

Enhanced Recovery and Production Solutions





It's what we do.

We are proud to celebrate our 45th year. It's been a long and often challenging road, but a hugely rewarding one for Transvac.

Our mission has remained simple; to be the World's leading supplier of innovative Ejector solutions. Delivering creative, effective, reliable solutions to the brightest, most forward thinking companies and their engineers. The ones that challenge the 'traditional' and demand more.

Oil & Gas production has changed significantly in the 45 years Transvac has been growing, yet the fundamental principles of production are much the same. It's about extracting more, for longer. Maximising recovery and reducing operating costs.

This is what we do. Our Ejector solutions can offer a valuable helping hand to ageing facilities, struggling with depleting reserves and changing conditions. They are also an important part of some of the most modern, cutting edge, production facilities, where traditional technologies cannot operate.

This brochure illustrates a number of our most successful solutions which we hope will inspire and give cause to re-evaluate development sites worldwide.

We call them solutions, but they are often much more than that.

They are opportunities.

David Ainge, Managing Director



“ The Ejector is showing excellent performance to date, generating up to 34.2 mmscfd of ‘extra gas’ from shut in wells. The Ejector will pay for itself in less than a month! We were all surprised to see production kicking in so easily.

- Client Comment

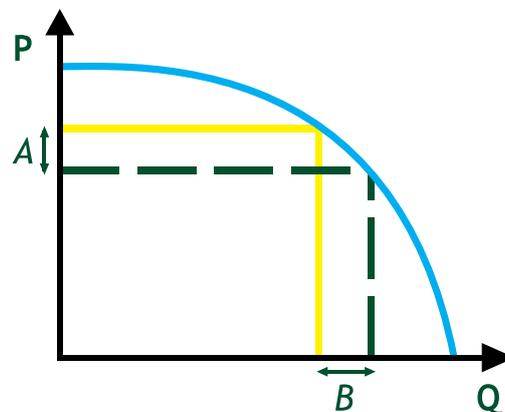
Maximising Recovery

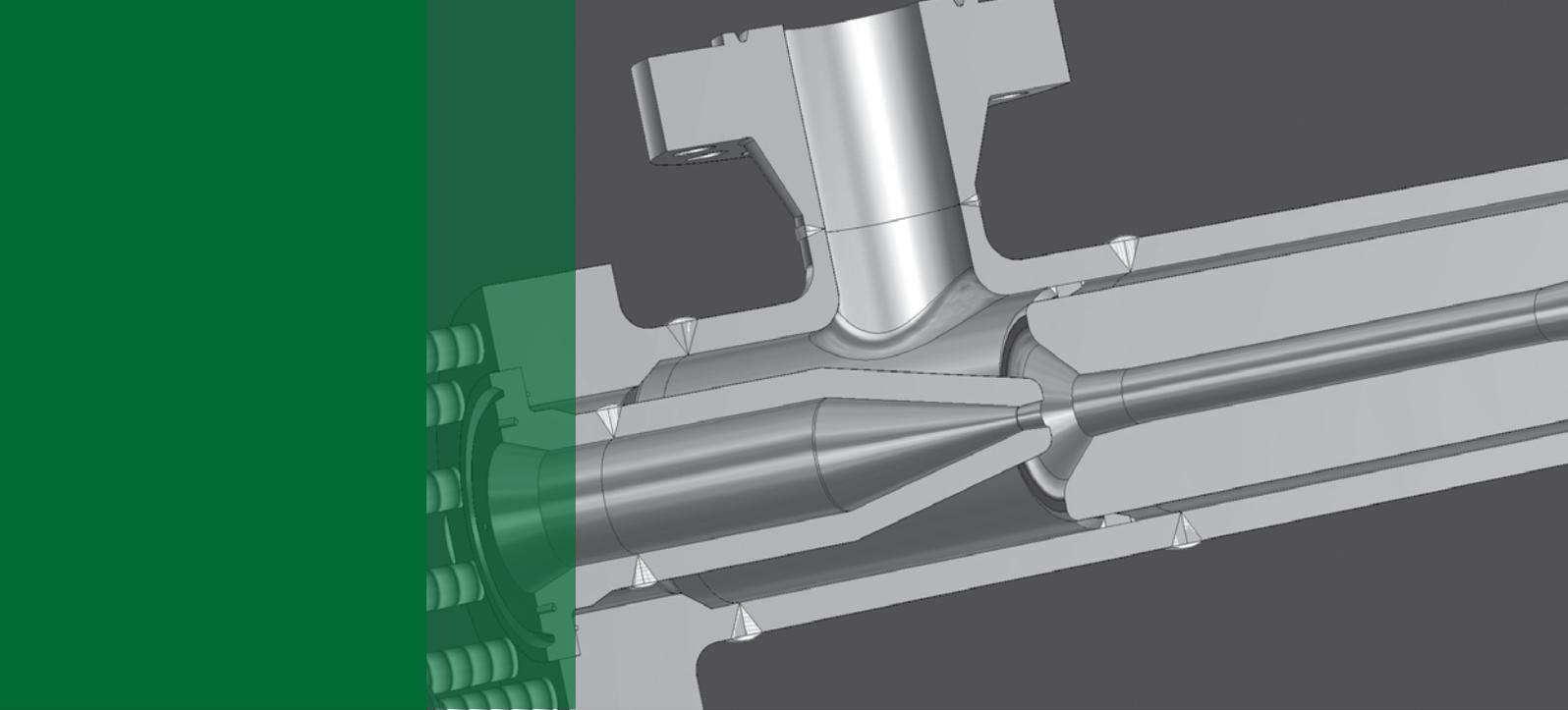
The diagram shows the P-Q curve from a typical LP Well.

