HEAT EXCHANGER WORLD
CONFERENCE & EXPO
AMERICAS

2022

Brask, Inc.

Design, Manufacture & Repair of Shell and Tube Heat Exchangers and Pressure Vessels

The Heat Exchanger People®

Sponsored by:

Dinesh Bakshi - Brask

Bundle Conversion: Straight Tube to U Tube

Overview of Benefits:

- Eliminate Gasketed Joint
- Change location of tube to tubesheet joint
- Decrease number of tube to tubesheet joints by half; increase reliability
- Ease of Maintenance for field to remove and install bundle

Bundle Conversion: Straight Tube to U Tube

Additional Considerations:

- Thermal Performance Evaluation for new design is a recommended best practice
  - Check for Heat Transfer Correlation Factor differences based on change in pass plate configuration (ribbon flow versus T pass or H pass)
  - Tube Side Fluid – check with process guidelines for minimum velocity requirements if applicable
- Check API 660 edition 9 Guidelines for minimum mean U-bend radius, section 7.5.1.4
  - 1.5 x tube OD
  - 2.0 x tube OD for martensitic, super austenitic & Duplex SS, titanium, & high nickel alloys (>30 wt% Ni) – work hardening materials
- Tube Availability – Tubes must be bent to bend schedule when being replaced

Step by Step Guide:

Convert a Straight Tube Bundle to a U Tube Bundle

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Bundle Conversion: Straight Tube to U Tube
TEMA Types Overview Chart

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A CHANNEL AND REMOVABLE COVER

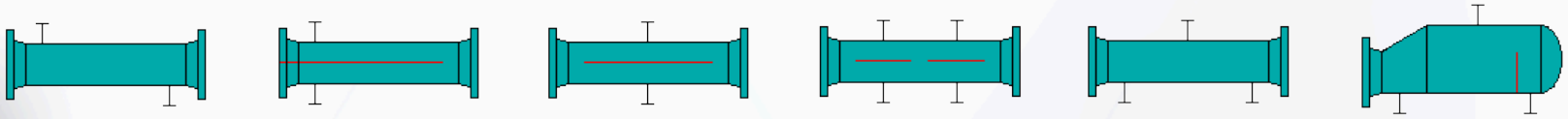
B BONNET (INTEGRAL COVER)

C CHANNEL INTEGRAL WITH TUBESHEET AND REMOVABLE COVER

N CHANNEL INTEGRAL WITH TUBESHEET AND REMOVABLE COVER

D SPECIAL HIGH PRESSURE CLOSURE

FRONT HEAD



E ONE PASS SHELL

F TWO PASS WITH LONGITUDINAL BAFFLE

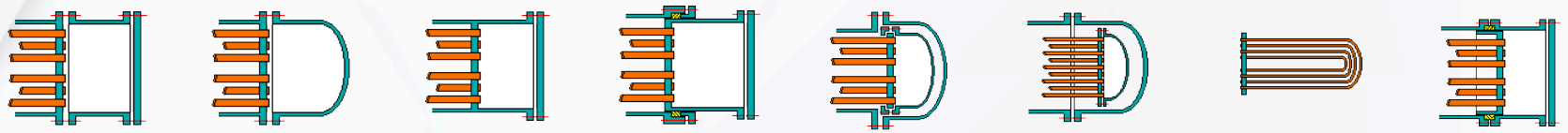
G SPLIT FLOW

H DOUBLE SPLIT FLOWL

J DIVIDED FLOW

K KETTLE TYPE REBOILER

SHELL



L FIXED TUBESHEET LIKE "A" STATIONARY HEAD

M FIXED TUBESHEET LIKE "B" STATIONARY HEAD

N FIXED TUBESHEET LIKE "N" STATIONARY HEAD

P OUTSIDE PACKED FLOATING HEAD

S FLOATING HEAD WITH BACKING RING

T PULL THROUGH FLOATING HEAD

U U-TUBE BUNDLE

W EXTERNALLY SEALED FLOATING TUBESHEET

REAR HEAD

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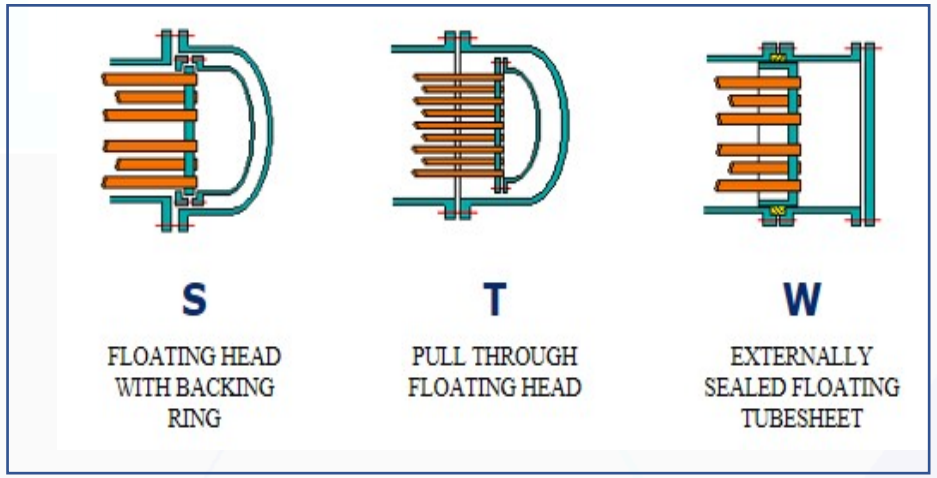
Bundle Conversion: Straight Tube to U Tube
Common Examples

Common Straight Bundle Designs
S Type, T Type, or W Type



Bundle Conversion: Straight Tube to U Tube

Steps for U Bundle Conversion:

1. Check the following items:

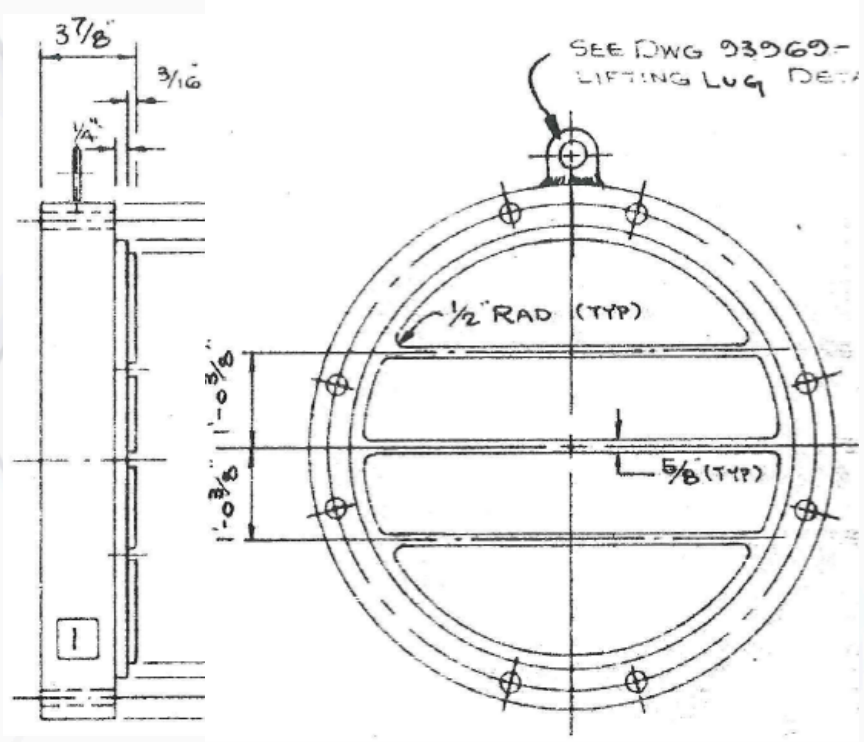
- → the number of passes on the tube side and check the front channel pass plate arrangement
- → Is a diverter plate required on the front channel for the U-Bundle Conversion?
- → the tube field layout to see if the existing tube layout can me maintained

