

PRESSURE INSPECTION SUMMARY REPORT

API 510 Inspection of Pressure Vessel

E2-R3 OVERHEAD CONDENSER

Client : Chemical Specialties (S) Pte Ltd

Location : 31 Ayer Merbau Road, Jurong Island

Project : API Inspection

Project No : LEADS-23-03

Report No : LEADS-23-03-API-06 R1

Date of Inspection : 04-05 May 2023



PRESSURE VESSEL INSPECTION SUMMARY REPORT

Table of Contents

1.0 Introduction

- 1.1 Works Brief
- 1.2 General Arrangement & Reference
 - 1.2.1 Reference Documents
- 1.3 Vessel Suitability for Service Statement
 - 1.3.1 General Condition
 - 1.3.2 Structural Integrity
 - 1.3.3 Coating Integrity
 - 1.3.4 Hydraulic Integrity
- 1.4 Suitability for Service Determination
- 1.5 Inspector's Certification

2.0 Vessel Summary

- 2.1 Project Scope
- 2.2 Vessel Repair Definitions
- 2.3 Vessel Repair Recommendations
- 2.4 Vessel Design Data

3.0 Inspection Checklists and Summary

- 3.1 Vessel External (Online) Inspection
 - 3.1.1 Remaining Life Calculations
- 3.2 Vessel Internal (Offline) Inspection

4.0 NDT Inspection Reports

- 4.1 Visual Inspection Photographs
- 4.2 UTG Report




PRESSURE VESSEL INSPECTION SUMMARY REPORT

5.0 Equipment and Personnel Certificates

5.1 Equipment Calibration

5.2 Personnel Certification

6.0 General Arrangement Drawing

Originated by	P Rajesh (API 510 Certificate: 61416)	Signature: 
Approved by	Sudhan P (General Manager)	Signature:  



PRESSURE VESSEL INSPECTION SUMMARY REPORT

1.0 Introduction

1.1 Works Brief

Leads was engaged as a third-party inspection company to carry out the inspection based on API 510 which encompasses below.

An American Petroleum Institute (API) 510 pressure vessel external inspection for overhead condenser E2-R3 at CSL facility, Jurong Island, Singapore in May 2023 has been carried out. The vessel was in service, scaffolding has been provided to perform for visual inspection & UTG inspection. This inspection complied with the API 510 standard. This vessel inspection included external visual inspection of the shell, nozzles, head, foundation and internal inspection. NDT data gathered will be part of the final report.

This report is generated on data gathered from three locations: applicable codes, regulations, and laws; the observed field conditions existent during the API inspection; and material provided in written form by the facility, end-user, or client (e.g., as-builts, previous inspection reports, written transcriptions of conversations with the facility.)

This inspection report is based solely on empirically observable conditions observed during the inspection process and correspondence with the facility or end-user. Information not empirically observable or presented to us in the course of this inspection, but which may be relevant to the inspection's findings, have not been evaluated or included in this inspection. The API inspector bears no responsibility for findings which could only be ascertained by information not made available to the API inspector.

1.2 General Arrangement & Reference

This inspection report is prepared with a photo and name of each item and / or a location for reference. In addition, the report is also complemented with all the necessary equipment and personnel certification to ensure that the job was performed in line with the requirements. Please note the content of the final report and report reference numbers are number numerical in each NDT method, however they are grouped in this summary by NDT method so they may not be sequential in their grouping.

1.2.1 Reference Documents

- API 510 – Pressure Vessel Inspection Code
- Leads NDT Technical Procedures
- General Arrangement Drawing: (CSL-HX-MHI-E2R3-001, Rev 01)



PRESSURE VESSEL INSPECTION SUMMARY REPORT

1.3 Vessel Suitability for Service Statement

This report contains all the details and evaluation results used to arrive at this vessel suitability for service determination. Based on the findings and the detailed report below, we have determined that:

- The vessel can continue to operate. However, recommendations are provided for further follow up.

1.3.1 General Condition

Overhead condenser E2-R3 is vertical vessel. The vessel is approx. 3968.75 mm tall with a 685.80 mm outer diameter. Vessel was in operation from June 2018.

1.3.2 Structural Integrity

We define vessel structural integrity as the capability of the vessel to remain freestanding, with or without product, under the conditions of its design basis. Structural attributes include the vessel foundation, shell, head and their attachments. Ultrasonic thickness inspections of the shell & head were performed.

Based on our inspection of the accessible components and engineering evaluation, vessel is considered to have suitable structural integrity.

1.3.3 Coating Integrity

We define coating integrity as the interior wetted coating's ability to provide an impervious, completely continuous film barrier that prevents harmful environmental and service conditions corrosive agents to penetrate to the base metal, which could over time compromise hydraulic integrity.

Although corrosion and coating failures may not indicate structural failures; they present conditions which, in time, can lead to structural integrity failures.

Based on our inspection of the accessible components and engineering evaluation, vessel is considered to have suitable coating integrity.

1.3.4 Hydraulic Integrity

Not Applicable as Hydrotest was not part of the scope this time.



PRESSURE VESSEL INSPECTION SUMMARY REPORT

1.4 Next Inspection Schedules

External Inspection:

API 510 recommends Unless justified by an RBI assessment, each aboveground vessel shall be given a visual external inspection at an interval that does not exceed the lesser of five years or the required internal/on-stream inspection. It is preferred to perform this inspection while the vessel is in operation.

Internal, On-stream, and Thickness Measurement Inspections:

Unless justified by a RBI assessment, the period between internal or on-stream inspections and thickness measurement inspections shall not exceed one-half the remaining life of the vessel or 10 years, whichever is less. Whenever the remaining life is less than four years, the inspection interval may be the full remaining life up to a maximum of two years.

Based on the thickness measurements, we recommend the below:

- **API internal inspection (out-of-service)** shall be conducted
 - no later than **previous inspection recommendation** (shall not exceed 10 years from last internal inspection or **Aug 2028** [5.3 years from May-2023 inspection] whichever comes first)
- **UTG inspection** shall be conducted
 - no later than **Aug 2028** (5.3 years from May-2023 inspection)
- **API external inspection (in-service)** be conducted
 - no later than **May 2028** (5 years from May-2023 inspection) for a visual inspection, and

or sooner if a change in condition has occurred.

1.5 Inspector's Certification

I acknowledge that I am familiar with API Standard 510's provisions; the inspection and evaluation performed on Vessel at CSL facility and certify that the inspection was performed per the API Standard 510 provisions, good engineering practices, and with usual and customary care.



PRESSURE VESSEL INSPECTION SUMMARY REPORT

2.0 Vessel Summary

2.1 Project Scope

An API 510 vessel inspection has been performed on the vessel. This vessel inspection included external visual inspection of the vessel shell, nozzles, head, foundation (where accessible) & UTG. Following the API 510 inspection's completion, report with findings is provided detailing all vessel conditions and repair recommendations.

2.2 Vessel Repair Definitions

Mandatory Repairs – repairs that need to be completed before the vessel can be returned to service. Mandatory Repairs consists of any failure / deficiency that has breached the hydraulic and/or structural integrity of the vessel, and/or presents an imminent danger to personnel and/or adjacent structures.

Non-Mandatory Recommended Repairs Preceding Return-To-Service – repairs that do not meet the requirements of being a Mandatory Repair, but will help maintain or improve vessel operability / serviceability, or else are required to meet current codes. Repairs noted under this category are recommended for performance prior to the vessel being returned to service.

Future Non-Mandatory Recommended Repairs – repairs that do not meet the requirements of being a Mandatory Repair, but will help maintain or improve vessel operability / serviceability, or else are required to meet current codes. Unlike the Non-Mandatory Recommended Repairs Preceding Return-To-Service, Future Non-Mandatory Recommended Repairs are not being recommended for performance prior to the vessel being returned to service.

Recurring Maintenance Recommendations - actions that should be taken on a recurring basis

PRESSURE VESSEL INSPECTION SUMMARY REPORT

2.3 Vessel Repair Recommendations

The API 510 inspection has resulted in the following repair conditions:

Mandatory Repairs Preceding Return To Service	
I.1	None
Non-Mandatory Recommended Repairs Preceding Return-To-Service	
II.1	None
Future Non-Mandatory Recommended Repairs	
III.1	Minor rusting on shell from the contact with material. Recommend to fix it.
Recurring Maintenance Recommendations	
IV.1	Let the fire and safety systems be checked on an annular base by a safety engineer.
IV.2	Perform proper housekeeping on a regular base.
IV.3	Perform visual and UT inspections as per Inspection Interval Recommendation.