The yellow line represents the operating conditions before the fitting of an Ejector. Using energy from a suitable high pressure source (a choked HP Well for example) an Ejector can be used to lower the flowing tubing head pressure (FTHP) of the LP Well.

If the pressure reduction achieved by the Ejector at the Well head is ‘A’ on the diagram, then the increased production from the LP Well will be represented by ‘B’.

In the case of nearly and fully shut-in Wells, the increase in production rates can be significant since the P-Q curves are at their flattest in this region. (Small drop in pressure causes large increase in production). In many cases ‘dead’ or shut-in Wells can be restarted by lowering the Well Head pressure.





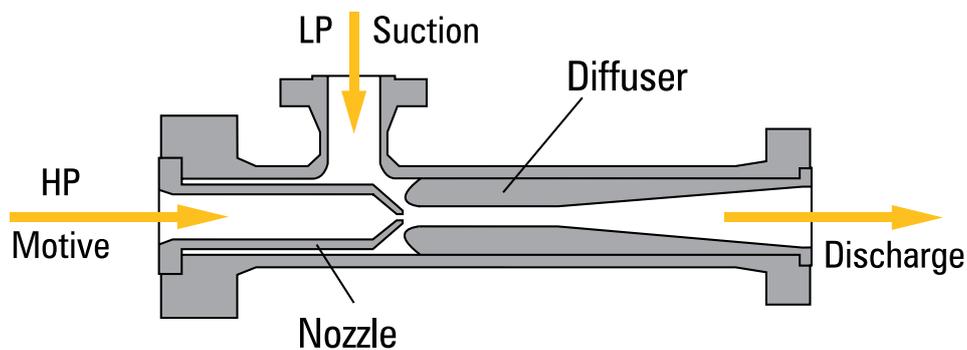
How Ejectors Work

Ejectors (also referred to as Surface Jet Pumps, Eductors or Venturi's) provide a simple, robust and reliable method of pumping and boosting the pressure of fluids.

The operation is based on Bernoulli's principle, whereby by increasing the velocity of a fluid as it passes through the nozzle, a low pressure region is created within the Ejector. This region entrains and compresses the secondary LP stream which we call the suction fluid. As the combined HP and LP streams pass through the Ejector's diffuser section, the velocity decreases and the pressure is regained, resulting in an intermediate pressure, which lies somewhere between the LP and HP inlet pressures.

“ Ejectors use a high pressure fluid to compress a low pressure fluid to an intermediate pressure.

David Hoon, Director





Why choose Ejectors?

- ▶ Environmentally friendly - zero emissions
- ▶ No maintenance
- ▶ No moving parts
- ▶ Proven reliability
- ▶ Easy to install
- ▶ Simple to control
- ▶ Controlled by standard techniques
- ▶ Low cost & weight
- ▶ Robust construction
- ▶ ATEX not applicable
- ▶ Short pay-back & significantly cheaper than mechanical pumps / compressors
- ▶ Safe to operate
- ▶ Performance easily modified to suit depleting well conditions
- ▶ Can be installed in tight spaces
- ▶ Handles solids and two-phase without damage
- ▶ Top-side, sub-sea, FPSO or onshore installation
- ▶ Can be performance tested prior to despatch



'Universal Design' Ejectors

We understand that production is not always predictable. Conditions change over time and facilities need to be able to deal with this.

Ejectors are fixed-design devices. Each of our Ejectors are custom designed to perform at specific operating conditions. That's why we invented our patented 'Universal Design' Ejector.

The patented Universal Design (UD) comprises an external pressure retaining shell into which are fitted two replaceable components which give the Ejector its operating characteristics. These two components are called the nozzle and the diffuser and in the Universal Design, they can be easily changed-out with different ones in order to give the Ejector different optimum operating characteristics.

Thus, as process/well conditions change over time, the internals can be replaced with new ones which are more suited to the changed conditions.

By changing-out the internals at recommended intervals, high performance efficiency can be maintained over the lifetime of the unit, thereby maximising recovery from the LP wells and from the field.



'Universal Design' nozzle and diffuser sections designed to allow the Ejector to operate at new production conditions



Why choose Universal Design?

