Explanation note
on wsgas-target system

Last modified at 25 of March, 2008

By H. Matsubara

WSGAS is …

- a gas target system for high resolution measurements at ws-course of RCNP.

- a cooling system by liquid nitrogen to increase target thickness.

- temperature and pressure of a gas are monitored and recorded to deduce the thickness.

- a target gas can be compressed into a target cell up to at 1 atm at the least, and 4 atm at the most.

- a recycling system that a gas used in a target cell can be collected and stored in a bottle, and be used again in measurements.
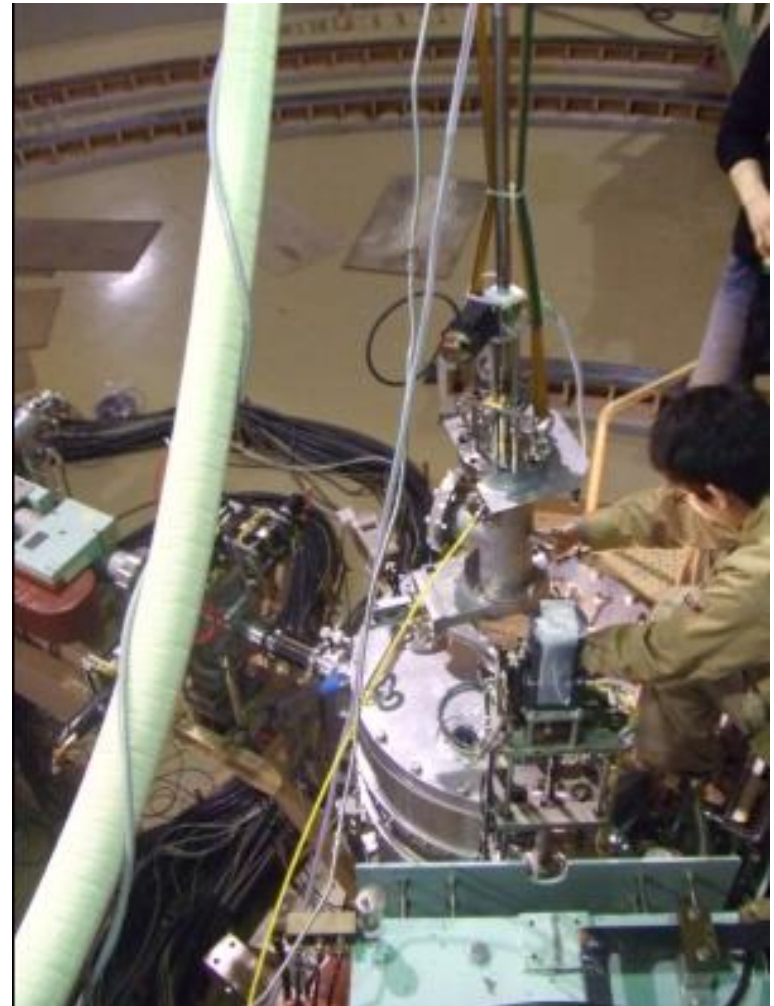
contents

- Specification
- Online monitor and recorder
- Controlling a position of the ladder
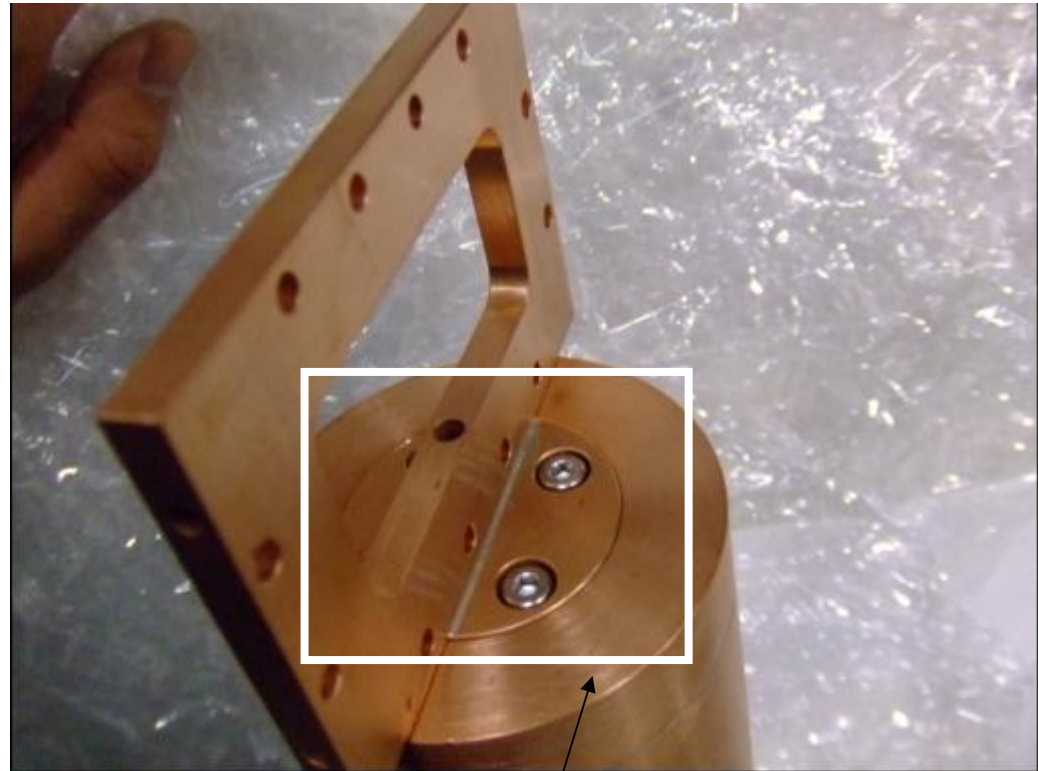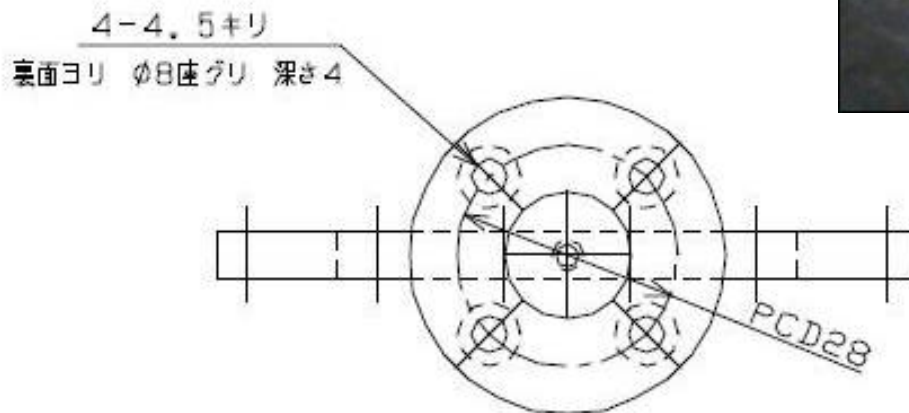- Gas handling

