



FurnXpert
 Continuous Reheat
 Strip solves Heat
 Transfer and
 Combustion Issues in
 large strip furnaces
 to heat metal strips

Furnace Configuration

Furnace Details
 Furnace Type: Pusher
 Heating Type: Top and Bot. Fired
 Width: 13 m, Length: 14 m
 Wrap Around Option: No Wrap

Charge Rolls
 # of Rolls: 10, Diameter: 0.3 m, Width: 0.6 m, Loss Factor charge: 0.2

Discharge Rolls
 # of Rolls: 0, Diameter: 0 m, Width: 0 m, Loss Factor discharge: 0.1

Other Specification
 Charge Door Area: 0.09 Sq. m, Discharge Door Area: 0.09 Sq. m, Bot. Zone Screen Input: 0 J/sec, Top Zone Screen Input: 0 J/sec, Q Misc. factor: 0

Zone Details
 # of Top Zones: 3, # of Bot. Zones: 2

Top Zone	Top Dist. m	Bot. Zone	Bot. Dist. m
1	3.82	1	3.82
2	9	2	9
3	14		

Heat Balance

SANKEY DIAGRAM

Gross Heat Input (G): 29,968,290.00 J/sec
 Net Heat Input (N): 28,564,464.00 J/sec
 Available Input (A): 25,600,430.00 J/sec

Net Heat to Air: 6,637,839.50 J/sec
 FLEE LOSS: 18,176,571.00 J/sec
 Combustion Air Temp: 797 Deg C
 RECUPERATOR

Door Loss: 28,712.29 J/sec
 Roll Loss: 56,022.44 J/sec
 Heat to Steel: 17,794,172.00 J/sec
 Refractory Loss: 7,501,126.50 J/sec
 Water Loss: 212,422.86 J/sec
 Slit Loss: 0.00 J/sec

Temperature Curve Inside Furnace

COMPUTED TEMPERATURE PROFILE

Temperature vs. Distance in m graph showing Zone Temp (Top, Bot), Charge Temp (Top, Center, Bot).

Charge Details

Charge Shape & Dimension: Shape: Flat, Diameter (D): cm, Thickness (H): 13 cm, Length (L): 10 m, Width (W): 13 cm

Legend

- Zone Temp -- Top
- Zone Temp -- Bot
- Charge Temp -- Top
- Charge Temp -- Center
- Charge Temp -- Bot

Charge Condition
 Charge Temp: 250 Deg C, Prod. Rate: 99 MT/Hr, Res. Time: 87 min

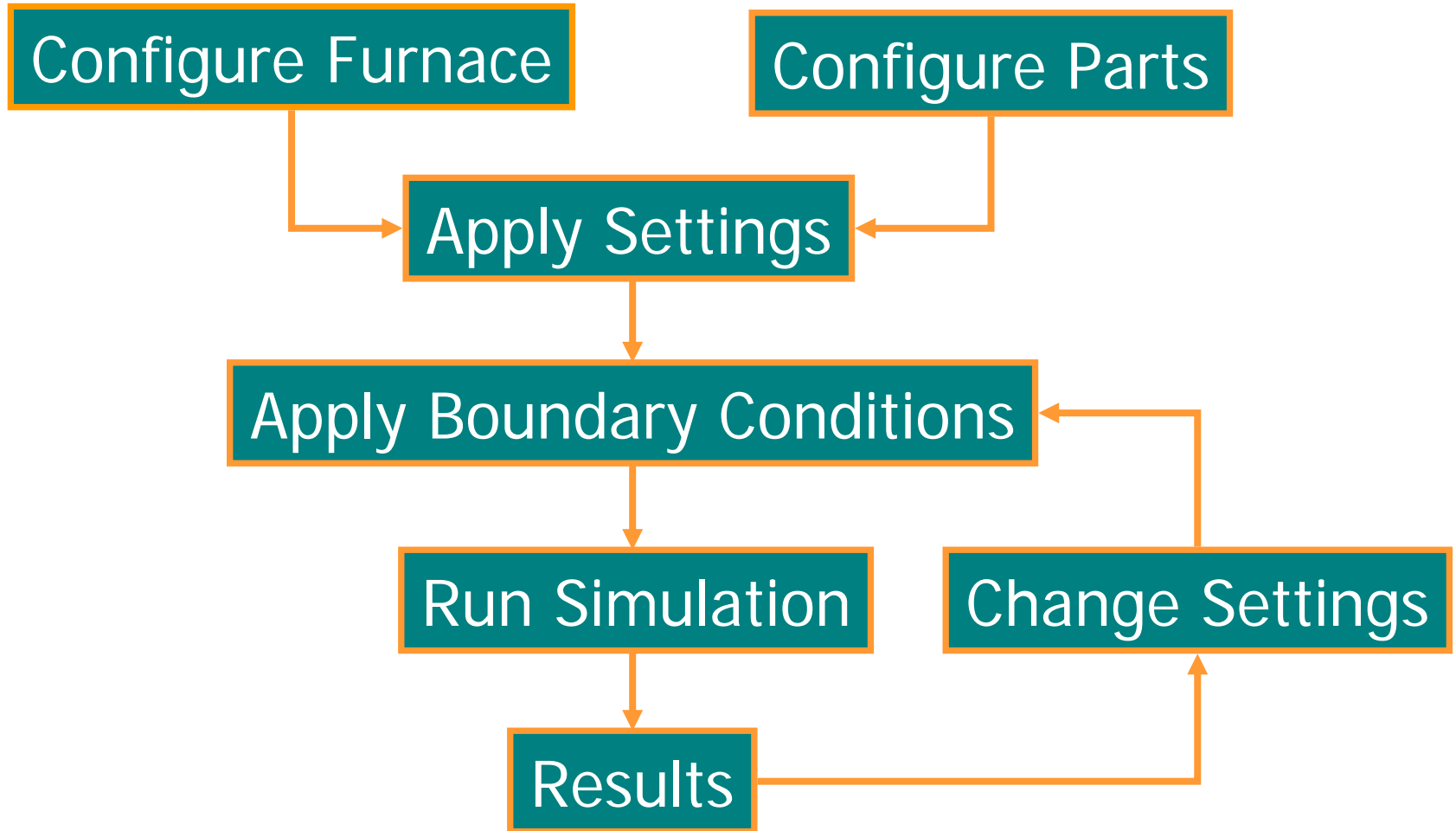
Actual
 Discharge Temp: 1000 Deg C, Discharge Delta T: 5

