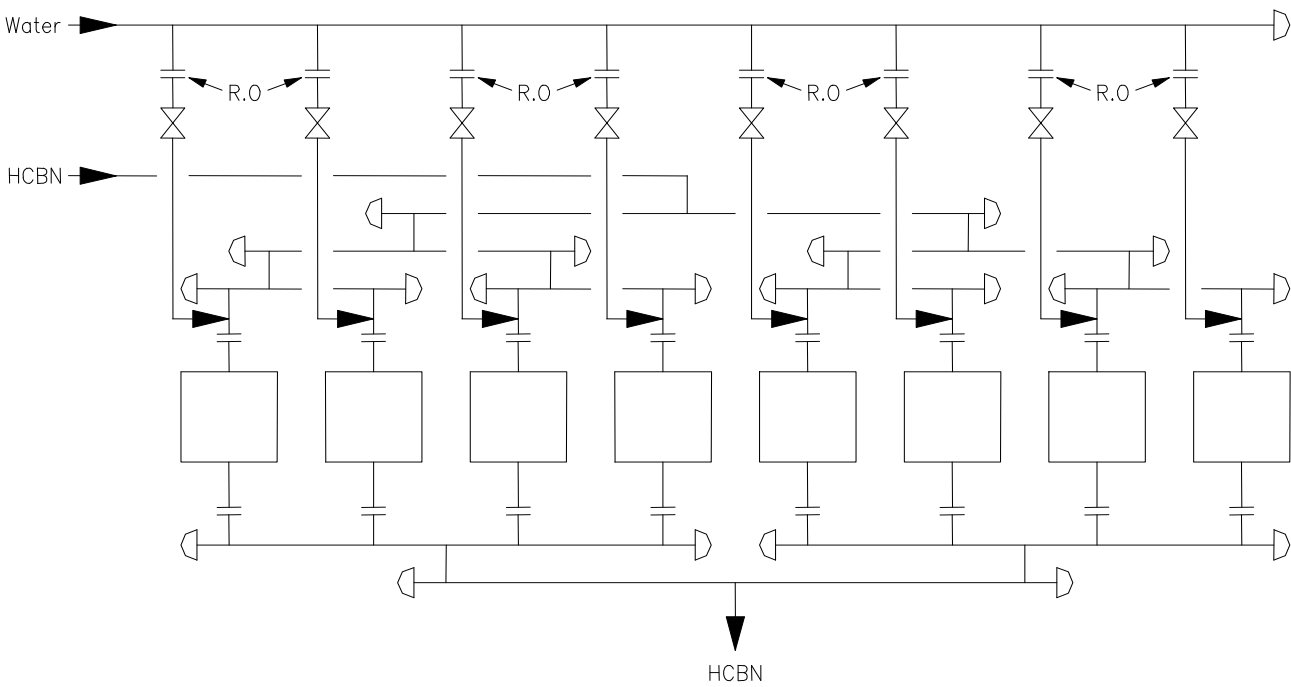
The MU-type pattern is a modification of "U-flow type".



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Fig. 4-2 Optional patterns of Manifold

(a) Water injection (Type-TW)



* Since orifices are not provided in all cases, this shall be specifically indicated.

(b) Block valve (Type-MUB)

