

as req. by the provisions of the ASME Code rules, Sec. VIII, Division 1

ITEM NO.

89-032

5116-7302-16

1. Manufactured and certified by Southern Heat Exchanger Corp. 400 65th St. E., Tuscaloosa, AL  
(name and address of manufacturer)
2. Manufactured for E. I. duPont de Nemours & Co. Inc. Wilmington, De.  
(name and address of purchaser)
3. Location of installation E. I. duPont de Nemours & Co. Inc. BEAUMONT, TX.  
(name and address)
4. Type: HT. EXCH. 89-032 — SP-2094.2 5175 1990  
(horiz. or vert. tank) (mfr's. serial no.) (CRN) (drawing no.) (Natl. Bd. no.) (year built)
5. The chemical and physical properties of all parts meet the requirements of material specifications of the ASME BOILER AND PRESSURE VESSEL CODE. The design, construction and workmanship conform to ASME Code, Section VIII, Division 1: 1986  
(year)

A87

(addenda (Date))

(Code Case no.)

(special service per UG-120(d))

Items 6-11 inclusive to be completed for single wall vessels, jackets of jacketed vessels, or shells of heat exchangers.

6. Shell: SA-106B 375" .063" 1'-11.250" 16'-2.375"  
(mat'l. (spec. no., grade)) (nom. thickness (in.)) (corr. allow. (in.)) (dia. ID (ft. & in.)) (length (overall) (ft. & in.))
7. Seams: SMLS — 85% — — — — —  
(long. (dbl. singl.)) (RT (spot or full)) (eff. (%)) (HT temp. (°F)) (time) (grin (dbl. singl.)) (RT (spot, partial, or full)) (no. of courses)
8. Heads: (a) — (b) —  
(mat'l. (spec. no., grade)) (mat'l. (spec. no., grade))

|     | Local on (top, bottom, ends) | Minimum Thickness | Corrosion Allowance | Crown Radius | Knuckle Radius | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side to Pressure (convex or concave) |
|-----|------------------------------|-------------------|---------------------|--------------|----------------|------------------|--------------------|----------------------|---------------|--------------------------------------|
| (a) |                              |                   |                     |              |                |                  |                    |                      |               |                                      |
| (b) |                              |                   |                     |              |                |                  |                    |                      |               |                                      |

If removable, bolts used (describe other fastenings):

(mat'l., spec. no., gr., size, no.)

9. Type of jacket: None Proof test: —
10. Jacket closure: None If bar, give dimensions: — If bolted, describe or sketch.  
(describe as ogee & weld, bar, etc.)
11. MAWP: 75 at max. temp. 300 Min design metal temp.: 15 at 75 Hydro. XXXXXXX test pressure 115  
(psa) (°F) (°F) (psa) (psa)

Items 12 and 13 to be completed for tube sections.

12. Tubesheets: SA-240-316L 29" 2.1875" 0 BOLTED  
(stationary mat'l. (spec. no., gr.)) (dia. (in.) (subject to pressure)) (nom. thickness (in.)) (corr. allow. (in.)) (attachment (welded, bolted))
- SA-240-316L 23" 1.750" 0 TUBES EXPANDED  
(floating mat'l. (spec. no., gr.)) (dia. (in.)) (nom. thickness (in.)) (corr. allow. (in.)) (attachment)
13. Tubes: SA-240-316L 1" 16 164 STRAIGHT  
(mat'l. (spec. no., gr.)) (OD (in.)) (nom. thickness (in. or gauge)) (no.) (type (straight or U))

Items 14-17 inclusive to be completed for inner chambers of jacketed vessels or channels of heat exchangers.

