

# Feedwater Heater

Thermal and mechanical design of feedwater heaters based on HEI standards and heat transfer coefficients for each zone based on classic correlations (Nusslet, McAdams,...) or proprietary methods. Full or split flow heaters are accommodated, as are horizontal and vertical units with up and down channel. In addition to the performance results required to complete heater specification datasheet, the program generates a heater drawing showing the principal dimensions of the unit and of the tube support system, tube layout and results sheet for thickness and weights. The program also generates the heater's performance for other thermal load conditions.

## DATA ENTRY WINDOW



### Feed Water Heater Thermal Calculation

<p>Instructions</p> <p>See Video</p> <p>Run File</p> <p>Results</p> <p>Print Results</p> <p>Drawings</p> <p>Print Drawings</p> <p>Save File</p> <p>Load File</p> <p>Clear All</p> <p>Performance Calculation</p> <p>Press For Mechanical Calculation</p> <p>Exit</p>	<p><b>INPUTS</b></p> <p>Units Code (1 = S.I. 2 = USA) <input type="text" value="1"/> Press Button <input type="button" value="Button"/></p>		<p>Job Name <input type="text" value="Feed Water Heater Test"/></p>
	<p>Steam Flow <input type="text" value="60.435"/></p>	<p>Number Of Steam Inlets <input type="text" value="1"/></p>	<p>Tubes Outlet Diameter <input type="text" value="19"/></p>
	<p>Steam Temperature At Inlet <input type="text" value="399.09"/></p>	<p>Steam Pressure At Inlet <input type="text" value="41"/></p>	<p>Tubes Thickness (0 = If According to HEI) <input type="text" value="1.5"/></p>
	<p>Steam Enthalpy At Inlet <input type="text" value="3211.84"/></p>	<p>Pressure Drop At Desuperheater <input type="text" value="0.3"/></p>	<p>Tubes Pitch <input type="text" value="23.75"/></p>
	<p>Steam Temperature At Desuperheater Outlet <input type="text" value="287.9"/></p>	<p>Flow At # 1 Drain Inlet <input type="text" value="0"/></p>	<p>Feed Water Velocity <input type="text" value="1.794"/></p>
	<p>Enthalpy At # 1 Drain Inlet <input type="text" value="0"/></p>	<p>Enthalpy At # 2 Drain Inlet <input type="text" value="0"/></p>	<p>Tubes Material :</p> <p>[ 1 ] .... Carbon Steel</p> <p>[ 2 ] .... Cooper Nickel 90/10 (If Steam Temperature &lt; 600oF)</p> <p>[ 3 ] .... Austenitic S.S.</p> <p>[ 4 ] .... Monel</p> <p>[ 5 ] .... Cooper Nickel 70/30 (If Steam Temperature &lt; 700oF)</p> <p>[ 6 ] .... Ferritic S.S.</p> <p>[ 7 ] .... Admiralty Brass 70/30 (If Steam Temperature &lt; 450oF)</p>
	<p>Flow At # 2 Drain Inlet <input type="text" value="0"/></p>	<p>Drain Outlet Temperature (If no D.C. tape 0) <input type="text" value="232.2"/></p>	<p>Enter Code Material or Thermal Conductivity</p> <p>At tube Material Temperature in W/(m.K) <input type="text" value="1"/></p>
