DESIGN AND APPLICATION OF HAIRPIN HEAT EXCHANGERS

Two Types of Hairpin Heat Exchangers

- Double pipe section with one tube, either finned or bare, within each shell pipe.
- Multi-tube section with multiple smaller tubes, either finned or bare, within each shell pipe.

Operate in true counter current flow permitting extreme temperature crossing.

Due to their modular concept, hairpin heat exchangers are especially adaptable economically to service changes.

The hairpin heat exchanger is ideal for wide temperature ranges and differentials.

Because of the U-tube construction, expensive expansion joints are not required.
The Hairpin Heat Exchanger

**ASME INSPECTED AND CODE STAMPED**

- All Holland hairpin heat exchangers are ASME inspected, code stamped and National Board Registered.

**FIT TUBES PRODUCED BY ELECTRIC RESISTANCE WELDING METHOD**

- Our longitudinal fintubes are produced by electric resistance welding method.
- This assures high heat transfer efficiency throughout the life of the equipment.

**COMPLETELY ASSEMBLED**

- Multiple sections are shipped completely assembled and ready for one inlet and outlet process piping connection.

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**The Hairpin Heat Exchanger Cont’d**

**WIDE RANGE OF SIZES**

- Holland hairpin heat exchangers are available in a wide range of sizes to meet most process requirement.

**ECONOMICAL STANDARD DESIGN**

- Although we standardize whenever possible, we custom engineer our equipment to meet process or piping requirements.
The Holland “Petrofin”® Closure

NO INTERSTREAM LEAKAGE
➢ The Holland closure has one shellside sealing ring and a separate tubeside gasket, thus, minimizing the possibility of interstream leakage. As an option, the tubes can be welded to the tubesheet to eliminate the possibility of interstream leakage.

ONE LOCKING SPLIT RING
➢ There are two reusable split rings on the standard closure and four on the separated head closure which are in full view and are the simplest of all to remove and install.

CLOSURE FLANGES
➢ On low pressure designs up through 6” shell sizes, the closure flanges are a square, four bolt design.
➢ All exchangers with design pressures greater than 500 psig will have circular closure flanges with additional bolting.
➢ Through bolted closures are not standard in sizes up to 8” shells, but are available upon request.

The Holland “Petrofin”® Closure

EASILY REMOVABLE TUBE BUNDLES
➢ Tube bundles are easily removed and do not require disassembling either the shell piping or mountings. Only four standard interchangeable replacement parts are required for reassembly after routine cleaning and maintenance.
  ➢ One Rear Cover Gasket
  ➢ Two Sealing Rings
  ➢ Two Tube Gaskets
  ➢ Two Nozzle Gaskets (by others)

➢ Most sizes are stocked for immediate replacement.
The Holland Separated Head Closure

- Has separate flanges and bolting for each sealing surface.

- Recommended for pressures above 2000 psig, cyclic services, low temperature service, extreme temperature differentials, and hard to hold fluids.

- Only four standard interchangeable replacement parts are required for reassembly after routine cleaning and maintenance.
  - One Rear Cover Gasket
  - Two Sealing Rings
  - Two Tube Gaskets
  - Two Nozzle Gaskets (by others)

- Most sizes are stocked for immediate replacement.
RETURN END CLOSURES

- **Holland standard closure.** When casting is to be removed, tube return is completely exposed for inspection.
- **Fabricated closure for high pressure and alloy design.** Where standard closure is not adequate.
- **Welded closure for all welded design units using elliptical or hemispherical heads.**

- **Welded closure for all welded design using a 90° return.**
- **Rid thru design with welded joint which allows straight thru cleaning of tubes and removing bundle.**
- **Rid thru design with welded tubeheets allows straight thru cleaning of tubes. Expansion joints furnished when required.**

Examples

www.rwholland.com
**EXCHANGER SPECIFICATION SHEET**

**CUSTOMER:** SOUTHERN CO.  
**INQ. NO:** BCC98-035  
**LOCATION:**                 
**DATE:** FEB. 8, 1999  
**QUOTE NO:** 99-046  
**SERVICE:**  
**ITEM:** E-1  
**SIZE:**  
**MODEL:** 10D38-16-02-UU-2C8B  
**PAR SHL/TUBE:** 1/1  
**TOT. SURF.:** 337 SQ.FT.  
**SEC./UNIT:** 1  
**SURF./SEC.:** 337 SQ.FT.  

