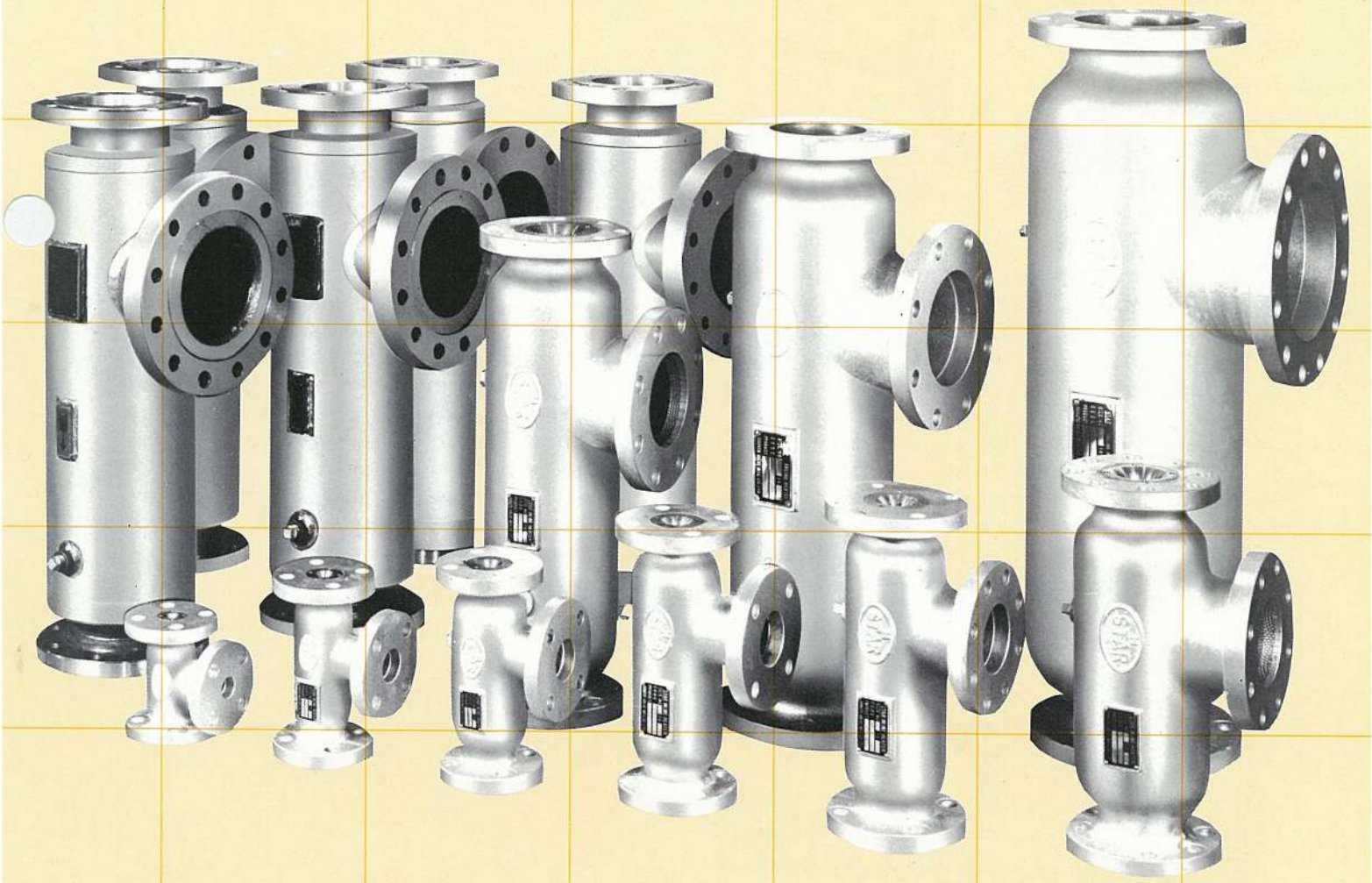
H STAR

Catalog No. TDR-89

INLINE STEAM HEATERS
TDR-M

No water hammer
Accurate temperature control
Steam flow control • 0 ~ max.
Manual or automatic control (T.I.C)



HOKUTO MFG. CO., LTD.

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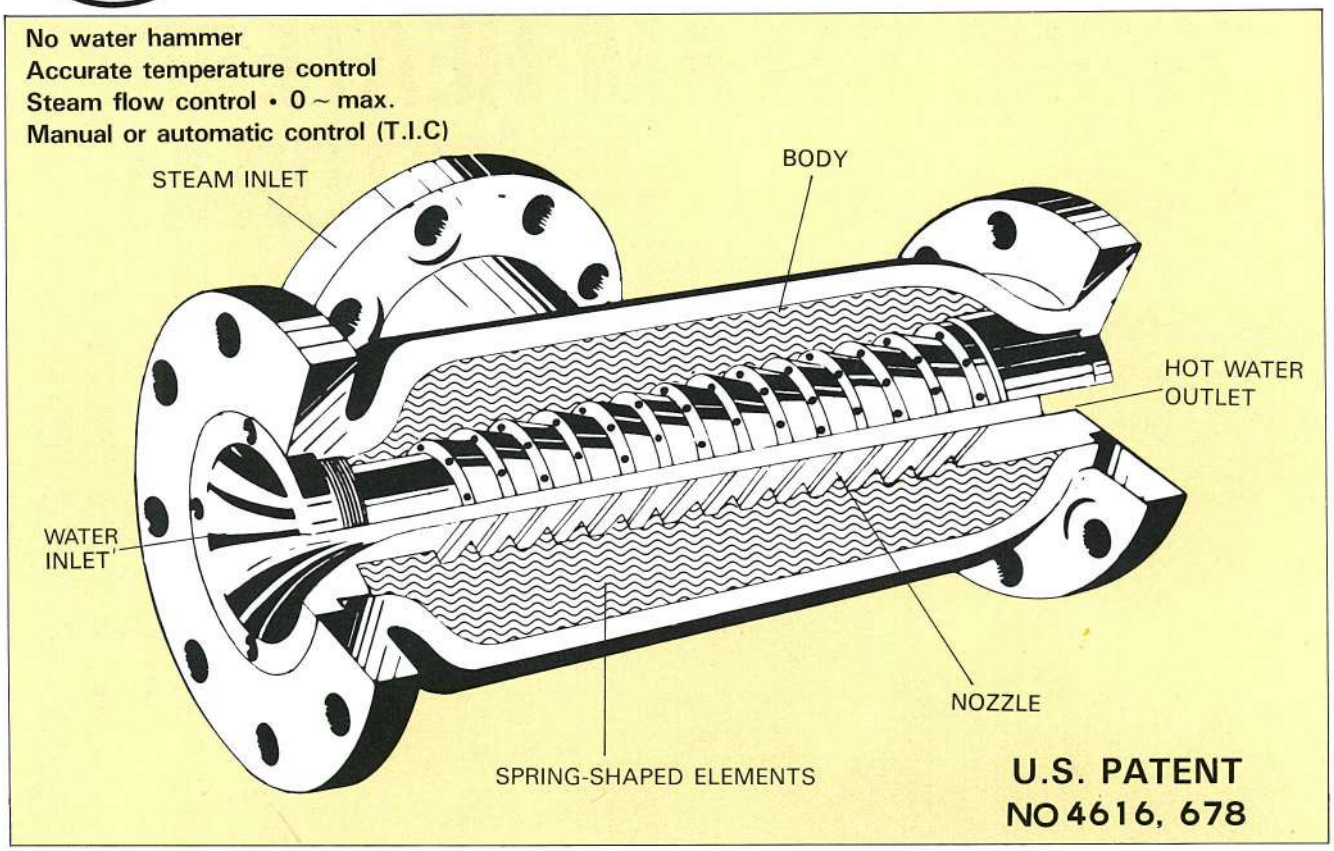


- The inline steam heater is a hot water heater which produces heated water/liquid by blowing steam directly to water or liquid inside piping. This is a highly efficient hot water heater of such system as quite different from conventional heat exchanging system.
- Water/liquid inside piping is mixed with steam injected from many tiny orifices provided aslant in the nozzle while passing through the inside of nozzle of an inline steam heater, resulting in being heated instantaneously. Thus, it is turned to be hot water/liquid and discharged from the outlet.
- The steam supplied for heating water is diffused while passing through a spring-shaped element filled inside body and sucked therein from tiny holes provided in the nozzle, resulting in being extremely small in noise and vibration. In the case of an automatic control system, even if the quantity of steam is increased or decreased, no hammering of steam/water is caused, resulting in being possible to carry out operation silently.

