

# Status of Stripline Feedthrough Prototype Development

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**2019. 10. 23**





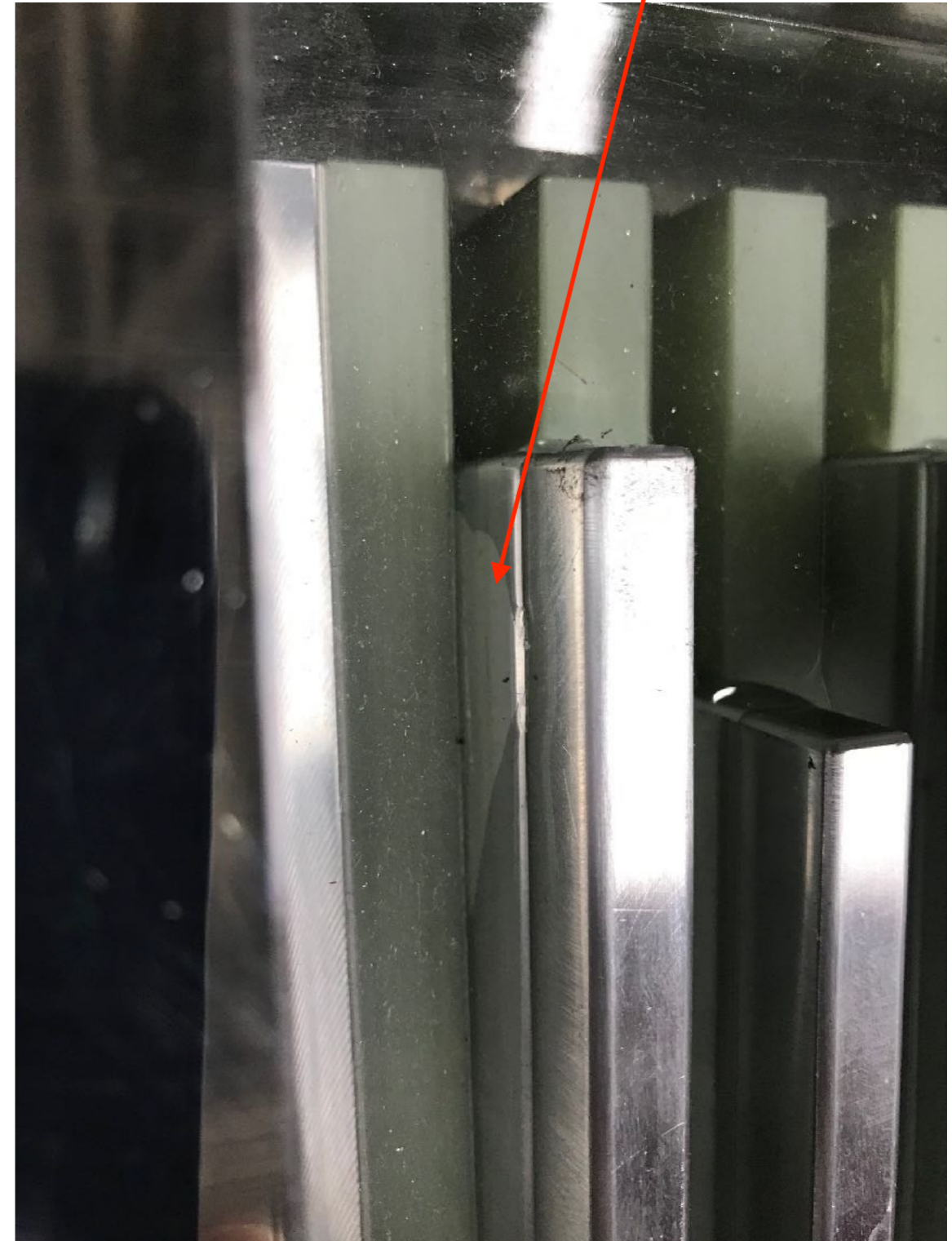
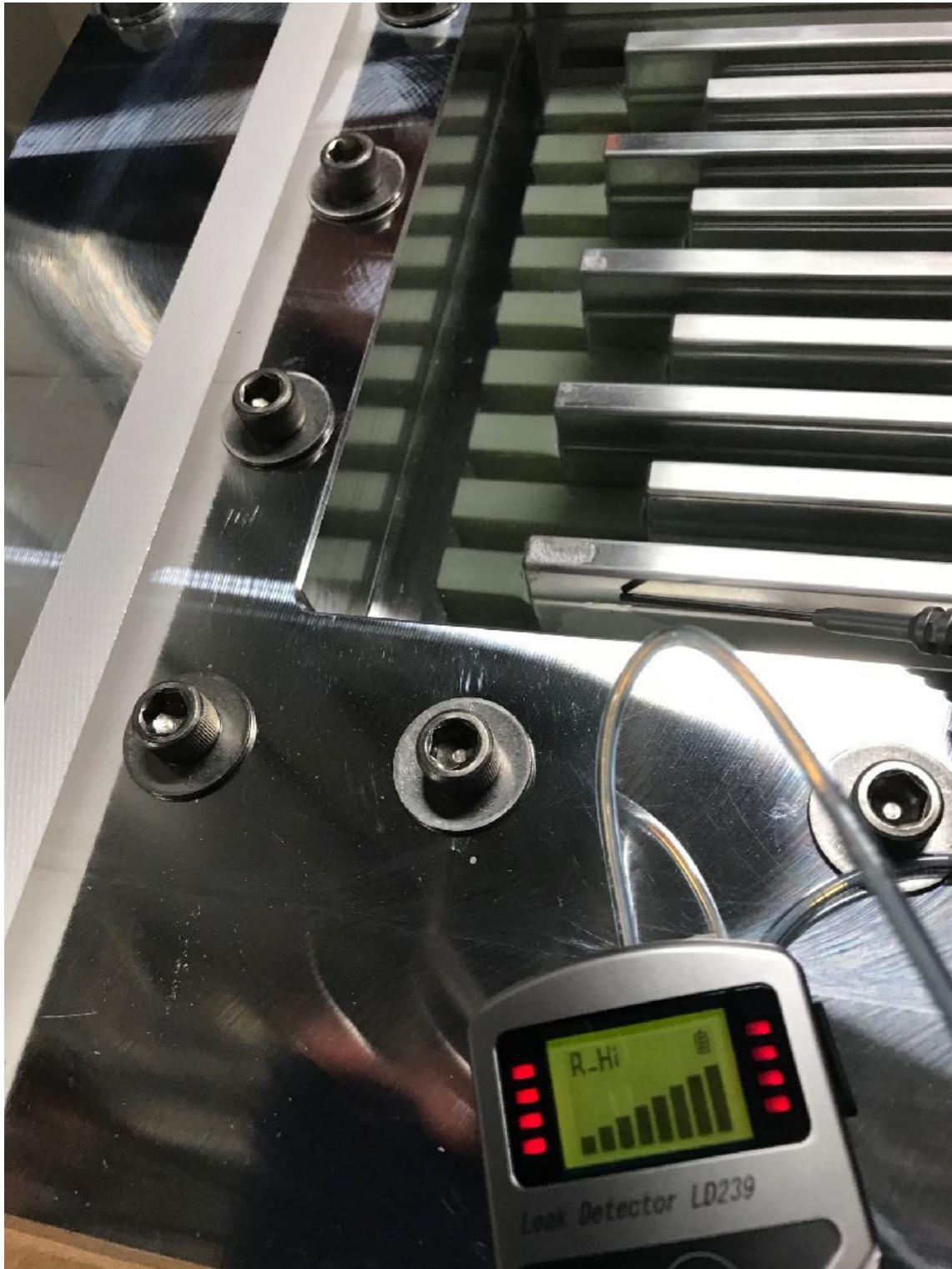
- Summary of the first prototype test @ J-PARC
- Test of pre-treatment using simple test piece
- Status of prototype modification

