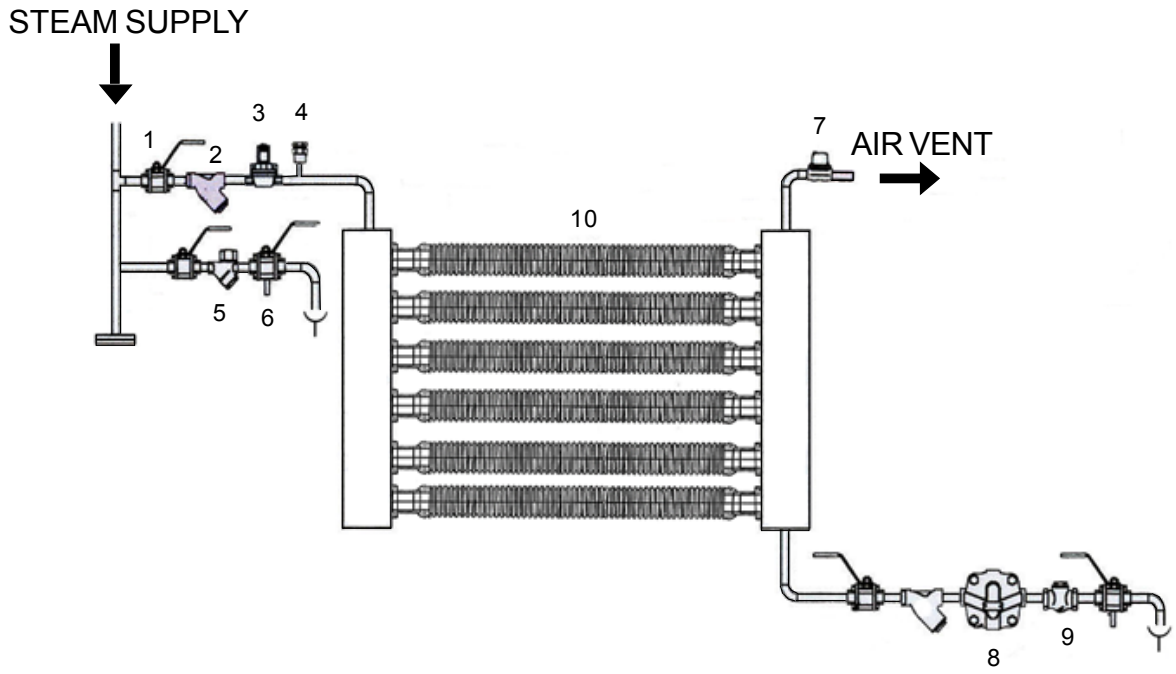
APPLICATION FOR BOILER FLEX
STEAM HEATING COIL (BATTERY)



1	"SUPERFLOW" 3 PIECES STAINLESS STEEL 316 BALL VALVE FULL BORE MODEL SF-3, PORT SCREWED BSP
2	"SUPERFLOW" Y-STRAINER STAINLESS STEEL 316 SCREWED BSP
3	"UNI-D" SOLENOID VALVE PISTON TYPE MODEL US-20
4	"AYVAZ" VACUUM BREAKER MODEL VK 71 BSP BODY STAINLESS STEEL
5	"AYVAZ" THERMODYNAMIC STEAM TRAP BODEL TDK 71
6	"AYVAZ" STEAM TRAP TEST VALVE
7	"AYVAZ" AIR VENT AT MAIN STEAM PIPE TYPE (THERMOSTATIC) MODEL TKK 21, PORT SCREWED BSP
8	"AYVAZ" FLOAT STEAM TRAP WITH THERMOSTATIC AIR VENT MODEL SK 51 SCREWED BSP
9	"SUPERFLOW" SWING CHECK VALVE STAINLESS STEEL 316 PORT SCREWED BSP
10	"AYVAZ" BOILER FLEX

Table U factor = overall heat transfer coefficient

Heat transfer from ..... to	**U w/m² °C**
Water - to - water	850
Water - to - oil	100
Steam - to - light fuel oil	200
Steam - to - heavy fuel oil	50
Steam condenser	1000
Freon condenser (water cooled)	300
Ammonia condenser (water cooled)	800
Gas - to - gas	10
Water - to - air in finned tube (water in tubes)	30
Steam - to - air in finned tube (steam in tubes)	30

BOILER FLEX SIZING CALCULATION

Reruired to heat water 2000 litres from 30 ^{o}C to 80 ^{o}C within 15 min to find

