

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

See Data Check Messages Report for Warning Messages.

See Runtime Message Report for Warning Messages.

| Process Conditions | | Hot Shellside | | Cold Tubeside | |
|--------------------|-----------------|---------------|--------|---------------|--------|
| Fluid name | | oil | | water | |
| Flow rate | (kg/s) | 17,360 | | 26,936 | |
| Inlet/Outlet Y | (Wt. frac vap.) | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Inlet/Outlet T | (Deg C) | 93,00 | 56,00 | 35,00 | 46,83 |
| Inlet P/Avg | (kPa) | 11000 | 10996 | 11000 | 10998 |
| dP/Allow. | (kPa) | 7,621 | 30,000 | 4,454 | 30,000 |
| Fouling | (m2-K/W) | 0,000528 | | 0,000352 | |

Exchanger Performance

| | | | | | |
|-------------|----------|--------------|------------|-------------|--------|
| Shell h | (W/m2-K) | 942,69 | Actual U | (W/m2-K) | 408,81 |
| Tube h | (W/m2-K) | 2838,7 | Required U | (W/m2-K) | 301,91 |
| Hot regime | (--) | Sens. Liquid | Duty | (MegaWatts) | 1,3318 |
| Cold regime | (--) | Sens. Liquid | Eff. area | (m2) | 150,53 |
| EMTD | (Deg C) | 29,3 | Overdesign | (%) | 35,41 |

Shell Geometry

| | | |
|-------------|-------|--------|
| TEMA type | (--) | BEU |
| Shell ID | (mm) | 601,60 |
| Series | (--) | 1 |
| Parallel | (--) | 1 |
| Orientation | (deg) | 0,00 |

Baffle Geometry

| | | |
|--------------------|------------|-------------|
| Baffle type | (--) | Single-Seg. |
| Baffle cut | (Pct Dia.) | 23,48 |
| Baffle orientation | (--) | Perpend. |
| Central spacing | (mm) | 379,00 |
| Crosspasses | (--) | 12 |

Tube Geometry

| | | |
|-------------|-------|--------|
| Tube type | (--) | Plain |
| Tube OD | (mm) | 19,05 |
| Length | (m) | 5,00 |
| Pitch ratio | (--) | 1,2500 |
| Layout | (deg) | 60 |
| Tubecount | (--) | 518 |
| Tube Pass | (--) | 2 |

Nozzles

| | | |
|---------------|------|--------|
| Shell inlet | (mm) | 205,00 |
| Shell outlet | (mm) | 205,00 |
| Inlet height | (mm) | 12,67 |
| Outlet height | (mm) | 12,67 |
| Tube inlet | (mm) | 154,05 |
| Tube outlet | (mm) | 154,05 |

Thermal Resistance; %

| | |
|---------|-------|
| Shell | 43,37 |
| Tube | 16,09 |
| Fouling | 37,66 |
| Metal | 2,88 |

Velocities; m/s

| | |
|-----------|------|
| Shellside | 0,25 |
| Tubeside | 0,46 |
| Crossflow | 0,38 |
| Window | 0,70 |

Flow Fractions

| | |
|---|-------|
| A | 0,241 |
| B | 0,565 |
| C | 0,036 |
| E | 0,158 |
| F | 0,000 |



Run Log

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Released to the following HTRI Member Company:

VUT v Brne

Tester

Xist Ver. 7 SP1 29. 3. 2018 12:42 SN: 01016-1007468327

SI Units

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Beginning Run

Run Completed. Solution Reached in 00:04.

*For
educational
use only*



Data Check Messages

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Tester

Xist Ver. 7 SP1 29. 3. 2018 12:42 SN: 01016-1007468327

SI Units

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Unit ID 100 - WARNING MESSAGES (CALCULATIONS CONTINUE)

Full support baffle at U-bend: has been added to be consistent with U-tube nozzle location.

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Runtime Messages

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Tester

Xist Ver. 7 SP1 29. 3. 2018 12:42 SN: 01016-1007468327

SI Units

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Unit ID 100 - WARNING MESSAGES (CALCULATIONS CONTINUE)

The estimated tube count for this shell is 470. A large variation from the expected tube count may indicate that program has used different clearances (such as bundle-to-shell clearance and heights-under-nozzles) than those expected. Although the specified number of tubes has been used to calculate the available heat transfer area, discrepancies in exchanger clearances can result in inaccurate pressure drop and heat transfer calculations.

The inlet baffle spacing is less than the recommended minimum spacing. Check the design. This condition may lead to problems when the exchanger is built.

The physical properties of the hot fluid have been extrapolated beyond the valid temperature range. Check the calculated values. The thermal analysis requires properties at bulk and skin/wall temperatures.

ASME Section VIII Div. 1 Code was used to ESTIMATE all pressure vessel dimensions and weights. The dimensions in this report cannot be used to fabricate the vessel.

Unspecified shellside gasket - defaulting to gasket code 5054 - Kammprofile

Unspecified channelside gasket - defaulting to gasket code 5054 - Kammprofile

Tube wall thickness specified may be less than required for pressure and temperature.

Maximum external pressure for tube wall thickness is less than shellside design pressure at design temperature.

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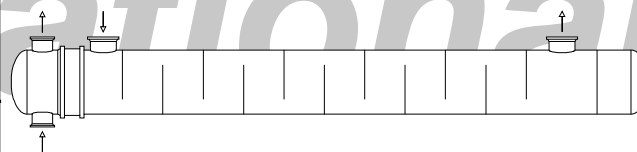
Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Process Data | | | Hot Shellside | | Cold Tubeside | |
|-------------------------------|----------|--------|---------------|--|---------------|--|
| Fluid name | oil | | | | water | |
| Fluid condition | | | Sens. Liquid | | Sens. Liquid | |
| Total flow rate | (kg/s) | | 17,360 | | 26,936 | |
| Weight fraction vapor, In/Out | (--) | 0,0000 | 0,0000 | | 0,0000 | |
| Temperature, In/Out | (Deg C) | 93,00 | 56,00 | | 35,00 | |
| Temperature, Average/Skin | (Deg C) | 74,50 | 58,17 | | 40,91 | |
| Wall temperature, Min/Max | (Deg C) | 45,83 | 64,90 | | 45,43 | |
| Pressure, In/Average | (kPa) | 11000 | 10996 | | 11000 | |
| Pressure drop, Total/Allowed | (kPa) | 7,621 | 30,000 | | 4,454 | |
| Velocity, Mid/Max allow | (m/s) | 0,25 | | | 0,46 | |
| Mole fraction inert | (--) | | | | | |
| Average film coef. | (W/m2-K) | | 942,69 | | 2838,7 | |
| Heat transfer safety factor | (--) | | 1,0000 | | 1,0000 | |
| Fouling resistance | (m2-K/W) | | 0,000528 | | 0,000352 | |

Overall Performance Data

| | | | | | | |
|--|-------------|--------|---|--------|---|--------|
| Overall coef., Req'd/Clean/Actual | (W/m2-K) | 301,91 | / | 655,81 | / | 408,81 |
| Heat duty, Calculated/Specified | (MegaWatts) | 1,3318 | / | | | |
| Effective overall temperature difference | (Deg C) | 29,3 | | | | |
| EMTD = (MTD) * (DELTA) * (F/G/H) | (Deg C) | 29,76 | * | 0,9847 | * | 1,0000 |

See Runtime Messages Report for warnings.



