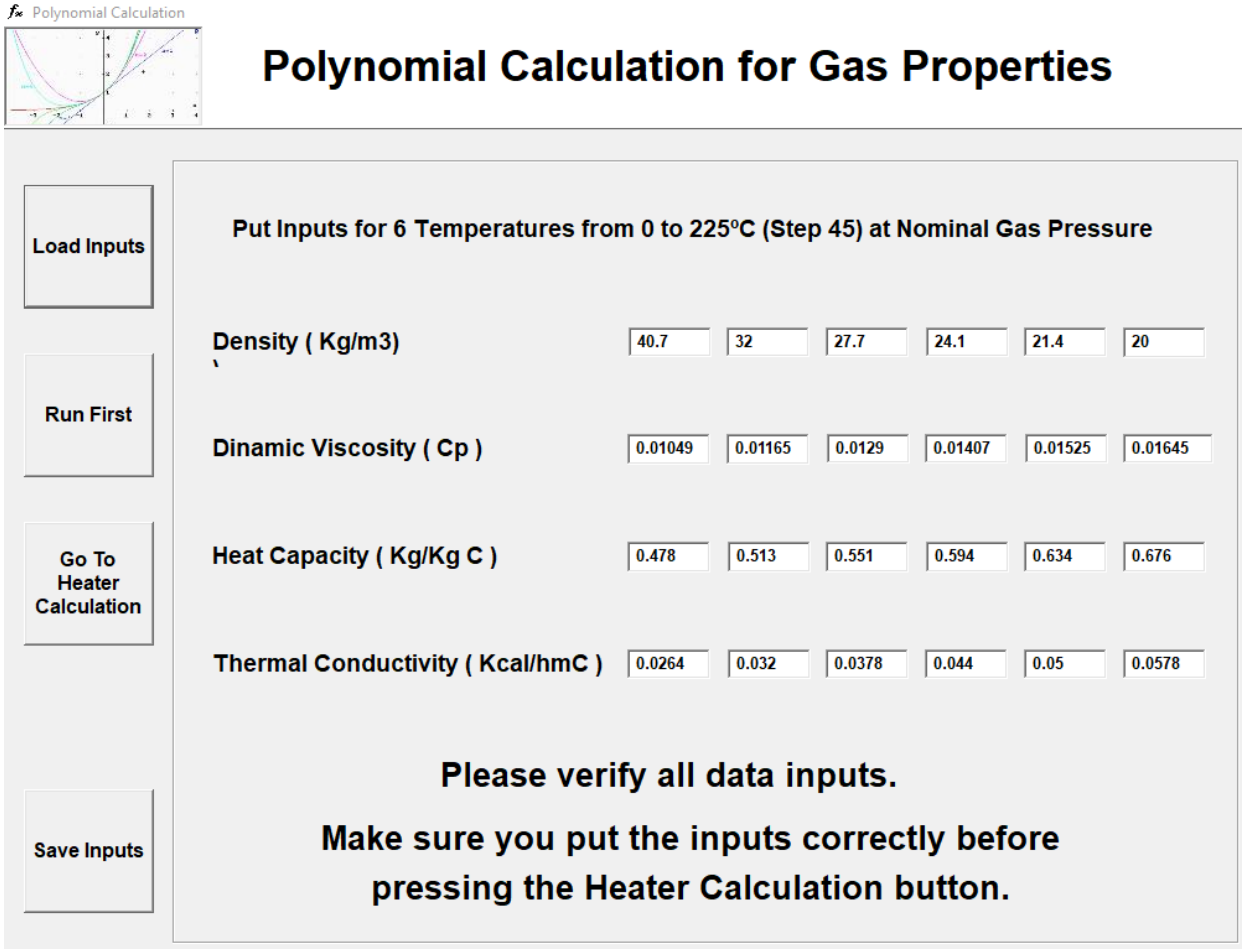
Natural Gas Heater

Thermal and mechanical design of shell and tube heat exchanger used to heat Natural Gas before using it as fuel for gas turbines in combined-cycle power stations. These units heat the gas to a high temperature using medium-pressure superheated steam with three surfaces (desuperheating, condensation, and drain cooler in a same shell , similar to traditional feedwater heaters at power plants).

