Production Status

RIKEN/RBRC

Itaru Nakagawa

COVID-19 Status

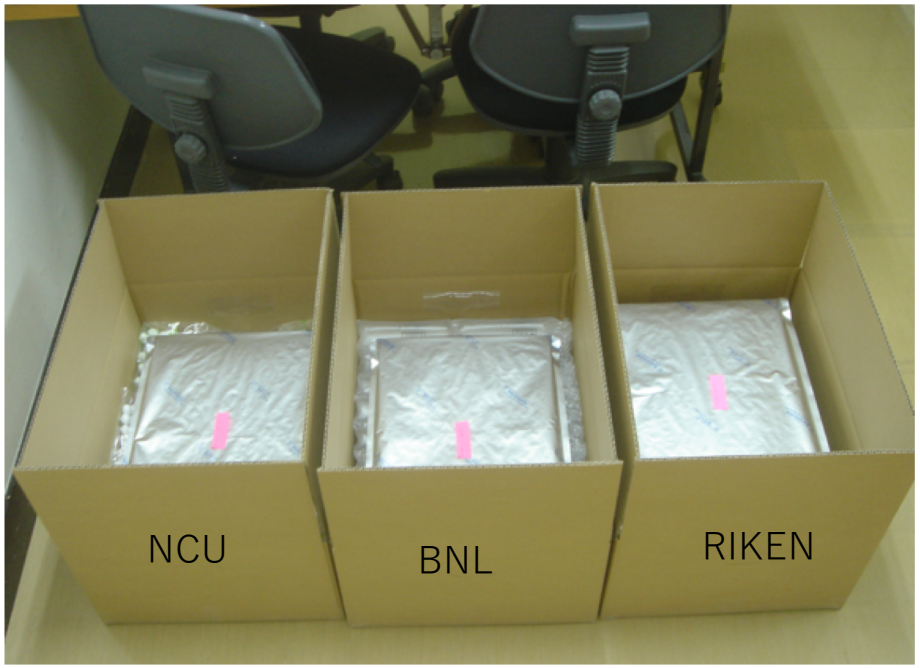
- NY State announced to be on pause until May 15th. BNL is closed until end of April, but may be extended accordingly.
  - Only work **approved as essential** can be done.
- RIKEN has been closed since April 8th until May 6th (likely to be extended)
  - Still can receive delivered items (HDI, Staves, …)
  - New contract will be pended until reopens
  - **Work which can cause trouble to other institute** may be approved as an essential business. (This logic is applied NCU shippings)
- NWU is closed as well. Takashi lost his access to the lab.
- NCU is still running.