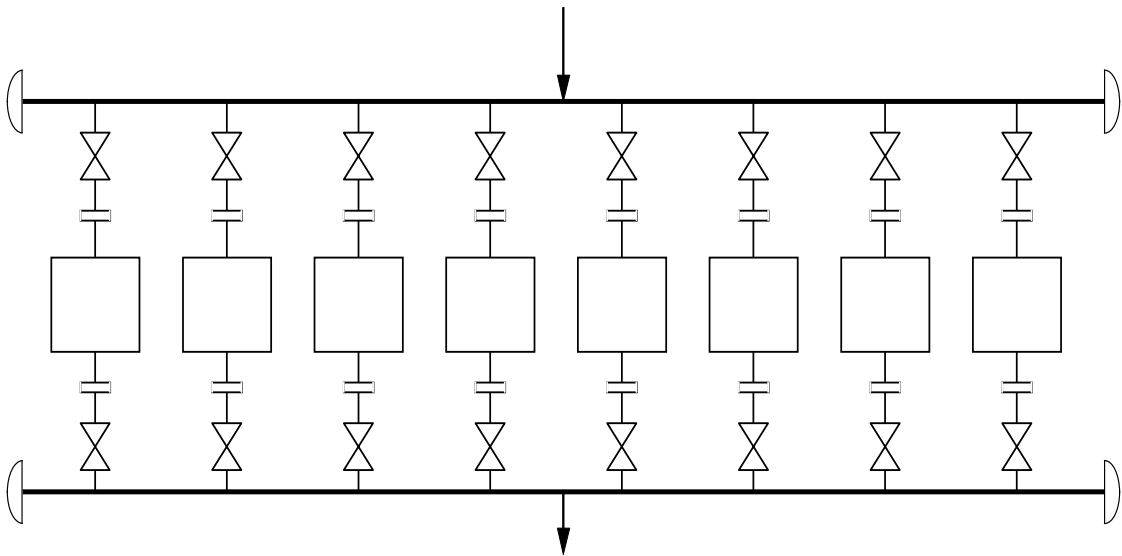
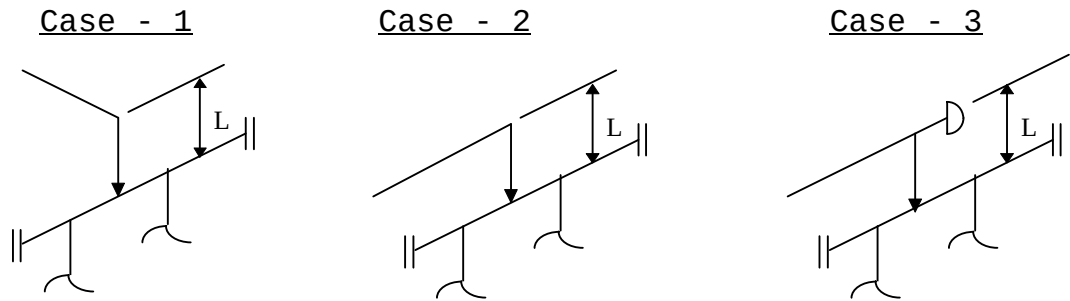


Fig. 4-3 Header Arrangement



In the case 1, there is no limitation on length L
In the case 2, the length L shall be larger than 30 times the pipe diameter.
In the case 3, the length L shall be larger than 10 times the pipe diameter. Capping is required to prevent flow increases in the right branch due to inertia(shoulder flow).

The above arrangements shall be used for two-passes and more.