14. Shell: SA-240-316L .750" 0 1'-11.50" 1'-9.50"  
(mat'l. (spec. no., gr.)) (nom. thickness (in.)) (corr. allow. (in.)) (dia. ID (ft. & in.)) (length (overall) (ft. & in.))
15. Seams: SINGL. BUTT SPOT 85% — — SINGL. BUTT — 1  
(long. (dbl. singl.)) (RT (spot or full)) (eff. (%)) (HT temp. (°F)) (time) (grin (dbl. singl.)) (RT (spot, partial, or full)) (no. of courses)
16. Heads: (a) SA-240-316L (b) SA-516-70 LINED W/ 3/8" SA-240-316L  
(mat'l. (spec. no., grade)) (mat'l. (spec. no., grade))

|     | Location (top, bottom, ends) | Minimum Thickness | Corrosion Allowance | Crown Radius | Knuckle Radius | Elliptical Ratio | Conical Apex Angle | Hemispherical Radius | Flat Diameter | Side to Pressure (convex or concave) |
|-----|------------------------------|-------------------|---------------------|--------------|----------------|------------------|--------------------|----------------------|---------------|--------------------------------------|
| (a) | <u>TOP</u>                   | <u>.1875</u>      | <u>0</u>            |              |                | <u>2:1</u>       |                    |                      |               | <u>CONCAVE</u>                       |
| (b) | <u>BOTTOM</u>                | <u>1.750"</u>     | <u>0</u>            |              |                |                  |                    |                      | <u>25.875</u> | <u>FLAT</u>                          |

If removable, bolts used (describe other fastenings):

SA-193-B7 (36) EA. 5/8"-11

(mat'l., spec. no., gr., size, no.)

17. MAWP: 75 at max. temp. 300 Min design metal temp.: 15 at 75 Hydro. XXXXXXX test pressure 115  
(psa) (°F) (°F) (psa) (psa)

## 18. Nozzles, inspection and safety openings:

| Purpose (inlet, outlet drain, etc.) | Number | Dia. or Size | Type | Mat'l.      | Nom. Thickness | Reinforcement Material | How Attached | Location |
|-------------------------------------|--------|--------------|------|-------------|----------------|------------------------|--------------|----------|
| IN-OUT                              | 1-1    | 6" ISO       | RAW  | SA-106B     | .280"          | INHERENT               | WELDED       | SHELL    |
| IN-OUT                              | 1-1    | 4" - 4"      | "    | SA-312-316L | .237"          | "                      | "            | BONNET   |
| VENT                                | 5      | 1" - "       | "    | "           | .133"          | "                      | "            | "        |
| DRAIN                               | 4      | 1" - "       | "    | "           | .133"          | "                      | "            | "        |
|                                     |        |              |      |             |                |                        |              |          |
|                                     |        |              |      |             |                |                        |              |          |
|                                     |        |              |      |             |                |                        |              |          |
|                                     |        |              |      |             |                |                        |              |          |
|                                     |        |              |      |             |                |                        |              |          |
|                                     |        |              |      |             |                |                        |              |          |

19. Supports: Skirt No Lugs 4 Legs 4 Other None Attached SHELL, WELDED  
(yes or no) (no.) (no.) (describe) (where and how)

20. Remarks: Manufacturers' Partial Data Reports properly identified and signed by Commissioned Inspectors have been furnished for the following items of the report: —  
(name of part, item number, mfr's name and identifying stamp)

"UG-20(f)" FLOATING BARREL WELDING TO FLOATING TIGHT, SA-240-316L, 1'-9.50"  
I.D. x 625" THICK x 1'-1.315" LONG, LONG SEAM SWEL. BUTT, 75% EFF,  
(1) COURSE, P.C.A.

## CERTIFICATE OF SHOP COMPLIANCE

We certify that the statements made in this report are correct and that all details of design, material, construction and workmanship of this vessel conform to the ASME Code for Pressure Vessels, Section VIII, Division 1.

