

# The Pre-bakeout and Vacuum Tests for the Vacuum Chambers before Installation in the SPring-8 Storage Ring.

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## 1. Introduction

The pre-bakeout and vacuum tests for the vacuum chambers of the SPring-8 storage ring have been carried out in advance of the chamber installation at the storage ring tunnel for the following purposes:

- 1) to certify the required specifications.
- 2) relaxation of the residual stress.
- 3) to reduce the outgassing rate inner surfaces of chambers.

The vacuum system of one unit cell consists of three straight section chambers (SSC's), two bending magnet chambers (BMC's), one dummy chamber (IDD) for a future installation of an insertion device, four bellows chambers (BEC's) and one or two photon-beam ducts (PD's). The chambers are extrusions made from aluminum alloy (6063-T5)[1]. The SSC's, BMC's and IDD's consist of a beam chamber and a slot-isolated antechamber in which a non-evaporable getter (NEG) strips are installed for distributed pumping.

Except for the BEC's and PD's, all chambers should be examined before the installation in the storage ring.

## 2. Equipment and Procedure

The schematic drawing of the system for the pre-bakeout and vacuum tests was shown in Fig. 1. The

system consisted of three major parts: (1) the vacuum pumping system, (2) the heating system for the bakeout and the NEG activation, (3) and the measuring instruments.

The roughing pumping system which was composed of a turbo molecular pump (TMP) and a rotary pump (RP) was used for evacuating chambers from an atmospheric pressure during the bakeout procedure. A sputter ion pump (SIP) was attached to the system in order to assist the NEG which is main pumping system after the NEG activation.

The chambers were mainly baked by means of super-heated water pumped through the water channels of the chambers[2]. Super-heated water was generated by the heated-water unit (HWU). In addition, the isolated areas from the water channels, for example the bellows were heated by the temperature-controlled electric heater. The power supply for the NEG activation (PSN) was used for the heat treatment for the NEG activation.

To measure the vacuum conditions of the chamber, ionization gauges (IG's), quadruple mass-spectrum analyzers (QMA's) and a helium leak detector were equipped in the vacuum system.

The whole system was arranged in the test room in the experimental hall of the SPring-8.

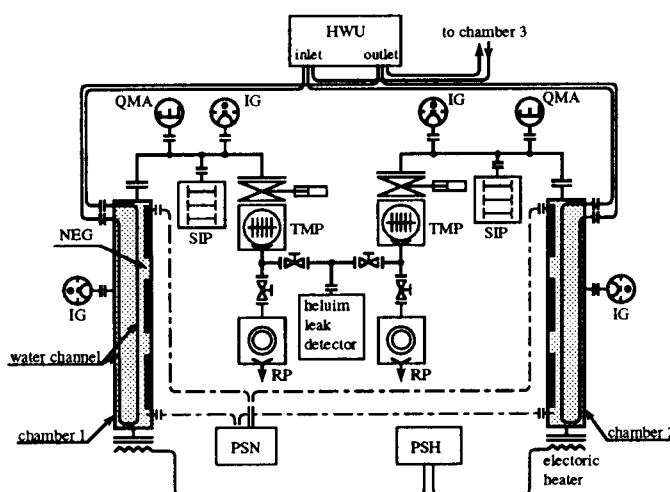


Fig. 1. Schematic drawing of the system

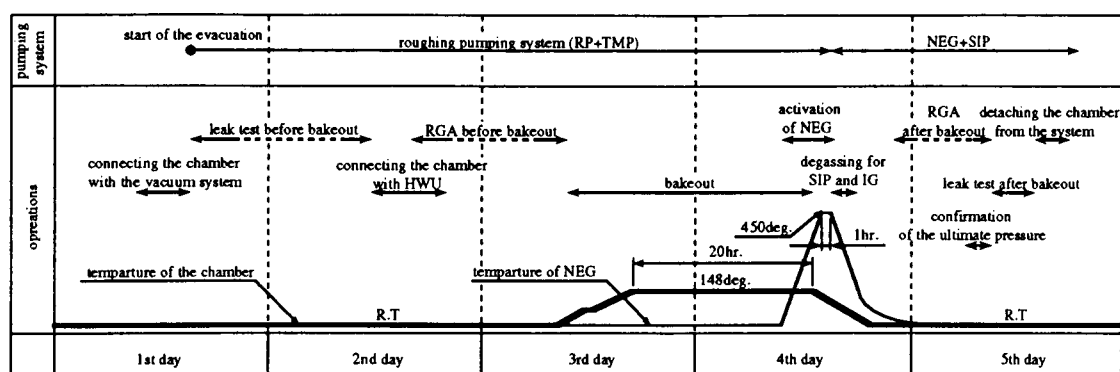


Fig. 2. Timetable of the pre-bakeout and vacuum tests.

Figure 2 shows the schedule of one cycle procedure for all the test items. Five days seem to be indispensable to complete these tests. Six chambers, i.e. three SSC's, two BMC's and one IDD, were pre-baked and tested on the one cycle procedure as the chambers of one unit cell.

The helium leak test was an essential item for estimating the performance of the vacuum chambers. The leak test should be done before and after the baking. While the leak detection had been done, the entire chamber was covered by the hood made of a polyethylene sheet. Then, helium as the probe gas was filled into the hood. The required criterion of the leak rate was less than  $1.3 \times 10^{-11} \text{ Pa} \cdot \text{m}^3/\text{s}$ . The result of the helium leak tests for the flanges is shown in Table 1. Although the leak from the welding parts was serious problem, there were leak detection for two chambers which were manufactured in the early stage. The leak parts of these chambers were re-welded.

Table 1. The incidence of the leaks from the flanges. The matching of the materials of the flanges are three different cases:

- (a) both flanges of Al alloy (A6063) and Al alloy (A1050) gasket
- (b) both flanges of stainless steel (SUS304) and Cu gasket
- (c) A6063 and SUS304 flanges, and Al alloy (A1050) gasket

From the experimental results, the leak of the type(b) is negligible. Two cases ((a) and (c)) is shown in the table.

Matching of the materials	Al ~ Al (case (a))	Al ~ stainless steel (case (c))
before bakeout	8.0%	3.3%
after bakeout	4.2%	1.2%

The pre-bakeout could be carried out after the 1st leak test. The bakeout temperature was increased at the rate of  $20^\circ\text{C}$  per hour, and then the temperature was kept for 20 hours at target temperature of  $148^\circ\text{C}$ . At the last stage of the bakeout period, the NEG strips were activated for 1 hour above at  $450^\circ\text{C}$ . The temperature of NEG strips were estimated by measuring the currents of the PSN. The relation between the temperature and the current was measured beforehand. According to the result of this experiences, it became clear that the ultimate pressure of lower than  $2 \times 10^{-8} \text{ Pa}$  could be reached within 20 hours after completing the activation.

The residual gas analysis(RGA) is planned to be done for a nearly quarter of the total number of chambers, but the high mass number peaks, which is the evidence of the residue of oil, were not observed in the spectrum of RGA before and after the baking.

The result of a helium leak test proved the vacuum seal performance of the chamber, the measured ultimate pressure proved the pumping capacity of NEG and the spectrum of RGA indicated the cleanness of the chamber inner surface.

### 3. Conclusion

The pre-bakeout and the vacuum tests will be finished in April 1996 according to the schedule. We have experienced many kinds of the troubles which would spoil the specifications of the chambers. However, all troubles including few mechanical accidents of the system have been recovered.

### References

- [1] S.H.Be, SPring-8 Annual Report 1994, p.25.
- [2] H.A.Sakaue et al., SPring-8 Annual Report 1994, p.122.