2.4 Vessel Design Data

DESIGN DATA		
DESIGN CODE: ASME SECTION VIII DIV1: 2017		
EQUIPMENT ITEM NO.	E2-R3	
EQUIPMENT TYPE	OVERHEAD CONDENSER	
POSITION	VERTICAL	
SHELL MATERIAL	SA-516-70	
CHANNEL HEAD	SA-240-304	
TUBESHEET MATERIAL	SA-240S31803	
TUBE MATERIAL	19.05mm [3/4"] OD x 0.85" SA-789 S31803 (AL2205 Duplex)	
TUBE LENGTH	3048 [10'-0"]	
TUBE PITCH	23.8125mm [0.9375"] TRIANGLE	
NO. TUBES	647	
	SHELL SIDE	TUBE SIDE
MEDIUM	WATER	NITROGEN GAS WITH TRACE PC @ 4 Bar g, 150°C
DESIGN PRESSURE	100 psi [6.89 bars] / F.V.	75 psi [5.171 bars] / F.V.
DESIGN TEMPERATURE	392 °F [200 °C]	392 °F [200 °C]
OPERATING PRESSURE	43.5 psi [3 bar] / F.V.	58 psig [4 bar] / F.V.
OPERATING TEMPERATURE	122 °F [50 °C]	284 °F [140 °C]
CORROSION ALLOWANCE	3.175mm [0.1250"]	1.5873mm [0.625"]
NUMBER OF PASSES	1	1
REQUIRED MDMT	16°C	16°C
CALCULATED MDMT	-37°C	-195°C
MAWP	229.74 psi [15.84 bar]	139.5 [9.62 bar]
HYDROTEST PRESSURE	130.5 [9 bar]	114.87 [7.92 bar]
FLOW RATE		
OPERATING S.G.	1.0	0.00318025
DESIGN S.G.	1.0	1.3
VISCOSITY		
YEAR MANUFACTURED	1989	1989
WIND DESIGN CODE	ASCE- 03	
WIND SPEED	22 m/s	
EARTHQUAKE DESIGN CODE	NO SEISMIC	
EMPTY WEIGHT	2641.7 KG	
OPERATING WEIGHT	3141.0 KG.	
FULL WEIGHT	3780.2 KG.	

PRESSURE VESSEL INSPECTION SUMMARY REPORT

3.0 Inspection Checklists and Summary

The following inspection summaries list all noted deficiencies and the governing criteria with which they fail to comply fully.

3.1 Vessel External (Online) Inspection

Ladders, Stairways, Platform, Walkways (API 572 Sec 9.3.2) :		
1	Ladder attachments to concrete base (corrosion, broken):	NA
2	Bolts and fasteners on stairways and ladder stringers (tightness and corrosion):	NA
3	Welds on stairways and ladder stringers (corrosion, broken):	NA
4	Welds on spiral stairway to shell supports (corrosion, broken):	NA
5	Stairways and ladders (corrosion, broken):	NA
6	Stairways and ladders (coating or paint failure):	NA
7	Attachment welds of handrails to stairways (corrosion, broken):	NA
8	Tubular / solid bar stairway handrails (corrosion, pitting, paint failure):	NA
9	The condition of flooring on platforms and walkways	NA
10	Crevice corrosion around the heads of bolts and nuts at bracket connections	NA
11	Loose or broken parts found any	NA
Foundation and Supports (API 572 sec 9.3.3)		
12	Plumpness of column supporting spherical tank	NA
13	Settlement Survey	NA
14	Condition of connected pipe lines due to settlement	NA
15	Misalignment of the foundation with the surrounding paving or ground due to settlement	NA
16	Check for deterioration such as spalling, cracking, and settling on the foundation	NA
Anchor Bolts (API 572 sec 9.3.4)		
17	Check for deterioration of the anchor bolt below the base plate	NA
18	Distortion of anchor bolts due to foundation settlement if any	NA
19	Tightness of nuts	NA
Concrete Support (API 572 sec 9.3.5)		
20	Sealing condition between concrete support and vessel shell	NA



PRESSURE VESSEL INSPECTION SUMMARY REPORT

Steel Support (API 572 sec 9.3.6)		
21	Check for corrosion, distortion, and cracking	2
22	Remaining thickness of (Skirts, Columns and bracing)	U/A
23	Check for buckling, Excessive Deflection (measurement by straightedge or plumb line)	2
24	NDE (MT /PT) result of attachment weld supporting tank	NA
25	Insulation condition of supporting skirts	NA
26	Piping attachment to Spherical tank (Check for evidence of distortion due to pipe movement)	NA
27	Fireproofing Condition (Bulge , Rust stain, Crack)	2
Guy Wires (API 572 sec 9.3.8)		
28	Check for corrosion and broken strands	NA
Nozzles (API 572 sec 9.3.9)		
29	Check for distortion due to settlement	2
30	Nozzles painting / coating condition	2
31	Nozzles corrosion pitting condition	2
32	Check for flange leak (discoloration to the vessel, insulation, fireproofing, or paint, or damage)	2
33	Thickness survey reading	2
Grounding Connections (API 572 sec 9.3.10)		
34	Tightness, positive bonding to the vessels, and corrosion, Continuity of wires	2
35	Recommended Resistance achieved (5 to 25 Ohms)	NA
Auxiliary Equipment (API 572 sec 9.3.11)		
36	Evidence of Vibration if any	2
37	Drain lines and other connected piping	2
38	Gauges for liquid level, pressure, and temperature and other instruments	2
39	Safety and relief valves	NA
40	External water sprays and other fire-fighting equipment	NE
41	Instrument or utility stations	NA
42	Structural steel for platforms, supports, and lifting lugs	NA
Protective Coatings and Insulation (API 572 sec 9.3.12)		
43	Check for Rust spots, blisters, and film lifting	2
44	Condition of Insulation	NA

PRESSURE VESSEL INSPECTION SUMMARY REPORT

External Metal Surfaces (API 572 sec 9.3.13)		
45	Picking, scraping, and limited hammering	2
46	General external painting / coating condition	2
47	General external corrosion pitting condition	2
48	Thickness survey reading	2
49	NDE (MT / PT) results of support attachment location	NA
50	Condition of weld joints wherever accessible (lower and upper equator plate, lower and upper temperate, top and bottom center crown weld joints)	2
Roof //Shell Appurtenances		
51	Manway covers secured in place, condition:	2
52	Roof nozzles condition:	NA
53	Roof Platform condition:	NA

Legend:

1	Good Condition	3	Repair or alteration recommended	U/A	Un-assessable
2	Satisfactory Condition	4	Repair or alteration required	NE	None Evident
xx	Not to Code			N/A	Not applicable

Comments:

- Generally, in satisfactory condition.
- Minor rusting on shell from the contact with material. Recommend to fix it.



PRESSURE VESSEL INSPECTION SUMMARY REPORT

3.1.1 Remaining Life Calculations:

SHELL:

When P does not exceed 0.385SE, the following formula shall apply:

$$t = \frac{PR}{SE - 0.6P} * 25.4$$

- t_{min} is the minimum required thickness in mm,

Material - SA 516 Grade 70

P (internal design pressure, lbf/in.²) - 100

R (inside radius, in.) - 13.50

S (Max. allowable stress, lbf/in.²) - 20000 (for temp 400 °F Ref ASME Sec II – part D – Table 1A)

E (Joint Efficiency) - 0.7 (no RT details available)

$$t = 2.46 \text{ mm}$$

Corrosion allowance from drawings = 3.175mm

Actual lowest thickness – 8.01mm (0.315 in)

Maximum Allowable working pressure (MAWP) for the noted thickness:

$$P = \frac{SEt}{R + 0.6t}$$

$$P = 333.23 \text{ psi}$$

PRESSURE VESSEL INSPECTION SUMMARY REPORT

CHANNEL CAP:

$$t = \frac{PD}{2SE - 0.2P} * 25.4$$

- t_{min} is the minimum required thickness in mm,

Material - SA 240 304

P (internal design pressure, lbf/in.²) - 100

D (inside diameter, in.) - 13.50

S (Max. allowable stress, lbf/in.²) - 13800 (for temp 400 °F, Ref ASME Sec II – part D – Table 1A)

E (Joint Efficiency) - 0.7 (no RT details available)

t=3.57mm

Corrosion allowance from drawings = 3.175mm

Remaining Life = $t_{actual} - t_{required}$ / corrosion rate

Plate No.	Original Thickness (mm)	Actual lowest Thickness (mm)	Wall loss (mm)	Years of Service	Long Term Corrosion Rate (mm/year)	Min. required thickness, incl CA (mm)	Remaining Life (Years)	Next recommended UTG
Shell	9.52	8.28	NA	5	0.248	5.63	10.6	5.3 years
Top Channel Head	9.52	9.82	NA	5	NA	6.75	Note 1	10 years
Bottom Channel Head	9.52	9.70	NA	5	NA	6.75	Note 1	10 years

- UTG report number: LEADS-23-CSL-UTG-12
- Note 1: Remaining life cannot be calculated as the actual thickness is higher than the design thickness.