STRUCTURE AND MATERIAL

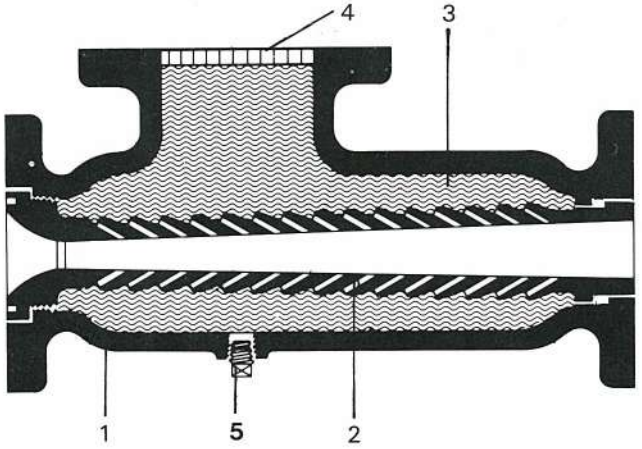


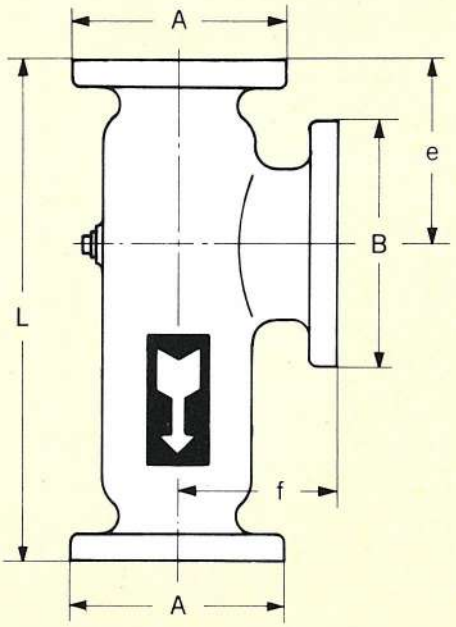
Table 1

No.	Nomenclature	Material (standard)		Material (over 40 TDR)
1	Body	Cast iron	Cast stainless	Steel
2	Nozzle	Stainless	Stainless	Stainless
3	Element	Stainless	Stainless	Stainless
4	Cover	Stainless	Stainless	Stainless
5	Drain plug	Steel	Stainless	Malleable iron

Size and dimensions

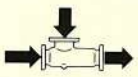
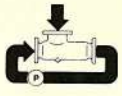
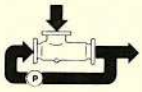
Table 2

SIZE No.	Pipe flange (inches)		Dimensions (mm)			
	A	B	L	e	f	Plug
4TDR-AM	1″	1″	160	80	95	¼″
6TDR-AM	1¼″	1¼″	180	90	110	¼″
8TDR-AM	1½″	1½″	190	95	115	¼″
10TDR-AM	2″	2″	220	110	120	3/8″
12TDR-AM	2½″	2½″	270	135	130	3/8″
16TDR-AM	3″	3″	300	150	150	3/8″
20TDR-AM	4″	4″	450	180	160	½″
20TDR-BM						
24TDR-AM	5″	4″	510	200	170	½″
24TDR-BM						
32TDR-AM	6″	5″	600	230	200	½″
32TDR-BM						
40TDR-AM	8″	—	—	—	—	3/4″
40TDR-BM						
48TDR-AM	10″	—	—	—	—	3/4″
48TDR-BM						
64TDR-AM	12″	—	—	—	—	3/4″
64TDR-BM						



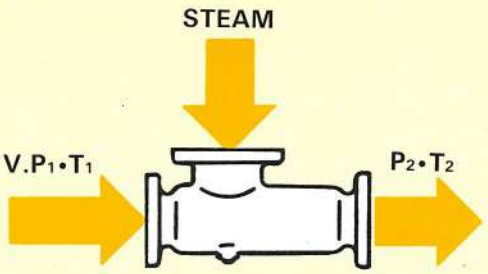
Flange ANSI 150LB-RF

- Steam pressure, body materials and differential heating value Δt and other specifications outside the specifications may be provided upon consultation. The above dimensions may be changed.
- Orders for sizes over 40 TDR are made to specifications.
- The above specifications are subject to change without notice.

Application	Remarks	Page
 ① ONE-PASS SYSTEM	Steam is injected directly into the water for instantaneous and continuous heating to the specified temperature at the discharge outlet of the inline steam heater with this fluid heat exchanger.	4～5 8～9
 ② RE-CYCLE SYSTEM	Fluid is recycled in the piping and steam is injected to heat to the specified temperature again and again. Furthermore, this application is for a continuously recycling heat exchanger.	6～7 8～9
 ③ HEATING ④ SUPPLY HOT WATER	Water is recycled in the piping and a specified temperature always can be maintained.	10～14

① ONE-PASS SYSTEM

Hot water discharge open type



One-pass system inline steam heater standard flow rate (m^3/h)

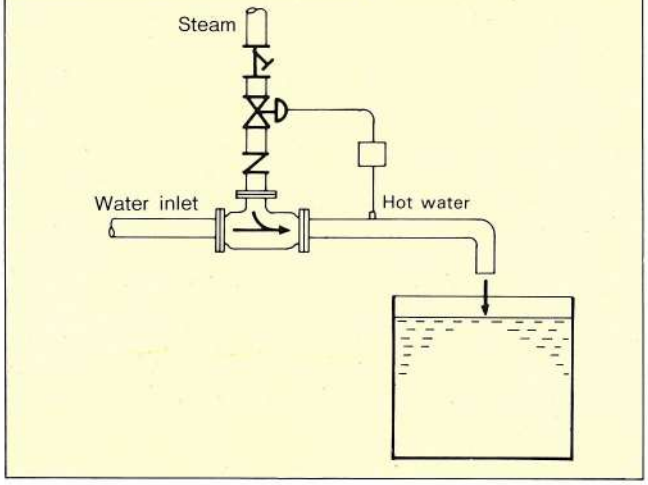
Table 3

SIZE No.	Standard flow rate V• m^3/hr	Minimum flow rate V• m^3/hr	Pipe flange (inches)	
			Liquid	Steam
4TDR-AM	2.4	1.2	1″	1″
6TDR-AM	5	2.5	1¼″	1¼″
8TDR-AM	9	4.5	1½″	1½″
10TDR-AM	14	7	2″	2″
12TDR-AM	20	10	2½″	2½
16TDR-AM	32	16	3″	3″
20TDR-AM	50	25	4″	4″
24TDR-AM	70	35	5″	4″
32TDR-AM	120	60	6″	5″
40TDR-AM	210	105	8″	*
48TDR-AM	330	165	10″	*
64TDR-AM	520	260	12″	*