### PERFORMANCE OF ONE UNIT

<table>
<thead>
<tr>
<th>SHELLSIDE</th>
<th>TUBESIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLUID CIRCULATED</td>
<td>CONDENSATE</td>
</tr>
<tr>
<td>TOTAL FLOW</td>
<td>LB/HR</td>
</tr>
<tr>
<td>VAPOR IN</td>
<td>LB/HR</td>
</tr>
<tr>
<td>LIQUID IN</td>
<td>LB/HR</td>
</tr>
<tr>
<td>FLUID VAP OR COND</td>
<td>LB/HR</td>
</tr>
<tr>
<td>TEMP. IN</td>
<td>DEG F</td>
</tr>
<tr>
<td>TEMP. OUT</td>
<td>DEG F</td>
</tr>
<tr>
<td>CP-LIQUID</td>
<td>BTU/LB/F</td>
</tr>
<tr>
<td>CP-VAPOR</td>
<td>BTU/LB/F</td>
</tr>
<tr>
<td>S.G. IN OR AVG</td>
<td></td>
</tr>
<tr>
<td>S.G. OUT</td>
<td></td>
</tr>
<tr>
<td>VISC. IN OR AVG</td>
<td>CP</td>
</tr>
<tr>
<td>VISC. OUT</td>
<td>CP</td>
</tr>
<tr>
<td>K-LIQUID</td>
<td>BTU/HR/FT/DEG F</td>
</tr>
<tr>
<td>VISC. GAS</td>
<td>CP</td>
</tr>
<tr>
<td>K-GAS</td>
<td>BTU/HR/FT/DEG F</td>
</tr>
<tr>
<td>MW-IN OR AVG</td>
<td></td>
</tr>
<tr>
<td>MW-OUT</td>
<td></td>
</tr>
<tr>
<td>OPER. PRESS.</td>
<td>PSIG</td>
</tr>
<tr>
<td>VELOCITY</td>
<td>FT/SEC</td>
</tr>
<tr>
<td>PRESS. DROP</td>
<td>ALLOW/CALC PSI</td>
</tr>
<tr>
<td>FOULING</td>
<td>HR-FT-DEG F/BTU</td>
</tr>
</tbody>
</table>

**DUTY - BTU/HR:** 2393463.  
**MTD - DEG F:** 66.7  
**SERVICE TRANSFER RATE - BTU/HR/FT2/DEG F:** 106.6

### CONSTRUCTION

**CORROSION ALLOWANCE**  
**IN.:** .0625  
**EX. TUBES:** .0625  
**DESIGN/TEST PRESSURE**  
**PSIG:** 800./CODE  
**DESIGN TEMPERATURE**  
**DEG F:** 370.  

**TUBES - MAT'L:** SA-249 TP304  
**1.000" O.D.**  
**THK:** .065"  
**NO. 38 LG. 16'**

**SHELL - MAT'L:** SA-106 C  
**10.00" IPS**  
**THK: STD. WT.**

**BAFFLE MAT'L:** C. STL.  
**TYPE: SEGM**  
**PITCH: 6"**

**RETURN BEND HOUSING MAT'L:** SA-516 70  
**TYPE: F.F.**

**SHELL FLANGES - MAT'L:** SA-516 70  
**TUBESHEET - MAT'L:** SA-240 304  
**CHANNEL MAT'L:** C.STL.

**GASKETS - SHELL:** COMP. NON-ASB  
**TUBE:** S.I.D.J/NON-ASB

**CONNECTIONS - SIZE & RATING - SHELL:** 2"-600# RF  
**TUBE:** 8"-300# RF  
**CODE REQUIREMENTS:** ASME SECTION VIII DIV. 1, W/ STAMP.