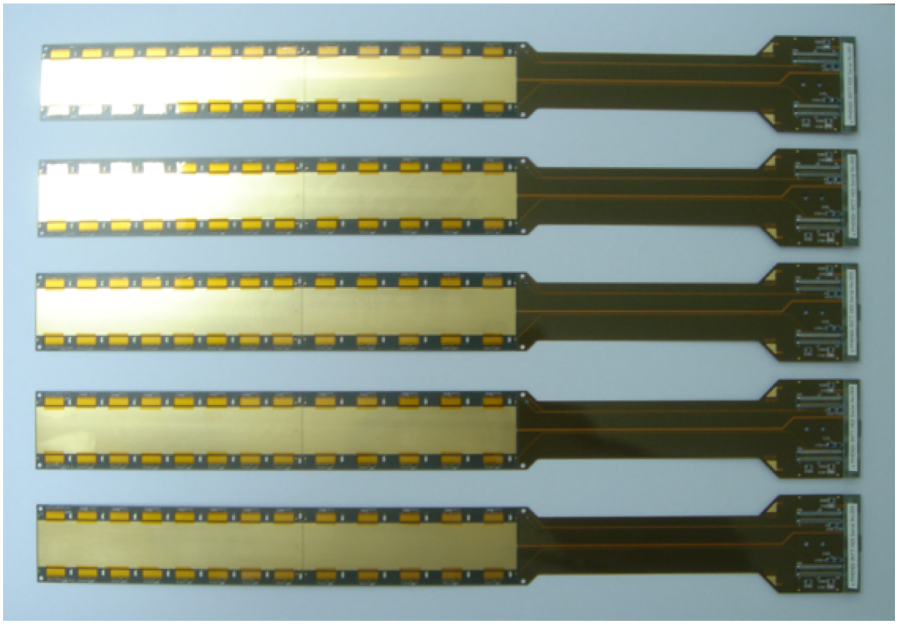
Executive Summary

- **Silicon Sensors**
  - 29 Sensors are delivered to NCU in April 17th.
- **HDI**
  - Delivered to RIKEN on April 17th.
    - 19 HDI's arranged to be shipped to NCU on April 24th.
    - 39 HDI's for BNL are on hold at RIKEN.
  - 2nd Batch (90 more HDI's) is on hold for PO until RIKEN reopens and we confirm the modification around the bias connector. However the company pre-orders rolled copper foils (see my presentation 2020/03/16) in advance to save a few months for the fabrication.
- **Stave**
  - Issues of the delivered 8 staves are mostly overcame.
  - Updated report from ASUKA co. about the leak test.
- **FPHX**
  - Arranging 1,5k good FPHX chips are on their way to Taiwan.
- **Thin Trigger Scintillators**
  - Got quote from G-Tech co. for 9mm and 230mm thin scintillators. We have to wait for PO until RIKEN reopens.

We have been managed to supply components to NCU to keep them running. At least , we would like to keep this at least as a bottom line.

HDI Delivery on April 17th





NCU box is to be picked up on April 24th.

FPHX Chips

2016+2018 FPHX Production Statistics

Btach	#	Wafer ID	Good	Bad	Total		
2016	1	19G4	729	108	837	2020/4/17 shipped to NCU	
	2	18H1	805	27	832	2020/4/17 shipped to NCU	
	3	24E5	738	95	833		
	4	23F2	798	30	828		
	5	21G4	792	47	839		
	6	20H1	814	22	836		
	7	22F7	705	119	824		
		Total	**5381**	**448**	**5829**		
2018	1	W6B752-01D0	831	9	840		
	2	W68752-02C3	837	3	840		
	3	W6B752-03B6	836	4	840		
	4	W6B752-04B1	833	7	840		
	5	W6B72-05A4	834	6	840		
	6	W6B752-06H2	830	10	840		
	7	W6B752-07G5	831	9	840		
	8	W6B752-08G0	834	6	840		
	9	W6B7562-09F3	838	2	840		
		Total	**7504**	**56**	**7560**		
2018+2019 TOTAL			**12885**	**504**	**13389**		
Quantity for 120 Ladders			6240				
Number of spares			6645				
							Itaru Nakagawa

Total : 1,669 FPHX
Good : 1,534 Chips
Bad : 135 Chips

We have 12k FPHX chips
About half (6k) are used for 120 Ladders
Remaining half (6k) are sufficient for spares

Package

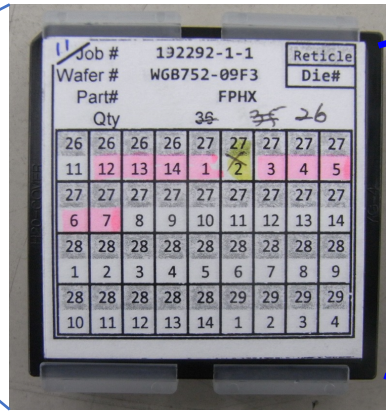
Contains 2 bags of FPHX
Dropped off on to the shipping yard yesturday on April 20th.

Special Thanks to Mike Lenz for packing FPHX bags and the shipping arrangement.

Bags of FPHX Chips

Bag contains multiple FPHX cases

Wafer ID
19G4
18H1
24E5
23F2
21G4
20H1
22F7

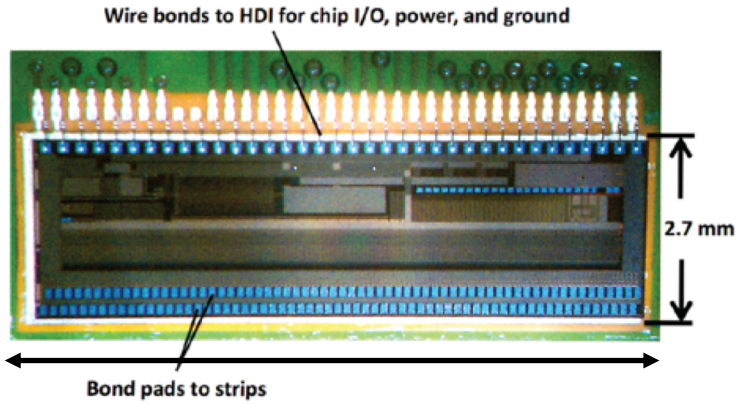


FPHX case

Please find the bags for wafer #**19G4** and **18H1** from the stack of bags in the desiccator and pack them in a box with cushioning materials