PRESSURE VESSEL INSPECTION SUMMARY REPORT

3.2 Vessel Offline Inspection

Internal Nozzles		
1	Check for distortion due to settlement	NA
2	Check for flange leak (discoloration to the vessel, insulation, fireproofing, or paint, or damage)	NA
3	Thickness survey reading	NA
Internal Linings / Coatings / Cladding		
4	Check for Rust spots, blisters, and film lifting	NA
5	Check for cracks, openings	NA
6	Others	NA
Internal Metal Surfaces		
7	Picking, scraping, and limited hammering	NA
8	NDE (MT / PT) results of support attachment location	NA
9	Condition of weld joints wherever accessible (lower and upper equator plate, lower and upper temperate, top and bottom center crown weld joints)	NA
Internal Evidence of Corrosion		
10	Evidence of Atmospheric corrosion, caustic embrittlement, hydrogen blistering, and soil corrosion	NA
Internal Appurtenances		
11	Manway covers secured in place, condition:	NA
12	Attachment welds condition	NA
13	Baffle / Weir / Impingement Plates / Mixer /Agitator / Heating coil / Thermowells / Tray / Distributor (where applicable) condition:	NA



PRESSURE VESSEL INSPECTION SUMMARY REPORT

4.0 NDT Inspection Reports

4.1 Visual Inspection Photographs

4.2 UTG Report

PRESSURE VESSEL INSPECTION SUMMARY REPORT

4.1 Visual Inspection Photographs



Photo 1: Name plate observed in satisfactory condition.



Photo 2: Shell with was observed in Satisfactory condition with coating

PRESSURE VESSEL INSPECTION SUMMARY REPORT



Photo 3: Shell pipe with was observed in Satisfactory condition in general. One location got minor rusting from the material in contact with the shell.



Photo 4: Bottom shell & channel flange joint were in satisfactory condition

PRESSURE VESSEL INSPECTION SUMMARY REPORT



Photo 5: Bottom shell nozzle was in satisfactory condition with rust bleeding



Photo 6: Shell & bottom channel were in satisfactory condition

PRESSURE VESSEL INSPECTION SUMMARY REPORT



Photo 7: Shell was observed in satisfactory condition



Photo 8: Top shell nozzle was in satisfactory condition

PRESSURE VESSEL INSPECTION SUMMARY REPORT



Photo 9: Top shell nozzle was observed in satisfactory condition.



Photo 10: During ultrasonic thickness measurement in top shell pipe and top flange area

PRESSURE VESSEL INSPECTION SUMMARY REPORT



Photo 11: During ultrasonic thickness measurement in nozzle and top flange area.



PRESSURE VESSEL INSPECTION SUMMARY REPORT

4.2 Ultrasonic Thickness Measurement Report




Client	: Chemical Specialties (Singapore) Pte Ltd	Report No.	: LEADS-23-CSL-UTG-012
Client Address	: 31 Ayer Merbau Rd, Singapore 627717	Inspection Date	: 04-05-2023
Project Name.	: E2-R3 Overhead Condenser	Report Date	: 05-05-2023
Location	: 31 Ayer Merbau Rd	Leads Ref No.	: LSS/23-05/018
Item Description	: E2-R3 Overhead Condenser	Client Request No.	: NA

Eq.Make / Model	: 38 DL PLUS	Test Mode	: Auto Echo to Echo	Procedure	: LEADS-IMSP-035 REV-02
Eq. Serial No	: 193390803	Screen Range	: 0-50mm	Standard	: ASME Sec V Art 23 SE-797 Ed 2019
Probe Frequency	: 5 MHZ	Material	: Carbon Steel / Stainless Steel	Drawing No.	: Refer attached Drawing
Probe Serial No	: 1123940	Surface Cond.	: Smooth	Couplant Type	: Wallpaper paste
Probe Size Ø	: 11mm	Probe Type	: Thru-Coat Dual / D7906	Cal Block(Sr.No)	: Step Wedge(3E/2-20mm/cs/24) / SS-018

S/NO	Item Description	UTG Measurement (mm)				Min	Max	AVG	Remarks
		North	East	South	West	mm	mm		
1	Top Channel - Location 1 (SS)	10.29	10.15	10.12	10.25	10.12	10.29	10.20	
2	Top Channel - Location 2 (SS)	9.90	9.87	9.85	10.08	9.85	10.08	9.93	
3	Top Channel - Location 3 (SS)	9.89	9.89	9.82	10.05	9.82	10.05	9.91	
4	Top Channel - Location 4 (SS)	9.98	10.04	9.90	10.02	9.90	10.04	9.99	
5	Top Channel - Location 5 (SS)	10.05	10.13	9.98	10.18	9.98	10.18	10.09	
6	Shell - Location 1 (CS)	8.61	8.17	8.98	9.08	8.17	9.08	8.71	
7	Shell - Location 2 (CS)	9.07	8.92	8.92	8.66	8.66	9.07	8.89	
8	Shell - Location 3 (CS)	8.28	8.78	8.63	8.56	8.28	8.78	8.56	
9	Shell - Location 4 (CS)	8.30	8.48	8.40	8.30	8.30	8.48	8.37	
10	Bottom Channel - Location 1 (SS)	10.20	10.31	10.23	10.28	10.20	10.31	10.26	
11	Bottom Channel - Location 2 (SS)	10.01	9.98	9.70	9.72	9.70	10.01	9.85	
12	Bottom Channel - Location 3 (SS)	9.98	10.07	10.09	9.73	9.73	10.09	9.97	
13	Bottom Channel - Location 4 (SS)	10.10	10.48	10.19	10.21	10.10	10.48	10.25	
14	Bottom Channel - Location 5 (SS)	10.22	10.25	10.31	10.15	10.15	10.31	10.23	

Item Description	Top	Right	Bottom	Left	Min (mm)	Max (mm)	AVG	
15 Outlet Nozzle (CS)	13.78	13.75	13.30	13.48	13.30	13.78	13.58	
16 Inlet Nozzle (CS)	11.98	11.83	11.78	11.69	11.69	11.98	11.82	

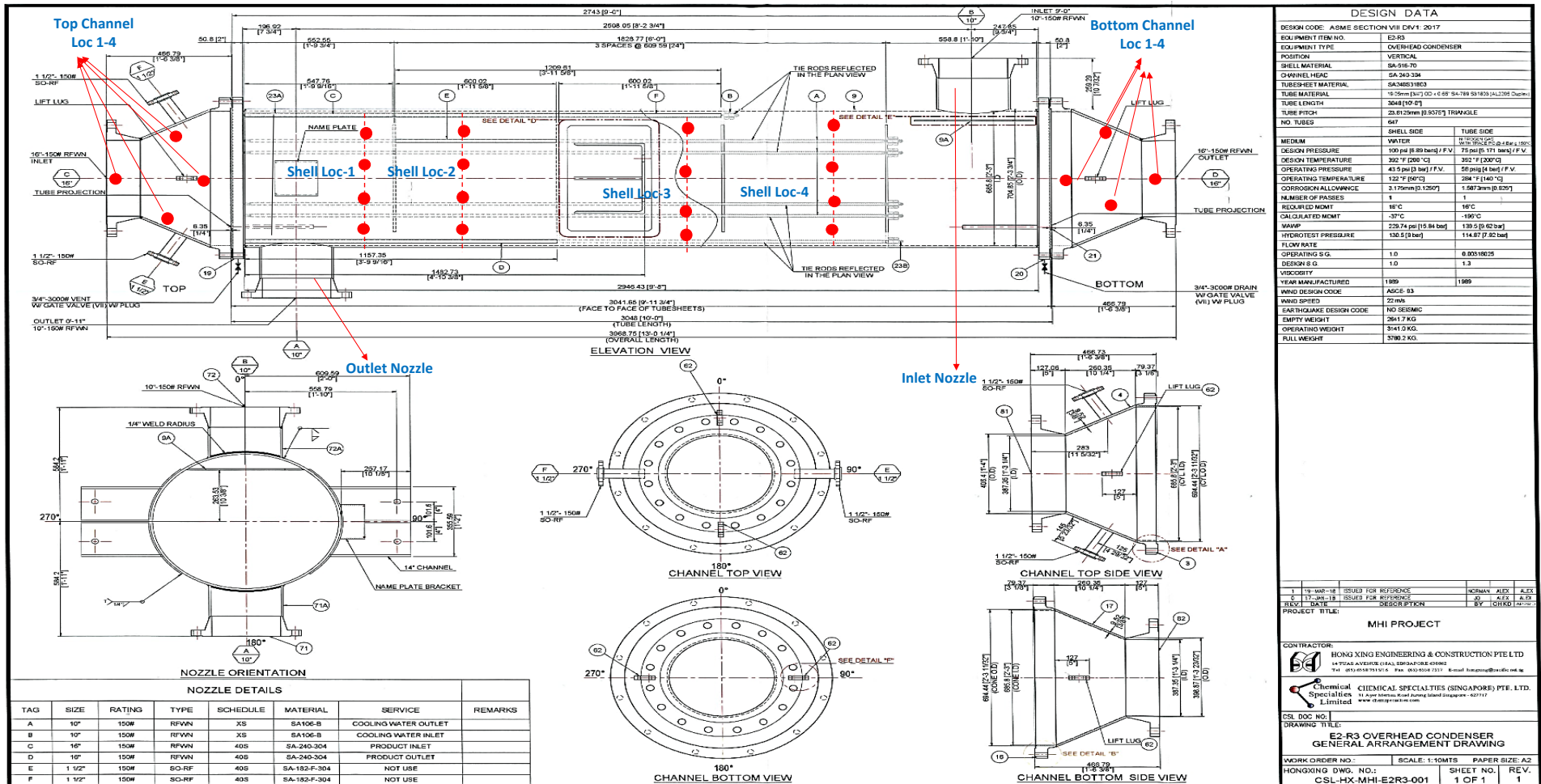
Leads Address : Leads Specialist Services Pte Ltd, Platinum@Pioneer, 32F Tuas Ave 11, Singapore 636855

Inspected By (Signature)	Approved By (Signature)	NDT Level III	CLIENT REP. (Signature)
 AL-MAHMUD 05-05-2023	 B. CHINNADURAI 05-05-2023	 P. RAJESH 05-05-2023	

- The report shall not be reproduced except in full, unless the management representative of the accredited organisation has given Approval in writing.
- The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council.
- Leads stand no responsibilities for changes in the quality of the same product tested in later stage with same variables but different conditions.

