



Best Practice Sharing Award


ชื่อโครงการ : **COMPABLOC REPAIR TECHNICAL**

บริษัท : **PTTGC**

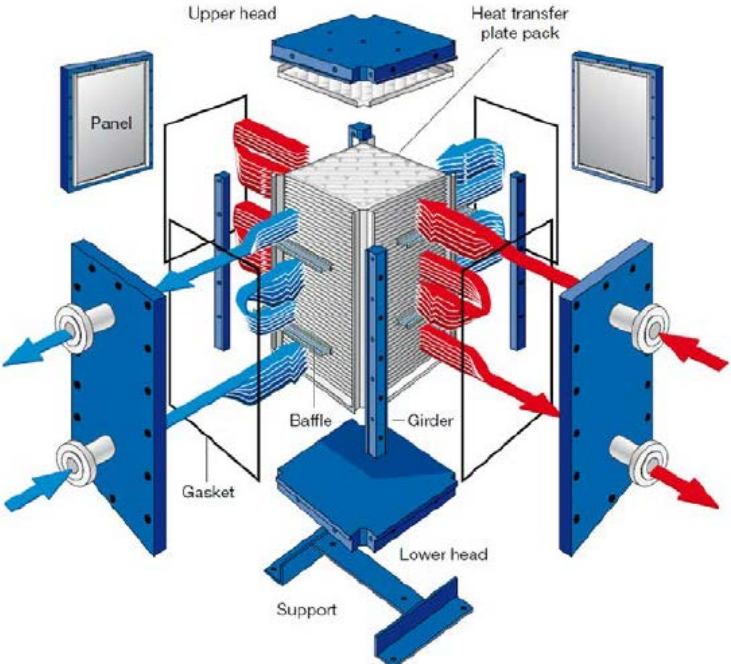
คณะทำงาน

Team	Name	Position
Execution	Jenjit S.	Sr. Mechanical Engineer
	Arruk B.	Mechanical Supervisor
	Manoch P.	Sr. Mechanical Technician
	Aekarat S.	Mechanical Technician
	Wethasak B.	Mechanical Technician
Planning	Kasemsak J.	Sr. Maintenance Planner
	Jaruwat M.	Maintenance Planner

1. Key Word (Taxonomy)

Project Type	<p>Please select the 6 Key word from the attached file below.</p>  <p>Key word.xls</p>
Business Line	
Operational Function	
Operational Unit	
Equipment Type	
Product Group	

2. Project Details

No.	Title	Details
1	Project Name*	(English*) Compabloc Repair Technical (Thai) เทคนิคการซ่อม Compabloc
2	Objective*	To find the repair and testing technical for several leakage of Compabloc.
3	Executive Summary*	To get the guideline and technical for repair Compabloc in PTTGC group (The first time for repair Compabloc in our group). We can identify and evaluate the leakage localization to select the proper technical for repair. In the next repair, we can fix the leakage by ourselves and then the cost saving and benefit will be 1.98 MB/time (no procurement for external service).
3.1	Executive Details	<p>Compabloc, which is a welded plate heat exchanger without interplate gaskets, service in PTTGC group with many units. In case of internal leakage, there is not anybody to know the repair technical of Compabloc. Therefore, an in-depth detail for repair had been studied. This paper aims to provide related guideline for repair and troubleshooting as well as testing technical, which are new knowledges of us. Example; Specific technical for repair</p> <ul style="list-style-type: none"> - The method to identify and localize a leak - How to repair internal leak - Joint design and facility of weld for repair - The acceptance criterial for unbalanced hydrostatic test, which allows pressure drop, is considered. - Dismantling and installation panel procedure 

