

Data Package for Orange Ultrasonics

Requested Information:

Request:	Note:
Coolant header volume	See following slides
Coolant access pipe IDs	See following slides and drawings
Inlet/outlet layout	See following slides and drawings
Weight of core	See following slides
Drawing/photo of catalyst retention assembly	See attached drawing (#: 1005643)
Photo pilot with person for scale	See following slides
Photo loading test device	See following slides
Video of wire and horn (UDU) working	See following slides for stills
Assisted discharge pictures	

Data Package for Orange Ultrasonics

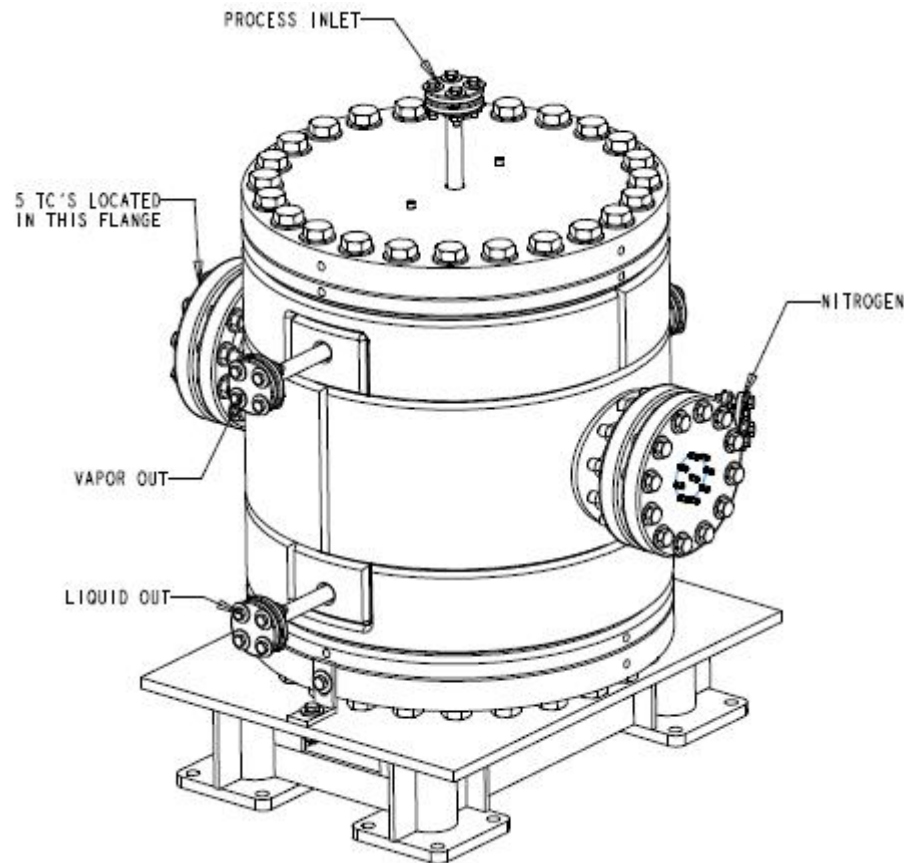
Overview

Reactors for catalyst discharge development:

- 1) Velocys Pilot Plant Scale (VPP)
 - a) Focus will be on VPP-4 style devices (ex. VPP-4B & VPP-4D)
 - b) Details and cross sections can be found in “Velocys Pilot Plant reactors for Catalyst Discharge Development.ppt”
- 2) Commercial validation core (Single Core)
 - a) ¼ scale commercial reactor (1 core) on site at Velocys’ Plain City office.
 - b) Currently loaded with unoperated FT catalyst.
 - c) Description and drawings follow
- 3) Commercial Reactor (Four Core)
 - a) Full scale reactor design being produced for operation at ENVIA project in Oklahoma City.
 - b) Description and drawings follow

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Velocys Pilot Plant Reactor 4th Generation (VPP-4) Overview



Velocys Pilot Plant Reactor 4 (VPP-4):

- 2 process layers (total of 6 waveforms)
- Core contained within pressure containment shell (PCS) pressurized with nitrogen
- approximate weight w/o headers is 3200lb
- process headers will be removed post operation prior to catalyst discharge
- catalyst retention materials will be removed prior to catalyst discharge

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Velocys Pilot Plant Reactor 4th Generation (VPP-4) Overview



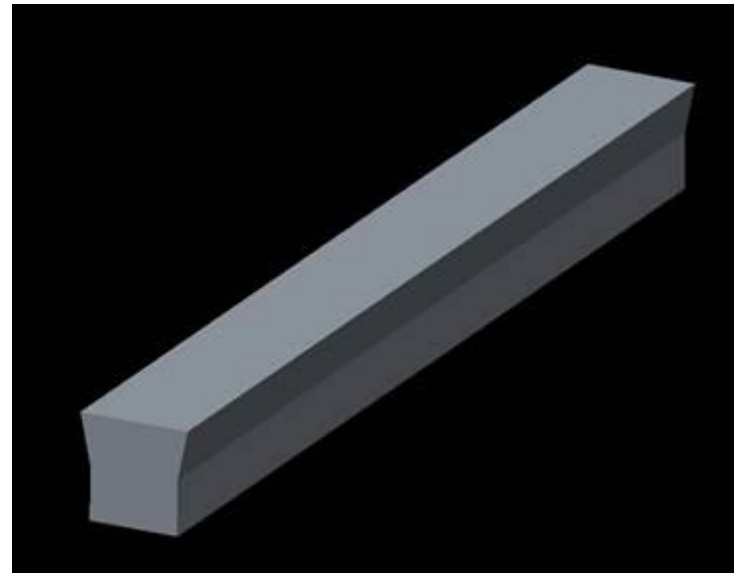
Note: The person pictured is 5'10"
(~1.78m) tall (although he claims he
is 6')

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Velocys Pilot Plant Reactor 4th Generation (VPP-4) Overview