Charge Size
 Length: 10.00 m, Width: 13.00 cm, Thickness: 13.00 cm

Target
 Discharge Temp: 1150 Deg C, Discharge Delta T: 1

Other Details
 Grade: 1000 GRADE, Charge Temperature: 250 Deg C, View Factor Top: 0.8, Target Temperature: 1151 Deg C, View Factor Bot: 0.5, Target delta T: 10 Deg C

- ⇒ Minimizes furnace design time
- ⇒ Reduces the requirements for test runs
- ⇒ Provides opportunity to quickly investigate multiple furnace designs
- ⇒ Enables viewing heat-treating process virtually
- ⇒ Offers platform for improved design accuracy
- ⇒ Bridges the gap between the furnace suppliers and furnace users
- ⇒ Can be used as a sales tool by furnace manufacturers as well as Heat-Treaters



The screenshot shows the main interface of the FurnXpert software. On the left is a vertical toolbar with icons for various functions. The main window displays a background image of a furnace with overlaid text: "SETUP FURNACES desktop software", "The software has been developed to", "configure their furnaces, select parts, and run what-if analysis to determine the best", "Sunnyvale, CA 94085", "Ph: (724) 388-0577", "info@furnxpert.com", "www.furnxpert.com", and "Single User License".

FUNCTIONS:

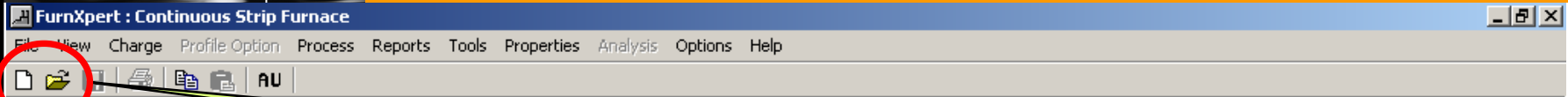
- CONFIGURE NEW FURNACES
- CREATE FURNACE TEMPERATURE PROFILE
- CREATE PARTS/CHARGES
- PROVIDE ADDITIONAL DATA FOR THE PARTS/CHARGES
- PLACE CHARGES ON THE FURNACE
- RUN SIMULATION
- RUN HEAT AUDIT
- RUN SANKEY DIAGRAM
- CREATE AND PRINT REPORTS
- HELP

TOOLBAR:

- Furnace
- Profile
- Create Charge
- Charge Detail
- Place Charge
- Run
- Heat Audit
- Sankey Dgrm
- Reports
- Help
- Exit

STATUS BAR:


- UNIT SYSTEM: Default
- FURNACE CREATED BY: None
- CONTRACT NO: None
- JOB NAME: None



Create a New Furnace file or use a Furnace File already created

- Furnace
- Profile
- Create Charge
- Charge Detail
- Place Charge
- Run
- Heat Audit
- Sankey Dgrm
- Reports
- Help
- Exit

SETUP FURNACES
SIMULATE FURNACES



CompAS Controls, Inc.
P O Box 61825
Sunnyvale, CA 94085
Ph: (724) 388-0577
info@furnxpert.com

www.furnxpert.com

Single User License

FurnXPert is a desktop software that simplifies the job of SETTING UP and SIMULATING industrial furnaces. The software has been developed to aid process engineers and furnace operators configure their furnaces, select parts, and run what-if analysis to determine the best furnace operating parameters.

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FurnXpert : Continuous Strip Furnace

File View Charge Profile Option Process Reports Tools Properties Analysis Options Help

Furnace
Profile
Create Charge
Charge Detail
Place Charge
Run
Heat Audit
Sankey Dgrm
Reports
Help
Exit

Unit Selection

Default

Length	ft	Energy	Btu
Time	min	Production Rate	lbs/hr
Temperature	Deg F	Power	Btu/hr
Weight	lbs	Energy Consumption	Btu/lb
Velocity	in/min	Flow	Cfh

Ok Cancel Apply

UNIT SYSTEM: Default FURNACE CREATED BY: None CONTRACT NO: None JOB NAME: None

Select Unit System From Drop Down Menu

INPUT WALL SPECIFICATION

- Refractory Factors
- Wall Area & Insulation details

- Furnace
- Profile
- Create Charge
- Charge Detail
- Place Charge
- Run
- Heat Audit
- Sankey Dgrm
- Reports
- Help
- Exit

Furnace Configuration

Furnace Details

Wall Specifications

Refractory Factors

Side Walls	0.5
Roof	0.5
Hearth	0.5

Wall Area

Top	2	Sq.ft / ft	Calculate
Bottom	3	Sq.ft / ft	Calculate

Wall & Skid Details

Custom Insulation

Layers -1-

Walls	2	FB	3	in
Roof	2	FB	3	in
Hearth	2	FB	3	in

Skid Parameter

Xover Yes No

Shielded Area

Skid		Sq.ft / ft	Calculate
Riser		Sq.ft / ft	Calculate
Xover		Sq.ft / ft	Calculate

Diameter (ft)