- 0.05 MPa gauge He pressure applied

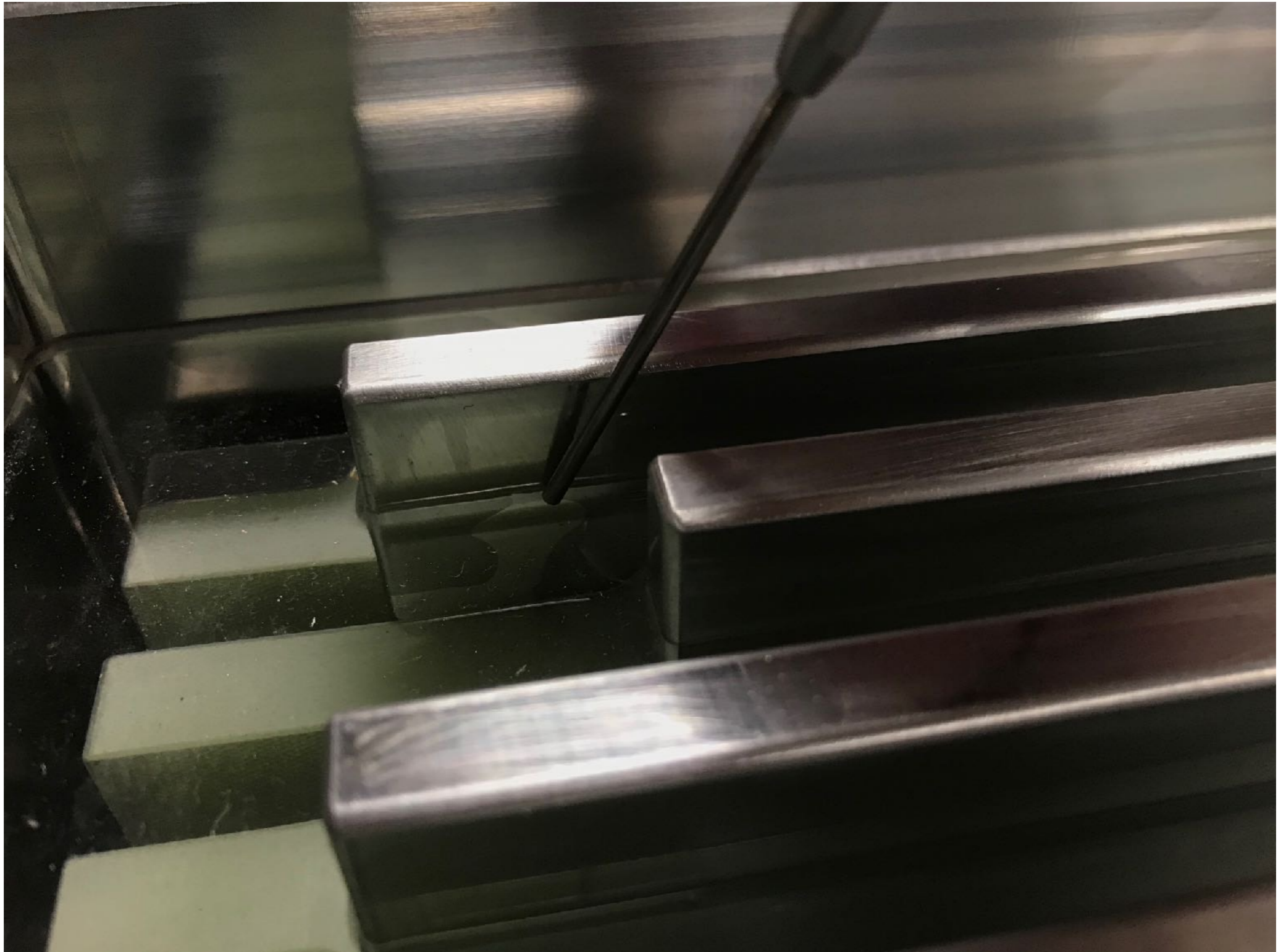


- He leak observed from stripline surface

Sylgard detached from stripline

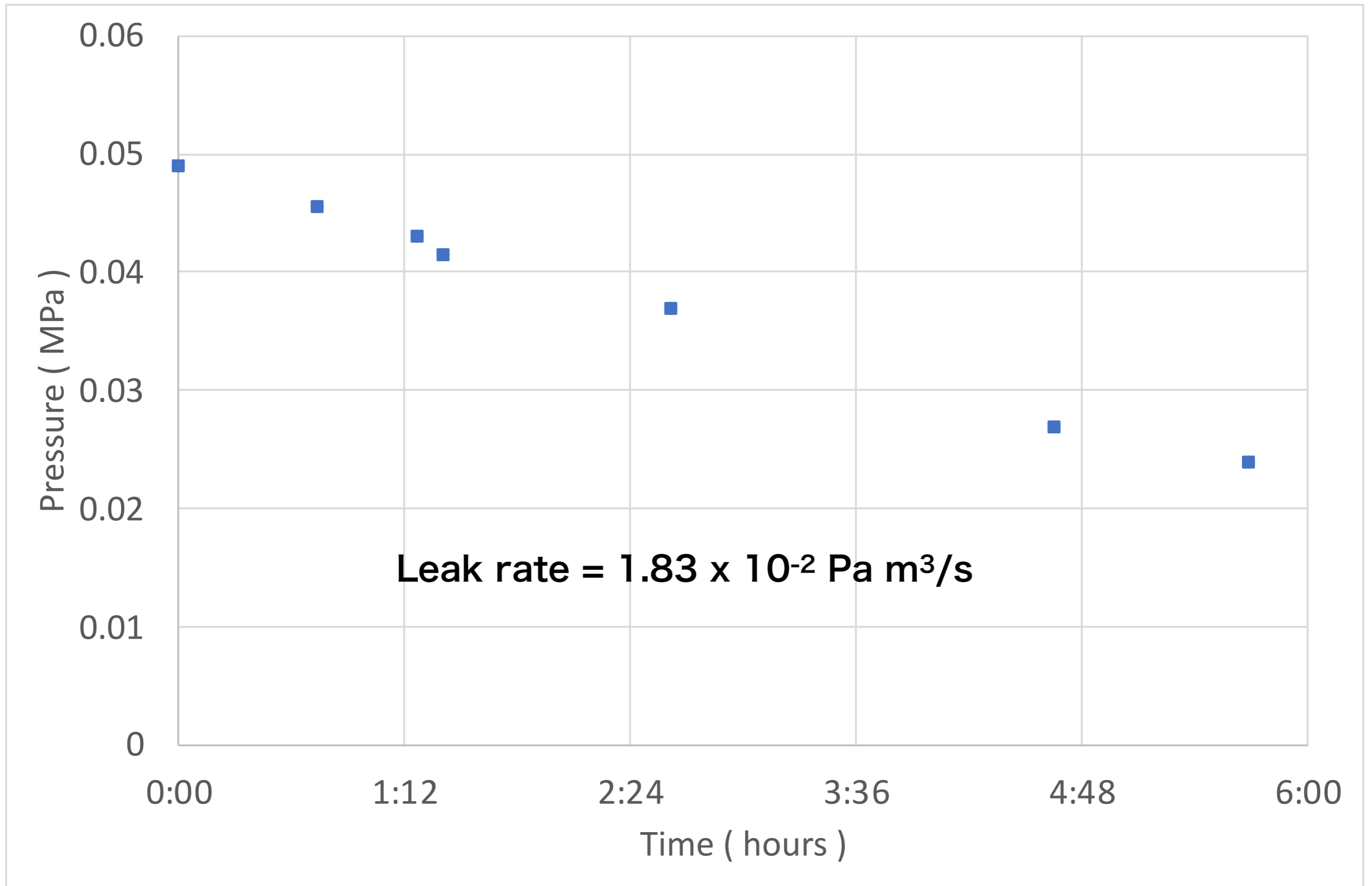


- Another He leak point at stripline

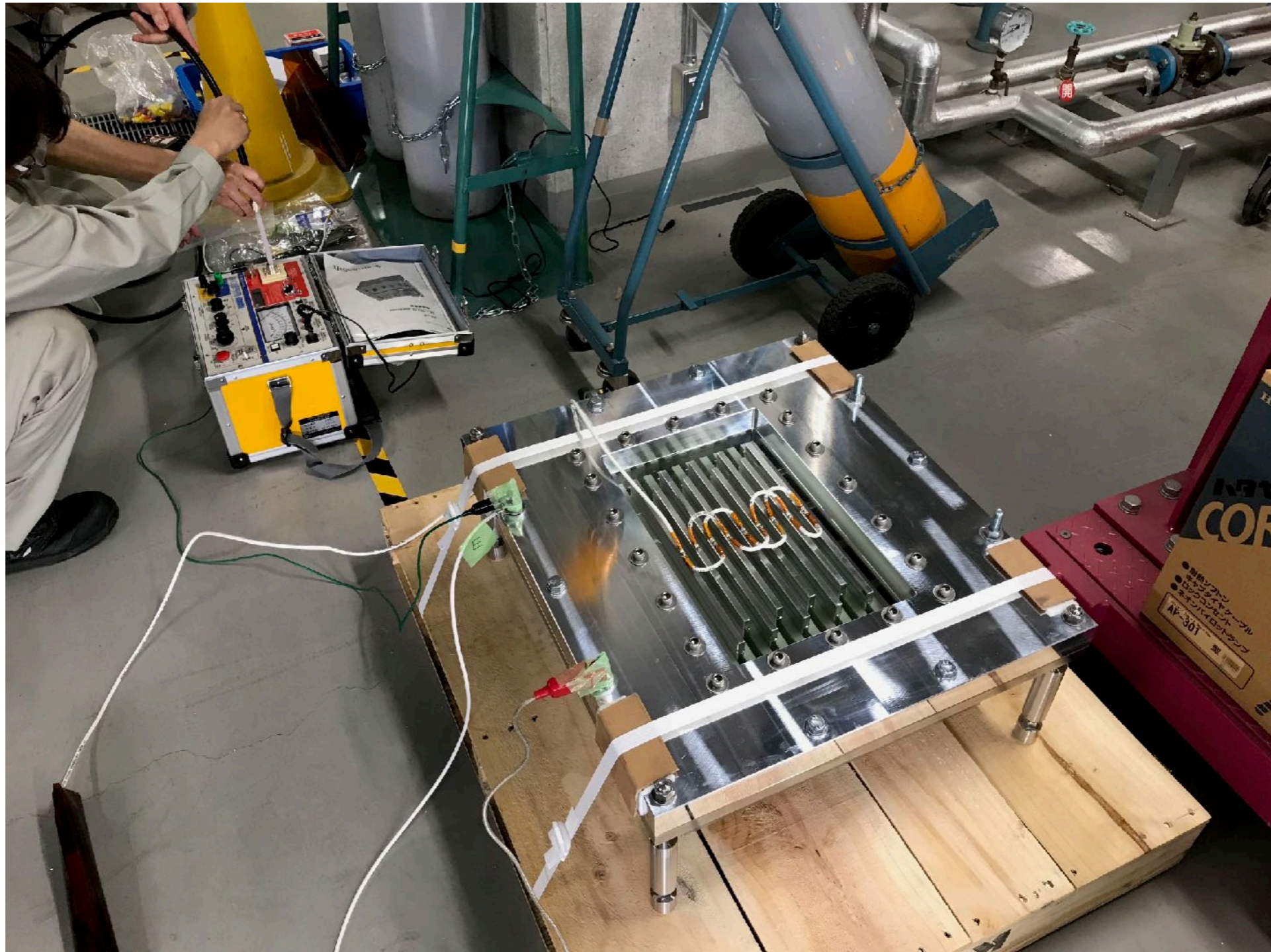




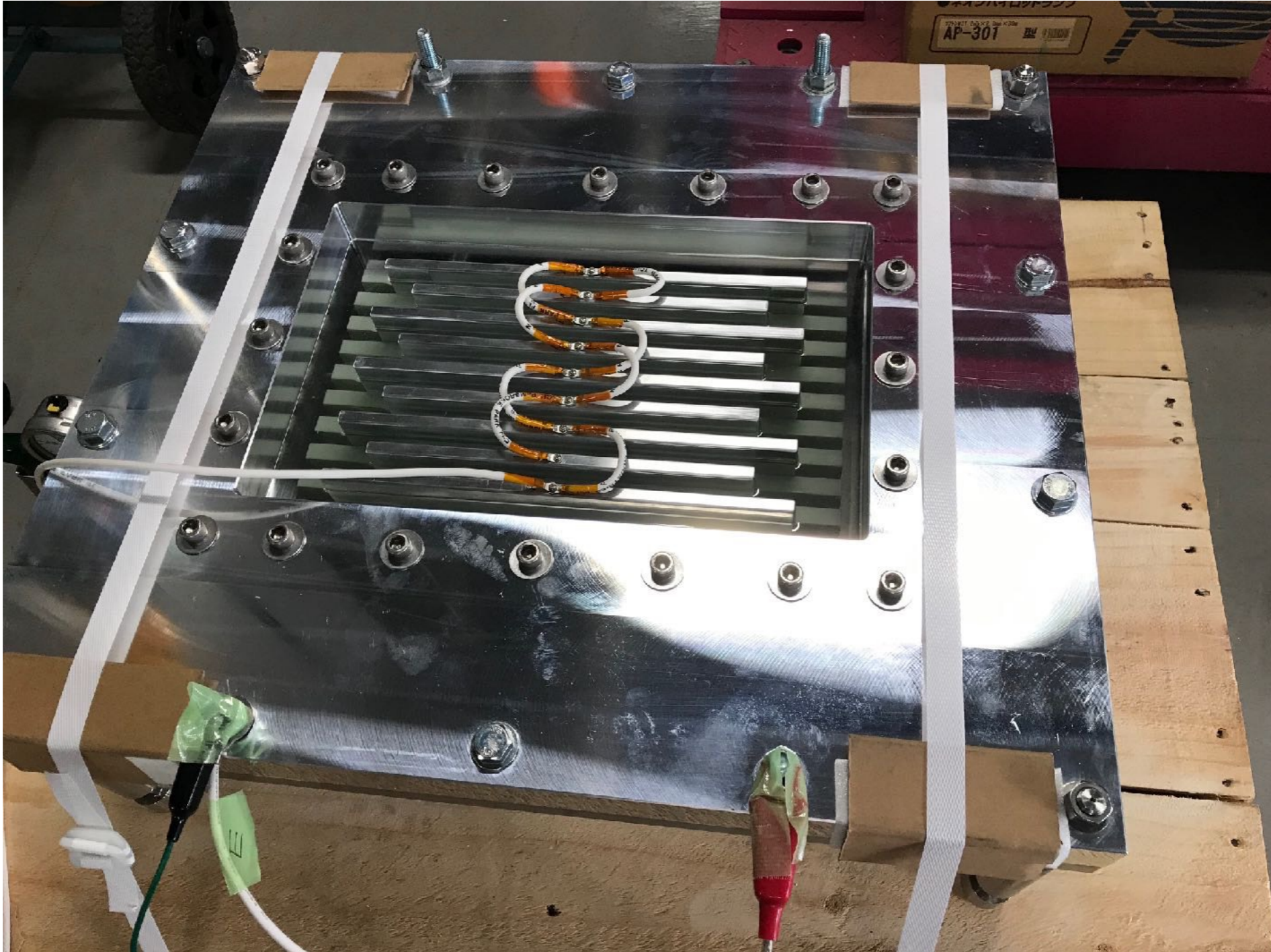
# He Leak Rate



- High voltage applied to the prototype
  - Leakage current is measured

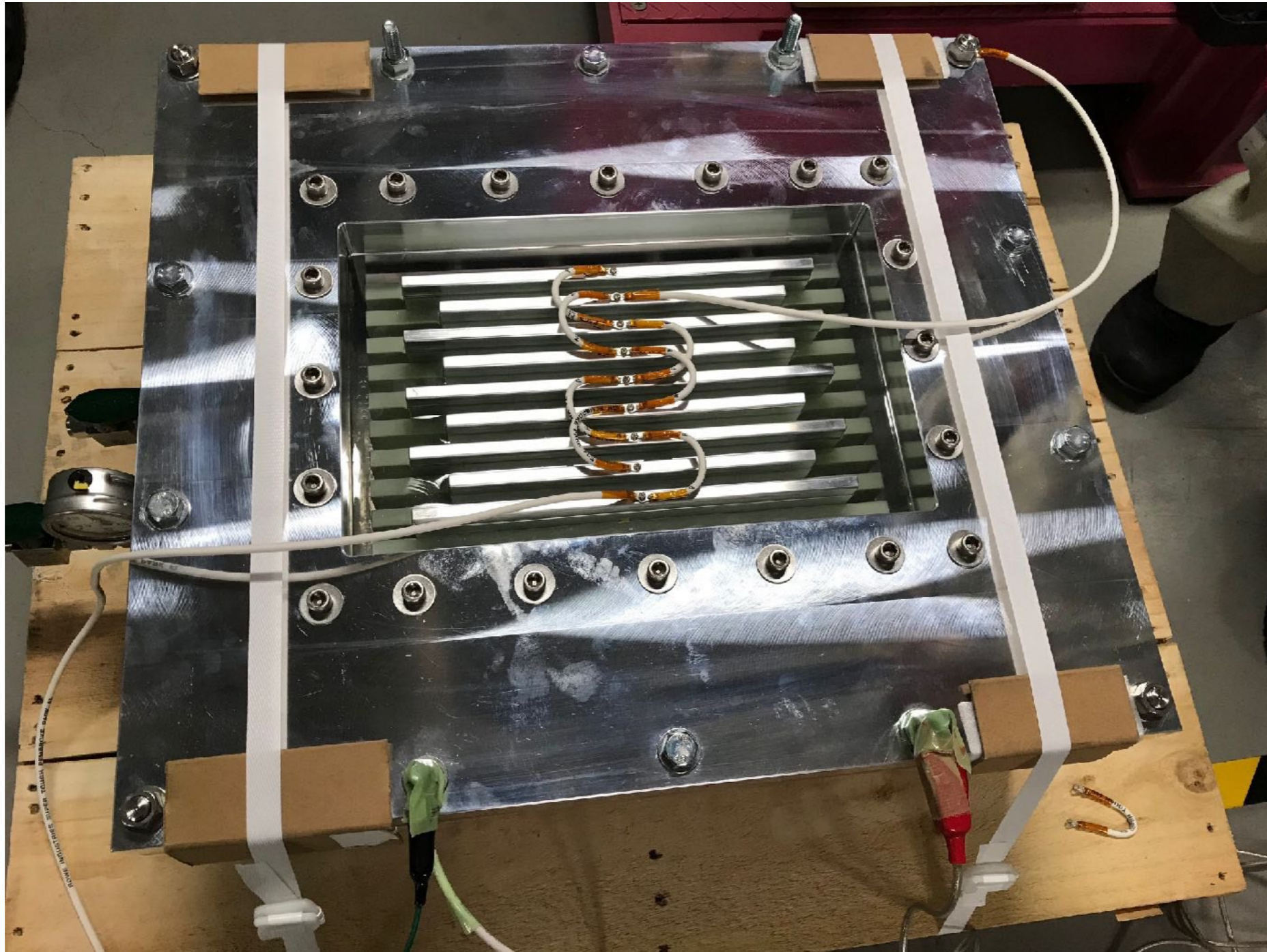


- All electrodes vs ground
- Leakage current suddenly increased at  $\sim 3.5$  kV





- Positive-side vs negative-side electrodes
- Leakage current suddenly increased at  $\sim 3.0$  kV

