Compact plunger pump with a big performance

"Conceived as a competitively-priced multi-application compact pump for the OEM sector, the new 7CP product line offers designers and users all the quality, performance and build attributes traditionally associated with Cat Pumps"

Cat Pumps UK Limited has expanded its range drive triplex plunger pumps.

Conceived as a competitively-priced multi-application compact pump for the OEM sector, the new 7CP product line offers designers and users all the quality, performance and build attributes traditionally associated with Cat Pumps. The valves and seats are manufactured from 304 Stainless Steel and are hardened and polished for ultimate seating and extended life. The forged brass manifold provides high levels of strength and resistance to corrosion, and the V-packings that are lubricated and cooled by the pumped fluid run on highly-polished alumina ceramic plungers resulting in excellent service life.

The 'press-in' style seal case and convenient access to the inlet and outlet valves makes the pump easy to maintain and operate.

Capable of pressures between 7 and 140 bar and flows up to 41 l/min, this positive-displacement pump is remarkably compact, delivering a performance that previously would have required stepping up to the next largest pump in the Cat Pumps product range. The 7CP products can be direct-driven at 4-pole or 6-pole motor speeds using a Cat Pumps bell-housing mounted directly to a suitable B5 motor flange. As a result, the 7CP plunger pump can fulfil those duties on plant and equipment where space is at a premium. Equally, should an intermediate speed be required, the 7CP pumps can be installed on a base plate using dedicated mounting rails, complete with belt-drive or inline geared motor.

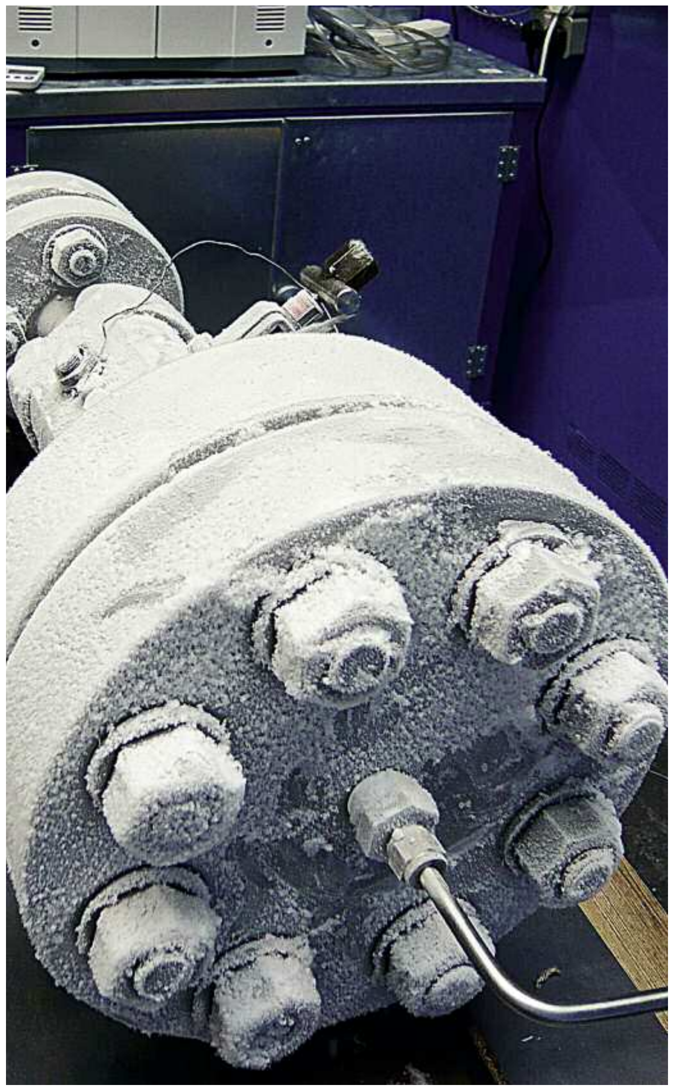
According to Cat Pumps, the applications for their 7CP range are too numerous to mention. However, in those countries where the pump has already been introduced, popular applications include stationary in-plant cleaning units, vehicle cleaning, misting, multi-lance wash down units in the food industry and coolant flushing.