Skid		Riser	
Xover			

Custom Insulation

Layers 1

Skid	<input type="checkbox"/>			in
Riser	<input type="checkbox"/>			
Xover	<input type="checkbox"/>			

Coverage

Skid	
Riser	

Side Wall Insulation

Furnace

L1 L2

Ambient 80 Deg F

L1	3	FB
L2	3	IB

Number of Layers

Layer 1	Material: Fire Brick	Thickness: 3 in
Layer 2	Material: Insulating Brick	Thickness: 3 in
Layer 3	Material:	Thickness: in
Layer 4	Material:	Thickness: in

Ok Cancel Apply

Save As Ok Cancel Apply

FUEL & BURNER DATA

- Type of Fuel
- Percent of Excess Air
- Combustion Air Temperature
- Fuel Temperature
- Type of Burner (Conventional/Regenerative)

Furnace Configuration

Furnace Data

Fuel Specification

Type of Fuel: NATURAL GAS - 8897 Gross kcal/cu.m

Percent of Excess Air: 10

Combustion Air Temperature: 500 Deg C

Fuel Temperature: 100 Deg C

Type of Burner

Conventional

Regenerative

Flue Gas Extraction (%)

Fuel & Burner

Type of Fuel

Gaseous

Liquid

Ratio (in Cu.m / Cu.m)

Air / Fuel: 8.44

Flue

NATURAL GAS - 8897 Gross kcal/cu.m

NATURAL GAS - 8897 Gross kcal/cu.m

COKE OVEN GAS - ARMCO MIDD. WKS.

PRODUCER GAS - LURGI COMMERCIAL

NO.2 OR DIESEL - 9920 net kcal/kg

NO.6 OR BUNKER C OIL - 9600 net kcal/kg

COREX GAS - ISCOR S.AFRICA

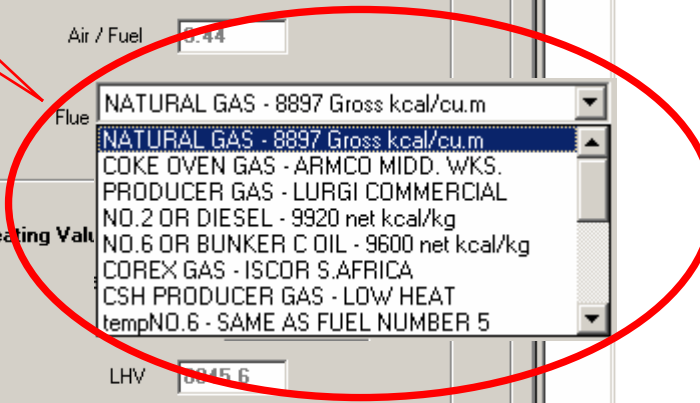
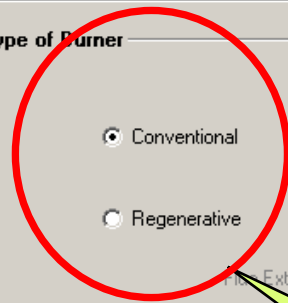
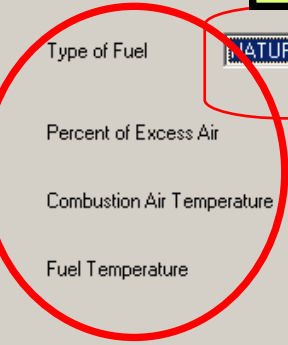
CSH PRODUCER GAS - LOW HEAT