"U" Certificate of Authorization no. 7037 expires Feb. 28, 19 91

Date 04-23-90 Name Southern Heat Exchanger Corp.  
(manufacturer)

Signed

Daniel H. Nolan  
(representative)

## CERTIFICATE OF SHOP INSPECTION

Vessel constructed by Southern Heat Exchanger Corporation at Tuscaloosa, AL

I, the undersigned, holding a valid commission issued by The National Board of Boiler and Pressure Vessel Inspectors and the state or province of — and employed by Commercial Union Insurance Co.

or Boston, MA have inspected the pressure vessel described in this Manufacturers' Data Report on 04-23, 19 90, and state that, to the best of my knowledge and belief, the manufacturer has constructed this pressure vessel in accordance with ASME Code, Section VIII, Division 1.

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in the Manufacturers' Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date 04-23-90 Signed B. M. Brooks Commissions NB5446 NY 2182  
(Authorized Inspector) (Nat'l. Bd. (incl. endorsement) state, prov. and no.)

## CERTIFICATE OF FIELD ASSEMBLY COMPLIANCE

We certify that the field assembly construction of all parts of this vessel conforms with the requirements of Section VIII, Division 1 of the ASME BOILER AND PRESSURE VESSEL CODE.

"U" Certificate of Authorization no. — expires —, 19 —

Date — Name — Signed —  
(assembler that certified and constructed field assembly) (representative)

## CERTIFICATE OF FIELD ASSEMBLY INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and Pressure Vessel Inspectors and the state or province of — and employed by —

of — have compared the statements in this Manufacturers' Data Report with the described pressure vessel and state that parts referred to as data items — not included in the certificate of shop inspection, have been inspected by me and that to the best of my knowledge and belief, the manufacturer has constructed and assembled this pressure vessel in accordance with ASME Code, Section VIII, Division 1. The described vessel was inspected and subjected to a hydrostatic test of — psi.

By signing this certificate neither the inspector nor his employer makes any warranty, expressed or implied, concerning the pressure vessel described in the Manufacturers' Data Report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from or connected with this inspection.

Date — Signed — Commissions —  
(Authorized Inspector) (Nat'l. Bd. (incl. endorsement) state, prov. and no.)

# THE RATING - SHELL AND TUBE HEAT EXCHANGERS

Checked JRT

F.A.A. No. 7302-16 Quantity 1 Cooler Condenser Vaporizer Heater  
 Project No. 6432 Plant BEAUMONT Rated by H.F. Hubble Date 8/3/88  
 12-23-88

This is not a complete specification. See Standard Engineering Specification SG7E, "Shell and Tube Heat Exchanger Procurement Work Sheet" for additional information which must be furnished vendor.

Lo Boiler Column TAILS Cooler

## MATERIALS

Tubes: 316 L S/S

## CONSTRUCTION

Type Name: Fixed tube sheet U-tube External floating head  
 Internal floating head Kettle reboiler

Type Figure: SG1E Figure 2A 2B 2C 3A 3B 3C 3D 4A 4B 5A 5B 5C 5D 6A 6B 6C  
 With Weir Without Weir

TEMA Type Designation: BEP

Position: Vertical Horizontal Inclined \_\_\_\_\_ degrees

(front) head: Bonnet Channel Cone Elbow  
 (rear) head: Bonnet Channel Baffle Funnel separator Cone  
 Elbow Cover plate

Shell expansion joint: Required Not required

|                    | Tube Side                              | Shell Side                                          |
|--------------------|----------------------------------------|-----------------------------------------------------|
| Design temperature | _____ °C                               | _____ °C                                            |
| Design pressure    | _____ psig                             | _____ psig                                          |
| Fluid              | Boiling liquid<br>Gas Condensing vapor | Boiling liquid Nonpulsating<br>Gas Condensing vapor |