Exchanger Fluid Volumes

| | |
|---------------------------|-------|
| Approximate shellside (L) | 707,9 |
| Approximate tubeside (L) | 850,2 |

Shell Construction Information

| | | | | |
|----------------------------------|------------|-------------------------|------------|----------------------------|
| TEMA shell type | BEU | Shell ID | (mm) | 601,60 |
| Shells Series | 1 Parallel | Total area | (m2) | 155,00 |
| Passes Shell | 1 Tube | Eff. area | (m2/shell) | 150,53 |
| Shell orientation angle (deg) | 0,00 | | | |
| Impingement present | No | | | |
| Pairs seal strips | 0 | Passlane seal rods (mm) | 0,000 | No. 0 |
| Shell expansion joint | No | Full support at U-Bend | Yes | |
| Weight estimation Wet/Dry/Bundle | | 9794,5 | / | 8237,2 / 1936,5 (kg/shell) |

Baffle Information

| | | | |
|--------------------------|----------------------|--------------------|--------------|
| Type | Perpend. Single-Seg. | Baffle cut (% dia) | 23,48 |
| Crosspasses/shellpass | 12 | No. (Pct Area) | (mm) to C.L |
| Central spacing | (mm) 379,00 | 1 | 19,36 158,92 |
| Inlet spacing | (mm) 400,00 | 2 | 0,00 0,00 |
| Outlet spacing | (mm) 675,05 | | |
| Baffle thickness | (mm) 6,35 | | |
| Use deresonating baffles | No | | |

Tube Information

| | | | |
|-------------------|-----------------|--------------------------|---------------------|
| Tube type | Plain | Tubecount per shell | 518 |
| Length to tangent | (m) 5,00 | Pct tubes removed (half) | 0,19 |
| Effective length | (m) 4,856 | Outside diameter | (mm) 19,050 |
| Total tubesheet | (mm) 144,46 | Wall thickness | (mm) 1,000 |
| Area ratio | (out/in) 1,1173 | Pitch (mm) | 23,813 Ratio 1,2500 |
| Tube metal | Carbon steel | Tube pattern (deg) | 60 |



Final Results

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Xist Ver. 7 SP1 29. 3. 2018 12:42 SN: 01016-1007468327

SI Units

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Shellside Performance

Nom vel, X-flow/window 0,38 / 0,70

Flow fractions for heat transfer 0,617

A=0,2413 B=0,5649 C=0,0362 E=0,1576 F=0,0000

Shellside Heat Transfer Corrections

| Total | Beta | Gamma | End | Fin |
|-------|-------|-------|-------|-------|
| 0,980 | 0,915 | 1,071 | 0,974 | 1,000 |

Pressure Drops (Percent of Total)

| Cross | Window | Ends | Nozzle | Shell | Tube |
|----------|--------|-------|--------|-------|-------|
| 34,84 | 28,09 | 14,15 | Inlet | 10,93 | 25,96 |
| MOMENTUM | | 0,00 | Outlet | 11,99 | 16,60 |

Two-Phase Parameters

| Method | Inlet | Center | Outlet | Mix F |
|--------|-------|--------|--------|-------|
|--------|-------|--------|--------|-------|

H. T. Parameters

| | | Shell | Tube |
|-------------------------|--------------|-------|-------|
| Overall wall correction | | 0,916 | 1,020 |
| Midpoint | Prandtl no. | 13,62 | 4,48 |
| Midpoint | Reynolds no. | 6055 | 11477 |
| Bundle inlet | Reynolds no. | 9099 | 10532 |
| Bundle outlet | Reynolds no. | 1735 | 12554 |
| Fouling layer | (mm) | | |

Thermal Resistance

| Shell | Tube | Fouling | Metal | Over Des |
|--------------------------|-------|---------|-------|----------|
| 43,37 | 16,09 | 37,66 | 2,88 | 35,41 |
| Total fouling resistance | | | | 9,21e-4 |
| Differential resistance | | | | 8,66e-4 |

Shell Nozzles

| Inlet at channel end-Yes | Inlet | Outlet | Liquid Outlet |
|--------------------------|-----------|--------|---------------|
| Number at each position | 1 | 1 | 0 |
| Diameter | (mm) | 205,00 | 205,00 |
| Velocity | (m/s) | 0,63 | 0,61 |
| Pressure drop | (kPa) | 0,833 | 0,914 |
| Height under nozzle | (mm) | 12,67 | 12,67 |
| Nozzle R-V-SQ | (kg/m-s2) | 331,84 | 322,92 |
| Shell ent. | (kg/m-s2) | 1921,6 | 1870,0 |

Tube Nozzle

| | Inlet | Outlet | Liquid Outlet |
|---------------|-----------|--------|---------------|
| | RADIAL | RADIAL | |
| Diameter | (mm) | 154,05 | 154,05 |
| Velocity | (m/s) | 1,45 | 1,46 |
| Pressure drop | (kPa) | 1,156 | 0,739 |
| Nozzle R-V-SQ | (kg/m-s2) | 2101,8 | 2111,8 |

Annular Distributor

| | Inlet | Outlet |
|-----------|-------|--------|
| Length | (mm) | |
| Height | (mm) | |
| Slot area | (mm2) | |

Diametral Clearances (mm)

| | | |
|-----------------|-----------------|----------------|
| Baffle-to-shell | Bundle-to-shell | Tube-to-baffle |
| 4,7625 | 11,764 | 0,7937 |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Externally Enhanced Tube Geometry | | Internally Enhanced Tube Geometry | |
|-----------------------------------|-------------|-----------------------------------|-------|
| Type | Plain | Type | None |
| Fin density | (fin/meter) | Thickness | (mm) |
| Fin height | (mm) | Pitch | (L/D) |
| Fin thickness | (mm) | | |
| Root diameter | (mm) | | |
| Area/length | (m2/m) | | |

Mean Metal Temperatures

Mean shell temperature 70,85 (C)

Mean tube metal temperature in each tubepass, (C)