- ECCN : EAR99
- Make : MOSIS Service https://www.mosis.com
- Year : 2010 (Wafer)
- Specification is summarized in other document : FPHXspecsSept08review08-14-08.pdf

FPHX Chip



Instruction to use:

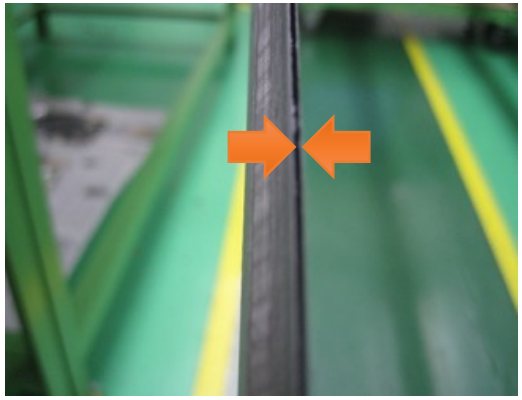
- Attention on the note pasted on the top of the case. This note represents result of the FPHX chip test after dicing for corresponding chips in the case.
- Highlighted or crossed IDs are identified as bad. Avoid them from the assembly.

Stave

1. Extra space between CFRP plates and end cap
2. Space between the top and bottom CFRP plates.
3. Leak performance

1.

2.