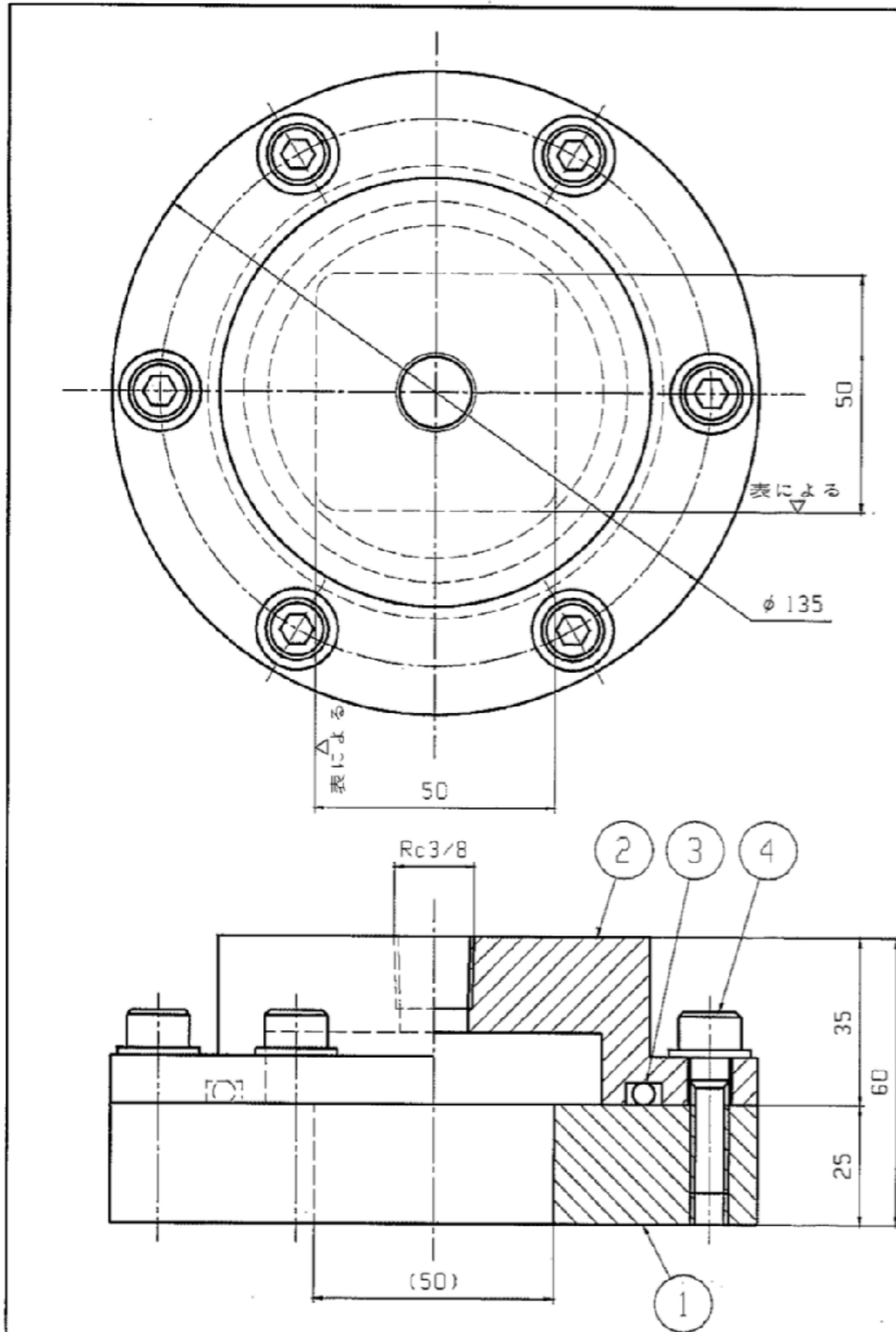




- **Test at manufacturing company**
  - Actually 0.15 MPa gauge N<sub>2</sub> pressure applied
  - The prototype once evacuated which might break the sealing
- **0.05 MPa He pressure applied to the prototype**
  - Observed He leakage at least from two points
  - Observed leak rate =  $1.83 \times 10^{-2}$  Pa·m<sup>3</sup>/s
- **High voltage test**
  - Withstand voltage to be ~3 kV which doesn't satisfy requirement of 5 kV
- **Proposed countermeasures**
  - Pretreatment of aluminum surface needed
    - Apply a primer between striplines and Sylgard
    - Roughing aluminum surface
  - These pretreatment should be tested with simple test pieces



- **Sylgard tests performed with some simple test pieces in the company**
  - Test item
    - Sylgard only
    - Primer (RTV-157) + Sylgard
    - Roughed surface + Sylgard
  - Applied N<sub>2</sub> 0.05 MPa (0.5 atom) gauge pressure to the test pieces



改 訂			
改訂年月日	担当	照査承認	改訂事項

種別	表面粗さ
1	▽
2	▽▽
3	▽▽▽

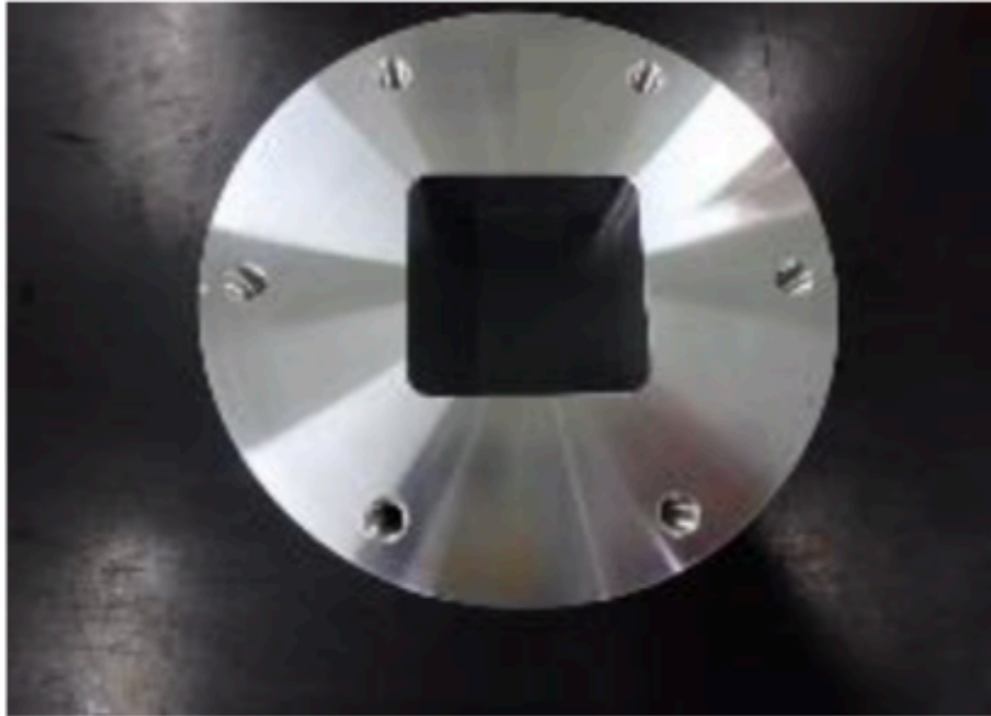


注記

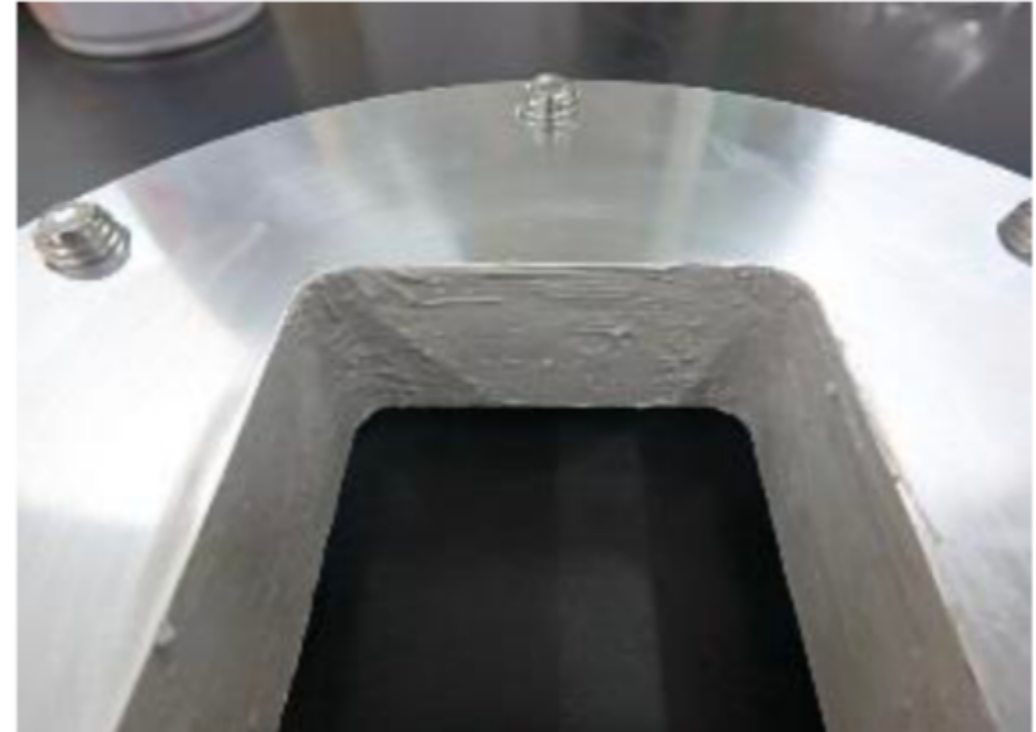
1. 部番1 口50穴の内面仕上粗さは、表による。

4	六角穴付ボルト・W	SUS	6s	—	—	M8x30L
3	リング	合成ゴム	1	—	—	P80
2	フランジ	A5052 又はA5056	1	—	—	SF7-1232-2
1	テストピース	A5052 又はA5056	1	—	—	SF7-1232-1
部番	名 称	材 質	数量	表面処理	熱 処 理	備 考