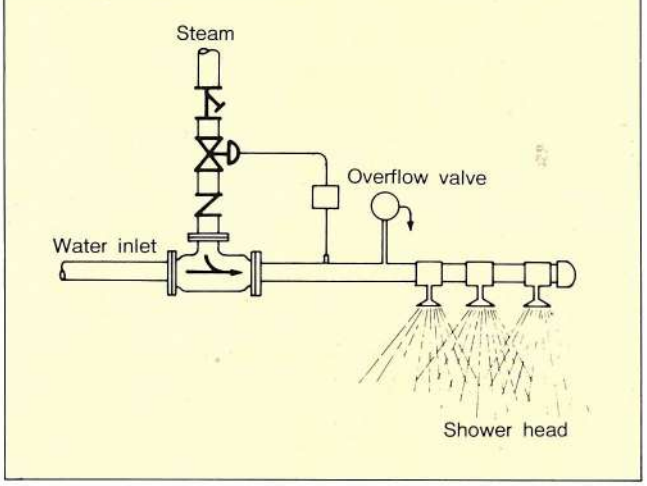
* Note: Orders for sizes over 40 TDR are made to specifications. ANSI 150 LB RF

ONE-PASS SYSTEM PIPING EXAMPLE

Discharging hot water



Hot water shower



INLINE STEAM HEATER ONE-PASS SYSTEM FEATURES

1. STEAM INJECTION RATE (max)

Example: Max steam injection rate • kg/hr
for 12 TDR-AM

Water pressure P_1 kg/cm²G	Steam pressure kg/cm²G						
	1	2	3	4	6	8	10
0.5	435	635	830	1,025	1,410	1,785	2,160
1	0	635	830	1,025	1,410	1,785	2,160
2	—	0	790	1,025	1,410	1,785	2,160
3	—	—	0	920	1,410	1,785	2,160
4		—	—	0	1,350	1,785	2,160
5	—		—	—	1,180	1,740	2,160

Steam injection rate coefficients

SIZE No.	4	6	8	10	12	16	20	24	32
Coefficient	0.17	0.28	0.38	0.61	1	1.4	2.4	2.4	3.7

2. STEAM INJECTION RATE (min)

Steam injection rate min = 0 kg/hr
Steam supply injection flow rate can be controlled to a minimum of 0 kg/hr without any noise or vibrations caused by hammering.

3. CALCULATION OF THE STEAM FLOW RATE

$$\text{Steam flow rate } Sw = \frac{V \times (t_2 - t_1)}{h'' - t_2} \quad \bullet \text{ kg/hr}$$

V: water flow rate ℓ/hr • h″: specific enthalpy (KCal/kg)
t_2: hot water temperature t_1: water temperature

Example 1: 12 TDR-AM
Water flow rate: V = 20 m³/hr
Steam pressure: 4 kg/cm²G

$$Sw = \frac{20{,}000\ (40° - 10°)}{656.1 - 40} = 974 \text{ kg/hr}$$

Example 2: 12 TDR-AM
Water flow rate: V = 10 m³/hr
Steam pressure: 6 kg/cm²G

$$Sw = \frac{10{,}000\ (80° - 10°)}{659.7 - 80} = 1208 \text{ kg/hr}$$

4. WATER FLOW RATE CONTROL (standard flow rate coefficients)

Water flow rate control	Water temperature rise $\Delta t = t_2 - t_1$	Inlet side water pressure P_1 kg/cm²G		
		0.5	1	2 ~ 5
MAX	0 ~ 10°C	0.9	1.0	1.0
	20°	0.9	1.0	1.0
	30°	0.8	1.0	1.0
	40°	0.75	0.9	1.0
	50°	0.7	0.85	1.0
Minimum	0 ~ 70°	0.5	0.5	0.5

5. WATER FRICTION LOSS (ΔP)

1. Steam is not injected (during standard flow rate) . . . . . max 5 mAq
2. Continuous steam injection above normal Δt of 20 deg C . . . . . 0 mAq

6. STEAM PIPE DIAMETER

Select the internal pipe diameter for steam with a velocity of 30 m/s as standard. Use a reducing flange to connect an inline steam heater flange to the flange of a steam pipe of different size.

7. ELEMENT

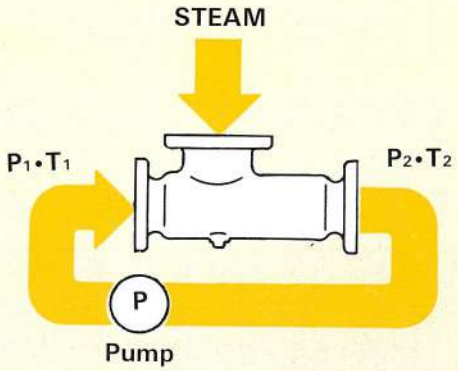
1. When the steam rate is controlled, hammering is completely eliminated by the element installed in the body.
2. If the flow rate declines in inline steam heaters that have been in use for a long time, performance is reduced by accumulations of impurities in the element.
   In this case, the element is removed by pressing it out to eliminate the problem.
3. When water quality causes element blockage, an inline steam heater without a element can be made. Please inquire about this type of application to the manufacturer.

Examples:
- Paper pulp water
- Sugar water
- Starch water

8. WATER FLOW RATE CONTROL

1. Water flow rate is controlled on the inline steam heater inlet side.
2. Water flow rate cannot be controlled on the outlet side.
3. If water flow rate is to be controlled on the controlled water volume is returned to the suction side of the pump or controlled as overflow from a relief valve.

② RECYCLE SYSTEM
LOOP HEATER
CLOSED SYSTEM



RECYCLE SYSTEM INLINE STEAM HEATER PUMP WATER FLOW RATE (ℓ/min)

Table 4

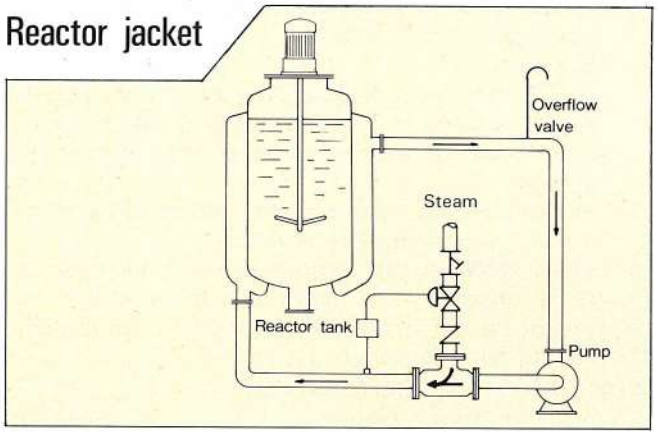
SIZE No.	Pump water flow rate ℓ/min	Pipe flange (inches)	
		Liquid	Steam
4TDR-AM	32	1″	1″
6TDR-AM	67	1¼″	1¼″
8TDR-AM	120	1½″	1½″
10TDR-AM	190	2″	2″
12TDR-AM	270	2½″	2½″
16TDR-AM	430	3″	3″

SIZE No.	Pump water flow rate ℓ/min	Pipe flange (inches)	
		Liquid	Steam
20TDR-BM	1,000	4″	4″
24TDR-BM	1,400	5″	4″
32TDR-BM	2,400	6″	5″
40TDR-BM	3,600	8″	*
48TDR-BM	5,600	10″	*
64TDR-BM	9,000	12″	*

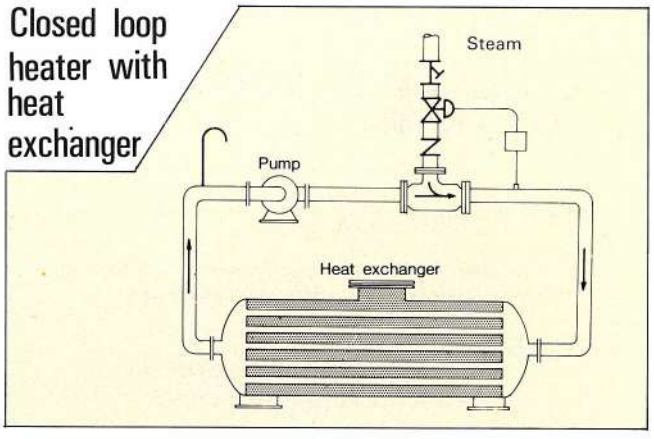
Note: Orders for sizes over 40TDR are made to specifications.