Client : Chemical Specialties (Singapore) Pte Ltd	Report No. : LEADS-23-CSL-UTG-012
Client Address : 31 Ayer Merbau Rd, Singapore 627717	Inspection Date : 04-05-2023
Project Name : E2-R3 Overhead Condenser	Report Date : 05-05-2023
Location : 31 Ayer Merbau Rd	Leads Ref No. : LSS/23-05/018
Item Description : E2-R3	Client Request No. : NA

UTG LOCATION MARKING





PRESSURE VESSEL INSPECTION SUMMARY REPORT

5.0 Equipment and Personnel Certificates

5.1 Equipment Calibration

5.2 Personnel Certification



PRESSURE VESSEL INSPECTION SUMMARY REPORT

5.1 Equipment Calibration



DIGITAL ULTRASONIC THICKNESS GAUGE CALIBRATION CERTIFICATE

Calibration Certificate No : LEADS-23-UTG-04

Date of Calibration : 29/12/2022

Client : LEADS

Equipment Details

Model & Make : 38DL PLUS & OLYMPUS

Product : DIGITAL ULTRASONIC THICKNESS GAUGE

Serial No : 193390803

Ambient Temperature : (24±2) ° C

Relative Humidity : (35 to 70) % RH

Calibration Accessories

Block Serial No : 5 Step Block

Certificate No. : BLD1903901-1S

This is to certify that the above instruments having serial no. 193390803 has been calibrated Under the ambient Conditions Stated according calibration Procedure ISO 16831:2012 the UTG was calibrated by comparison with a reference Calibration block the reference Standards are traceable to National Standards.

Calibration Date: 29/12/2022

Calibration Due Date: 28/12/2023

Calibrated by

Approved By

Name : M. Bharath

Name : P.Rajesh

Signature :

Signature :



Date : 29-12-2022

Date : 29-12-2022



S/No.	Reference Readings	Test Readings	Deviation	Results
1	12.5 mm	12.52	+0.02	Passed
2	10.0 mm	10.00	0.00	Passed
3	7.5 mm	7.51	+0.01	Passed
4	5.0 mm	5.02	+0.02	Passed
5	2.5 mm	2.52	+0.02	Passed

The expanded Uncertainty of measurement found to be 0. 02 mm at Confidence level is approximately 95% with coverage factor $K = 2$



PRESSURE VESSEL INSPECTION SUMMARY REPORT

5.2 Personnel Certification

API INDIVIDUAL CERTIFICATION PROGRAMS



verifies that

Peramaiyan Rajesh

HAS MET THE ESTABLISHED AND PUBLISHED REQUIREMENTS FOR API CERTIFICATION AS AN
API 510 PRESSURE VESSEL INSPECTOR

IN ACCORDANCE WITH THE KNOWLEDGE DEFINED IN THE **API Standard 510**

CERTIFICATION NUMBER **61416**

ORIGINAL CERTIFICATION DATE	September 30, 2015
CURRENT CERTIFICATION DATE	September 30, 2021
EXPIRATION DATE	September 30, 2024

Director, Individual Certification Programs





NDT CERTIFICATION

Certificate Reference No: LEADS-IMSC-NDTC-048

Date of Issue: 29/01/2020

Date of Expiry: 28/01/2025

This is to certify and authorize **Al Mahmud Mohammad (G2712531Q)** Represent Leads Specialist Services Pte. Ltd, to work in the following NDT methods, as he satisfactorily met the qualification and certification requirements of company written practice LEADS-IMSP-0029 Rev 02, which is based on ASNT RP No SNT-TC-1A 2016 Ed.



Method	NDT Level	Scope/Sectors/Categories
Magnetic Particle Inspection	Level II	Electromagnetic yoke, Visible/ Fluorescent, Dry/ Wet Particles
Ultrasonic Test	Level II	Flaw Detection
Liquid Penetrant Inspection	Level II	Visible/ Fluorescent
Ultrasonic Thickness Gauging	Level II	A Scan Thickness & Spot Measurement
Radiography Test	Level II	Radiography

This record is only evidence of competence when supported by the following evidence as specified by the minimum requirements of leads specialist services pte ltd competence management system

- Valid eye test
- Prior experience
- Examination
- No Interrupted Services of the respective NDT Methods with the previous 6 months

This inspector has met lead's requirements for the respective methods: this record is only valid during employment with Leads Specialist services pte ltd

This document is uncontrolled if printed: authorization history can be provided on demand

Authorized by	Position	Date	Signature
P. Sudhan	Operation Manager	29/01/2020	
Sengottaian Velmurugan	ASNT Level III	29/01/2020	

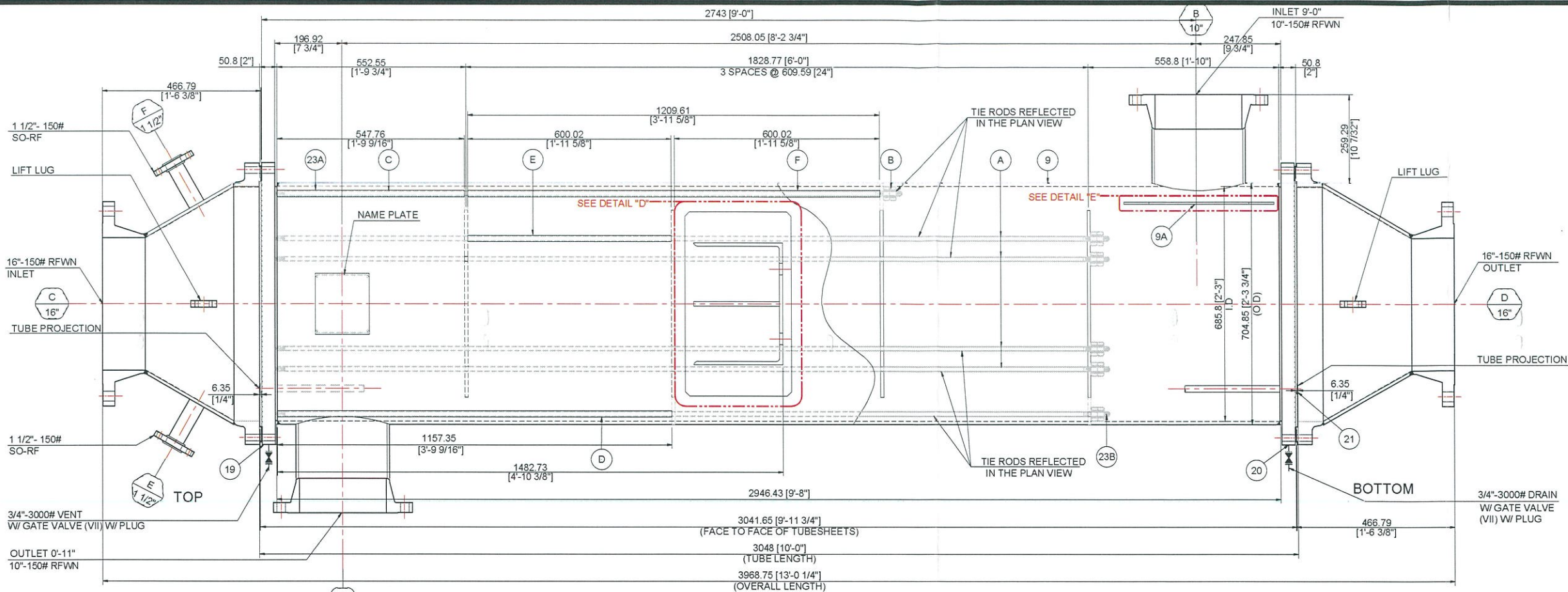
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SINGAPORE 637601
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IMSF-028 Rev-00