第三角法		単位 : mm	品名	接着剤試験治具
承認	照査	設計		
			1/N	SF7-1232
古河電力パワーシステムズ株式会社				番

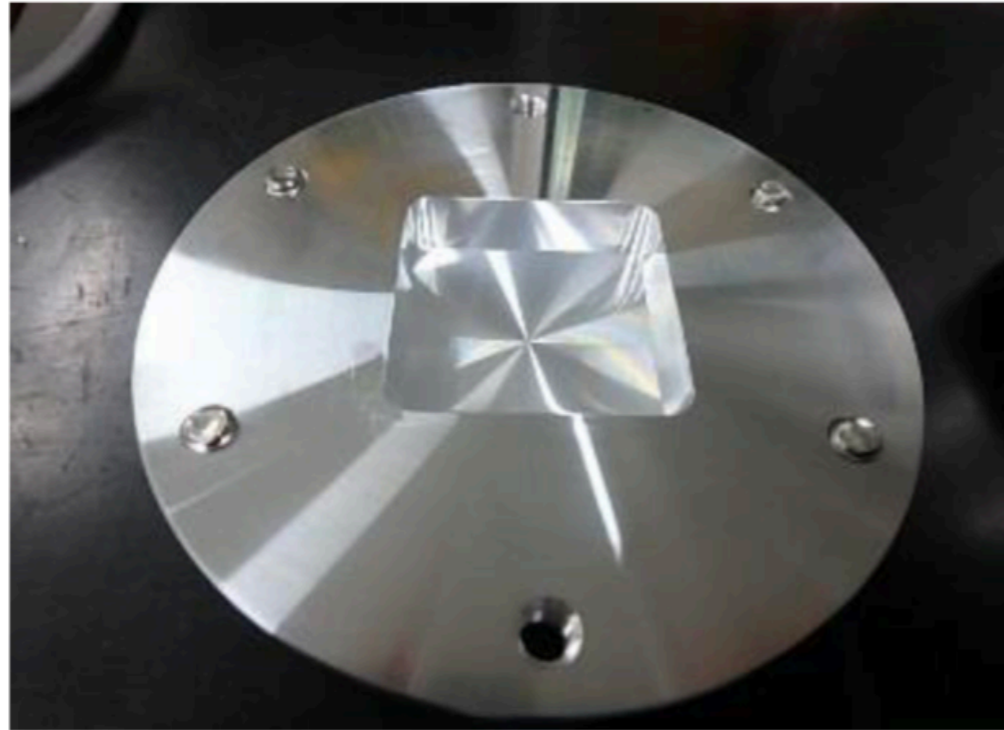


Window piece

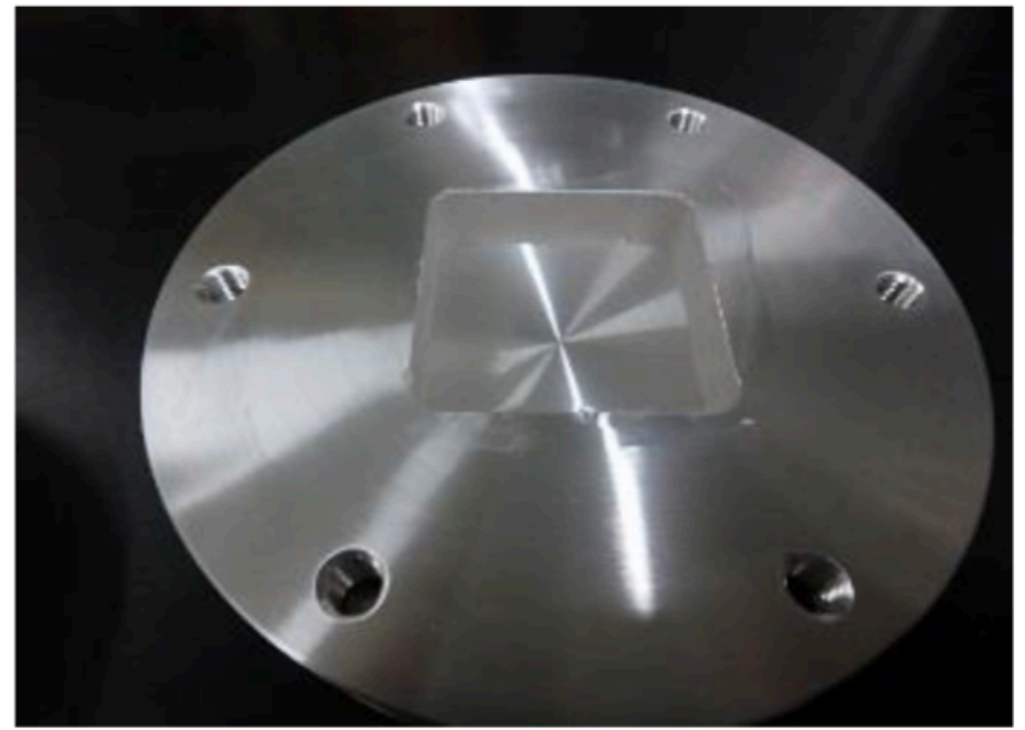


RTV applied to the surface  
and wait for 24 hours

- RTV actually got hard in a short time
- Difficult to make a smooth surface



Sylgard only



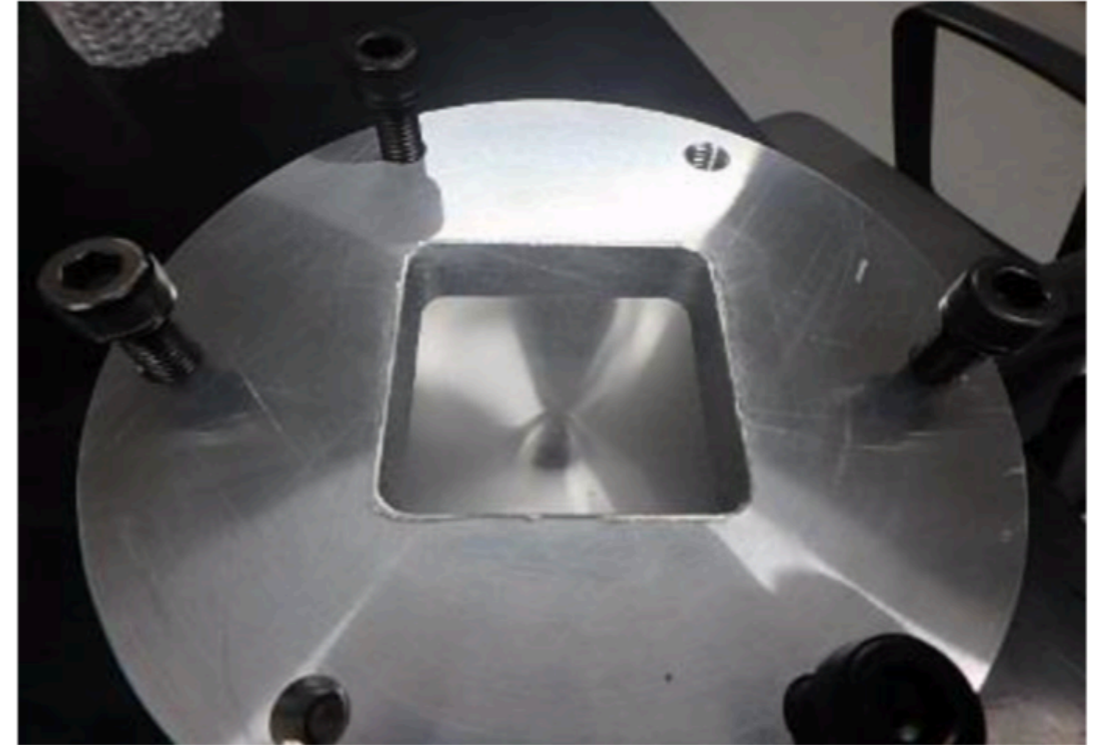
RTV + Sylgard

- Sylgard applied
- Evacuation
- Wait 48 hours for curing



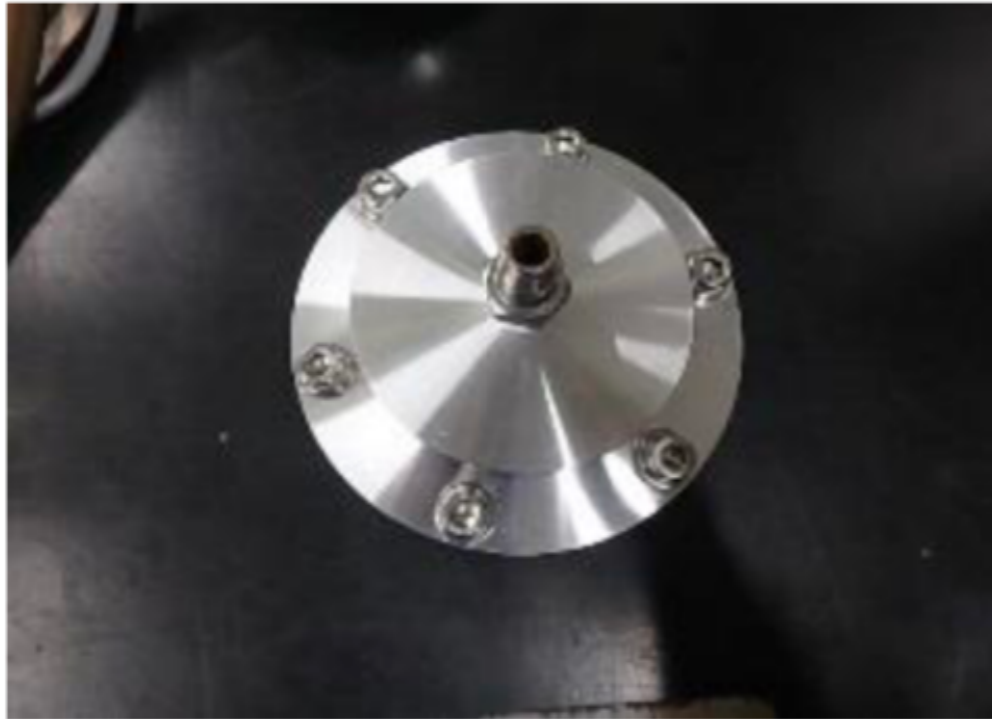


**Blast finished surface**

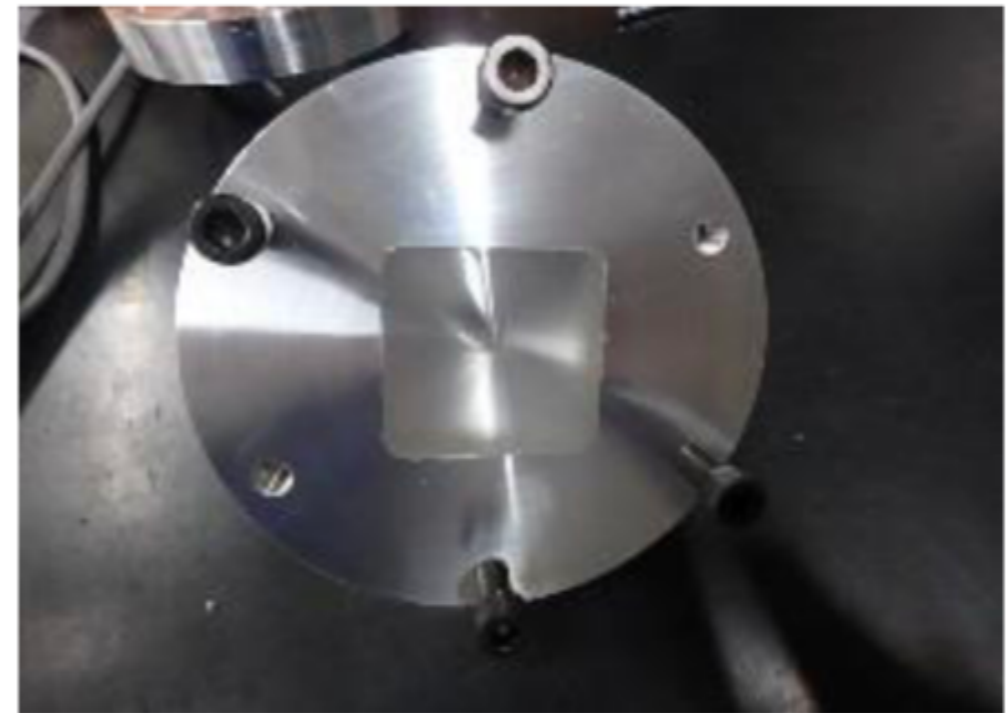


**Blast + Sylgard**

- Blast finishing
- Sylgard applied
- Wait 48 hours for curing

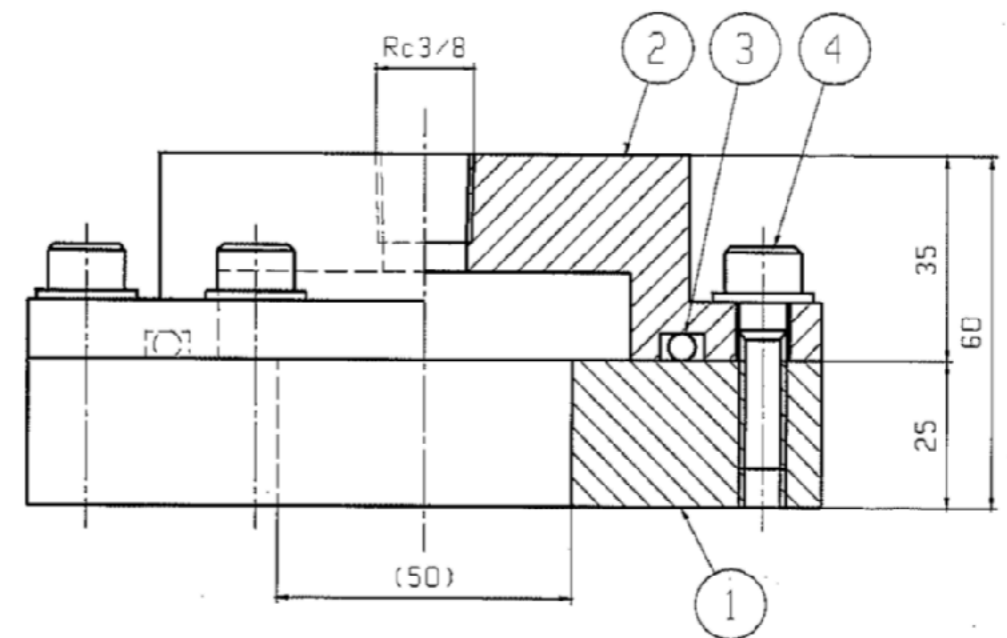


Pressure vessel

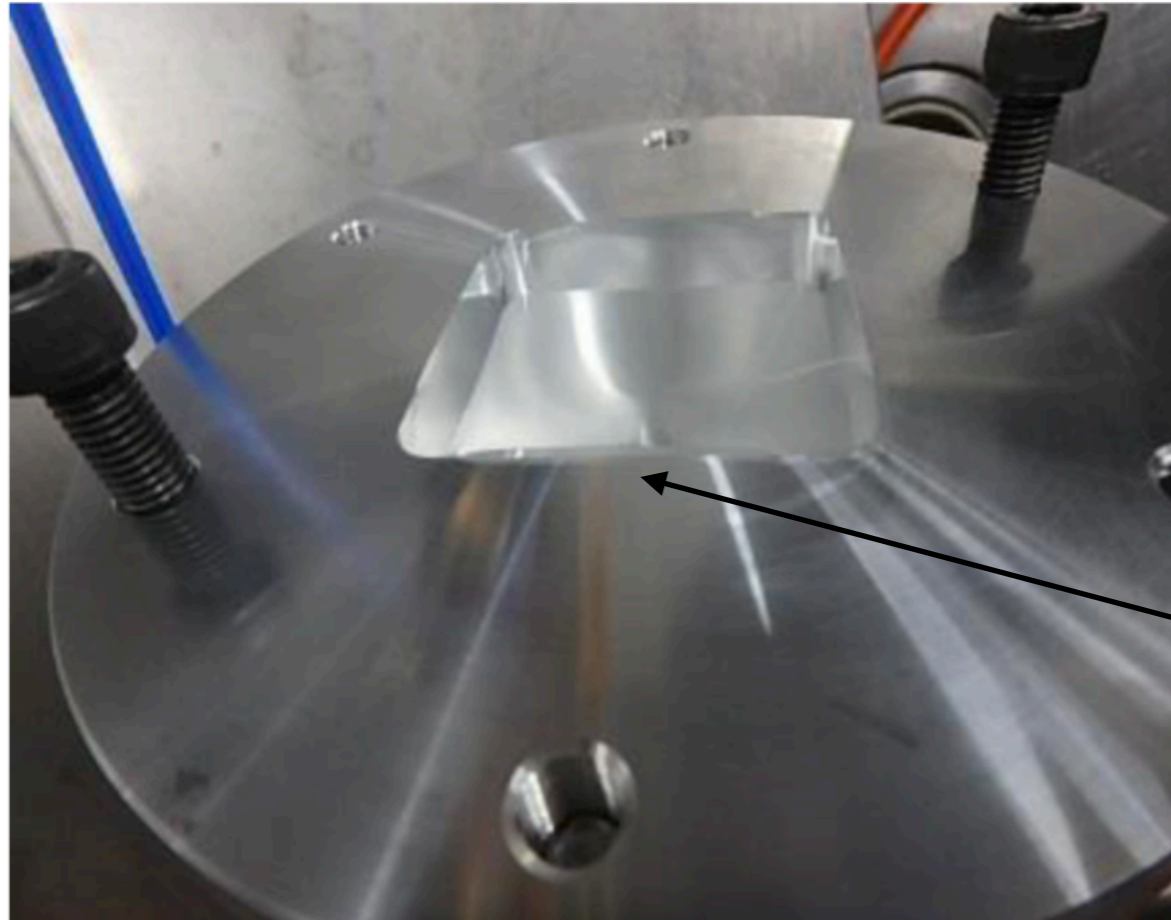


View from bottom

- Window piece attached to the pressure vessel