Specification-1
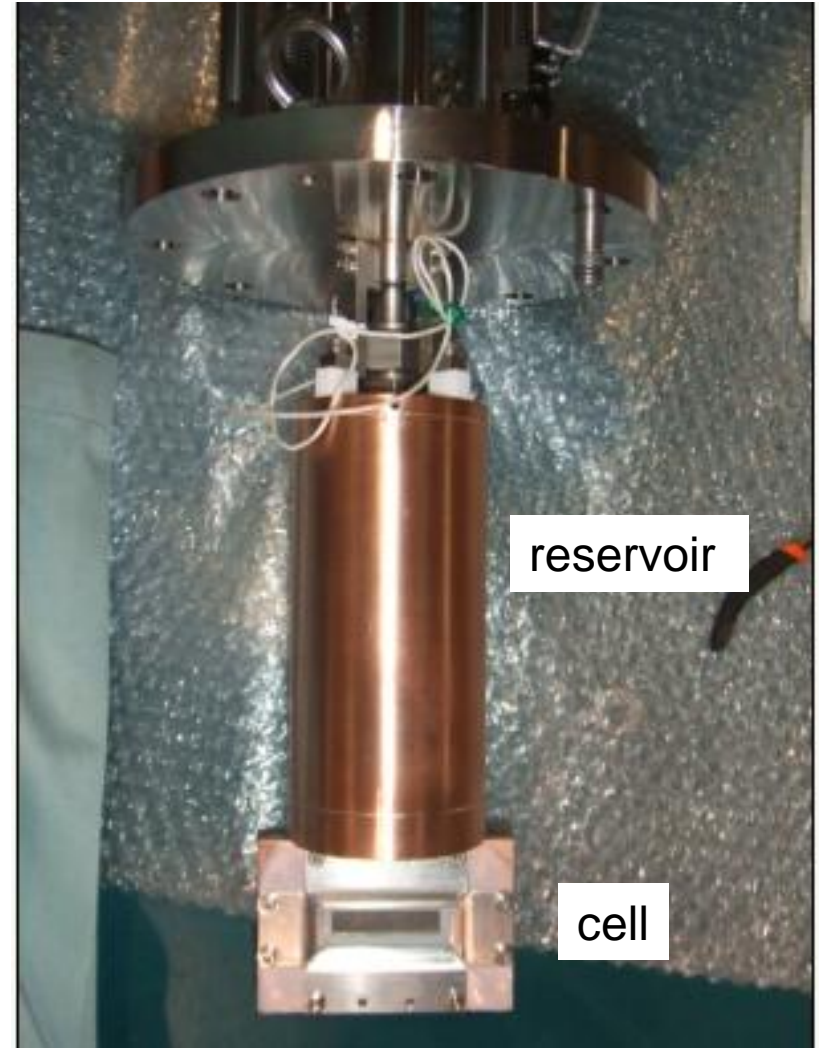
reservoir

cell

Specification-2
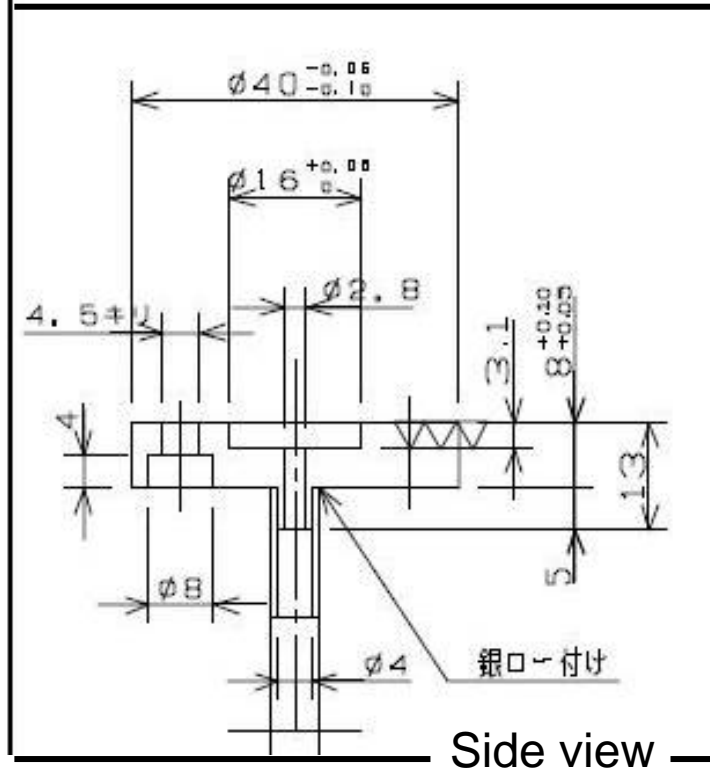

The system is put on the scattering chamber

Specification-3

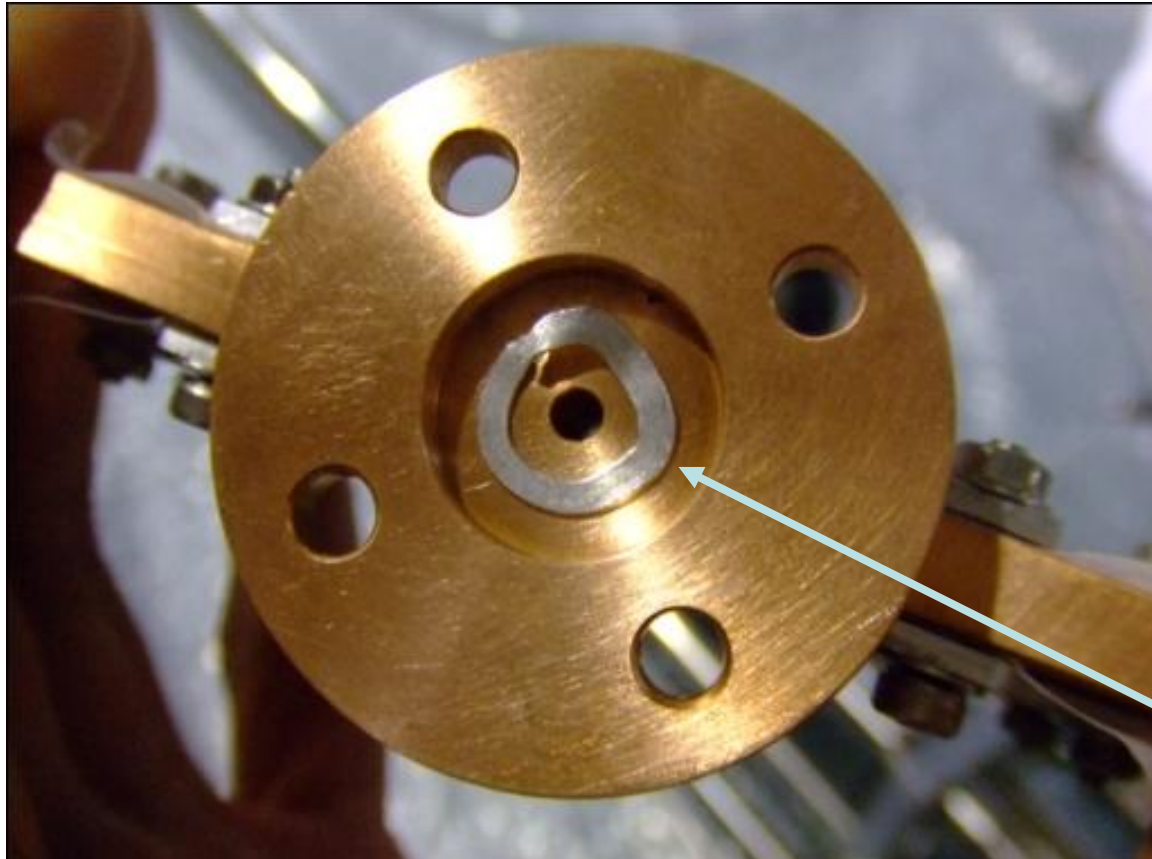A connection between a cell and the reservoir

Side view

Top view

This part

reservoir

Specification-4

Top view of a cell

indium

An indium(In) line is used to isolate a gas in the cell from a vacuum.
An O-ring cannot be used at a temperature of LN2.
1 mm thickness and 1 m length one was purchased from NILACO.

Specification-5

- The cell length should be 6—20mm.

  (The available length is 10—26mm including a balloon like property of aramid windows)

- 4 kinds of target can be set at the same time. (1 gas target and 3 foil targets)

- LN2 is automatically supplied every 1h.   (30L of LN2 is consumed in 12—15 h.)

- More than 3 of the target cells should be prepared as a spare.

- 6μm of aramid can bear up to 1 atm as windows.

- The pipe is easily rotated, but it should not be rotated more than a half round because cables in the pipe could be disconnected. (very hard to repair it)

- Any tensions should not be added to cables appearing from a top part of the system to monitor temperatures. It will be disconnect easily. (hard to repair it)

contents

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Online monitor and recorder

- A target thickness is deduced via a temperature and a pressure using the equation of state.

- Because aramid has a balloon like property, a length of a cell is calibrated from a cross section of 12C using CO_2 gas. (One should note that aramid also has carbon.)

- Monitoring and recording are performed by linux PC through GPIB connection.