**REMARKS:** SANDBLAST AND PRIME W/ CARBOZINC 11.

**SEALWELD TUBES TO TUBESHEETS.**

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**www.rwholland.com**
CUSTOMER: SOUTHERN CO
LOCATION: SMITH/WANSLEY/GOAT ROCK  DATE: MAY 2, 2000
SERVICE: FUEL GAS HEAT EXCHANGER
ITEM: ALT 2
SIZE:              MODEL:   W12A158-30-02-VU-6D10C  PAR SHL/TUBE  1/1
TOT. SURF.: 1612 SQ.FT.        SEC./UNIT:   1   SURF./SEC.:1612 SQ.FT.

PERFORMANCE OF ONE UNIT

SHELLSIDE         TUBESIDE
FLUID CIRCULATED                        CONDENSATE       NATURAL GAS
TOTAL FLOW        LB/HR                   75000.            84500.
VAPOR IN          LB/HR                       0.            84500.
LIQUID IN         LB/HR                   75000.                0.
FLUID VAP OR COND LB/HR                       0.                0.
TEMP. IN          DEG F                    297.0              25.0
TEMP. OUT         DEG F                    130.6             280.0
CP-LIQUID         BTU/LB/F                 1.010              .000
CP-VAPOR          BTU/LB/F                  .000              .585
S.G. IN OR AVG                              .922              .000
S.G. OUT                                    .999              .000
VISC. IN OR AVG   CP                        .186              .000
VISC. OUT         CP                        .500              .000
K-LIQUID          BTU/HR/FT/DEG F           .371              .000
VISC. GAS         CP                        .000              .012
K-GAS             BTU/HR/FT/DEG F           .000              .019
MW-IN OR AVG.                                .00             17.40
MW-OUT                                       .00             17.40
OPER. PRESS.      PSIG                    655.30            475.00
VELOCITY          FT/SEC                   4.100            86.900
PRESS. DROP  ALLOW/CALC  PSI           30.00/29.57        30.00/26.75
FOULING           HR-FT-DEG F/BTU          .0005             .0010

DUTY - BTU/HR   12605300.   MTD - DEG F   48.5
SERVICE TRANSFER RATE-BTU/HR/FT2/DEG F   161.2

CONSTRUCTION

CORROSION ALLOWANCE  IN.                 .0625          .0625 EX.TUBES
DESIGN/TEST PRESSURE PSIG                1500./CODE      690./CODE
DESIGN TEMPERATURE   DEG F                400.           400.

TUBES - MAT'L:SA-249-304     .625" O.D.  THK: .065"MW  NO.158 LG. 30'-0"
SHELL - MAT'L:SA-106-C         12.00" IPS   THK: SCH 80
BAFFLE  MAT'L: C/STL           TYPE: SEGM     PITCH: 7"
RETURN BEND HOUSING  MAT'L: SA-516-70           TYPE: F.F.
SHELL FLANGES -      MAT'L: SA-516-70
TUBESHEET -          MAT'L: SA-240-304          CHANNEL MAT'L:C. STL.
GASKETS -            SHELL: COMP. NON-ASB       TUBE: SIDJNA       SB
TUBESIDE R.B.C. -    MAT'L: SA-234-WPB   SIZE:10 " IPS   THK:  .500"
CONNECTIONS -SIZE & RATING - SHELL:  6"-900# RFWN  TUBE:  10"-600# RFSO
CODE REQUIREMENTS:ASME SECTION VIII DIV. 1, W/ STAMP.
REMARKS:SANDBLAST AND PAINT 2-3 MILS CZ-11
VENTS AND DRAINS
PRESSURE AND TEMP. CONNECTIONS ALL NOZZLES
WELD TUBES TO TUBESHEET
ALL WELDED DESIGN WITH REMOVEABLE CHANNELS
### Customer Data

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td>PEERLESS MFG. CO.</td>
</tr>
<tr>
<td>Inq. No.</td>
<td>D00D-01068</td>
</tr>
<tr>
<td>Location</td>
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</tr>
<tr>
<td>Date</td>
<td>JUN. 21, 2001</td>
</tr>
<tr>
<td>Quote No.</td>
<td>00-388-4</td>
</tr>
</tbody>
</table>