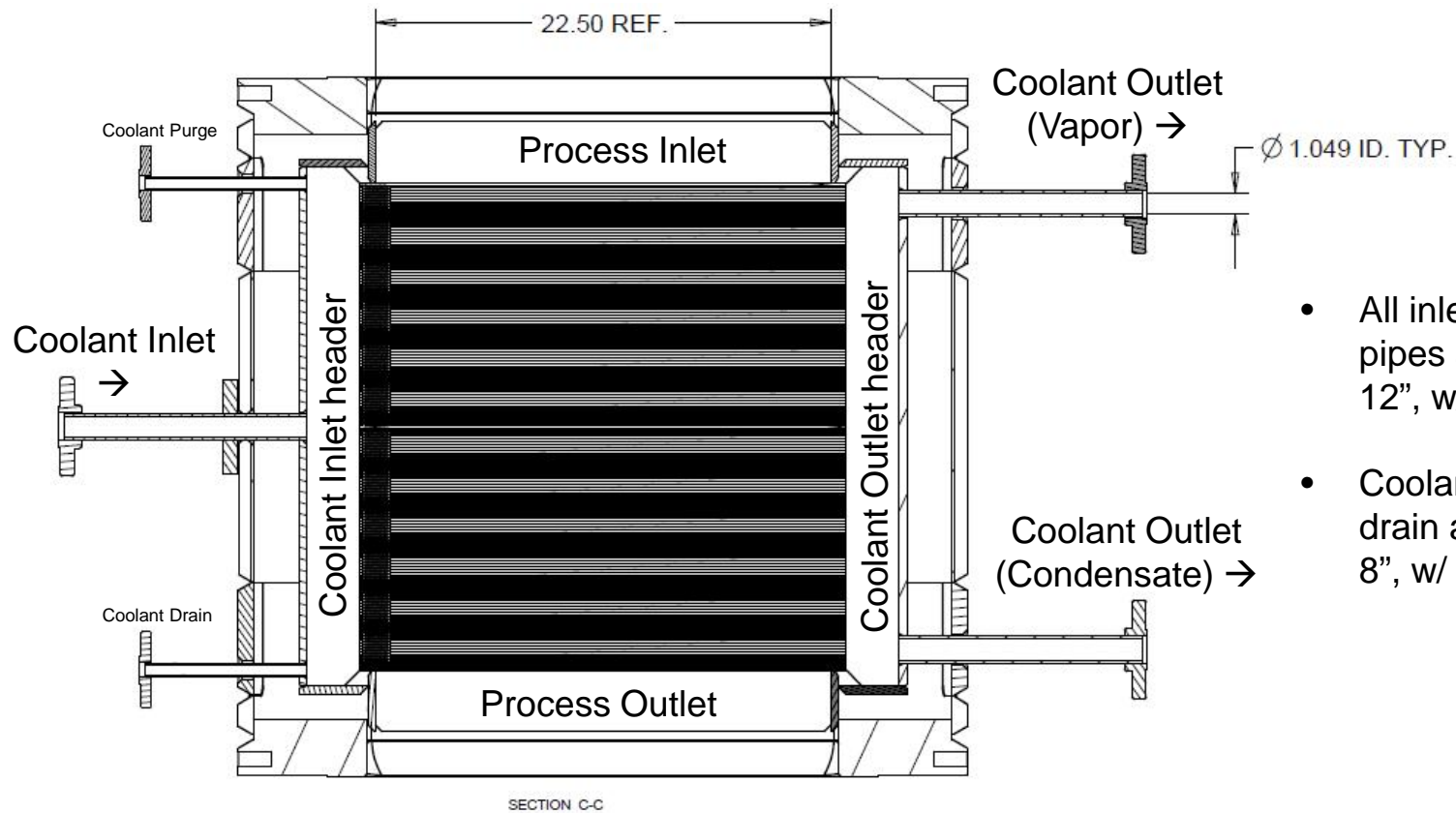
Velocys Pilot Plant Reactor 4 (VPP-4):

- VPP coolant header/footer volume is approx. **159 cubic inch per side** without pipe volume.
- Coolant inlet and outlet headers are mirror images in shape and volume with the exception that the coolant inlet has one inlet pipe and the coolant outlet header has two outlet pipes.
- See cross sections and drawings of VPP-4 in “Velocys Pilot Plant reactors for Catalyst Discharge Development.ppt” for more details and dimensions.



Depiction of coolant header volume (w/o pipes)

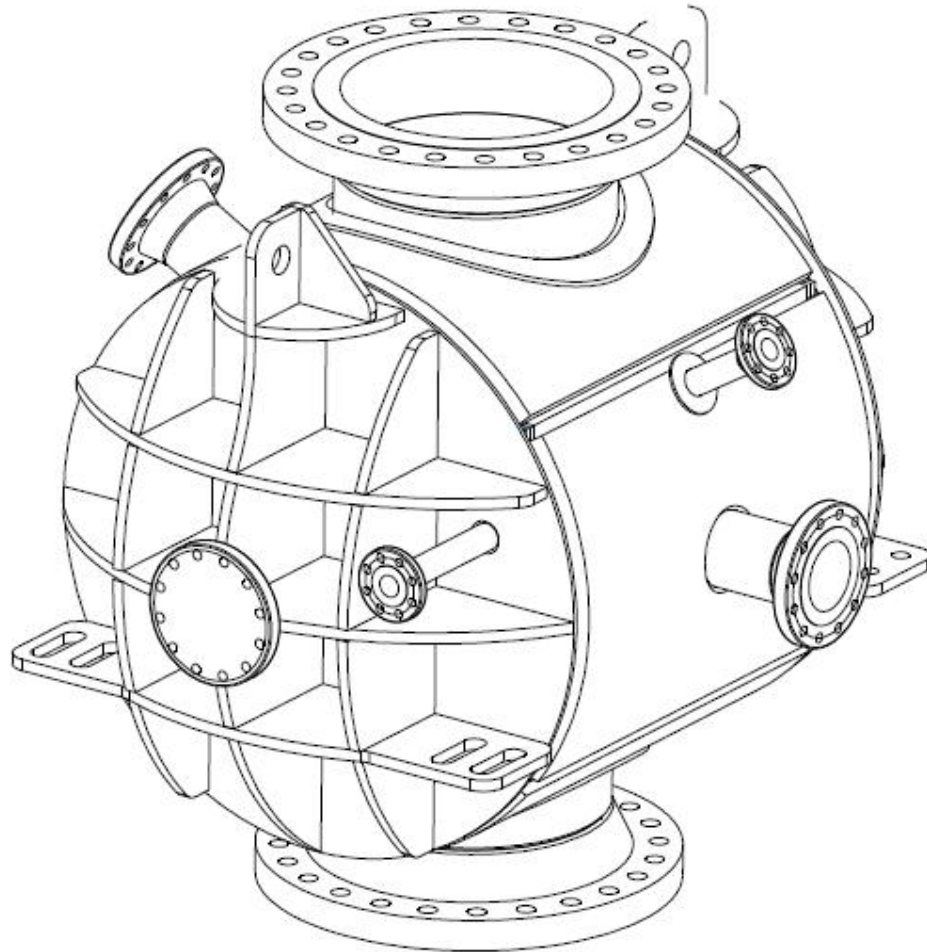
Drawing package for Orange Ultrasonics VPP4D Cross section of coolant system