tempNO.6 - SAME AS FUEL NUMBER 5

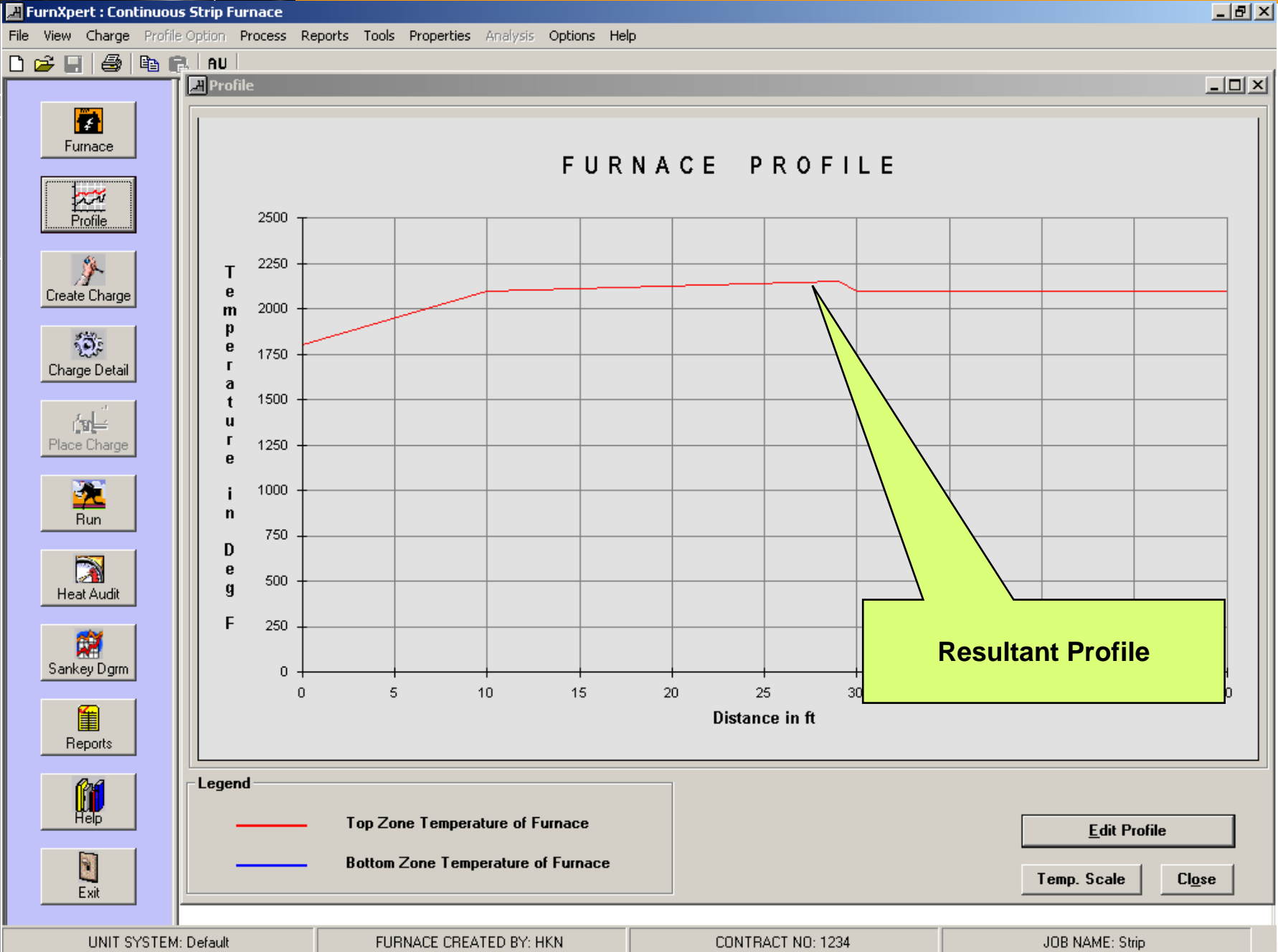
Heating Value

LHV: 8845.6

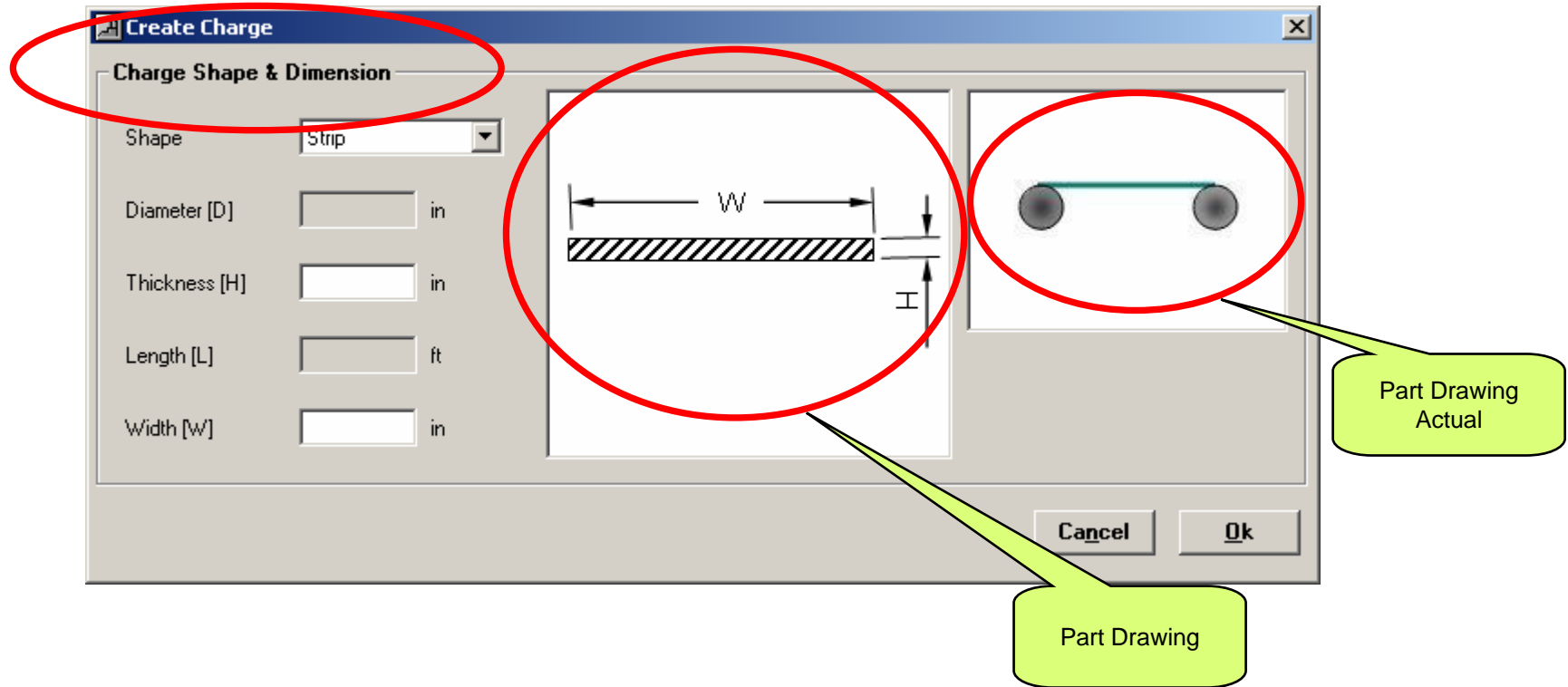
Save As Ok Cancel Apply



Can select between conventional and Regenerative Burner



Create charges from list of shapes



Charge Details

Charge Shape & Dimension

Shape:

Diameter [D]: in

Thickness [H]: in

Length [L]: ft

Width [w]: in

Other Details

Grade:

View Factor Top:

View Factor Bot.:

Target Temperature: Deg F

Target delta T: Deg F

Charge Temperature

Node 1: Deg F

Node 2: Deg F

Node 3: Deg F

Node 4: Deg F

Node 5: Deg F

Select from a list of material

Input Initial nodal Temperature

Input View Factors

Other Details

Grade:

View Factor Top:

View Factor Bot.:

Target Temperature: Deg F

Target delta T: Deg F

Charge Temperature

Node 1: Deg F

Node 2: Deg F

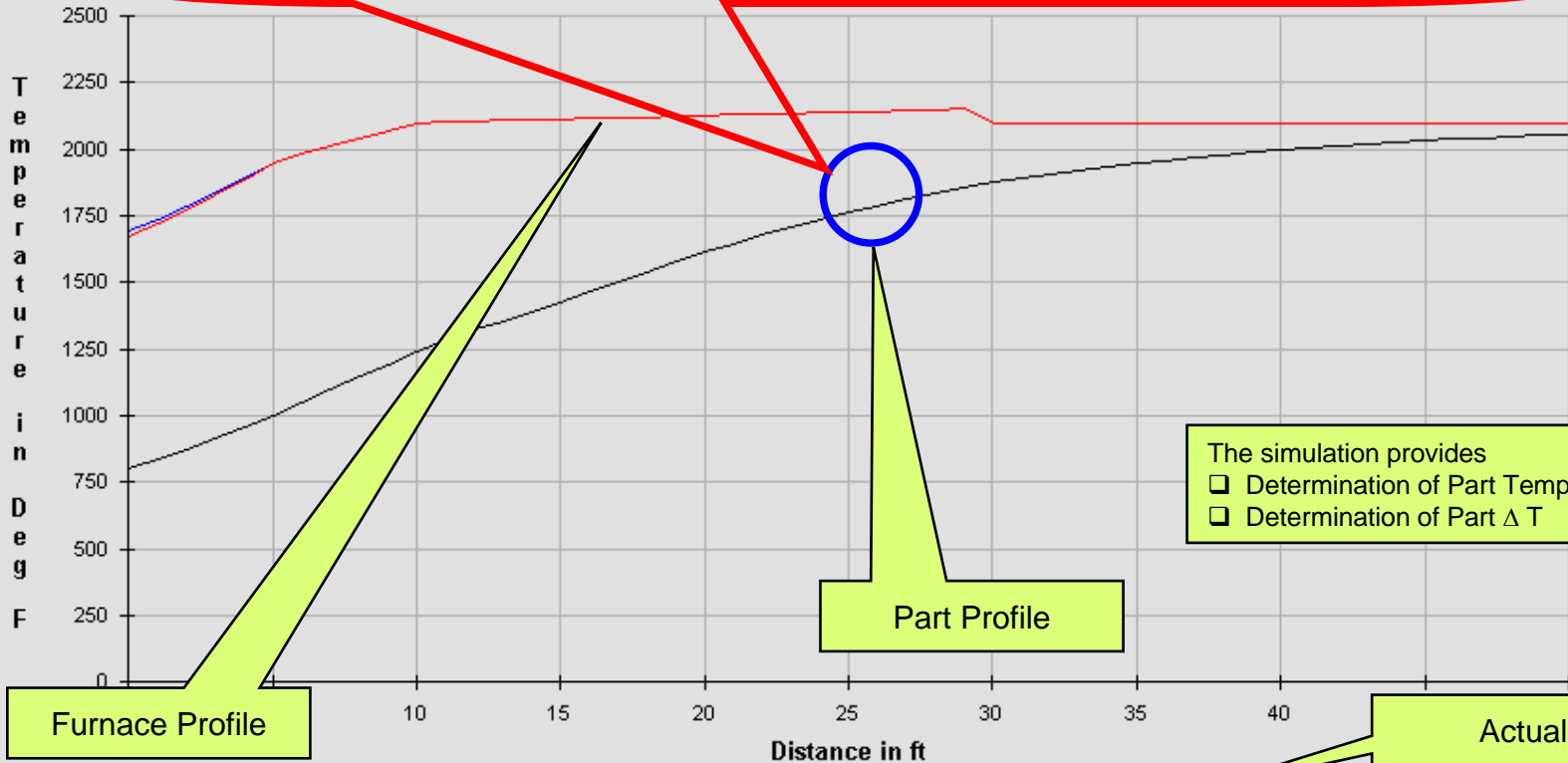
Node 3: Deg F

Node 4: Deg F

Node 5: Deg F

Temperature Curve Inside Furnace

COMPUTED TEMPERATURE PROFILE



The simulation provides

- Determination of Part Temperature
- Determination of Part ΔT

Furnace Profile

Part Profile

Actual

Legend

—	Zone Temp --- Top	<input checked="" type="checkbox"/>
—	Zone Temp --- Bot	<input checked="" type="checkbox"/>
—	Charge Temp --- Top	<input checked="" type="checkbox"/>
—	Charge Temp --- Center	<input checked="" type="checkbox"/>
—	Charge Temp --- Bot	<input checked="" type="checkbox"/>

Charge Condition

Charge Temp.	800	Deg F
Prod. Rate	10	Ton/Hr
Res. Time	7	Sec

Charge Size

Length	NA
Width	6 in
Thickness	6 in

Actual

Discharge Temp.	2056	Deg F
Discharge Delta T	NA	

Target

Discharge Temp	2100	Deg F
Discharge Delta T	NA	

Steel Grade

Steel Grade	1008 GRADE
-------------	------------

Calculation Sheet

Temp. Scale

Close

- Furnace
- Profile
- Create Charge
- Charge Detail
- Place Charge
- Run
- Heat Audit
- Sankey Dgrm
- Reports
- Help
- Exit