| <u>Tube Pass</u> | <u>Inside</u> | <u>Outside</u> | <u>Radial</u> |
|------------------|---------------|----------------|---------------|
| 1 | 49,34 | 50,26 | 49,82 |
| 2 | 52,26 | 53,05 | 52,67 |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Shellside Flow Region | 1 | 17,360 kg/s | | | | | |
|---|-----------------------|-------------|----------|----------|----------|----------|----------|
| Point number | (--) | 1 | 2 | 3 | 4 | 5 | 6 |
| Shell pass | (--) | 1 | 1 | 1 | 1 | 1 | 1 |
| Length from tube inlet | (mm) | 0,000 | 200,00 | 589,50 | 968,50 | 1347,5 | 1726,5 |
| Mass fraction vapor | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 93,00 | 90,39 | 85,56 | 81,34 | 77,53 | 74,09 |
| Skin temperature | (C) | | 71,34 | 67,65 | 64,98 | 62,39 | 60,27 |
| MTD | (C) | | 49,5 | 44,3 | 40,3 | 36,3 | 32,9 |
| Superheat for Onset of Nucleate Boiling | (C) | | | | | | |
| Delta MTD correction | (--) | | 0,9993 | 0,9973 | 0,9957 | 0,9933 | 0,9913 |
| Pressure | (kPa) | 11000 | 10999 | 10999 | 10998 | 10998 | 10997 |
| Pressure drop | (kPa) | 0,833 | 0,647 | 0,475 | 0,476 | 0,477 | 0,478 |
| Friction loss | (kPa) | | 0,647 | 0,475 | 0,476 | 0,477 | 0,478 |
| Static head loss | (kPa) | | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Momentum loss | (kPa) | | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Crossflow velocity | (m/s) | | 0,29 | 0,25 | 0,25 | 0,25 | 0,25 |
| Longitudinal velocity | (m/s) | | 0,39 | 0,33 | 0,33 | 0,33 | 0,33 |
| Shear stress at tube wall | | | | | | | |
| Crossflow | (Pa) | | 0,00 | 0,81 | 0,85 | 0,88 | 0,91 |
| Longitudinal flow | (Pa) | | 0,79 | 0,81 | 0,83 | 0,84 | 0,86 |
| Area | (m ²) | | 12,400 | 11,749 | 11,749 | 11,749 | 11,749 |
| Cumulative area | (m ²) | | 12,400 | 24,150 | 35,899 | 47,648 | 59,398 |
| Duty | (MegaWatts) | | 0,1941 | 0,1621 | 0,1462 | 0,1307 | 0,1178 |
| Cumulative duty | (MegaWatts) | | 0,1941 | 0,3562 | 0,5024 | 0,6331 | 0,7508 |
| Heat flux | (W/m ²) | | 15650 | 13800 | 12445 | 11120 | 10023 |
| Calculated heat flux | (W/m ²) | | 21792 | 19140 | 17210 | 15320 | 13768 |
| Critical heat flux | (W/m ²) | | | | | | |
| Overall U | (W/m ² -K) | | 444,13 | 433,46 | 428,24 | 422,76 | 418,21 |
| Shellside h | (W/m ² -K) | | 1155,8 | 1090,6 | 1058,8 | 1027,1 | 1001,1 |
| Sensible liquid h | (W/m ² -K) | | 1155,8 | 1090,6 | 1058,8 | 1027,1 | 1001,1 |
| Sensible vapor h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Condensate film h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Vapor phase h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Nucleate boiling h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Conv. boiling h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Film boiling h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Boiling thin film h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Natural convective h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Local Reynolds | (--) | 9098,8 | 11557 | 9199,1 | 8216,7 | 7335,4 | 6653,5 |
| Vapor Reynolds | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Reynolds | (--) | 9098,8 | 11557 | 9199,1 | 8216,7 | 7335,4 | 6653,5 |
| Vapor Prandtl | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Prandtl | (--) | 7,6879 | 8,2035 | 9,3121 | 10,312 | 11,438 | 12,499 |
| Flow regime param. | (--) | | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Condensate regime | (--) | | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |
| Boiling regime | (--) | | | | | | |
| Boiling mechanism | (--) | | | | | | |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Shellside Flow Region | 1 | | | | | | |
|---|-----------------------|----------|----------|----------|----------|----------|----------|
| Point number | (--) | 7 | 8 | 9 | 10 | 11 | 12 |
| Shell pass | (--) | 1 | 1 | 1 | 1 | 1 | 1 |
| Length from tube inlet | (mm) | 2105,5 | 2484,5 | 2863,5 | 3242,5 | 3621,5 | 4000,5 |
| Mass fraction vapor | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 70,98 | 68,17 | 65,64 | 63,36 | 61,30 | 59,44 |
| Skin temperature | (C) | 58,24 | 56,55 | 54,95 | 53,61 | 52,35 | 51,27 |
| MTD | (C) | 29,7 | 26,9 | 24,3 | 22,0 | 19,9 | 18,1 |
| Superheat for Onset of Nucleate Boiling | (C) | | | | | | |
| Delta MTD correction | (--) | 0,9884 | 0,9859 | 0,9825 | 0,9793 | 0,9753 | 0,9713 |
| Pressure | (kPa) | 10997 | 10996 | 10996 | 10995 | 10995 | 10994 |
| Pressure drop | (kPa) | 0,479 | 0,480 | 0,481 | 0,482 | 0,483 | 0,483 |
| Friction loss | (kPa) | 0,479 | 0,480 | 0,481 | 0,482 | 0,483 | 0,483 |
| Static head loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Momentum loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Crossflow velocity | (m/s) | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 | 0,25 |
| Longitudinal velocity | (m/s) | 0,32 | 0,32 | 0,32 | 0,32 | 0,32 | 0,32 |
| Shear stress at tube wall | | | | | | | |
| Crossflow | (Pa) | 0,94 | 0,97 | 1,00 | 1,02 | 1,05 | 1,07 |
| Longitudinal flow | (Pa) | 0,87 | 0,89 | 0,91 | 0,92 | 0,93 | 0,94 |
| Area | (m ²) | 11,749 | 11,749 | 11,749 | 11,749 | 11,749 | 11,749 |
| Cumulative area | (m ²) | 71,147 | 82,897 | 94,646 | 106,40 | 118,15 | 129,89 |
| Duty | (MegaWatts) | 0,1053 | 0,0949 | 0,0849 | 0,0765 | 0,0686 | 0,0617 |
| Cumulative duty | (MegaWatts) | 0,8562 | 0,9511 | 1,0360 | 1,1125 | 1,1811 | 1,2428 |
| Heat flux | (W/m ²) | 8964,6 | 8076,3 | 7228,0 | 6509,4 | 5836,9 | 5255,4 |
| Calculated heat flux | (W/m ²) | 12267 | 11017 | 9821,4 | 8814,8 | 7871,6 | 7059,8 |
| Critical heat flux | (W/m ²) | | | | | | |
| Overall U | (W/m ² -K) | 413,65 | 409,64 | 405,57 | 402,14 | 398,85 | 395,89 |
| Shellside h | (W/m ² -K) | 976,15 | 954,41 | 933,19 | 915,49 | 899,04 | 884,32 |
| Sensible liquid h | (W/m ² -K) | 976,15 | 954,41 | 933,19 | 915,49 | 899,04 | 884,32 |
| Sensible vapor h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Condensate film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Vapor phase h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Nucleate boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Conv. boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Film boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Boiling thin film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Natural convective h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Local Reynolds | (--) | 6055,2 | 5560,3 | 5111,8 | 4754,6 | 4442,4 | 4174,2 |
| Vapor Reynolds | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Reynolds | (--) | 6055,2 | 5560,3 | 5111,8 | 4754,6 | 4442,4 | 4174,2 |
| Vapor Prandtl | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Prandtl | (--) | 13,624 | 14,733 | 15,922 | 17,018 | 18,119 | 19,193 |
| Flow regime param. | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Condensate regime | (--) | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |
| Boiling regime | (--) | | | | | | |
| Boiling mechanism | (--) | | | | | | |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Shellside Flow Region | 1 | | |
|---|-----------------------|----------|--------|
| Point number | (--) | 13 | 14 |
| Shell pass | (--) | 1 | 1 |
| Length from tube inlet | (mm) | 4527,5 | 4865,1 |
| Mass fraction vapor | (--) | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 57,28 | 56,00 |
| Skin temperature | (C) | 49,40 | |
| MTD | (C) | 15,9 | |
| Superheat for Onset of Nucleate Boiling | (C) | | |
| Delta MTD correction | (--) | 0,9686 | |
| Pressure | (kPa) | 10994 | 10992 |
| Pressure drop | (kPa) | 0,431 | 0,914 |
| Friction loss | (kPa) | 0,431 | |
| Static head loss | (kPa) | 0,000 | |
| Momentum loss | (kPa) | 0,000 | |
| Crossflow velocity | (m/s) | 0,18 | |
| Longitudinal velocity | (m/s) | 0,32 | |
| Shear stress at tube wall | | | |
| Crossflow | (Pa) | 0,00 | |
| Longitudinal flow | (Pa) | 0,96 | |
| Area | (m ²) | 20,927 | |
| Cumulative area | (m ²) | 150,82 | |
| Duty | (MegaWatts) | 0,0890 | |
| Cumulative duty | (MegaWatts) | 1,3318 | |
| Heat flux | (W/m ²) | 4252,7 | |
| Calculated heat flux | (W/m ²) | 5697,5 | |
| Critical heat flux | (W/m ²) | | |
| Overall U | (W/m ² -K) | 365,26 | |
| Shellside h | (W/m ² -K) | 759,29 | |
| Sensible liquid h | (W/m ² -K) | 759,29 | |
| Sensible vapor h | (W/m ² -K) | 0,00 | |
| Condensate film h | (W/m ² -K) | 0,00 | |
| Vapor phase h | (W/m ² -K) | 0,00 | |
| Nucleate boiling h | (W/m ² -K) | 0,00 | |
| Conv. boiling h | (W/m ² -K) | 0,00 | |
| Film boiling h | (W/m ² -K) | 0,00 | |
| Boiling thin film h | (W/m ² -K) | 0,00 | |
| Natural convective h | (W/m ² -K) | 0,00 | |
| Local Reynolds | (--) | 3859,3 | 1735,1 |
| Vapor Reynolds | (--) | 0,0000 | 0,0000 |
| Liquid Reynolds | (--) | 3859,3 | 1735,1 |
| Vapor Prandtl | (--) | 0,0000 | 0,0000 |
| Liquid Prandtl | (--) | 20,701 | 21,605 |
| Flow regime param. | (--) | 0,0000 | |
| Condensate regime | (--) | Sens Liq | |
| Boiling regime | (--) | | |
| Boiling mechanism | (--) | | |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Point number | (--) | 1 | 2 | 3 | 4 | 5 | 6 |
|---|-----------------------|--------|----------|----------|----------|----------|----------|
