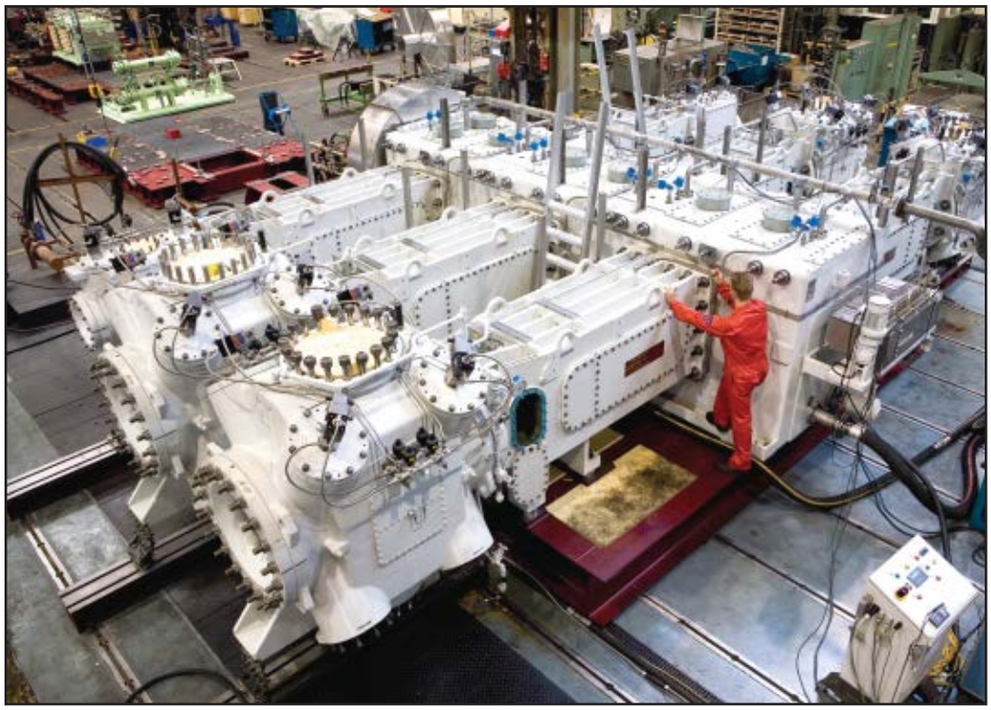

■ A C-85.6 is shown here undergoing its API test at the Thomassen premises in Rheden, Netherlands. The API 618 range of reciprocating compressors is seven strong, ranging from the C-7 model with a maximum power of 1070 hp (800 kW) at a rated speed of 600 rpm, up to the largest — the C-85.

THOMASSEN'S PRESCIENCE PAYS DIVIDENDS

Market Need is Growing to Meet Company's Line of Large Reciprocating Compressors

By Ian Cameron

The recent unveiling of what is said to be the world's largest API hydrogen compressor marked a major landmark for Thomassen Compression Systems, which is located in Rheden, Netherlands.

The company manufactures the API 618 range of reciprocating compressors and is continuing to enjoy considerable sales success with the C-85 model from that lineup, which is able to operate at a continuous piston rod load of 280,000 lb. (1250 kN).

This yields, for an eight-cylinder machine, a design rating of some 33,500 hp (25 MW) at 375 rpm. The company reports that a C-85.6 (six-cylinder compressor) was also recently hooked up to the company's new test rig, which can also be configured to test a C-85.8 unit.

Thomassen, which celebrated its centenary last year, showcased its largest C-85 yet built for customers and contractors at its Dutch headquarters. The compressors on show have been sold to Reliance Industries of India and have an installed power rating in excess of 17,400 hp (13 MW). SK and Caltex of Korea have also bought C-85 compressors with different power ratings.

The company originally produced gas engines and then diversified to produce reciprocating compressors. Elliot Centrifugal compressors and G.E. gas turbines were also company products but the Reciprocating Compressor Division has become a separate company with 300 employees, and said it is now expanding its market share.

Thomassen has always specialized in the production of tailor-made API 618 compressors and has supplied major international oil companies including Shell, Exxon, Caltex and B.P. The API 618 range of reciprocating compressors is seven strong, ranging from the C-7 model with a maximum power of 1070 hp (800 kW) at a rated speed of 600 rpm, up to the largest — the C-85.

The recent growth in interest in Thomassen's huge compressors, such as the C-85, vindicates a decision some years ago when an analysis of future compression markets by the company made it clear that refinery capacity, which was on the increase, would require a larger compressor than the biggest frame size made then. The company decided to develop the C-85 — a new, larger model of compressor — to meet these requirements, although during that period there was not yet a substantial market for machines of that size.

Thomassen said the timing of that decision was fortunate, as the engineering tools available to the design team had been extended considerably in the preceding years, and there was experience with smaller machines from which Thomassen was able to draw.