A full range of installation accessories is available to complement this new development from the most highly regarded manufacturer of high-pressure pumps of this type. Data sheets on all these products, together with comprehensive application and installation guides, are available for download from www.catpumps.co.uk ■

Fugitive emissions; the challenge for valve manufacturers

By Bob Clegg, technical director, Sabre Instrument Valves Limited

"The oil and gas industry has grown rapidly over the course of the 20th century and whilst attitudes and actions towards reducing pollution and waste have become more sophisticated within the industry there are still areas that demand constant attention"



Double bock and bleed valve undergoing FE testing

Background

Emissions from human activity are nothing new. The waste and by-products of early civilization were simply accepted as part of everyday life and went untreated (if not un-noticed) and were left to find their natural place in the world. The affect on the environment was minimal as the activities were at a very low level.

However, things changed dramatically in the late 18th and early 19th centuries as the Industrial Revolution that started in Britain quickly spread throughout Europe and then around the world.

The rapid increase in demand for goods produced by the new machinery of mass production ensured a corresponding increase in demand for raw materials and the energy required to power the whole process. Pollutants and waste became the all too obvious and abundant co-products of this revolution and were produced unchecked for decades, affecting nature and the man made environment in equal measure.

It is only over the past 50 years or so that coordinated action has been taken to reduce or even remove the worst excesses of this industrial explosion.

The oil and gas industry has grown rapidly over the course of the 20th century and whilst attitudes and actions towards reducing pollution and waste have become more sophisticated within the industry there are still areas that demand constant attention.

One such area is that of fugitive emissions (or FE) – defined as the 'irregular or unintended loss of gases or vapours from pressurised systems and associated equipment'.

Fugitive emissions and valves

It is important to differentiate fugitive emissions from other emissions or system losses evident in the oil and gas industry. These system losses are the inevitable consequence of the activities that are a necessary part of the exploration, development, extraction, processing and distribution of oil and gas assets. Such system losses (from wellhead preparation, flaring, venting, process treatment, maintenance activity, de-commissioning and so forth) are significant contributors to the overall level of losses. However, a number of studies have shown that losses resulting from fugitive emissions (essentially leakages from the system) can account for up to 50% of the total losses over the lifetime of a facility.

The incentives for operators to understand and control fugitive emissions are therefore clear:

Health and Safety: risk of explosion and fire, safety of personnel etc

Environmental: Legislative requirements, environmental responsibility, positive public image etc

Financial: very high costs of lost process, asset protection, high maintenance costs, possible punitive financial penalties etc

Equally, those companies supplying products to the oil and gas industry have an incentive to design and manufacture their products such that process losses through fugitive emissions are minimised. This is particularly true of valve manufacturers.

The types and range of valves used within the industry is enormous, from very large bore primary shutdown valves to very small instrument isolation valves. However, all valves have to overcome the same basic challenge.

A valve (in whatever variant) is basically an obstruction (or obturator) within a flow path that can be opened and closed. This is achieved using an operating stem or other device attached to the obturator and this must pass from the obturator to the outside of the valve in order to be actuated. The resultant gap between the valve body and the stem is a potential leak point and therefore a seal of some kind is required. It is the effectiveness of this seal to retain the process within the valve which determines its ability to control fugitive emissions.

These potential leak points on a valve are multiplied if the valve has a number of obturators (for example as with a double block and bleed valve) and if the body is made of various bolted components (for example if specific bolted on end connections are used).

Standards and testing

In recognition of the need to control the level of fugitive emissions from valves a number of international standards and operator specifications have been developed over the years. These seek to define testing criteria that can be applied to valve products to qualify designs and to verify valves that are produced as part of manufactured batches.