| Tube Pass | (--) | 1 | 1 | 1 | 1 | 1 | 1 |
| Length from tube inlet | (mm) | 0,000 | 200,00 | 589,50 | 968,50 | 1347,5 | 1726,5 |
| Mass fraction vapor | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 35,00 | 35,46 | 36,33 | 37,09 | 37,76 | 38,36 |
| Skin temperature | (C) | | 45,05 | 45,11 | 44,51 | 44,64 | 44,19 |
| MTD | (C) | | 53,7 | 50,2 | 43,3 | 40,6 | 34,9 |
| Superheat for Onset of Nucleate Boiling | (C) | | | | | | |
| Pressure | (kPa) | 11000 | 10999 | 10999 | 10999 | 10998 | 10998 |
| Pressure drop | (kPa) | 1,208 | 0,116 | 0,081 | 0,081 | 0,081 | 0,081 |
| Enhanced pressure drop mult | (--) | | | | | | |
| Friction loss | (kPa) | | 0,116 | 0,081 | 0,081 | 0,081 | 0,081 |
| Static head loss | (kPa) | | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Momentum loss | (kPa) | | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Maximum velocity | (m/s) | | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Average velocity | (m/s) | | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Shear stress at tube wall | (Pa) | | 0,91 | 0,91 | 0,91 | 0,91 | 0,91 |
| Area | (m ²) | | 6,200 | 5,875 | 5,875 | 5,875 | 5,875 |
| Cumulative area | (m ²) | | 6,200 | 12,075 | 17,950 | 23,824 | 29,699 |
| Duty | (MegaWatts) | | 0,1043 | 0,0913 | 0,0780 | 0,0729 | 0,0622 |
| Cumulative duty | (MegaWatts) | | 0,1043 | 0,1955 | 0,2736 | 0,3465 | 0,4087 |
| Heat flux | (W/m ²) | | 16817 | 15538 | 13285 | 12409 | 10585 |
| Calculated heat flux | (W/m ²) | | 23426 | 21619 | 18447 | 17216 | 14665 |
| Critical heat flux | (W/m ²) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Overall U | (W/m ² -K) | | 439,32 | 432,34 | 424,86 | 422,27 | 415,69 |
| Tubeside h | (W/m ² -K) | | 2751,2 | 2762,5 | 2768,8 | 2778,2 | 2783,5 |
| Enhanced heat transfer mult | (--) | | | | | | |
| Sensible liquid h | (W/m ² -K) | | 2751,2 | 2762,5 | 2768,8 | 2778,2 | 2783,5 |
| Sensible vapor h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Condensate film h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Vapor phase h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Nucleate boiling h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Conv. boiling h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Film boiling h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Boiling thin film h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Natural convective h | (W/m ² -K) | | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Local Reynolds | (--) | 10532 | 10536 | 10667 | 10784 | 10891 | 10989 |
| Vapor Reynolds | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Reynolds | (--) | 10464 | 10536 | 10667 | 10784 | 10891 | 10989 |
| Vapor Prandtl | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Prandtl | (--) | 4,9811 | 4,9434 | 4,8723 | 4,8107 | 4,7557 | 4,7065 |
| Grashof | (--) | | 333901 | 317676 | 275763 | 259568 | 224628 |
| Richardson | (--) | | 0,0030 | 0,0028 | 0,0024 | 0,0022 | 0,0019 |
| Flow regime param. | (--) | | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Condensate regime | (--) | | | | | | |
| Boiling regime | (--) | | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |
| Boiling mechanism | (--) | | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Point number | (--) | 7 | 8 | 9 | 10 | 11 | 12 |
|---|-----------------------|----------|----------|----------|----------|----------|----------|
| Tube Pass | (--) | 1 | 1 | 1 | 1 | 1 | 1 |
| Length from tube inlet | (mm) | 2105,5 | 2484,5 | 2863,5 | 3242,5 | 3621,5 | 4000,5 |
| Mass fraction vapor | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 38,89 | 39,37 | 39,79 | 40,17 | 40,51 | 40,81 |
| Skin temperature | (C) | 44,31 | 43,96 | 44,06 | 43,79 | 43,88 | 43,66 |
| MTD | (C) | 32,7 | 28,1 | 26,4 | 22,6 | 21,2 | 18,2 |
| Superheat for Onset of Nucleate Boiling | (C) | | | | | | |
| Pressure | (kPa) | 10998 | 10998 | 10998 | 10998 | 10998 | 10998 |
| Pressure drop | (kPa) | 0,081 | 0,081 | 0,081 | 0,081 | 0,081 | 0,081 |
| Enhanced pressure drop mult | (--) | | | | | | |
| Friction loss | (kPa) | 0,081 | 0,081 | 0,081 | 0,081 | 0,081 | 0,081 |
| Static head loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Momentum loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Maximum velocity | (m/s) | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Average velocity | (m/s) | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Shear stress at tube wall | (Pa) | 0,91 | 0,91 | 0,91 | 0,91 | 0,91 | 0,91 |
| Area | (m ²) | 5,875 | 5,875 | 5,875 | 5,875 | 5,875 | 5,875 |
| Cumulative area | (m ²) | 35,574 | 41,448 | 47,323 | 53,198 | 59,072 | 64,947 |
| Duty | (MegaWatts) | 0,0581 | 0,0494 | 0,0462 | 0,0392 | 0,0366 | 0,0310 |
| Cumulative duty | (MegaWatts) | 0,4668 | 0,5162 | 0,5624 | 0,6015 | 0,6381 | 0,6691 |
| Heat flux | (W/m ²) | 9888,4 | 8414,1 | 7858,1 | 6667,8 | 6229,8 | 5268,5 |
| Calculated heat flux | (W/m ²) | 13691 | 11640 | 10867 | 9218,4 | 8612,4 | 7285,5 |
| Critical heat flux | (W/m ²) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Overall U | (W/m ² -K) | 413,54 | 407,73 | 405,78 | 400,80 | 399,23 | 394,90 |
| Tubeside h | (W/m ² -K) | 2791,2 | 2795,5 | 2801,6 | 2805,3 | 2810,2 | 2813,2 |
| Enhanced heat transfer mult | (--) | | | | | | |
| Sensible liquid h | (W/m ² -K) | 2791,2 | 2795,5 | 2801,6 | 2805,3 | 2810,2 | 2813,2 |
| Sensible vapor h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Condensate film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Vapor phase h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Nucleate boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Conv. boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Film boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Boiling thin film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Natural convective h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Local Reynolds | (--) | 11078 | 11159 | 11232 | 11299 | 11359 | 11413 |
| Vapor Reynolds | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Reynolds | (--) | 11078 | 11159 | 11232 | 11299 | 11359 | 11413 |
| Vapor Prandtl | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Prandtl | (--) | 4,6626 | 4,6234 | 4,5884 | 4,5572 | 4,5295 | 4,5048 |
| Grashof | (--) | 210879 | 182027 | 167758 | 146843 | 135109 | 117985 |
| Richardson | (--) | 0,0017 | 0,0015 | 0,0013 | 0,0012 | 0,0010 | 9,06e-4 |
| Flow regime param. | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Condensate regime | (--) | | | | | | |
| Boiling regime | (--) | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |
| Boiling mechanism | (--) | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| | | | | | | | |
|---|-----------------------|----------|----------|----------|----------|----------|----------|
| Point number | -- | 13 | 14 | 15 | 16 | 17 | 18 |
| Tube Pass | -- | 1 | 2 | 2 | 2 | 2 | 2 |
| Length from tube inlet | (mm) | 4527,5 | 4527,5 | 4000,5 | 3621,5 | 3242,5 | 2863,5 |
| Mass fraction vapor | -- | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 41,15 | 41,55 | 41,87 | 42,15 | 42,46 | 42,80 |
| Skin temperature | (C) | 43,58 | 43,72 | 44,69 | 45,07 | 45,85 | 46,31 |
| MTD | (C) | 16,7 | 15,0 | 18,0 | 18,6 | 21,4 | 22,2 |
| Superheat for Onset of Nucleate Boiling | (C) | | | | | | |
| Pressure | (kPa) | 10998 | 10997 | 10997 | 10997 | 10997 | 10997 |
| Pressure drop | (kPa) | 0,165 | 0,406 | 0,080 | 0,080 | 0,080 | 0,080 |
| Enhanced pressure drop mult | -- | | | | | | |
| Friction loss | (kPa) | 0,165 | 0,406 | 0,080 | 0,080 | 0,080 | 0,080 |
| Static head loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Momentum loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Maximum velocity | (m/s) | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Average velocity | (m/s) | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Shear stress at tube wall | (Pa) | 0,91 | 0,91 | 0,90 | 0,90 | 0,90 | 0,90 |
| Area | (m ²) | 10,464 | 10,464 | 5,875 | 5,875 | 5,875 | 5,875 |
| Cumulative area | (m ²) | 75,411 | 85,874 | 91,749 | 97,624 | 103,50 | 109,37 |
| Duty | (MegaWatts) | 0,0470 | 0,0420 | 0,0308 | 0,0320 | 0,0373 | 0,0388 |
| Cumulative duty | (MegaWatts) | 0,7161 | 0,7581 | 0,7889 | 0,8209 | 0,8582 | 0,8969 |
| Heat flux | (W/m ²) | 4492,9 | 4012,6 | 5242,3 | 5444,0 | 6350,9 | 6597,9 |
| Calculated heat flux | (W/m ²) | 6211,6 | 5552,5 | 7250,6 | 7529,0 | 8783,2 | 9125,3 |
| Critical heat flux | (W/m ²) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Overall U | (W/m ² -K) | 366,28 | 364,24 | 396,88 | 398,47 | 403,48 | 405,35 |
| Tubeside h | (W/m ² -K) | 2820,3 | 2826,6 | 2835,4 | 2841,6 | 2852,3 | 2860,4 |
| Enhanced heat transfer mult | -- | | | | | | |
| Sensible liquid h | (W/m ² -K) | 2820,3 | 2826,6 | 2835,4 | 2841,6 | 2852,3 | 2860,4 |