RECYCLE SYSTEM PIPING EXAMPLES

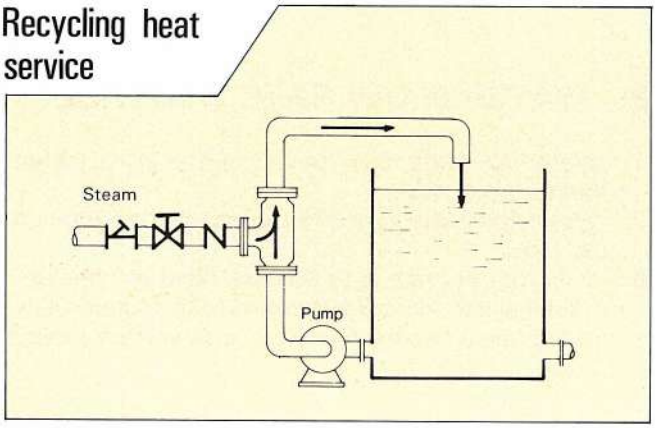
Reactor jacket



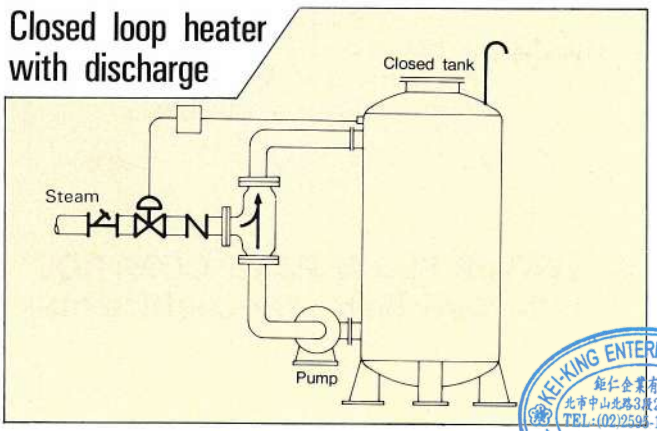
Closed loop heater with heat exchanger



Recycling heat service



Closed loop heater with discharge



INLINE STEAM HEATER RECYCLE SYSTEM FEATURES

1. STEAM INJECTION RATE (max)

The maximum differential average heating temperature with an inline steam heater installed is 10 deg. C. The maximum steam injection rate is calculated for each size based on the formula with a differential average heating temperature of 10 deg. C.

Example: Calculation of the quantity of steam flow (max)

$$\text{Steam flow } Sw = \frac{V \times 60 \times 10^{\Delta t}}{h'' - t_2}$$

V: pump water flow rate ℓ/min
h″: specific enthalpy (KCal/kg)
t_2: hot water temperature
steam pressur 4 kg/cm²G

Example 1: 12 TDR-AM V = 270 ℓ/min

$$Sw = \frac{270 \times 60 \times 10^{0}}{656.1 - 90} = 286 \text{ kg/hr}$$
(steam pipe dia 1¼″)

Example 2: 20 TDR-BM V = 1000 ℓ/min

$$Sw = \frac{1{,}000 \times 60 \times 10^{0}}{656.1 - 90} = 1{,}060 \text{ kg/hr}$$
(steam pipe dia 2½″)

2. STEAM INJECTION RATE (min)

Steam injection rate min = 0 kg/hr
Steam supply injection flow rate can be controlled to a minimum of 0 kg/h without any noise or vibrations caused by hammering.

3. DIFFERENTIAL AVERAGE HEATING TEMPERATURE (Δt)

Water temperature rise
Δt = 0 ~ 10 deg. C°

4. PUMP WATER FLOW RATE CONTROL (standard flow rate coefficients)

When it is necessary to control the pump water flow rate, the following control ranges are possible.

Water flow rate control	Differential average heating temperature Δt °C	Inlet water pressure P_1 kg/cm²G					
		0.5	1	2	3	4	5
NOR	0 ~ 10	0.9	1	1	1	1	1
MIN	0 ~ 10	0.4	0.4	0.4	0.4	0.4	0.4

5. WATER FRICTION LOSS (ΔP)

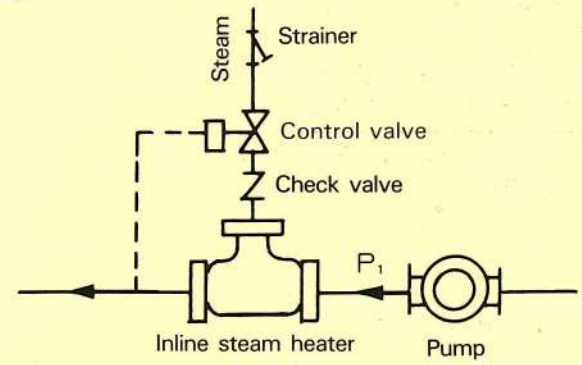
Water flow rate . . . . . max 3 mAq

6. STEAM PIPE DIAMETER

Select the internal pipe diameter for steam with a velocity of 30 m/s as standard. Use a reducing flange to connect an inline steam heater flange to the flange of a steam pipe of different size.

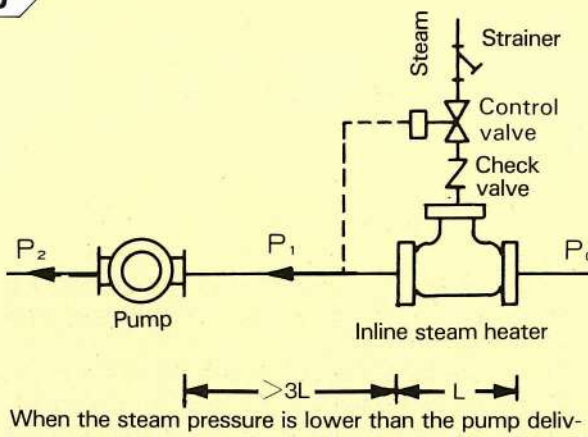
7. INLINE STEAM HEATER AND PUMP PIPE SYSTEMS

A



When the steam pressure is higher than the pump delivery pressure
SP > P_1

B

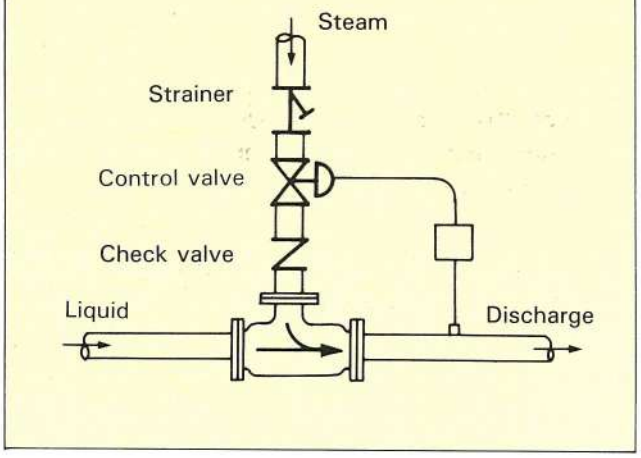


When the steam pressure is lower than the pump delivery pressure
$P_2 > SP > P_1$