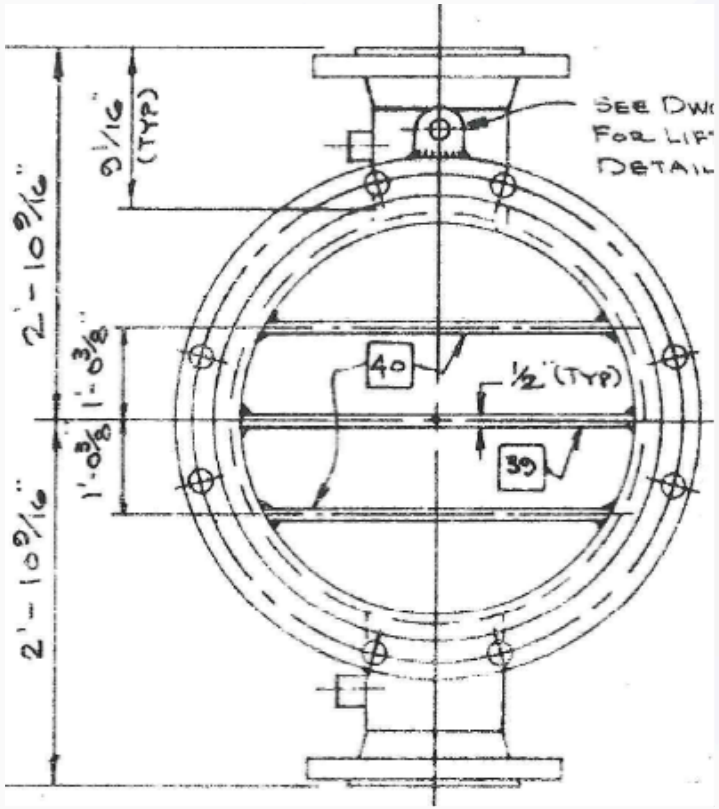
2. Design Goal: maintain tube external surface area from existing design
3. Maintain at least 2 inches of clearance between outer most tube bend and shell cover ID
4. Maintain number of baffles, baffle thickness, and center to center spacing of baffles
5. Note: Tubesheet thickness increases when converting from straight to U-tube bundle. Extra thickness to be "stepped" and tucked within the shell flange ID.
6. Maintain existing tubesheet bolting thickness for tubesheet in order to maintain nozzle to nozzle locations
7. Check to see if a U-Bend support is required based on TEMA unsupported span
8. Maintain continuous cleaning lanes when a square pitch or rotated square pitch is present
9. Design goal: locate the last baffle / support plate inside the shell (not shell cover) and approximately 2" from the face of the rear shell flange

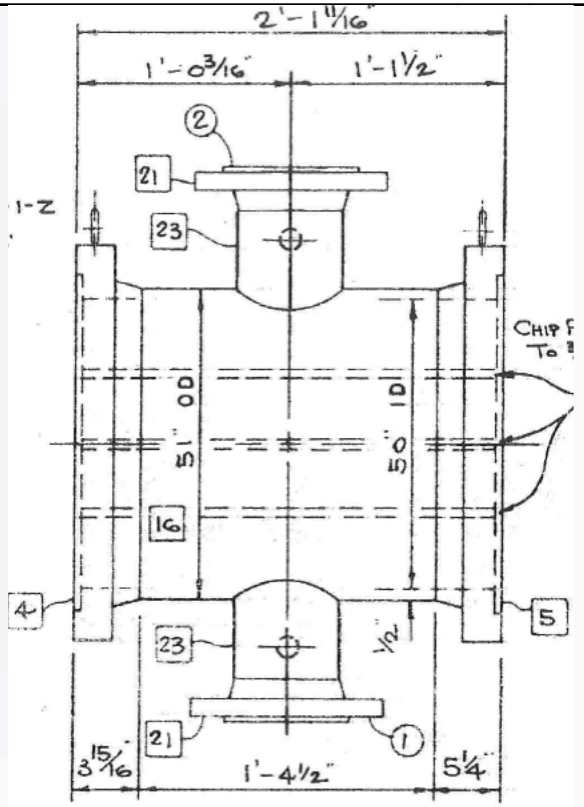
Bundle Conversion: Straight Tube to U Tube

→Review the number of passes, and nozzle details on the front channel

→Is a diverter plate required on the front channel?







Bundle Conversion: Straight Tube to U Tube

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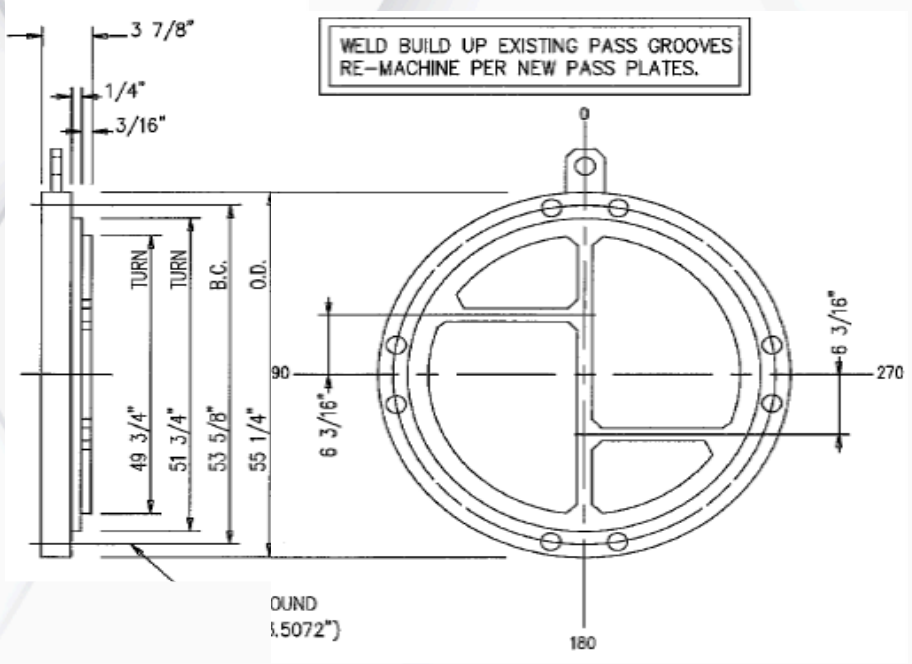
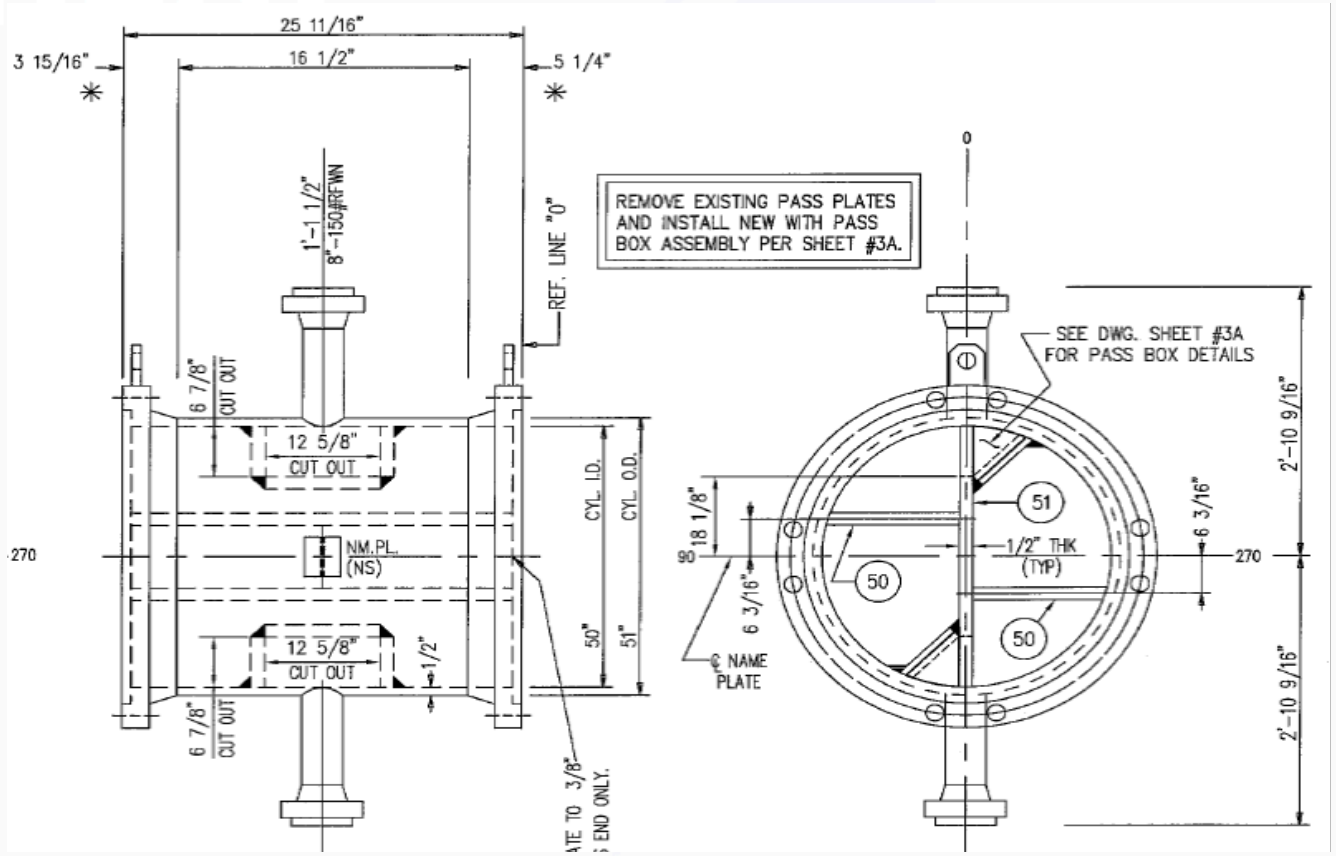
→Yes, diverter plate and channel modifications are required