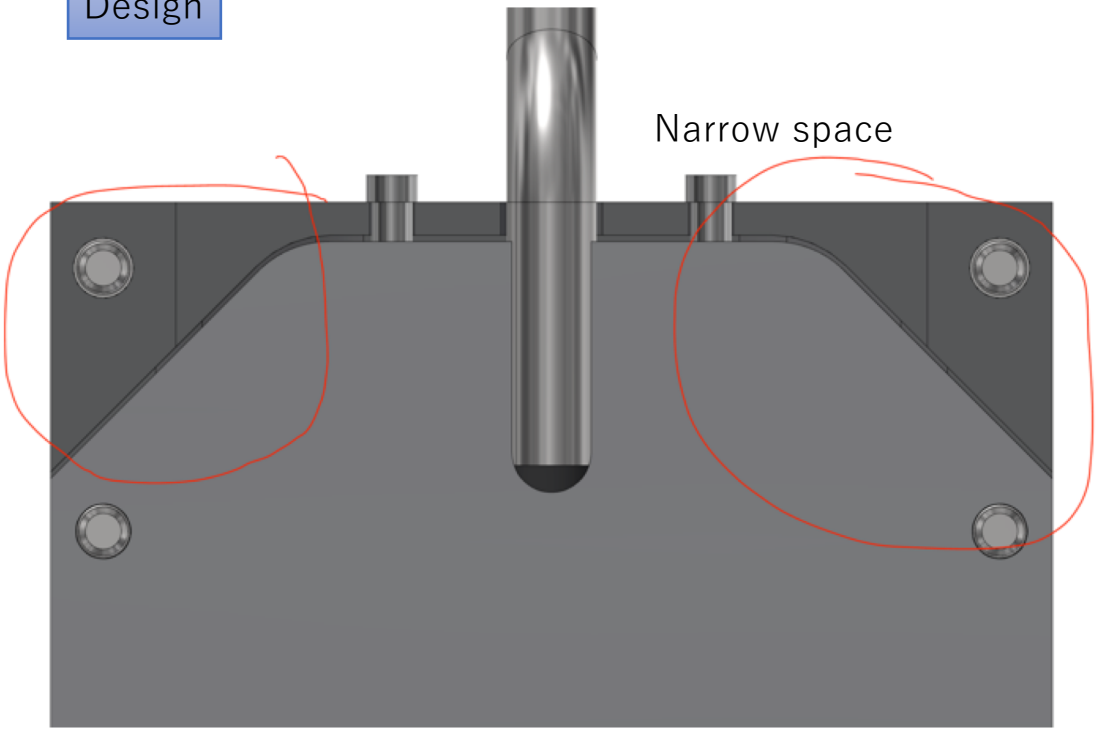
Stave Schedule

- 12 Staves to be delivered by the end of April is on schedule.
  - 4 staves are to be shipped to NCU
  - 8 staves for BNL are to be on hold in RIKEN(?)
- Note these staves are **pre-production**, not production yet. Thus the ladders assembled on these staves considered as pre-production ladders (can be used for the assembly practice), but good to evaluate the performances.
- The design can be modified later depending on the performance of this version.
- Do we need an additional leak test in NCU before the assembly? Depends on the purpose of the ladder use. Do we need the leak test if the ladder is meant to be used for a future beam test?