- ▶ For instances where operating conditions may change gradually over time (e.g. declining well conditions)
- ▶ UD pressure retaining shell can be sized to suit future operating conditions
- ▶ UD Nozzle and Diffuser internals easily changed-out to suit different operating conditions
- ▶ UD pressure retaining shell can be manufactured before operating conditions have been confirmed
- ▶ Manufacture of UD Nozzle & Diffuser can be delayed until the last few weeks of contract, when operating conditions are confirmed (e.g. when a new well is completed)
- ▶ Change-out of the new UD internals can be completed in one day
- ▶ Less risk to project if predicted operating conditions are found to be wrong, because new internals can be made relatively quickly and with no changes to associated pipework
- ▶ Easier to realise short-term well opportunities with UD design approach
- ▶ Without internals fitted, pressure retaining shell simply behaves as a piece of pipework
- ▶ Potential to relocate UD to a new site with different operating conditions and different internals



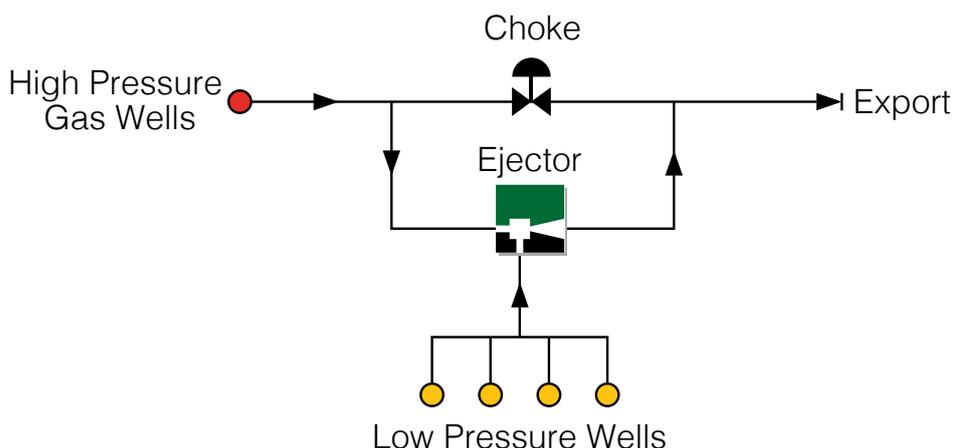
Increase recovery from LP wells - for free!

Ejectors offer an attractive solution for generating extra production from LP wells and in the process extending field life. Most commonly, shut-in or liquid loaded wells can be revived, as well as satellite or stranded wells deemed too expensive to recover with 'traditional' techniques.

In this example, gas from HP wells was being choked to a lower pressure to meet downstream process conditions. Wasting 'usable' energy in this way offers no added value to production.

Instead, the HP gas was used to 'drive' an Ejector, which not only delivered the HP gas at a suitable lower pressure to meet downstream conditions, but also lowered the back-pressure on the nearby LP wells, bringing them back to life.

The 'Universal Design' Ejector allowed for new internals to be fitted as HP well pressures declined over time, keeping the Ejector operating at the optimal design point and, as such, keeping production steady.