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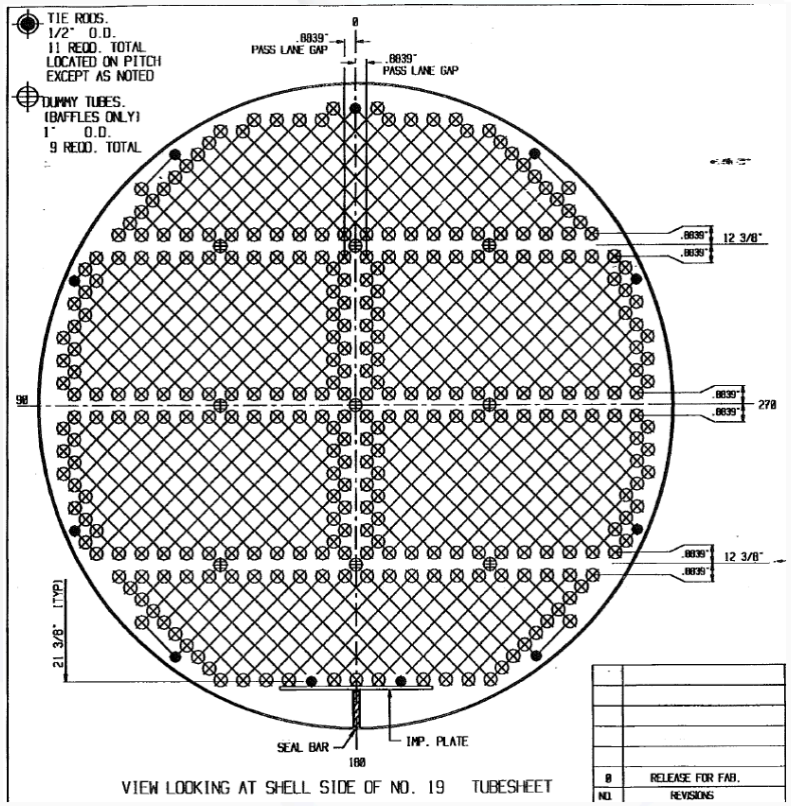
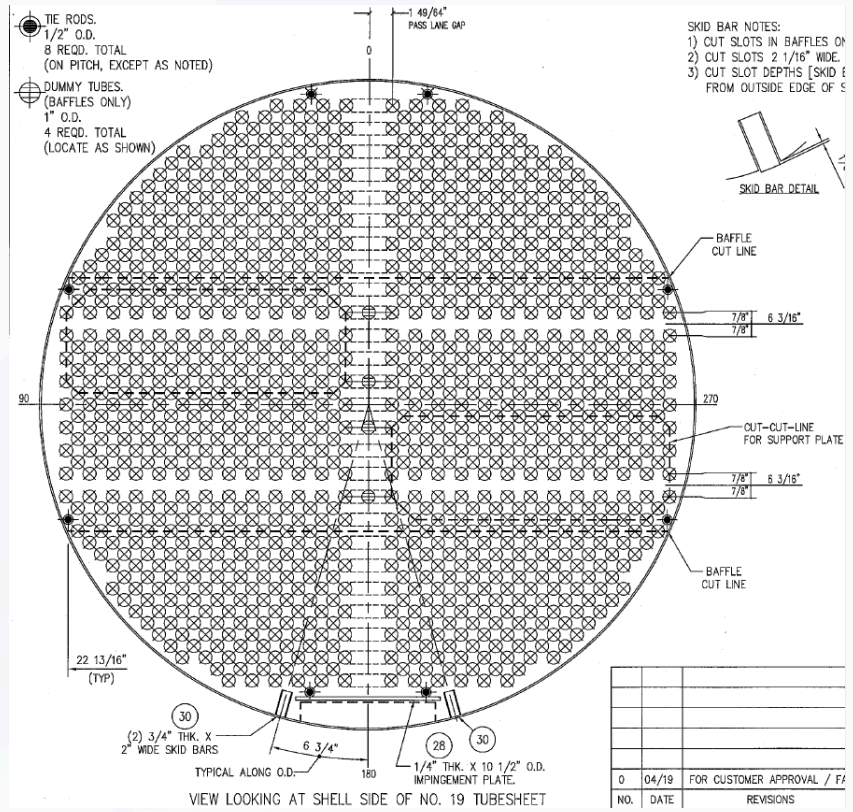
→Check the tube field layout to see if the existing tube layout can be maintained





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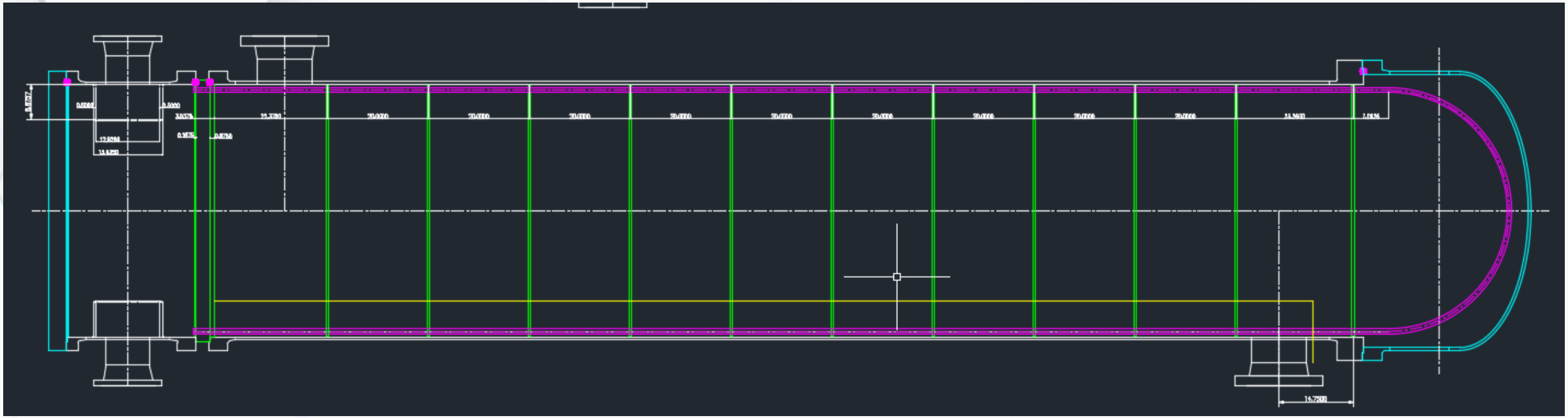
Bundle Conversion: Straight Tube to U Tube

2022

Maintain at least 2” of clearance between out most tube bend & shell /cover ID
additional space is required if a U-Bend Support is needed



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Bundle Conversion: Straight Tube to U Tube