	<p>Enthalpy At # 2 Drain Inlet <input type="text" value="0"/></p>	<p>Feed Water Flow <input type="text" value="1200"/></p>	<p>Heater Installation :</p> <p>[ 0 ] .... Horizontal Full Flow      [ 1 ] .... Vertical Channel Down</p> <p>[ 2 ] .... Horizontal Split Flow      [ 3 ] .... Vertical Channel Up</p>
	<p>Drain Outlet Temperature (If no D.C. tape 0) <input type="text" value="232.2"/></p>	<p>Feed Water Inlet Temperature <input type="text" value="226.85"/></p>	<p>Enter Installation Code <input type="text" value="0"/></p>
	<p>Feed Water Flow <input type="text" value="1200"/></p>	<p>Feed Water Pressure <input type="text" value="90"/></p>	<p>Water Box (1=Hemispheric 2=Cylindrical) <input type="text" value="1"/></p>
	<p>Feed Water Inlet Temperature <input type="text" value="226.85"/></p>	<p>Feed Water Outlet Temperature <input type="text" value="250.44"/></p>	<p>Desuperheating Correction Coefficient <input type="text" value="1"/></p>
	<p>Feed Water Pressure <input type="text" value="90"/></p>	<p>Tube Side Design Pressure <input type="text" value="150"/></p>	<p>Condensation Correction Coefficient <input type="text" value="1"/></p>
	<p>Feed Water Outlet Temperature <input type="text" value="250.44"/></p>	<p>Tube Material Allowable Stress at Design Temp. <input type="text" value="765"/></p>	<p>Drain Cooler Correction Coefficient <input type="text" value="1"/></p>
	<p>Tube Side Design Pressure <input type="text" value="150"/></p>	<p>Tube Material Allowable Stress at Design Temp. <input type="text" value="765"/></p>	<p>Number Of Tube Passes (2 Or 4) <input type="text" value="2"/></p>
	<p>Tube Material Allowable Stress at Design Temp. <input type="text" value="765"/></p>	<p>Mini.Radius of Tube Curvature (0 = not considered) <input type="text" value="28.5"/></p>	
<p>Mini.Radius of Tube Curvature (0 = not considered) <input type="text" value="28.5"/></p>	<p>Allowable Tube Material Corrosion <input type="text" value="0.1"/></p>		
<p>Allowable Tube Material Corrosion <input type="text" value="0.1"/></p>	<p>Drain Cooler Tube Outlet Velocity <input type="text" value="0.5"/></p>		
<p>Drain Cooler Tube Outlet Velocity <input type="text" value="0.5"/></p>	<p>Coefficients According To Nusselt And McAdams (1 = Yes 0 = No) <input type="text" value="1"/></p>		
<p>Coefficients According To Nusselt And McAdams (1 = Yes 0 = No) <input type="text" value="1"/></p>	<p>Tube Side Fouling Resistance (1 if H.E.I. Code) <input type="text" value="1"/></p>		
<p>Tube Side Fouling Resistance (1 if H.E.I. Code) <input type="text" value="1"/></p>	<p>Shell Side Fouling Resistance (1 if H.E.I. Code) <input type="text" value="1"/></p>		
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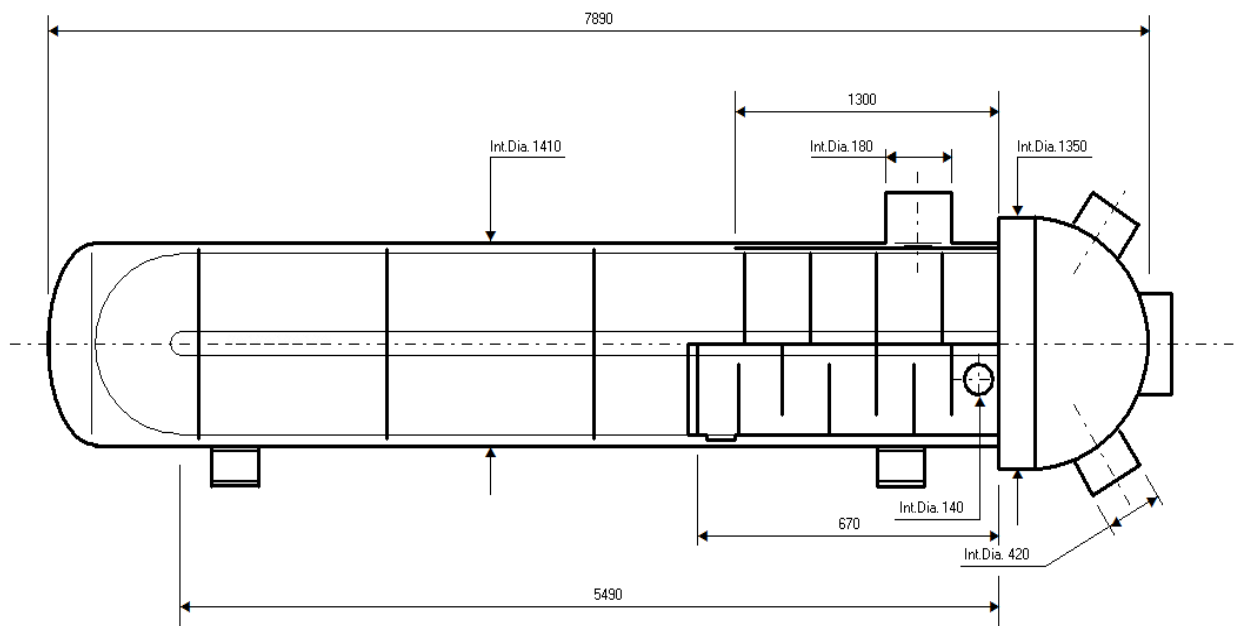