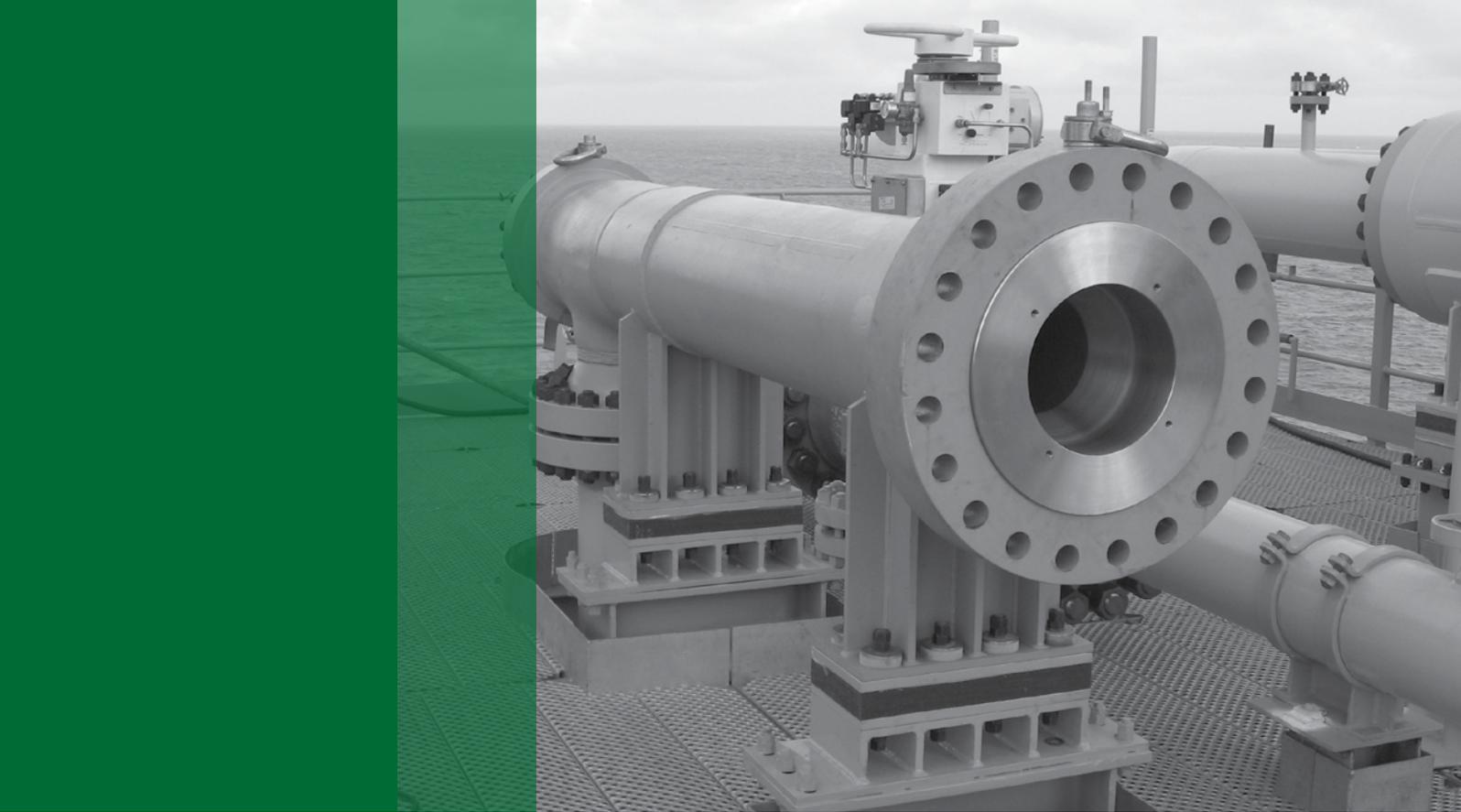
This Ejector recovered
\$127,000 per day
of extra gas from a well
that had been shut-in
for 2 years.



10,000lb rated Size 6
Universal Design Gas Ejector

Benefits

- ▶ Extra 32MMscfd of gas produced from shut-in wells
- ▶ New ejector internals fitted as well pressures declined to maximise production.
- ▶ New internals were fitted in less than one shift.
- ▶ The new internals increased production of well by 17.7MMscfd.
- ▶ Ejector has no running costs, as it utilises motive gas energy which is normally wasted across a choke valve
- ▶ Ejector requires no maintenance and produces no emissions
- ▶ Universal design allowed manufacture of new Ejector internals to be delayed until new HP well was drilled, thereby reducing project risk.



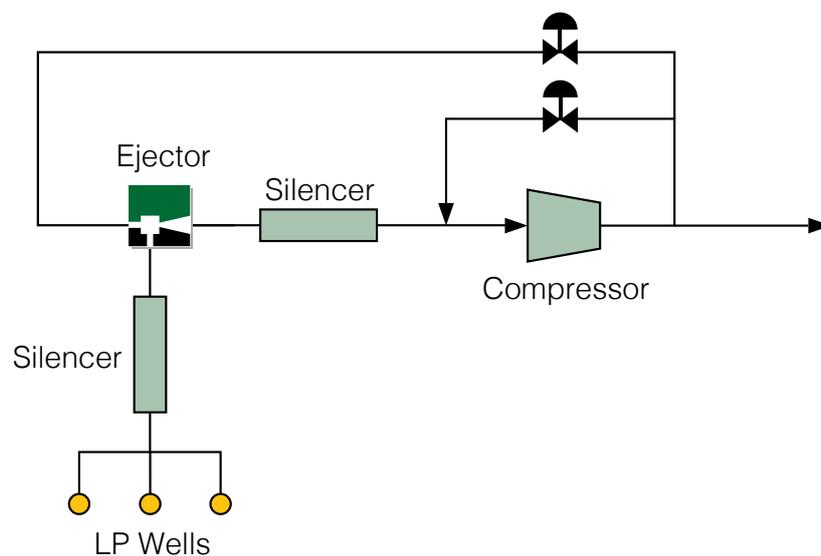
Boost production using compressor recycle gas

Many older production facilities have compressors operating in constant recycle as conditions have changed from design point and the compressors themselves are less efficient. Gas is compressed from low to high pressure then some of this is let-down and fed back into the compressor to maintain operating throughput.

By making use of this available energy to 'drive' an Ejector, back-pressure on LP wells can be reduced

by the Ejector to increase production or even restart shut-in wells.

This method of boosting production is achieved 'for free' by making use of otherwise wasted energy. In many instances significant capital savings are also made by eliminating the need for modifications of, or secondary, mechanical compressors.





“ the gas ejector gave us about a 15% increase in production and we didn't need to install the extra compressor.

- Client comment



Benefits

- ▶ Total gas production increased by 91MMscfd.
- ▶ Changeable Ejector internals allowed production to be maximised as wellhead pressure declined.
- ▶ Replaced requirement for compressor re-wheeling, saving capital and accelerating the benefit.
- ▶ Requirement for 1st stage compressor eliminated saving the client over £10m capital cost.