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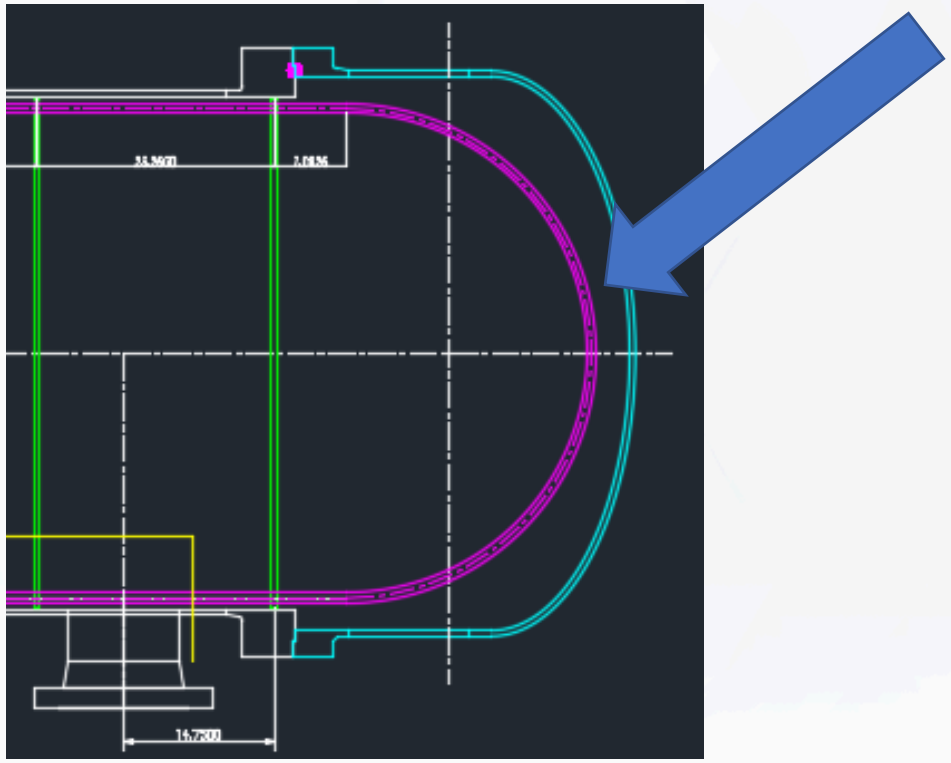
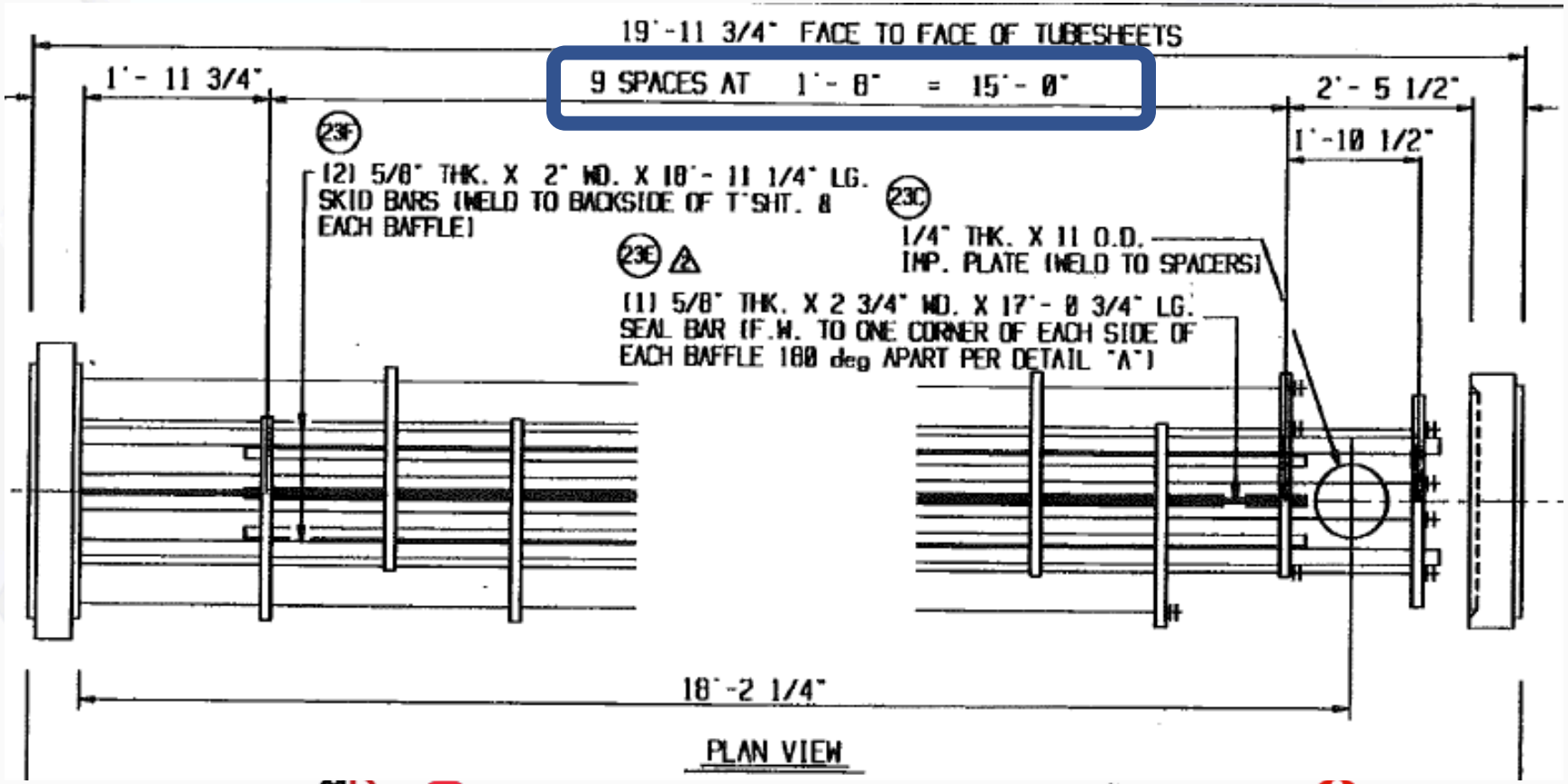


Bundle Conversion: Straight Tube to U Tube

Maintain number of baffles, baffle thickness, & center to center spacing of baffles



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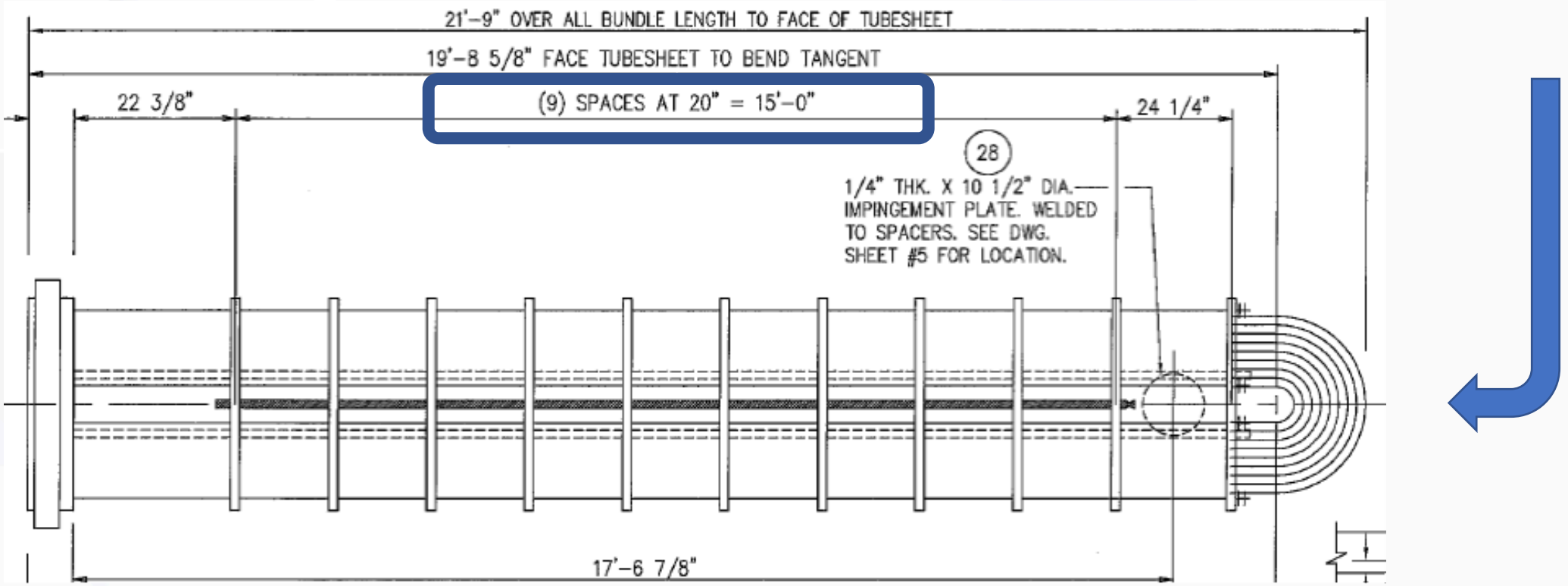

Bundle Conversion: Straight Tube to U Tube

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Maintain number of baffles, baffle thickness, & center to center spacing of baffles

Existing Baffle Details:

Baffle A: Quantity 5 @ 5/8” thk
Baffle B: Quantity 5 @ 5/8” thk
Support Plate: Qty. 1 @ 3/4” thk
Baffle Spacing = 20”

New Design Baffle Details:

Baffle A: Quantity 5 @ 5/8” thk
Baffle B: Quantity 5 @ 5/8” thk
Support Plate: Qty. 1 @ 3/4” thk
Baffle Spacing = 20”

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Bundle Conversion: Straight Tube to U Tube