### Service

- **Type:** GAS/WATER EXCHANGER (DESIGN CASE)
- **Item:** E-1

### Size and Model

- **Size:**
- **Model:** 16A258-21-00-UU-10B4C
- **Par Shl/Tube:** 1/1
- **Total Surf.:** 1905 SQ.FT
- **Sec./Unit:** 1
- **Surf./Sec.:** 1905 SQ.FT

### Performance of One Unit

<table>
<thead>
<tr>
<th>Shellside</th>
<th>Tubeside</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Circulated</td>
<td></td>
</tr>
<tr>
<td>Total Flow</td>
<td>LB/HR</td>
</tr>
<tr>
<td>Vapor In</td>
<td>LB/HR</td>
</tr>
<tr>
<td>Liquid In</td>
<td>LB/HR</td>
</tr>
<tr>
<td>Fluid Vap Or Cond</td>
<td>LB/HR</td>
</tr>
<tr>
<td>Temp. In</td>
<td>DEG F</td>
</tr>
<tr>
<td>Temp. Out</td>
<td>DEG F</td>
</tr>
<tr>
<td>CP-Liquid</td>
<td>BTU/LB/F</td>
</tr>
<tr>
<td>CP-Vapor</td>
<td>BTU/LB/F</td>
</tr>
<tr>
<td>S.G. In Or Avg</td>
<td></td>
</tr>
<tr>
<td>S.G. Out</td>
<td></td>
</tr>
<tr>
<td>Visc. In Or Avg</td>
<td>CP</td>
</tr>
<tr>
<td>Visc. Out</td>
<td>CP</td>
</tr>
<tr>
<td>K-Liquid</td>
<td>BTU/HR/FT/DEG F</td>
</tr>
<tr>
<td>Visc. Gas</td>
<td>CP</td>
</tr>
<tr>
<td>MW-In Or Avg.</td>
<td>16.70</td>
</tr>
<tr>
<td>MW-Out</td>
<td>16.70</td>
</tr>
<tr>
<td>Oper. Press.</td>
<td>PSIG</td>
</tr>
<tr>
<td>Velocity</td>
<td>FT/SEC</td>
</tr>
<tr>
<td>Press. Drop</td>
<td>PSI</td>
</tr>
<tr>
<td>Fouling</td>
<td>HR-FT-DEG F/BTU</td>
</tr>
</tbody>
</table>

### Duty

- **Duty - BTU/HR:** 14447420
- **Mtd - DEG F:** 90.1
- **Service Transfer Rate - BTU/HR/FT2/DEG F:** 83.6

### Construction

- **Corrosion Allowance:** IN. 0.0625 EX. TUBES
- **Design/Test Pressure:** PSIG 550/990
- **Design Temperature:** DEG F 400/517

### Tube Bundle Data

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>5/8&quot; 13.1, 106Cmg. W.</td>
</tr>
<tr>
<td>Count</td>
<td>(21) 10&quot; L. TUBE</td>
</tr>
<tr>
<td>Material</td>
<td>SA-214</td>
</tr>
<tr>
<td>Tube OD</td>
<td>0.625&quot;</td>
</tr>
<tr>
<td>Tube THK</td>
<td>0.065&quot; AW</td>
</tr>
<tr>
<td>Tube Length</td>
<td>21'</td>
</tr>
<tr>
<td>Shell OD</td>
<td>16.00&quot; IPS</td>
</tr>
<tr>
<td>Shell THK</td>
<td>STD WT</td>
</tr>
<tr>
<td>Shell Flanges</td>
<td>MAT'L: SA-516 70</td>
</tr>
<tr>
<td>Tubesheet</td>
<td>MAT'L: SA-516 70</td>
</tr>
<tr>
<td>Channel Mat'L</td>
<td>C. STL.</td>
</tr>
<tr>
<td>Gaskets</td>
<td>SHELL: COMP. NON-ASB</td>
</tr>
<tr>
<td></td>
<td>TUBE: S.I.D.J./NON-ASB</td>
</tr>
<tr>
<td>Connections</td>
<td>SIZE &amp; RATING-SHELL: 10&quot;-300# RFSO</td>
</tr>
<tr>
<td></td>
<td>TUBE: 4&quot;-600# RFSO</td>
</tr>
<tr>
<td>Code</td>
<td></td>
</tr>
<tr>
<td>ASME</td>
<td>SECTION VIII DIV. 1, W/ STAMP.</td>
</tr>
<tr>
<td>Remarks</td>
<td>SANDBLAST AND ONE COAT CARBOZINC 11.</td>
</tr>
</tbody>
</table>