The standards define the procedure by which the valves are tested, including the test pressures, test medium, number of cycles for the valve and number of thermal steps that may be involved. These vary depending on whether the valve is a prototype (tested to qualify a range of valves) or a production valve (tested to cover a manufactured batch).

They also define the test medium (commonly helium) and the qualitative measuring devices required to detect the leakage from the valve under test. The testing is done across the working range of the valve (typically -50 degrees C to + 200 degrees C) or a specific range determined by the end user.

Tested valves can qualify other similar valves in a product range up to 1 nominal size smaller and 2 nominal sizes larger. They can also qualify other pressure ratings as follows: Class 600 also qualifies classes 150 and 300 whilst Class 1500 also qualifies class 900. Class 2500 tests only qualify that class.

Health and safety

Lower temperatures are commonly achieved by using liquid nitrogen as a cooling medium. Higher temperatures are achieved by heating the valve assembly (typically by using a heating platen or oven).

In addition, the trace media used within the valve is usually helium gas under high pressure (because the molecular size of helium is very small compared to hydrocarbons – so ensuring that tests are particularly onerous and searching).

Consequently, there a number of significant health and safety issues (high pressure systems, materials handling, COSHH etc) which need to be addressed and overcome when designing, commissioning and operating any fugitive emissions test facility.

FE testing facilities

Independent test houses offer a valuable service to those valve companies that do not have their own facilities. They operate to recognised standards and can provide safe and consistent FE testing to the manufacturer.

However, there is a distinct advantage where a valve manufacturer has its own facility. This is because feedback from its own tests, the relative performance of different sealing arrangements and materials is instantaneous. The 'hands on' activity of testing in-house can therefore help the manufacturer to better understand the product and its behaviour under the various temperature steps and operating cycle stages of FE tests such that small but significant improvements can be made to the product design. Verified by continued testing, these improvements can rapidly be incorporated into the standard valve range of that manufacturer. The result is true continuous improvement.

This is not so easily achieved when relying on the services of a 'hands off' independent test house.

Ongoing benefits – manufacturers and users

From the valve manufacturers view point having an in-house test facility can be an integral and invaluable part of their research and development programme.

In addition, there is a requirement within the standards to have prototypes continuously verified to maintain full product range coverage and this can be easily accommodated within a manufacturers forward test programme.

Product improvement is also significantly assisted by the use of FE testing as a tool within the product development process.

Customers procuring valves from a manufacturer with in-house FE testing capabilities will avoid the higher costs associated with third party test houses.

But more importantly, the valve user themselves can be assured that valves specified, procured and installed within their oil and gas production, processing and storage facilities have passed rigorous tests to ensure that fugitive emissions have been minimised, so increasing plant safety and significantly reducing operating costs.

Sabre is a leading manufacturer of instrumentation and process valves supplying the major oil and gas operators around the world. ■

Difficulty of applying traditional NPSH concept to metering pumps

By Patrick Deniau, business development manager, Milton Roy Europe

The PRIMEROY®L, the most recent pump launched by Milton Roy, offers a minimum positive inlet pressure (MPIP) of more than 8 m suction lift

NPSH stands for Net Positive Suction Head and quantify the level of usable energy at pump entrance. It is usually expressed in mlc (meter of liquid columns). The objective of NPSH calculations is to verify that the pump will work outside of the cavitation risk zone for a given process.

1- Centrifugal pump

The concept is quite understood in the centrifugal pump area and its approach is fully normalised.

NPSHa

This is the available NPSH :

- in suction tank, we have a certain pressure
- less the liquid vapour pressure at working temperature to prevent cavitation, it represents the usable energy at storage tank level
- geometry of the installation defines the differential elevation between level of liquid in suction tank and the pump itself. When positive, pump is in flooded suction configuration and can benefit from extra usable energy. When negative pump is in suction lift configuration and disposes of less usable energy
- along the suction pipe, we have friction loses which can be easily determined through abacus or by calculation, based on suction equivalent length. Components manufacturers gives equivalent length of each of their products (elbow, valve, reduction nozzle, etc.) to facilitate the approach. Friction loses reduce the usable energy
- this determines the available NPSH at pump entrance (NPSHa), whose determination is of the full responsibility of the purchaser.