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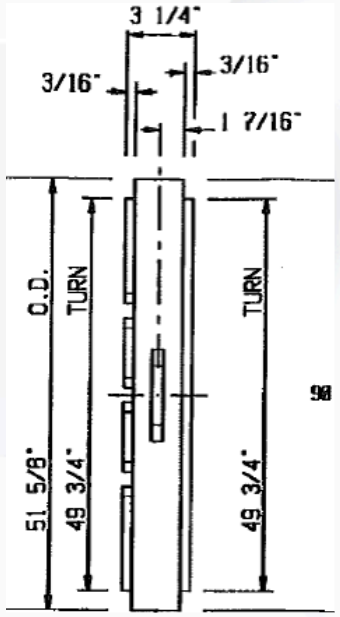
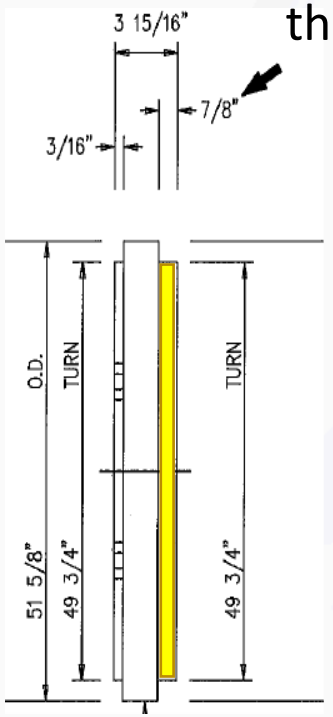
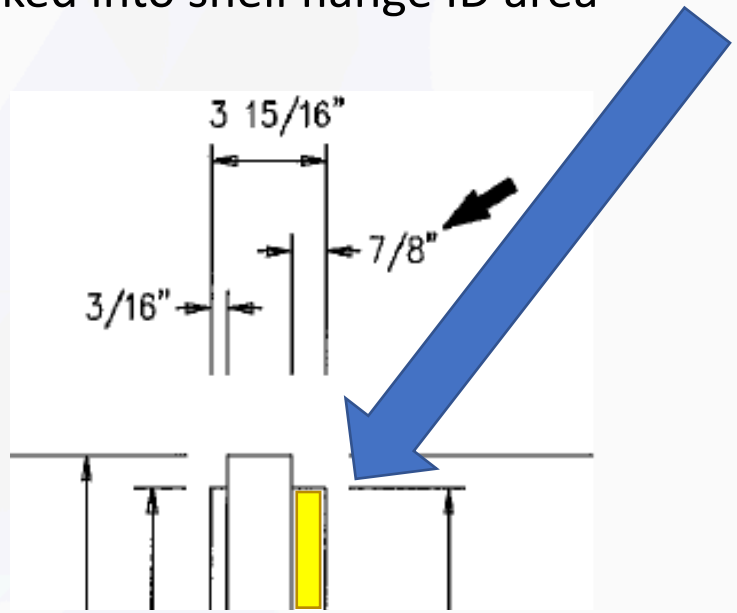
Note: Tubesheet thickness increases when converting from straight to U Bundle; extra thickness to be “stepped” &“tucked” within the shell flange ID

Existing Stationary Tubesheet Thickness = 3 1/4”



New Tubesheet Thickness = 3 15/16” with the 11/16” of additional thickness tucked into shell flange ID area`





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Bundle Conversion: Straight Tube to U Tube

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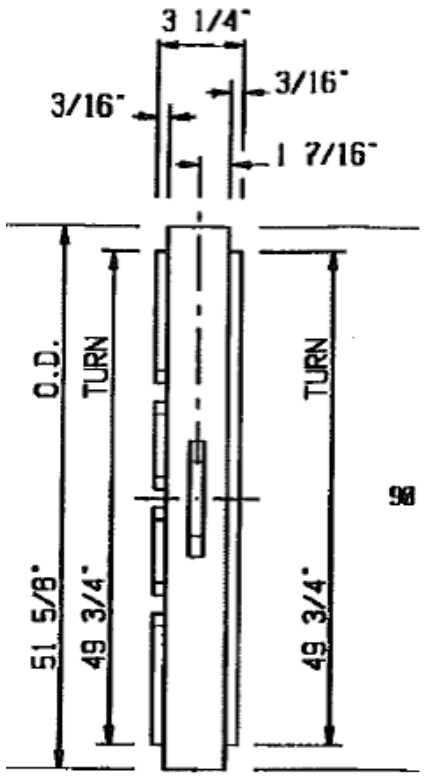

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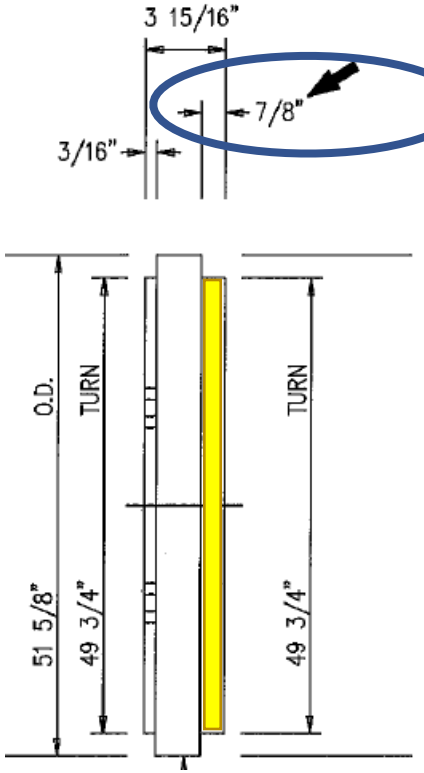
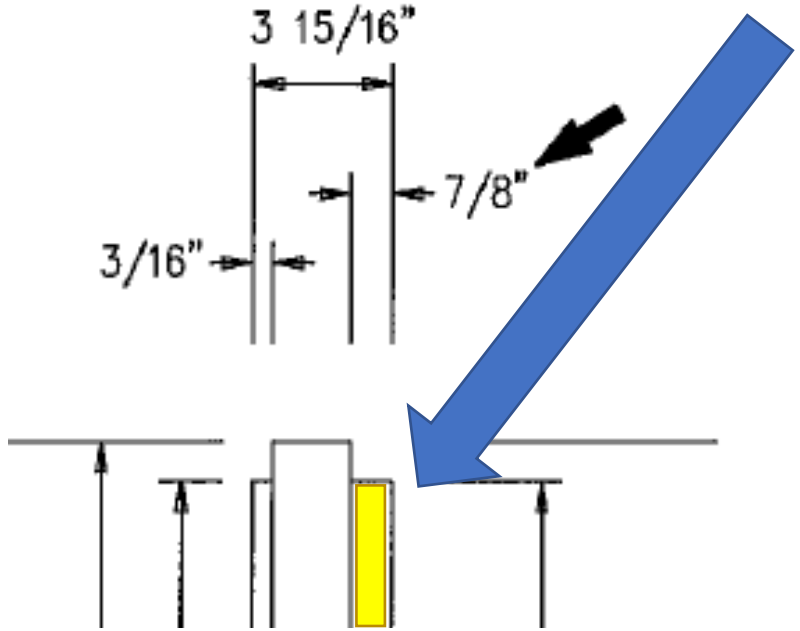
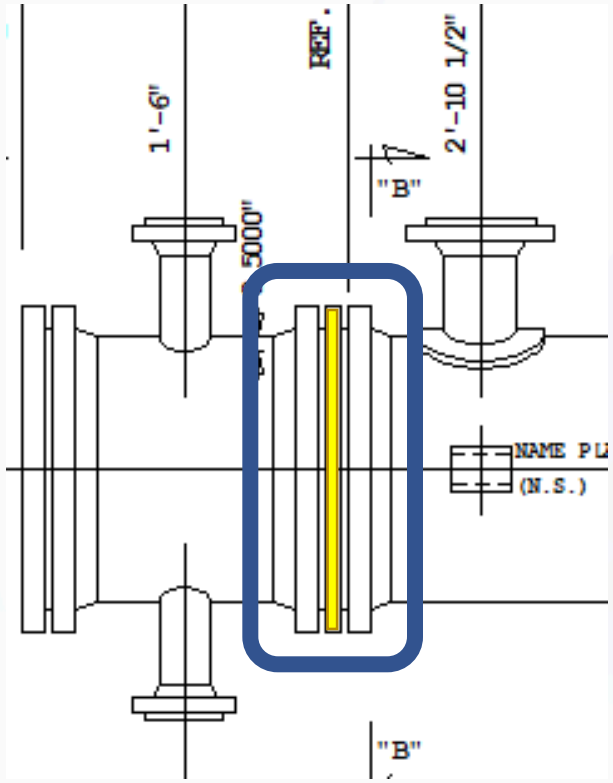




Bundle Conversion: Straight Tube to U Tube

Maintain existing tubesheet thickness at bolting area to maintain nozzle to nozzle locations



Bundle Conversion: Straight Tube to U Tube

Check to see if a U-Bend support is required based on TEMA unsupported span

RCB-4.5.4 U-TUBE REAR SUPPORT

The support plates or baffles adjacent to the bends in U-tube exchangers shall be so located that, for any individual bend, the sum of the bend diameter plus the straight lengths measured along both legs from supports to bend tangents does not exceed the maximum unsupported span determined from Paragraph RCB-4.5.2. Where bend diameters prevent compliance, special provisions in addition to the above shall be made for support of the bends.