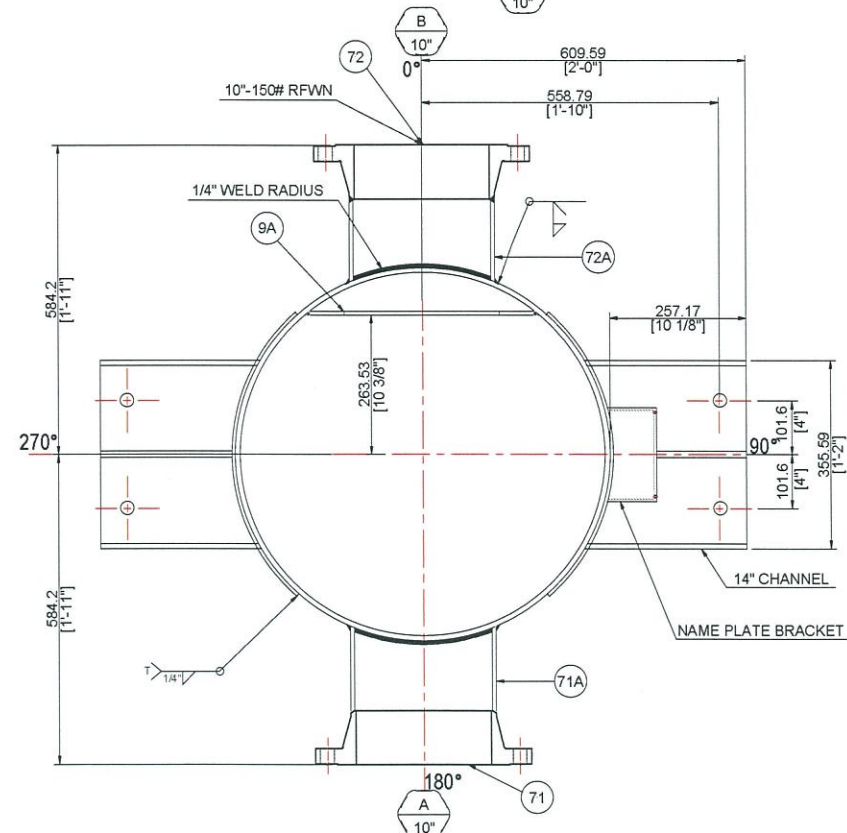


PRESSURE VESSEL INSPECTION SUMMARY REPORT

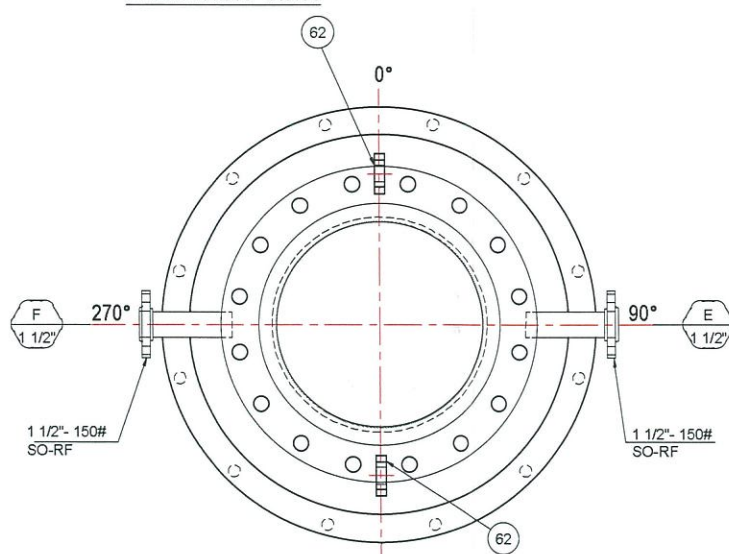
6.0 General Arrangement Drawing



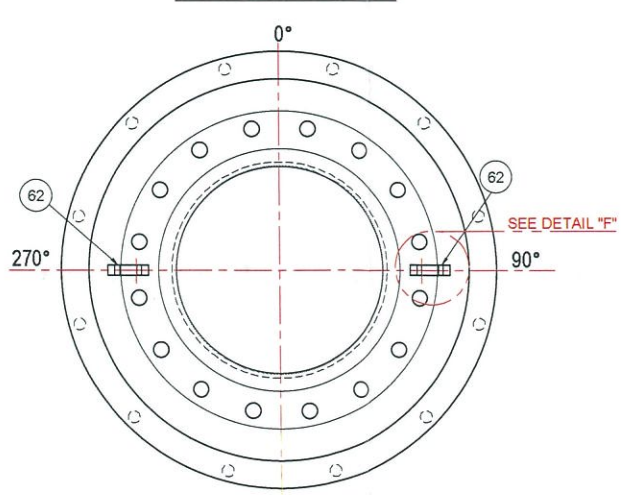
ELEVATION VIEW



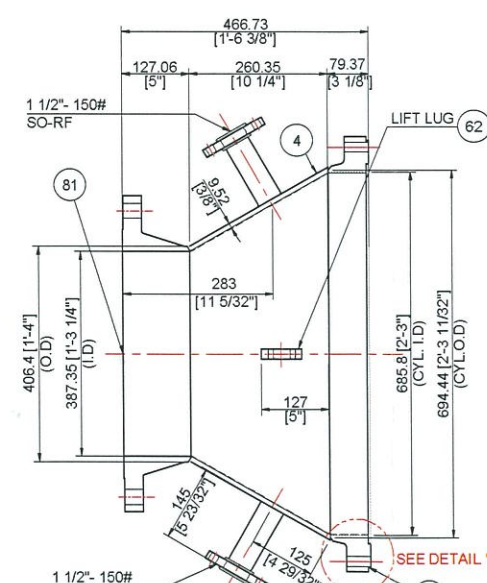
NOZZLE ORIENTATION



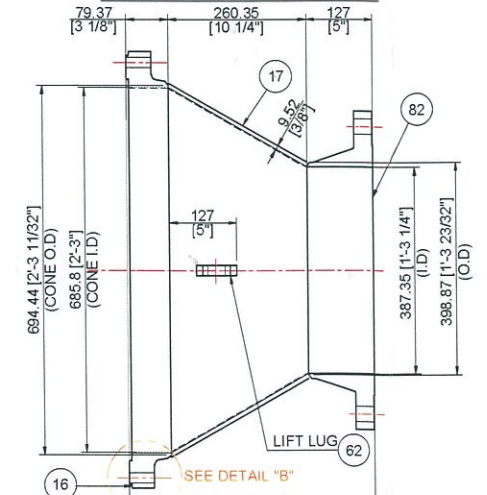
CHANNEL TOP VIEW



CHANNEL BOTTOM VIEW



CHANNEL TOP SIDE VIEW



CHANNEL BOTTOM SIDE VIEW

DESIGN DATA

DESIGN CODE:	ASME SECTION VIII DIV1: 2017	
EQUIPMENT ITEM NO.	E2-R3	
EQUIPMENT TYPE	OVERHEAD CONDENSER	
POSITION	VERTICAL	
SHELL MATERIAL	SA-516-70	
CHANNEL HEAD	SA-240-304	
TUBESHEET MATERIAL	SA240S31803	
TUBE MATERIAL	19.05mm [3/4"] OD x 0.85" SA-789 S31803 (AL2205 Duplex)	
TUBE LENGTH	3048 [10'-0"]	
TUBE PITCH	23.8125mm [0.9375"] TRIANGLE	
NO. TUBES	647	
	SHELL SIDE	TUBE SIDE
MEDIUM	WATER	NITROGEN GAS WITH TRACE PO @ 4 Bar g 150°C
DESIGN PRESSURE	100 psi [6.89 bars] / F.V.	75 psi [5.171 bars] / F.V.
DESIGN TEMPERATURE	392 °F [200 °C]	392 °F [200 °C]
OPERATING PRESSURE	43.5 psi [3 bar] / F.V.	58 psig [4 bar] / F.V.
OPERATING TEMPERATURE	122 °F [50 °C]	284 °F [140 °C]
CORROSION ALLOWANCE	3.175mm [0.1250"]	1.5873mm [0.625"]
NUMBER OF PASSES	1	1
REQUIRED MDMT	16°C	16°C
CALCULATED MDMT	-37°C	-196°C
MAWP	229.74 psi [15.84 bar]	139.5 [9.62 bar]
HYDROTEST PRESSURE	130.5 [9 bar]	114.87 [7.92 bar]
FLOW RATE		
OPERATING S.G.	1.0	0.00318025
DESIGN S.G.	1.0	1.3
VISCOSITY		
YEAR MANUFACTURED	1989	1989
WIND DESIGN CODE	ASCE-93	
WIND SPEED	22 m/s	
EARTHQUAKE DESIGN CODE	NO SEISMIC	
EMPTY WEIGHT	2641.7 KG	
OPERATING WEIGHT	3141.0 KG	
FULL WEIGHT	3780.2 KG	