4	Procedures*	<p><u>CPI Step 1:</u> Compabloc, which is a welded plate heat exchanger, was cleaned since Mar 2016 and then found internal leakage at Aa side (hot side) during hydrostatics test. The leakage need to be fixed by special technical. The repairable achievement is no leak to be observed.</p> <p><u>CPI Step 2:</u> The leak point which observed during hydrostatics test shall be repaired due to its loss heat transfer performance but the number of leak point was very difficult to identify the actually location. Therefore, it had to move for full inspection by air-bundle and penetrant testing.</p> <p><u>CPI Step 3:</u> Repair and testing Compabloc as following manufacturer standard</p> <ol style="list-style-type: none"> 3.1 Simulation design support to remove bundle from under the grating. 3.2 Install removal support on-site 3.3 Lift and remove bundle to manufacturer workshop where has suitable facility for repair. 3.4 Lay down on horizontal position and loosen the nut for open panel with dismantling procedure. 3.5 Perform air-bubble test and identify leak location. (need to fix a dimension change by using chain) 3.6 Loosening nut to remove all panels to perform penetrant testing on plate pack to find other cracks. (Loosen nut sequence shall be strictly followed to avoid deformed plate pack) 3.7 Repair a crack by GTAW with special backing procedure (avoid burn through and oxidation on back side) 3.8 Weld testing by PT 3.9 Install back all panel and flip the unit to horizontal 3.10 Perform 2nd air-bubble test 3.11 Assemble all panels with tightening 3.12 Unbalanced hydrostatic test 3.13 Complete
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CPI Step 4: Repair result



Leak location on the top left of Aa side (at the first channel)



Completed weld repair on the other side. No bubbles show during air-bubble test.

CPI Step 5: Guideline to repair other Compabloc leakage in PTTGC group

- 5.1 The way to identify and localize a leak is to do an air-bubble test. The Compabloc must place horizontally on the floor, with the top panel removed and that circuit is filled with water.
- 5.2 Chain pulley should be used to maintain the plate pack dimension during filled water for air-bubble test.
- 5.3 Need PT check on all plate pack surface.
- 5.4 There are three types of Compabloc leak as following corner weld leaks, cross leaks over the plate and plate-weld leaks,
 - 5.4.1 Corner weld leaks, repair by GTAW with or without filler metal
 - 5.4.2 Cross leaks over the plate, sealed with a metal-strip at four sides by GTAW
 - 5.4.3 Plate-weld leaks, this type of leak is uncommon because of the high quality of laser welding.
- 5.5 Filler rod diameter is 0.8 mm for repair only. More diameters will effect to burn through.
- 5.6 Corner weld which occurs at top left of Aa side cannot repair because Aa side leakage point could not be reached properly, it need to be repaired on Bb side (at the same point on Aa side leakage).
- 5.7 Dismantling and installation panel sequence shall be strictly performed as

		<p>procedure to avoid plate pack deformation due to unbalanced torque.</p> <p>5.8 After reassembly with original components, an unbalanced hydrostatic test at 1.1 design pressure indicated on the nameplate is mandatory.</p> <p>Unbalanced hydrostatic test should be carried out with one circuit empty, the other circuit being full & pressurized at the test pressure.</p> <p>5.9 Nitrogen blanket pressure during preservation between two circuits should differ around 0.5 barg in order to monitor the cross leak.</p> <p>5.10 Not allow to use shackle at panel for lifting bundle. Recommend to use lifting link at top and bottom panel instead.</p>
5.1	Operation Duration*	start date: 1/7/2016 end date : 15/7/2016
5.2	Project Duration	N/A
6	Application*	Team can advise the technical for repair Compabloc in PTTGC group. We can conduct the leakage and testing including sequential installation.
7	Investment (Mil.Baht)*	1.98 MB.
8	Benefit*	<ul style="list-style-type: none"> ● Recover equipment integrity with welding quality ● Get knowledge about repair and testing technical from manufacturer ● 1.98 MB will come back to us whenever it need to repair the leakage. (Reuse bundle removal support and there is not procurement the OEM to consult)
9	Benefit Value(Mil.Baht/year)*	1.32 MB/Year (Cleaning interval about 18 months)
10	Benefit Value Calculation	Total benefit of each repair Compabloc in the next time = Total investment of this project.
11	Apply From	N/A
12	Company	PTTGC