| Sensible vapor h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Condensate film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Vapor phase h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Nucleate boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Conv. boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Film boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Boiling thin film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Natural convective h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Local Reynolds | -- | 11477 | 11533 | 11595 | 11648 | 11708 | 11774 |
| Vapor Reynolds | -- | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Reynolds | -- | 11477 | 11533 | 11595 | 11648 | 11708 | 11774 |
| Vapor Prandtl | -- | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Prandtl | -- | 4,4759 | 4,4508 | 4,4238 | 4,4006 | 4,3751 | 4,3470 |
| Grashof | -- | 99607 | 91815 | 121909 | 119776 | 149456 | 151115 |
| Richardson | -- | 7,56e-4 | 6,90e-4 | 9,07e-4 | 8,83e-4 | 0,0011 | 0,0011 |
| Flow regime param. | -- | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Condensate regime | -- | | | | | | |
| Boiling regime | -- | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |
| Boiling mechanism | -- | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| | | | | | | | |
|---|-----------------------|----------|----------|----------|----------|----------|----------|
| Point number | (--) | 19 | 20 | 21 | 22 | 23 | 24 |
| Tube Pass | (--) | 2 | 2 | 2 | 2 | 2 | 2 |
| Length from tube inlet | (mm) | 2484,5 | 2105,5 | 1726,5 | 1347,5 | 968,50 | 589,50 |
| Mass fraction vapor | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 43,17 | 43,58 | 44,04 | 44,54 | 45,10 | 45,72 |
| Skin temperature | (C) | 47,28 | 47,84 | 49,05 | 49,73 | 51,23 | 52,06 |
| MTD | (C) | 25,7 | 26,6 | 30,9 | 32,0 | 37,3 | 38,6 |
| Superheat for Onset of Nucleate Boiling | (C) | | | | | | |
| Pressure | (kPa) | 10997 | 10997 | 10997 | 10997 | 10997 | 10997 |
| Pressure drop | (kPa) | 0,080 | 0,080 | 0,079 | 0,079 | 0,079 | 0,078 |
| Enhanced pressure drop mult | (--) | | | | | | |
| Friction loss | (kPa) | 0,080 | 0,080 | 0,079 | 0,079 | 0,079 | 0,078 |
| Static head loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Momentum loss | (kPa) | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Maximum velocity | (m/s) | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Average velocity | (m/s) | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 | 0,46 |
| Shear stress at tube wall | (Pa) | 0,90 | 0,90 | 0,89 | 0,89 | 0,89 | 0,88 |
| Area | (m ²) | 5,875 | 5,875 | 5,875 | 5,875 | 5,875 | 5,875 |
| Cumulative area | (m ²) | 115,25 | 121,12 | 127,00 | 132,87 | 138,75 | 144,62 |
| Duty | (MegaWatts) | 0,0455 | 0,0472 | 0,0556 | 0,0578 | 0,0682 | 0,0709 |
| Cumulative duty | (MegaWatts) | 0,9424 | 0,9896 | 1,0452 | 1,1030 | 1,1711 | 1,2420 |
| Heat flux | (W/m ²) | 7738,4 | 8040,8 | 9460,5 | 9831,1 | 11606 | 12062 |
| Calculated heat flux | (W/m ²) | 10709 | 11130 | 13112 | 13630 | 16122 | 16764 |
| Critical heat flux | (W/m ²) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Overall U | (W/m ² -K) | 411,54 | 413,77 | 420,73 | 423,25 | 431,63 | 434,59 |
| Tubeside h | (W/m ² -K) | 2873,8 | 2884,0 | 2901,4 | 2914,4 | 2937,4 | 2955,3 |
| Enhanced heat transfer mult | (--) | | | | | | |
| Sensible liquid h | (W/m ² -K) | 2873,8 | 2884,0 | 2901,4 | 2914,4 | 2937,4 | 2955,3 |
| Sensible vapor h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Condensate film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Vapor phase h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Nucleate boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Conv. boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Film boiling h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Boiling thin film h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Natural convective h | (W/m ² -K) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Local Reynolds | (--) | 11848 | 11932 | 12027 | 12133 | 12255 | 12393 |
| Vapor Reynolds | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Reynolds | (--) | 11848 | 11932 | 12027 | 12133 | 12255 | 12393 |
| Vapor Prandtl | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Prandtl | (--) | 4,3158 | 4,2814 | 4,2432 | 4,2009 | 4,1538 | 4,1016 |
| Grashof | (--) | 185431 | 187966 | 232482 | 236357 | 294878 | 308660 |
| Richardson | (--) | 0,0013 | 0,0013 | 0,0016 | 0,0016 | 0,0020 | 0,0020 |
| Flow regime param. | (--) | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Condensate regime | (--) | | | | | | |
| Boiling regime | (--) | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |
| Boiling mechanism | (--) | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq | Sens Liq |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| | | | |
|---|-----------------------|----------|--------|
| Point number | (--) | 25 | 26 |
| Tube Pass | (--) | 2 | 2 |
| Length from tube inlet | (mm) | 200,00 | 0,000 |
| Mass fraction vapor | (--) | 0,0000 | 0,0000 |
| Bulk temperature | (C) | 46,43 | 46,83 |
| Skin temperature | (C) | 54,04 | |
| MTD | (C) | 45,3 | |
| Superheat for Onset of Nucleate Boiling | (C) | | |
| Pressure | (kPa) | 10996 | 10996 |
| Pressure drop | (kPa) | 0,112 | 0,844 |
| Enhanced pressure drop mult | (--) | | |
| Friction loss | (kPa) | 0,112 | |
| Static head loss | (kPa) | 0,000 | |
| Momentum loss | (kPa) | 0,000 | |
| Maximum velocity | (m/s) | 0,46 | |
| Average velocity | (m/s) | 0,46 | |
| Shear stress at tube wall | (Pa) | 0,88 | |
| Area | (m ²) | 6,200 | |
| Cumulative area | (m ²) | 150,82 | |
| Duty | (MegaWatts) | 0,0898 | |
| Cumulative duty | (MegaWatts) | 1,3318 | |
| Heat flux | (W/m ²) | 14484 | |
| Calculated heat flux | (W/m ²) | 20186 | |
| Critical heat flux | (W/m ²) | 0,00 | |
| Overall U | (W/m ² -K) | 448,94 | |
| Tubeside h | (W/m ² -K) | 2988,9 | |
| Enhanced heat transfer mult | (--) | | |
| Sensible liquid h | (W/m ² -K) | 2988,9 | |
| Sensible vapor h | (W/m ² -K) | 0,00 | |
| Condensate film h | (W/m ² -K) | 0,00 | |
| Vapor phase h | (W/m ² -K) | 0,00 | |
| Nucleate boiling h | (W/m ² -K) | 0,00 | |
| Conv. boiling h | (W/m ² -K) | 0,00 | |
| Film boiling h | (W/m ² -K) | 0,00 | |
| Boiling thin film h | (W/m ² -K) | 0,00 | |
| Natural convective h | (W/m ² -K) | 0,00 | |
| Local Reynolds | (--) | 12559 | 12554 |
| Vapor Reynolds | (--) | 0,0000 | 0,0000 |
| Liquid Reynolds | (--) | 12559 | 12649 |
| Vapor Prandtl | (--) | 0,0000 | 0,0000 |
| Liquid Prandtl | (--) | 4,0409 | 4,0145 |
| Grashof | (--) | 383645 | |
| Richardson | (--) | 0,0024 | |
| Flow regime param. | (--) | 0,0000 | |
| Condensate regime | (--) | | |
| Boiling regime | (--) | Sens Liq | |
| Boiling mechanism | (--) | Sens Liq | |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| | | | | |
|--|-----------|--------------------------|-------------------|---------------|
| Shellside condition | | Sens. Liquid | (Level 2,3000) | |
| Axial stress loading | (MPa) | 0,000 | Added mass factor | 1,761 |
| Beta | | 3,250 | | |
| Position In The Bundle | | Inlet | Center | Outlet |
| Length for natural frequency | (m) | 0,779 | 0,758 | 1,054 |
| Length/TEMA maximum span | (--) | 0,511 | 0,497 | 0,692 |
| Number of spans | (--) | 6 | 6 | 6 |
| Tube natural frequency | (Hz) | 60,8 | 60,6 | 50,6 + |
| Shell acoustic frequency | (Hz) | 0,0 | 0,0 | 0,0 |
| Flow Velocities | | Inlet | Center | Outlet |
| Window parallel velocity | (m/s) | 0,54 | 0,53 | 0,53 |
| Bundle crossflow velocity | (m/s) | 0,10 | 0,11 | 5,83e-2 |
| Bundle/shell velocity | (m/s) | 0,17 | 0,17 | 9,23e-2 |
| Fluidelastic Instability Check | | Inlet | Center | Outlet |
| Log decrement | HTRI | 0,079 | 0,086 | 0,097 |
| Critical velocity | (m/s) | 3,05 | 3,35 | 1,83 |
| Baffle tip cross velocity ratio | (--) | 0,0840 | 0,0808 | 0,0808 |
| Average crossflow velocity ratio | (--) | 0,0772 | 0,0743 | 0,0742 |
| Acoustic Vibration Check | | Inlet | Center | Outlet |
| Vortex shedding ratio | (--) | 0,000 | 0,000 | 0,000 |
| Chen number | (--) | 0 | 0 | 0 |
| Turbulent buffeting ratio | (--) | 0,000 | 0,000 | 0,000 |
| Tube Vibration Check | | Inlet | Center | Outlet |
| Vortex shedding ratio | (--) | 0,084 | 0,089 | 0,048 |
| Parallel flow amplitude | (mm) | 0,001 | 0,001 | 0,001 |
| Crossflow amplitude | (mm) | 0,001 | 0,001 | 0,001 |
| Tube gap | (mm) | 4,762 | 4,762 | 4,762 |
| Crossflow RHO-V-SQ | (kg/m-s2) | 46,23 | 52,44 | 15,80 |
| Bundle Entrance/Exit (analysis at first tube row) | | | Entrance | Exit |
| Fluidelastic instability ratio | (--) | | 0,076 | 0,114 |
| Vortex shedding ratio | (--) | | 0,732 | 0,422 |
| Crossflow amplitude | (mm) | | 0,00959 | 0,01501 |
| Crossflow velocity | (m/s) | | 0,88 | 0,51 |
| Tubesheet to inlet/outlet support | (mm) | | None | None |
| Shell Entrance/Exit Parameters | | | Entrance | Exit |
| Impingement device | | | None | -- |
| Flow area | (m2) | | 0,014 | 0,014 |
| Velocity | (m/s) | | 1,52 | 1,48 |
| RHO-V-SQ | (kg/m-s2) | | 1921,6 | 1870,0 |
| Shell type | BEU | Baffle type | Single-Seg. | |
| Tube type | Plain | Baffle layout | Perpend. | |
| Pitch ratio | 1,2500 | Tube diameter; (mm) | 19,050 | |
| Layout angle | 60 | Tube material | Carbon steel | |
| Number U-Bend supports | 0 | Supports/baffle space | 0 | |
| | | Use deresonating baffles | No | |