REV.	DATE	DESCRIPTION	BY	CHKD	APPRD
1	19-MAR-18	ISSUED FOR REFERENCE			
0	17-JAN-18	ISSUED FOR REFERENCE			

PROJECT TITLE: MHI PROJECT

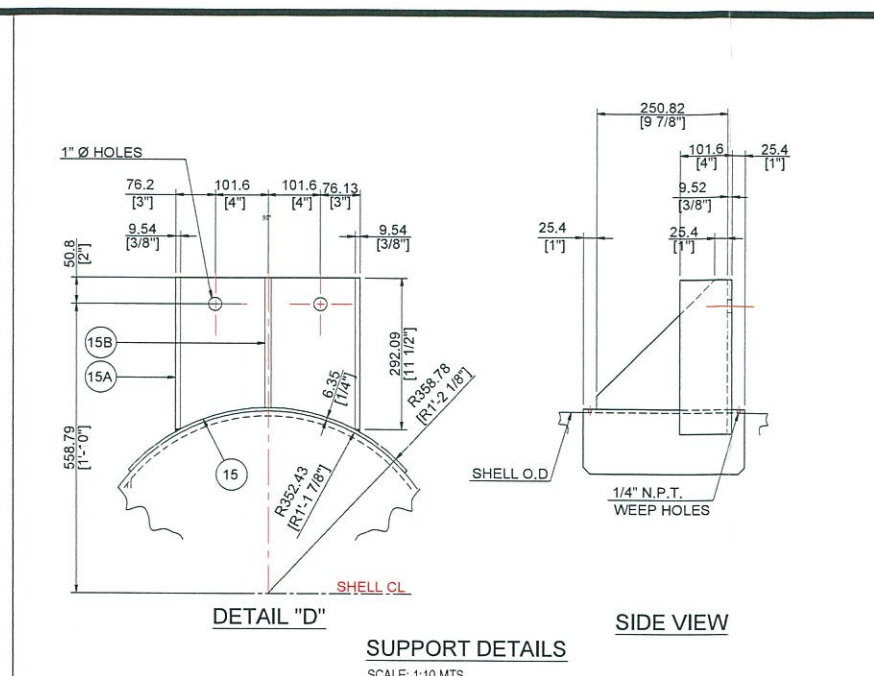
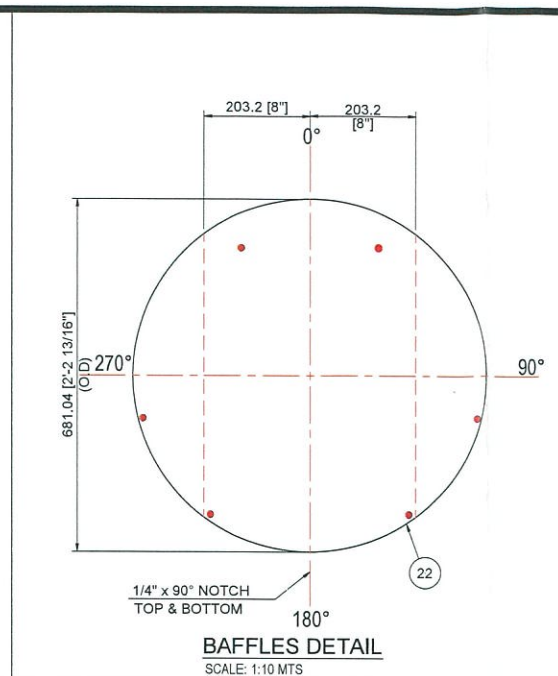
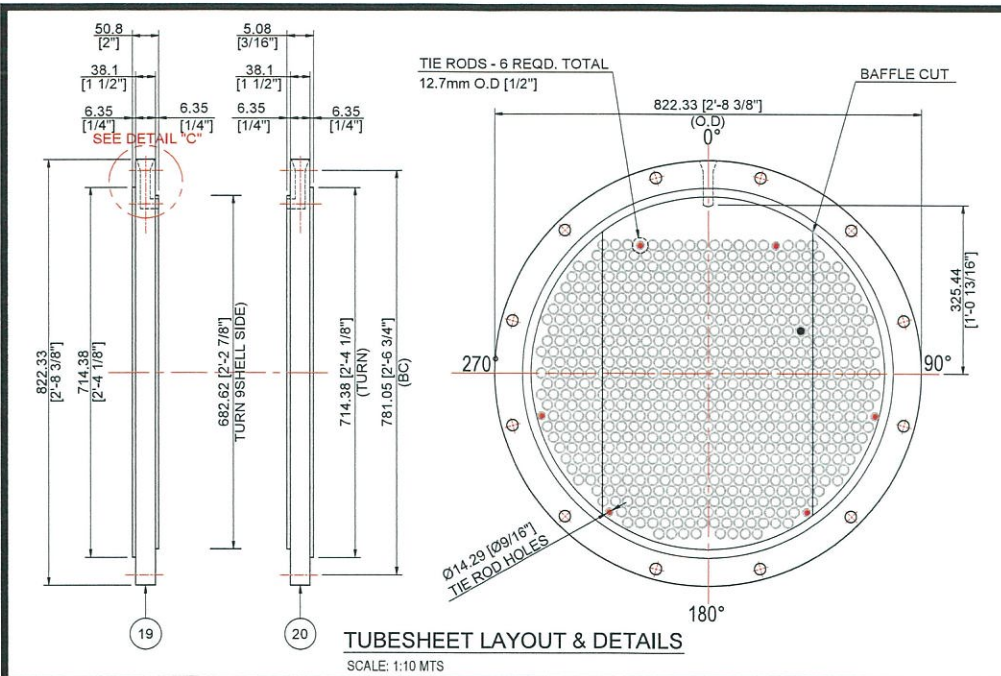
CONTRACTOR: HONG XING ENGINEERING & CONSTRUCTION PTE LTD
14 TUAS AVENUE (18A), SINGAPORE 638062
Tel (65) 6558 7515/16 Fax (65) 6558 7517 E-mail hongxing@pacific.net.sg

Chemical Specialties Limited
CHEMICAL SPECIALTIES (SINGAPORE) PTE. LTD.
31 Ayer Merbau Road Jurong Island Singapore - 627117
www.chemspecialties.com

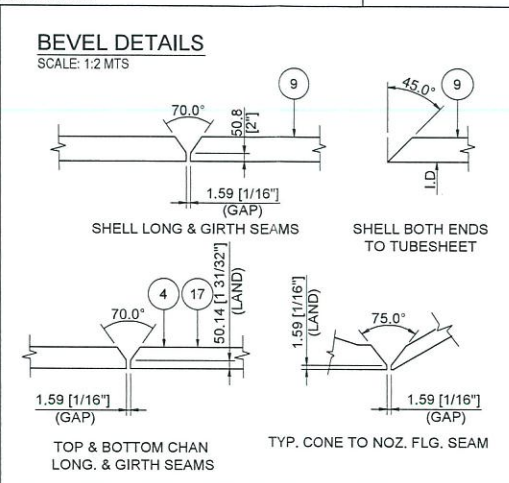
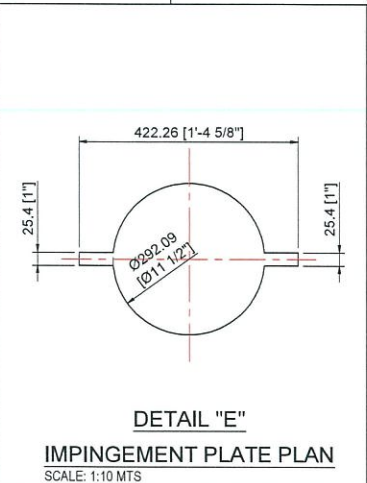
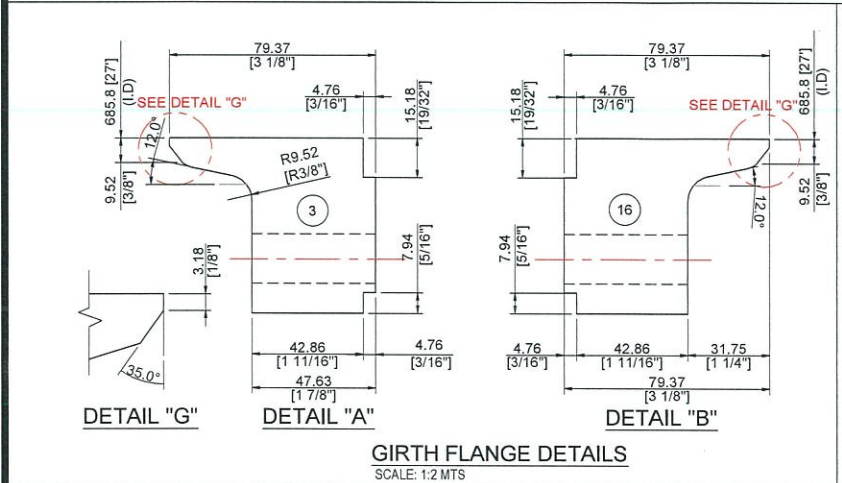
CSL DOC NO: E2-R3 OVERHEAD CONDENSER
DRAWING TITLE: GENERAL ARRANGEMENT DRAWING