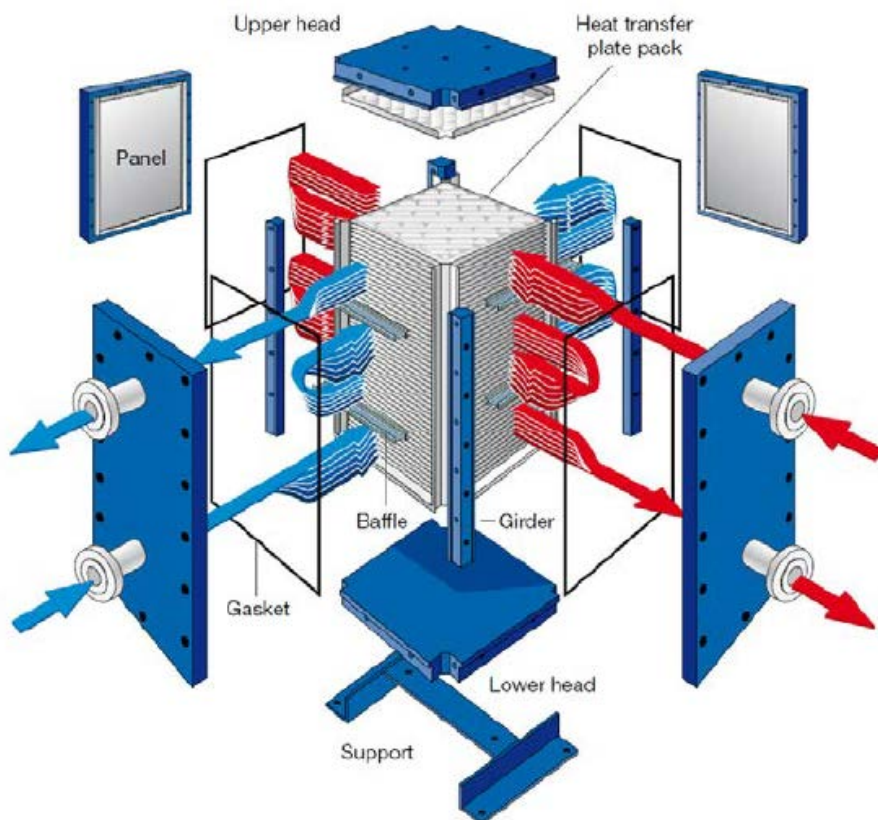
13	Team member*	<table><tr><th>Team</th><th>Name</th><th>Position</th></tr><tr><td rowspan="5">Execution</td><td>Jenjit S.</td><td>Sr. Mechanical Engineer</td></tr><tr><td>Arruk B.</td><td>Mechanical Supervisor</td></tr><tr><td>Manoch P.</td><td>Sr. Mechanical Technician</td></tr><tr><td>Aekarat S.</td><td>Mechanical Technician</td></tr><tr><td>Wethasak B.</td><td>Mechanical Technician</td></tr><tr><td rowspan="2">Planning</td><td>Kasemsak J.</td><td>Sr. Maintenance Planner</td></tr><tr><td>Jaruwat M.</td><td>Maintenance Planner</td></tr></table>	Team	Name	Position	Execution	Jenjit S.	Sr. Mechanical Engineer	Arruk B.	Mechanical Supervisor	Manoch P.	Sr. Mechanical Technician	Aekarat S.	Mechanical Technician	Wethasak B.	Mechanical Technician	Planning	Kasemsak J.	Sr. Maintenance Planner	Jaruwat M.	Maintenance Planner
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14	Contact Person*	Name : Jenjit Suriyanitigul Phone: 2215 Email: Jenjit.S@pttgcgroup.com																			
15	Year Contest	2016																			
16	Project Type*	Maintenance																			
17	Business Line*	Testing Service																			
18	OEMS Element	Reliability and Asset Integrity																			
19	Operational Function*	Maintenance Change Management																			
20	Operational Unit*	Reforming																			
21	Equipment Type*	Heat Exchanger																			
22	Product Group	Aromatics																			

23	Community of Practice	N/A
24	People Tag Account	Jenjit.s@pttgcgroup.com
25	People Tag Name	กรณีไม่ทราบอีเมลล์ หรือ พนักงานลาออกไปแล้วให้ใส่ชื่อที่ ช่องนี้แทน
	OpEx Committee	รายชื่อคณะกรรมการของบริษัทนั้นๆ
	OpEx Team	รายชื่อคณะทำงานของบริษัทนั้นๆ ที่ดำเนินการ Upload เอกสาร
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3. Support Information

Background

CPI Step 1: Compabloc, which is a welded plate heat exchanger, was cleaned since Mar 2016 and then found internal leakage at Aa side (hot side) during hydrostatics test. The leakage need to be fixed by special technical. The repairable achievement is no leak to be observed.