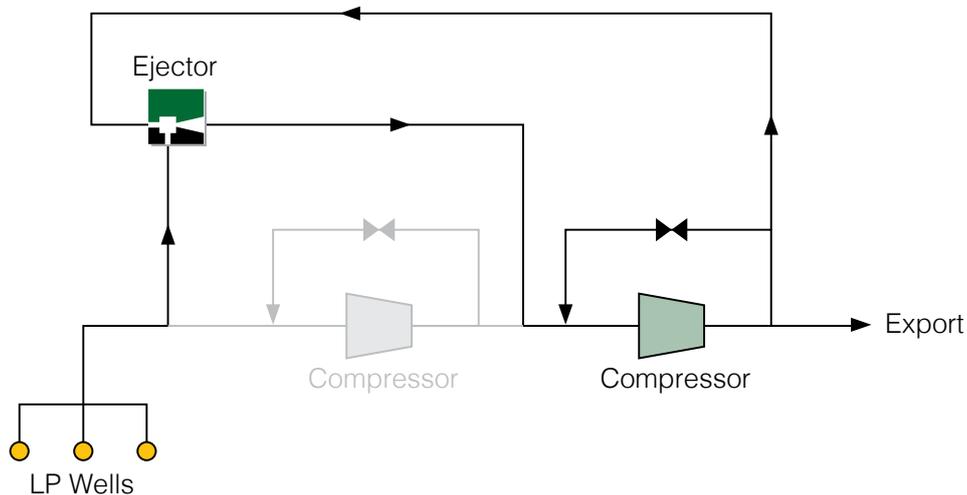


Replacing a 1st stage compressor

Ejectors can be used to completely replace existing mechanical compressors. With no maintenance and utilising available energy, this approach can often be justified on lower CAPEX and OPEX alone.

The Ejector discharges at the required inlet pressure for the 2nd stage compressor, thus completely eliminating the need for the expensive mechanical 1st stage compressor.

In this example, high pressure gas from the 2nd stage separator is used to power the Ejector, boosting the pressure of the 1st stage separator gas.





“ “ When it’s such a simple idea people often ask ‘what’s the catch?’ ...but there isn’t one, and the benefits are huge.

- Peter Ainge, Business Development Manager



Gas Ejector used to replace 1st stage mechanical Compressor

Benefits

- ▶ Flare Gas of 2 MMscfd at 1bara captured and delivered at the suction pressure of 2nd stage compressor.
- ▶ Used energy that was already available.
- ▶ 1st stage compressor was removed from service. It simplified system operation and reduced maintenance costs.
- ▶ Gas no longer burned to power this compressor.



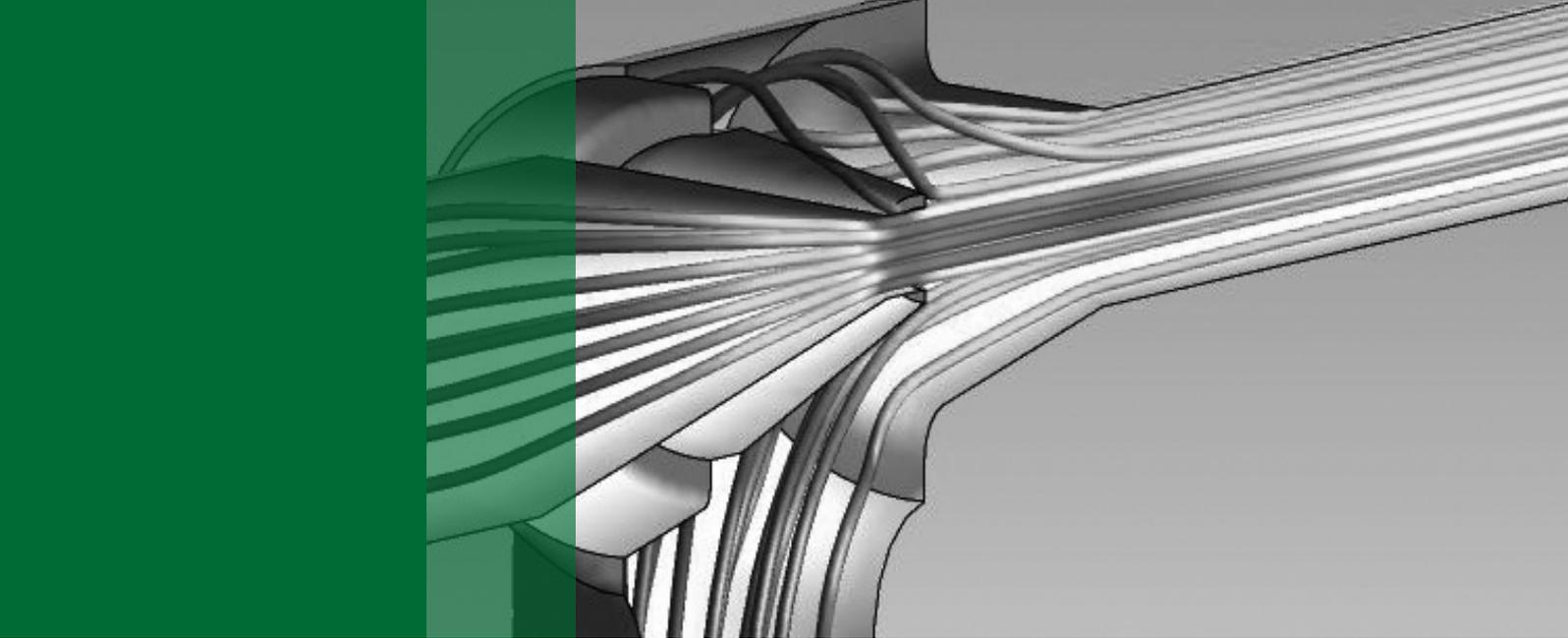
ahead of the game...