WORK ORDER NO.: SCALE: 1:10MTS PAPER SIZE: A2
HONGXING DWG. NO.: CSL-HX-MHI-E2R3-001 SHEET NO. 1 OF 1 REV. 1

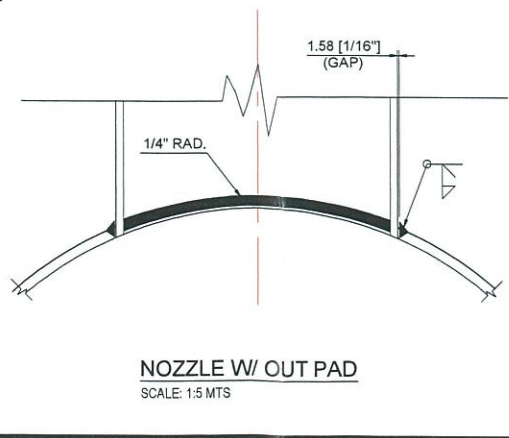
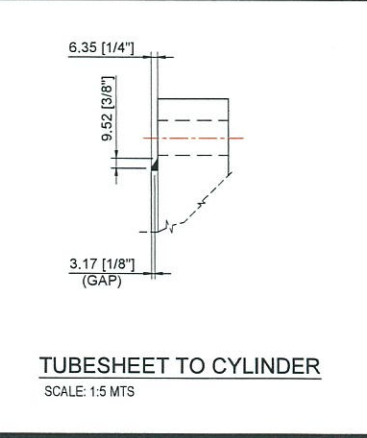
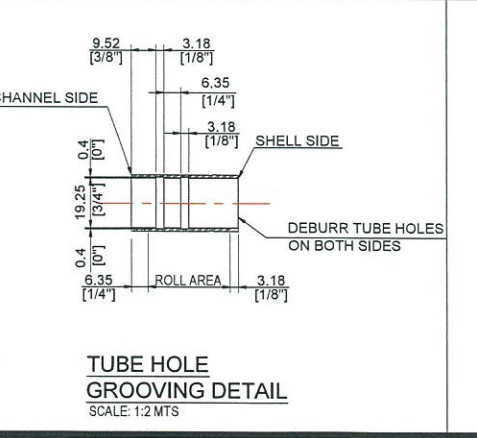
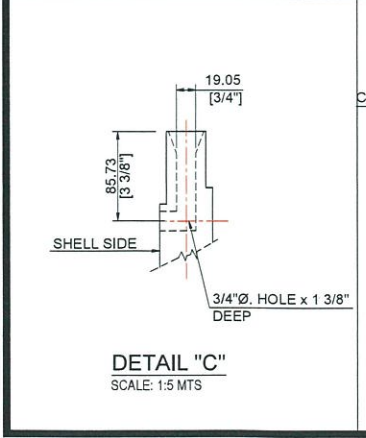
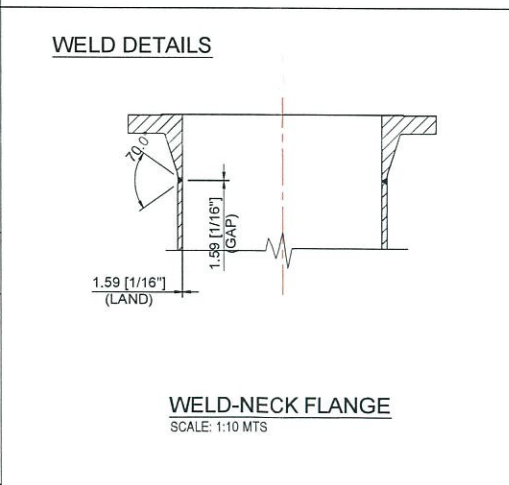
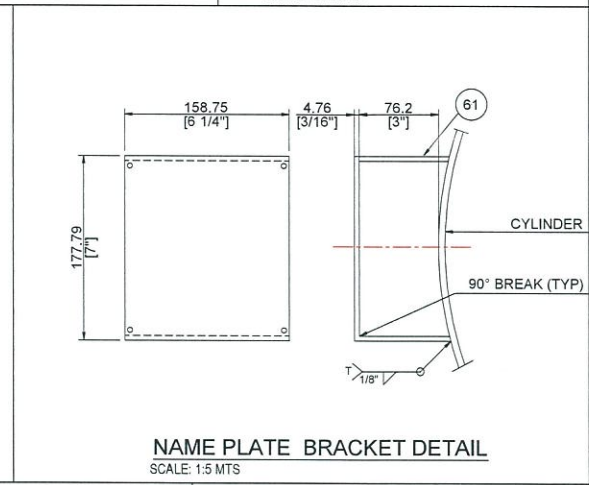
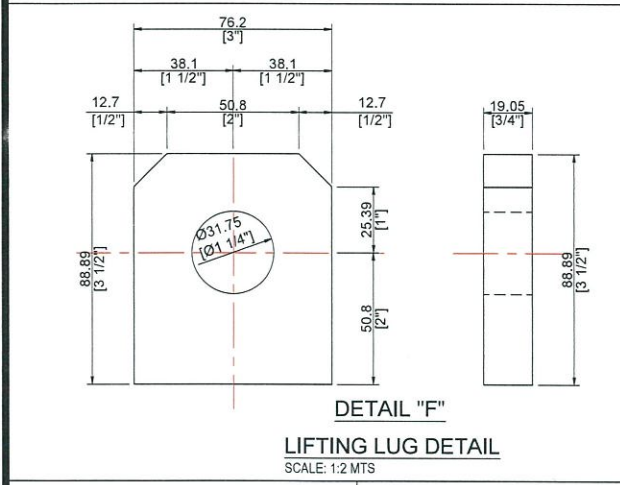
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A	10"	150#	RFWN	XS	SA106-B	COOLING WATER OUTLET	
B	10"	150#	RFWN	XS	SA106-B	COOLING WATER INLET	
C	16"	150#	RFWN	40S	SA-240-304	PRODUCT INLET	
D	16"	150#	RFWN	40S	SA-240-304	PRODUCT OUTLET	
E	1 1/2"	150#	SO-RF	40S	SA-182-F-304	NOT USE	
F	1 1/2"	150#	SO-RF	40S	SA-182-F-304	NOT USE	



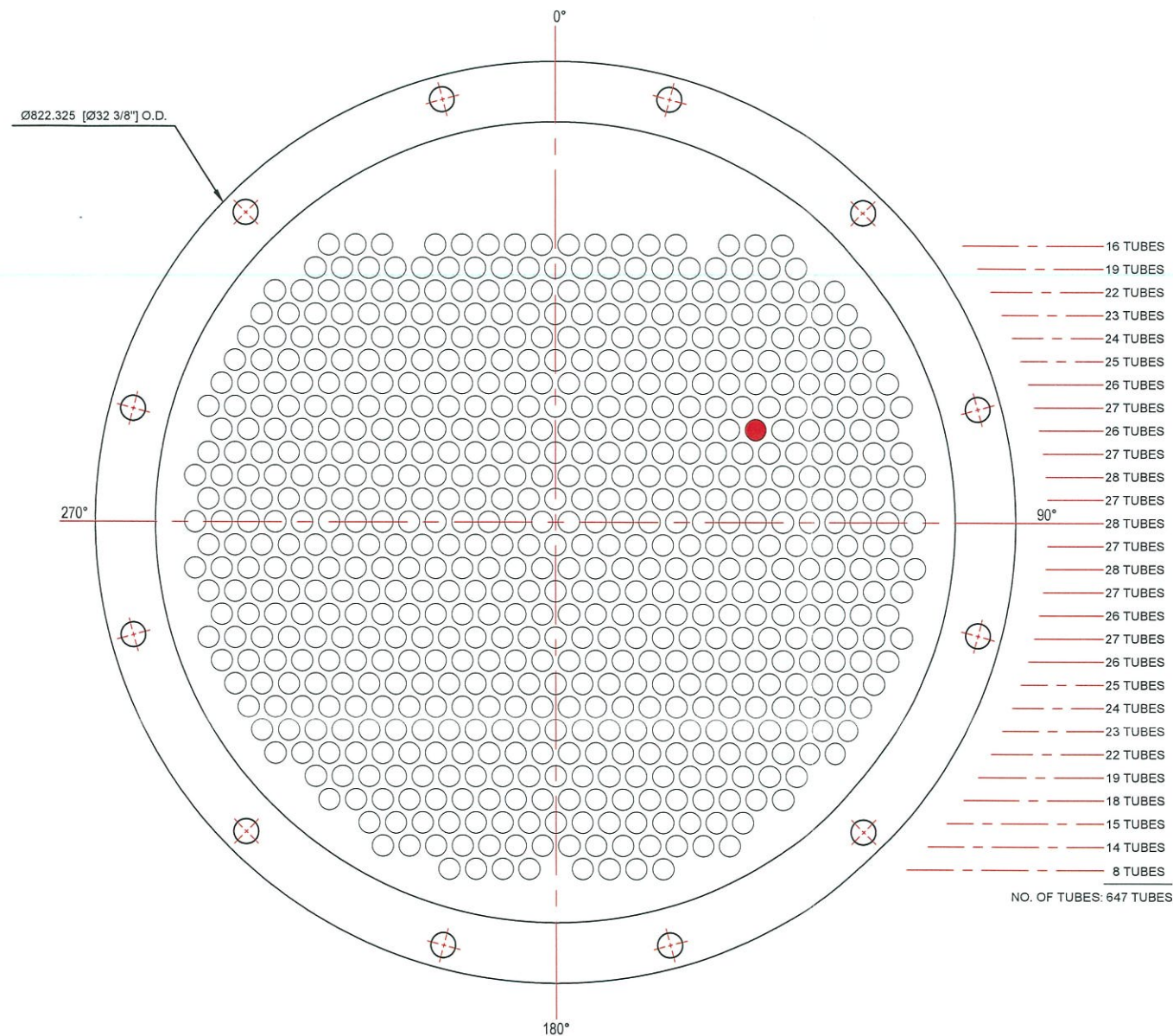
REQ'D		LENGTH
A	5	2444.75 [8'-0 1/4"]
B	1	1835.15 [6'-0 1/4"]
(23A) 3/4" O.D. SPACER TUBING		
C	5	547.76 [1'-9 9/16"]
D	1	1157.35 [3'-9 9/16"]
E	12	600.02 [1'-11 5/8"]
F	2	1209.61 [3'-11 5/8"]