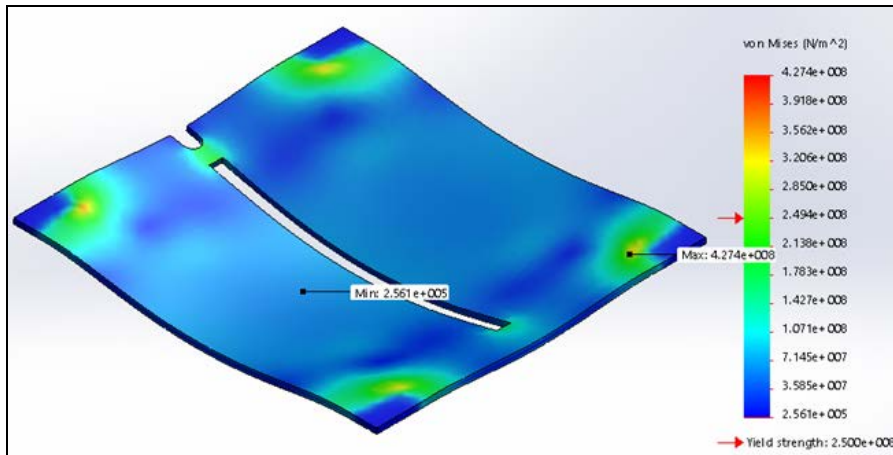
Why Did It Need Repair?

CPI Step 2: The leak point which observed during hydrostatics test shall be repaired due to its loss heat transfer performance but the number of leak point was very difficult to identify the actually location. Therefore, it had to move for full inspection by air-bundle and penetrant testing.

Repair Procedure for Every Series of Compabloc

CPI Step 3: Repair and testing Compabloc as following manufacturer standard

3.1 Simulation design support to remove bundle from under the grating.



3.2 Install removal support on-site



3.3 Lift and remove bundle to manufacturer workshop where has suitable facility for repair.



3.4 Lay down on horizontal position and loosen the nut for open panel with dismantling procedure.

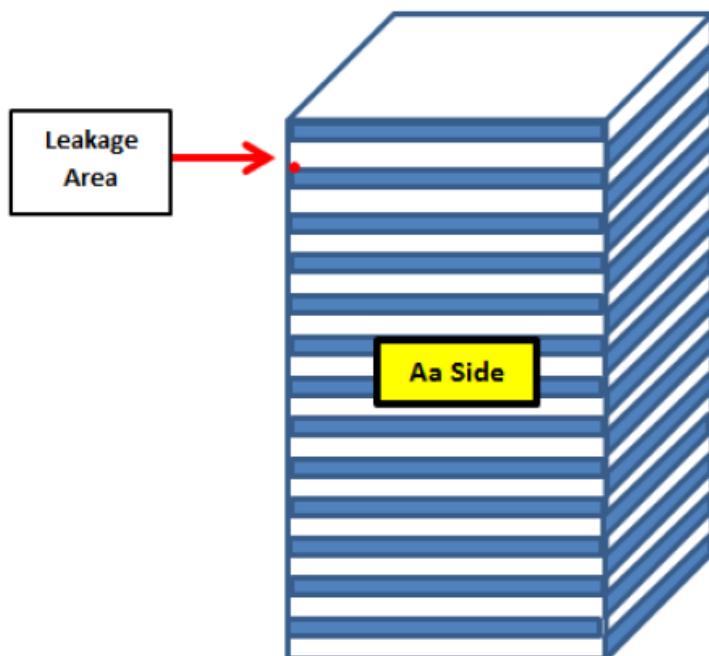
3.5 Perform air-bubble test and identify leak location. (need to fix a dimension change by using chain pulley)



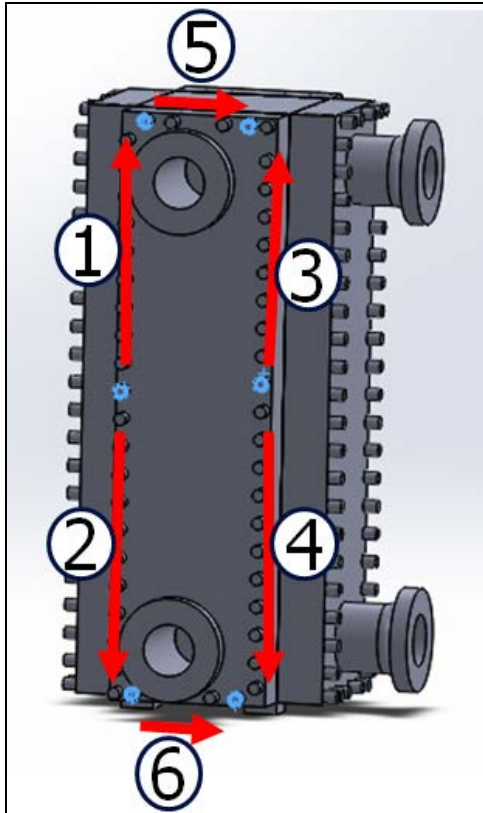
Chain pulleys were pulling the Compabloc frame



The bubble was appearing at blue mark below which is a leak point.