- All inlet and outlet pipes are 1.049" ID x 12", w/ 1" 300# flange
- Coolant purge and drain are 0.549" ID x 8", w/ 1/2" 300# flange .

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Single Core Overview

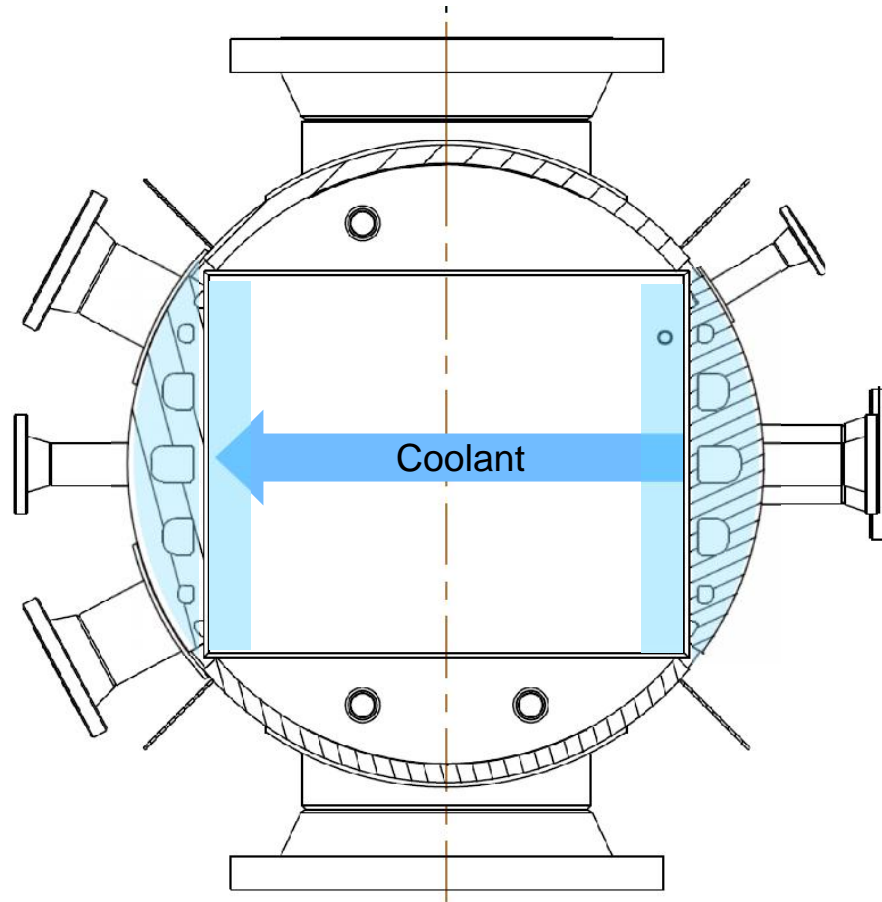


The single core reactor is a single core reactor which is designated to be used as a catalyst loading and unloading validation test bed. It is not intended to be operated. It is currently on site at Velocys' Plain City, OH office.

The volume of each coolant header is ~ **13306 cubic inches** without inlet/outlet pipe volumes.

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Commercial scale coolant header volume