## FEED WATER HEATER - Data Results

Job Name : **Feed Water Heater Test**

■ Data Input		■ Results		
Steam Flow (Including 0.3% Lost)	60,355 tn/h	Desuperheating Duty	17342,9 Mj/h	Dew Point Verification 272,21 oC  (It Must Be Less Than Temperature At Desuperheater Outlet)
Steam Temperature At Inlet	399,09 oC	Condensation Duty	110194 Mj/h	
Steam Enthalpy At Inlet	3211,84 kj/kg	Drain Cooler Duty	5511 Mj/h	
Steam Pressure At Inlet	41 bara	Desuperheating L.M.T.D.	83,15 oC	
Specific Volume Of Steam Inlet	0,07135 m3/Kg	Condensation L.M.T.D.	10,95 oC	
Steam Saturation Temp. At Inlet Pressure	251,797 oC	Drain Cooler L.M.T.D.	12,26 oC	
Steam Temp. At Condensation Pressure	251,357 oC	Desup.Heat Transfer Coefficient	2386 kj/hoCm2	
Condensed Water Enthalpy	1092,39 kj/kg	Conden.Heat Transfer Coefficient	14997 kj/hoCm2	
Steam Temp. At Desuperheater Outlet	287,9 oC	D.C. Heat Transfer Coefficient	9905 kj/hoCm2	
Steam Enthalpy At Desuperheater Outlet	2923,62 kj/kg	Desuperheater Effective Surface	87,4 m2	
Flow At # 1 Drain Inlet	0 tn/h	Condensation Effective Surface	670,9 m2	<b>For Desuperheater :</b>  Support Plates Number 3 Pressure Drop 0,22 bar
Enthalpy At # 1 Drain Inlet	0 kj/kg	D.C. Effective Surface	45,4 m2	
Flow At # 2 Drain Inlet	0 tn/h	Total Surface	808,6 m2	<b>For Drain Cooler :</b>  Support Plates Number 3 Pressure Drop 0,11 bar
Enthalpy At # 2 Drain Inlet	0 kj/kg	Inactive Surface	5 m2	
Drain Outlet Temperature	232,2 oC	Number Of U Tubes	1125	<b>For Condensing :</b>  Support Plates Number 6 Pressure Drop NEGLIGIBLE
Drain Outlet Enthalpy	1000,8 kj/kg	Tube Side Pressure Drop	0,26 bar	
Feed Water Flow	1200 tn/h	Feed Water Temp. At Conden. Inlet	227,84 oC	
Feed Water Inlet Temperature	226,85 oC	Feed Water Temp. At Conden. Outlet	247,41 oC	
Feed Water Inlet Enthalpy	977,02 kj/kg	Terminal Temperature Difference	1,35 oC	
Feed Water Outlet Temperature	250,44 oC	Drain Cooler Approach	5,34 oC	
Feed Water Outlet Enthalpy	1087,9 kj/kg	Approx. Inlet Channel Diameter	1350 mm	
Average Feed Water Specific Volume	0,001218 m3/Kg	Approx. Inlet Shell Diameter	1410 mm	
Tubes Outlet Diameter	19 mm	Approx. Heater Total Length	7,89 m	
Tubes Thickness	1,5 mm	Approx. Straight Tube Length	5490 mm	
Tubes Pitch	23,75 mm	Approx. Desuper. Casing Length	1300 mm	
Feed Water Velocity	1,794 m/s	Approx. Drain Cooler Casing Length	670 mm	
Tubes Material	Carbon Steel	Tube Number In Drain Cooler	1125	
Heater Installation	Horizontal Full Flow	Feed Water Nozzles Diameters	420 mm	
Desuperheating Correction Coefficient	1	Number Of Steam Nozzles	1	
Condensation Correction Coefficient	1	Diameter Of Steam Nozzles	180 mm	
Drain Cooler Correction Coefficient	1	Diameter Of Drain Nozzle	140 mm	