Program Messages

+ Frequency ratios are based upon lowest natural or acoustic frequency

* Items with asterisk exceed a conservative lower limit for vibration-free design. Review your case using the procedure described in Online Help; You may find that a vibration problem is unlikely.

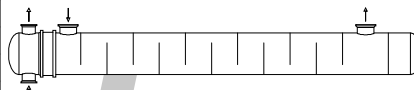
| | | | | | | | |
|-----------------------|--------|---|--------|-------------|------------|---|------------------------|
| Service of Unit | | | | Item No. | | | |
| Type | BEU | | | Orientation | Horizontal | | Connected In |
| Surf/Unit (Gross/Eff) | 155,00 | / | 150,53 | m2 | Shell/Unit | 1 | Surf/Shell (Gross/Eff) |
| | | | | | | | 155,00 / 150,53 m2 |

PERFORMANCE OF ONE UNIT

| | | | | | |
|---------------------------|--|------------------|--|-----------|--|
| Fluid Allocation | | Shell Side | | Tube Side | |
| Fluid Name | | oil | | water | |
| Fluid Quantity, Total | | kg/s | | 17,360 | |
| Vapor (In/Out) | | wt% | | 26,936 | |
| Liquid | | wt% | | 0,00 | |
| Temperature (In/Out) | | C | | 0,00 | |
| Density | | kg/m3 | | 100,00 | |
| Viscosity | | mN-s/m2 | | 100,00 | |
| Specific Heat | | kJ/kg-C | | 35,00 | |
| Thermal Conductivity | | W/m-C | | 46,83 | |
| Critical Pressure | | kPa | | 833,55 | |
| Inlet Pressure | | kPa | | 856,57 | |
| Velocity | | m/s | | 993,63 | |
| Pressure Drop, Allow/Calc | | kPa | | 988,96 | |
| Average Film Coefficient | | W/m2-K | | 0,7419 | |
| Fouling Resistance (min) | | m2-K/W | | 0,6148 | |
| Heat Exchanged | | 1,3318 MegaWatts | | 4,1765 | |
| Transfer Rate, Service | | 301,91 W/m2-K | | 4,1778 | |

CONSTRUCTION OF ONE SHELL

Sketch (Bundle/Nozzle Orientation)

| | | Shell Side | | Tube Side | |  |
|---------------------|-------------|------------|----------|-----------|----------|---|
| Design Pressure | | kPaG | | 11997 | | |
| Design Temperature | | C | | 121,11 | | |
| No Passes per Shell | | 1 | | 2 | | |
| Flow Direction | | | | Upward | | |
| Connections | In mm | 1 | @ 205,00 | 1 | @ 154,05 | |
| Size & | Out mm | 1 | @ 205,00 | 1 | @ 154,05 | |
| Rating | Liq. Out mm | | @ | 1 | @ | |

| | | | | | | | | | | | | | | | |
|---------------------|----------|-------------|--------|-------------------|----------|-------------------|----|--------------------|-------|-----------------------|-------|------------|----|-------------------|----|
| Tube No. | 518,00 | OD | 19,050 | mm | Thk(Avg) | 1,000 | mm | Length | 5,000 | m | Pitch | 23,813 | mm | Tube pattern | 60 |
| Tube Type | Plain | Material | | Carbon steel | | Pairs seal strips | | 0 | | Passlane Seal Rod No. | | 0 | | Impingement Plate | |
| Shell ID | 601,60 | mm | | Kettle ID | | mm | | No. of Crosspasses | | 12 | | Shell Exit | | 1870,0 | |
| Cross Baffle Type | Perpend. | Single-Seg. | | %Cut (Diam) | | 23,48 | | Bundle Entrance | | 646,75 | | kg/m-s2 | | Bundle Exit | |
| Spacing(c/c) | 379,00 | mm | | Inlet | | 400,00 | | mm | | kg/m-s2 | | 220,98 | | kg/m-s2 | |
| Rho-V2-Inlet Nozzle | 331,84 | kg/m-s2 | | Shell Entrance | | 1921,6 | | kg/m-s2 | | Shell Exit | | 1870,0 | | kg/m-s2 | |
| Weight/Shell | 8237,2 | kg | | Filled with Water | | 9794,5 | | kg | | Bundle | | 1936,5 | | kg | |

| | | | | | | | |
|--------|--|-----------------------|--|-----------------|--|----------------|--|
| Notes: | | Thermal Resistance, % | | Velocities; m/s | | Flow Fractions | |
| | | Shell | | 43,37 | | Shellside | |
| | | Tube | | 16,09 | | Tubeside | |
| | | Fouling | | 37,66 | | Crossflow | |
| | | Metal | | 2,88 | | Window | |

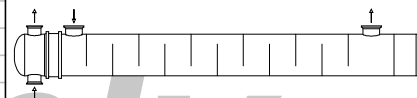
| | | | |
|-----------------------|-----------------------------|------------------------|-----------------------------|
| Customer | Job No. | | |
| Address | Reference No. | | |
| Plant Location | Proposal No. | | |
| Service of Unit | Date | 29. 3. 2018 | Rev |
| Size | 601,6 x 5000 mm | Type | BEU Horizontal |
| Surf/Unit (Gross/Eff) | 155 / 150,53 m ² | Shell/Unit | 1 |
| | | Connected In | 1 Parallel 1 Series |
| | | Surf/Shell (Gross/Eff) | 155 / 150,53 m ² |