HEAT AUDIT

Top Zones			Bottom Zones						
Zone #	Heat to Steel	Ref. Heat Loss	Total	Zone #	Heat to Steel	Ref. Heat Loss	Water Loss	Slot Loss	Total
	MMBtu/Hr	MMBtu/Hr	MMBtu/Hr		MMBtu/Hr	MMBtu/Hr	MMBtu/Hr	MMBtu/Hr	MMBtu/Hr
1	0.313	0.204	0.523	1	0.325	0.264	0.000	0.000	0.589
2	1.880	1.204	3.084	2	1.880	1.548	0.000	0.000	3.428
3	0.391	0.961	1.352	3	0.391	1.236	0.000	0.000	1.627
Total	2.590	2.369	4.959	Total	2.596	3.048	0.000	0.000	5.644

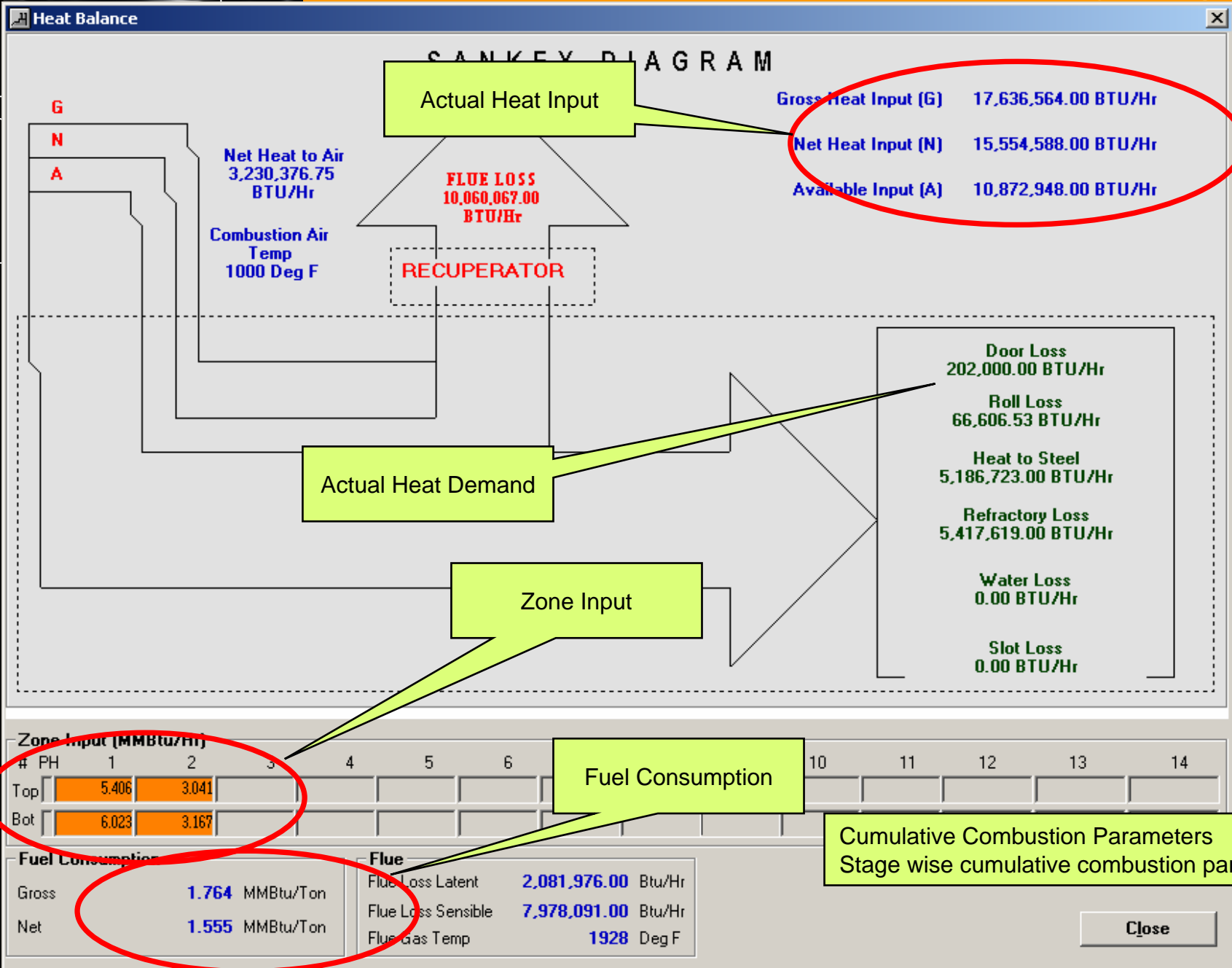
Close

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The simulation provides
 Heat Audit to determine zone wise heat losses



Click to print the report

Unit System

Heat : MMBtu/Hr. Dimension : Special
Temperature : Deg F Fuel Consumption : MMBtu/Ton