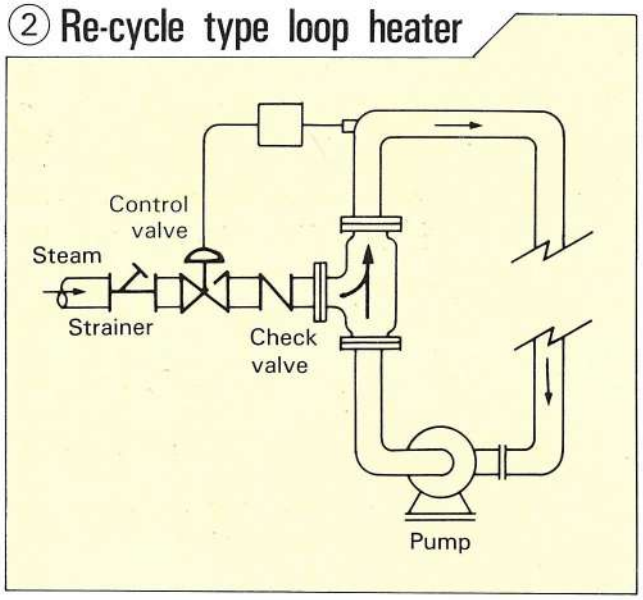
In figure B, the system is not of the suction type for water supply.
$P_0 > 0.5 kg/cm^2G$

ONE-PASS AND RECYCLE INLINE STEAM HEATER APPLICATIONS WITH WATER TEMPERATURE CONTROL

① One-pass system to supply heated water



② Re-cycle type loop heater



INSTALLATION

1. The inline steam heater can be used with piping either in the horizontal or vertical direction as shown in the figures.
2. The steam line connected to the steam inline heater should be horizontal or flowing down if vertical. A vertical steam line with upward flow cannot be used.
3. Install the check valve near the connection between the steam line and the inline steam heater.
4. As shown in the drawing, install a Y strainer (40 to 60 mesh) in the steam line.
5. High temperature heated water may reverse its flow even after operation ends in the system shown in figure ① so a check valve should be installed between the inline steam heater and pump.

LIQUID TEMPERATURE CONTROL

1. Liquid temperature can be controlled by installing an automatic steam control valve.
2. In principal, control of heated water temperature can be accomplished by controlling steam flow rate but when necessary it can also be done at the inlet of the inline steam heater.
3. Controlling range for steam inlet flow rate can be controlled from 0 to max by and ON-OFF control.
4. Prevention of hammering
   By controlling the steam injection flow rate, if the steam pressure becomes less than or equal to the water pressure hammering is completely prevented by the elements installed in the body.
5. Liquid pressure control
   The controlling range for water pressure should be from a minimum of 0.5 kg/cm²G to a maximum of 5 kg/cm²G
6. In the one-pass system shown in figure ① the injection steam pressure enables keeping the water pressure P_1 and the heated water pressure P_2 equal and the average temperature difference ΔT greater than 20 deg. C.
7. Maximum temperature T_2 for heated water can be kept approximately 10 deg. C lower than the steam saturation temperature, which has a pressure equal to that of the heated water pressure inside the discharge pipe.
8. If the steam input is small and a standard diameter pipe is not necessary, select a suitable steam pipe that matches the steam flow volume (steam flow velocity in the pipe is 30 m/s) and make the connections by a reducer.

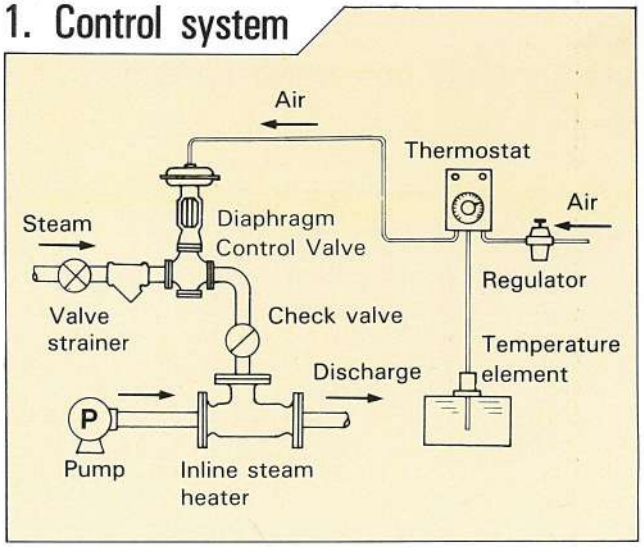
HOW TO USE

Starting (1) Water is supplied.
(2) Open the steam valve.
Water temperature control
(3) Control the steam flow to obtain the desired water temperature.
Shut down (4) Closed the steam valve
(5) Shut off the water.

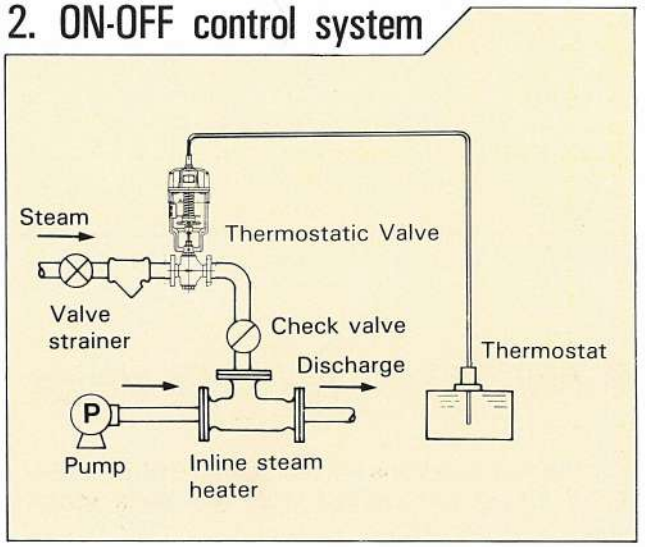
AUTOMATIC LIQUID HEATING CONTROL

The inline steam heater can automatically control heated liquid temperature if combined with a suitable automatic temperature controller.
Example of automatic control of heated liquid temperature

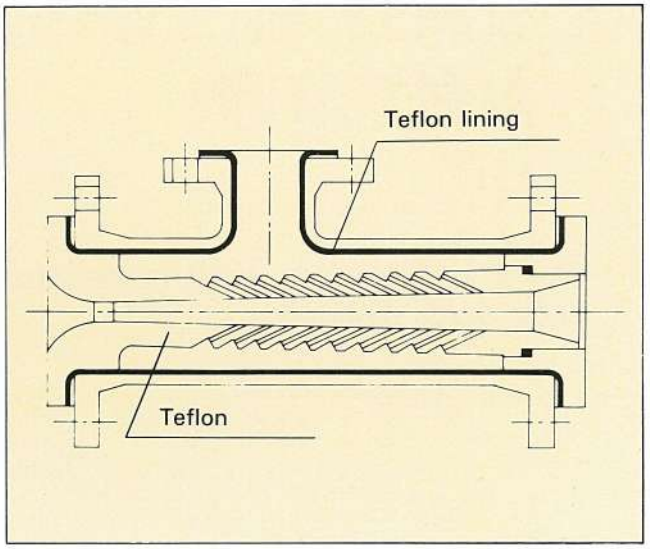
1. Control system



2. ON-OFF control system



CORROSION RESISTANT INLINE STEAM HEATER AND MIXER



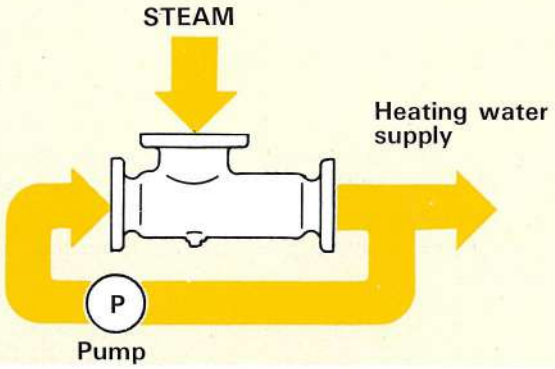
TEFLON

A teflon lining is applied to the body and the nozzles are made of teflon in this inline steam heater and mixer.
Chemical resistance . . . Sulfuric acid, acetic acid, nitric acid, hydrochloric acid, phosphoric acid and others.