1. Total heat required (kw)
2. Steam consumption kg/hr.
3. Total area of boiler flex (m^2)

From heat energy equation $\dot{Q} = \dot{m} c_p \Delta T$

$\dot{Q}$ = Heat transfer from steam to water

$\dot{m}$ = Weight of water = 2,000 litres = 2,000 kg

C_P = Specific of water 4,187 KJ/kg ^{o}C

ΔT = Temperature difference of water = 80 - 30 = 50 ^{o}C

time required to heat water from 30 ^{o}C to 80 ^{o}C = 15 min

$$\dot{Q} = \frac{2{,}000 \text{ kg}}{15 \text{ min}} \times 4.187 \text{ KJ/kg} \times 50\ ^{o}\text{C}$$

$$= 27{,}913.33 \text{ KJ/min}$$

$$= 465.22 \text{ KW}$$

Steam pressure = 3 barg

from steam table hfg at 3 barg = 2,133 KJ/kg

Temp. of steam = 143.75 ^{o}C

Steam required $= \frac{\dot{Q}}{hfg} = \frac{27{,}913.33 \text{ KJ/min}}{2{,}133 \text{ KJ/hr}}$

$= 13.086$ kg/min

$= 785$ kg/hr

from heat transfer equation $\dot{Q} = AU\Delta T = 465.22 \text{ KW} = 465{,}220 \text{ W}$

final surface area $A = \frac{\dot{Q}}{U \Delta T}$

A = ?

U = overall heat transfer coefficient from steam to STL tube to water

= 1,000 W/m^2 ^{o}C

ΔT = temp.diff steam to water = 143.75 ^{o}C - $\frac{(80 + 30)}{2}$ ^{o}C = 143.75 - 55 ^{o}C

= 88.75 ^{o}C

$$\therefore \quad A = \frac{465{,}220 \text{ W}}{1{,}000 \text{ W/m}^2\ ^{o}\text{C} \times 88.75\ ^{o}\text{C}}$$

$$= 5.2 \text{ m}^2$$

Suppose choose ID of boiler flex = 16 mm surface area (m^2/m) = 0.11312
and Safety factor 10 %

$$\therefore \text{ Total length} = \frac{5.2 \times 1.1}{0.11312} = 50.56 \text{ m}$$

BOILER FLEX SIZING CALCULATION

Reruired to heat water 2000 litres from 30 ^{o}C to 85 ^{o}C within 10 min to find

1. Total heat required (kw)
2. Steam consumption kg/hr.
3. Total area of boiler flex (m^2)

From heat energy equation $\dot{Q} = \dot{m} c_p \Delta T$

$\dot{Q}$ = Heat transfer from steam to water

$\dot{m}$ = Weight of water = 1,200 litres = 1,200 kg

C_P = Specific of water 4,187 KJ/kg ^{o}C

ΔT = Temperature difference of water = 85 - 30 = 55 ^{o}C

time required to heat water from 30 ^{o}C to 85 ^{o}C = 10 min

$$\dot{Q} = \frac{1{,}200 \text{ kg}}{10 \text{ min}} \times 4.187 \text{ KJ/kg} \times 55\ ^{o}\text{C}$$

$$= 27{,}634.2 \text{ KJ/min}$$

$$= 460.57 \text{ KW}$$

Steam pressure = 2 barg

from steam table hfg at 2 barg = 2,163.3 KJ/kg

Temp. of steam = 143.75 ^{o}C

$$\text{Steam required} = \frac{\dot{Q}}{hfg} = \frac{27{,}634.2 \text{ KJ/min}}{2{,}163.3 \text{ KJ/hr}}$$

$$= 12.77 \text{ kg/min}$$

$$= 766.2 \text{ kg/hr}$$

from heat transfer equation $\dot{Q} = AU\Delta T = 460.57 \text{ KW} = 460{,}570 \text{ W}$

final surface area $A = \frac{\dot{Q}}{U \Delta T}$

A = ?

U = overall heat transfer coefficient from steam to STL tube to water

= 1,000 W/m^2 ^{o}C

ΔT = temp.diff steam to water = 133.7 ^{o}C - $\frac{(85 + 30)}{2}$ ^{o}C = 133.7 - 57.5 ^{o}C

= 76.2 ^{o}C

$$\therefore \quad A = \frac{460{,}570 \text{ W}}{1{,}000 \text{ W/m}^2\ ^{o}\text{C} \times 76.2\ ^{o}\text{C}}$$

$$= 6.044 \text{ m}^2$$

Suppose choose ID of boiler flex = 40 mm surface area (m^2/m) = 0.3155

and Safety factor 10 %

$$\therefore \quad \text{Total length} = \frac{6.044 \times 1.1}{0.3155} = 21.07 \text{ m}$$