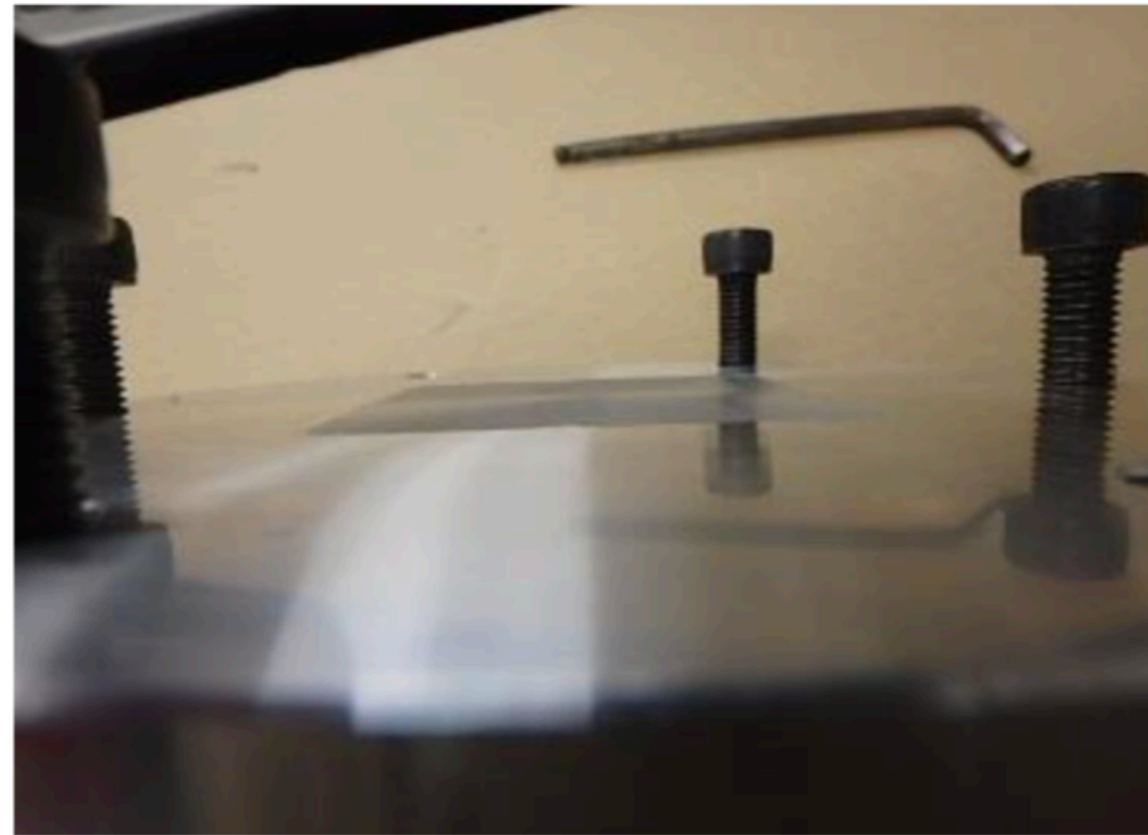


Sylgard pushed out a bit

- Pressure applied gradually, but large sound heard around 0.04 MPa
- Then pressure dropped immediately
- Due to a clean surface Sylgard didn't withstand that pressure



Setup



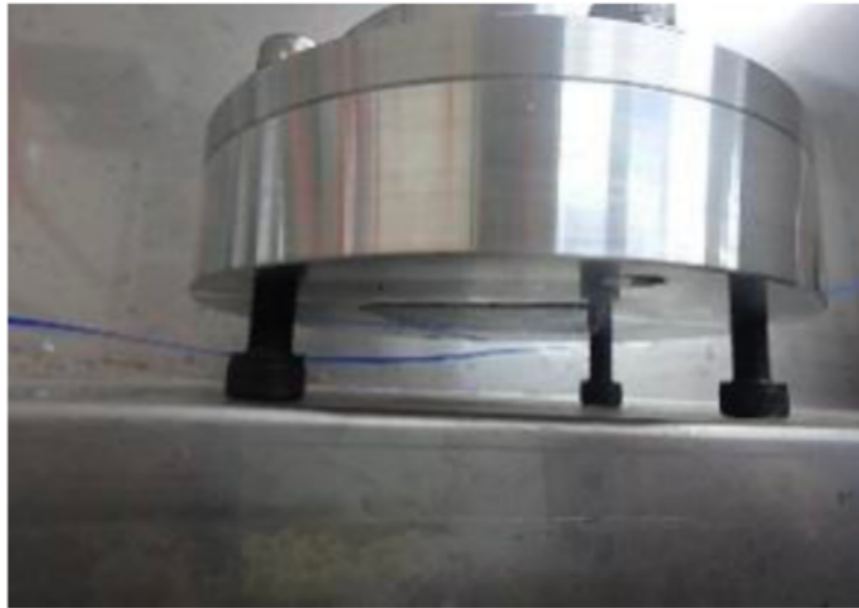
During pressure applied



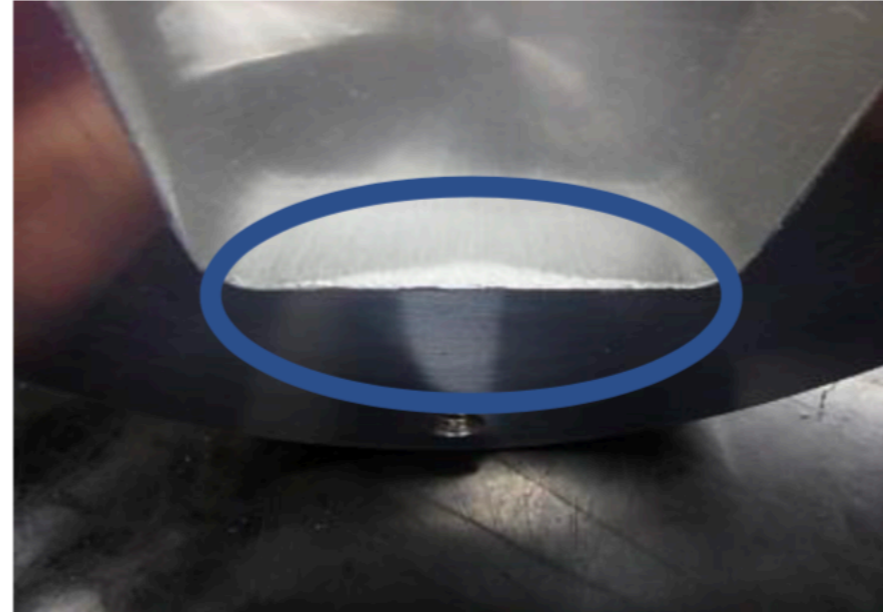
↓ After 24 hours



- 0.05 MPa pressure applied for 24 hours
- Sylgard surface didn't move during this period
- No pressure drop observed after 24 hours



Under pressure



Sylgard moved a bit



↓ After 24 hours



- 0.05 MPa pressure applied for 24 hours
- A slight pressure drop ( $\sim 0.002$  MPa) observed
- Sylgard surface inside the vessel moved a bit

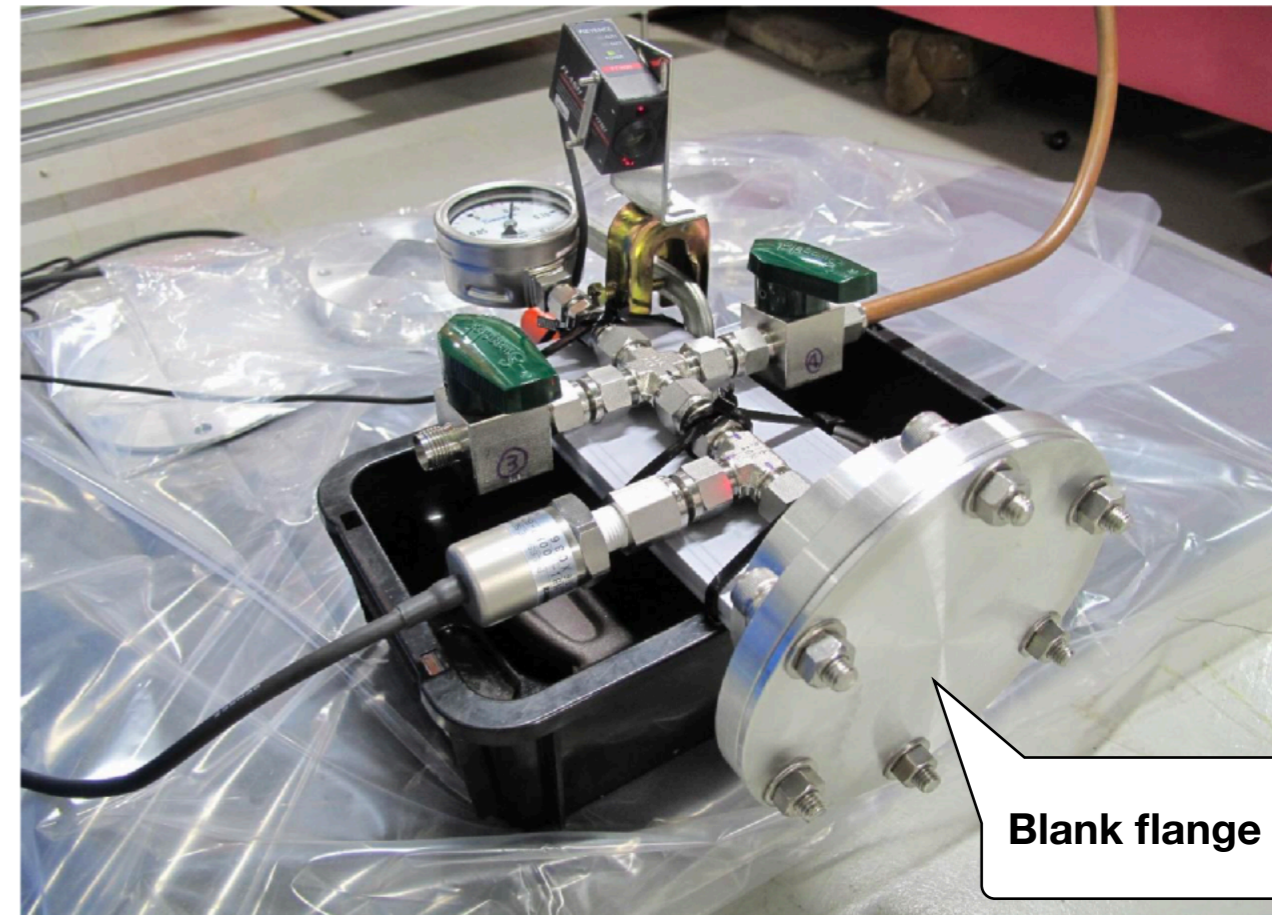
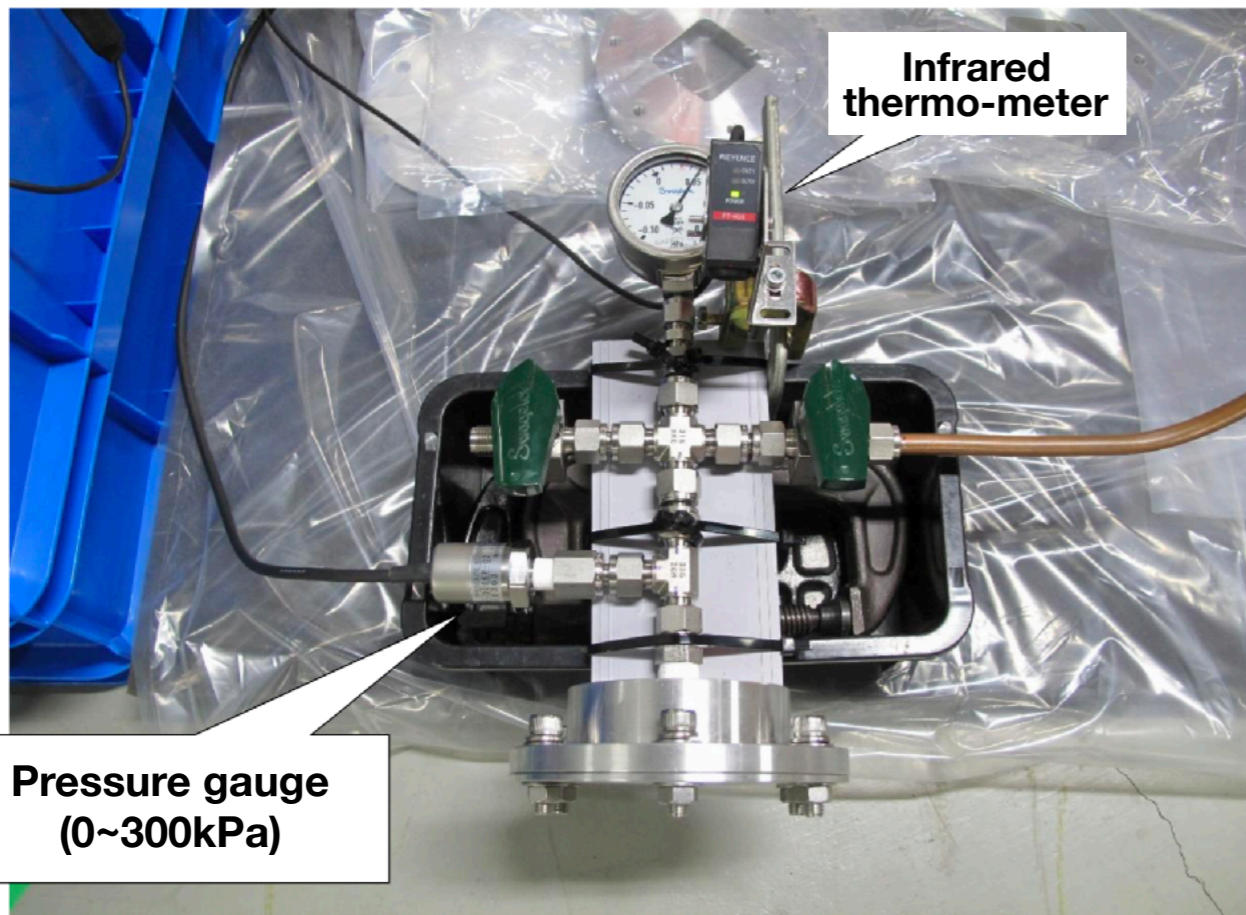