1. preparation

Login to a linux PC of "li6"

```
>ssh e299@li6 (.rcnp.osaka-u.ac.jp)
User : e299
Pass : (ask Matsubara or Tamii-san)
```

Copy the default folder to make a new one for your experiment

```
>cp –r  default/   e###
>cd e###
```

If you like to modify the source program,

```
>cd src
--- modifying the source ---
>make clean
>make
```

2, monitor and record

At your new directory (e.g. at /home/e299/e###), type

> wsgas

Then, you will be asked twice, choose proper numbers

```
li6:~/data$ wsgas
Gas?
        (1)  20-Neon
        (2)  36-Argon
        (3)  CO2
        (4)  Empty
1
20-Ne was chosen.

Mearuremant?
        (1)  inelastic
        (2)  elastic
```

Hence, measurement will start.
Two kinds of files are created and named automatically.
They are .raw and .dat files, and are named after the time you start.
(e.g. Nov30_233705.raw and Nov30_233705.dat)
*.raw file has raw data of temperatures and pressures before calibrated
so that you can deduce an accurate target thickness after experiment.
*.dat file has calibrated data to check the present status of a gas.
Actually, the same description of *.dat file is displayed on the interactive window.
Type ctrl+C and y when you want to stop . The files are automatically closed.

3, sensors

A pt-100 is used to monitor a temperature,
A transmitter is for a pressure.

A pt-100 temperature sensor
made by CHINO (model no. R610-3)

A pressure transmitter made by
NAGANO-KEIKI
(model no. KM31)

4, sensors

Two pt-100s are used.

One locates at a top part of the reservoir (named TOP)

The other locates near the cell. (named CELL)

Just CELL is used to deduce a target thickness.

5. *.raw file


```
# Gas:20-Ne  Inelastic.  This file was opened at Fri Nov 30 23:37:05 2007
#                                        time   top_pt     top_cable    cell_pt     cell_calbe    trans
(1196433426 '07/11/30 23:37:06)            1   1.0843e+02  2.2643e+00  1.0843e+02  2.2265e+00  1.7748e+00
(1196433436 '07/11/30 23:37:16)           11   1.0843e+02  2.2639e+00  1.0843e+02  2.2259e+00  1.7752e+00
(1196433446 '07/11/30 23:37:26)           21   1.0844e+02  2.2639e+00  1.0843e+02  2.2251e+00  1.7748e+00
(1196433457 '07/11/30 23:37:37)           32   1.0844e+02  2.2646e+00  1.0844e+02  2.2258e+00  1.7750e+00
(1196433467 '07/11/30 23:37:47)           42   1.0844e+02  2.2656e+00  1.0844e+02  2.2259e+00  1.7752e+00
(1196433477 '07/11/30 23:37:57)           52   1.0844e+02  2.2653e+00  1.0844e+02  2.2255e+00  1.7753e+00
(1196433487 '07/11/30 23:38:07)           62   1.0845e+02  2.2635e+00  1.0844e+02  2.2265e+00  1.7750e+00
(1196433497 '07/11/30 23:38:17)           72   1.0845e+02  2.2644e+00  1.0844e+02  2.2266e+00  1.7752e+00
(1196433507 '07/11/30 23:38:27)           82   1.0845e+02  2.2633e+00  1.0844e+02  2.2265e+00  1.7752e+00
(1196433518 '07/11/30 23:38:38)           93   1.0845e+02  2.2640e+00  1.0845e+02  2.2262e+00  1.7751e+00
(1196433528 '07/11/30 23:38:48)          103   1.0845e+02  2.2648e+00  1.0845e+02  2.2258e+00  1.7750e+00
(1196433538 '07/11/30 23:38:58)          113   1.0846e+02  2.2646e+00  1.0845e+02  2.2264e+00  1.7751e+00
(1196433548 '07/11/30 23:39:08)          123   1.0846e+02  2.2642e+00  1.0845e+02  2.2248e+00  1.7756e+00
(1196433558 '07/11/30 23:39:18)          133   1.0846e+02  2.2639e+00  1.0846e+02  2.2258e+00  1.7752e+00
(1196433568 '07/11/30 23:39:28)          143   1.0846e+02  2.2640e+00  1.0846e+02  2.2260e+00  1.7753e+00
(1196433579 '07/11/30 23:39:39)          154   1.0847e+02  2.2640e+00  1.0846e+02  2.2261e+00  1.7753e+00
(1196433589 '07/11/30 23:39:49)          164   1.0847e+02  2.2647e+00  1.0846e+02  2.2254e+00  1.7751e+00
(1196433599 '07/11/30 23:39:59)          174   1.0847e+02  2.2655e+00  1.0846e+02  2.2253e+00  1.7749e+00
(1196433609 '07/11/30 23:40:09)          184   1.0847e+02  2.2644e+00  1.0847e+02  2.2265e+00  1.7753e+00
(1196433619 '07/11/30 23:40:19)          194   1.0847e+02  2.2645e+00  1.0847e+02  2.2275e+00  1.7752e+00
(1196433629 '07/11/30 23:40:29)          204   1.0848e+02  2.2649e+00  1.0847e+02  2.2263e+00  1.7751e+00
Nov30_233705.raw
```
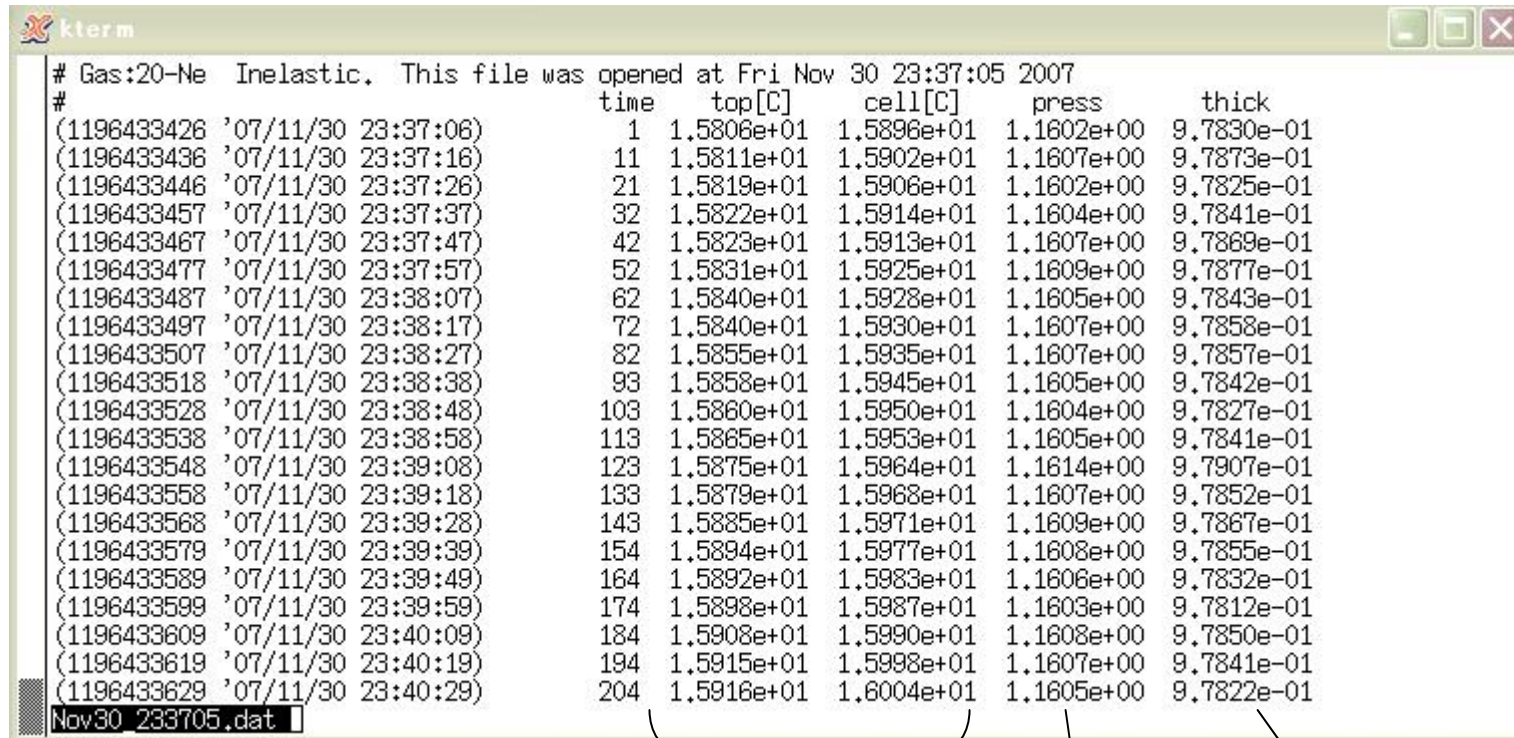
Expressed in ohm unit

A typical example of *.raw file is shown.
True result of pt-100 = cell_pt – cell_cable.