NPSHr

On its side, the pump manufacturer will qualify its pump, particularly by measuring the pump requested NPSH (NPSHr).

At a given working point, the pump will be installed with a starving device on its suction line so that the test loop can deliver an adjustable NPSHa. At the point where NPSHa is low enough to affect the pump volumetric efficiency (by usually 3%), the value is normalised as the pump NPSHr. This data is of the full responsibility of the pump manufacturer.

NPSH criteria

Responsibility of the pump supplier is to select a pump with a NPSHr below the NPSHa given on the customer data-sheet with enough safety margin (usually 0.5mlc).

NPSHa > NPSHr + 0.5mlc

2- Metering pump

Only one clear definition of a metering pump is given by the API675 standard : "A reciprocating pump in which precise volume control is provided by varying its effective stroke length. Such pumps are also known as proportioning chemical injection, dosing, or metering pumps".

Being a reciprocating pump, a metering pump does generate a highly pulsated flow. Instantaneous flow variation being fluid speed variation, it means that the pump will have to alternately accelerate and decelerate the liquid column. Translation on the suction side of a metering pump :

- at the beginning of the suction stroke, liquid column is to be put in motion and accelerated, which is achieved by the pump in creating a relative vacuum to pull the fluid
- at the end of the suction stroke, the liquid column is in motion, and due to its inertia, pump has to decelerate it seeing an over-pressure.
- friction losses are maximum at the middle of the suction stroke when speed is maximum. Except for high viscosity, it does not interfere with acceleration, as they are out of phase one to the other.

Impact on NPSH approach

Problematic #1 is that acceleration is largely predominant when compared to friction losses (by a factor of more than 50 in most cases), and must be integrated in NPSH calculations.

A consequence of that is that in his NPSHa calculation, the buyer do not need to take care of friction losses.

Problematic #2 is that acceleration is a function of the installation (responsibility of the buyer), and of the selected metering pump (responsibility of the seller). Typically :

$$Acc. = 0.016\ L.Q.N/d^2$$

This formula is not normalised, each manufacturer has its own one, but they are all equivalent between each others. Here, L and d are respectively the actual length (in m) and the internal diameter (in mm) of the suction line, Q and N are respectively the pump maximum output (in L/h) and its stroking speed (spm).

It is to be noticed that, on the installation side, the pipe diameter is at square, so of a very big influence, and on the pump side, stroking speed N may be a critical factor as well since a low stroking speed may meant a larger pump, therefore a likely more expensive one.

3- ISO 13710 Standard

This ISO Standard has been published in December 2004 and addresses "Reciprocating positive displacement pumps for use in the petroleum and natural gas industries". In its NPSH section, it stipulates that NPSHa is of the responsibility of the buyer, similarly to the centrifugal NPSH approach, and as the writers knew that there are acceleration issues in case of reciprocating pumps, they simply add that NPSHa must include acceleration losses.

Patrick Deniau, business development manager, Milton Roy

Problematic #3 is that the buyer cannot determine the NPSHa as it is also a function of the selected pump.

ISO 13710 also defines a NPSHr for reciprocating pump, to be given by the manufacturer. This NPSHr is measured exactly the same way it is done for centrifugal pumps.

Problematic #4 : if the NPSHr approach in centrifugal pump is meaningful as it measures a working point where volumetric efficiency starts to lower, therefore approaching the point where risk of cavitation appears, it is not meaningful for reciprocating pumps. Reciprocating pumps are supposed to deliver the same volume at each stroke, and such measurement simply qualify its ability to work under starved suction conditions, what we use to call the MPIP (Minimum Positive Inlet Pressure), which is the minimum static pressure on suction, needed for the pump to deliver its volume per stroke. It is not a sign of coming cavitation, as cavitation is caused by acceleration, and regards a very short period of time at the beginning of the suction stroke, independently of MPIP pump performances.