## RESULTS SHEET



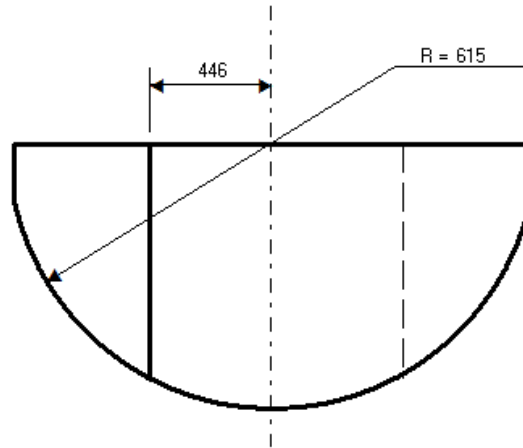
HORIZONTAL TYPE - Three Zones

Dimensions in mm

## DIMENSIONAL DRAWING

## DRAIN COOLER TUBES SUPPORT PLATE ARRANGEMENT

RIGHT-LEFT FULL FLOW WINDOW TYPE

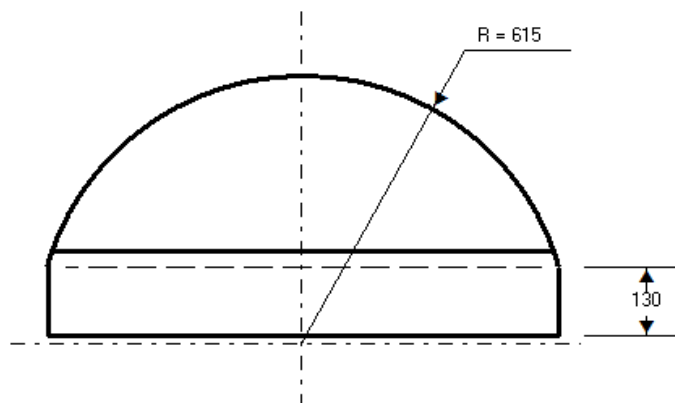


Type and dimensions are for information only and must be fixed during the final conception after order