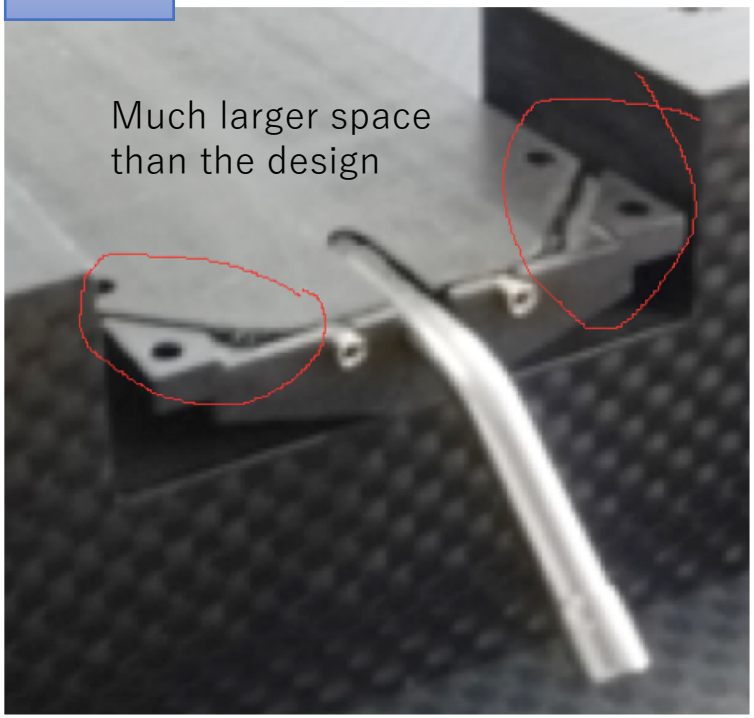
Space between End cap and CFRP

Delivered in March

Design



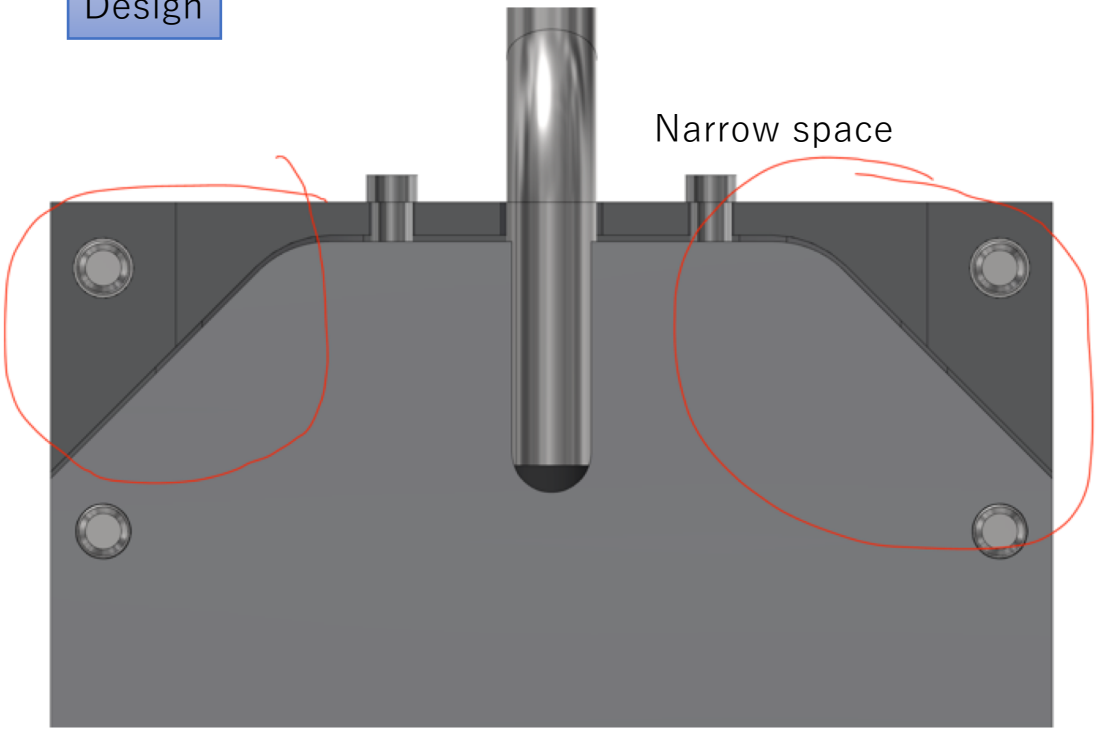
Product



Space between End cap and CFRP

Ongoing assembly today

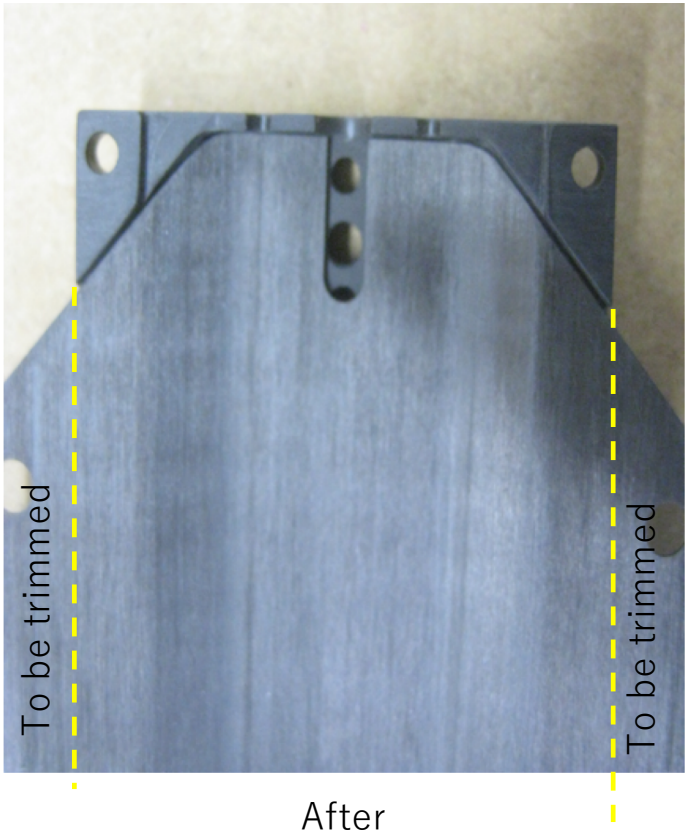
Design



Product

Before & After Comparison

before



After

Cooling tube leak test update

Report from ASUKA Co. on April 16th

Vacuum Leak Test Using a Pressure Gage

$$Q = \frac{V\Delta P}{\Delta t}$$

Report from March 18th

where

Q : Leak quantity $[Pa \cdot l/s]$

V : Test Volume $[l]$

ΔP : $P_0 - P_{\Delta t}$= Pressure difference after Δt $[Pa]$

Δt : Measurement time [s]

Requirement:
Q <0.01 $mbar \cdot ml/s = 1\ Pa \cdot ml/s$

Actual measurements

Δt [s]	0	10	20	30
$P_{\Delta t}$ [kPa]	48.8	48.9	48.9	48.9

Error : ± 0.1[kPa]

$$Q = \frac{1.57|48.8-48.9|}{30} = 5 \pm 5\ [Pa \cdot ml/s]$$

This measurement doesn't satisfy the requirement $< 1\ [Pa \cdot ml/s]$

Solution

A) Upgraded the pressure gauge which can measure 10 times better precision.
B) Leak Tight the fitting joint with the cooling tube.
C) Longer measurement (15 minutes) for stability.