“ our latest liquid driven Ejectors offer super-high compressions to meet our clients most demanding applications

- Lilly Smith - Technical Sales Engineer



Compress low pressure gas **x150**
0 → 150 bar in one stage



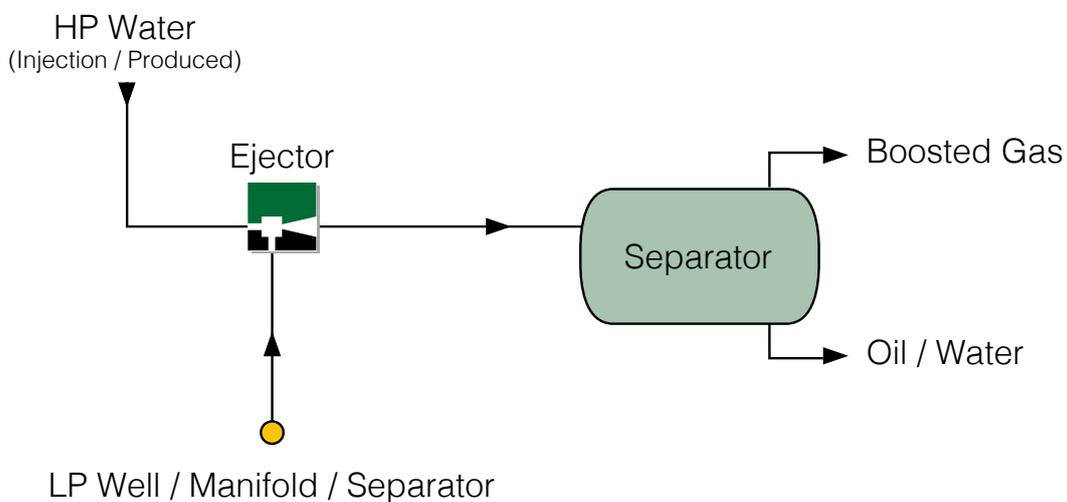
Harnessing the power of the liquid jet.

Transvac's Research and Development team have made huge advances in the efficiency and capability of liquid motivated Ejectors. Offering compression ratios of up to 150:1, these latest designs open the door to a wealth of new Ejector applications throughout the Upstream and Downstream Oil & Gas Industry.

The below diagram shows how operators can make use of this technology for enhanced recovery applications.

Typically, injection water or produced water is employed to motivate the Ejector, thus making use of existing facilities - perfect for brownfield developments.

The Ejector can entrain and compress gas from a number of sources including a separator, manifold or individual well. The resultant reduction of backpressure on the upstream process delivers a boost to production and promotes steady flow where liquid loading is an issue, particularly in long tiebacks.