3.6 Loose nut to remove all panels to perform penetrant testing on plate pack to find other cracks. (Loosen nut sequence shall be strictly followed to avoid deformed plate pack)



Step: 1

Remove the nuts at 1, 2, 3, 4 on nozzle side first then opposite side and the others side.

Step: 2

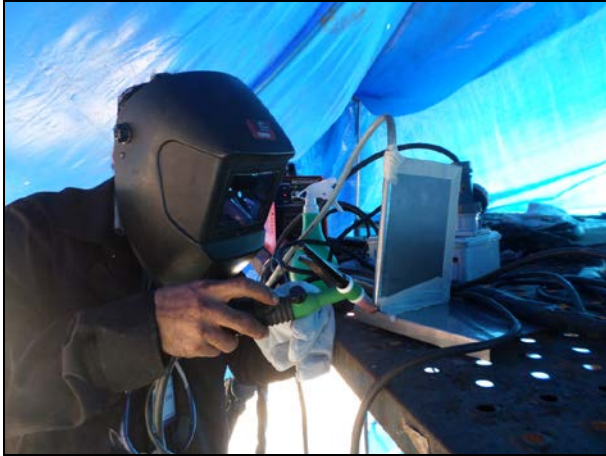
Remove the nuts at 5, 6 on nozzle side first then opposite side and the others side.

Note: The six blue positions still remain after loose torque. Do not remove the nuts for prevent the panel fall down.

3.7 PT check on all plate pack surfaces to detect the discontinuity



3.8 Welding demonstration and welding test by PT



3.9 Repair a crack by GTAW with special backing procedure (avoid burn through and oxidation on back side)



Sealing for argon backing



Backing flow rate by argon should be 1.2 l/min



Electrode holder was not able to access at Aa side for welding



According to Aa side leakage point could not be reached properly, it will be repaired on Bb side (at the same point on Aa side leakage).

3.10 Weld testing at Bb side by PT



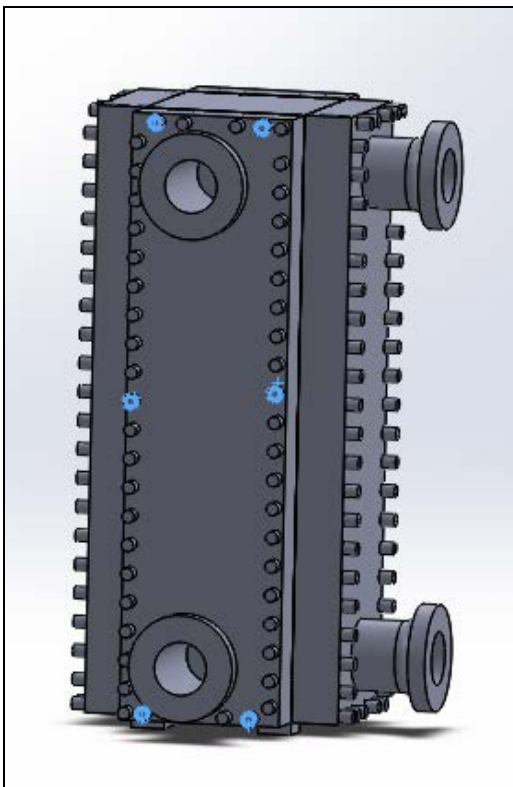
3.11 Install back all panel and flip the unit to horizontal



