



Fuel system components are submitted at 4000 bar pulsations on this test stand.

Production of High-Pressure Fuel Lines

Nova Swiss grows its size, capabilities and list of reference customers

► Nova Swiss, the trademark of Nova Werke AG, a Swiss enterprise specializing in high-pressure diesel engine components, has recently inaugurated its restructured Effretikon headquarters.

The company is part of the Swiss MK Holding SA (owned by Nova's CEO Martin Knechtli) together with Ceramaret SA and Bieri Hydraulik AG.

The restructuring project, worth about US\$9 million, was established in 2003 to face the growing business the company has experienced during the past years.

Remo Oppliger, manager of the Engine Components and High-Pressure Technology division, explained that the company's growth dates back long before common rail fuel systems came into use. Expansion is rather due to the specialization of the company in the field of high-pressure engine components that attract new customers. Considering the company's reference list — Caterpillar, GE, EMD, MAN Diesel, MTU/DDC, Rolls-Royce, Wärtsilä, just to name a few — it gives an idea of its worldwide business.

The aforementioned investment was necessary to completely restructure and redesign the 10 000 m² shop floor. This investment includes all infrastructures necessary to streamline production flow and ensure the cleanliness of the working environment. On top of this, the company has invested an undisclosed amount of money to modernize production means by purchasing new automatic machining centers, bending machines, laboratory equipment, etc.

The restructuring process was completed in the fall of 2006 and has allowed for

the doubling of production in the same physical space, leaving the possibility to grow a further 20 to 25%.

However, as Oppliger explained, business has grown more than forecasted back in 2003 when the present plan was decided. In 2006 the turnover reached US\$32 million. The engine components and high-pressure technology division accounts for 85% of the business, while surface coatings (for gas turbine hot gas path) and valve revisions cover the remaining 15%. The great majority of the production, 95%, is exported. Production is carried out at the Effretikon company's headquarters and also by the Nova Werke AG subsidiary of Cesson in France, whereas the Dortmund, Germany, facility is primarily a sales office.

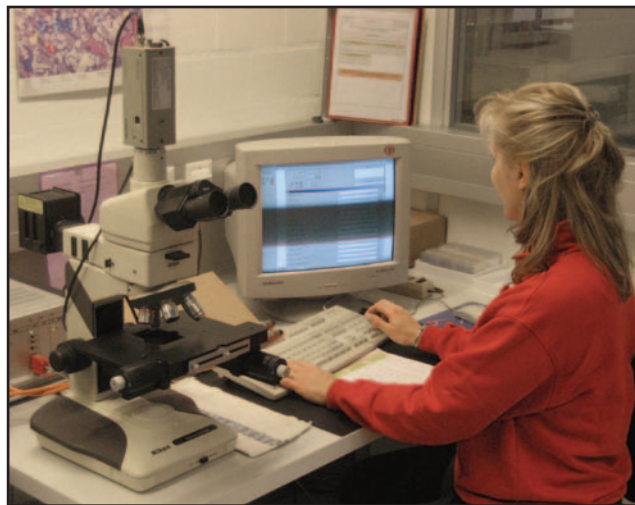
If the company has doubled its turnover during the last five years, the present forecast is to double the production output again in the next four to five years and new space has to be planned quickly. This expansion should be in the same Effretikon industrial area, possibly across the street.

The reason for such success, which dates back to the beginning of the 1990s — when the general economy was somewhat in a depression stage and worldwide competition was very aggressive — has to be found in the commitment the company made with its customers. Nova policy has been crystal clear, working only with OEMs, and assisting them in development and engineering of the components needed for their new engines in a partnership agreement. Nova is supplying all high-pressure components connecting the fuel pumps to the injectors of high- and medium-speed diesel engines.

They are also supplying engine manufacturers with starting valves and distributors to crank large diesel and gas engines with cylinder bores over 150 mm and powers above 750 kW.

Products of the high-pressure division are so-called standard components such as needle valves, fittings, tubes and membrane-type compressors, but also special high-pressure systems for gas and liquid applications up to 10 000 bar.

The company has concentrated on



(Left) Final assembly of high-pressure piping. **(Right)** After flashing a high-pressure piping, the filter is submitted to microscopic examination to assess internal cleanliness.

the components required by industrial engines with powers over 500 kW used in locomotives, marine propulsion and power generation. Traditionally, they have focused on the supply of high-pressure fuel lines for medium-speed, four-stroke engines, for which they have a share of over 50% of the worldwide market, but they also supply components for larger high-speed engines, as well as low-speed, two-stroke engines.

Engine manufacturers have soon realized that Nova Swiss could engineer the best technical solution to their request to start with and then follow up by supplying the most reliable components.

Attention is now concentrated on customer satisfaction by shortening the lead time, stabilizing the price, increasing the quality to reach the ultimate goal of zero defects and deliver at least 98% of the orders on time. Deliveries to strategic partners are performed under the principles of kanban/just-in-time production. Presently, all of the industry is under pressure and on-time delivery is a priority, however, Nova is carefully monitoring its cost-reduction program because in a few years the pressure will unavoidably shift from delivery to cost.

Oppliger explained that more than 90% of the 120 employees of the company are involved in continuous improvement processes (CIP). Each

worker is encouraged to continuously improve by stating an identified deviation, defining the objective, finding the solution, implementing it and presenting it to the colleagues. The system enables the finalization of about 400 projects every year primarily aimed to shorten the production cycle, increase quality and reduce costs.

The production process starts by receiving the raw material from selected suppliers, which should carry out all quality checks prior to delivery. In case a defect is discovered, the supplier is submitted to extensive quality investigation during the next deliveries until it is safe to requalify. Each batch of material entering the shop is classified and remains fully traceable along the whole production process and also after delivery to the customer.

Dimensional checks and other tests are carried out after each production step.


Stress relieving is carried out on high-pressure piping after bending.

Autofrettage is performed on the high-pressure lines and rails to obtain a plastic deformation of the material to increase the strength of the component, thus extending its lifetime. All the high-pressure equipment needed to carry out the autofrettage process is developed and manufactured in-house by Nova, which also supplies to the water jet cutting industry. At present, this process is carried out up to 10 000 bar pressure for fuel lines and rails operat-

ing at pulsating pressures exceeding 2000 bar but, according to Oppliger, the autofrettage pressure is in relation, among others, to the operating pressure of the component, and in view of a future further rise of the operating pressure, Nova is developing equipment capable of reaching 15 000 bar and beyond in the near future.

An in-house-built test bench carries out pulsation cycles up to 4000 bar to assess the durability of single components.

Interior cleanliness is most important to avoid injector clogging once the fuel line is assembled on the engine. The cleanliness test is performed by placing a filter element at the end of the line to collect all particles entrained by the flashing fluid. At the end of the test the filter element is dried and examined in Nova's lab to detect the number of particles collected — following that, the result is coded. At the end of the manufacturing process, single components or completely assembled fuel lines, as well as rails are submitted to hydraulic test prior to shipment.

Nova Swiss is presently planning the further growth in the production of common rail piping systems for high-speed engines that require larger component numbers and is evaluating its penetration into the U.S. and Asian markets. 

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