Expressed in volt unit

6. *.dat file and interactive window


```
kterm                                                                   _ □ X
# Gas:20-Ne  Inelastic.  This file was opened at Fri Nov 30 23:37:05 2007
#                                  time   top[C]    cell[C]    press      thick
(1196433426 '07/11/30 23:37:06)     1   1.5806e+01  1.5896e+01  1.1602e+00  9.7830e-01
(1196433436 '07/11/30 23:37:16)    11   1.5811e+01  1.5902e+01  1.1607e+00  9.7873e-01
(1196433446 '07/11/30 23:37:26)    21   1.5819e+01  1.5906e+01  1.1602e+00  9.7825e-01
(1196433457 '07/11/30 23:37:37)    32   1.5822e+01  1.5914e+01  1.1604e+00  9.7841e-01
(1196433467 '07/11/30 23:37:47)    42   1.5823e+01  1.5913e+01  1.1607e+00  9.7869e-01
(1196433477 '07/11/30 23:37:57)    52   1.5831e+01  1.5925e+01  1.1609e+00  9.7877e-01
(1196433487 '07/11/30 23:38:07)    62   1.5840e+01  1.5928e+01  1.1605e+00  9.7843e-01
(1196433497 '07/11/30 23:38:17)    72   1.5840e+01  1.5930e+01  1.1607e+00  9.7858e-01
(1196433507 '07/11/30 23:38:27)    82   1.5855e+01  1.5935e+01  1.1607e+00  9.7857e-01
(1196433518 '07/11/30 23:38:38)    93   1.5858e+01  1.5945e+01  1.1605e+00  9.7842e-01
(1196433528 '07/11/30 23:38:48)   103   1.5860e+01  1.5950e+01  1.1604e+00  9.7827e-01
(1196433538 '07/11/30 23:38:58)   113   1.5865e+01  1.5953e+01  1.1605e+00  9.7841e-01
(1196433548 '07/11/30 23:39:08)   123   1.5875e+01  1.5964e+01  1.1614e+00  9.7907e-01
(1196433558 '07/11/30 23:39:18)   133   1.5879e+01  1.5968e+01  1.1607e+00  9.7852e-01
(1196433568 '07/11/30 23:39:28)   143   1.5885e+01  1.5971e+01  1.1609e+00  9.7867e-01
(1196433579 '07/11/30 23:39:39)   154   1.5894e+01  1.5977e+01  1.1608e+00  9.7855e-01
(1196433589 '07/11/30 23:39:49)   164   1.5892e+01  1.5983e+01  1.1606e+00  9.7832e-01
(1196433599 '07/11/30 23:39:59)   174   1.5898e+01  1.5987e+01  1.1603e+00  9.7812e-01
(1196433609 '07/11/30 23:40:09)   184   1.5908e+01  1.5990e+01  1.1608e+00  9.7850e-01
(1196433619 '07/11/30 23:40:19)   194   1.5915e+01  1.5998e+01  1.1607e+00  9.7841e-01
(1196433629 '07/11/30 23:40:29)   204   1.5916e+01  1.6004e+01  1.1605e+00  9.7822e-01
Nov30_233705.dat
```

Celsius degree   atm   mg/cm^2

A typical example of *.dat file is shown.
The same description can be seen in an interactive window.

When you start a measurement, three windows will appear.
They show changes of temperature, pressure, and thickness
 and keep to renew them.

7. calibrations

In the default wsgas.c, the below correlations are used to deduce a target thickness.

From ohm of pt-100 to Celsius degree :
$t[C] = -243.33 + 2.2993*R + 1.3328E-02*R^2$
(-200 < t < +50, R=ohm)

$R = cell\_pt - cell\_cable$

From volt of a pressure transmitter to atm :
$atm = -1.4673 + 1.4804*volt$

The transmitter should not be used to measure a pressure lower than 1E-03 atm owing to its performance. When a pressure goes over the lower limitation, * mark is added to inform that the datum is not reliable.

An example

```
(1195934241 '07/11/25 04:57:21)  551  2.7000e+01  2.7004e+01   9.6296e-01   1.7207e+00
(1195934251 '07/11/25 04:57:31)  561  2.6994e+01  2.7005e+01   6.3366e-01   1.1322e+00
(1195934261 '07/11/25 04:57:41)  571  2.6987e+01  2.7004e+01   2.8103e-01   5.0215e-01
(1195934271 '07/11/25 04:57:51)  581  2.6990e+01  2.7004e+01   8.5767e-02   1.5325e-01
(1195934281 '07/11/25 04:58:01)  591  2.6996e+01  2.7003e+01  -1.5305e-03  -2.7348e-03 *
(1195934292 '07/11/25 04:58:12)  602  2.6994e+01  2.7002e+01  -6.4366e-03  -1.1501e-02 *
(1195934302 '07/11/25 04:58:22)  612  2.6993e+01  2.6995e+01  -8.0117e-03  -1.4316e-02 *
(1195934312 '07/11/25 04:58:32)  622  2.6983e+01  2.6989e+01   3.9126e-02   6.9917e-02
(1195934322 '07/11/25 04:58:42)  632  2.6986e+01  2.6991e+01  -4.2936e-03  -7.6724e-03 *
(1195934332 '07/11/25 04:58:52)  642  2.6984e+01  2.6981e+01  -7.3730e-03  -1.3175e-02 *
(1195934343 '07/11/25 04:59:03)  653  2.6979e+01  2.6977e+01   7.7939e-03   1.3928e-02 *
(1195934353 '07/11/25 04:59:13)  663  2.6987e+01  2.6973e+01   9.3107e-02   1.6639e-01
(1195934363 '07/11/25 04:59:23)  673  2.6986e+01  2.6972e+01   1.6331e-02   2.9184e-02
```

contents

- Specification
- Online monitor and recorder
- Controlling a position of the ladder
- Gas handling

Controlling a position of the ladder

- The detail described here can be changed because a new controlling system is being constructed by Tamii-san at spring of 2008.
- operations are remotely performed via a terminal server through RS-232 connection.

Remote control

To login the terminal server `> telnet ntsrw 7003`

Sometimes these commands are required to initialize the system `0> pulse2`
`0> v300`

Make it sure a target position of WSDEV window is almost 0 (around 0.4).

```
0> h+     (enter the direction)
0> mc     (start to move)
          *CCW limit  (A comment with lower limitation will emerge)
0> h-     (eneter the direction)
0> d_____  (enter a step number, a distance)
0> mi     (start to move)
```

In a case of a foil target is used,

```
0> h-     (enter the direction)
0> mc     (start to move)
```

After the gas cell is out of a camera,
you can handle the WSDEV window.