PROGRAM WINDOWS

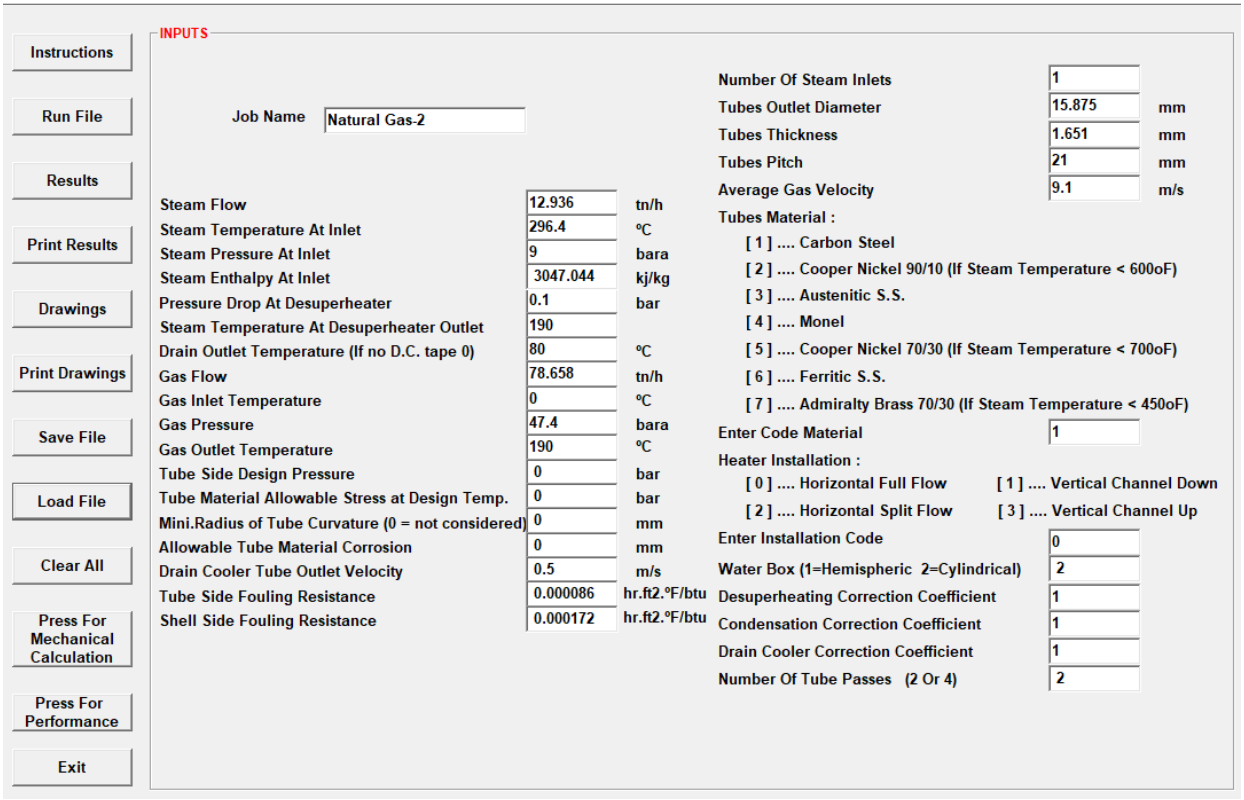
FIRST ENTRY WINDOW



GAS DATA WINDOW

Natural Gas Heater

Natural Gas Heater Thermal Calculation



MAIN DATA WINDOW

RESULTS SHEET

NATURAL GAS HEATER - Data Results

Job Name : **Natural Gas-2**

■ Data Input

Steam Flow	12,69	tn/h
Steam Temperature At Inlet	296,4	oC
Steam Enthalpy At Inlet	3047,04	kj/kg
Steam Pressure At Inlet	9	bara
Specific Volume Of Steam Inlet	0,28541	m3/Kg
Steam Saturation Temp. At Inlet Pressure	175,357	oC
Steam Temp. At Condensation Pressure	174,879	oC
Condensed Water Enthalpy	740,54	kj/kg
Steam Temp. At Desuperheater Outlet	190	oC
Steam Enthalpy At Desuperheater Outlet	2809,27	kj/kg
Drain Outlet Temperature	80	oC
Drain Outlet Enthalpy	335,55	kj/kg
Gas Pressure	47,4	bar
Gas Flow	78,658	tn/h
Gas Inlet Temperature	0	oC
Gas Outlet Temperature	188,2	oC
Average Gas Specific Volume	0,0365	m3/Kg
Tubes Outlet Diameter	15,875	mm
Tubes Thickness	1,651	mm
Tubes Pitch	21	mm
Average Gas Velocity	9,1	m/s
Tubes Material	Carbon Steel	
Heater Installation	Horizontal Full Flow	
Desuperheating Correction Coefficient	1	
Condensation Correction Coefficient	1	
Drain Cooler Correction Coefficient	1	