# Summary Of Test At Company

Condition	Result	OK/NG
Sylgard only	Cannot withstand 0.04 MPa	NG
RTV + Sylgard	Withstand 0.05 MPa for 24 hours	OK
Blast + Sylgard	0.05 MPa pressure applied for 24 hours but 0.002 MPa pressure drop observed	NG

- RTV + Sylgard is promising
- Longer-term tests will be performed at KEK

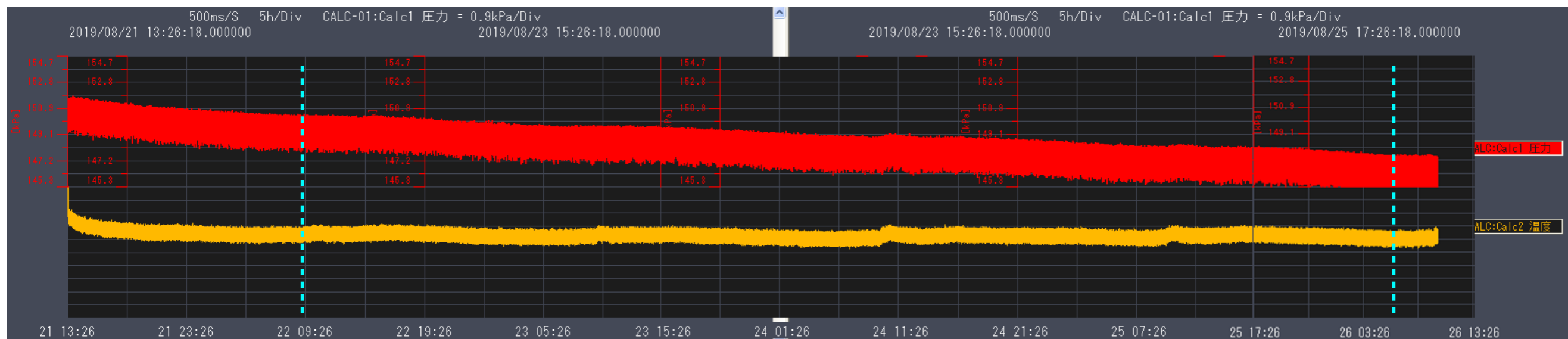
- **Long-term pressure test performed at J-PARC**
  - Pressure gauge : measures absolute pressure 0~300kPa
  - Infrared thermo-meter to measure temperature  $\Rightarrow$  measure temp. at outer case
  - At first, He leakage test with blank flange to check any leakage other than test piece
    - No visible pressure drop observed





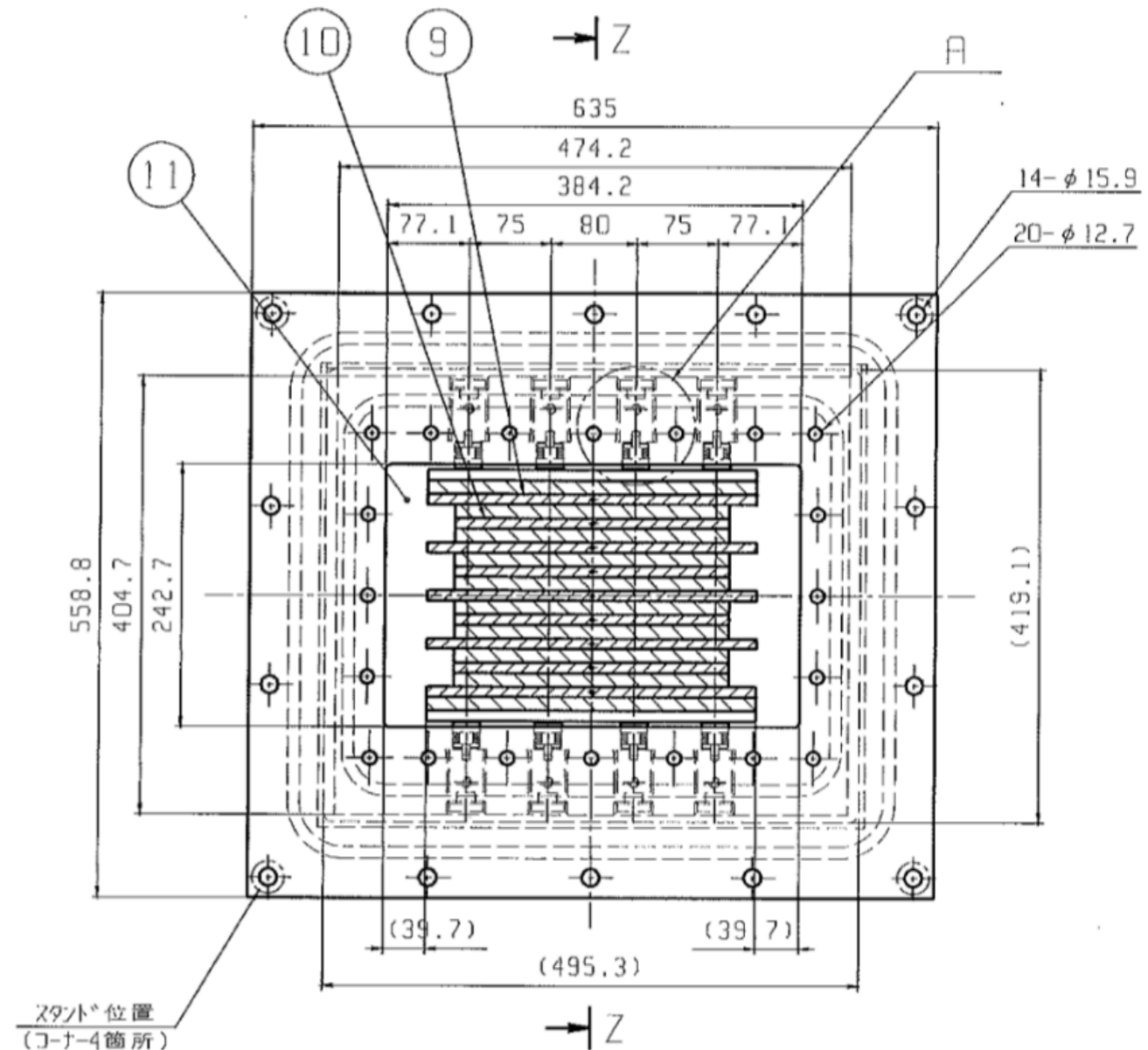
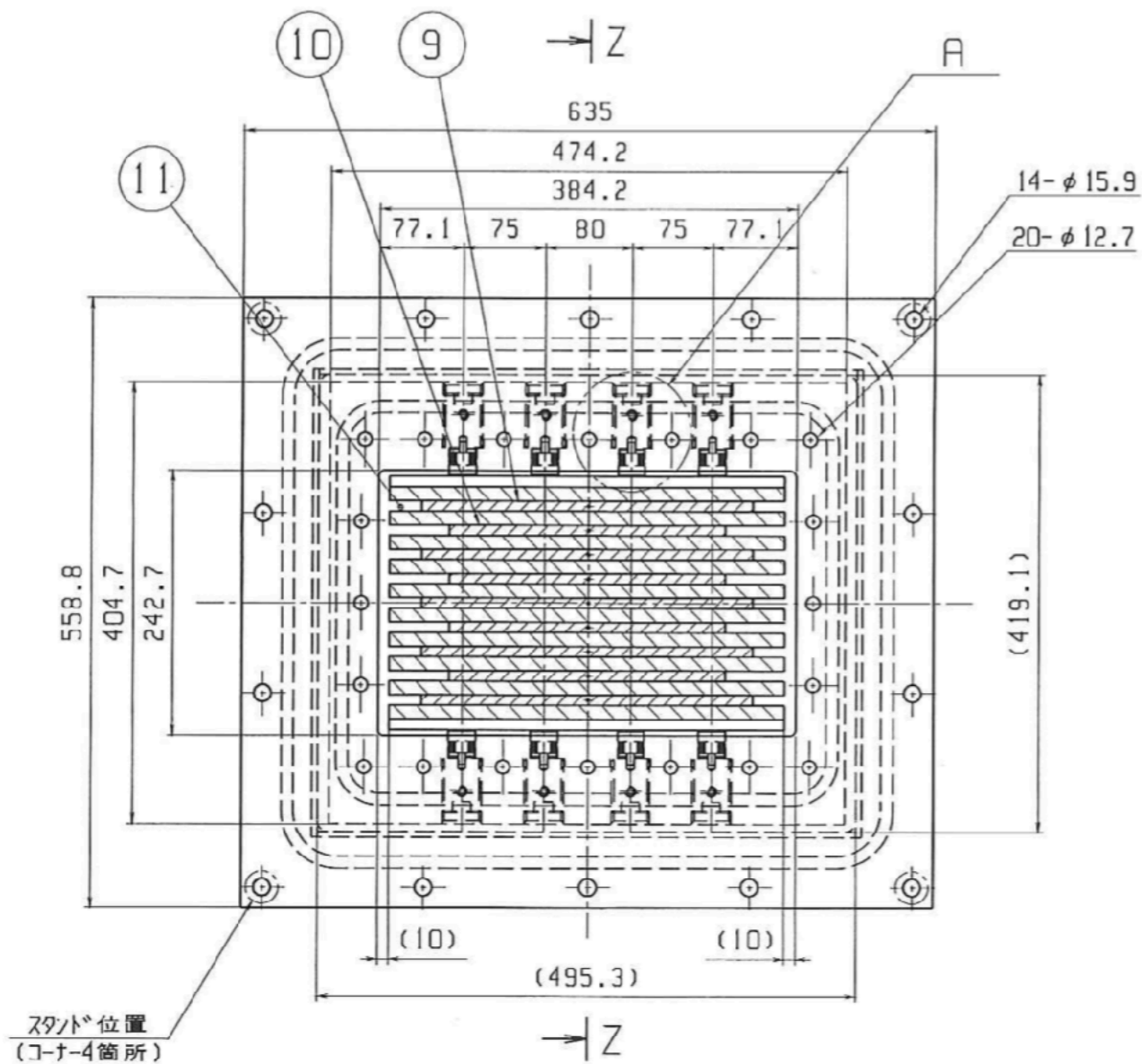
# Long-term Test At J-PARC

- Pressure test performed during August 21-26
- 0.05 MPa gauge pressure applied to the test piece with Sylgard + RTV
  - 149.1 kPa @ August 22 5:00am
  - 146.8 kPa @ August 26 9:00am
  - -2.3 kPa for 100 hours
  - Temperature variation during this period 2.5°C
- Measured leak rate to be  $6.3 \times 10^{-7} \text{ Pa} \cdot \text{m}^3/\text{s}$



## • Modifications

- Width of G10 plates to be same as that of striplines
- Application of RTV before filling Sylgard
- Improved bottom sealing for pouring Sylgard



止め栓 M36

シム

SUSワッパ

皿ワッパ x6 H-25

ガイトピオン φ25xφ12.0 SUSプレート

G10 Insulation Assembly

改訂 年 月 日 担当 照査承認 改訂事項

注記

<工程>

1. 部品の用意
2. 21番のシムの量調整のみの準備

部番4,5,9,10を単品の状態で重ね合わせ  
シロコワで締付、厚み測定=基準寸法 232.7mmと比較  
厚みの差を算出 0.5mm単位に近い値に設定

基準値 -0.5mmごと +1枚、+0.5mmごと -1枚  
(基準は21番シムを4枚使用、図面上側のシム  
下側のシムの順で交互に増減させること)

3. 組み立て

(1) 部番3,11,12,13を除いて組立。  
(部番6はA部詳細に従い互い違いに載せること。  
重ねあうようにした場合は性能が異なる為注意。  
シムの枚数は(工程2)で算出したものを使用。)

(2) 部番8が動かなくなるまで締め付けること。

(3) 部番14を図のとおりレットし、締め付けること。

4. シリコン注入

(1) (工程3)で組み立てたものに  
SF7-1241-3のシリコン注入時の  
治具および組立工程について記載。

皿ワッパの設計

50%~75%の圧縮率になるように設定しました。

1枚あたり 50% : 0.275 75% : 0.413

6枚合計 1.65mm~2.478mm

締付基準 2mm (に近くなるようシムで調整)

シム調整基準寸法 232.7

スウェジロック位置 (2箇所)

シム調整基準寸法 232.7

スウェジロック位置 (2箇所)

スタット位置 (コナ4箇所)

閉 19.8.20 野

部番	名称	材質	数量	表面処理	熱処理	備考
21	シム	SUS304	8s			SF7-1200-11
20	SUSワッパ	SUS304	8			SF7-1200-10
19	スウェジロック	SUS304	2			SS-810-1-8W
18	六角穴付ボルト・W	SUS304	20s			3/8インチxL55
17	六角ナット	SUS304	12			1/2インチナット
16	スタット(B)	SUS304	4			SF7-1200-8
15	スタット(A)	SUS304	4			SF7-1200-7
14	止めジヤ	SUS304	16			M10x15L
13	リング	EPDM	1			P485
12	リング	EPDM	1			P620
11	Poured Silicone Elastomer	—	1s			Sylgard184 (Silpat184) (flow Corning)
10	導体(W254)	Ag061-T6	4			SF7-1200-6(部番2)
9	導体(W304.8)	Ag061-T6	5			SF7-1200-6(部番1)
8	止め栓	SCM	8			SF7-1200-12
7	皿ワッパ	SK85H	48			H-25(磐田電工製)
6	ガイトピオン	SUS304	8			SF7-1200-9
5	SUSプレート	SUS304	2			SF7-1241-2
4	G10 Insulation Assembly	—	1s			SF7-1241-1
3	フランジ	SUS304	1			SF7-1200-3
2	インナーフランジ	PS052 又はPS056	1			SF7-1200-2
1	アウトフランジ	PS052 又はPS056	1			SF7-1200-1