contents

- Specification
- Online monitor and recorder
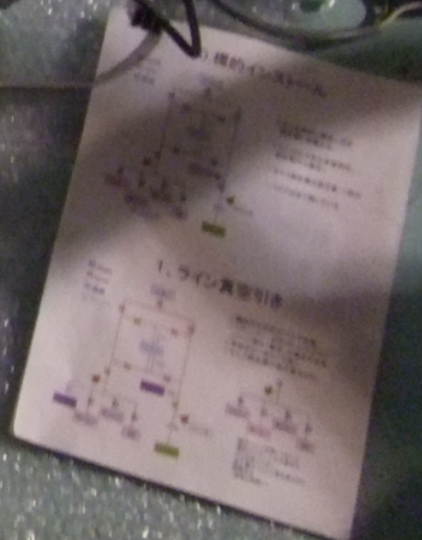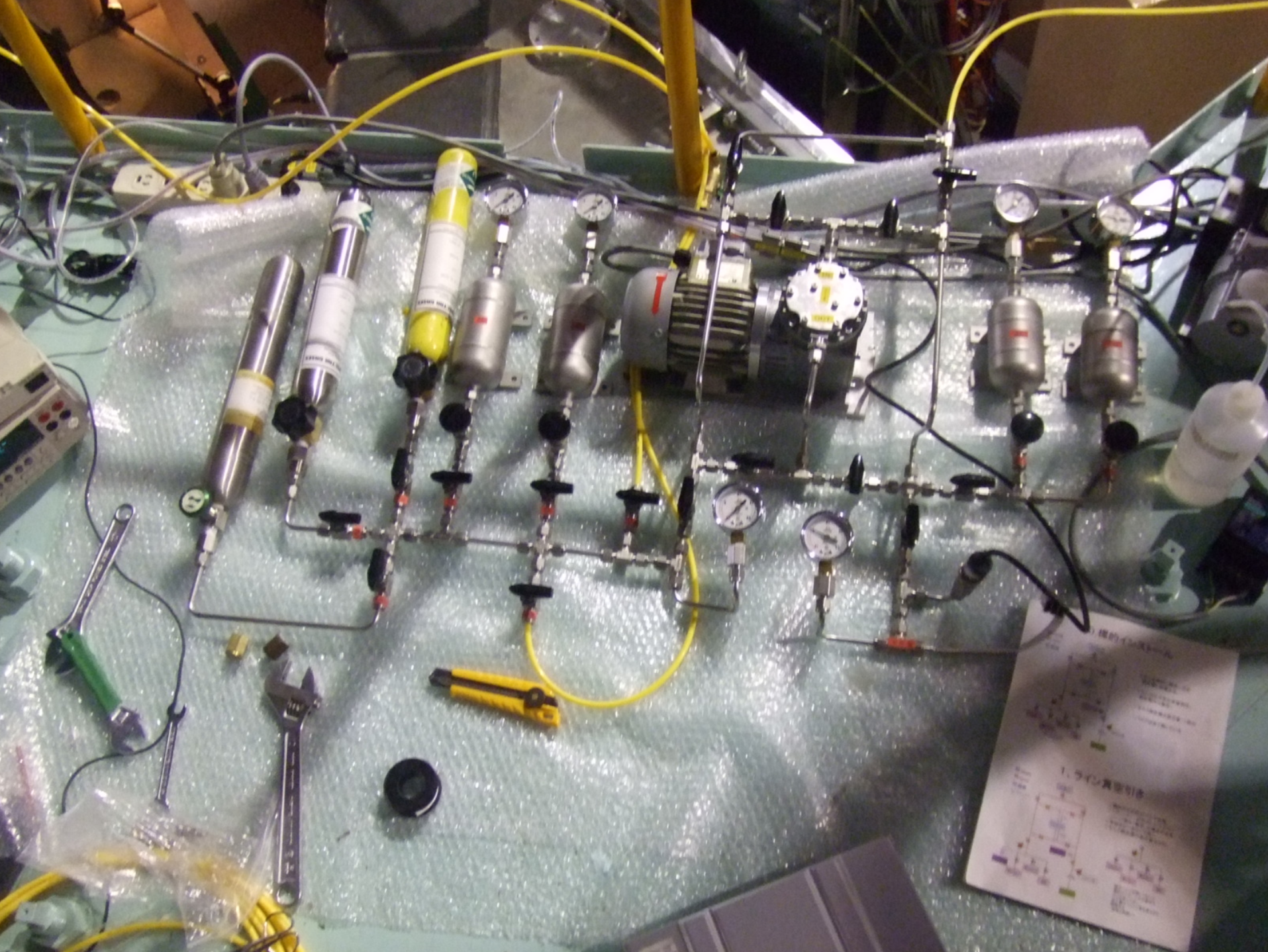- Controlling a position of the ladder
- Gas handling

Note for gas handling system

This is an explanation note for a gas handling system
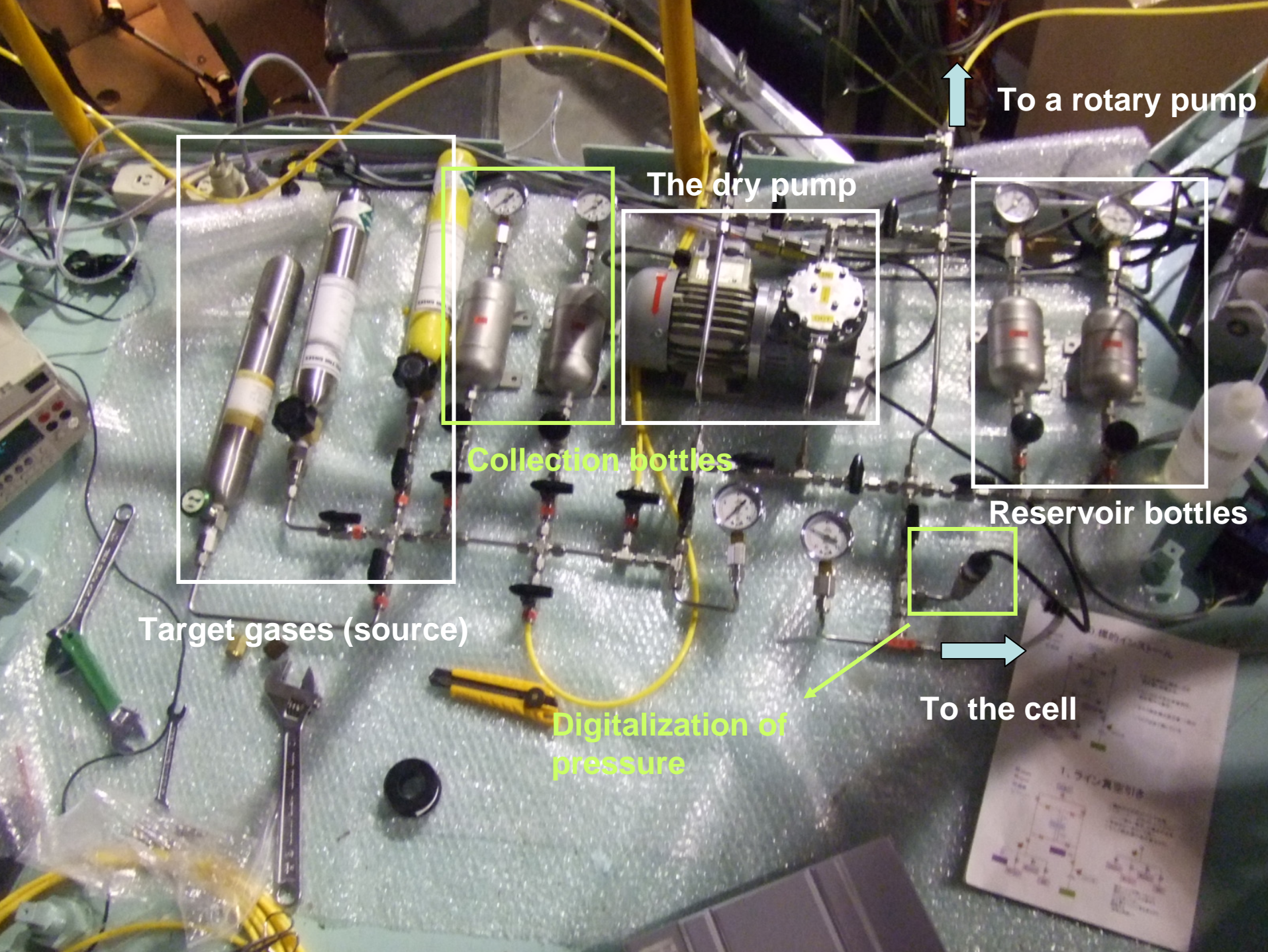which was developed at RCNP WS-course.
The system can fill a target gas up to 1 atm, even if a pressure
of the source gas bottle is less than 1 atm.
Additionally, it contains a recycling system of gas.