■ Results

Desuperheating Duty	3010,3	Mj/h
Condensation Duty	26192,2	Mj/h
Drain Cooler Duty	5127,1	Mj/h
Desuperheating L.M.T.D.	48,61	oC
Condensation L.M.T.D.	29	oC
Drain Cooler L.M.T.D.	108,5	oC
Desup.Heat Transfer Coefficient	824	kj/hoCm2
Conden.Heat Transfer Coefficient	3081	kj/hoCm2
D.C. Heat Transfer Coefficient	2541	kj/hoCm2
Desuperheater Effective Surface	75,1	m2
Condensation Effective Surface	292,7	m2
D.C. Effective Surface	18,6	m2
Total Surface	389	m2
Inactive Surface	2,6	m2
Number Of U Tubes	706	
Tube Side Pressure Drop	0,27	bar
Gas Temp. At Conden. Inlet	31,78	oC
Gas Temp. At Conden. Outlet	173,8	oC
Terminal Temperature Difference	-12,25	oC
Drain Cooler Aproach	80	oC
Approx. Inlet Channel Diameter	990	mm
Approx. Inlet Shell Diameter	1090	mm
Approx. Heater Total Length	7,44	m
Approx. Straight Tube Length	5130	mm
Approx. Desuper. Casing Length	2130	mm
Approx. Drain Cooler Casing Length	520	mm
Tube Number In Drain Cooler	706	
Gas Nozzles Diameters	270	mm
Number Of Steam Nozzles	1	
Diameter Of Steam Nozzles	160	mm
Diameter Of Drain Nozzle	70	mm

Dew Point Verification 177,83 oC

(It Must Be Less Than Temperature At Desuperheater Outlet)

For Desuperheater :

Support Plates Number 4
Pressure Drop 0,09 bar

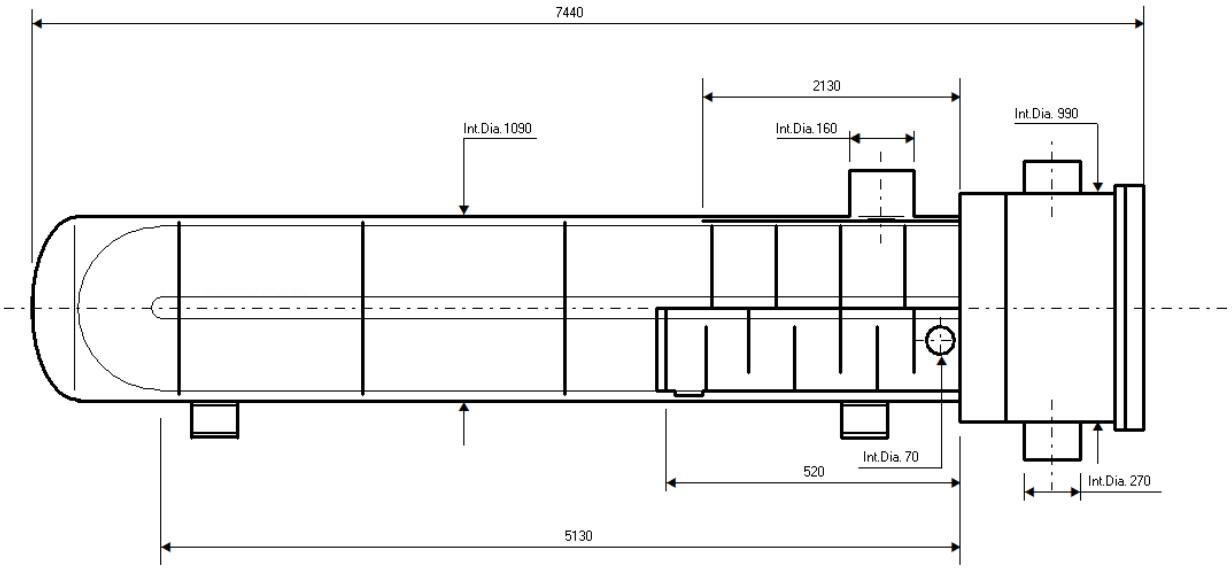
For Drain Cooler :