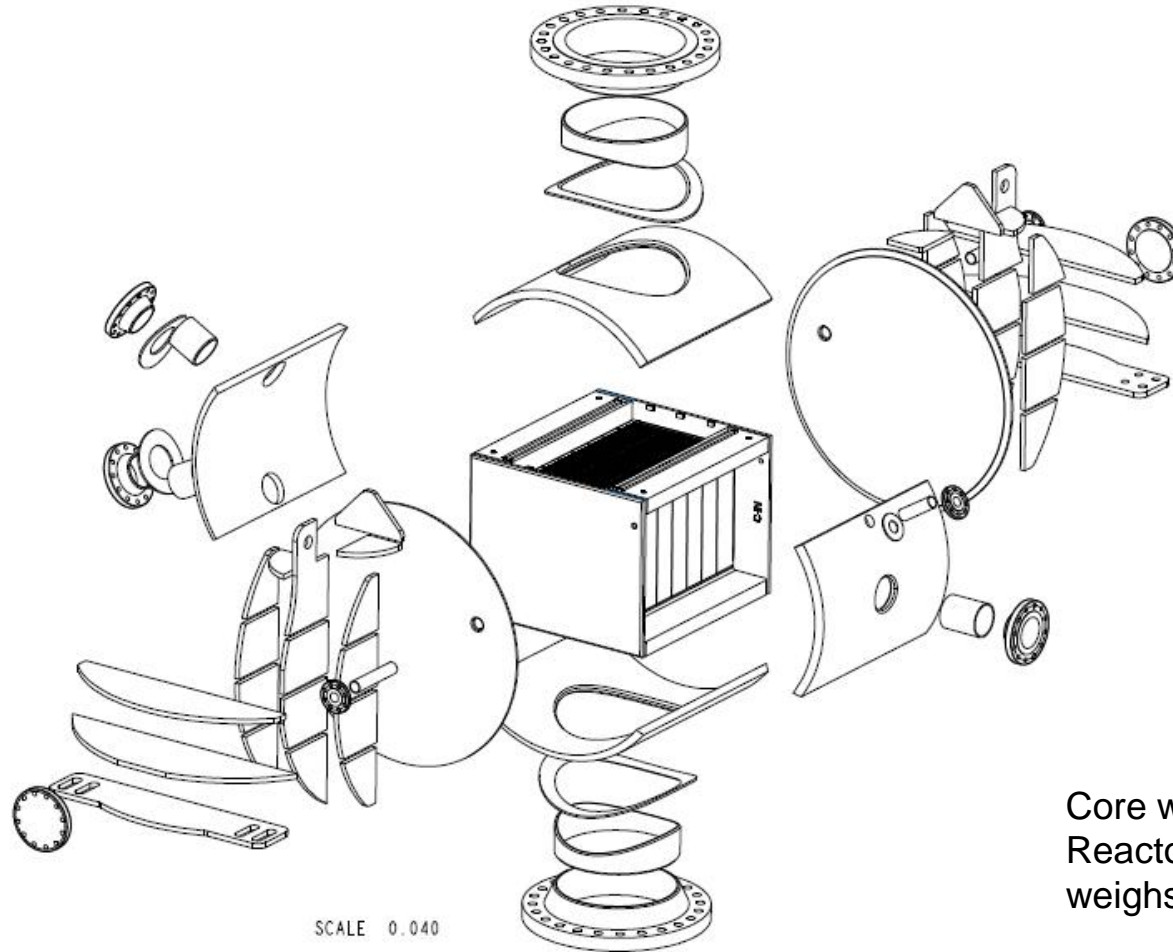


A commercial scale reactor consists of 4 cores each with a coolant header which communicates it adjacent cores via holes in supports (highlighted blue in drawing to left).

The single core reactor only has 1 core.

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Single Core Overview



Core weighs ~5100lbs.
Reactor as a whole
weighs ~ 14500lbs.

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Single and 4-core attachment point



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Single Core Overview



Note: Person is 5'10" (~1.78m) tall

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Single Core Coolant System

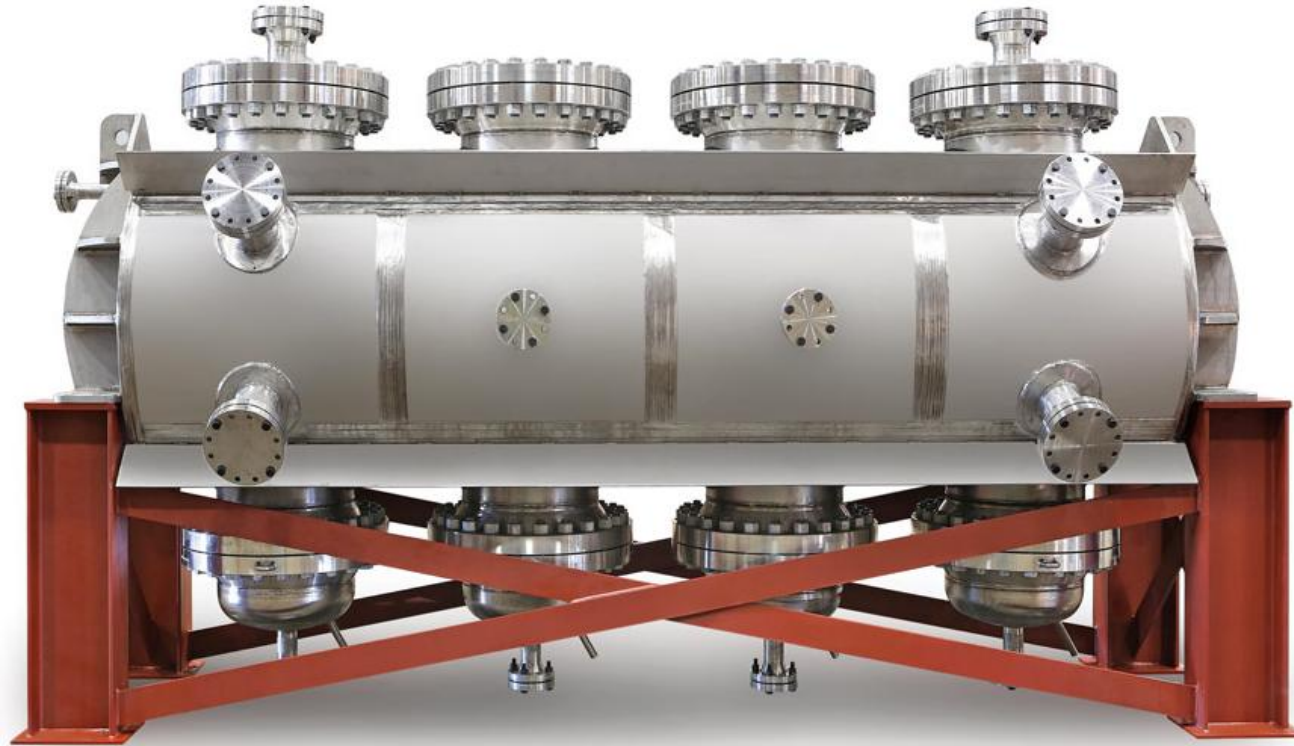
Access to Coolant Headers:

- Coolant Inlet
 - 1x Coolant Inlet Pipes (6", Schedule 40, w/ 300# flange)
 - 1x Thermocouple Pipes (2", Schedule 40, w/ 300# flange)
- Coolant Outlet
 - 2x Coolant Outlet Pipes (6", Schedule 40, w/ 300# flange)