The choice faced at the beginning was between a radical new design or an evolutionary one based on the existing designs, although the company said it ultimately decided in favor of the use of the latter. There was, therefore, no radical departure from the common design features of smaller frame sizes, but Thomassen said it was in a position to make improvements and refinement to them for the new machine. Features that were tried and tested over many years could be incorporated in the larger machine, which allowed Thomassen to have confidence in the performance and reliability of the new machine.

Thomassen's initial design objective was to produce a robust high-perform-

A C-85.4, which was shipped to GS Caltex in Korea.

ance machine with features exclusive to the company.

Two aspects that were given extra consideration were the impact of future uprating, and the machine structural distortions under load. Thomassen said it believes that the latter does not always gain the recognition that it should for large-sized machines.

Thomassen's manager of technology Peter Duineveld said, "Reciprocating machines have, by nature, relatively large cyclic forces, and will therefore always vibrate. What cannot be eliminated must be controlled, and vibration needs to be limited to ensure long-term reliability of not only the machine, but very importantly, its ancillary process equipment and instrumentation.

"Naturally, there are well-known international and industry standards for both machines and process systems which have been developed over the years. These serve as reference material for a designer to keep in mind while developing the design."

The company said that a direct result of this consideration is that the crankcase and crosshead guide material selected was nodular cast iron. According to the company, nodular cast iron has several advantages over grey cast iron, such as higher tensile and fatigue strengths, and a significantly higher Young's modulus, which the company said was convenient for distortion control.

The crosshead guide used is of a double compartment type, as the compressor was initially intended for hydrogen duty in refineries. The axial length of a guide is therefore greater than for a single compartment style as is common in, for example, low-density polyethylene (LDPE) applications, the company said. That stretch under load is greater due to the fact that it is a larger component, a factor that must be taken into account when evaluating overall cylinder movement during compressor service.

The C-85 crankshaft journal diameter, which is partly determined by torque transmission requirements, was designed for an eight-cylinder configuration from the outset. The company said the decision was taken to oversize the journal diameter to a mild degree to include margins for future development of the machine, thus ensuring that crankshaft size would never become the first important limitation of the design.

Thomassen reported that the consequence is generous oversize for machines with a smaller number of cylinders. The crankshaft material chosen also allows the possibility for a future upgrade. Main and big end bearings are identical tri-metal Micro-Babbitt type. The large crankshaft driving flange dimensions also reflect on the influence of the increasingly severe requirements with regard to short circuit and reconnection torques generated by main drivers, the company added.

Another feature included from the outset of the C-85 design was the hydraulic tensioning of all major bolting. According to the company, this is something that has gained appreciation by users for ease of assembly and is also attractive from the designers' perspective as it promotes accurate tensioning, meaning that the machine in service will be able to more consistently meet the basic conditions that the mechanical design was based upon. This is important for the control of cyclic stresses in bolted jointing, which is necessary to ensure that reliability in the domain of fatigue failures can be maintained, said the company.

Duineveld added, "On the other hand, extra margins were included here to accommodate less than ideal assemblies and negative environmental factors, as all machines need some headroom to allow for the nastier things in everyday life, which are simple realities in practice.

"One of the most important components in a reciprocating compressor is perceived by many users to be the piston rod. This is not without reason, as breakage during operation is not unknown, is obviously inconvenient, and of course not without danger in the operating environment in which it finds itself.

"Consequential damage to other machine components is not unusual either, which results in additional costs and possible delays in repair — undesirable from any perspective. For more than 25 years Thomassen has used a design of piston rod that has a pretensioned attachment to the crosshead and piston.

"This has resulted in a piston rod of outstanding reliability, and failures of this attachment are extremely rare. Here, also, the tensioning is hydraulic, with all the advantages that it has to offer for this assembly. It is interesting to see that some other manufacturers have also recognized these advantages and introduced their own versions during the passage of time."

The C-85 compressor can be outfitted with cylinders that can be chosen from several series of cylinders, as is usual with most compressor manufacturers, varying from large, low-pressure cast iron to small, high-pressure forged steel models, with many intermediate size and special material options. This enables close tailoring to individual process requirements for a variety of service applications, the company said.

Another development that can be incorporated in the C-85 is Thomassen's patented Free Floating Piston (FFP), in which the piston has an integrated aerostatic bearing system that the company believes is a simple solution for nonlube wear problems. Here, the rider or wear bands have no physical contact with the cylinder liner surface, which means a reduction in piston trim wear, Thomassen said. The company said the FFP is a proven design with more than 100 cylinders — the first of which has run for more than 60,000 hours without replacement.

Duineveld said, "The foresight of years ago has provided Thomassen with a machine well suited to current market requirements for very large machines, and it is notable that there has been a shift from the Thomassen model C-45 compressor, (piston rod rating of 825 kN) which had an extended period of extremely strong sales, to the larger C-85.

"Indications in the LDPE market are an anticipation that plant capacity may increase in this particular field, which could, if realized, result in a demand for even larger machines." ■

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