Support Plates Number 3
Pressure Drop 0,03 bar

For Condensing :

Support Plates Number 6
Pressure Drop NEGLIGIBLE

DIMENSIONAL DRAWING

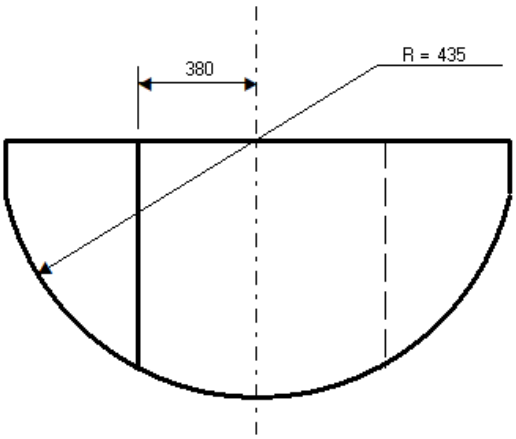


HORIZONTAL TYPE - Three Zones

Dimensions in mm

DRAIN COOLER TUBES SUPPORT PLATE ARRANGEMENT

RIGHT-LEFT FULL FLOW WINDOW TYPE

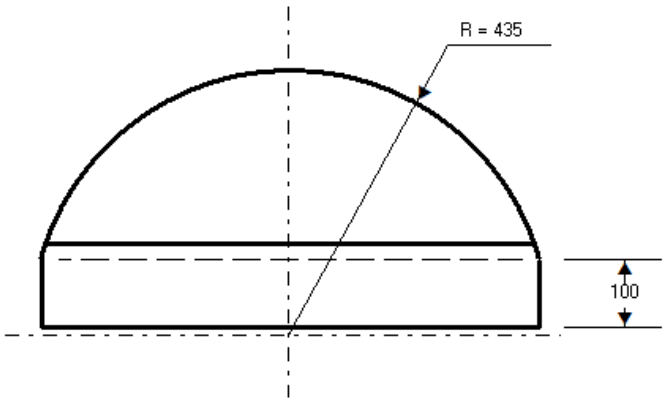


Type and dimensions are for information only and
must be fixed during the final conception after order