Pipe Size	Schedule	Inner Diameter (in)
2"	40	2.067
3"	40	3.068
6"	40	6.065

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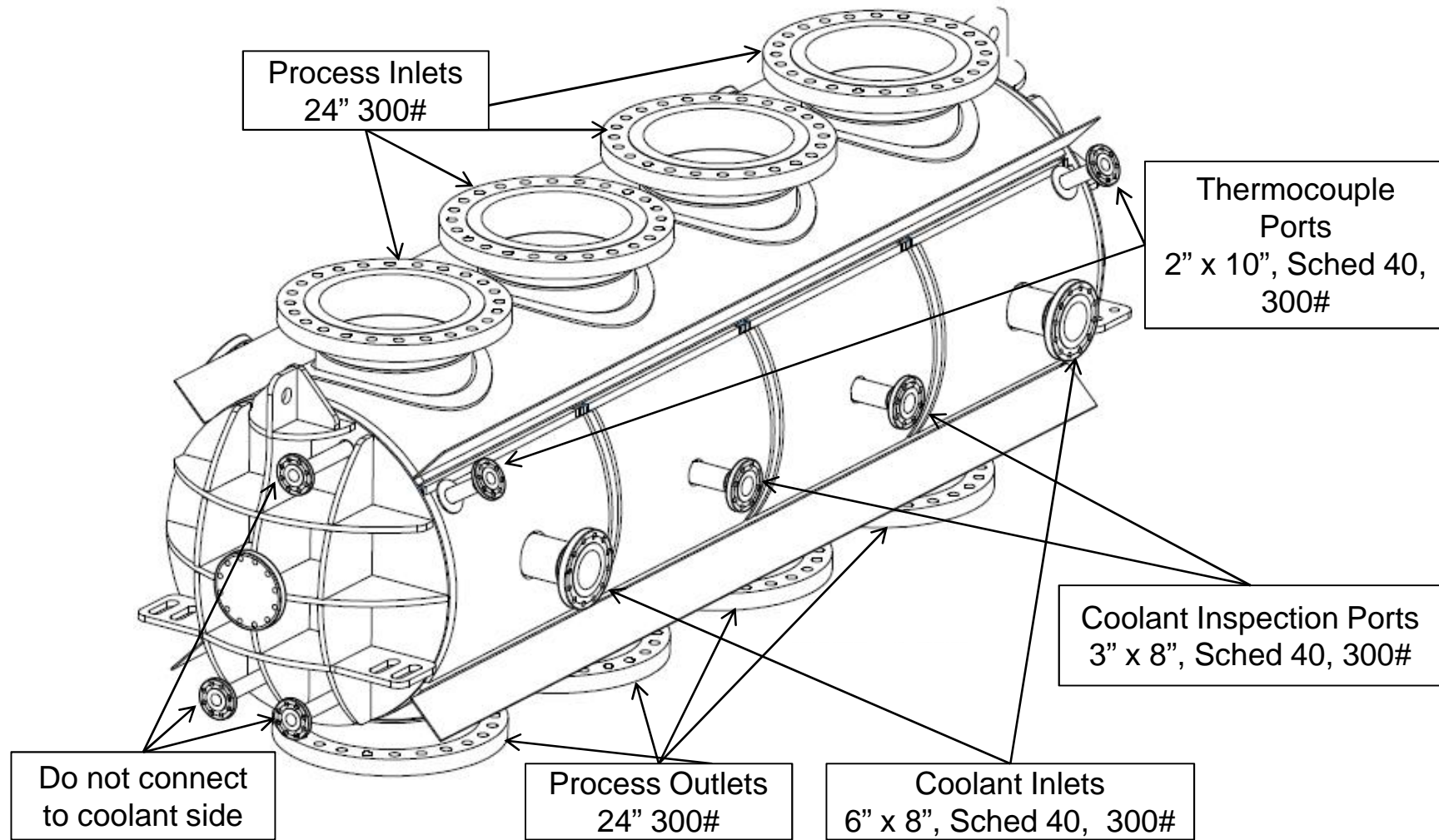
Commercial scale reactor overview



A commercial scale reactor consists of four process cores enclosed in a common header/pressure containment vessel.

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Commercial scale reactor overview (view 1)



Data Package for Orange Ultrasonics Commercial Reactor Coolant System

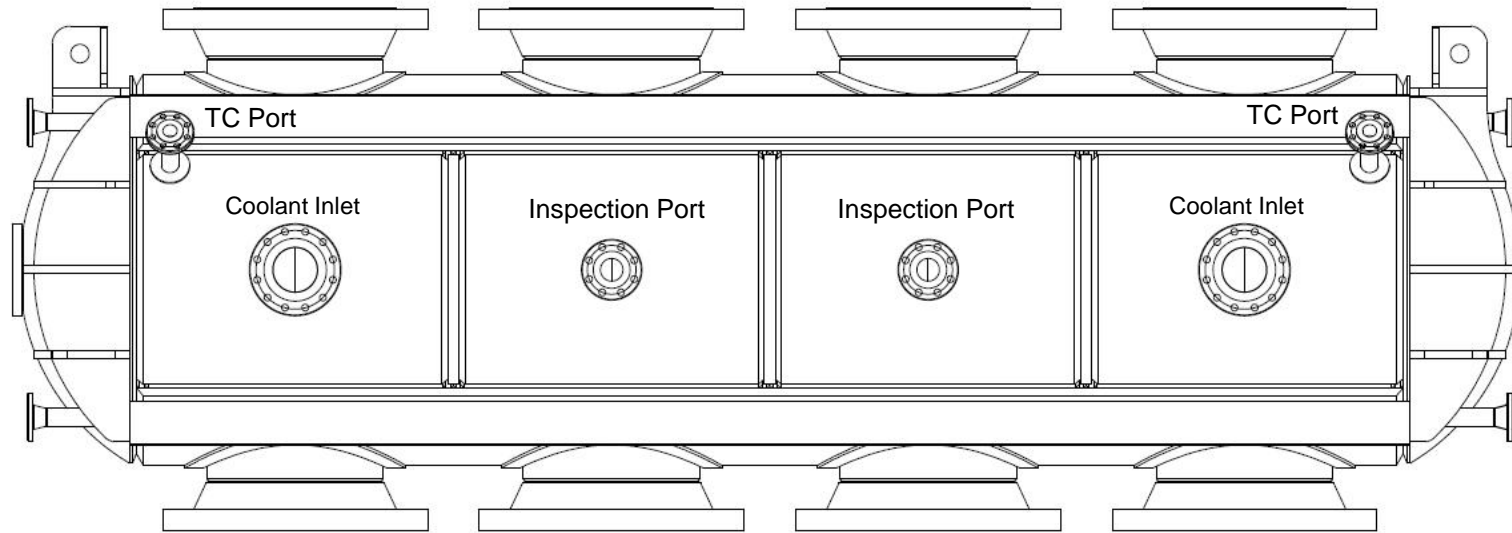
Access to Coolant Headers:

- Coolant Inlet
 - 2x Coolant Inlet Pipes (6", Schedule 40, w/ 300# flange)
 - 2x Coolant Inspection Pipes (3", Schedule 40, w/ 300# flange)
 - 2x Thermocouple Pipes (2", Schedule 40, w/ 300# flange)
- Coolant Outlet
 - 4x Coolant Outlet Pipes (6", Schedule 40, w/ 300# flange)
 - 2x Coolant Inspection Pipes (3", Schedule 40, w/ 300# flange)

Pipe Size	Schedule	Inner Diameter (in)
2"	40	2.067
3"	40	3.068
6"	40	6.065

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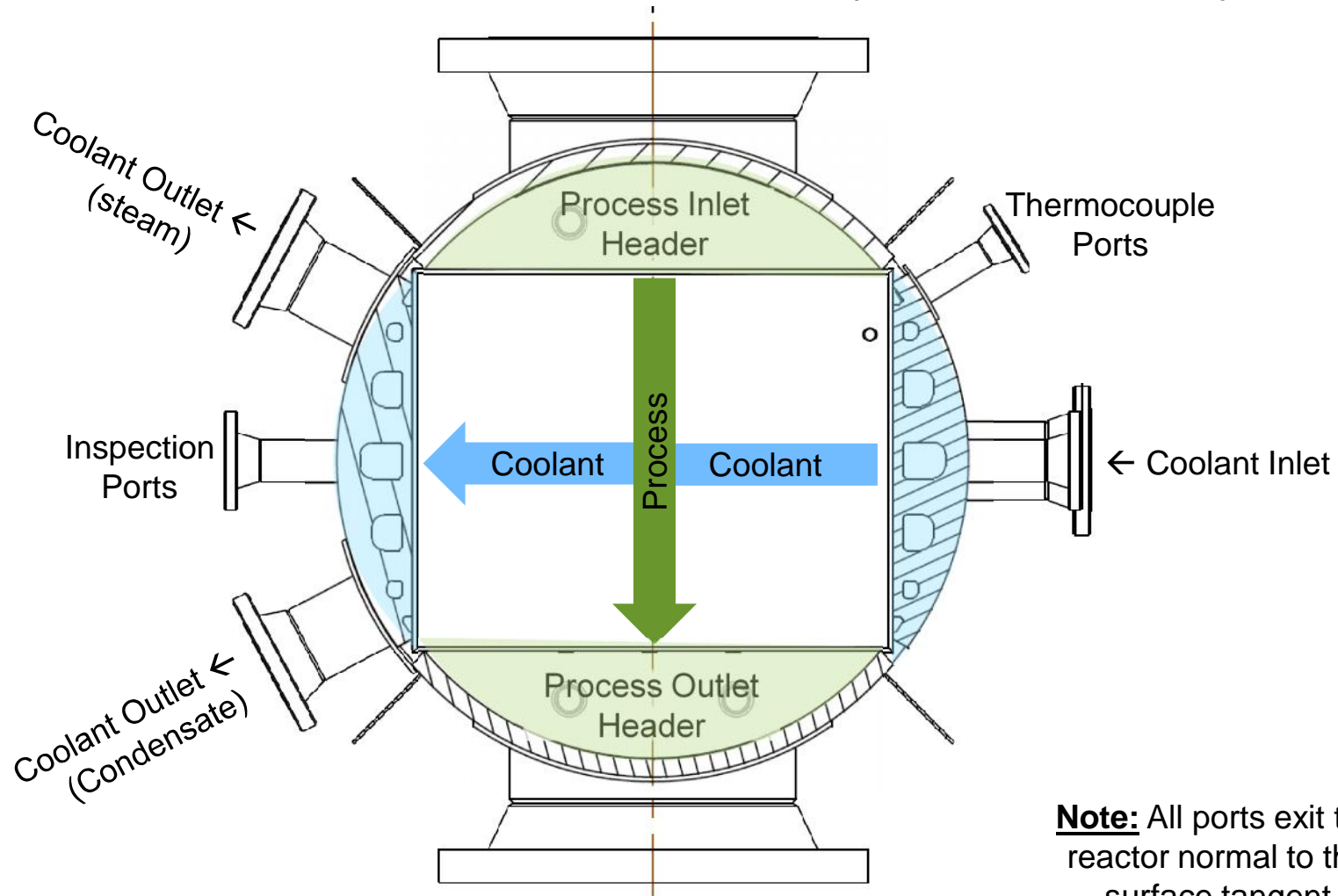
Commercial scale reactor overview (view 2)



The total weight of the reactor (independent from support stand or associated piping) is ~51000lbs. Each individual core (without surrounding pressure vessel) weighs ~5100lbs.