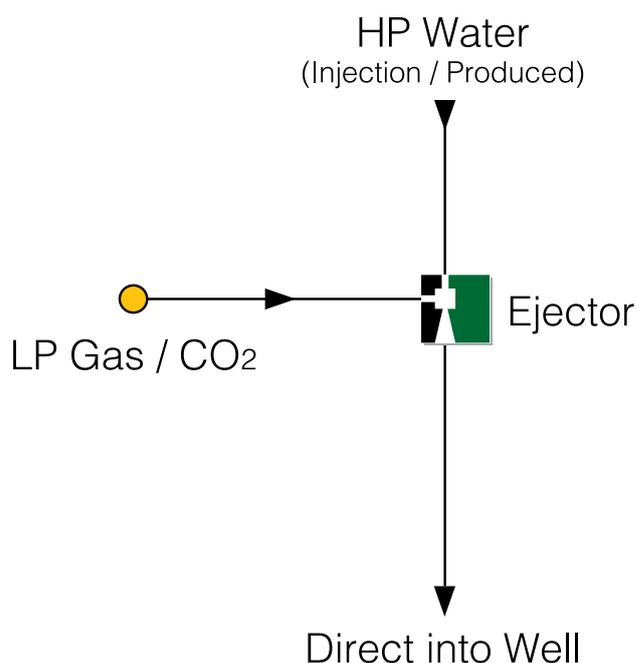
Gas Reinjection & SWAG Injection

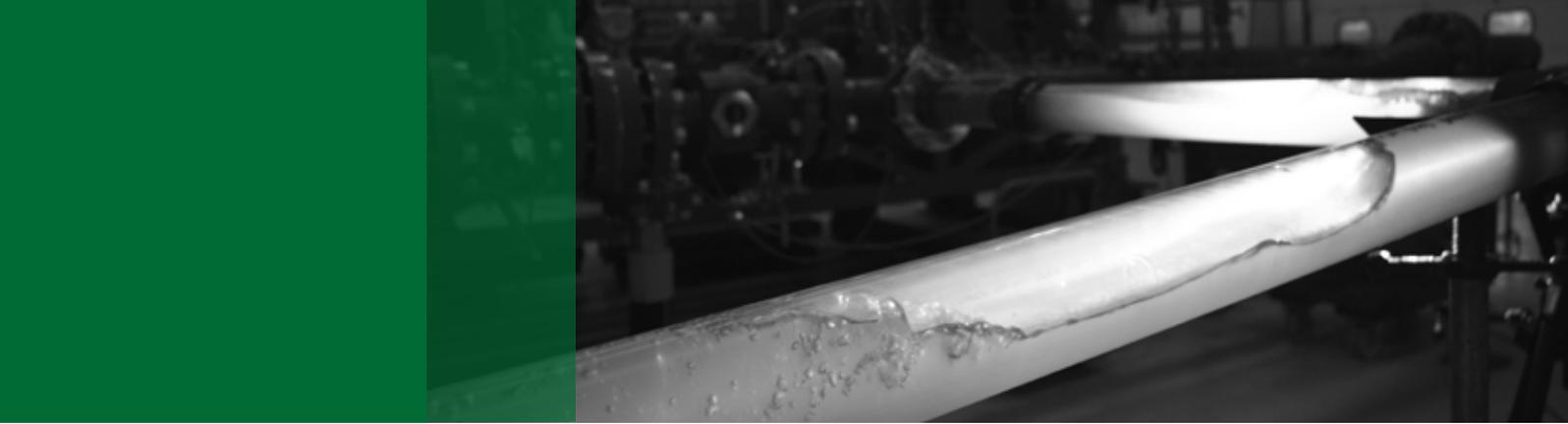
There are a number of situations in which operators require gasses to be reinjected back into the reservoir. This can include:

- ▶ Stranded gas, where there is no gas export line from oil producing fields
- ▶ Disposal of waste gases as an alternative to flaring
- ▶ Carbon Capture & Storage (CCS) / Carbon Sequestration
- ▶ Increasing reservoir pressure as part of enhanced oil recovery (EOR) process

Our new range of liquid driven Ejectors (which typically utilise injection or produced water as the motive fluid) offer high compression ratios, necessary for overcoming reservoir backpressures. SWAG (Simultaneous Oil and Gas injection) is becoming more widely used to stimulate underperforming or mature fields. In some instances this offers an additional benefit for flare gas recovery where otherwise-flared gas can be reinjected downhole.

Making use of freely-available local energy sources in this way, eliminates the need for installation of high CAPEX and OPEX mechanical gas compressors, as well as offering a simple, brownfield-friendly, retrofit solution.

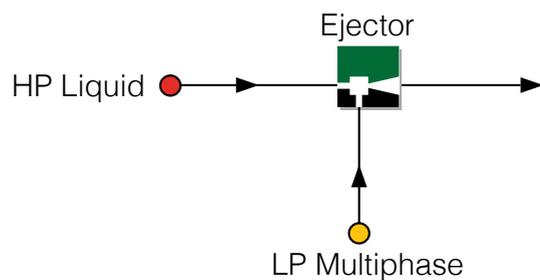




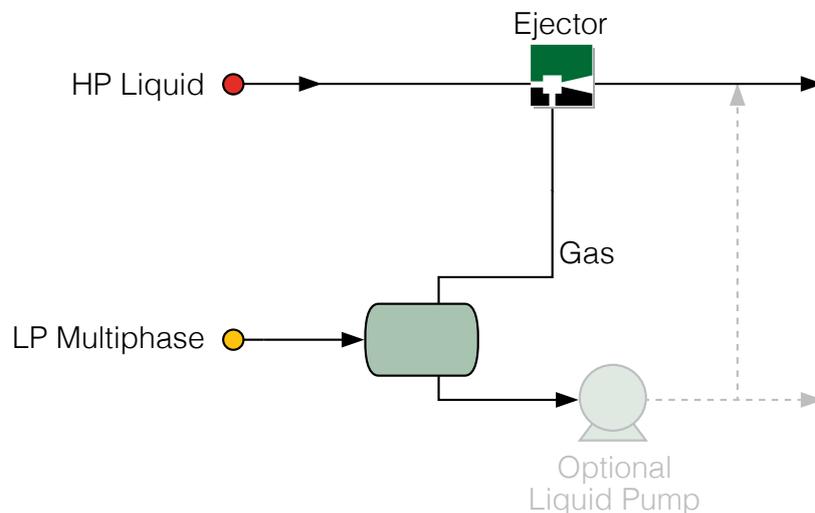
Multiphase Well Boosting Techniques

Transvac Ejectors are ideally suited for multiphase well boosting applications, where the high cost and maintenance issues associated with mechanical/rotating multiphase pumps are prohibitive.