第三角法 単位 : mm

承認照査設計製図尺度

品名 Stripline Feedthrough

名 バスパー貫通部試作機

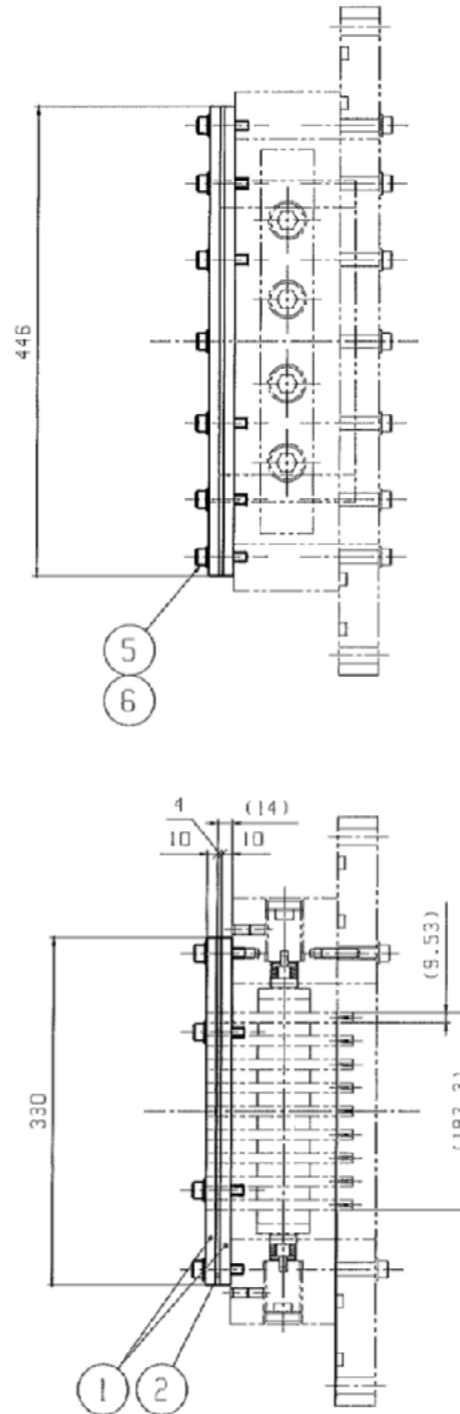
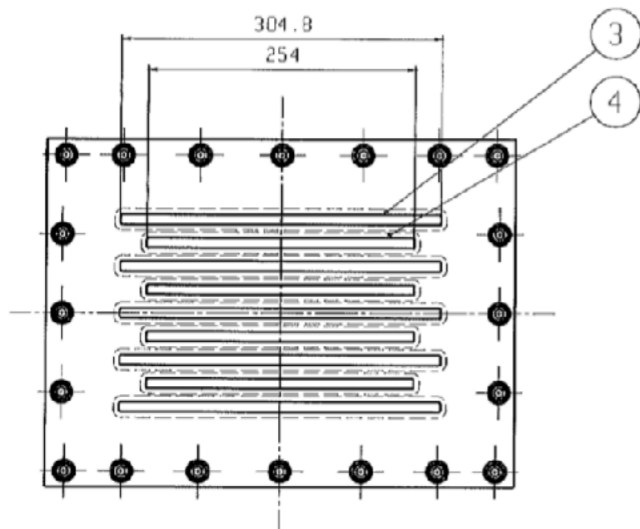
図 SF7-1241

番 SF7-1198

古河電工パワーシステムズ株式会社



- Sylgard leakage during curing last time
- Rubber O-ring to fill any gaps to avoid leakage



注記

<工程>

1. SF7-1241-4,5とボルトを用意
2. シリコン注入時 SF7-1241で組み立てを行いさらに本図形状に注入治具をセット。
3. シリコン注入  
 Sygrad184 (Silpot184) のシリコンを使用し2液混合の規定量(主剤:硬化剤=10:1)を混合させる。  
 混合したものを真空脱泡装置により脱泡  
 その後、本図製品に注入しさらに真空脱泡を行うこと。  
 その後、規程時間シリコンを硬化させ検査を行うこと。
4. 検査  
 4-1. 圧力保持および発泡試験  
 真空1.5気圧(約0.15MPa)1時間保持および発泡試験  
 圧力低下および発泡のないこと。  
 ヘリウムリーク試験  
 133Pa程度まで真空引きを行い、ヘリウムの噴き付けを行うこと。  
 目標リーク量  $1 \times 10^{-5} \text{ Pa} \cdot \text{m}^3/\text{sec}$ 以下



部番	名称	材質	数量	表面処理	熱処理	備考
5	六角穴付ボルト・W	SUS304	20s			3/8インチxL3/2インチ
4	Oリング	合成ゴム	4			G165
3	Oリング	合成ゴム	5			G195
2	加圧プレート(B)	フロン	1			SF7-1241-5
1	加圧プレート(R)	F5052P	1			SF7-1241-4
第三角法 単位 : mm 承認照査設計製図 尺度 品名 Stripline Feedthrough 通電試験用 図名 シリコン注入治具 図番 SF7-1241-3 番 SF7-1198-1200 古河電気パワーシステムズ株式会社						



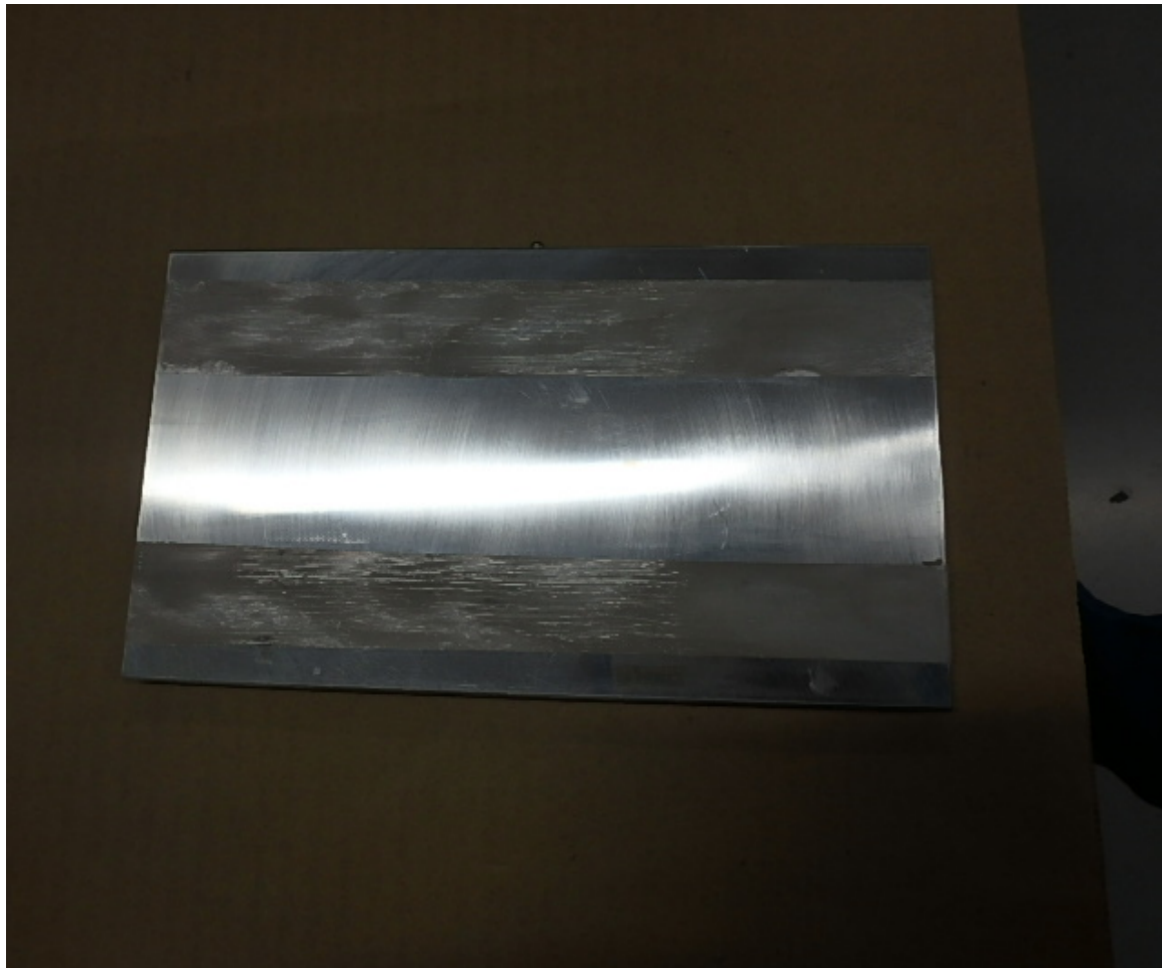
- **Current status**

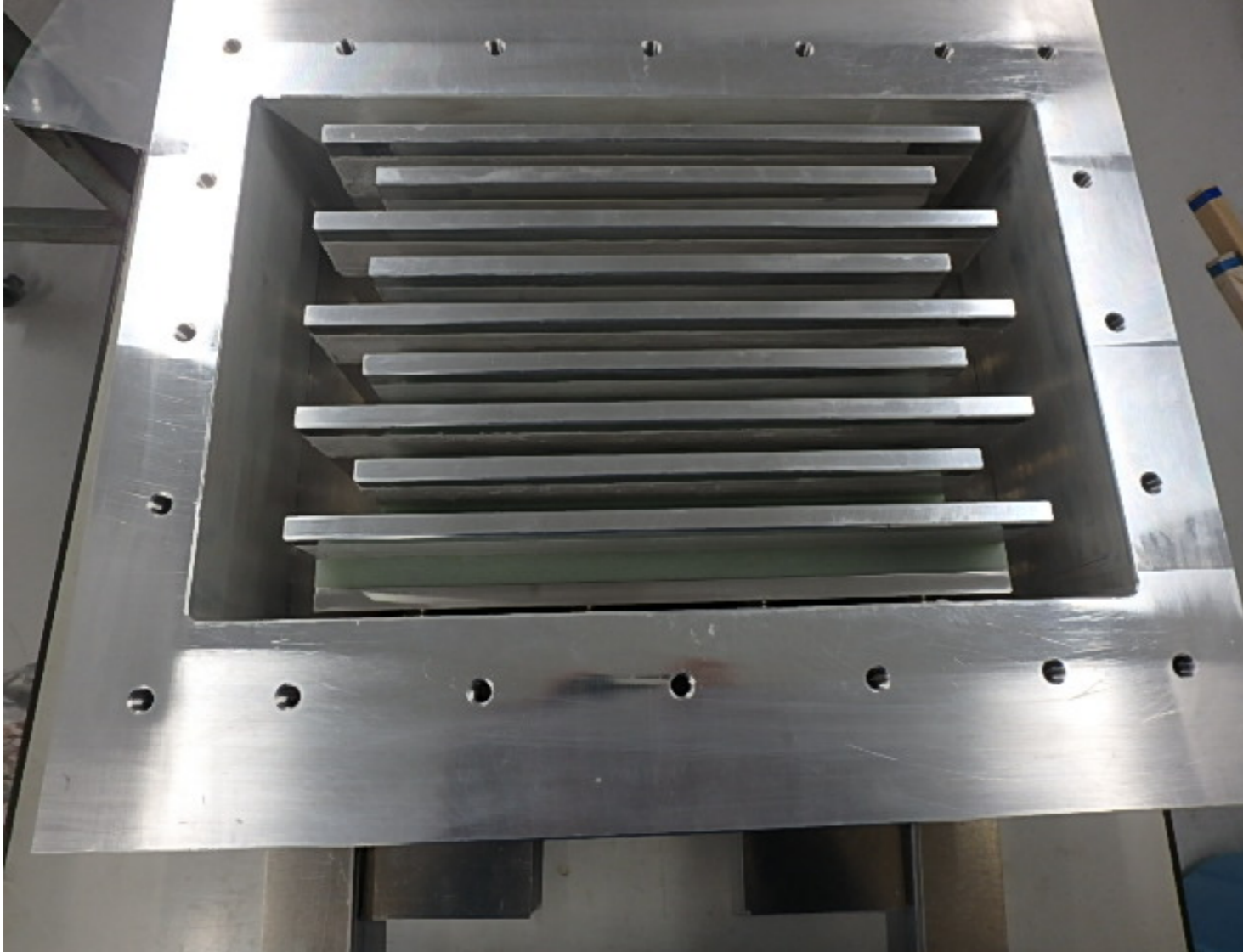
- Parts production completed
- RTV primer applied to the striplines
- Assembly of sealing parts already done
- Initial Sylgard filling done, additional filling tomorrow

- **To do**

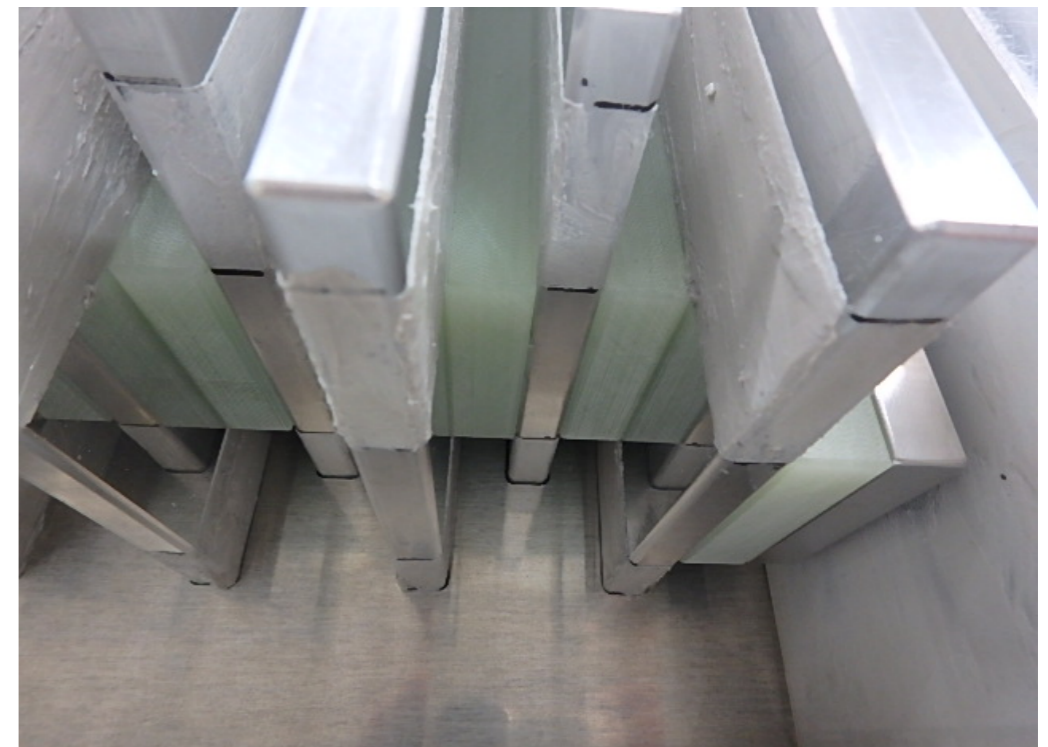
- Pressure test at company to be done next week
- Pressure test at J-PARC in November

