NOTES:
1. ALL FLANGE BOLT HOLES TO SUDDLE CENTER LINES.
2. WATER TO BE FLOWING PRIOR TO INJECTION OF STEAM.

<table>
<thead>
<tr>
<th>DIMENSIONS &amp; DATA CERTIFIED FOR</th>
<th>DESIGN DATA</th>
<th>SHELL</th>
<th>TUBE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUST. ORDER</td>
<td>5025983-101</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>BASCO ORDER</td>
<td>5025983-101</td>
<td>300</td>
<td>150</td>
</tr>
<tr>
<td>DT: 7-26-02 DATE: 5-28/03</td>
<td>SELL2, COMMERCIAL STANDARD</td>
<td>302</td>
<td>30</td>
</tr>
</tbody>
</table>

TYPES 500 U-TUBE 4-PASS ASSEMBLY
5/8" U-TUBES 5" SPACING

API Basco
BUFFALO, NY
FROM SHELL SIDE:
(4) 10-32 TPI TAPPED HOLES
.25 DEEP ON A 4.500 DIA. T.R.C.
DO NOT DRILL THRU.

(8) 7/16" DIA. HOLES
ON A 6.000 DIA. B.C.
EQUALLY SPACED &
STRADDLING CENTERLINES.

DRILL (16) ø0.631"-.635" TUBEHOLES
LAYOUT SYMM. ABOUT CENTERLINES
CHAMFER SLIGHTLY SHELL SIDE
T-05-0016-04-750-02

5" TUBESHEET, TYPE 500
(16) 5/3" ON 3/4" TRI

API Basco
BUFFALO, NY
<table>
<thead>
<tr>
<th>RDW No.</th>
<th>QTY REQ'D</th>
<th>CTR/CTR LENGTH</th>
<th>TOTAL LENGTH BEFORE BEND</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>1.750</td>
<td>74.750</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>3.063</td>
<td>76.875</td>
</tr>
</tbody>
</table>

MATERIAL:
5/8” O.D. x 18 B.W.G. ADMIRALTY SB-111-443

U-BEND PORTION OF TUBES TO BE RELIEF ANNEALED AFTER BENDING.

U-TUBES TO BE BENT IN ACCORDANCE WITH SB-395 AND BASCO SPEC 106-1302-A.

NOTE:
HYDRO TEST TO 1000 P.S.I. AFTER BENDING

OLD P/N 63K03B36

"U"-TUBE DRAWING
8 U'S, 5/8" O.D. ON .75" TRI.

API Basco
(3) .218 DIA HOLES ON A 4.50 DIA T.R.C. LOCATE AS SHOWN

+.006

(16) .640 -.000 DIA TUBEHOLES REMOVE BURRS BOTH SIDES

**API Basco**

BUFFALO, NY

---

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>STEEL</th>
<th>MATL</th>
<th>SPECIFICATIONS</th>
<th>Dwg SIZE</th>
<th>Dwg NO.</th>
<th>PART NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>CIRCLE, 4.992 OD, 1/16 THK</td>
<td>STEEL</td>
<td>520-16-0219-000</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

**Baffle, 45% Vert Cut**

**Type:** 500 (16) 5/8 ON .75" TRI

**By:** TJC  **CO:** TJC  **Scale:** 1/2

**Drawing Number:** A3016-06-719-005  **Previous:** 45B1205

**Date:** 12/18/01  **Date:** 12/18/01

---
## API Heat Transfer

### Basco/Whitlock Shell and Tube Heat Exchanger

<table>
<thead>
<tr>
<th>Job No.</th>
<th>CUSTOMER</th>
<th>ADDRESS</th>
<th>REFERENCE NO.</th>
<th>PLANT LOCATION</th>
<th>SERVICE OF UNIT</th>
<th>SIZE</th>
<th>SHELLS/UNIT</th>
<th>SQ. FT. SURF/UNIT (EFF.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>University of Michigan</td>
<td></td>
<td>Dave Caspary</td>
<td></td>
<td>Water Heater</td>
<td>M05535-5&quot; Pass</td>
<td></td>
<td>7.9</td>
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</tbody>
</table>