Dimensions in mm

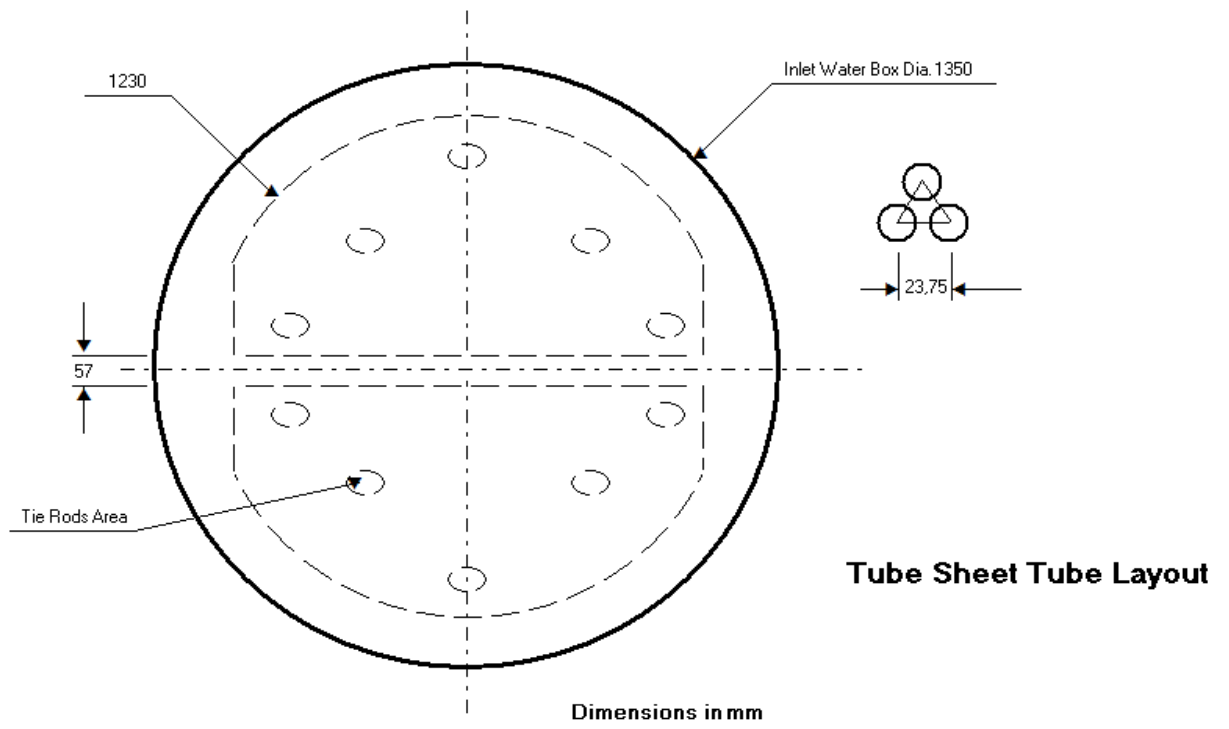
## DESUPERHEATER TUBES SUPPORT PLATE ARRANGEMENT

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





# FWH Performance

## Coefficients from Nusselt and McAdams

**Run File**

**Results**

**Print Results**

**Drawing**

**Print Drawing**

**Save File**

**Load File**

**Exit**

**INPUTS**

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

Steam Temperature At Inlet	399.09	oC
Steam Enthalpy At Inlet	3211.84	kj/kg
Steam Pressure At Inlet	41	bara
Flow At # 1 Drain Inlet	0	tn/h
Enthalpy At # 1 Drain Inlet	0	kj/kg
Flow At # 2 Drain Inlet	0	tn/h
Enthalpy At # 2 Drain Inlet	0	kj/kg
Feed Water Flow	1200	tn/h
Feed Water Inlet Temperature	226.85	oC
Number Of Tubes In D. C. If Code = 2 Or 3	0	
~ Ext. Surf. Of D. C. Casing If Code 3	0	m2

**End Of Calculation. Press Results**

**60,736**

### PERFORMANCE CALCULATION DATA



## F W H Performance - Data Results

Job Name : **Feed Water Heater Test**

### ■ Data

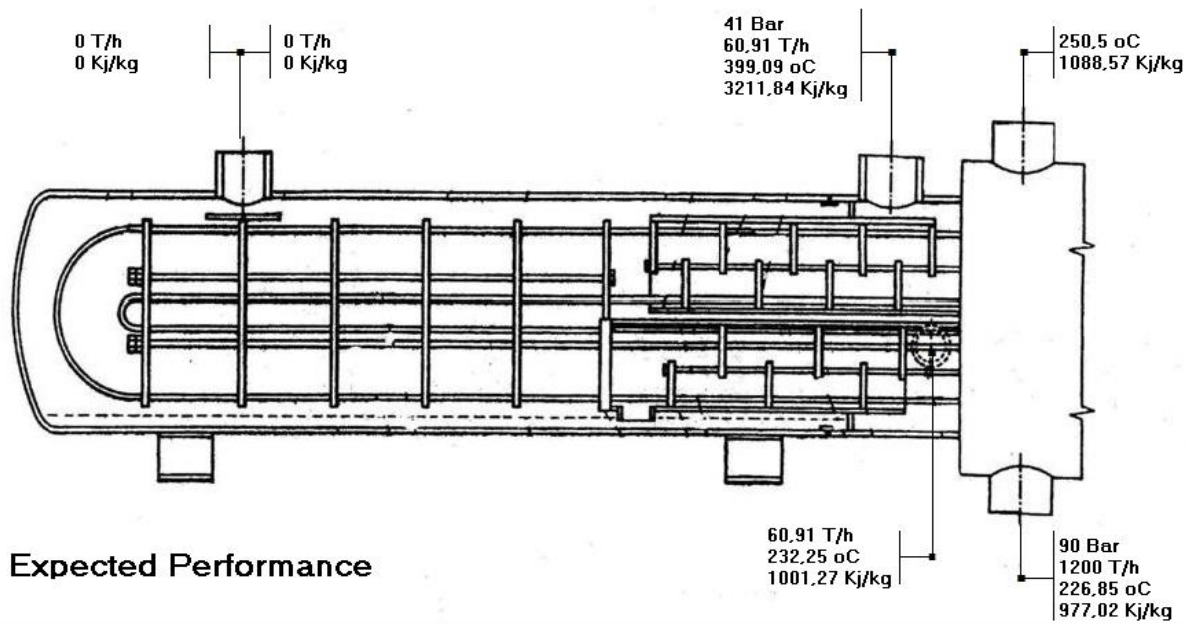
Steam Pressure At Inlet	41	Bara
Steam Saturation Temp.At Inlet Pressure	251,797	oC
Steam Temperature At Inlet	399,09	oC
Steam Enthalpy At Inlet	3211,84	Kj/Kg
Temperature At Condensation Zone	251,474	oC
Enthalpy At Condensation Zone	1092,96	Kj/Kg
Flow At # 1 Drain Inlet	0	Tn/h
Enthalpy At # 1 Drain Inlet	0	Kj/Kg
Flow At # 2 Drain Inlet	0	Tn/h
Enthalpy At # 2 Drain Inlet	0	Kj/Kg
Feed Water Pump Pressure	90	Bara
Feed Water Flow	1200	T/h
Feed Water Inlet Temperature	226,85	oC
Feed Water Inlet Enthalpy	977,02	Kj/Kg
Number Of Non Pugged Tubes	1125	
Tubes Outlet Diameter	19	mm
Tubes Thickness	1,5	mm
Tubes Material	Carbon Steel	
Active Desuperheating Surface	87,7	m2
Active Condensing Surface	672,3	m2
Active Drain Cooler Surface	45,5	m2
Heater Installation	Horizontal Full Flow	
Desuperheating Correction Coefficient	1	
Condensation Correction Coefficient	1	
Drain Cooler Correction Coefficient	1	