PERFORMANCE OF ONE UNIT

| Fluid Allocation | | Shell Side | | Tube Side | |
|---|--|------------------------|----------------------------|-----------|----------------------------|
| Fluid Name | | oil | | water | |
| Fluid Quantity, Total kg/hr | | 62495 | | 96970 | |
| Vapor (In/Out) | | | | | |
| Liquid | | 62495 | 62495 | 96970 | 96970 |
| Steam | | | | | |
| Water | | | | | |
| Noncondensables | | | | | |
| Temperature (In/Out) C | | 93,00 | 56,00 | 35,00 | 46,83 |
| Specific Gravity | | 0,8339 | 0,8570 | 0,9941 | 0,9894 |
| Viscosity mN-s/m ² | | 0,4563 | 1,4086 | 0,7419 | 0,6148 |
| Molecular Weight, Vapor | | | | | |
| Molecular Weight, Noncondensables | | | | | |
| Specific Heat kJ/kg-C | | 2,1418 | 2,0010 | 4,1765 | 4,1778 |
| Thermal Conductivity W/m-C | | 0,1273 | 0,1306 | 0,6227 | 0,6405 |
| Latent Heat kJ/kg | | | | | |
| Inlet Pressure kPa | | 11000 | | 11000 | |
| Velocity m/s | | 0,25 | | 0,46 | |
| Pressure Drop, Allow/Calc kPa | | 30,000 | 7,621 | 30,000 | 4,454 |
| Fouling Resistance (min) m ² -K/W | | 0,000528 | | 0,000352 | |
| Heat Exchanged 1331799 W | | MTD (Corrected) 29,3 C | | | |
| Transfer Rate, Service 301,91 W/m ² -K | | Clean | 655,81 W/m ² -K | Actual | 408,81 W/m ² -K |

CONSTRUCTION OF ONE SHELL

| | | Shell Side | | Tube Side | |
|---------------------------|--------------|------------|--|------------|--|
| Design/Test Pressure kPaG | | 11997 / | | 11997 / | |
| Design Temperature C | | 121,11 | | 65,56 | |
| No Passes per Shell | | 1 | | 2 | |
| Corrosion Allowance mm | | 3,175 | | 3,175 | |
| Connections | In mm | 1 @ 205,00 | | 1 @ 154,05 | |
| | Out mm | 1 @ 205,00 | | 1 @ 154,05 | |
| | Intermediate | @ | | @ | |



| | | | | | | | | | |
|-------------------------|--------------|---------------|---------------------|----------------------|-----------|----------------------|-------------|--------------|---------------------|
| Tube No. | 259U | OD | 19,050 mm | Thk(Avg) | 1,000 mm | Length | 5,000 m | Pitch | 23,813 mm |
| Tube Type | Plain | Material | | Carbon steel | | Tube pattern | | 60 | |
| Shell | Carbon steel | ID | 601,60 | OD | 690,50 mm | Shell Cover | | (Integ.) | |
| Channel or Bonnet | | Channel Cover | | Tubesheet-Floating | | Impingement Plate | | None | |
| Floating Head Cover | | Type | | Single-Seg. | | %Cut (Diam) | 23,48 | Spacing(c/c) | 379,00 |
| Baffles-Cross | | Type | | Single-Seg. | | %Cut (Diam) | 23,48 | Spacing(c/c) | 379,00 |
| Baffles-Long | | Seal Type | | None | | Inlet | | 400,00 mm | |
| Supports-Tube | | U-Bend | | | | Type | | Full support | |
| Bypass Seal Arrangement | | 0 | pairs seal strips | Tube-Tubesheet Joint | | Expanded (No groove) | | | |
| Expansion Joint | | Type | | | | | | | |
| Rho-V2-Inlet Nozzle | | 331,84 | kg/m-s ² | Bundle Entrance | | 646,75 | Bundle Exit | 220,98 | kg/m-s ² |
| Gaskets-Shell Side | | Tube Side | | | | | | | |
| -Floating Head | | | | | | | | | |
| Code Requirements | | | | TEMA Class | | R | | | |
| Weight/Shell | | 8237,2 | kg | Filled with Water | | 9794,5 | kg | Bundle | 1936,5 kg |

Remarks:

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Physical Properties Profile: Hot Shellside (oil)

| | | | | | | | |
|-------------------------------|-------------|----------|----------|----------|----------|----------|----------|
| Reference pressure; (kPa) | (P1= 11000) | | | | | | |
| | (P) | 1 | 2 | 3 | 4 | 5 | 6 |
| Temperature; (C) | 1 | 100,00 | 90,00 | 80,00 | 70,00 | 60,00 | 50,00 |
| Heat duty/flow rate; (kJ/kg) | 1 | 0,0000 | 21,493 | 42,608 | 63,345 | 83,704 | 103,67 |
| Weight fraction vapor | 1 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Properties | | | | | | | |
| Density; (kg/m3) | 1 | 829,19 | 835,41 | 841,64 | 847,86 | 854,08 | 860,30 |
| Viscosity; (mN-s/m2) | 1 | 0,3754 | 0,4961 | 0,6551 | 0,8783 | 1,2145 | 1,7596 |
| Thermal conductivity; (W/m-C) | 1 | 0,1265 | 0,1276 | 0,1285 | 0,1294 | 0,1303 | 0,1311 |
| Enthalpy; (kJ/kg) | 1 | 0,0000 | -21,49 | -42,61 | -63,35 | -83,70 | -103,7 |
| Specific heat; (kJ/kg-C) | 1 | 2,1682 | 2,1304 | 2,0926 | 2,0548 | 2,0170 | 1,9762 |
| Surface tension; (mN/m) | 1 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Critical pressure; (kPa) | 1 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Latent heat; (kJ/kg) | 1 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |

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use only*

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Physical Properties Profile: Cold Tubeside (water)

| Reference pressure; (kPa) | (P1= 11000) | | | | | | | |
|-------------------------------|-------------|--------|--------|--------|--------|--------|--------|--------|
| | (P) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Temperature; (C) | 1 | 95,00 | 90,00 | 80,00 | 70,00 | 60,00 | 55,00 | 30,00 |
| Heat duty/flow rate; (kJ/kg) | 1 | 272,09 | 251,07 | 209,08 | 167,18 | 125,34 | 104,44 | 0,0000 |
| Weight fraction vapor | 1 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Liquid Properties | | | | | | | | |
| Density; (kg/m3) | 1 | 961,90 | 965,63 | 972,11 | 978,08 | 983,51 | 985,70 | 995,60 |
| Viscosity; (mN-s/m2) | 1 | 0,2922 | 0,3146 | 0,3545 | 0,4041 | 0,4666 | 0,5099 | 0,7924 |
| Thermal conductivity; (W/m-C) | 1 | 0,6800 | 0,6756 | 0,6704 | 0,6635 | 0,6547 | 0,6520 | 0,6150 |
| Enthalpy; (kJ/kg) | 1 | 0,0000 | -21,02 | -63,01 | -104,9 | -146,8 | -167,7 | -272,1 |
| Specific heat; (kJ/kg-C) | 1 | 4,2060 | 4,2035 | 4,1940 | 4,1866 | 4,1813 | 4,1790 | 4,1760 |
| Surface tension; (mN/m) | 1 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Critical pressure; (kPa) | 1 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 | 0,000 |
| Latent heat; (kJ/kg) | 1 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 | 0,0000 |

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Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

[illegible]

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

| Cold Tubeside Fluid | Inlet | Outlet |
|--------------------------|----------------|----------------|
| Fluid name | water | |
| Temperature (C) | 35,00 | 46,83 |
| Pressure (kPa) | 11000 | 10996 |
| Weight fraction vapor | 0,0000 | 0,0000 |
| Vapor Properties | | |
| Density (kg/m3) | -- | -- |
| Viscosity (mN-s/m2) | -- | -- |
| Conductivity (W/m-C) | -- | -- |
| Heat capacity (kJ/kg-C) | -- | -- |
| Molecular weight | -- | -- |
| Liquid Properties | | |
| Density (kg/m3) | 993,63 | 988,96 |
| Viscosity (mN-s/m2) | 0,7419 | 0,6148 |
| Conductivity (W/m-C) | 0,6227 | 0,6405 |
| Heat capacity (kJ/kg-C) | 4,1765 | 4,1778 |
| Molecular weight | -- | -- |
| Latent heat (kJ/kg) | -- | -- |
| Surface tension (mN/m) | 0,0000 | 0,0000 |
| Molar Composition | Vapor | Liquid |
| | K-Value | Vapor |
| | | Liquid |
| | | K-Value |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Exchanger Data

| | |
|------------------------------|------------------------|
| Service type | Generic shell and tube |
| TEMA type | BEU |
| Run mode | Rating |
| Hot fluid location | Shellside |
| Unit orientation | Horizontal |
| Number of shells in series | 1 |
| Number of shells in parallel | 1 |
| Flow in 1st tubepass | Cocurrent |
| Train flow direction | Countercurrent |