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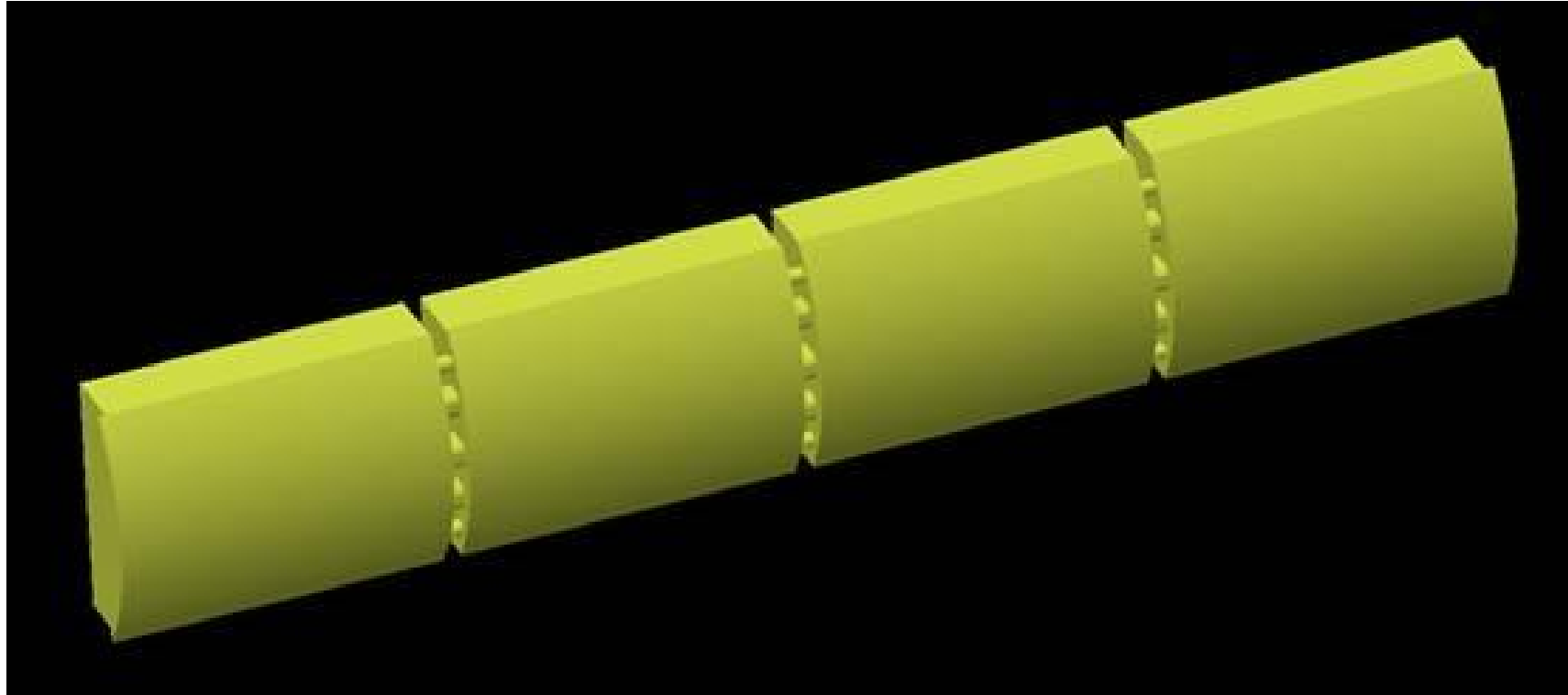
Commercial scale reactor overview (Cross-section)



Note: All ports exit the reactor normal to the surface tangent

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Commercial scale coolant header volume