### ■ Results

Steam Flow (Including 0.3 % Lost)	60,91	T/h
Desuperheating Duty	17143	Mj/h
Condensation Duty	111145	Mj/h
Drain Cooler Duty	5568	Mj/h
Desuperheating L.M.T.D.	83,52	oC
Condensation L.M.T.D.	10,95	oC
Drain Cooler L.M.T.D.	12,37	oC
Desup.Heat Transfer Coefficient	2386	Kj/hoCm2
Conden.Heat Transfer Coefficient	14976	Kj/hoCm2
D.C. Heat Transfer Coefficient	9876	Kj/hoCm2
F W Heater Shell Outlet Temperature	232,25	oC
Feed Water Outlet Temperature	250,5	oC
Feed Water Temp.At In Conden.Zone	227,76	oC
Feed Water Temp.At Out Conden.Zone	247,58	oC
F W Heater Shell Outlet Enthalpy	1001,27	Kj/Kg
Feed Water Outlet Enthalpy	1088,57	Kj/Kg
Feed Water Enthal.At In Conden.Zone	981,66	Kj/Kg
Feed Water Enthal.At Out Conden.Zone	1074,29	Kj/Kg
Steam Temp.At Desuperheater End	288,47	oC
Steam Enthal.At Desuperheater End	2922,95	Kj/Kg
Terminal Temperature Difference	1,29	oC
Drain Cooler Approach	5,4	oC
Tube Number In Drain Cooler	1125	
Number Of Plugged Tubes	0	
Dew Point Verification	272,02	oC

(It Must Be Less Than Temperature At Desuperheater Outlet)