CORROSION RESISTANT METALS

Stainless steel, carpenter metal, monel, nickel, hastelloy, titanium and others.
Inline heater may be coated with teflon or made of corrosion resistant metal for handling the heating of the specific fluid.
Our product line includes inline steam heaters capable of withstanding hydrochloric acid, sulfuric acid, mixed acids, caustic soda and several hundred other fluids. We have data on corrosive fluids with the following ranges:
Density 0 to 100% Heating temperature 0 to 200 deg. C and offer the most suitable and economical metal for your corrosive environment needs.

③ HEATING
④ SUPPLY HOT WATER APPLICATION



Pump delivery and heat output for heating/supply hot water application (standard application)

Table 5

Size No.	Heat output Kcal/hr		Pump water flow rate ℓ/min	Pipe flange (inches)	
	Heating Δt 10°C	Hot water supply Δt 15°C		Hot water	Steam
4TDR-AM	19,000	29,000	32	1″	1″
6TDR-AM	40,000	60,000	67	1¼″	1¼″
8TDR-AM	72,000	108,000	120	1½″	1½″
10TDR-AM	114,000	171,000	190	2″	2″
12TDR-AM	162,000	243;000	270	2½″	2½″
16TDR-AM	258,000	387,000	430	3″	3″
20TDR-BM	600,000	900,000	1,000	4″	4″
24TDR-BM	840,000	1,260,000	1,400	5″	4″
32TDR-BM	1,440,000	2,160,000	2,400	6″	5″

Note: Selection of inline steam heater and pump may be made from Table 6. Make the selection based on the STAR Inline Steam Heater selection chart. (Table 6)

INLINE STEAM HEATER HEATING WATER APPLICATION FEATURES (design)

1. DESIGN

Although much of the existing piping may be used when replacing a ordinary heater with an inline steam heater, generally heating and hot water supply piping supply examples are used.
The inline steam heater and pump are selected according to the heating range and load shown in Table 6 and the inline steam heater selection table.
For the inline steam heater, structually, it is necessary to have the steam pressure higher than the inlet water pressure.
The range for inlet steam heater supply water pressure should be 0.5 kg/cm² (min) to 5 kg/cm² (max). It is absolutely necessary to have a check valve and Y-type strainer at the steam connection to the inline steam heater.

In making computations for the pump head, it is possible to ignore friction losses of the inline steam heater.

2. HEATING APPLICATION

The heating output in table 5 is calculated based on the average differential heating temperature of Δt 10 deg. C.
For steam pressure at the inline steam heater inlet, use the following ranges:

TDR-A type: Minimum (water pressure + 0.5 kg/cm²) to maximum of 7 kg/cm²

TDR-B type: Minimum (water pressure + 1.5 kg/cm²) to maximum of 7 kg/cm²

3. SUPPLY HOT WATER APPLICATION

The heat output in table 5 is increased by the steam injection flow rate and the average differential heating value of Δt 15 deg. C is calculated based on this. At the inline steam heater inlet, the steam pressure is in the following ranges:

TDR-Atype: Minimum (water pressure + 1.5 kg/cm²) to maximum of 7 kg/cm²

TDR-B type: Minimum (water pressure + 3 kg/cm²) to maximum of 7 kg/cm²

4. WATER FRICTION LOSS (ΔP)

Inline steam heater friction loss, for steam flow stopped, is as shown in the following table but when steam is flowing, the friction loss ΔP is less than ⅓.

Pump water flow rate	Friction loss ΔP
(Table 5) pump water flow rate	MAX 3 mAq
Water flow increases 12%	MAX 4 mAq

5. MAINTENANCE

Up till now, heat exchangers have been sheet metal cans and copper tubes, which require periodical inspection. However, the inline steam heater requires no periodical inspection because it is not a pressure vessel.

Moreover, galvanic corrosion has been a problem with heat exchangers up to the pressure but there are no concerns of galvanic corrosion with the inline steam heater at all.

6. NOISE GENERATION

Injecting steam into water resembles a silencer but there is absolutely low noise and vibration. Quiet operation is possible. When it is desired to operate in a quiet environment, sound deadening box and flexible joints can be used.

7. EQUIPMENT SPACE

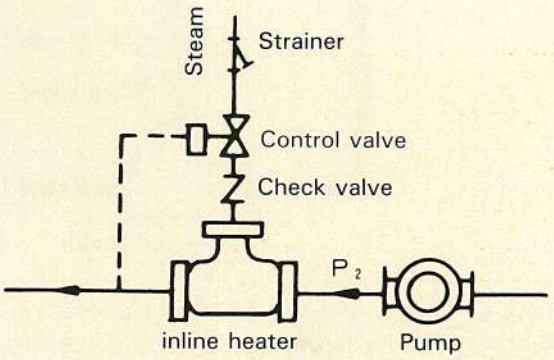
Inline steam steam heater can be installed in the ceiling, in a pipe shaft or where a valve group is installed. Generally, the inline steam heater and pump are installed in a mechanical room.

8. STEAM PIPES DIAMETER

Select the internal pipe diameter for steam with a velocity of 30 m/s as standard. Use a reducing flange to connect an inline steam heater flange to the flange of a steam pipe of different size.