Dimensions in mm

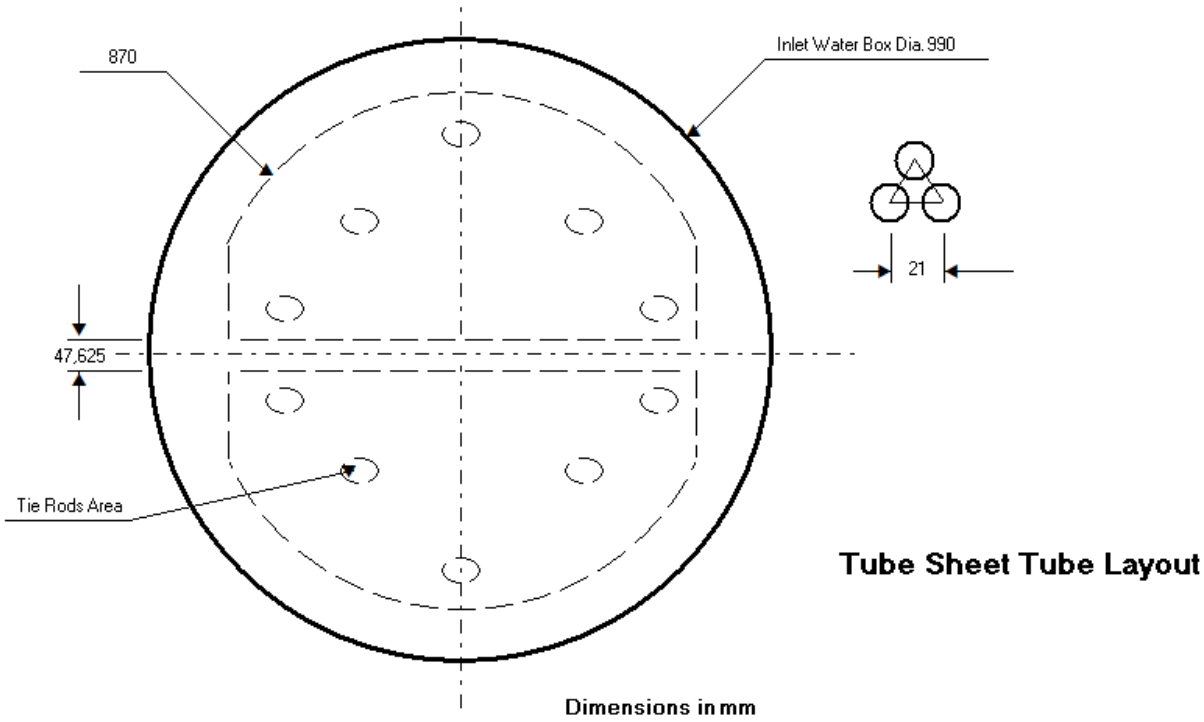
DESUPERHEATER TUBES SUPPORT PLATE ARRANGEMENT

UP-DOWN FULL FLOW WINDOW TYPE



Type and dimensions are for information only and
must be fixed during the final conception after order

Dimensions in mm



Tube Sheet Tube Layout

Dimensions in mm

Natural Gas

Natural Gas Heater Mechanical Calculation

Run File

Results

Print Results

Save File

Load File

To First Page

Clear All

Exit

INPUTS

Units Code (1 = S.I. 2 = USA) 1 Press Button Button

Shell Side Design Pressure	12	bar
Feed Water Side Design Pressure	60	bar
General Allowable Corrosion	2	mm

Allowable Stress Value At Design Temperature In Bar For Material Of :
(Taking account reduction due to joint efficiency)

Shell	1200
Shell Skirt (Without Put Zero)	1500
Tube Sheet	1200
Water Box Cylindrical Type (If Hemispherical Put Zero)	1000
Water Box Hemispheric Type (If Cylindrical Put Zero)	0
Steam Inlet Connection	1000
Inlet / Outlet Water Box Connections	1000
Water Box Cover For Cylindrical Type (Without Put Zero)	1500

GAS HEATER RESULTS - Thickness (mm) and Weights (Kg)