Construction Data

| | |
|----------------------------------|--------------|
| Shell material | Carbon steel |
| Tube material | Carbon steel |
| Shellside design pressure | 11997 kPaG |
| Tubeside design pressure | 11997 kPaG |
| Shellside vacuum pressure | None |
| Tubeside vacuum pressure | None |
| Shellside design temperature | 121,11 C |
| Tubeside design temperature | 65,56 C |
| Shellside corrosion allowance | 3,175 mm |
| Tubeside corrosion allowance | 3,175 mm |
| Shellside radiography | None |
| Tubeside radiography | Spot |
| TEMA class | R |
| Shell outside diameter | 690,50 mm |
| Shell inside diameter | 601,60 mm |
| Shell wall thickness | 44,450 mm |
| Front head outside diameter | 677,80 mm |
| Front head inside diameter | 601,60 mm |
| Front head thickness | 38,100 mm |
| Rear head outside diameter | 690,50 mm |
| Rear head inside diameter | 601,60 mm |
| Rear head thickness | 44,450 mm |
| Suppress mechanical calculations | No |

Reboiler Data

| | |
|---------------|---------------------|
| Reboiler type | No piping specified |
|---------------|---------------------|



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SI Units

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Tube Data

| | |
|------------------------------------|--------------|
| Tube type | Plain |
| Tube outside diameter | 19,050 mm |
| Tube wall thickness | 1,000 mm |
| Tube pitch | 23,813 mm |
| Tube pitch ratio | 1,250 |
| Tubepasses per shell | 2 |
| Tube pattern | 60 degrees |
| Number of tubes per shell | 518,00 |
| Tube count method | Rigorous |
| Tube length | 5,000 m |
| Tube material | Carbon steel |
| Tube material thermal conductivity | 15,000 W/m-C |

Baffle Data

| | |
|--------------------------|------------------|
| Baffle type | Single segmental |
| Baffle orientation | Program sets |
| Adjust baffle cut | Program set |
| Number of crosspasses | 12 |
| Central baffle spacing | 379,00 mm |
| Inlet baffle spacing | 400,00 mm |
| Variable baffle spacing | No |
| Window cut from baffles | No |
| Use deresonating baffles | No |

Supports Data

| | |
|----------------------------------|------|
| Floating head support type | None |
| Full support at U-Bend | None |
| Include inlet vibration support | No |
| Include outlet vibration support | No |

Nozzle Data

Shellside

| | |
|---------------------|----------------------------------|
| Nozzle standard | 01-ANSI_B36_10.TABLE |
| Shell entrance type | Add impingement if TEMA requires |
| Shell exit type | Remove tubes if TEMA requires |

| Inlet | Outlet | Liq. Outlet |
|-------|--------|-------------|
| 1 | 1 | -- |

Number at this position

Tubeside

| | |
|-------------------------|--------------------------|
| Nozzle standard | 01-ANSI_B36_10.TABLE |
| Number at this position | Inlet Outlet Liq. Outlet |
| | 1 1 -- |



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SI Units

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Nozzle Location Data

| | |
|--|-----------------|
| Radial position on shell inlet nozzle | Program decides |
| Longitudinal position on shell of inlet nozzle | At front head |
| Radial position on shell outlet nozzle | Same side |
| Location of nozzle at U-bend | Before U-bend |
| Tubeside entry type | Radial |
| Tubeside inlet position | Front head |
| Tubeside exit type | Same as inlet |

Impingement Data

| | |
|----------------------------------|-------------|
| Impingement type | Rods |
| Use tube positions to place rods | No |
| Impingement rod rows | 2 |
| Impingement rod diameter | 20,637 mm |
| Impingement rod pitch | 23,813 mm |
| Impingement rods on centerline | Program set |
| Impingement rod layout angle | 60,00 deg |
| Rod row width to nozzle diameter | 1,0000 |

Tube Layout Data

| | |
|--|-------------|
| Force symmetric layout | No |
| Force continuous cleaning lanes | No |
| Force uniform layout | No |
| Fill knock out area with dummy tubes | Program set |
| Fill bundle periphery with dummy tubes | Program set |
| Fill passlanes with dummy tubes | Program set |
| Shifted staggard layout | Program set |
| Use crossed U-bends | Program set |
| Use tube layout drawing as input | No |

Clearance Data

| | |
|------------------------------|------------|
| Number of seal strip pairs | Calculated |
| Block A stream | No |
| Block E stream | No |
| Block F stream | No |
| Number of passlane seal rods | Calculated |
| Tubes to remove for tie rods | Calculated |
| Locate tie rods | No |
| Number of tie rods | 6 |
| Tie rod outside diameter | 9,525 mm |
| Baffle to shell clearance | 4,762 mm |
| Baffle clearance type | TEMA |

Optional Geometry Data

| | |
|-----------------------|----|
| Small exchanger | No |
| Double tubesheet | No |
| Shell expansion joint | No |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Process Conditions Data

| | Hot Fluid | Cold Fluid |
|-------------------------|-----------------|-----------------|
| Phase condition | Sensible liquid | Sensible liquid |
| Flow rate | 17,360 | 26,936 kg/s |
| Inlet vapor fraction | 0,0000 | 0,0000 |
| Outlet vapor fraction | 0,0000 | 0,0000 |
| Inlet temperature | 93,00 | 35,00 C |
| Outlet temperature | 56,00 | -- C |
| Inlet pressure | 11000 | 11000 kPa |
| Allowable pressure drop | 30,000 | 30,000 kPa |
| Duty multiplier | | 1,0000 |

Process Fouling Data

| | Hot Fluid | Cold Fluid |
|--------------------|-----------|----------------|
| Fouling resistance | 5,28e-4 | 3,52e-4 m2-K/W |

Hot Fluid Property Data

| | |
|----------------------------------|---------------------|
| Fluid name | oil |
| Physical property method | User specified grid |
| Temperature interpolation option | Program |
| Flash type | Integral |
| Quantity units | Moles |
| Pure component condensation | No |
| Heat release type | Specific enthalpy |

Hot Fluid Physical Property Data

| Pressure Set - 1 | | | | |
|------------------|----------------------------|---|-------------------------------------|---------------------------------------|
| Temp. C | Liquid Density kg/m3 | Liquid Dynamic Viscosity mN-s/m2 | Liquid Thermal Cond. W/m-C | Liquid Heat Capacity kJ/kg-C |
| 50,00 | 860,30 | 1,7596 | 0,1311 | 1,9762 |
| 60,00 | 854,08 | 1,2145 | 0,1303 | 2,0170 |
| 70,00 | 847,86 | 0,8783 | 0,1294 | 2,0548 |
| 80,00 | 841,64 | 0,6551 | 0,1285 | 2,0926 |
| 90,00 | 835,41 | 0,4961 | 0,1276 | 2,1304 |
| 100,00 | 829,19 | 0,3754 | 0,1265 | 2,1682 |

Cold Fluid Property Data

| | |
|----------------------------------|---------------------|
| Fluid name | water |
| Physical property method | User specified grid |
| Temperature interpolation option | Program |
| Flash type | Integral |
| Quantity units | Moles |
| Pure component boiling | No |
| Heat release type | Specific enthalpy |

Rating - Horizontal Multipass Flow TEMA BEU Shell With Single-Segmental Baffles

Cold Fluid Physical Property Data

| Pressure Set - 1 | | | | |
|------------------|----------------------------|---|-------------------------------------|---------------------------------------|
| Temp. C | Liquid Density kg/m3 | Liquid Dynamic Viscosity mN-s/m2 | Liquid Thermal Cond. W/m-C | Liquid Heat Capacity kJ/kg-C |
| 30,00 | 995,60 | 0,7924 | 0,6150 | 4,1760 |
| 55,00 | 985,70 | 0,5099 | 0,6520 | 4,1790 |
| 60,00 | 983,51 | 0,4666 | 0,6547 | 4,1813 |
| 70,00 | 978,08 | 0,4041 | 0,6635 | 4,1866 |
| 80,00 | 972,11 | 0,3545 | 0,6704 | 4,1940 |
| 90,00 | 965,63 | 0,3146 | 0,6756 | 4,2035 |
| 95,00 | 961,90 | 0,2922 | 0,6800 | 4,2060 |

Control Methods Data

| | |
|----------------------------------|---|
| Shellside friction factor method | Commercial |
| Tubeside friction factor method | Commercial |
| Pure longitudinal flow | No |
| Pure component condensation | No |
| Condensing correlation | HTRI Proration |
| Mole fraction inerts | 0,0000 |
| Momentum exclusion | 0,0000 % |
| Pure component boiling | No |
| Check film boiling | Yes |
| Nucleate boiling method | Physical property/theoretical boiling range |
| Component boiling method | Nucleate and convective |
| Increments per baffle | Calculated |

Control User-Defined Methods Data

| | |
|--------------------------|-----|
| Add non-nucleate boiling | Yes |
|--------------------------|-----|