## SIZE

|                           |                  |                              |                                   |
|---------------------------|------------------|------------------------------|-----------------------------------|
| No. shells per unit       | <u>1</u>         | Finned tube                  | _____ in.                         |
| No. tube passes per shell | <u>8</u>         | Tube OD                      | <u>1</u> in.                      |
| Outside area per shell    | <u>685</u> sq ft | Tube wall thick.             | <u>.065</u> in.                   |
| Outside area per unit     | <u>685</u> sq ft | Tube pitch                   | <u>1.25</u> in.                   |
| Nominal shell ID          | <u>21</u> in.    | Tube pattern                 | <u>Triangular</u> Rotated square  |
| No. tubes per shell       | <u>164</u>       |                              | Square                            |
| Tube length               | <u>16</u> ft     | Baffle pitch                 | <u>73/4</u> in.                   |
|                           |                  | Baffle cut                   | <u>20</u> % of dia.               |
|                           |                  | Baffle type                  | <u>Segmental</u> Double Segmental |
| Shell Type <u>E</u> F J   |                  | No. pairs of sealing devices | <u>2</u>                          |

## CONNECTIONS (Per SG1E Par. 20)

|                                |                   |                    |         |
|--------------------------------|-------------------|--------------------|---------|
| Front <del>on-top</del> head   | <u>86</u> " inlet | <u>86</u> " outlet | _____ " |
| Rear <del>on-bottom</del> head | _____ " inlet     | _____ " outlet     | _____ " |
| Shell                          | <u>86</u> " inlet | <u>86</u> " outlet | _____ " |

## PERFORMANCE PER UNIT

|                           | Tube Side             | Shell Side          |
|---------------------------|-----------------------|---------------------|
| Load                      | <u>2.56 MM</u> Pcu/hr | _____               |
| Fluid                     | <u>PROCESS</u>        | <u>WATER</u>        |
| Total fluid in            | <u>75300</u> lb/hr    | <u>543</u> gpm      |
| Condensate out            | _____ lb/hr           | _____ lb/hr         |
| Vapor out                 | _____ lb/hr           | _____ lb/hr         |
| Inlet temperature         | <u>104.7</u> °C       | <u>30.6</u> °C      |
| Outlet temperature        | <u>45</u> °C          | <u>40</u> °C        |
| Normal operating pressure | _____ psig-mmHg abs   | _____ psig-mmHg abs |
| Pressure drop             | <u>9</u> psi-mmHg     | <u>11</u> psi-mmHg  |

# TECHNICAL RATING - SHELL AND TUBE HEAT EXCHANGERS

F.A.A. No. 2302-16 Quantity 1 Cooler Condenser Vaporizer Heater  
 Project No. 6432 Plant BEAUMONT Rated by H.F. Hubble Date 8/3/88

This is not a complete specification. See Standard Engineering Specification SG7E, "Shell and Tube Heat Exchanger Procurement Work Sheet" for additional information which must be furnished vendor.

*to Boiler Column TAILS Cooler*

## MATERIALS

Tubes: 316 L 5/8

## CONSTRUCTION

Type Name: Fixed tube sheet U-tube External floating head  
 Internal floating head Kettle reboiler

Type Figure: SG1E Figure 2A 2B 2C 3A 3B 3C 3D 4A 4B 5A 5B 5C 5D 6A 6B 6C  
 With Weir Without Weir

TEMA Type Designation: BEP

Position: Vertical Horizontal Inclined \_\_\_\_\_ degrees

~~Top~~ (front) head: Bonnet Channel Cone Elbow  
 Bottom (rear) head: Bonnet Channel Baffle Funnel separator Cone  
 Elbow Cover plate

Shell expansion joint: Required Not required

|                             | Tube Side                              | Shell Side                                          |
|-----------------------------|----------------------------------------|-----------------------------------------------------|
| Design temperature _____ °C |                                        |                                                     |
| Design pressure _____ psig  |                                        |                                                     |
| Fluid _____                 | Boiling liquid<br>Gas Condensing vapor | Boiling liquid Nonpulsating<br>Gas Condensing vapor |