Job Name : **Natural Gas-2**

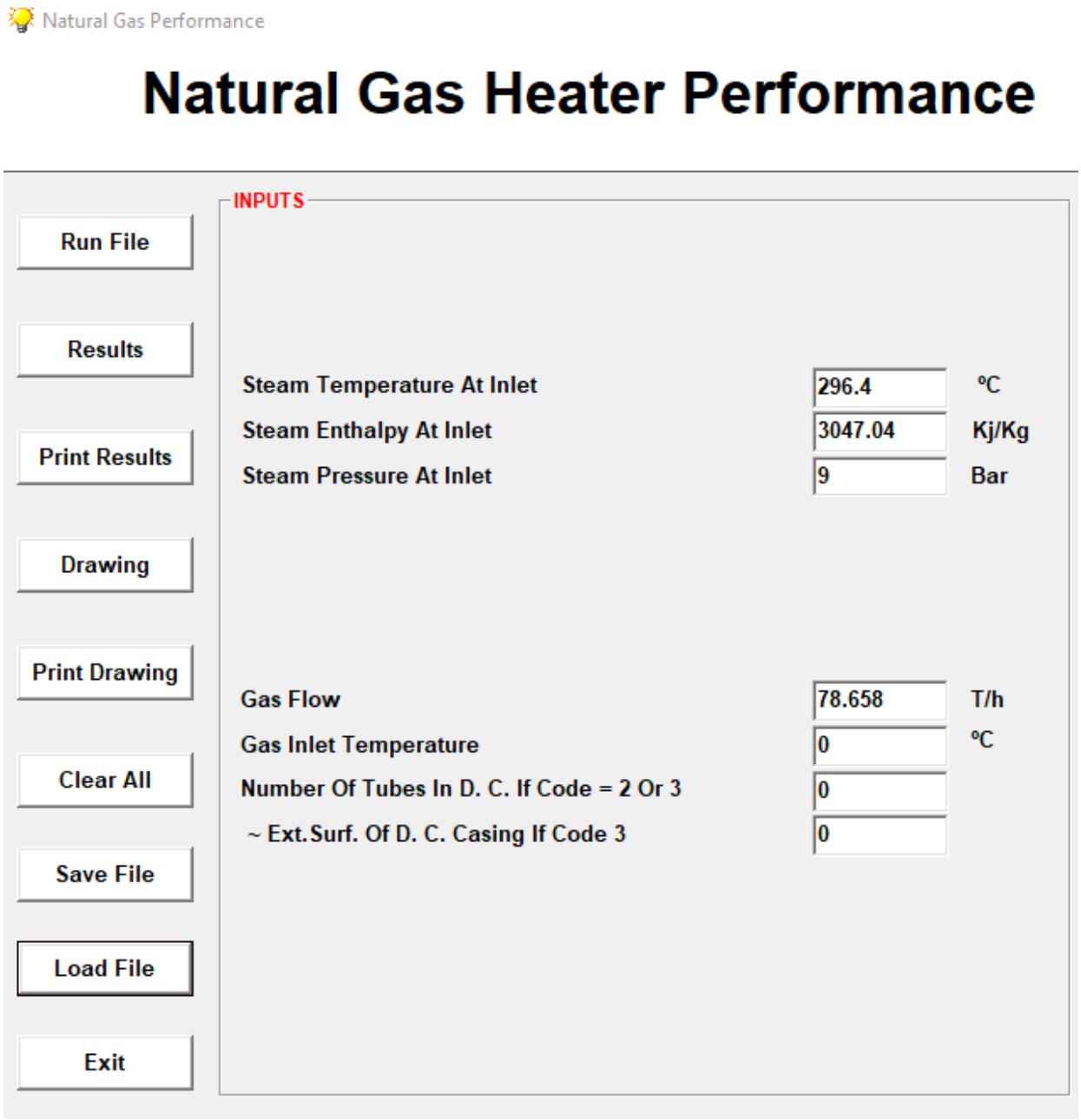
■ THICKNESSES

Shell	10
Shell Skirt	10
Elliptical Shell Cover End	10
Tube Sheet	135
Water Box (Hemispherical Type)	0
Water Box (Cylindrical Type)	33
Water Box Cover (Plate Type)	111
Water Box Cover (Elliptical Type)	0
Tubes Support Plate	10
Water Box Pass Partition Sheet	16
Steam Inlet Pipe	3
Feedwater Inlet/Outlet Pipe	11
Drains Outlet Pipe	3

■ WEIGHTS

Exchange Tubes	4650
Tube Sheet Gross Weight	1030
Tube Sheet Net Weight	730
Shell With Cover End, Pipes And Internals	1720
Shell Skirt	130
Hemispherical Water Box, Pipes And Manhole	0
Cylindrical Water Box , Pipes And Plate Cover	1740
Cylindrical Water Box, Pipes And Elliptical Cover	0
Complete Desuperheating Crate	400
Complete Drain Cooler Crate	210
Condensing Zone Tubes Support Plates	430
Heater Supports	230
Heater Empty	10240
Heater In Operation	11900
Heater Full Of Water	15400

RESULTS SHEET


Natural Gas Performance
Natural Gas Heater Performance
Run File
Results
Print Results
Drawing
Print Drawing
Clear All
Save File
Load File
Exit
INPUTS
Steam Temperature At Inlet
296.4
°C
Steam Enthalpy At Inlet
3047.04
Kj/Kg
Steam Pressure At Inlet
9
Bar
Gas Flow
78.658
T/h
Gas Inlet Temperature
0
°C
Number Of Tubes In D. C. If Code = 2 Or 3
0
~ Ext.Surf. Of D. C. Casing If Code 3
0

