

NEW SEALING METHOD FOR METAL GATE VALVE

Toshihiro Terasawa, Masaki Saito, Fumio Kimijima
and Chikara Hayashi

R/D Division, ULVAC Corporation

1. INTRODUCTION

Recently, the necessity of the large metal-seal gate valve which is capable to bake out and long maintenance-free life are increasing, as the scale of ultra high vacuum system becomes larger, especially for experimental Tokamak thermonuclear fusion system or high energy particle accelerators. A few large all metal gate valve have been manufactured, however, as far as operating life time concerned, they do not satisfy enough the requirement. New sealing technique is developed at ULVAC laboratory to achieve much longer life.

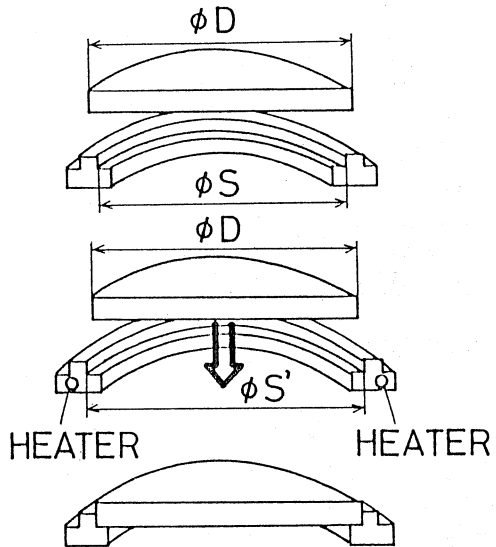


Fig.1 New sealing technique
1) At room temperature. $D > S$
2) Heat the valve seat. $D < S'$
3) Cool the seat after inserting it to the disk.

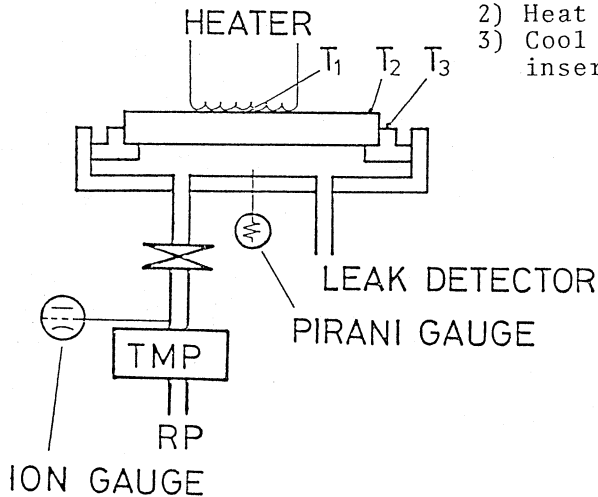


Fig.2 Schematic representation of experimental set-up

In the present paper, details of the new sealing technique and the preliminary experimental results are described.

2. NEW SEALING TECHNIQUE

In the metal seal gate valve manufactured today, the principle of sealing is to apply mechanical force produced by screw drive mechanism or pneumatic force. In contrast to it the new sealing technique requires to

utilize thermal expansion. The outer diameter of the valve disk is set larger than the inner diameter of the valve seat at room temperature, as shown in Fig. 1. For sealing, the inner diameter of the valve seat is expanded by heating, then it is cooled to room temperature after the valve disk is inserted to the valve seat; the side of the valve disk and mating surface of the valve seat becomes to contact.

3. EXPERIMENTAL RESULTS

The experimental set-up is constructed as shown in Fig. 2. A valve disk diameter is 440 mm. Silver is deposited about 0.04 mm on the valve seat to keep away from cold welding between the valve disk and the valve seat. The sealing conductance is calculated from the pressure difference between the both side of the sealing, where the high vacuum side pressure is balanced with the effective pumping speed.

Figure 3 shows the relationship between the sealing conductance and the calculated tightening pressure which is obtained from the measured temperature difference between the valve disk and the valve seat. The sealing conductance decreases linearly down to 1×10^{-9} m³/s as the tightening pressure increases.

A UHV all metal gate valve of which leak rate is lower than 1×10^{-10} Pa.m³/s can be manufactured by using the double sealing mechanism with sealing conductance of 2×10^{-9} m³/s and intermediate vacuum pumping of 3×10^{-3} m³/s in 10^{-2} Pa range.

After 2000 sealing cycling test, tightening pressure to acquire necessary sealing conductance increased only about 10 percent and no deformation at the disk and seat were observed. The sealing cycle is expected to be several thousands.

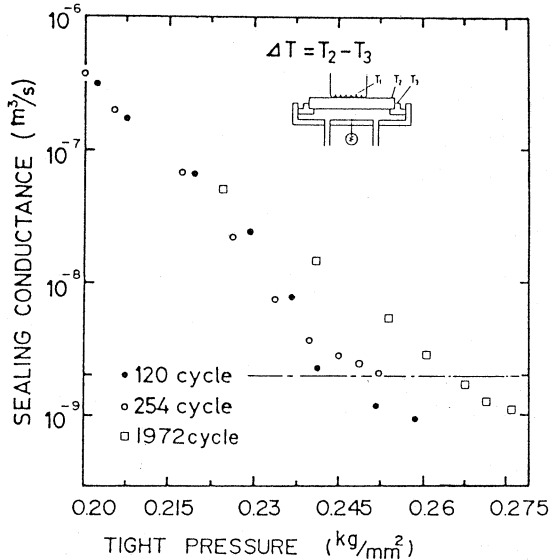


Fig.3 The relationship between the sealing conductance and the calculated tightening pressure.