Fig. 6-1. Effect of Louver Control

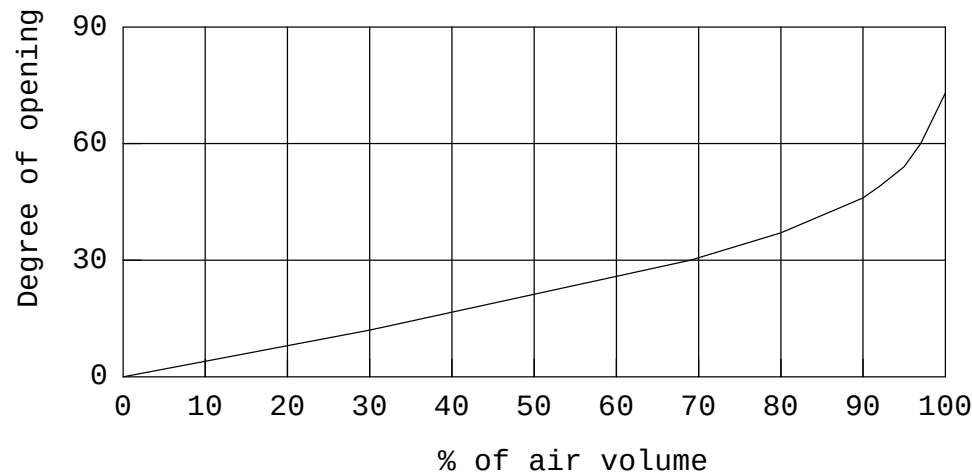


Fig. 7-1 Solidification Preventive Measure 1

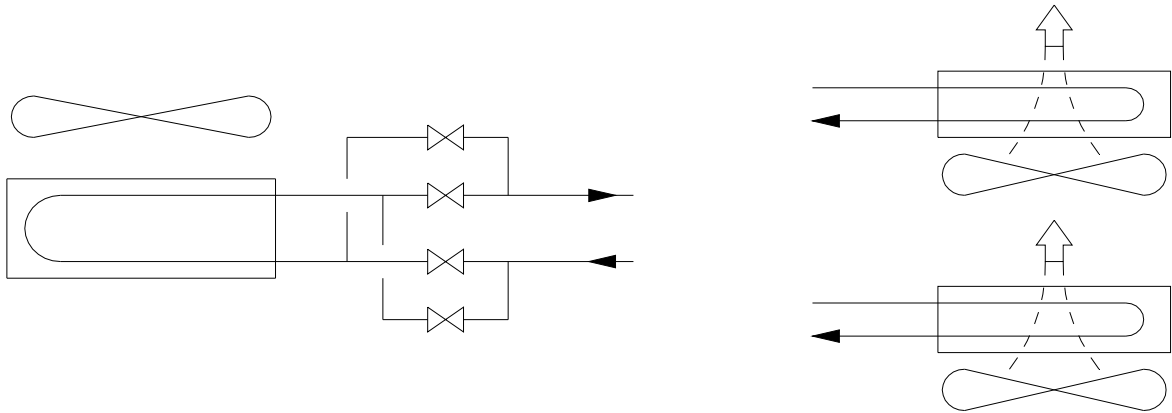


Fig. 7-2 Solidification Preventive Measure 2

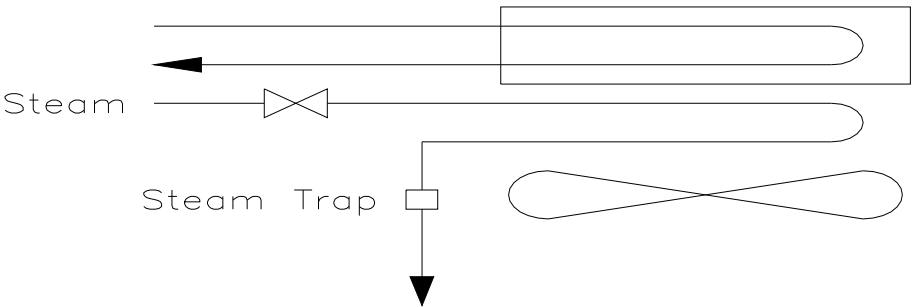
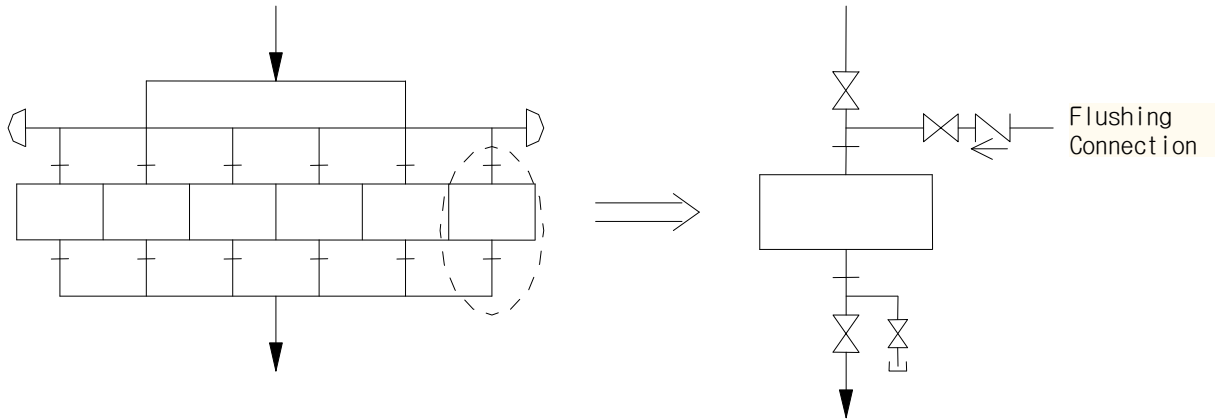
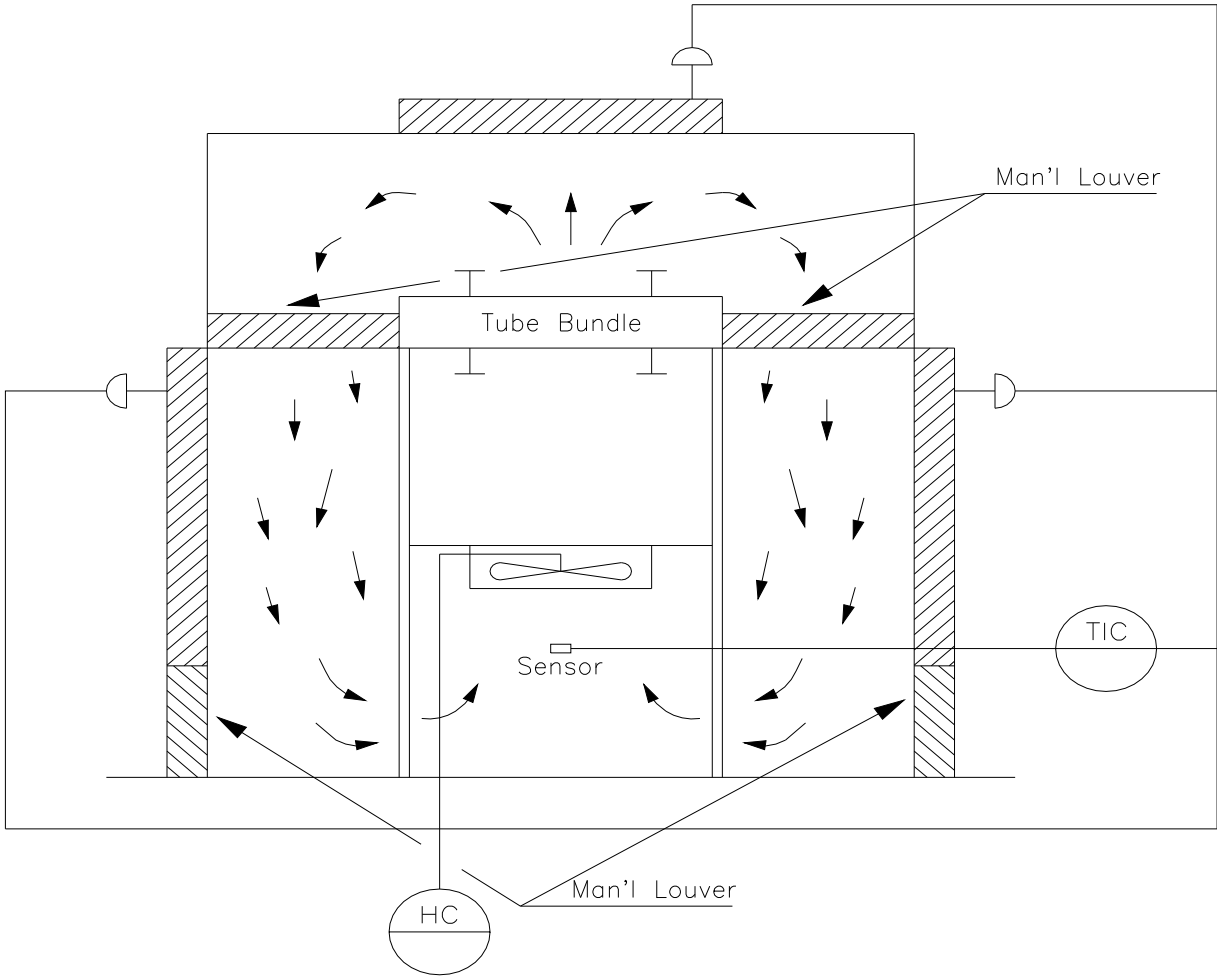


Fig. 7-3 Solidification Preventive Measure 3



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Fig. 7-4 Hot Air Circulation



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9. HISTORY

Rev. No.	Rev. Date	Rev. Page	Rev. Status
0	1998.04.17	all	Newly prepared as design guide - Original Dept. : Process Engineering Team - Prepared by : Sung-Hyun Han, In-Soo Kim - Reviewed by : Bong-Il Lee, Seok-Beom Jo, Jae-Chul Ro - Approved by : Sung-Gook Oh
1	2003.10.23	4,7,8,9,10, 12,13,14,15, 16,20,21	Partly developed as design guide - Original Dept. : System Engineering Team - Prepared by : Min-Seob Sim - Reviewed by : Jae-Chul Ro - Approved by : Chan-Sul Jung
2	2010.11.20	All	Document number revision - Prepared by : T.H. Lee - Reviewed by : H. Sung, J.C. Ro, H.H. Kwak, M.H. Oh, S.U. Hong - Approved by : E.D. Lee
<u>3</u>	<u>2013.07.12</u>	<u>All</u>	<u>Add Datasheet form of Air Cooled Heat Exchanger, (Form No.C-6330-202AA4 (Metric unit) as Appendix A.</u> <u>Add US Units symbol and SI Units symbol for values.</u> <u>Update Equations, references and tables,</u> <u>- Prepared by : C.H. Park</u> <u>- Reviewed by : J.C. Ro</u> <u>- Approved by : S.B .Lee</u>

