



High-precision surface processing

with Pfeiffer Vacuum solutions



Concave mirrors for observatories – processed in the largest ion beam processing plant in the world

In astronomical observatories, high-precision concave mirror telescopes allow us a view into the deepest reaches of the universe. This technology has achieved significant insights into the origin and development of our universe as well as groundbreaking scientific breakthroughs in the field of astrophysics. The quality of these concave mirrors is essential for these observatories and for the success of the research conducted by them. Perfecting the shape of these mirrors is of crucial importance. To prevent imaging errors, and to achieve the best possible resolution of the images obtained at these observatories, the mirrors must be crafted with the greatest accuracy. For this purpose, the mirrors are ground and polished during production to a precision of

150 to 30 Nm. An excellent way to achieve this precision is to process mirrors and other optical elements with an ion beam. This technique permits extremely accurate corrections to be made to the shape, and results in ultra-high quality surfaces. The mirrors are then evaporated with one or more reflective layers of aluminum, before being coated with a final protective layer.

Nanotechnology experts put their trust in Pfeiffer Vacuum

NTG GmbH & Co. KG, headquartered in Hesse, Germany, are one of the experts in the field of processing optics and surfaces with nanometer tolerances using ion beams. For almost 25 years, the company has developed ion beam processing plants of various sizes for a wide variety of applications. Its systems are not only used in astronomy, but also



Figure 1: The IBF-2000 is the largest ion beam processing plant in the world



Figure 2: Using a three-axis manipulator system inside the chamber of the IBF-2000, work pieces with a diameter up to 2,000 mm can be processed

in EUV lithography and traditional optical applications. The portfolio includes plants for processing work pieces with diameters from 5 mm to 2,000 mm.

The technique of processing the work pieces with an ion beam takes place under vacuum. Before processing begins, the plant chamber is evacuated and a vacuum of 10^{-6} hPa is created. To satisfy the high requirements defined by their customers and the applications themselves, NTG GmbH & Co. KG have relied on Pfeiffer Vacuum solutions for more than 15 years.

Vacuum solution for IBF-2000 ion beam processing plant

With the construction of the IBF-2000, NTG have achieved a milestone in nanotechnology. This worldwide largest ion beam processing plant achieves ultra-fast and simple processes for treating the large-format mirrors used in astronomical applications such as in the observatories referred to above. It can hold mirrors or optics with a diameter of up to 2,000 mm, a maximum thickness of 600 mm, and a total weight of up to 1.5 tonnes. Inside the huge chamber, which is evacuated very quickly to the necessary final pressure of 10^{-6} hPa with the vacuum solutions made by Pfeiffer Vacuum, the surface of the mirrors can be processed with ion beams in



Figure 3: Work pieces are transported into the chamber with special lifting gear



Figure 4: NTG General Manager Thomas Franz (right) in conversation with Pfeiffer Vacuum's Gerd Riemenschneider

the required way. This procedure does not leave any traces or tensions on the surface, and allows almost any geometry or material to be processed.

A special device for rotating the work piece is available to match the dimensions of the IBF-2000. This enables mirrors and optical components to be mounted, fine-adjusted and aligned.

Requirements to be met by the vacuum solution

The high quality standards of NTG GmbH & Co. KG translate into specific requirements placed on the vacuum technology used in their plants. NTG General Manager Thomas Franz: "Depending on the properties and size of the optics, the processing steps performed in our IBF-2000 take between one and fifty hours. To enable us to guarantee the fastest possible processing time for our customers, it is tremendously important that the vacuum pumps used are capable of evacuating the chamber and creating the required 10^{-6} hPa vacuum in a very short time."

The solution created by Pfeiffer Vacuum

The IBF-2000 was fitted with a Roots pumping station from the Pfeiffer Vacuum CombiLine, consisting of a single-stage Hena 300 rotary vane pump, an Okta 1000 Roots pump, as well as a HiPace 2300 turbopump. This vacuum solution enabled Pfeiffer Vacuum to satisfy the customer's requirements extensively.

Thomas Franz: "We've been working with Pfeiffer Vacuum products for many years. The pumps are absolutely reliable and meet the high technological standard we want to offer our customers with our plants. We therefore had no hesitation in using vacuum solutions from Pfeiffer Vacuum again in our largest and most technically advanced plant to date, the IBF-2000."

Advantages of the vacuum solution at a glance:

- High pumping speeds for light and heavy gases
- High process integrity, resistant to particulate matter
- High gas throughputs
- Unmatched high compression values
- Integrated overflow valve in the Okta 1000
- No cooling water consumption
- Worldwide use due to the range of available motor voltages
- Integrated oil mist filter with highest-degree separation
- Special vane materials in the Hena 300 for a long lifetime



Figure 5: The Pfeiffer Vacuum CombiLine pumping station inside the IBF-2000



Figure 6: HiPace turbopumps in use in the IBF-2000

**Vacuum solutions
from a single source**

Pfeiffer Vacuum stands for innovative and custom vacuum solutions worldwide, technological perfection, competent advice and reliable service.

**Complete range
of products**

From a single component to complex systems: We are the only supplier of vacuum technology that provides a complete product portfolio.

**Competence in
theory and practice**

Benefit from our know-how and our portfolio of training opportunities! We support you with your plant layout and provide first-class on-site service worldwide.

**Are you looking for a
perfect vacuum solution?
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