Furnace Created By : HKN
Contract : 1234
Job : Strip

R E P O R T

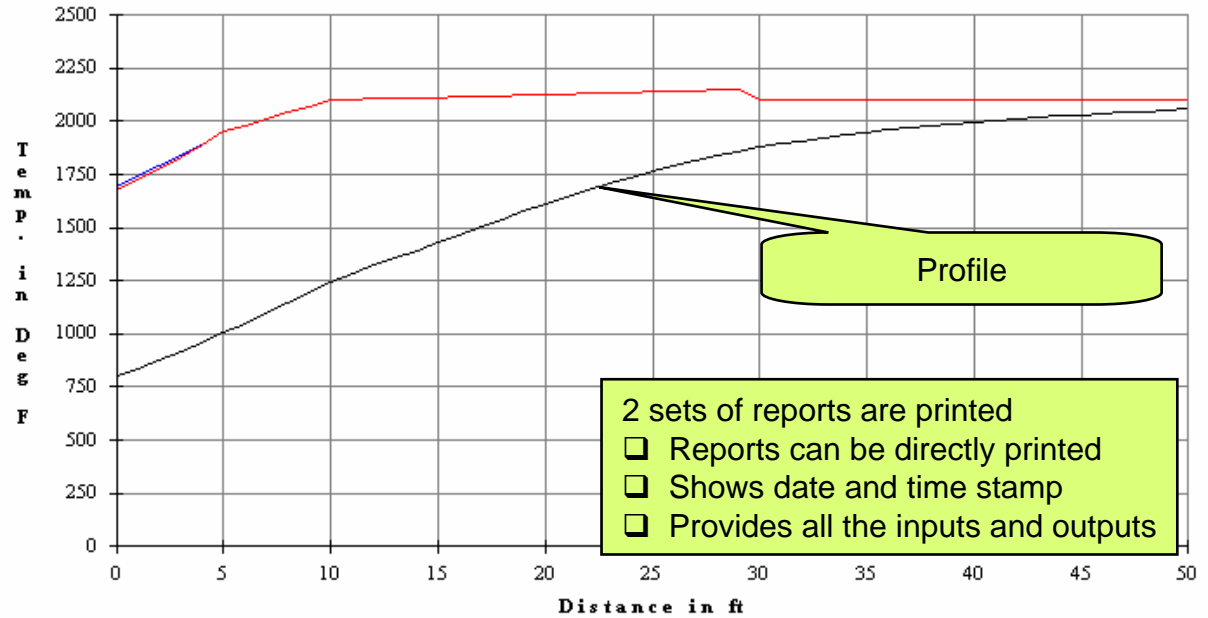
Furnace Specifications
Furnace Type : Strip
Heating Type : Top and Bottom fired
Furnace Length : 50 ft
Furnace Width : 3 ft
Charge Door Area : 2 Sq.ft
Discharge Door Area : 2 Sq.ft
Top Wall Area : 2 Sq.ft / ft
Bottom Wall Area : 3 Sq.ft / ft
Production Rate : 10 Ton

Charge Specifications
Charge Shape : Strip
Steel Grade : 1008 GRADE
Charge Width : 24 in
Charge Thickness : 0.01 in
Charge Length : NA
Charge Spacing : 24 in
Charge Gap : NA in
Initial Charge Temp : 800

Skid Specification
Insulation Type : NA
Skid Pipe Shielded Area : NA
Riser Pipe Shielded Area : NA
Insulation Coverage on Skid : NA
Insulation Coverage on Posts : NA
Slot Area : NA
Slot View Factor : NA

— Charge Temp - Top
— Charge Temp - Center
— Charge Temp - Bot

— Zone Temp - Top
— Zone Temp - Bot



Profile

- 2 sets of reports are printed
- Reports can be directly printed
- Shows date and time stamp
- Provides all the inputs and outputs

Refractory Fact.
Side Wall : 0.5
Hearth : 0.5
Roof : 0.5

Fuel & Comb. Spec.
Fuel : NATURAL GAS - 8897 Gross kcal/cu.m
Comb. Air Temp. : 1000
Fuel Temp. : 100
Excess Air : 10%

Discharge Temp
Avg. Temp. : 2056
Delta T : NA

Click to print the report

Unit System

Heat : MMBtu/Hr. Dimension : Special
 Temperature : Deg F Fuel Consumption : MMBtu/Ton

R E P O R T

Furnace Created By : HKN
 Contract : 1234
 Job : Strip

Top Zone Heat Input

Zone	Steel	Wall Loss	Total
1	0.319	0.204	0.523
2	1.880	1.204	3.084
3	0.391	0.961	1.352
Total	2.590	2.369	4.959

Bottom Zone Heat Input

Zone	Steel	Wall Loss	Water Loss	Slot Loss	Total
1	0.325	0.264	0.000	0.000	0.589
2	1.880	1.548	0.000	0.000	3.428
3	0.391	1.236	0.000	0.000	1.627
Total	2.596	3.048	0.000	0.000	5.644

Zone Inputs

Fuel Consumption

Flue Gas Temp.: 1928
 Tot.Fuel Input-Gross: 17.637
 Tot.Fuel Input-Net : 15.555
 Gross Fuel Consump.: 1.764
 Net Fuel Consump.: 1.556

Available Heat

Heat to Steel : 5.187
 Heat to Wall : 5.418
 Water Loss : 0.000
 Slot Loss : 0.000
 Door Loss: 0.202
 Roll Loss : 0.067
 Total Heat Available : 10.874

Flue Gas Loss

Recuperated Heat : 3.230
 Flue Gas Latent : 2.082
 Flue Gas Sensible : 7.978
 Total Flue Gas Loss : 10.060

Entry Data

List of existing Insulation

Create New Data

Temperature Deg F	Conductivity kcal/m-hr-degC	Specific Heat Kcal/Kg-DegC
38	0.0533	0.203
538	0.0856	0.203
816	0.0856	0.203
1093	0.0856	0.203
1371	0.0856	0.203

Block Insulation
Ceramic Fibre
Fire Brick
Heavy Castable
Insulating Brick
Light Castable
xxx

Block Insulation
0.0533
0.0856
0.0856
0.0856
0.0856
0.203
0.203
0.203
0.203

Reset **New** Delete Ok Save

Reset **New** Delete Ok Save

Module to enter insulation data

- Density
- Conductivity as a function of temperature
- Specific Heat as a function of temperature

Material Data

Material Name: 1008 GRADE

Units: English Unit Metric Unit

Density: 7851.597 Kg/cu.m % Carbon: 0.08

Temperature: Deg C Sp. Heat: J/gm-K

Emissivity: 0.85

Conductivity

Temperature Deg C	Conductivity Watt/m-Deg C	Temperature Deg C	Conductivity Watt/m-Deg C	
1	16	59.34479	10	482
2	38	59.04548	11	538
3	93	57.99775	12	593
4	149	55.603	13	649
5	204	53.05856	14	704
6	260	50.21483	15	732
7	316	48.86777	16	760
8	371	47.25047	17	816
9	427	44.67695	18	871