SIZE

|                           |                  |                              |                                   |
|---------------------------|------------------|------------------------------|-----------------------------------|
| No. shells per unit       | <u>1</u>         | Finned tube                  | <u>—</u> in.                      |
| No. tube passes per shell | <u>8</u>         | Tube OD                      | <u>1.0</u> in.                    |
| Outside area per shell    | <u>685</u> sq ft | Tube wall thick.             | <u>.065</u> in.                   |
| Outside area per unit     | <u>685</u> sq ft | Tube pitch                   | <u>1.25</u> in.                   |
| Nominal shell ID          | <u>21</u> in.    | Tube pattern                 | <u>Triangular</u> Rotated square  |
| No. tubes per shell       | <u>164</u>       |                              | Square                            |
| Tube length               | <u>16</u> ft     | Baffle pitch                 | <u>7 3/4</u> in.                  |
|                           |                  | Baffle cut                   | <u>20</u> % of dia.               |
| Shell Type <u>E</u> F J   |                  | Baffle type                  | <u>Segmental</u> Double Segmental |
|                           |                  | No. pairs of sealing devices | <u>2</u>                          |

## CONNECTIONS (Per SG1E Par. 20)

|                                |                  |                   |  |
|--------------------------------|------------------|-------------------|--|
| Front <del>on top</del> head   | <u>3</u> " inlet | <u>3</u> " outlet |  |
| Rear <del>on bottom</del> head | <u>—</u> " inlet | <u>—</u> " outlet |  |
| Shell                          | <u>8</u> " inlet | <u>8</u> " outlet |  |

## PERFORMANCE PER UNIT

|                           | Tube Side              | Shell Side             |
|---------------------------|------------------------|------------------------|
| Load                      | <u>2.56 MM</u> Pcu/hr  | <u>—</u>               |
| Fluid                     | <u>PRODCEES</u>        | <u>WATER</u>           |
| Total fluid in            | <u>75300</u> lb/hr     | <u>543</u> gpm         |
| Condensate out            | <u>—</u> lb/hr         | <u>—</u> lb/hr         |
| Vapor out                 | <u>—</u> lb/hr         | <u>—</u> lb/hr         |
| Inlet temperature         | <u>101.7</u> °C        | <u>30.6</u> °C         |
| Outlet temperature        | <u>45</u> °C           | <u>40</u> °C           |
| Normal operating pressure | <u>—</u> psig-mmHg abs | <u>—</u> psig-mmHg abs |
| Pressure drop             | <u>9</u> psi-mmHg      | <u>11</u> psi-mmHg     |

\*\*\*\* PROCESS DATA \*\*\*\*

|                                                    |              |                |               |
|----------------------------------------------------|--------------|----------------|---------------|
| 01 FLUID NAME                                      |              | COLD SHELLSIDE | HOT TUBESIDE  |
| 02 FLUID CONDITION                                 |              | WATER          | PROCESS       |
| 03 TOTAL FLOW RATE                                 | (1000 LB/HR) | SENS. LIQUID   | SENS. LIQUID  |
|                                                    |              | 271.355*       | 75.300        |
| 04 TEMPERATURE, IN/OUT                             | (DEG F)      | 87.0 / 104.0   | 215.0 / 113.0 |
| 05 TEMPERATURE, AVERAGE/SKIN                       | (DEG F)      | 95.5/ 102.2    | 164.0/ 135.7  |
| 06 PRESSURE, INLET/AVERAGE                         | (PSIA)       | 0.00/ 0.00     | 0.00/ 0.00    |
| 07 PRESSURE DROP, TOTAL/ALLOW                      | (PSI)        | 9.89/ 10.00    | 7.45/ 10.00   |
| 08 VELOCITY, CALC./MAX.ALLOW                       | (FT/SEC)     | 2.88/ 0.00     | 4.50/ 0.00    |
| 09 FILM COEF (SAF.FACT) (BTU/HR FT <sup>2</sup> F) |              | 1500.91 (0.97) | 407.88 (0.97) |
| 10 FOULING RESISTANCE (HR FT <sup>2</sup> F/BTU)   |              | 0.00100        | 0.00150       |
| 11 DENSITY (LB/FT <sup>3</sup> )                   |              | 61.9480        | 54.9048       |
| 12 THERMAL CONDUCTIVITY (BTU/HR FT F)              |              | 0.3652         | 0.0776        |
| 13 SPECIFIC HEAT CAPACITY (BTU/LB F)               |              | 0.9990         | 0.6000        |
| 14 VISCOSITY AT AVERAGE TEMP (CP)                  |              | 0.72583        | 0.33622       |
| 15 VISCOSITY AT SKIN TEMP (CP)                     |              | 0.67584        | 0.38619       |