### Shell Assy. Data

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Size</td>
<td>16&quot; 304 S. 316</td>
</tr>
<tr>
<td>Weight</td>
<td>10% EXCESS SURFACE AREA IN DESIGN</td>
</tr>
<tr>
<td>Weld Procedure</td>
<td></td>
</tr>
</tbody>
</table>

### Design Conditions

- **Material:** 316 316
- **Connections:** 1/2" 3/8" 1/2" THK 316 L. TUBE
- **Weld Procedure:** 15.5 15.6 15.6

### Section Arrangement

<table>
<thead>
<tr>
<th>Item No.</th>
<th>Item</th>
<th>Unit</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Remarks

- Shell Sided and one tube connected.
- 1% Larger Excess Area in Design.

www.rwholland.com
### EXCHANGER SPECIFICATION SHEET (ENGLISH UNITS)

**CUSTOMER:** PREPA  
**LOCATION:** SAN JUAN, PR  
**DATE:** MAY 31, 2000  
**QUOTE NO:** 00-204

**SERVICE:** POWER PLANT FUEL OIL HEATER  
**ITEM:** BASE  
**SIZE:**  
**MODEL:** 3.5H1-21-00-24UU-2.5C1.5C  
**PAR SHL/TUBE:** 8/8  
**TOT. SURF.:** 2356 SQ.FT.  
**SEC./UNIT:** 16  
**SURF./SEC.:** 147 SQ.FT.

### PERFORMANCE OF ONE UNIT

<table>
<thead>
<tr>
<th>SHELLSIDE</th>
<th>TUBESIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FLUID CIRCULATED</strong></td>
<td><strong>FUEL OIL</strong></td>
</tr>
<tr>
<td><strong>TOTAL FLOW</strong></td>
<td>LB/HR</td>
</tr>
<tr>
<td><strong>VAPOR IN</strong></td>
<td>LB/HR</td>
</tr>
<tr>
<td><strong>LIQUID IN</strong></td>
<td>LB/HR</td>
</tr>
<tr>
<td><strong>FLUID VAP OR COND</strong></td>
<td>LB/HR</td>
</tr>
<tr>
<td><strong>TEMP. IN</strong></td>
<td>DEG F</td>
</tr>
<tr>
<td><strong>TEMP. OUT</strong></td>
<td>DEG F</td>
</tr>
<tr>
<td><strong>CP-LIQUID</strong></td>
<td>BTU/LB/F</td>
</tr>
<tr>
<td><strong>CP-VAPOR</strong></td>
<td>BTU/LB/F</td>
</tr>
<tr>
<td><strong>S.G. IN OR AVG</strong></td>
<td></td>
</tr>
<tr>
<td><strong>S.G. OUT</strong></td>
<td></td>
</tr>
<tr>
<td><strong>VISC. IN OR AVG</strong></td>
<td>CP</td>
</tr>
<tr>
<td><strong>VISC. OUT</strong></td>
<td>CP</td>
</tr>
<tr>
<td><strong>K-LIQUID</strong></td>
<td>BTU/HR/FT/DEG F</td>
</tr>
<tr>
<td><strong>K-GAS</strong></td>
<td>BTU/HR/FT/DEG F</td>
</tr>
<tr>
<td><strong>MW-IN OR AVG</strong></td>
<td></td>
</tr>
<tr>
<td><strong>MW-OUT</strong></td>
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<tr>
<td><strong>OPER. PRESS.</strong></td>
<td>PSIG</td>
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<tr>
<td><strong>VELOCITY</strong></td>
<td>FT/SEC</td>
</tr>
<tr>
<td><strong>PRESS. DROP</strong></td>
<td>ALLOW/CALC</td>
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<tr>
<td></td>
<td>PSI</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>FOULING</strong></td>
<td>HR-FT-DEG F/BTU</td>
</tr>
</tbody>
</table>