Feb-2, 2008 by H. Matsubara

To a rotary pump

The dry pump

Collection bottles
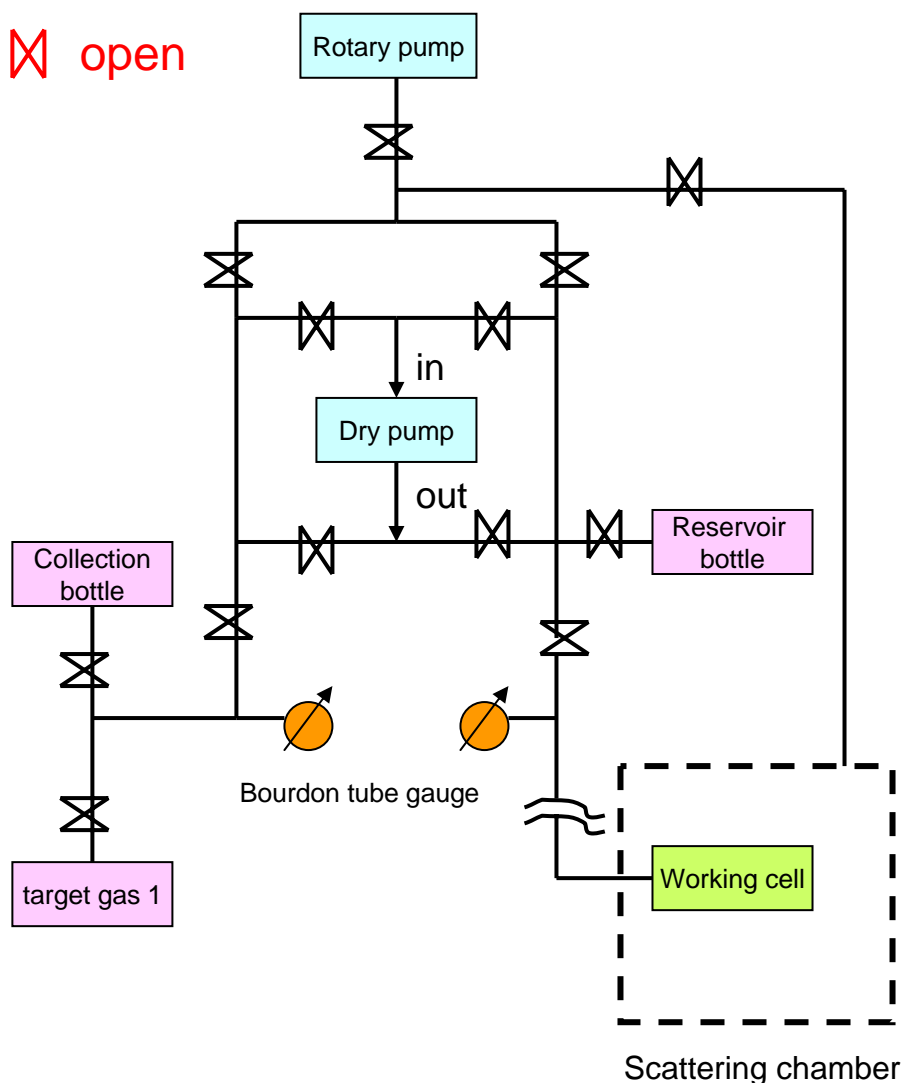
Reservoir bottles

Target gases (source)

Digitalization of pressure

To the cell

0,introduction

close

open

Rotary pump

Dry pump

in

out

Collection bottle

Reservoir bottle

target gas 1

Bourdon tube gauge

Working cell

Scattering chamber

Schematic view of the gas handling system

✓The dry pump can compress a target gas up to 1 atm without any contaminations from mechanical oil.

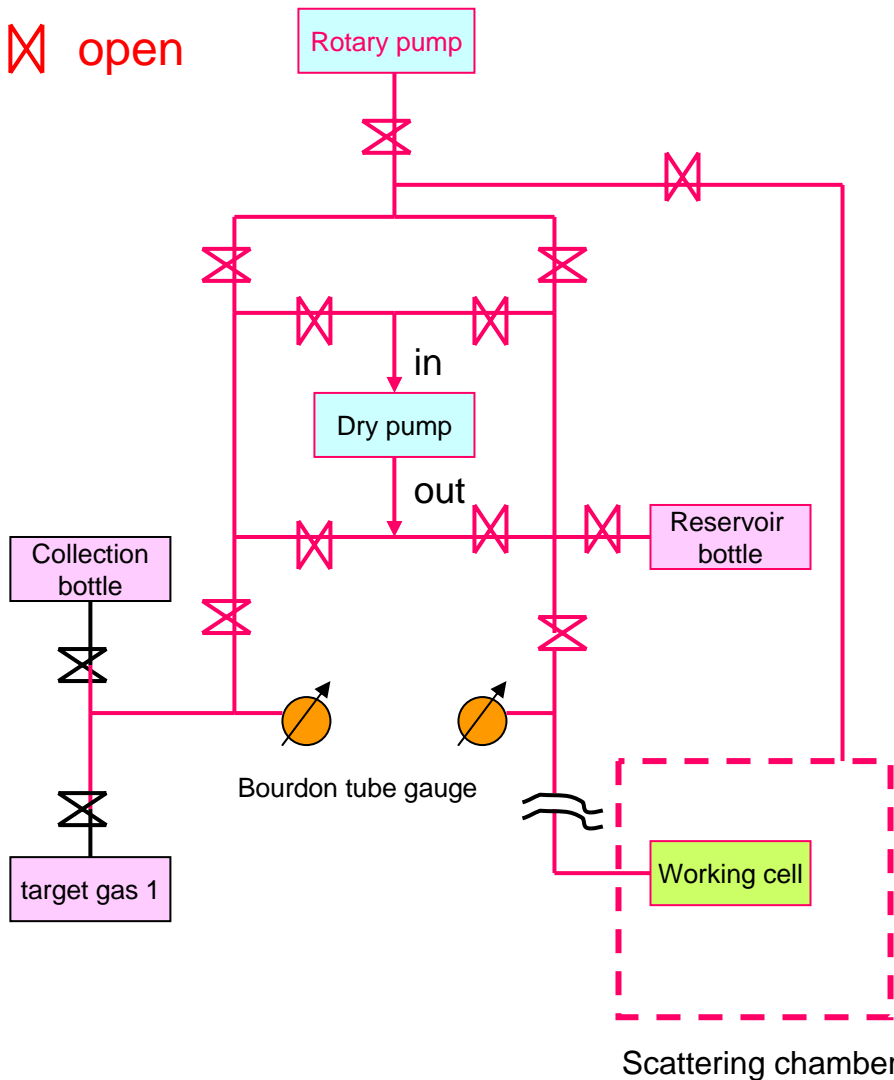✓If there is much target gas, the pump can fill it up to 4 atm at the most.

✓When the pump is reversely connected from the working cell, gas used in the cell can be collected and be stored in a bottle.