\*\*\*\* OVERALL PERFORMANCE DATA \*\*\*\*

|                                                                         |                         |
|-------------------------------------------------------------------------|-------------------------|
| 16 TOTAL HEAT DUTY REQUIRED (1.0E6 BTU/HR)                              | 4.608360                |
| 17 EFFECTIVE MTD, (LMTD)(F)(DELTA) = (DEG F)                            | 58.56(0.89)(1.00)= 52.2 |
| 18 F FACTOR=(TUBE)(BAFFLES)(F/G)(HOT/COLD)=(0.897)(1.000)(1.000)(0.997) |                         |
| 19 OVERALL COEF, REQD/CLEAN/ACTUAL(BTU/HR FT <sup>2</sup> F)            | 131.36/ 244.11/ 146.61  |

\*\*\*\* CONSTRUCTION INFORMATION \*\*\*\*

|                                           |                                          |        |
|-------------------------------------------|------------------------------------------|--------|
| 20 NO. SHELLS SERIES 1 PARALLEL 1         | TOTAL SURFACE AREA (FT <sup>2</sup> )    | 687    |
| 21 NO. PASSES SHELL 1 TUBE 8              | EFF. SURF. AREA (FT <sup>2</sup> /SHELL) | 672.6  |
| 22 SHELL I.D. (IN.) 21.250                | TEMA SHELL TYPE E REAR HEAD OPFH         |        |
| 23 BAFFLE TYPE HORIZ SEGMENTAL            | NO. CROSSPASSES/SHELL PASS               | 23     |
| 24 CENTRAL SPACING (IN.) 7.850            | BAFFLE CUT (PCT. DIA)                    | 19.41  |
| 25 INLET SPACING (IN.) 12.578             | CUT AREA(PCT)1) 15.8 2) 0.0 3) 0.0       |        |
| 26 OUTLET SPACING (IN.) 10.578            | CUT HEIGHT FROM CENTER LINE (IN.)        |        |
| 27 BAFFLE THICKNESS (IN.) 0.188           | POS-1) 6.5 2) 0.0 3) 0.0                 |        |
| 28 PAIRS SEAL STRIPS 2 TOT.TUBESHEET(IN.) | 4.0 IMPINGEMENT PLATE NO                 |        |
| 29 F-STREAM SEAL RODS(IN.) 1.000          | NO. 4 PCT.TUBES REM.(NONE)               | 0.00   |
| 30 TUBE TYPE PLAIN                        | TUBECOUNT PER SHELL                      | 164    |
| 31 OVERALL LENGTH (FT) 16.000             | TUBE PITCH (IN.)                         | 1.2500 |
| 32 EFFECTIVE LENGTH (FT) 15.667           | OUTSIDE DIAMETER (IN.)                   | 1.000  |
| 33 LAYOUT ANGLE (DEG) 30                  | INSIDE DIAMETER (IN.)                    | 0.870  |
| 34 PITCH RATIO 1.250                      | SURFACE AREA RATIO (OUT/IN)              | 1.149  |
| 35                                        |                                          |        |
| 36 WEIGHT ESTIMATION (LB/SHELL)           | DRY 6186 WET 8705                        |        |

\*\*\*\* SHELLSIDE PERFORMANCE \*\*\*\*

|                                            |                |
|--------------------------------------------|----------------|
| 01 NOM. VEL, X-FLOW/WINDOW                 | 4.35/ 4.90     |
| 02 FILM COEF, X-FLOW/WINDOW                | 1763.4/ 1183.5 |
| 03 FLOW FRACTIONS FOR HEAT TRANSFER=       | 0.623          |
| 04 A=0.199 B=0.395 C=0.129 E=0.139 F=0.138 |                |