TABLE RCB-4.5.2

MAXIMUM UNSUPPORTED STRAIGHT TUBE SPANS
Dimensions in Inches (mm)

Tube OD	Tube Materials and Temperature Limits ° F (° C)	
	Carbon Steel & High Alloy Steel, 750 (399) Low Alloy Steel, 850 (454) Nickel-Copper, 600 (316) Nickel, 850 (454) Nickel-Chromium-Iron, 1000 (538)	Aluminum & Aluminum Alloys, Copper & Copper Alloys, Titanium Alloys At Code Maximum Allowable Temperature
1/4 (6.4)	26 (660)	22 (559)
3/8 (9.5)	35 (889)	30 (762)
1/2 (12.7)	44 (1118)	38 (965)
5/8 (15.9)	52 (1321)	45 (1143)
3/4 (19.1)	60 (1524)	52 (1321)
7/8 (22.2)	69 (1753)	60 (1524)
1 (25.4)	74 (1880)	64 (1626)
1 1/4 (31.8)	88 (2235)	76 (1930)
1 1/2 (38.1)	100 (2540)	87 (2210)
2 (50.8)	125 (3175)	110 (2794)
2 1/2 (63.5)	125 (3175)	110 (2794)
3 (76.2)	125 (3175)	110 (2794)

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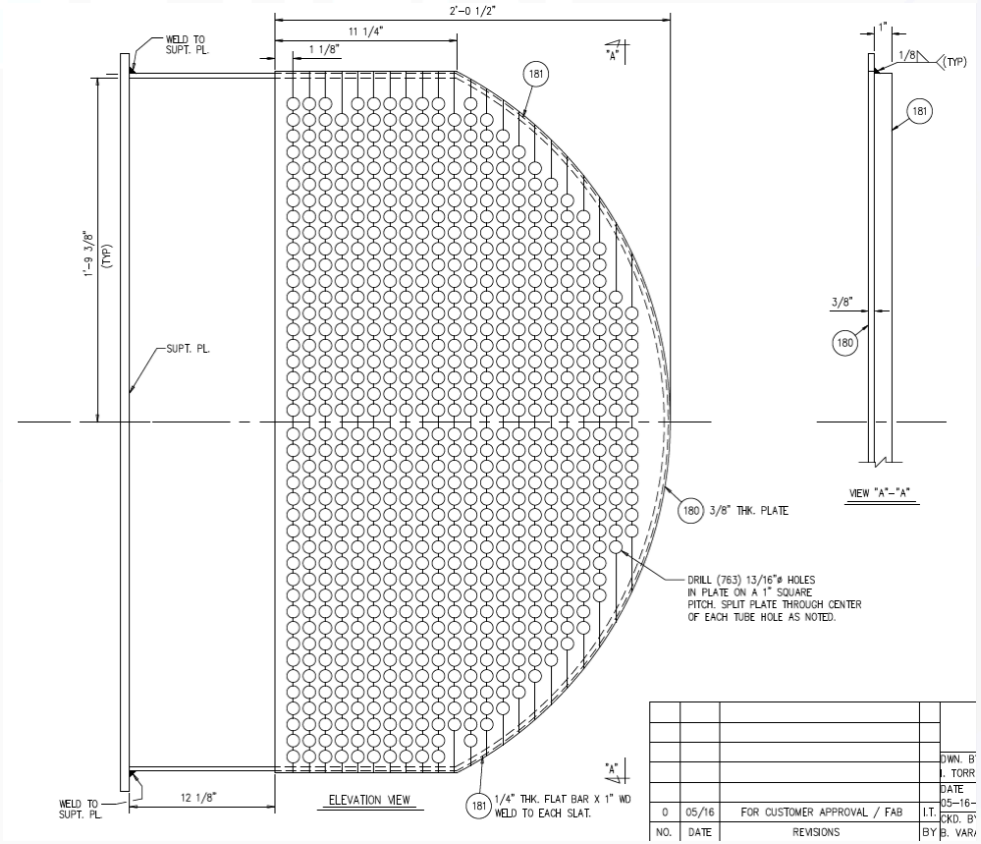
Examples of U-Bend Support Designs – Baffle Plate



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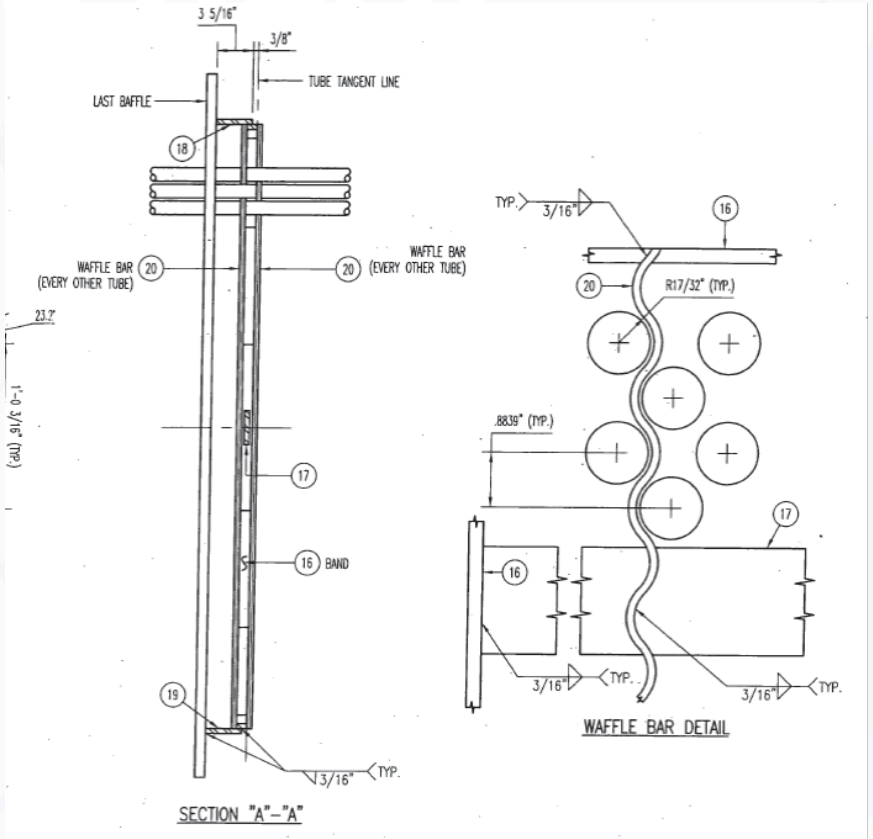
Examples of U-Bend Support Designs – Waffle Bars



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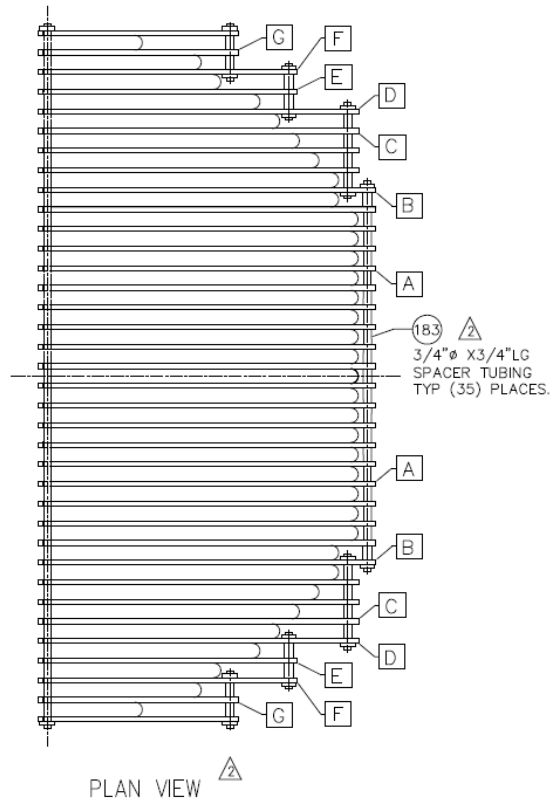
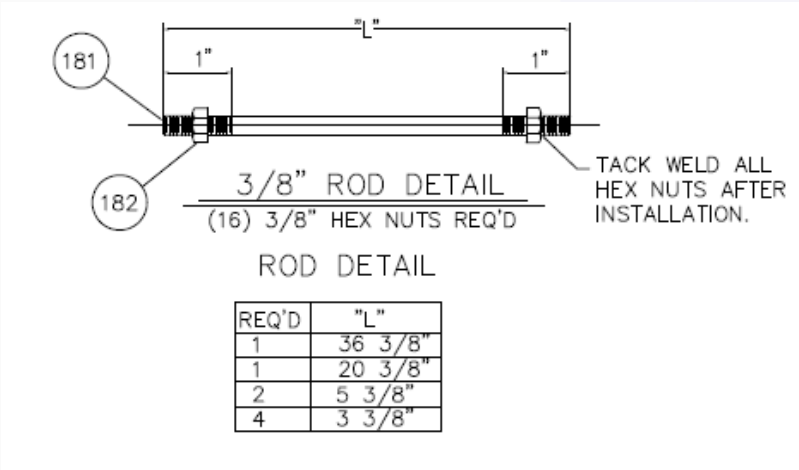
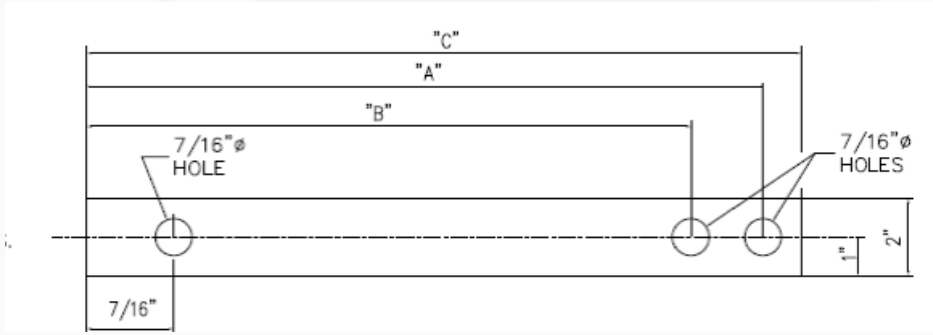
Examples of U-Bend Support Designs – Flat Bar with Rod





