



**ANEST IWATA Corporation**



## Oil-free Pump Plays a Key Role in Evacuation of Beamlines that Carry "21st Century Light"

Customer: SPring-8 (Super Photon Ring 8), Large-Scale Synchrotron Radiation Facility



By courtesy of "Japan Synchrotron Radiation Research Institute"

### Overview of Facility

- Design and Construction: Japan Atomic Energy Research Institute, The Institute of Physical and Chemical Research
- Administration and Operation: Japan Synchrotron Radiation Research Institute
- Commencement of Operation: October 1997 (commencement of beamlines' availability for public use)
- Main Business: Provision of radiation beams to researchers who use them
- Address: 323-3 Mihara, Mikazuki-cho, Sayou-gun, Hyougo-ken
- Area of Site: 141 hectares (portion of site occupied by facility)
- Composition of Facility: Various laboratory and other buildings (some still underconstruction), including a Linear Accelerator Building, Synchrotron Building, Storage Ring Building, and Central Administration Building

The world's largest synchrotron radiation facility, located in Harima Science Garden City, is using a large number of Anest Iwata's ISP-250B oil-free scroll vacuum pumps. Below is a brief description of the facility and its use of vacuum pumps.

**The World's Highest-Performance Synchrotron Radiation Facility has opened for Public Use**

Harima Science Garden City is being developed on a sprawling 2,000-ha site set amid the rolling hills of southwest Hyogo Prefecture. The core of this development project, construction of which began in 1986, is a large-scale synchrotron radiation facility known as SPring-8 (Super Photon ring-8).

Financed with a 1,110 billion investment by Japan's Science and Technology Agency and designed and constructed by the Japan Atomic Energy Research Institute and the Institute of Physical and Chemical Research, SPring-8 is a facility where electromagnetic waves known as synchrotron radiation are used for research purposes. SPring-8 is the largest and highest-performance synchrotron radiation facility in the world. In 1997 SPring-8 began offering its facilities for public use, marking Harima's full-scale inauguration as the "Town of Light."

**Dream Beams Enable People to Observe Ultra-Microscopic Worlds of the Order of  $10^{-10}$  m**

When electrons rotate around a magnetic field, they emit bundles of light-radiation-beams in a straight line tangential to their orbit. SPring-8's most salient feature is its ability to boost electrons' energy up to 8 GeV (8 billion electron volts\*), thereby achieving bright, sharp light of extremely high intensity. Radiation beams are aggregates of light spanning a wide range of wavelengths. In particular, SPring-8 excels at generating beams in the shortwave band,



▲The exterior of the Storage Ring Building. From outermost to innermost, the building consists of a corridor, laboratories, experimental hall, and the storage ring (overall length:1,436m).



▲An experimental hall inside the Storage Ring Building.

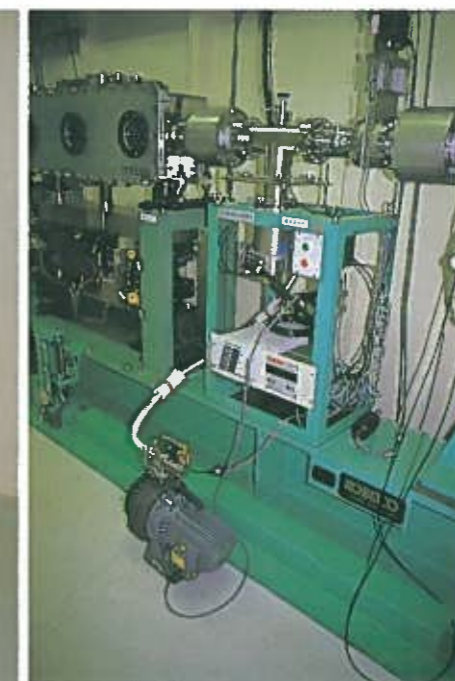
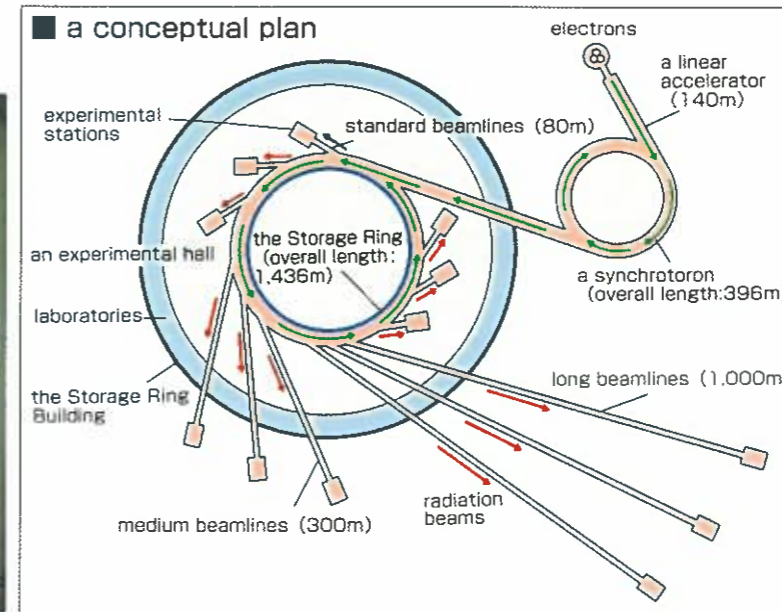