**Appendix A. Air Cooled Heat Exchanger,
(Form No.C-6330-202AA4 (Metric unit))**

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		SAMSUNG ENGINEERING CO., LTD. SEOUL, KOREA		SHEET OF △	
AIR COOLED HEAT EXCHANGER				CUSTOMER	
				LOCATION	
				JOB NO.	ITEM NO.
				REQ'N NO	
				SERVICE	
Size & Type		(Induced) (Forced) Draft		No. of Bays	
Surface per Unit-Finned Tube		m ² ; Bare Tube		m ²	
Heat Exchanged		kcal/h		MTD Effective °C	
Transfer Rate-Finned Tube, Service		Bare Tube, Service		Bare Tubes Clean kcal/h m ² °C	
PERFORMANCE DATA - TUBE SIDE					
Fluid Name		Lethal Service (Yes) (No)		IN OUT	
Total Fluid Entering		kg/h		Density, Liq./Vap. kg/m ³ / /	
Temperature °C		IN OUT		Viscosity, Heat, Liq./Vap kcal/kg °C / /	
Liquid kg/h				Specific Heat, Liq./Vap kcal/h m °C / /	
Vapor kg/h		MW		Conductivity, Liq./Vap kcal/h m °C / /	
Nocond. kg/h		MW		Dew Point °C	
Steam kg/h				Bubble Point °C	
Water kg/h				Latent Heat °C	
Inlet Pressure kg/cm ² G				Press. Drop, Allow./Calc. kg/cm ²	
				Fouling Resist. Inside m ² °C h/kcal	
PERFORMANCE DATA-AIR SIDE					
Air Quantity Total		kg/h		Temperature °C	
Air Quantity / Fan		act. m ³ /s		Temperature Out °C	
Altitude Above Sea Level		m		Minimum Design Ambient °C	
Actual Static Pressure		mm water		Fouling Resis. Extended m ² °C h/kcal	
Face Velocity		std m/s		Mass Velocity (Net Free Area) kg/m ² s	
DESIGN - MATERIAL - CONSTRUCTION					
Design Pressure kg/cm ² G		Test Pressure kg/cm ² G		Design Temperature °C	
TUBE BUNDLE		HEADER Type		TUBE Material	
Size x m		Material		(Seamless) (Welded)	
No./Bay No. Tube Rows		No. Pass. Arrangement		OD mm Min. Thick. mm	
Arrangement		Plug Material		No./Bundle Length mm	
Bundles In Parallel In Series		Gasket Material		Pitch mm Slope mm/m	
Bays In Parallel In Series		Corrosion Allowance mm		FIN Type	
Bundle Frame		Inlet Nozzle, No.-Size - mm		Material	
MISCELLANEOUS		Outlet Nozzle, No.-Size - mm		OD Stock Th'k mm	
Struct. Mount. (Grade) (Piperack)		Special Nozzles mm		No./m Fin Des. Temp. °C	
Louvers (Auto) (Manual) (No)		Rating & Facing		Code-ASME VIII Div.1 Stamp (Yes) (No)	
Vibration Switches (Yes) (No)		TI PI		Specs	
Steam Coil (Yes) (No)		Chem. Cleaning			
MECHANICAL EQUIPMENT					
FAN Mfr & Model		DRIVER Type		SPEED REDUCER Type	
No./BAY RPM		Mfr.		Mfr. & Model	
Dia. m No. Blades		No./Bay kW/Driver		No./Bay	
Pitch (Adj) (Auto) Angle		Rpm		Service Factor Ratio /1	
Material, Blade Hub		Enclosure		Support (Structure) (Pedestal)	
kW / Fam. Des. Min. Amb.		Volt/Phase/Cycle			