### PERFORMANCE OF ONE UNIT

<table>
<thead>
<tr>
<th>SHELL SIDE</th>
<th>TUBE SIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td>STEAM</td>
<td>WATER</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FLUID CIRCULATED</th>
<th>TOTAL FLUID ENTERING</th>
<th>LB/HR</th>
<th>344.8 LB/hr</th>
<th>5.0 GPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAPOR</td>
<td>LIQUID</td>
<td>LB/HR</td>
<td>2461.0</td>
<td></td>
</tr>
<tr>
<td>STEAM</td>
<td></td>
<td>LB/HR</td>
<td>344.8</td>
<td></td>
</tr>
<tr>
<td>NON-CONDENSABLES</td>
<td></td>
<td>LB/HR</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>STEAM CONDENSED</th>
<th>SPECIFIC GRAVITY</th>
<th>VISCOSITY @ TEMP</th>
<th>MOLECULAR WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>op @ °F</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.59</td>
<td>115</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>SPECIFIC HEAT</th>
<th>THERMAL CONDUCTIVITY</th>
<th>LATENT HEAT</th>
<th>TEMPERATURE IN</th>
<th>TEMPERATURE OUT</th>
<th>OPERATING PRESSURE</th>
<th>NO. PASSES PER SHELL</th>
<th>VELOCITY</th>
<th>PRESSURE DROP</th>
<th>FOULING RESISTANCE (Min)</th>
<th>HEAT EXCHANGED</th>
<th>TRANSFER RATE - SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>BTU/LB°F</td>
<td>BTU/H-F-FT°F</td>
<td>BTU/LB</td>
<td>°F</td>
<td>°F</td>
<td>PSIA</td>
<td>ONE (1)</td>
<td>FT/SEC</td>
<td>PSI</td>
<td>0.0007</td>
<td>32197.5</td>
<td>288.7 BTU/H-FT°F</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>DESIGN PRESSURE</th>
<th>TEST PRESSURE</th>
<th>DESIGN TEMPERATURE (Max/Min)</th>
<th>TUBES</th>
<th>SHELL</th>
<th>BONNET/CHANNEL</th>
<th>TUBESHEET-STATIONARY</th>
<th>BAFFLES-CROSS</th>
<th>BATTERIES-LONG</th>
<th>TUBE SUPPORTS</th>
<th>TUBE TO TUBESHEET JOINT</th>
<th>GASKETS</th>
<th>CODE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSIG</td>
<td>PSIG</td>
<td>°F</td>
<td>Admiralty</td>
<td>Carbon Steel</td>
<td>Cast Iron</td>
<td>Carbon Steel</td>
<td>Carbon Steel</td>
<td>TYPE Seg.</td>
<td>Type ---</td>
<td>Mechanically Rolled</td>
<td>Compressed Fiber</td>
<td>Commercial Standard</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>8 U°5</td>
<td>0.525&quot; OD 18</td>
<td>36&quot; 3/8&quot; Long</td>
<td>0.75&quot; Tri</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>TEMA CLASS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CONNECTIONS-SHELL SIDE</th>
<th>CONNECTIONS-TUBE SIDE</th>
<th>BONNET CHANNEL SIDE</th>
<th>CORROSION ALLOWANCE - SHELL SIDE</th>
<th>CODE REQUIREMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IN 1&quot; Top</td>
<td>OUT 1&quot; Bottom</td>
<td>IN 1&quot;</td>
<td>TUBE SIDE</td>
<td>Commercial Standard</td>
</tr>
</tbody>
</table>

**Remarks:** Water to be flowing prior to injection of steam.

**Note:** Non-Removable Bundle

---

* API Basco • 2777 Walden Avenue, Buffalo, NY 14225 • (716) 684-4500 Fax: (716) 684-2129 • [www.apibasco.com/photocat]  
* API Kelmar • 2300 West Marshall Drive, Grand Prairie, TX 75051 • (972) 647-2625 Fax: (972) 641-1518 • [www.apiheattransfer.com]
INPUT DATA:

SHELL SIDE:

TUBE SIDE:

FLUID CONDITION/FLUID CODE
HOT STEAM / 0
COLD LIQUID / 1

FLUID NAME
USER DEFINED
WATER

TOTAL FLOW RATE
(LB/HR)/(GPM) 344.8 / 0.0
2481.0 / 5.0

IN/OUT TEMPERATURES
(DEG F) 266.8 / 266.8
50.0 / 180.0

OPERATING PRESSURE
(PSIA) 39.7
0.0

ALLOWABLE PRESSURE DROP
(PSI) 0.00
10.00

FOULING RESISTANCE
0.00007
0.00005

MAX/MIN VELOCITY ALLOW. (FT/SEC) 0.0 / 0.0
9.0 / 0.0

THERMAL COND. (BTU/HR/FT/DEG F) 0.000
0.366

SPECIFIC HEAT
(BTU/LLB/DEG F) 0.000
0.998

SPECIFIC GRAVITY
0.0000
0.9913

DENSITY
(LB/ CU FT) 0.0000
61.8548

BULK/WALL VISCOSITY
(cP) 0.000 / 0.000
0.587 / 0.332

LATENT HEAT
(BTU/LB) 933.9

TOTAL HEAT LOAD, BTU/HR: 321975.
CORRECTED MTD, DEG F: 142.007

PASSES (ACTUAL: 4; LAYOUT: 4)
FLOWS - QUADRANT (MTD CE1.000)
PERCENT CLEAN: 100.0
MAX TUBE LENGTH: 15.0
RECT. PITCH WIDTH: IN: 0.0
SERVICE FACTOR: : 3.0

SEGMENTAL SELECTION # 1

TUBE MATERIAL : COPPER
TUBE O.D., IN.: 0.6250
TUBE I.D., IN.: 0.5270

TUBE PITCH, IN.: 0.750000
TUBE PATTERN: TRIANG

UNIT TYPE: 61
DESIGN PSIG, SS: 300
TS: 150

DRILLING: STANDARD

SHIELDS IN SERIES: 1

GEOMETRY: SHELL I.D.: IN: 5.010
SHELL SIDE: TOTAL DELTA P: PSI: 0.000

REQ'D/ACT TL: FT: 2.97/ 3.00
SHELL NOZZLE LOSS: PSI: 0.000

NUMBER OF TUBES: 16
SS CLEAN COEFFICIENT: 2000.0

ACT. SURFACE AREA: SQ. FT: 7.85
SS FOULED COEFFICIENT: 833.33

MIN/ACT END ZONES: IN: 0.000 / 0.000
SS REYNOLDS NO: 0.000

OUTER TUBE LIMIT: IN: 4.414
ENTRANCE VELOCITY: FT/SEC: 0.000

BAFFLE SPACING: IN: 22.500
BUNDLE CROSS VEY: FT/SEC: 0.000

SHELL/TUBE NOZZLE I.D., IN: 0.000 / 1.049
NOZZLE VELOCITY: FT/SEC: 0.000

WINDOW AREA: SQ. FT: 0.000
WINDOW VELOCITY: FT/SEC: 0.000

BAFFLE CUT (%diam)/%area: 0.0 / 0.0
TUBE SIDE: PRESSURE DROP: PSI: 0.358

NUMBER OF CROSSES: 0
TS CLEAN COEFFICIENT: 733.51

SHELL EFFECTIVENESS: 0.000
TS FOULED COEFF (REF S/S): 452.53

OVERALL: HEAT TRANSFER RATE: 288.68
TS REYNOLDS NO: 12676

TUBE MEAN METAL TEMP., DEG F: 216.7
TUBE VELOCITY: FT/SEC: 1.839

SHELL MEAN METAL TEMP., DEG F: 266.8
LENGTH CORR. (REI<10000): 0.000

DIFF. THERMAL EXP.: IN: 0.0022

Unit Selected: 05036 - 22.500 - 4 Special

TOTAL P.04