ROD DETAIL

REQ'D	"L"
1	36 3/8"
1	20 3/8"
2	5 3/8"
4	3 3/8"



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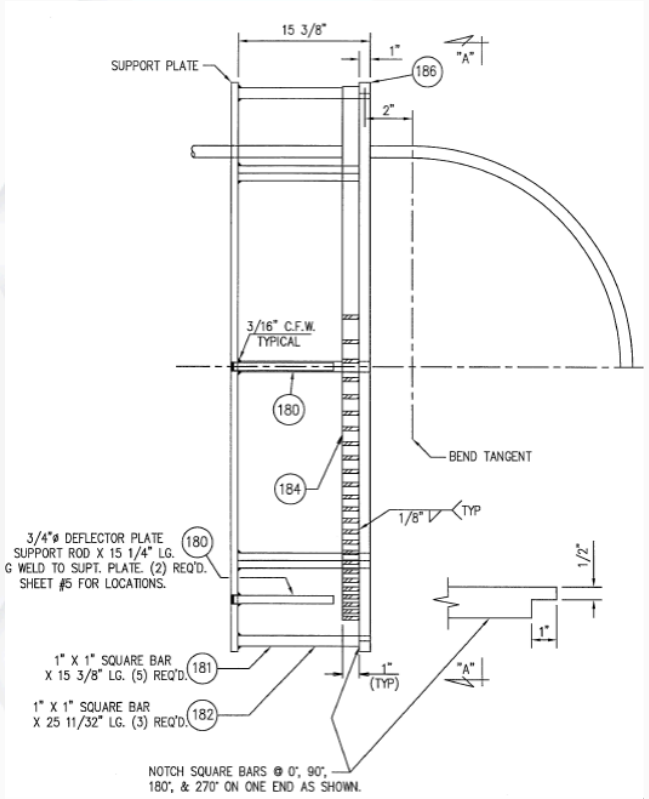
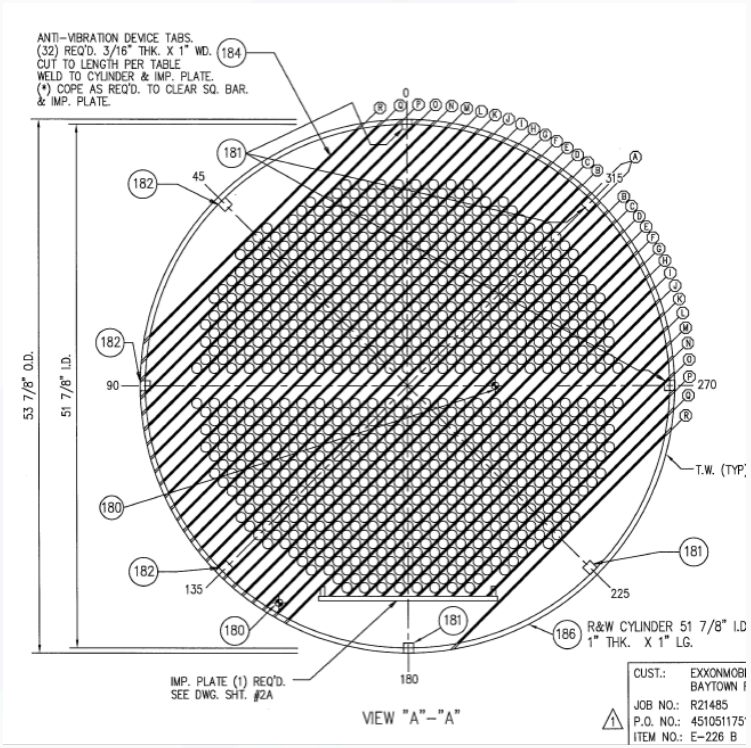
Examples of U-Bend Support Designs – Ring with Rod





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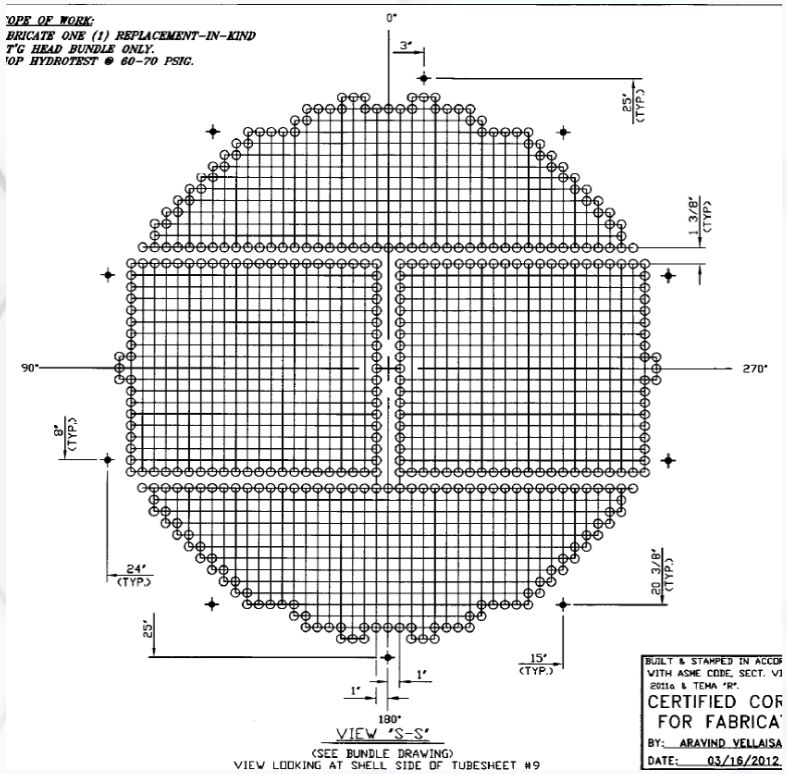
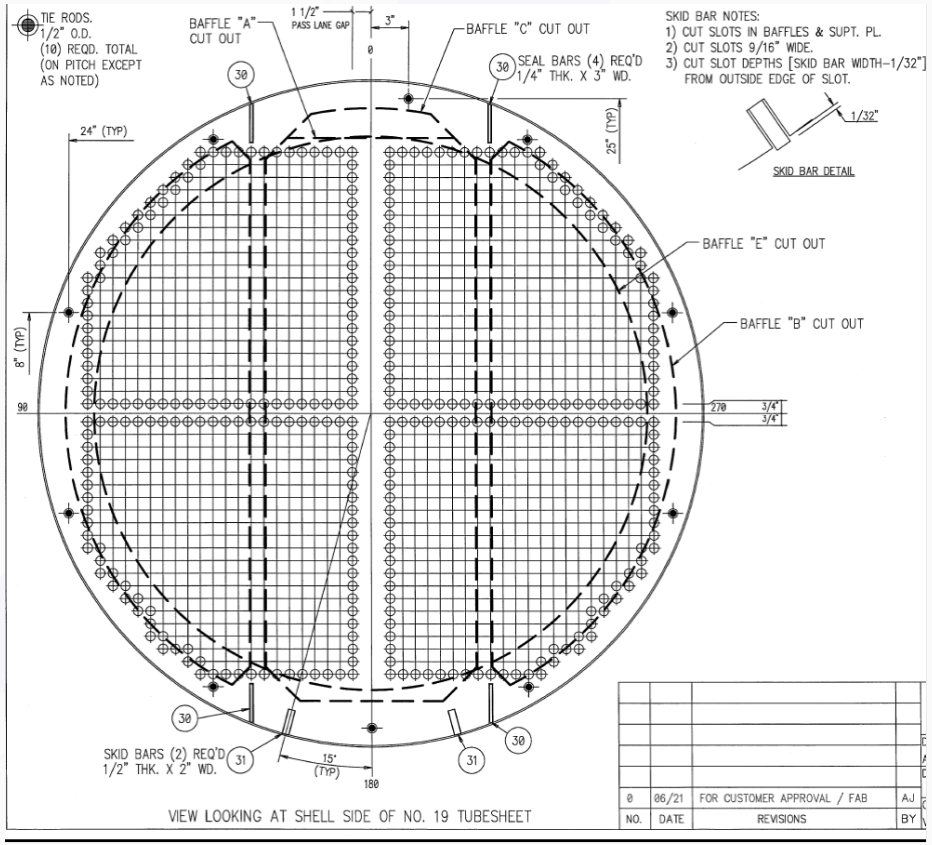
→Maintain continuous cleaning lanes when a square layout or rotated square layout is present