1、preparation

close

open

Rotary pump

Dry pump

in

out

Collection bottle

Reservoir bottle

target gas 1

Bourdon tube gauge

Working cell

Scattering chamber

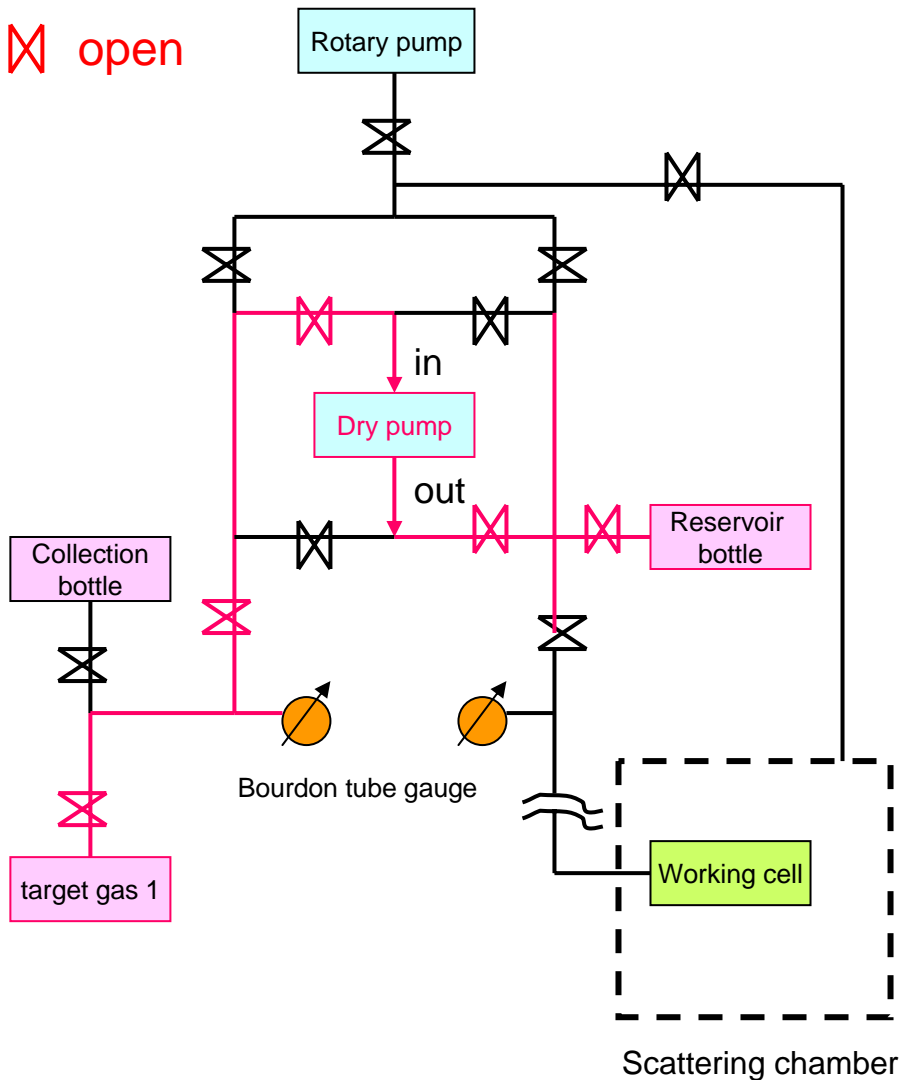At first, a vacuum of the system is made by using the rotary pump.

✓A pressure of the working cell should be always larger than that of the scattering chamber because cell windows can not bear a negative pressure.
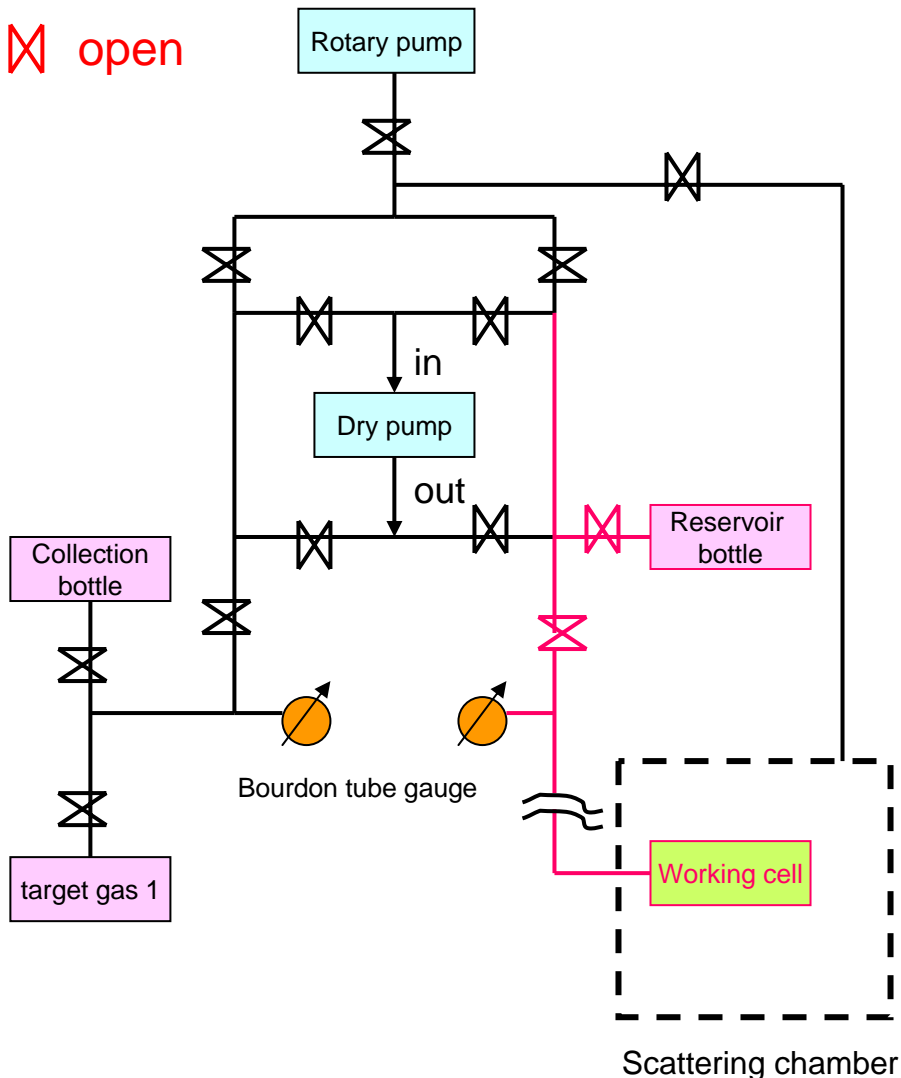
2、fill a gas with the pump-1

⋈ close
⋈ open

A compressed gas by the dry pump should be stored in a reservoir bottle at first for safety.

Rotary pump

Dry pump

in

out

Collection bottle

Reservoir bottle

Bourdon tube gauge

target gas 1

Working cell

Scattering chamber

3、fill a gas with the pump-2

Ⓧ close

Ⓧ open

Rotary pump

Dry pump

in

out

Collection bottle

Reservoir bottle

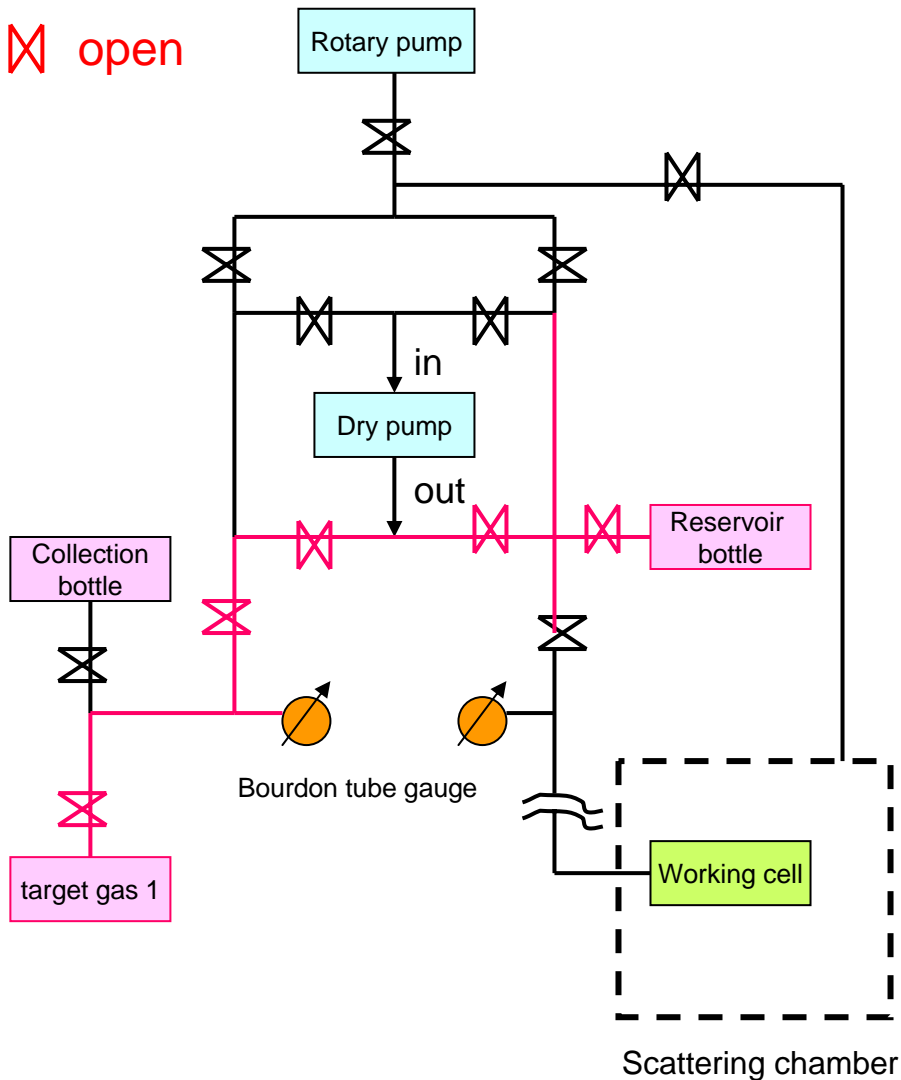Bourdon tube gauge

target gas 1

Working cell

Scattering chamber

✓When a target gas is filled in the reservoir bottle up to a pressure you want, the valves are closed and the dry pump is turned off. One have to open a valve to the working cell SLOWLY.