\*\*\*\* SHELLSIDE HEAT TRANSFER CORRECTIONS \*\*\*\*

|          |       |       |       |       |
|----------|-------|-------|-------|-------|
| 05 TOTAL | BETA  | GAMA  | END   | FIN   |
| 06 0.959 | 0.897 | 1.070 | 0.978 | 1.000 |

\*\*\*\* PRESSURE DROPS \*\*\*\* (PERCENT TOTAL DP)

|               |               |            |
|---------------|---------------|------------|
| 07 WIND 28.23 | NOZZLE SHELL  | 2.88/ 2.85 |
| 08 END 3.97   | (IN/OUT) TUBE | 5.01/ 2.96 |

\*\*\*\* H.T. PARAMETERS \*\*\*\*

|                               |         |         |
|-------------------------------|---------|---------|
| 09 WALL CORRECTION            | SHELL   | TUBE    |
| 10 PRANDTL NO.                | 1.010   | 0.977   |
| 11 AVERAGE REYNOLDS NO.       | 4.8     | 6.3     |
| 12 BUNDLE INLET REYNOLDS NO.  | 48264   | 79391   |
| 13 BUNDLE OUTLET REYNOLDS NO. | 43907   | 98960   |
| 14 FOULING LAYER (IN.)        | 52820   | 61241   |
|                               | 0.00000 | 0.00000 |

\*\*\*\* THERMAL RESISTANCES \*\*\*\* (PCT. OVERALL)

|                             |          |
|-----------------------------|----------|
| 15 SHELL TUBE FOULING METAL | OVER DES |
| 16 9.77 41.32 39.94 8.976   | 11.616   |
| 17 TOTAL FOULING RESISTANCE | 0.002724 |
| 18 DIFFERENTIAL RESISTANCE  | 0.000792 |

\*\*\*\* SHELL NOZZLE INFO. \*\*\*\*

|                                             |        |        |
|---------------------------------------------|--------|--------|
| 19 INSIDE DIAMETER (IN.)                    | INLET  | OUTLET |
| 20 VELOCITY (FT/SEC)                        | 8.1    | 8.1    |
| 21 DENSITY (LB/FT <sup>3</sup> )            | 3.42   | 3.43   |
| 22 R-V-SQ -NOZZLE (LB/FT SEC <sup>2</sup> ) | 62.057 | 61.836 |
| 23 -SHELL ENT. (LB/FT SEC <sup>2</sup> )    | 725    | 728    |
| 24 HEIGHT UNDER NOZZLE (IN.)                | 2198   | 2206   |
|                                             | 0.7    | 0.7    |

\*\* TUBE NOZZLES (RADIAL) \*\*

|                                  |        |        |
|----------------------------------|--------|--------|
| 25 INSIDE DIAMETER (IN.)         | INLET  | OUTLET |
| 26 VELOCITY (FT/SEC)             | 3.1    | 3.1    |
| 27 DENSITY (LB/FT <sup>3</sup> ) | 7.70   | 7.16   |
|                                  | 52.881 | 56.929 |

\*\*\*\* DIAMETRAL CLEARANCES \*\*\*\*

|                                    |        |
|------------------------------------|--------|
| 28 BAFFLE-TO-SHELL (IN.)           | 0.1426 |
| 29 BUNDLE-TO-SHELL (IN.)           | 1.4483 |
| 30 TUBE-TO-BAFFLEHOLE (IN.)        | 0.0313 |
| 31 MULTI.SEG. BAFFLE OVERLAP (IN.) | 0.000  |
| 32                                 |        |

\*\*\*\*\* SEE FOLLOWING PAGES FOR CALCULATION WARNING MESSAGES \*\*\*\*\*