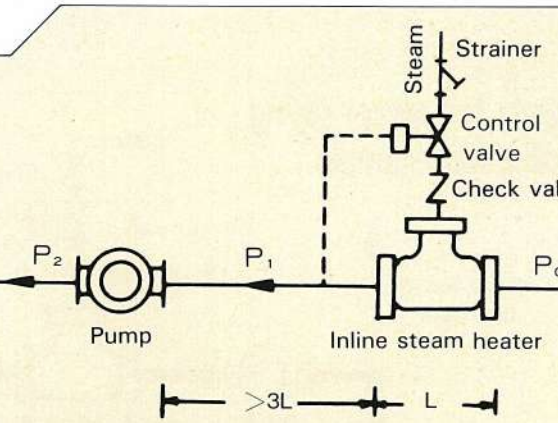
9. PIPING LAYOUT EXAMPLES FOR INLINE STEAM HEATER AND PUMP

A



Steam pressure is higher than pump delivery pressure
$SP > P_2$

B



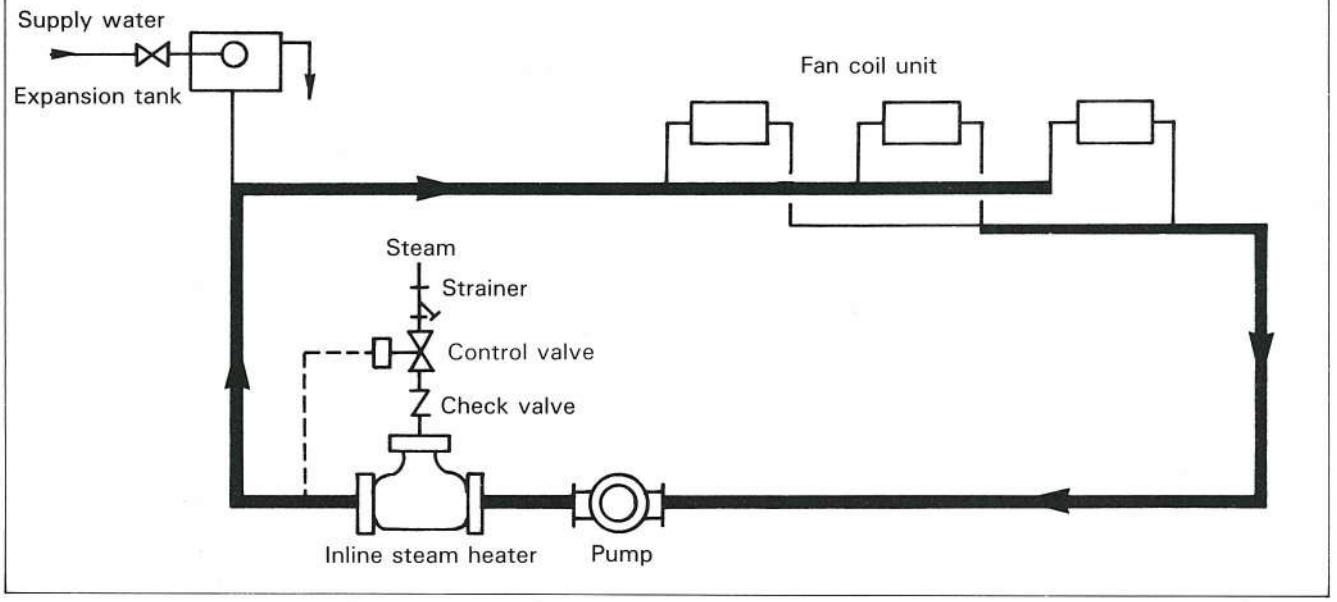
Steam pressure is lower than pump delivery pressure
$P_2 > SP > P_1$

In Figure B, the water cannot be sucked up vertically.

$P_0 > 0.5 kg/cm^2G$

③ HEATING

Heating application piping example and expansion tank system (without flow control)

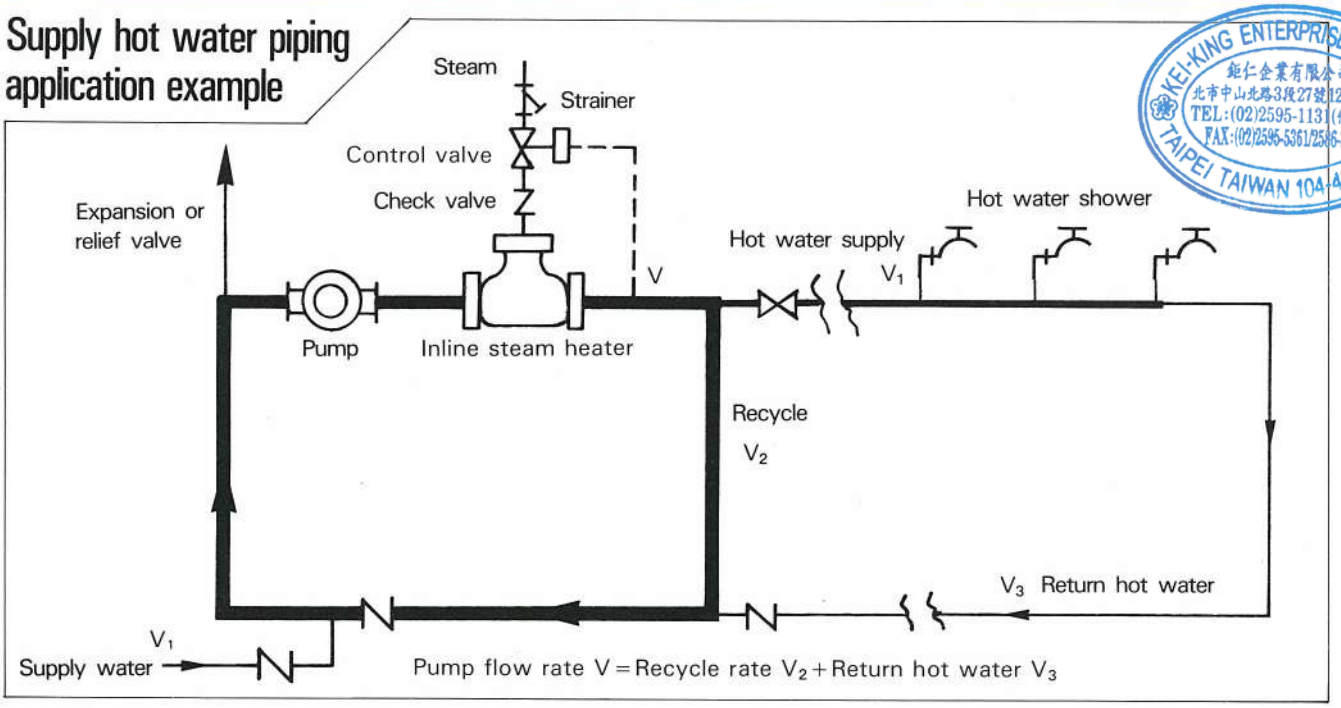


The piping system can be combined with a cooling system in the same manner as a conventional system. Install the air relief valve in the inline steam heater discharge pipe to serve as an air separator.

To control water flow on the radiator side, bypass the radiator inlet and pump inlet and install a back pressure valve.