3.12 Perform 2nd air-bubble test



3.13 Assemble all panels with tightening as manufacturer procedure

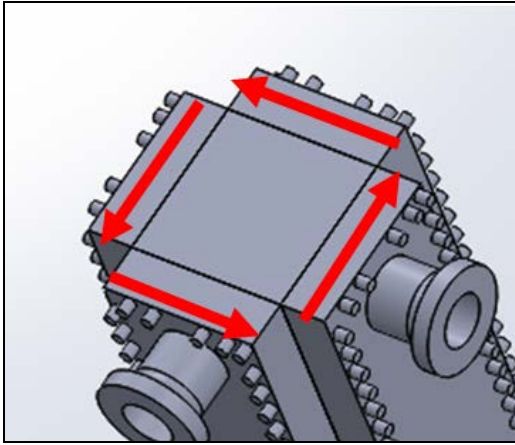


Require torque 50% (700 Nm) from step 1 to step 4

Step:1

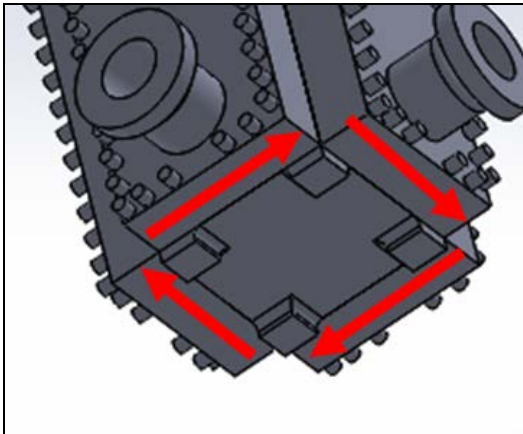
Install the nut at the blue position on one side first then opposite side and the others side.

Note: Model CP75 requires 1,400 Nm for nominal tightening forces of threaded panels



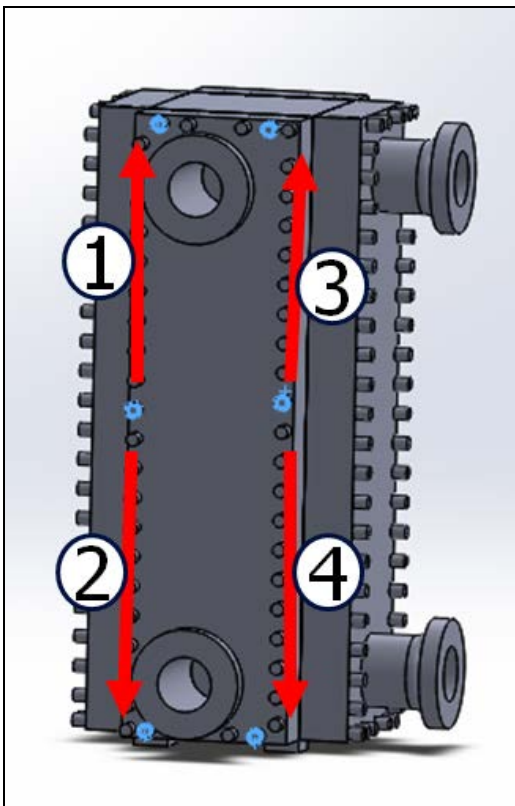
Step: 2

Install the nut at the top of the Compabloc.



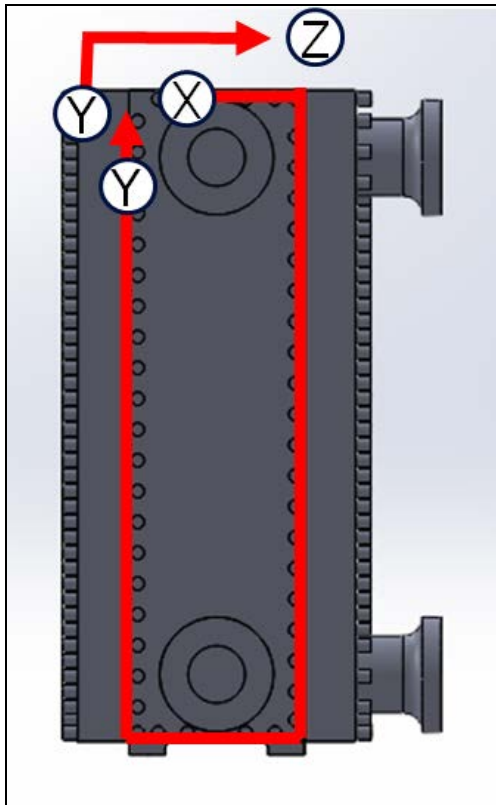
Step: 3

Install the nut at the bottom of the Compabloc.



Step: 4

Install the nuts with sequence as picture on nozzle side first and then opposite side and the others side after that.