Material Data

Material Name: 1008 GRADE

Units: English Unit Metric Unit

Temperature: Deg C Sp. Heat: J/gm-K

Conductivity: Watt/m-Deg C Density: Kg/cu.m

Specific Heat

Temperature Deg C	Specific Heat J/gm-K	Temperature Deg C	Specific Heat J/gm-K	Temperature Deg C	Specific Heat J/gm-K			
1	16	0.4594	10	482	0.66735	19	927	0.92885
2	38	0.46819	11	538	0.71086	20	982	0.93303
3	93	0.48953	12	593	0.75437	21	1038	0.93722
4	149	0.51212	13	649	0.79788	22	1093	0.93931
5	204	0.53555	14	704	0.84139	23	1149	0.6481
6	260	0.55354	15	760	0.88490	24	1204	0.65061
7	316	0.57153	16	816	0.92841	25	1260	0.66442
8	371	0.58952	17	871	0.97192	26	1316	0.71295
9	427	0.60751	18	927	1.01543			

Buttons:

List of existing Insulation

Create New Data

- Module to enter material data
- Density and emissivity
 - Conductivity as a function of temperature
 - Specific Heat as a function of temperature

The screenshot shows the 'Fuel Data' software interface. A callout bubble labeled 'List of existing Insulation' points to a dropdown menu containing a list of fuel types such as 'NATURAL GAS - 8897 Gross kcal/cu.m', 'COKE OVEN GAS - ARMCO', and 'PRODUCER GAS - LURGI'. Another callout bubble labeled 'Create New Data' points to the 'New' button at the bottom of the interface. Red circles highlight several input fields: the fuel name dropdown, the 'Air / Fuel' ratio (9.44), the 'Flue / Fuel' ratio (10.46), the 'HHV' (9122.5), the 'LHV' (8045.6), the 'Product of Combustion' section (CO₂ [Dry] 0.11), and the 'Fuel Composition (%)' section (CH₄ 90). A legend in the bottom left corner lists the data entry options: A/F, A/FI, HHV, LHV; POC - CO₂, H₂O, N₂; and Fuel Composition.

- Module to enter fuel data
- A/F, A/FI, HHV, LHV
 - POC - CO₂, H₂O, N₂
 - Fuel Composition

Heat Loss Calculation

Number of Layers: 2

Furnace Temperature [Tf]: 1300 Deg C

Ambient Temperature [Ta]: 38 Deg C

Apply Resistance to Inside Wall: Yes

Layer 1

Material: Fire Brick

Thickness [L1]: 6 cm

Layer 2

Material: Insulating Brick

Thickness [L2]: 6 cm

Layer 3

Material:

Thickness [L3]: cm

Layer 4

Material:

Thickness [L4]: cm

Temperatures

T1	1064	Deg C
T2	957	Deg C
T3	167	Deg C
T4		Deg C
T5		Deg C

Heat Flux: 2193.38 KCal/hr/sq.m

Conductivities [K1, K2, K3, K4] in : KCal/m/hr/Deg C

Ready

Close Show Calculation Sheet Reset Calculate

Number of Layers

Furnace Temperature

Ambient Temperature

Select the refractory material

Heat Loss result

Module to calculate heat loss through insulation

Heat Storage Calculations

Number of Layers: 2
 Height of Refractory: 20 cm
 Ambient Temperature [Ta]: 30 Deg C
 Init Furnace Temperature [Ti]: 500 Deg C
 Final Furnace Temperature [Tf]: 1300 Deg C

Apply Resistance to Inside Wall: Yes No

Layer 1
 Material: Fire Brick
 Thickness [L1]: 6 cm

Layer 2
 Material: Insulating Brick
 Thickness [L2]: 6 cm

Layer 3
 Material:
 Thickness [L3]:
 cm

Layer 4
 Material:
 Thickness [L4]:
 cm

Initial Furnace Temperature Final furnace Temperature

Average Temperature Deg C	At Init. Furnac Temp.	At Final Furnace Temp.	Heat Gain Btu/sq.ft
L1	478	1231	9478.35
L2	268	681	1019.66
L3			
L4			
Total Gain			10498.01

Select the refractory material

Heat Storage result

Module to calculate heat storage in insulation

Unit Calculator

Select Entity

- Distance
- Time
- Temperature
- Weight
- Velocity
- Energy
- Production Rate
- Power
- Energy Consumption
- Flow

<<Back Next>> Convert Close

Unit Calculator

From	To	Input/Output
<input checked="" type="radio"/> Btu/hr	<input type="radio"/> Btu/hr	POWER
<input type="radio"/> kCal/hr	<input type="radio"/> kCal/hr	From : 1000 Btu/hr
<input type="radio"/> kW	<input checked="" type="radio"/> kW	To: 0.292997 kW
<input type="radio"/> J/sec	<input type="radio"/> J/sec	

<<Back Next>> Convert Close

Module to convert units

Unit Selection

English (ft) ▼
Default
MKS
CGS
English (ft)
Custom

Energy

Production Rate oz/hr ▼

Power Btu/hr ▼

Temperature Deg F ▼

Weight oz ▼

Velocity ft/min ▼

Unit Selection

MKS ▼

Length m ▼

Time sec ▼

Temperature Deg C ▼

Weight kg ▼

Velocity m/min ▼

Energy J ▼

Production Rate kgs/hr ▼

Power kCal/hr ▼

Energy Consumption J/kg ▼

Flow m³/hr ▼

Ok Cancel Apply

Different unit system can be selected

The software is designed for any unit system including custom