Natural Gas Performance - Data Results

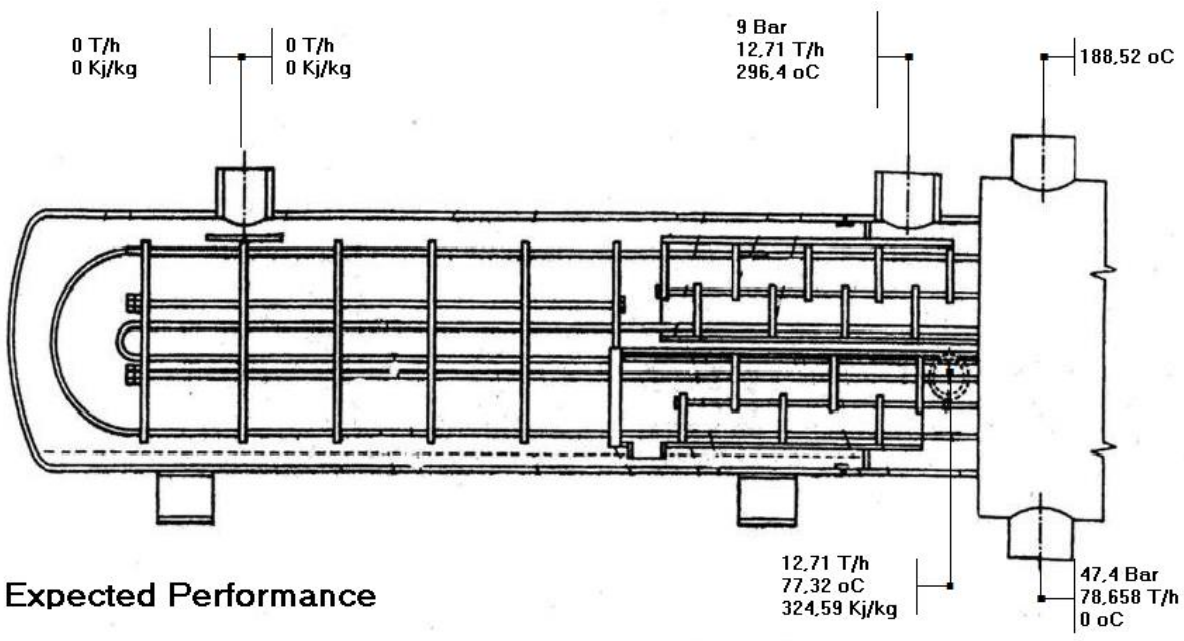
Job Name : **Natural Gas-2**

■ Data

Steam Pressure At Inlet	9	Bara
Steam Saturation Temp.At Inlet Pressure	175,357	oC
Steam Temperature At Inlet	296,4	oC
Steam Enthalpy At Inlet	3047,04	kj/Kg
Temperature At Condensation Zone	174,93	oC
Enthalpy At Condensation Zone	740,76	Kj/Kg
Natural Gas Pump Pressure	47,4	Bara
Natural Gas Flow	78,658	T/h
Natural Gas Inlet Temperature	0	oC
Number Of Non Pugged Tubes	706	
Tubes Outlet Diameter	15,875	mm
Tubes Thickness	1,651	mm
Tubes Material	Carbon Steel	
Active Desuperheating Surface	75	m2
Active Condensing Surface	292,6	m2
Active Drain Cooler Surface	18,6	m2
Heater Installation	Horizontal Full Flow	

■ Results

Steam Flow	12,71	T/h
Desuperheating Duty	3014	Mj/h
Condensation Duty	26218	Mj/h
Drain Cooler Duty	5276	Mj/h
Desuperheating L.M.T.D.	47,33	oC
Condensation L.M.T.D.	28,23	oC
Drain Cooler L.M.T.D.	106,54	oC
Desup.Heat Transfer Coefficient	839	Kj/hoCm2
Conden.Heat Transfer Coefficient	3160	Kj/hoCm2
D.C. Heat Transfer Coefficient	2661	Kj/hoCm2
Gas Heater Shell Outlet Temperature	77,32	oC
Natural Gas Outlet Temperature	188,52	oC
Natural Gas Temp.At In Conden.Zone	32,59	oC
Natural Gas Temp.At Out Conden.Zone	173,97	oC
Steam Temp.At Desuperheater End	188,93	oC
Steam Enthal.At Desuperheater End	2804,2	Kj/Kg
Terminal Temperature Difference	-13,17	oC
Drain Cooler Approach	77,31	oC
Tube Number In Drain Cooler	706	
Number Of Plugged Tubes		
Dew Point Verification	177,58	oC



Expected Performance