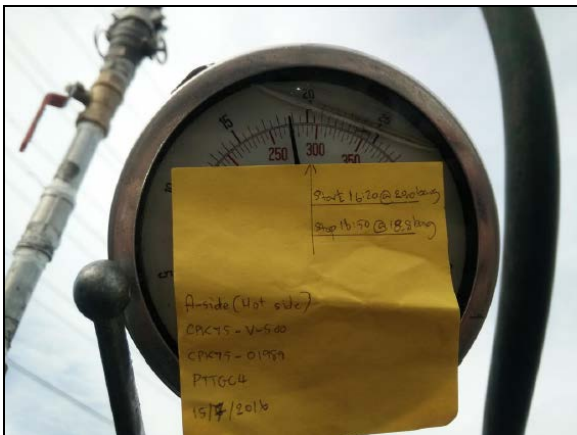


Required torque 100% (1,400 Nm)

Step: 5

Install nut sequence from X to Y and then from Y to Z about 5 nuts on nozzle side first and then opposite side and the order side after that.

3.14 Unbalanced hydrostatic test at 19.8 barg on both side.



3.15 The moisture was eliminated by nitrogen purging. Then the unit was blanked with nitrogen at A circuit of 1.0 barg and B circuit 0.5 barg.

3.16 Complete



CPI Step 4: Repair result, recover equipment integrity with weld quality



Before repair



After repair

Result and Guideline for Repair

CPI Step 5: Guideline to repair other Compabloc leakage in PTTGC group

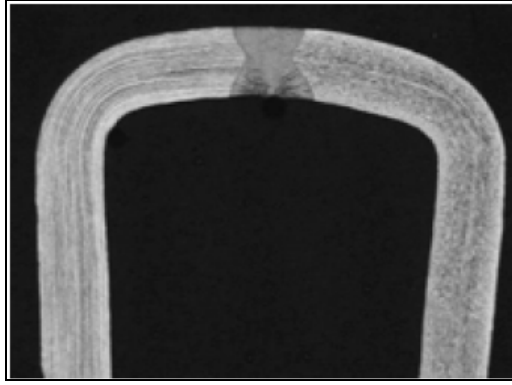
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- 5.4.3 Plate-weld leaks, this type of leak is uncommon because of the high quality of laser welding.



5.5 Filler rod diameter is 0.8 mm for repair only. More diameters will effect to burn through.



5.6 Corner weld which occurs at top left of Aa side cannot repair because Aa side leakage point could not be reached properly, it need to be repaired on Bb side (at the same point on Aa side leakage).



Aa side



Bb side

- 5.7 Dismantling and installation panel sequence shall be strictly performed as procedure to avoid plate pack deformation due to unbalanced torque.
- 5.8 After reassembly with original components, an unbalanced hydrostatic test at 1.1 design pressure indicated on the nameplate is mandatory. Unbalanced hydrostatic test should be carried out with one circuit empty, the other circuit being full & pressurized at the test pressure.
- 5.9 A tolerance on tightening torques is $\pm 10\%$ tolerance of the tightening.
- 5.10 Nitrogen blanket pressure for preservation between two circuits should differ around 0.5 barg in order to monitor the cross leak.
- 5.11 Not allow to use shackle at panel for lifting bundle. Recommend to use lifting link at top and bottom panel instead.

Benefit Valve Calculation

PROJECT INVESTMENT

No.	Activities	Baht
1	Remove bundle from foundation	405,832
2	Inspection fee - Dismantling panel - Re-assmbly and tightening - Hydraulic test - Air bubble test	693,000
3	Supervise and repair 5 days - Supervise by OEM - Repair by GTAW	887,000
Total		1,985,832

COST SAVING

No.	Activities	Baht	Action
1	Remove bundle from foundation	405,832	Mechanic
2	Inspection fee - Dismantling panel - Re-assmbly and tightening - Hydraulic test - Air bubble test	693,000	Sr. Mechanical Engineer
3	Supervise and repair 5 days - Supervise and control work - Repair technical by GTAW	887,000	Sr. Mechanical Engineer
Total		1,985,832	

Compabloc cleaning interval of ARO1 about 18 months or 1.5 year

Therefore, a total benefit will be 1,985,832 Baht/ 1.5 year or 1,323,888 Bath/year (if leak)

If it is not leakage, we will save about 693,000 Baht/time for inspection fee.