# Vacuum System

**Haruo OHKUMA**
**Kowashi WATANABE**
**Hiroshi SAEKI**
**Mitsuhiro MASAKI**
**Takashi NODA**
**Teruhiko BIZEN**
**Seiichi SATO**
**Motoaki IIZUKA**
**Takafumi HIGASHIURA**
**Yukiko TANIUCHI**
**Michio MAENO**

## 1. Introduction

The installation of the vacuum system in the storage ring tunnel including the injection section chamber was completed during 1996, as was the vacuum control system.

## 2. Installation of the Vacuum System

Completed in March 1996 were: the calibration of beam position monitors (BPM's)[1], which were designed to determine the difference between their mechanical and electrical centers; and the installation of distributed nonevaporable getter (NEG) pumps into the antechambers.

In order to remove chamber warps, the vacuum chambers were pre-baked[2]. Prior to the chamber installation in the storage ring tunnel, the pre-baking was applied successively to the straight section chambers (SSC's), to the bending magnet chambers (BMC's), and to the dummy chambers.

The baking of the entire vacuum chambers installed at the storage ring tunnel was completed in November 1996. The ultimate chamber pressure was in the order of $10^{-8}$ to $10^{-9}$ Pa at most sections of the vacuum system. Figure 1 shows the pumping down curves of a typical unit cell after the baking was applied. Those marks in this figure indicate the vacuum pressures that were read from the gauges attached to each chamber along the unit cell.

## 3. Injection Section Chamber[3]

The manufacture of the injection section chamber consisting of a stainless steel part and an aluminum alloy part was completed in September 1996, and so were the pre-baking

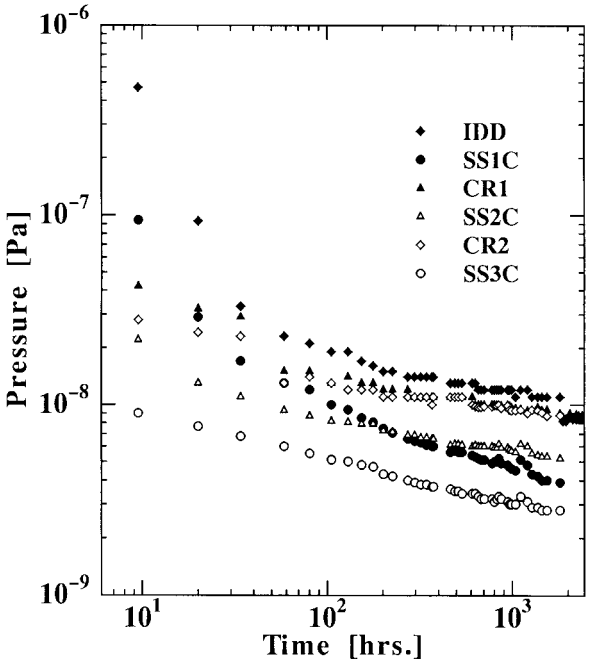


Fig.1. IDD : The dummy chamber which will be replaced by the vacuum system of the insertion device. SS1C, SS2C and SS3C : three straight section chambers which are located at the quadrupole and sextupole sections. CR1 and CR2 : two crotch chambers which are equipped with absorber-crotches.

procedure at the test stand and the installation of the chamber at the injection section of the actual ring in October 1996. In order to achieve an ultra high vacuum, this was followed by the baking of the chamber at the storage ring tunnel. The baking temperature was kept at the maximum of 140˚C for 30 hours. The NEG strips which had been installed in the aluminum alloy part of the chamber were activated for approximately 60 minutes under the temperature of 450˚C at the last stage of the baking procedure. The ultimate pressure of this section was $3\times10^{-8}$Pa.

## 4. Vacuum Control System[4]

The vacuum control system consisting of the VME system with the remote input/output devices (VME-RIO) and the programmable logic controller (PLC), were manufactured and installed at the maintenance pathway along the storage ring tunnel. The VME-RIO controls and monitors the vacuum apparatus such as vacuum pumps, vacuum gauges, vacuum

valves, etc. The PLC operates as an interlock system to protect the vacuum system against vacuum related problems such as leaks. The system has been operational from December 1996, and the vacuum pressure data have been collected routinely.

## 5. Measurement of BPM Positions[5]

Since the button pickup electrodes of BPM were directly welded to the vacuum chambers, SSC's, the position of BPM depends on the position of the chamber which is in turn determined by the chamber alignment. After the chamber installation and baking were completed, the positions of BPM were measured as the reference points for the adjacent quadrupole magnets. The BPM positions can be determined within an accuracy of ±23 μm in the horizontal direction and ±19 μm in the vertical direction.

## References


[1] S. Sasaki; Spring-8 Annual Report, 1995, p.134.

[2] M. Iizuka, H. A. Sakaue, K. Watanabe, H. Saeki, S. H. Be and H. Ohkuma; ibid., p.130.

[3] T. Bizen, H. Saeki, K. Watanabe, T. Shimada, K. Kumagai, and H. Ohkuma; ibid., p.126.

[4] T. Higashiura, K. Watanabe, M. Masaki and H. Ohkuma; ibid., p.138.

[5] M. Masaki, M. Maeno, S. Takano, H. Ohkuma; in this issue of Spring-8 Annual Report.