C) They've done extended ours measurement for 56 min. (3360 sec).

t=0[s] : P=-58.2 [kPa]
t=3360[s] : P=-57.7 [kPa]

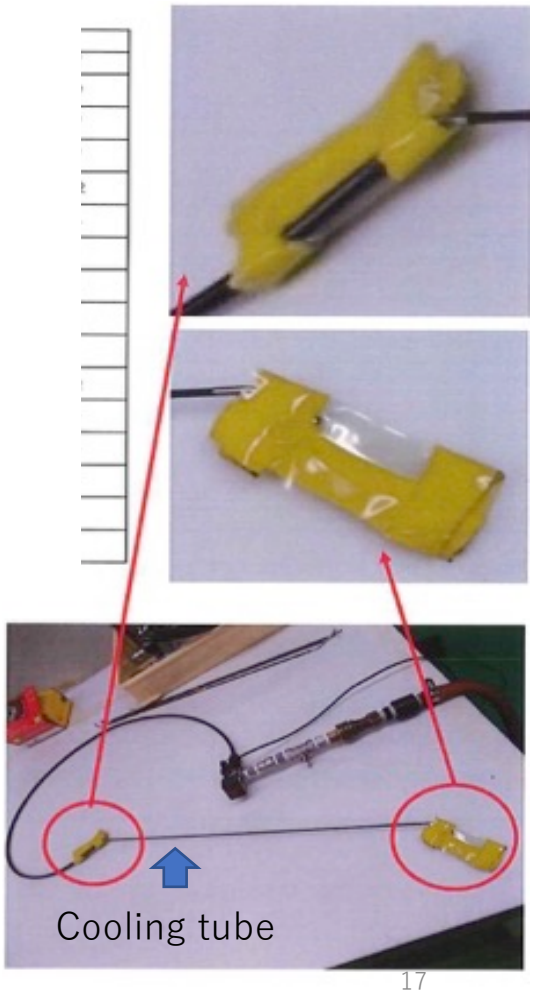
$Q = 0.23 \pm 0.046$ [Pa ml/s] < 1 $[Pa \cdot ml/s]$

☛This well meets the criteria, but tested only one tube.

A) **.* kPa → **.** kPa

Pressure gauge
Range : 0 ~ 20 kPa

B) Leak Tight Fitting Joint



Cooling Pipe Leak Test (April 17th Update)

Sample Number	Gauge Pressure (*.** kPa)			Leak Rate
	t=0 [s]	t=30 [s]	ΔP	Q [ml Pa/s]
1	-10.24	-10.24	0.00 ± 0.01	0.0 ± 0.52
2	-9.50	-9.50	0.00 ± 0.01	0.0 ± 0.52
3	-9.85	-9.85	0.00 ± 0.01	0.0 ± 0.52
4	-9.36	-9.35	0.01 ± 0.01	0.5 ± 0.52
5	-9.54	-9.53	0.01 ± 0.01	0.5 ± 0.52
6	-9.73	-9.72	0.01 ± 0.01	0.5 ± 0.52
7	-9.89	-9.89	0.00 ± 0.01	0.0 ± 0.52
8	-9.37	-9.37	0.00 ± 0.01	0.0 ± 0.52
9	-9.13	-9.11	0.02 ± 0.01	1.0 ± 0.52
10	-8.97	-8.97	0.00 ± 0.01	0.0 ± 0.52
11	-8.85	-8.84	0.01 ± 0.01	0.5 ± 0.52
12	-8.07	-8.06	0.01 ± 0.01	0.5 ± 0.52
13	-8.11	-8.10	0.01 ± 0.01	0.5 ± 0.52