✓After the gas has been filled into the cell, repeat the procedures of 2 and 3 till the pressure in the cell becomes what you want.

4、fill a gas without the pump

⋈ close

⋈ open

Rotary pump

Dry pump

in

out

Collection bottle

Reservoir bottle

target gas 1
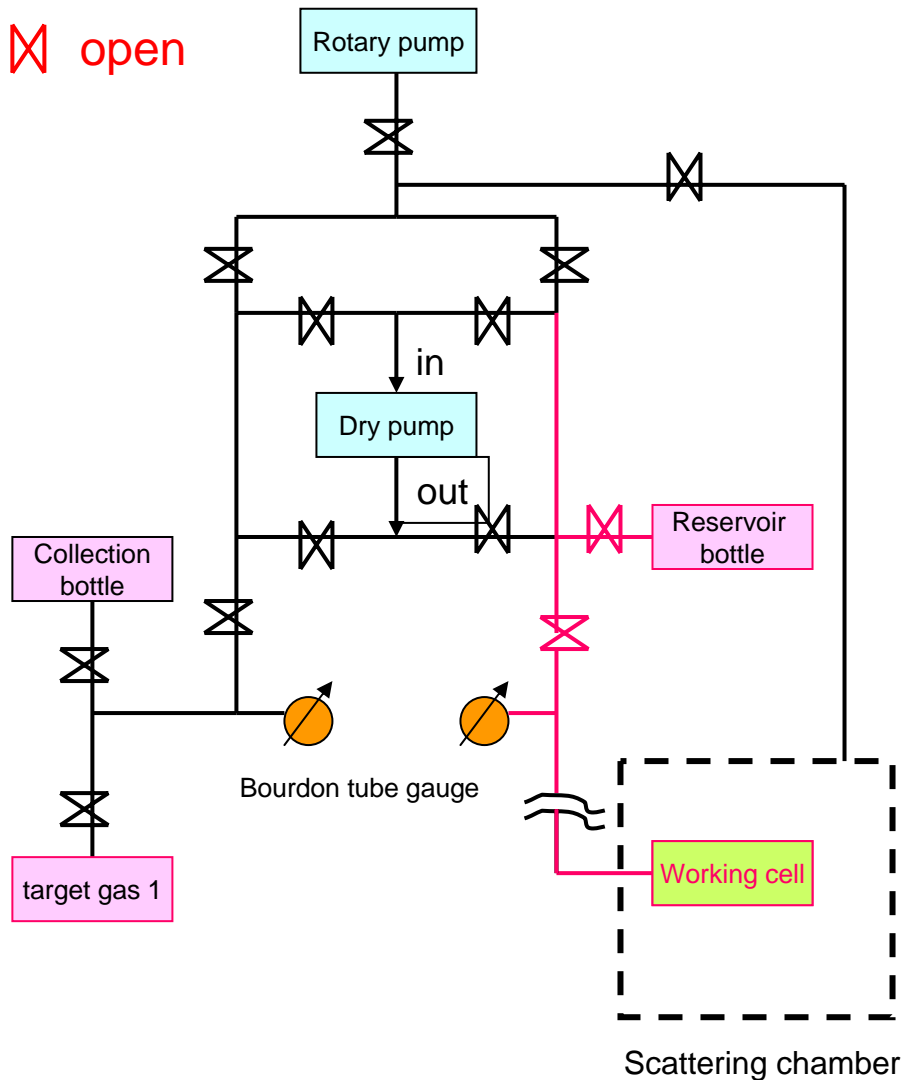
Bourdon tube gauge

Working cell

Scattering chamber

✓If there is much target gas, one can fill it to the reservoir bottle without using the dry pump.

After the filling to the reservoir, the same procedure to the previous case is done.
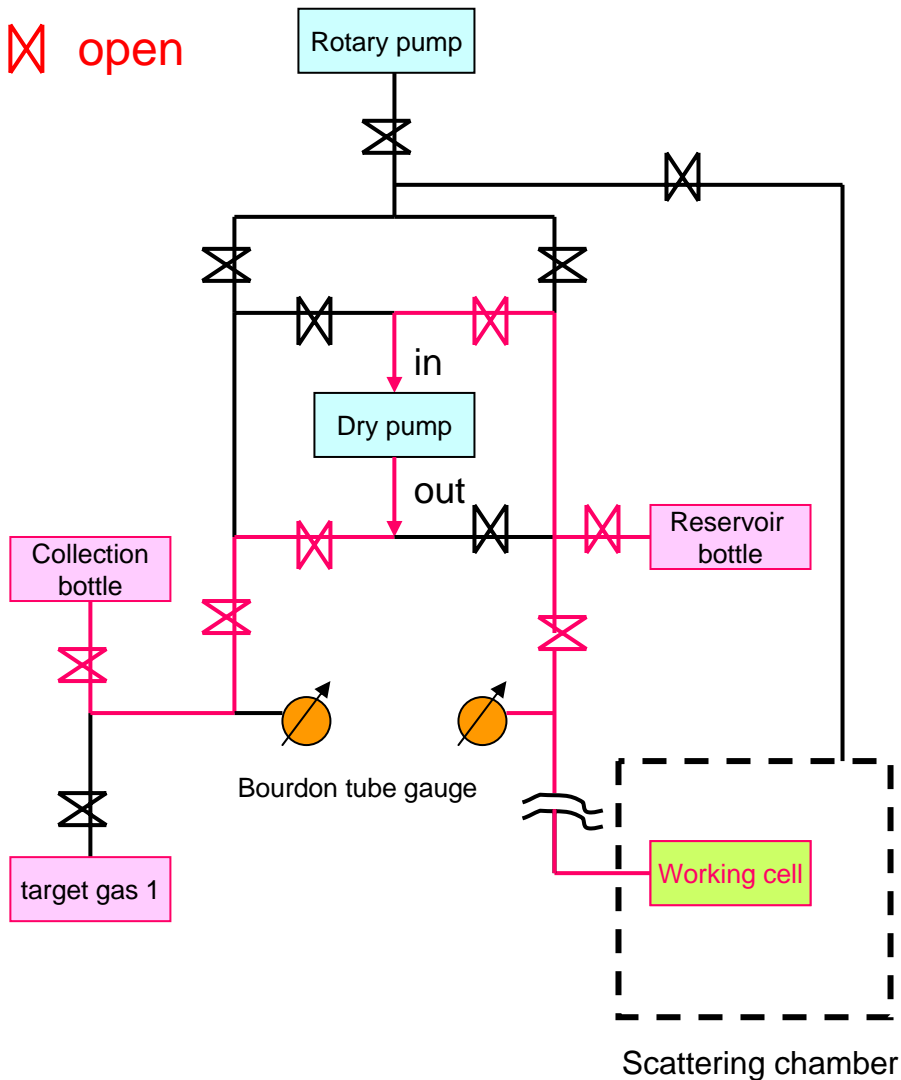
5、during measurements

close

open

Rotary pump

in

Dry pump

out

Collection bottle

Reservoir bottle

target gas 1

Bourdon tube gauge

Working cell

Scattering chamber

The valves to the reservoir bottle are kept on opening through measurements.

6、collect a used gas

close
open

After measurements, a used gas can be collected and be stored into a bottle from the working cell and the reservoir bottle by the dry pump.

The stored gas is expected to be able to be used as a target again.
(To be confirmed in my experiment of April)