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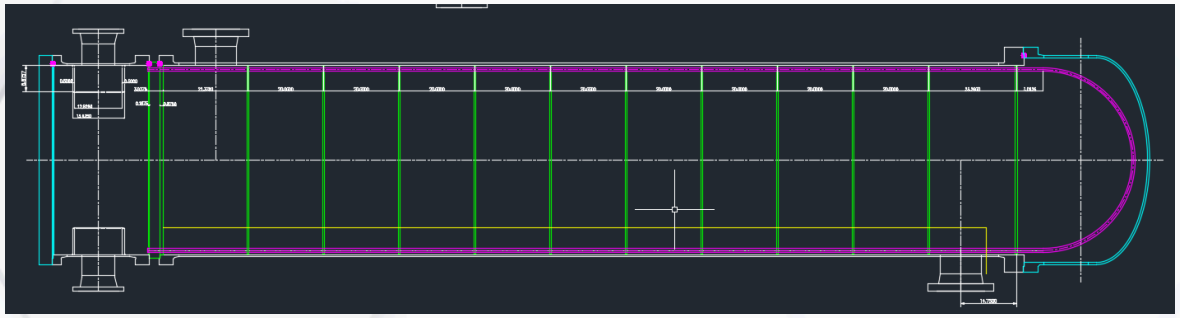
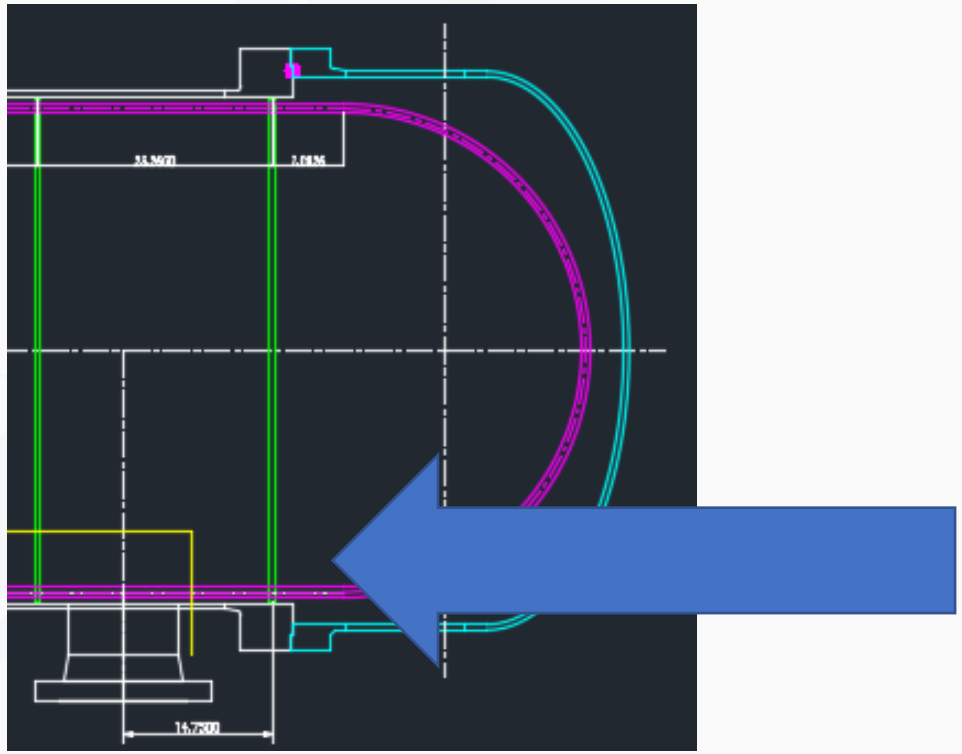
Design goal: locate last baffle / support plate inside the shell (not shell cover) and approximately 2” inside the rear shell flange





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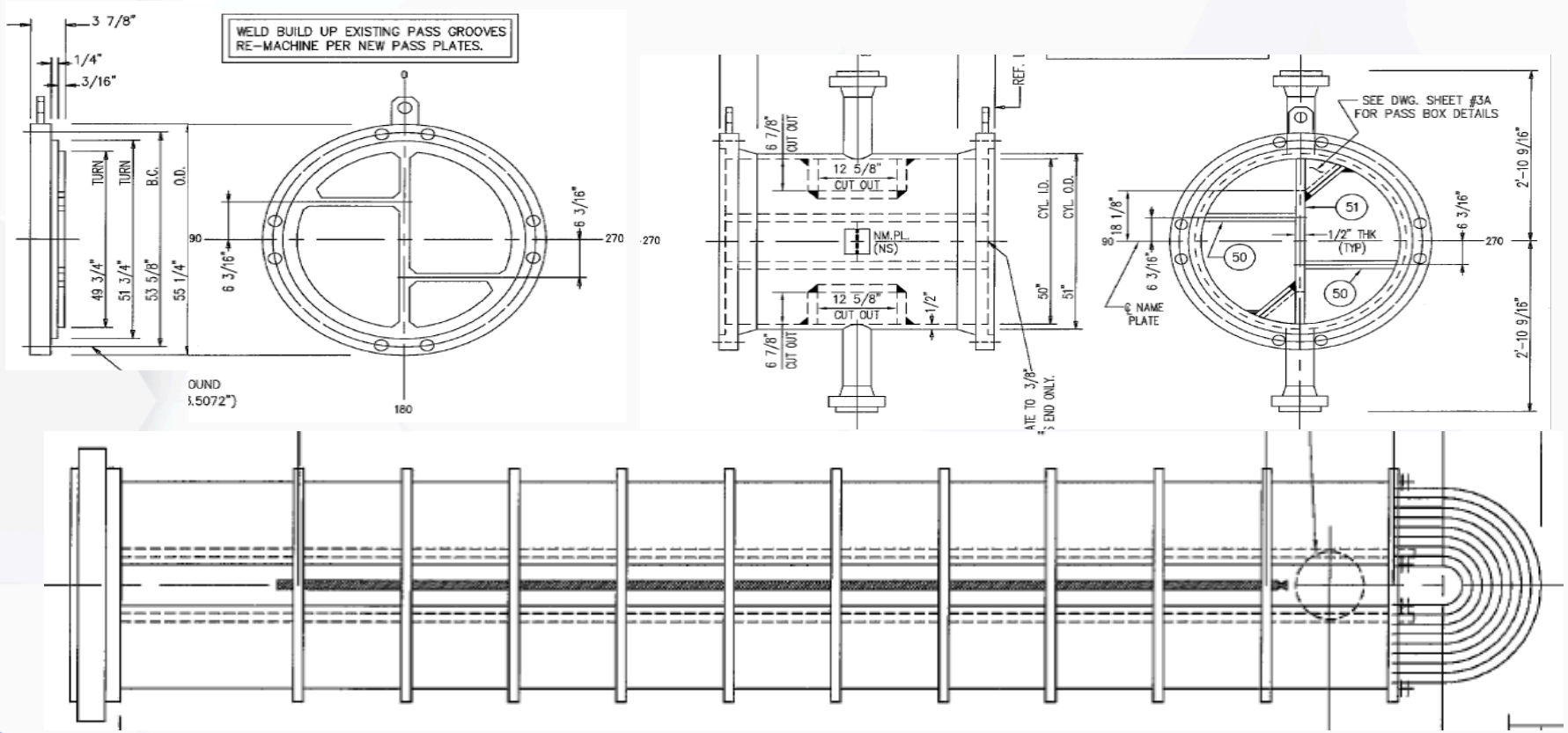
Finished Product: U Tube Bundle and Modified Front Channel



Open Discussion

Q & A

Bundle Conversion: Straight Tube to U Tube

Thank you for your time

Brask, Inc.
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