Illustration

Some years back, I had an intellectual fight with a witness inspector willing to apply the ISO 13710 NPSH approach. Application was for liquefied gas metering. As usual for these complex applications, installation was quite simple : a suction tank pressurised at the vapour pressure level (to stay in liquid phase), a short and strait suction line providing a flooded suction configuration to the pump.

Pressure in suction tank less vapour pressure (equalling zero at this stage), plus tank relative elevation to the pump less acceleration, not even considering friction losses, was leaving a very low NPSHa… which was below the pump MPIP reported in the data-sheet. As per ISO 13710 NPSH interpretation, it gives :

NPSHa < NPSHr, and…

… not any metering pump can do the job !
By the way, today, this pump is working well;
Why ?

- First, tank elevation was slightly larger than the calculated acceleration, leaving some usable energy at pump entrance,
- Second, the static pressure under which the pump is working (pressure in the suction tank plus tank elevation) was larger - by far - than the MPIP requested by the pump. Vapour pressure is not to be considered here, as the pump does not differentiate if the pressure is coming from a liquid or a gas.

4- NPSH test

Another issue arises here. As for centrifugal pumps, customers more and more want to secure the pump selection by a NPSH test, again another possible intellectual fight between the parties.

Do we want to measure the pump MPIP ? Easy, but as illustrated above, it has nothing to see with a NPSH approach whose purpose is to prevent cavitation.

Do we want to simulate acceleration ? A little bit more complex to do, but it is not a real test, as it is a simulation based on calculations.

Do we want to really test what the seller says (that the pump will work under specified conditions) ? We would have to reproduce the entire installation (!), using a fluid with the same specific gravity, vapour pressure, etc. (!). Everybody can understand that this is simply not feasible.

5- Conclusion

TRUST !

Customer has to provide to the manufacturer the best reliable information on the product and the installation (usually well define in his data-sheets). Manufacturer has to make the best appropriate metering pump choice, including the NPSH criteria approach, and give advices, like recommending to enlarge the suction pipe diameter, shorten it, recommending the use of a dampening device, or a multiplex pump design, etc.

The final and good NPSH criteria for metering pumps, and covering more than 90% of metering pump application cases, is :

NPSHa (without friction losses) > Acc. + 2mlc (the safety margin)

AND BE QUIET…

New explosive decompression perfluoroelastomer for pumps and valves

“Perlast G92E is an important development which expands the EnDura range’s capability into the upper end of the performance range for elastomers in oil and gas processing”

Aberdeen O-Rings & Seals Ltd has announced a new explosive decompression resistant perfluoroelastomer for seals used in ultra-aggressive, processing applications. The Perlast® G92E elastomer combines high levels of chemical resistance with an increased explosive decompression capability, setting a new performance standard for perfluoroelastomer seals in pumps and valves in oil and gas exploration and processing.

Perlast G92E is part of the EnDura® range of elastomers designed specifically for the oil and gas offshore industry. The polymer’s high fluorine content renders it inert to a wide range of liquids and gases such as hydrogen sulphide and methane encountered during oil and gas operations. Suitable for environments up to 260°C, G92E has tested successfully in a range of high temperature, high pressure and aggressive gas conditions, including those described in NORSOK M710, and is currently undergoing further industry and international explosive decompression standards testing.

EnDura – high performance elastomers for oil and gas

EnDura is a family of different elastomer types that offer superior chemical resistance compared to conventional explosive decompression grades, greater high and low temperature capabilities and are tested to the major international explosive decompression standards such as NOROSK M-710. The EnDura range includes HNBR, TFE/P, and FKM elastomers.

“Perlast G92E is an important development which expands the EnDura range’s capability into the upper end of the performance range for elastomers in oil and gas processing,” says Rachel Armell, business manager, Aberdeen O-Rings & Seals. ■

Contact Rachel Armell for more details on Perlast G92E on 01224 877844, e-mail: rachel.armell@aberdeenseals.co.uk and web site www.aberdeenseals.co.uk