- RTV primer applied to the aluminum surface
  - The surface where G10 plates are attached are masked

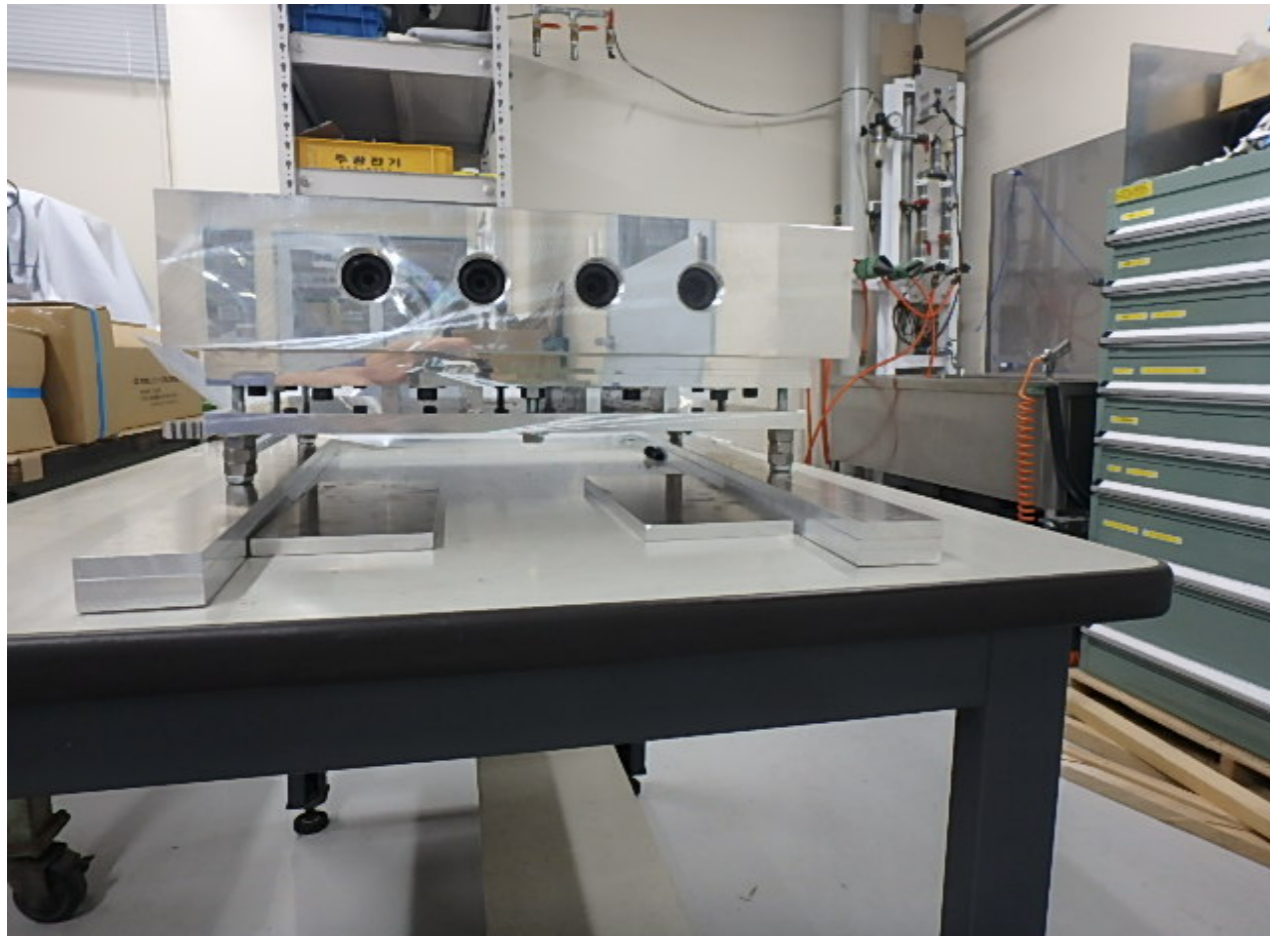


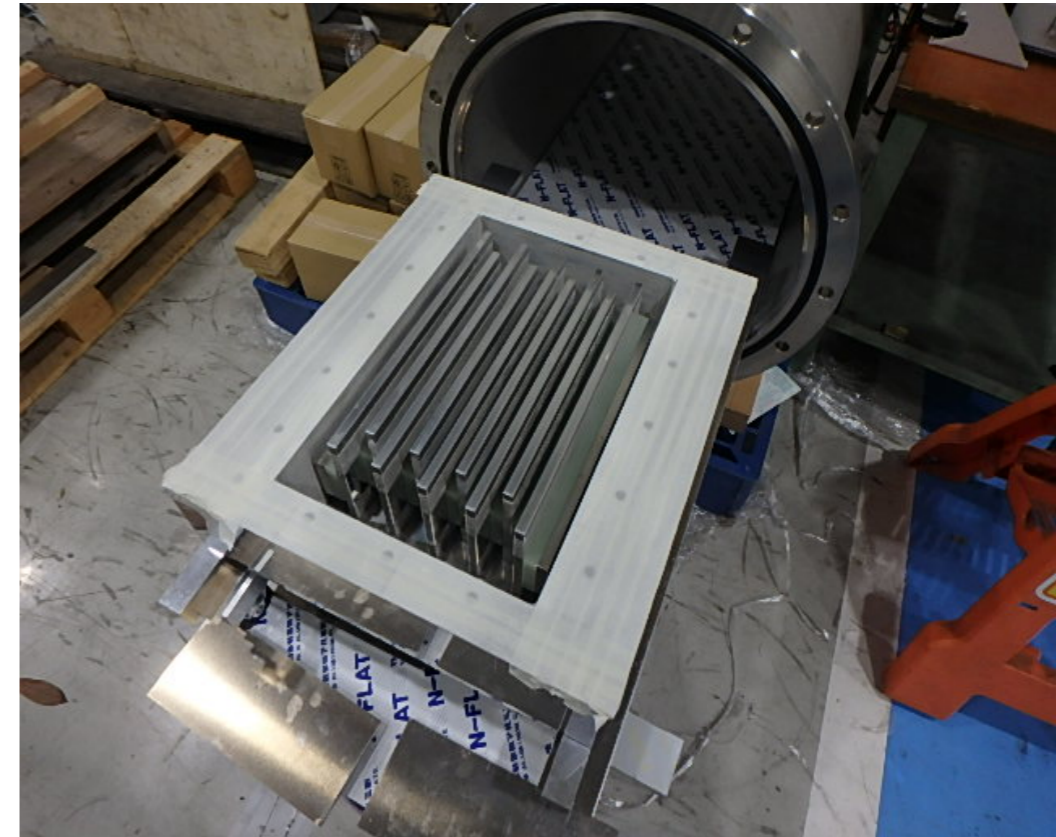


- Assembly completed

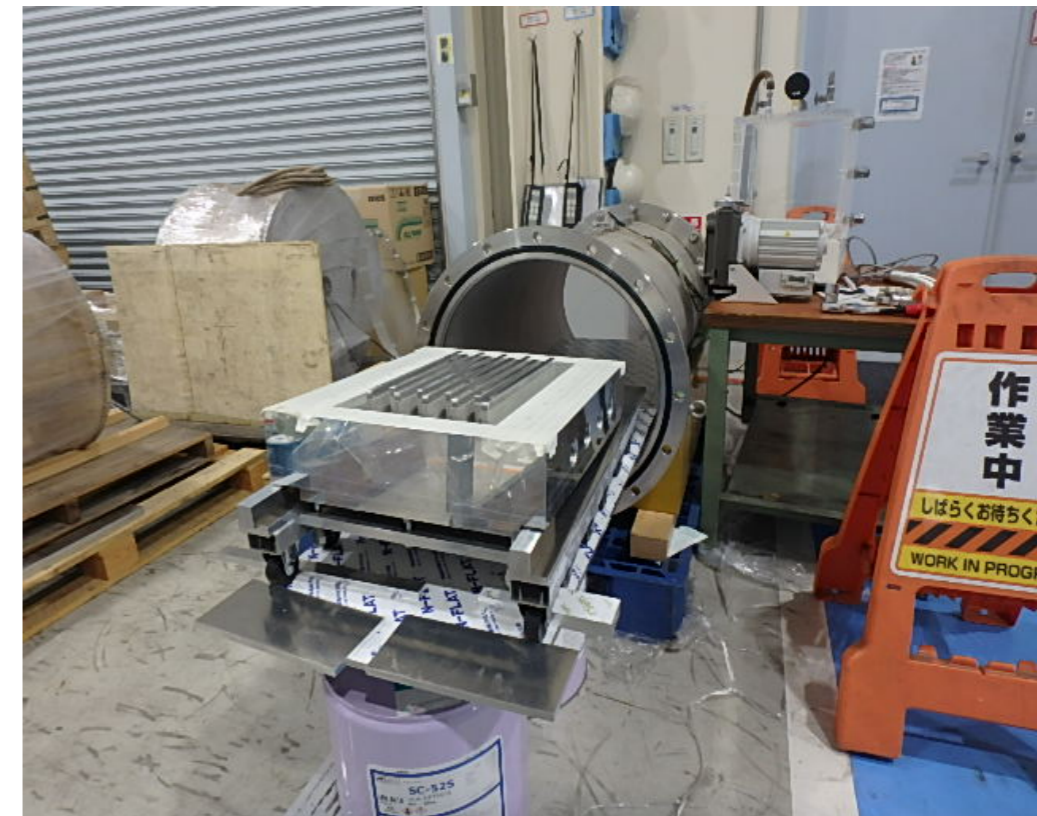


- Bottom sealing plates attached



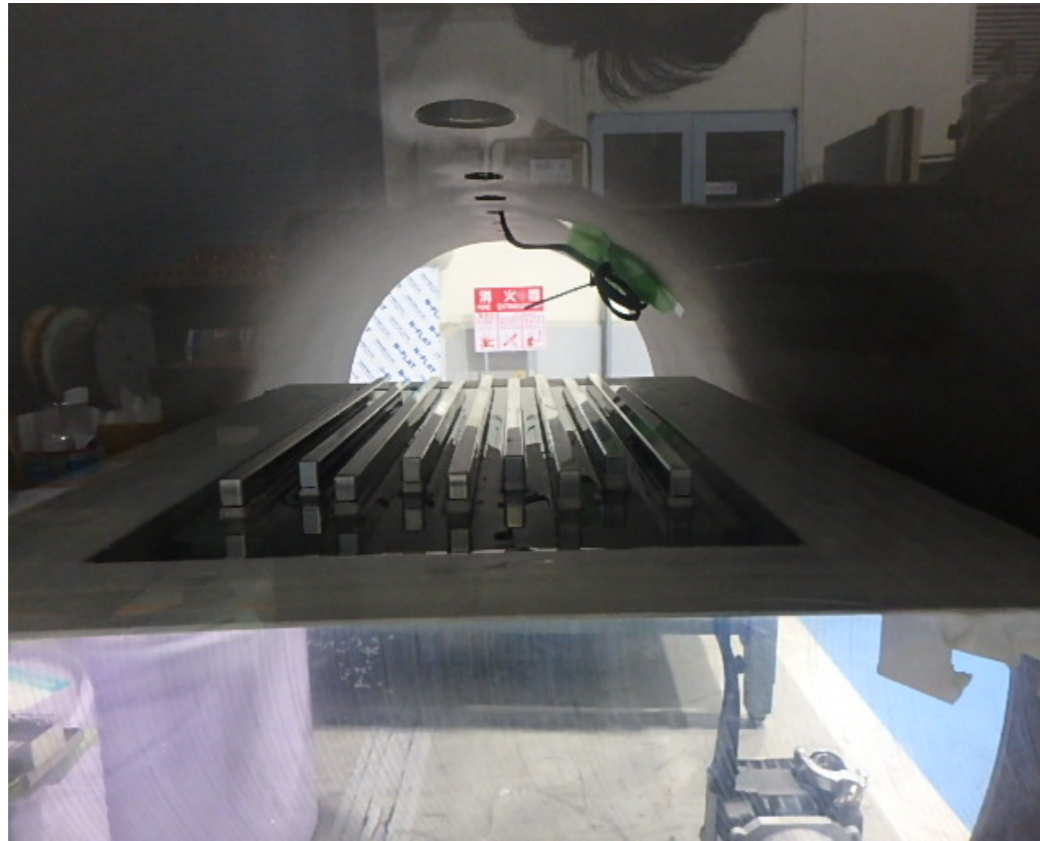


- The feedthrough to be inserted in the vacuum chamber



- Vacuum degassing of Sylgard
- Sylgard filled to the feedthrough





- Vacuum degassing in the chamber
- Tiny leakage of Sylgard occurred
  - But significant improvement on sealing
- Then waited 48 hours for curing
- Add small amount of Sylgard to the leaked point





- Corona discharge test is suggested
  - Apply 8kV(peak) AC voltage and measure corona charge
- Dedicated instruments are needed
  - Fujikura Dia Cable B010
    - Cost is \$40k too expensive
  - Looking for a possibility to rent the instrument



**Fujikura Dia Cable B010**