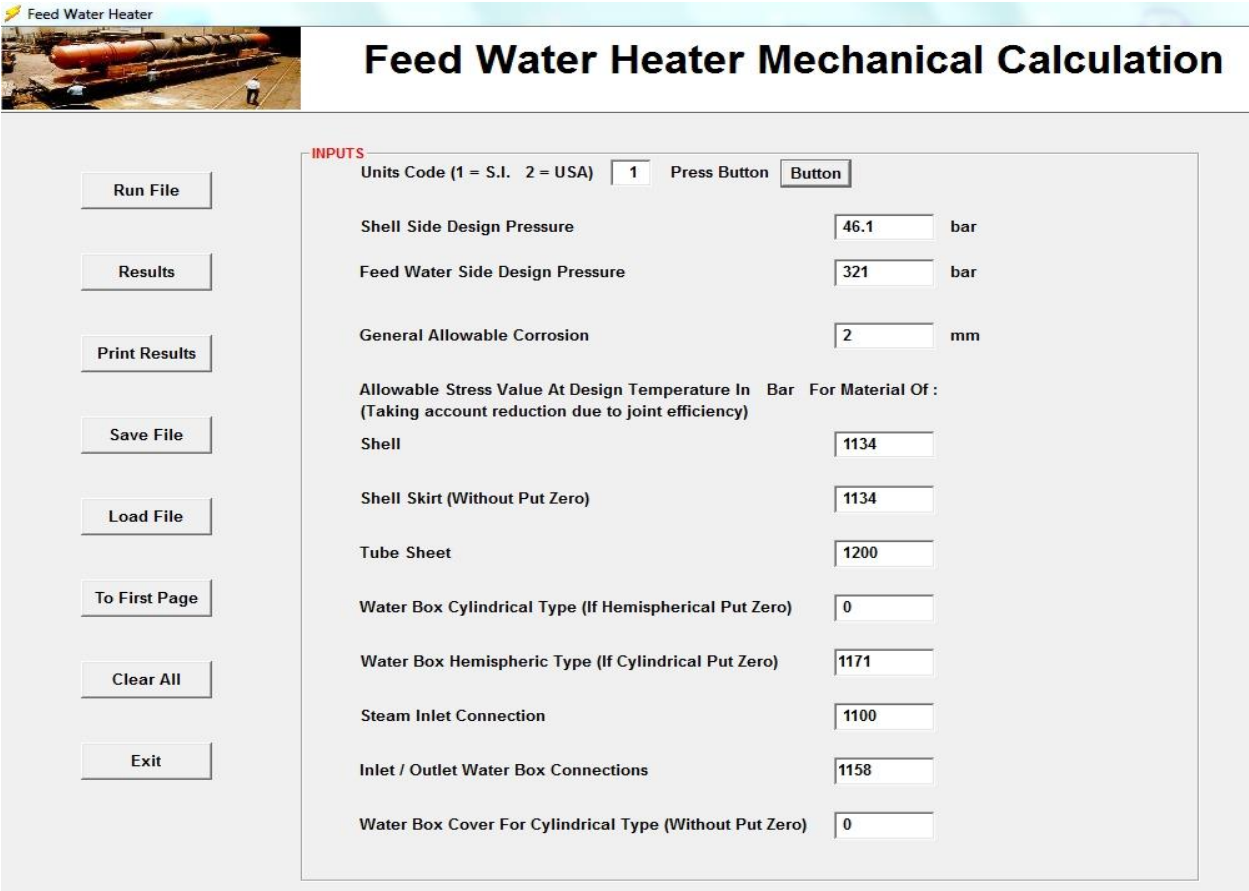
## PERFORMANCE RESULTS



## PERFORMANCE DATA DRAWING

# MECHANICAL CALCULATION

Feed Water Heater



The image shows a software interface for 'Feed Water Heater Mechanical Calculation'. It features a sidebar with buttons for 'Run File', 'Results', 'Print Results', 'Save File', 'Load File', 'To First Page', 'Clear All', and 'Exit'. The main area is titled 'INPUTS' and contains a list of input fields with their respective values and units.

## Feed Water Heater Mechanical Calculation

**INPUTS**

Units Code (1 = S.I. 2 = USA)	1	Press Button	Button
Shell Side Design Pressure	46.1	bar	
Feed Water Side Design Pressure	321	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	1134		
Shell Skirt (Without Put Zero)	1134		
Tube Sheet	1200		
Water Box Cylindrical Type (If Hemispherical Put Zero)	0		
Water Box Hemispheric Type (If Cylindrical Put Zero)	1171		
Steam Inlet Connection	1100		
Inlet / Outlet Water Box Connections	1158		
Water Box Cover For Cylindrical Type (Without Put Zero)	0		

# MECHANICAL CALCULATION DATA WINDOW



## FW HEATER RESULTS - Thickness (mm) and Weights (Kg)

Job Name : HP7

■ THICKNESSES		■ WEIGHTS	
Shell	36	Exchange Tubes	21470
Shell Skirt	36	Tube Sheet Gross Weight	7280
Elliptical Shell Cover End	36	Tube Sheet Net Weight	5340
Tube Sheet	425	Shell With Cover End, Pipes And Internals	13750
Water Box (Hemispherical Type)	117	Shell Skirt	1400
Water Box (Cylindrical Type)	0	Hemispherical Water Box, Pipes And Manhole	3360
Water Box Cover (Plate Type)	0	Cylindrical Water Box , Pipes And Plate Cover	0
Water Box Cover (Elliptical Type)	0	Cylindrical Water Box, Pipes And Elliptical Cover	0
Tubes Support Plate	10	Complete Desuperheating Crate	560
Water Box Pass Partition Sheet	16	Complete Drain Cooler Crate	860
Steam Inlet Pipe	7	Condensing Zone Tubes Support Plates	870
Feedwater Inlet/Outlet Pipe	61	Heater Supports	400
Drains Outlet Pipe	7	Heater Empty	48010
		Heater In Operation	52500
		Heater Full Of Water	64400

## RESULTS SHEET