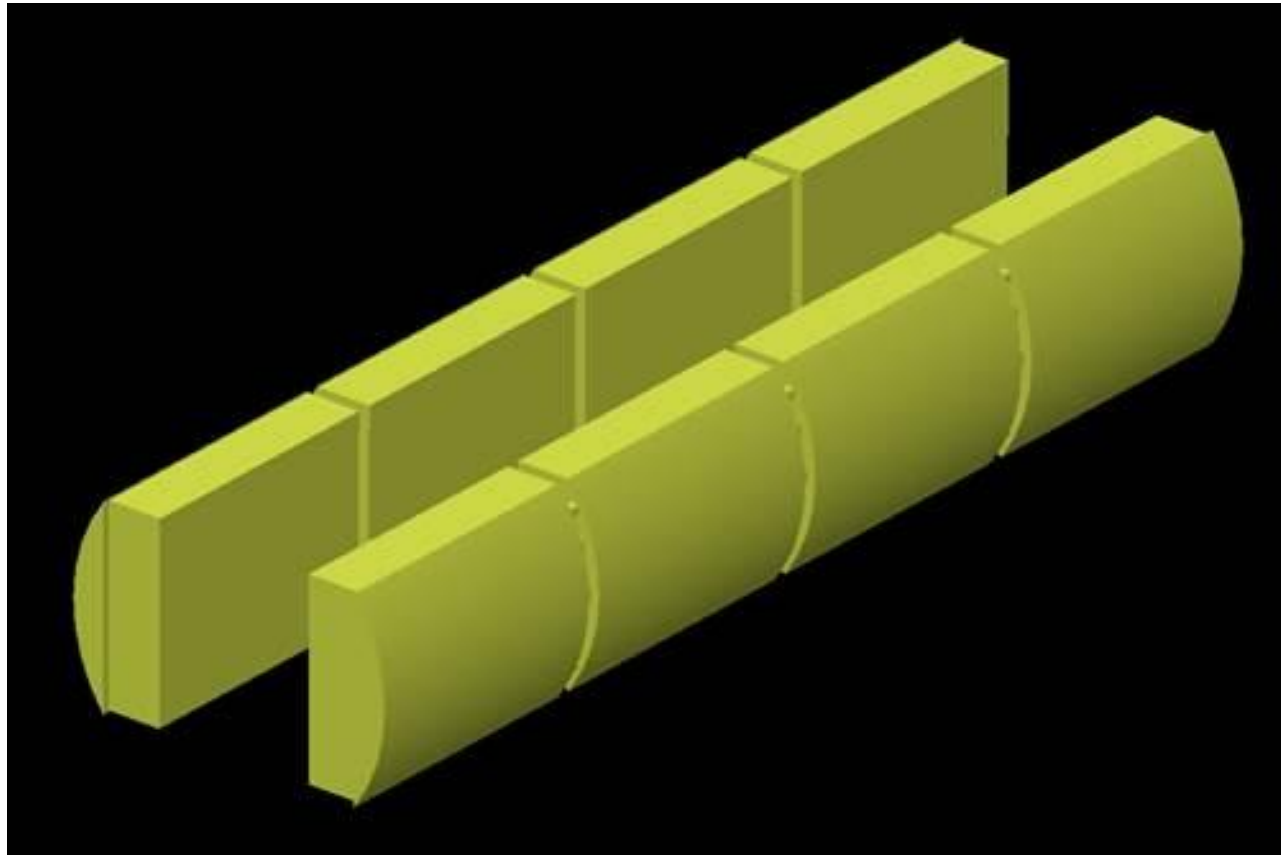


A commercial scale reactor consists of 4 cores each with a coolant header which communicates it adjacent cores via holes in supports (as shown in clipping from drawing). Volume pictured above = **54209 cubic inch per side.**

These headers are accessible by means of either coolant inlet pipes (6" SCHED 40), inspection pipes (3" SCHED 40), and thermocouple ports (2" SCHED 40) on coolant inlet side.

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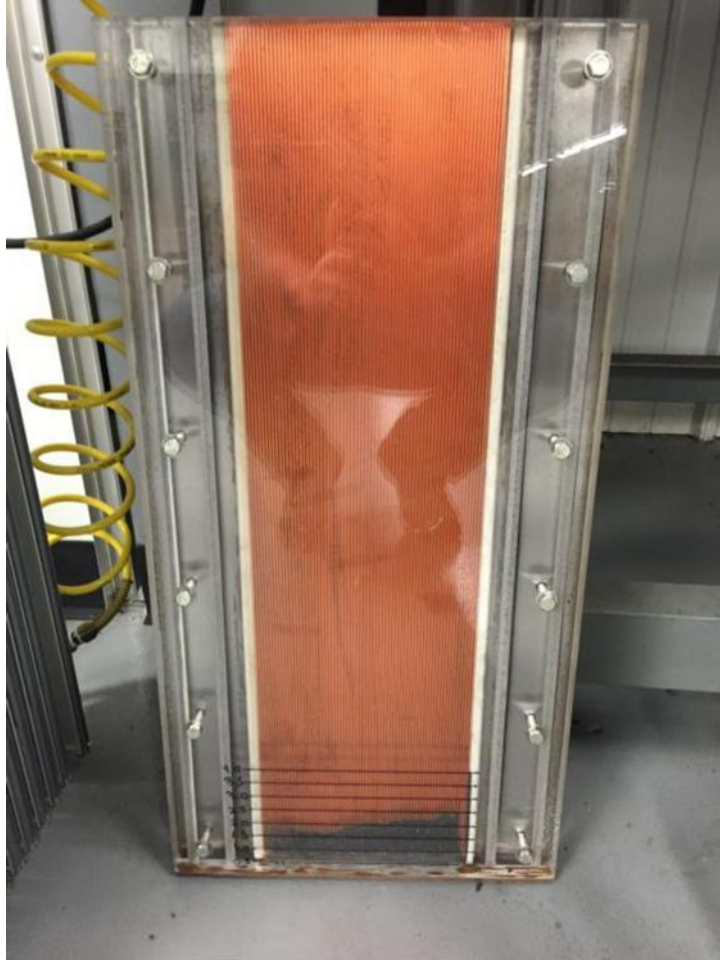
Commercial scale coolant header volume



Example of both (inlet and outlet) coolant header volumes which sit on either side of the process core. Total volume of both header volumes without inlet/inspection pipes or internal coolant channels (the volumes shown above) is nominally 108418 cubic inches.

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Loading test device



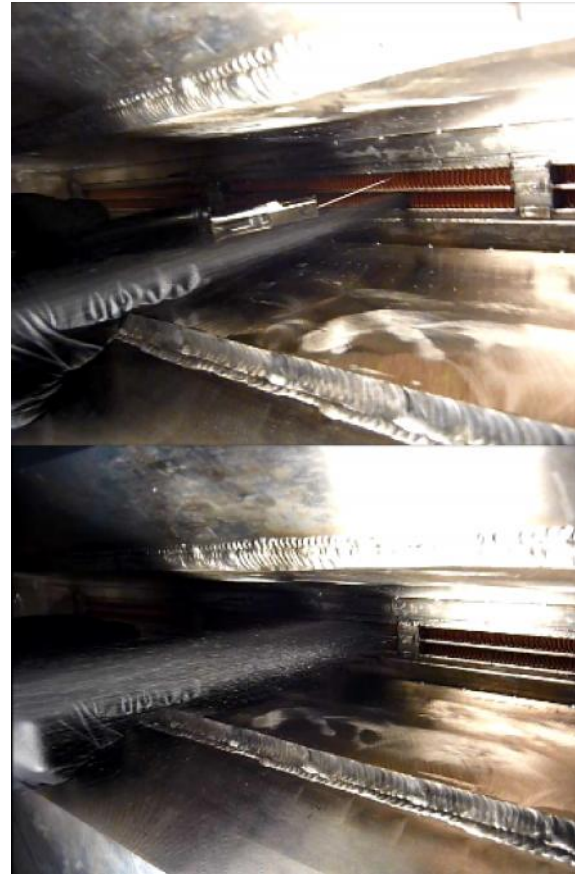
Loading test device consists of a copper waveform sandwiched between a steel plate and a clear acrylic plate to allow for visualizing catalyst loading and discharge.

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Ultrasound used for discharge



Ultrasound (22 kHz, 1000 W) applied to outlet face results in discharge



Ultrasound (20 kHz, 45 W) applied to waveforms results in significant discharge