▲Visible within is a beamline that guides radiation beams to an experimental station. The beamline in this experimental hall and the beamline on the opposite side of the protective wall separating this hall from the storage ring have a combined length of approximately 80 meters.

▼Protruding from the hole in the wall is the tip of a beamline. Normally, an experimental station would be installed here. (The photograph shows a measurement instrument for testing and adjusting radiant beams.)



▲A beamline with evacuation units installed at about 5 meter intervals.



▲The ISP-250B oil-free scroll vacuum pump integral to the evacuation unit. It is plain to see that the ISP 250B is used as the turbo molecular pump's fore pump.

such as soft X-rays. By irradiating matter with radiation beams, SPring-8 makes accessible the ultra-microscopic world that is the realm of the Angstrom ( $10^{-10}$  m). When illuminated with higher-energy light beams, smaller worlds become observable. Radiation beams are called "dream beams" and "21st Century light" because they do nothing less than allow people to see hitherto invisible worlds.

**The ISP-250B Maintains a Clean Vacuum as the TMP's Fore pump**

These dream beams are trans-

ported from the storage ring to experimental stations by beamlines. These beamlines, not to mention the orbits of the electrons that flow from the accelerator to the storage ring, require an ultra-high vacuum of the order of  $10^{-5}$  to  $10^{-6}$  Pa. This is because if the ultimate pressure in the channel is of a low degree, energy will tend to dissipate and measurement accuracy also will decline due to noise, even if a clean radiation beam that emits only photons (electromagnetic-wave particles) from the light source is attained. On a standard beamline, evacuation units are installed at intervals of approximately five met-

ers. The units comprise a turbo molecular pump (TMP) and an Anest Iwata ISP-250B oil-free scroll pump, among other components. In all, 600 ISP-250B pumps have been installed as the fore pump of the TMP. The ISP-250Bs are contributing to the realization of the "clean vacuum" desired for SPring-8's usage system.

According to Messrs. Kimura and Ohashi, who were involved in the design process, "A so-called 'dirty vacuum' is teeming with hydrocarbon molecules. If a hydrocarbon molecule is hit by a strong beam, the carbon is burnt. So, we combined a TMP with an oil-free pump and

designed an evacuation unit that can be used anywhere. The TMP's pumping speed is 300 l/sec, so we selected a pumping speed of 250 l/min for the medium vacuum pump used as a fore pump. But if a pump were available in the 100 - 125 class, that would be even handier.

**From Basic Research to Medical Diagnosis, Radiation Beams Have a Wide Range of Potential Uses**

The storage ring has a total of 61 beamlines, including standard ones (80m), medium ones (300 m), and long ones (1,000m). Possessing extremely strong directivity, radiation beams have a



**User Interview**

Anest Iwata's vacuum pump is distinguished by being oil-free, a feature perfectly suited to the way we use vacuum pumps at SPring-8, where a clean vacuum is required. Moreover, replacing seals is simple and the pump itself is convenient to use. With rotary pumps, changing the oil is a major hassle, and equipping them with a trap nearly doubles their price. And since unspecified people use our equipment, we would also need magnetic valves. So rotary pumps are also unfeasible in terms of cost. Anest Iwata's pumps are equipped with a check valve that prevents reflux even during power failures. And they are attractive in terms of cost as well.

**Dr. Tetsuya Ishikawa**

SPring-8 Project Team, The Institute of Physical and Chemical Research

property whereby they travel great distances without diverging. Hence, long beams are used when a broad field of view is required, such as when photographing the entire heart for diagnostic purposes. SPring-8's radiation beams can in fact be used for a wide range of applications—from structural analysis of atoms and molecules to solid-state physics research, catalytic reactions, materials processing, and medical diagnosis. Radiation beams can truly be called a new light that illuminates realms that we have been unable to explain using prior experimental technologies.

\*One electron volt is the amount of energy an electron gains when accelerated by a voltage of 1 V in a vacuum.