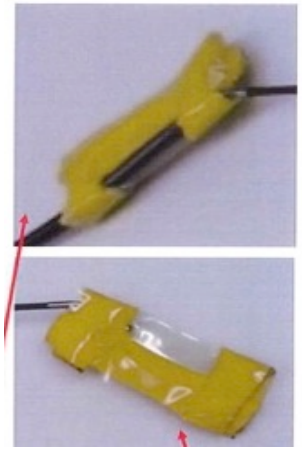
Gauge measures 10 Pa level

Discussion

- 13 cooling tubes are tested
  - 6 tubes observed 0.00 kPa/30s pressure change : < 0.01 mbar ml/s
  - 6 tubes observed 0.01 kPa/30s pressure change : ≦ 0.01 mbar ml/s
  - 1 tube observed 0.02 kPa/30s pressure change : ~ 0.01 mbar ml/s
- Evidently, their measurement needs to be improved to safely meet the requirement.
- The applied pressure was around -10 ~ -8 instead of ~-58 last time. The pressure was factor of 6 ~ 7 weaker, which cannot be blamed because we didn't specify in the contract. However tubes suppose to be survivors of 60 psi (~4atm) for 1hour burst test.
- For this time, I will let them proceed to 12 stave assembly except for 0.02 kPa/30s tube.

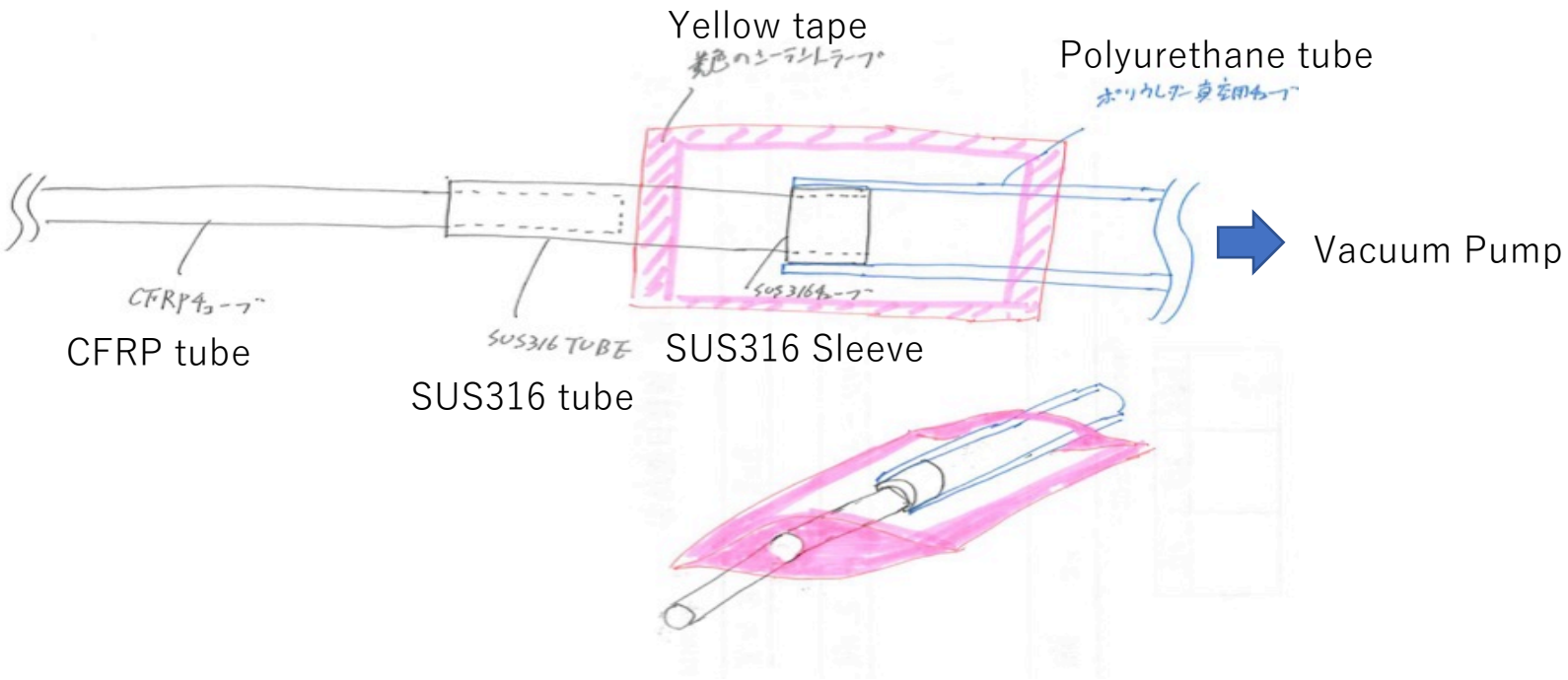
For Next Round (Future)