④ SUPPLY HOT WATER

Supply hot water piping application example

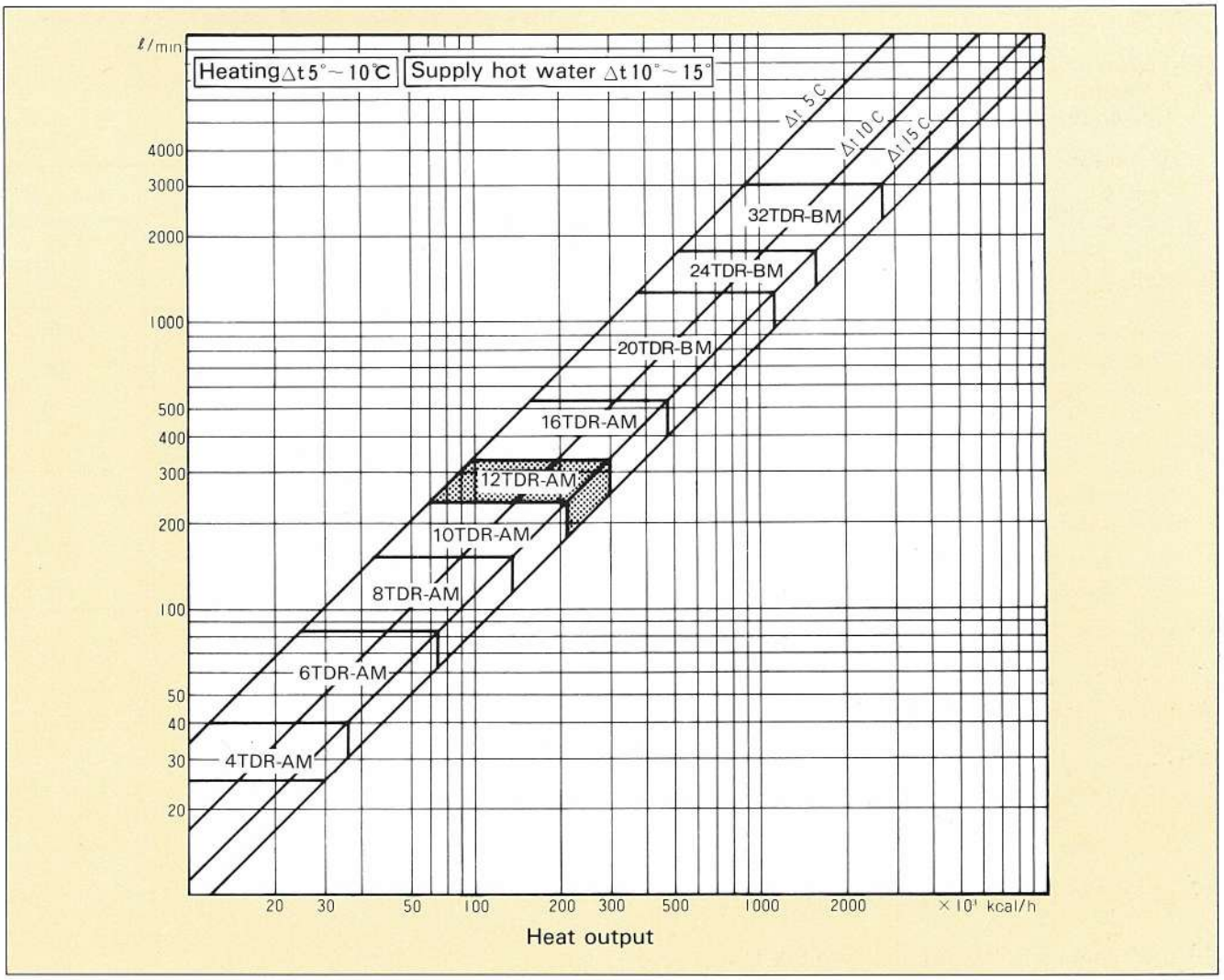


Recycle water V_2 and return hot water V_3 from the inline steam heater are recycle so the supply hot water is always maintained at the same specified temperature, e.g., 60 deg. C. Excess water due to expansion caused by steam injection is discharged into an expansion tank or a high water tank and may be discharged by the relief valve.

Expanded water volume corresponds to the heating load used to heat up the water in the pipe to the set temperature.

STAR INLINE STEAM HEATER SELECTION CHART

Table 6



CALCULATION EXAMPLES FOR INLINE STEAM HEATER AND PUMP SELECTION

Inline steam heater and pump can be selected according to the following examples in terms of heat output and water temperature rise (Δt).

Example 1
Heating load is 180,000 kcal/h
Select 12TDR-AM by using the selection chart and finding the intersection of the lines for 180,000 kcal/h heating output and Δt of 10 deg. C.
Recycling pump flow rate V in liters/min:

$$V = \frac{180{,}000}{\Delta t\ 10 \times 60} = 300\,\ell/\text{min (Pipe diameter } 2\tfrac{1}{2}\text{")}$$

Example 2
Supply hot water load is 270, 000 kcal/h
Select 12TDR-AM by using the selection chart and finding the intersection of the lines for 270,000 kcal/h heating output and Δt of 15 deg. C.
Recycling pump flow rate V in liters/min:

$$V = \frac{270{,}000}{\Delta t 15 \times 60} = 300\,\ell/\text{min (Pipe diameter } 2\tfrac{1}{2}\text{")}$$

SUPPLY HOT WATER CALCULATION EXAMPLE

(1) Supply hot water in liters/min at 60 deg. C.

A. Showers

Hot water valve ½″

$$12 \text{ showers} \times 15.1\,\ell \times \frac{45-5}{60-5} \times 0.62 = 82\,\ell/\text{min} \ldots V_1$$

$\frac{45-5}{60-5}$: Supply hot water temperature conversion rate

0.62: Simultaneous use rate

B. Bath tubs $^3/_4$″ • 1 tub × 35 liters

Hot water for bath tubs does not require calculation of a supply hot water flow rate.

(2) Supply hot water load kcal/h 60 deg. C

Supply hot water flow rate $82\,\ell \times 60 \times (60° - 5°)$ = 271,000 kcal/h

(3) To maintain a flow rate of supply hot water of 82 liters/minute at 60 deg. C, a recycling flow rate V_2 for the inline steam heater average differential heating Δt of 15 deg. C,

$$\frac{(V_2 \times t_2) + (V_1 \times t_1)}{V_2 + V_1} + \Delta t = t_2$$

recycling flow rate $V_2 = 218\,\ell$/min.

Accordingly, the pump flow rate is

$V_1 + V_2 = 82 + 218 = 300\,\ell$/min....

(4) Inline steam heater and pump selection

Select 12TDR-AM by using the selection chart and finding the intersection of the lines for 271,000 kcal/h and Δt of 15 deg. C.

Recycling pump flow rate V in liters/min:

The pump water flow in liters/min is

$$V = \frac{271{,}000}{15 \times 60} = 300\,\ell/\text{min}$$ (Pipe diameter 2½″)...

(5) Calculations for steam flow rate SW in kg/h and steam pressure of 3 kg/cm² (steam pressure ≧ inlet water pressure + 1.5 kg/cm²)

$$SW = \frac{271{,}000}{h'' - t_2} = 460 \text{ kg/h}$$ (Pipe diameter 2″)

SUPPLY HOT WATER PIPE SIZE DETERMINATION METHOD FOR COMPUTED HOT WATER FLOW (reference)

Table 7

Device	Discharge hot water flow rate calculated at 45 deg. C	Number of devices	Rate of simultaneous use
Wash basin	5.7 ℓ/min	1 ~ 2	100
Bath tub	15.1	4	83
Shower	15.1	8	70
Water for washing down	18.9	12	62
Water for cooking	7.6	16	60
Water for clothes washing	18.8	20	57
		24	54

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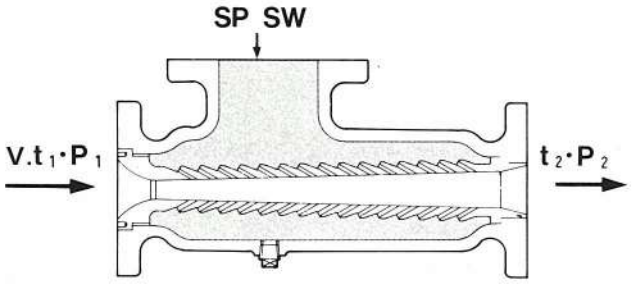

$\Delta t = t_2 - t_1$
$\Delta p = p_1 - p_2$

FOR ESTIMATING AND ORDERS

1. Heating method		Symbol	Unit	*① One-pass system	*② Recycle system	*③ Heating *④ Supply hot water
2. Liquid name/condition				*	*	Water
3. Liquid	Volume•load			—	System volume • m^3	*Heating load KCal/hr
	Flow rate	V	ℓ/min	*	—	*Supply hot water ℓ/min
	Temperature	t_1	°C	*	—	—
4. Temperature of heated liquid		t_2	°C	*	*	*
5. Average differential heating temperature		Δt	°C	*	*	*
6. Intake liquid pressure		P_1	kg/cm²G	*	*	*
7. Discharge liquid pressure		P_2	kg/cm²G	*	*	*
8. Water friction loss		ΔP	kg/cm²G			
9. Pump	Diameter		inches			
	Head	H	feet		*	*
	Water flow rate	V	ℓ/min		*	*
10. Steam	Pressure temperature	S.P	kg/cm²G °C	*	*	*
	Flow rate	S.W	kg/hr	*	*	*
11. Material	Body Nozzle	*		Cast iron • Cast stainless • Carbon steel Stainless steel		
12. Flange standard		*		ANSI LB.		

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