**DUTY - BTU/HR:** 2706000.  
**MTD - DEG F:** 200.0

**SERVICE TRANSFER RATE - BTU/HR/FT²/DEG F:** 5.7

### CONSTRUCTION

| **CORROSION ALLOWANCE** | IN. | .0625 | .0625 EX.* |
| **DESIGN/TEST PRESSURE** | PSIG | 650./CODE | 1000./CODE |
| **DESIGN TEMPERATURE** | DEG F | 650. | 650. |

**TUBES:**  
- **MATERIAL:** SA-106 B  
- **SIZE:** 1.5" IPS  
- **THK:** STD. WT  
- **NO.:** 1  
- **LG.:** 21'

**SHELL:**  
- **MATERIAL:** SA-106 B  
- **SIZE:** 3.5" IPS  
- **THK:** STD. WT

**FINS:**  
- **MATERIAL:** C. STL.  
- **HT.:** .7500"  
- **THK:** .035"  
- **NO.:** 24

**RETURN BEND HOUSING:**  
- **MATERIAL:** SA-216 WCB  
- **TYPE:** C.J.

**SHELL FLANGES:**  
- **MATERIAL:** SA-516 70

**TUBESHEET:**  
- **MATERIAL:** SA-516 70 OR EQ.  
- **CHANNEL:** C. STL.

**GASKETS:**  
- **SHELL:** COMP. NON-ASB  
- **TUBE:** S.W. SS/NON-ASB

**TUBESIDE R.B.C.:**  
- **MATERIAL:** SA-234 WPB  
- **SIZE:** 1.5" IPS

**CONNECTIONS:**  
- **SHELL:** 2.5"-600# RF  
- **TUBE:** 1.5"-600# RF

**CODE REQUIREMENTS:**  
- ASME SECTION VIII DIV. 1, W/ STAMP.

**REMARKS:**  
- SANDBLAST & ONE COAT CARBOLNE CARBOZINC #11 PRIMER.  
- SHELLSIDE (6") & TUBSIDE (2") HEADERS INCLUDED.  
- * IN AMERICAN INSTALLATIONS SP (7) INCHES BL. AND REQUIRED.

---

*FACTOR FACTORY*  
**SUBSIDIARY OF THE**  
**R.W. HOLLAND, INC.**

**www.rwholland.com**

---

**ASSEMBLY:**  
- AS SHOWN ABOVE FOR TIGHTNESS
- **UNIT 1:** REMOVE HEADERS & SHIP LOOSE IN CASE w/ HARDEN STOCK.
- **UNIT 2:** SHIP AS A B/L. BLANKETED COMPLETE ASSEMBLY IN CRATE.

**www.rwholland.com**

---

**ASSEMBLY:**  
- AS SHOWN ABOVE FOR TIGHTNESS
- **UNIT 1:** REMOVE HEADERS & SHIP LOOSE IN CASE w/ HARDEN STOCK.
- **UNIT 2:** SHIP AS A B/L. BLANKETED COMPLETE ASSEMBLY IN CRATE.

**www.rwholland.com**

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**ASSEMBLY:**  
- AS SHOWN ABOVE FOR TIGHTNESS
- **UNIT 1:** REMOVE HEADERS & SHIP LOOSE IN CASE w/ HARDEN STOCK.
- **UNIT 2:** SHIP AS A B/L. BLANKETED COMPLETE ASSEMBLY IN CRATE.

**www.rwholland.com**
LMTD Example - 5 Deg. approach

LMTD Example - 10.8 LMTD