PARTS LIST					
ITEM NO.	NO. REQ'D.	DESCRIPTION	MAT'L.	SIZE OR PATT. NO.	REMARKS
21	647	TUBES .065" THK.	SA-789 S31803	19.05 [3/4"] OD x 1.651mm [0.065"] THK. x 3048mm [10' 0"] LG.	
FORGED RING MATERIAL					
3	1	FLANGE 3 1/8" THK.	SA-182-F304	822.32mm [32 3/8"] O.D. x 685.80mm [27"] I.D. x 79.38mm [3 1/8"] THK.	
16	1	FLANGE 3 1/8" THK.	SA-182-F304	822.32mm [32 3/8"] O.D. x 685.80mm [27"] I.D. x 79.38mm [3 1/8"] THK.	
TUBESHEETS & COVERS					
19	1	TUBESHEET, 2" THK.	SA-240S31803	822.32mm [32 3/8"] O.D. x 50.80mm [2"] THK.	
20	1	TUBESHEET, 2" THK.	SA-240S31803	822.32mm [32 3/8"] O.D. x 50.80mm [2"] THK.	
BAFFLES					
22	4	BAFFLE PLATE 3/8" THK.	SA-516-70	681.037mm [26 3/16"] O.D. x 9.52mm [3/8"] THK.	TUBE HOLES IN BAFFLES 19.43mm [9/16"] Ø & DEBURR.
CYLINDERS					
9	1	R & W CYLINDER 3/8" THK. (86 3/16" WRAP) 1-CYL 9'-8"	SA-516-70	685.8mm [27"] I.D. x 9.52mm [3/8"] THK. x 2946.39mm [9'-8"] LG.	
4	1	CONE 3/8" THK.	SA-240-304	685.8mm [27"] I.D. x 387.35mm [15 1/4"] I.D. x 9.525mm [3/8"] THK. x 280.35mm [10 1/4"] LG.	
17	1	CONE 3/8" THK.	SA-240-304	685.8mm [27"] I.D. x 387.35mm [15 1/4"] I.D. x 9.525mm [3/8"] THK. x 280.35mm [10 1/4"] LG.	
ANSI FLANGES					
71	1	WELD NECK FLANGE, RF	SA-105	ANSI 10" - 150# RF WN, X-HVY BORE	
72	1	WELD NECK FLANGE, RF	SA-105	ANSI 10" - 150# RF WN, X-HVY BORE	
81	1	WELD NECK FLANGE, RF	SA 182-F304	ANSI 16" - 150# RF WN, X-HVY BORE	
82	1	WELD NECK FLANGE, RF	SA 182-F304	ANSI 16" - 150# RF WN, X-HVY BORE	
NOZZLE PIPES					
71A	1	SMLS. NOZZLE PIPE	SA106-B	273.1mm [10 3/4"] O.D. x [5000"] X-HVY x 184.15mm [7 1/4"] LG.	
72A	1	SMLS. NOZZLE PIPE	SA106-B	273.1mm [10 3/4"] O.D. x [5000"] X-HVY x 184.15mm [7 1/4"] LG.	
BOLTING & GASKETS					
40	2	SS316L KAMPROFILE GASKET C/W 0.5mm GRAPHITE ON BOTH SIDE (RECON) 4.5mm THK.		715.96mm [28 3/16"] O.D. x 688.97mm [27 1/8"] I.D.	USED 125 AARH ON GSKT. SURF.
41	12	3/4" ROUND x 10 N.C. THD. STUDS x 6" LG. (3 & 19)	SA-193-B7	3/4" O.D. x 6" LG.	
42	24	3/4" HEAVY HEX NUTS	SA-194-2H		
43	12	3/4" ROUND x 10 N.C. THD. STUDS x 6" LG. (15 & 20)	SA-193-B7	3/4" O.D. x 6" LG.	
44	24	3/4" HEAVY HEX NUTS	SA-194-2H		
MISCELLANEOUS MATERIAL					
60	1	STD. NAME PLATE	18-8 STN. STL. (16 GA)		
61	1	STD. NAME PLATE BRACKET	SA 36 OR EQUAL	4.76mm [6 1/4"] x 158.75mm [31 1/8"] THK. x 320.67mm [12 5/8"] LG.	
62	4	STD. LIFTING LUGS	304 S.S.	76.2mm [3"] LG x 88.9mm [3 1/2"] x 19.04mm [3/4"] THK.	
23	47	FT. 1/2" O.D. TIE RODS	C-STEEL		
23B	12	1/2" HEAVY HEX TIE ROD NUTS	C-STEEL		
23A	47	FT. 3/4" O.D. SPACER TUBING	C-STEEL		
9A	1	IMPINGEMENT PLATE	SA 36 OR EQUAL	292.09mm [11 1/2"] O.D. x 6.35mm [1/4"] THK. x 422.27mm [16 5/8"] LG.	
100	-	-	-	-	-
SUPPORT MATERIAL					
15	2	PLATE (1/4" THK.)	SA-516-70	12 1/4" x 1/4" THK. x 18 1/2" (ROLL TO 13 7/8" & R)	
15A	2	PLATE (3/8" THK.)	SA-516-70	11 1/2" x 3/8" THK. x 20 5/8" LG.	
15B	2	PLATE (1/2" THK.)	SA-516-70	9 7/8" x 1/2" THK. x 9 7/8" LG.	



0	17-JAN-18	ISSUED FOR REFERENCE	JO	ALEX	ALEX
REV.	DATE	DESCRIPTION	BY	CHKD	APPRD
PROJECT TITLE: MHI PROJECT					
MANUFACTURE: HONG XING ENGINEERING & CONSTRUCTION PTE LTD					
14 TUAS AVENUE (18A), SINGAPORE 638602					
Tel : (65) 6558 7515 Fax: (65) 6558 7517 E-mail: hongxing@pacific.net.sg					
Chemical Specialties (SINGAPORE) PTE. LTD.					
31 Ayer Marbau Road Jurong Island Singapore - 627117					
www.chemspecialties.com					
CSL DOC NO:					
DRAWING TITLE: E2-R3 OVERHEAD CONDENSER ASSEMBLY DETAIL DRAWING					
WORK ORDER NO.:		SCALE: AS SHOWN		PAPER SIZE: A2	
HONGXING DWG. NO.:		SHEET NO.		REV.	
CSL-HX-MHI-E2R3-002		1 OF 1		0	



TOP TUBESHEET LAYOUT

LEGEND:
● PLUGGED TUBE

TUBESHEET DATA

DESIGN CODE: ASME SECTION VIII DIV1: 2017		
EQUIPMENT ITEM NO.	E2-R3	
EQUIPMENT TYPE	OVERHEAD CONDENSER	
POSITION	VERTICAL	
SHELL MATERIAL	SA-516-70	
CHANNEL HEAD	SA-240-304	
TUBESHEET MATERIAL	SA240S31803	
TUBE MATERIAL	19.05mm [3/4"] OD x 0.65" SA-788 S31803 (AL2205 Duplex)	
TUBE LENGTH	3048 [10'-0"]	
TUBE PITCH	23.8125mm [0.9375"] TRIANGLE	
NO. TUBES	647	
	SHELL SIDE	TUBE SIDE
MEDIUM	WATER	NITROGEN GAS WITH TRACE PO @ 4 Bar g 150°C
DESIGN PRESSURE	100 psi/FV [6.89 bars]	75 psi [5.171 bars]
DESIGN TEMPERATURE	300.2 °F [149 °C]	300.2 °F [149 °C]
OPERATING PRESSURE	43.5 psi [3 bar/FV]	58 psi [4 bar]
OPERATING TEMPERATURE	122 °F [50°C]	284 °F [140 °C]
CORROSION ALLOWANCE	3.175mm [0.1250"]	1.5873mm [0.625"]

0	22-DEC-17	ISSUED FOR REFERENCE	JO	ALEX	ALEX
REV.	DATE	DESCRIPTION	BY	CHKD	APPRO

PROJECT TITLE: MHI PROJECT

MANUFACTURE:
HONG XING ENGINEERING & CONSTRUCTION PTE LTD
14 TUAS AVENUE (18A), SINGAPORE 638862
Tel : (65) 6558 7515/16 Fax : (65) 6558 7517 E-mail hongxing@pacific.net.sg

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CHEMICAL SPECIALTIES (SINGAPORE) PTE. LTD.
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www.chemspecialties.com

CSL DOC NO:
DRAWING TITLE:

E2-R3 OVERHEAD CONDENSER
TUBESHEET LAYOUT

WORK ORDER NO.:	SCALE: NTS	PAPER SIZE: A2
HONGXING DWG. NO.:	SHEET NO.	REV.
CSL-HX-MHI-E2R3-003	1 OF 1	0