Leak tight established by tape (not ideal solution for production)



- Dan and Rob proposed even higher leak tight criteria:
  - 0.01 ml-mbar/s (0.6 ml-mbar/min) -> 0.2 ml-mbar/min
- Perhaps we better provide leak tight fitting joint to them if possible. As you can imagine for their setup photo, they have a hard time to establish leak tight condition at the joint.
- Longer measurement in the order of 15 minutes to 12hours need to develop measurement infrastructure. Sequential measurement of 150 cooling tubes doesn't sound feasible. Need to achieve at least 10 tubes parallel measurement which requires investment on their infrastructure.

ASUKA's setup around the joint



Carbon Fiber Tubes

http://www.saoya-kimuraya.com

- I found Asuka co. procured carbon fiber tubes from one of local fishing rod makers and not from ROCKWEST.com
- There is no specification available in their web page. The order was custom made.
- As far as I heard, the carbon fiber tubes are made based on TORAYCA T700 which is allowed based on the statement in the design “TORAYCA T700 or equivalent”.
- I will ask them to check the leak tightness of the carbon fiber tube for extended period at least once.
- Do you have any suggestion in further testing?

Asuka's Original Report

2020/4/16 (株)アスカ　吉川

Prototype Stave Design
CFRPチューブリークテスト

Q<0.01mbar・ml/s
0.01mbar=0.001kpa=1pa

圧力変化法(真空引きにて検査)

圧力ゲージ表示Kpa(**.**)
真空引き実施圧力ゲージ確認し
真空ポンプバルブ締め後の圧力ゲージを確認

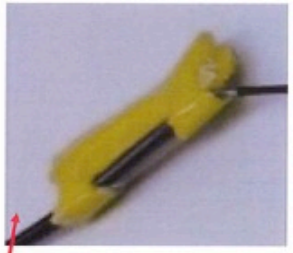
圧力ゲージ

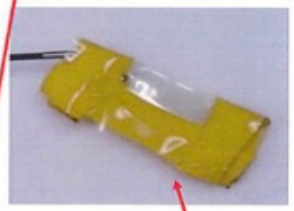
30秒間にて圧力ゲージの値の偏差を確認
0.01Kpa以下の偏差であれば合格と判断

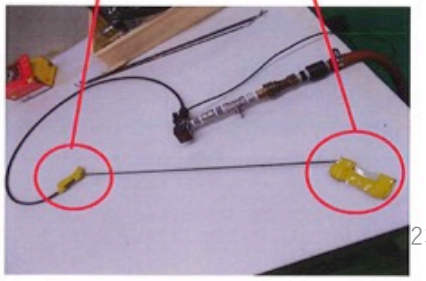
(測定例)　$Q(Pa,L/S) = \frac{V(P1-P2)}{\Delta t} = \frac{1.57(48.90-48.89)}{30} =$ リーク量 0.00052

サンプルNo	ゲージ圧力(*.**Kpa) 0秒	30秒	リーク量
1	-10.24	-10.24	0
2	-9.50	-9.50	0
3	-9.85	-9.85	0
4	-9.36	-9.35	0.00052
5	-9.54	-9.53	0.00052
6	-9.73	-9.72	0
7	-9.89	-9.89	0
8	-9.37	-9.37	0.0010
9	-9.13	-9.11	0
10	-8.97	-8.97	0.00052
11	-8.85	-8.84	0.00052
12	-8.07	-8.06	0.00052
13	-8.11	-8.10	0.00052

上記試験にて12本とも圧力偏差は0.01Kpaまでであった為
0.01mbar・ml/s=0.001kpa・ml/s以下としております。







Summary

- Feeding materials to NCU has been managed so far not to stop their activities.
- 12 Staves are to be delivered by the end of April. These preproduction versions are to be evaluated in BNL before we move on to production.
- Stave is the schedule driver of the INTT ladder assembly.
- Shipping to BNL of HDI and Staves are on hold. I need a logic to approve this shipping as the essential business in RIKEN.
- What we can do?