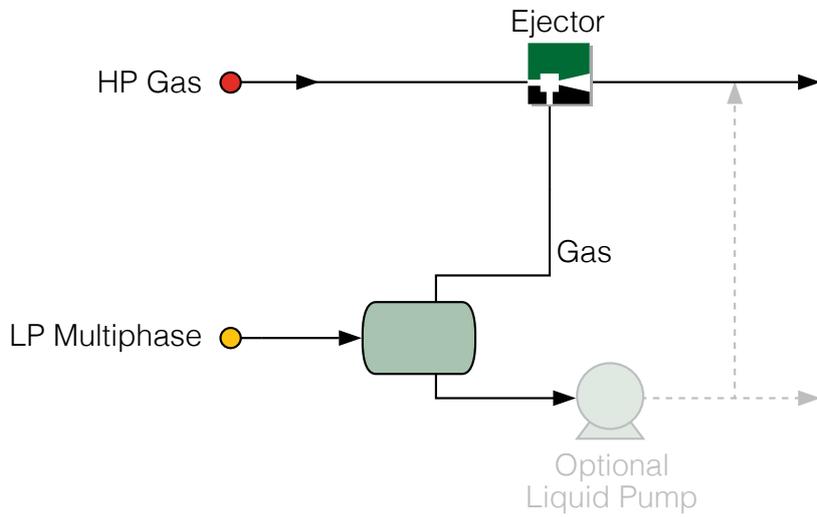
Transvac has developed a range of techniques to improve recovery rates from multiphase wells using energy from available HP liquid, Gas or multiphase streams. Below are a selection of the most common techniques:



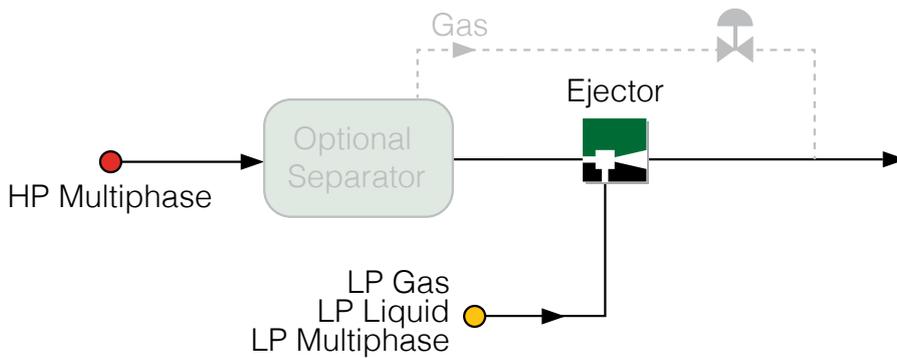
Using HP Liquid to lower backpressure on multiphase wells



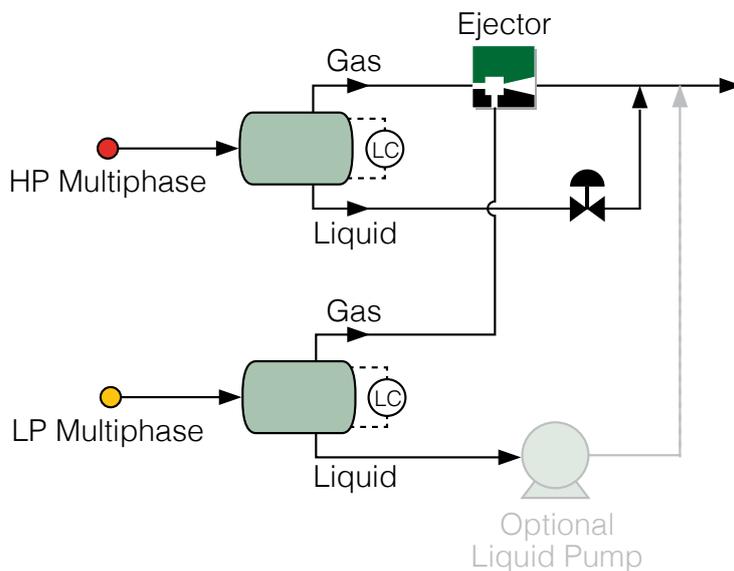
Using HP Liquid to lower separator pressure to boost inlet flow



Using HP Gas to lower separator pressure to boost inlet flow



Using HP Multiphase to lower backpressure on multiphase wells



Using HP Multiphase to lower backpressure on multiphase wells, alternative option

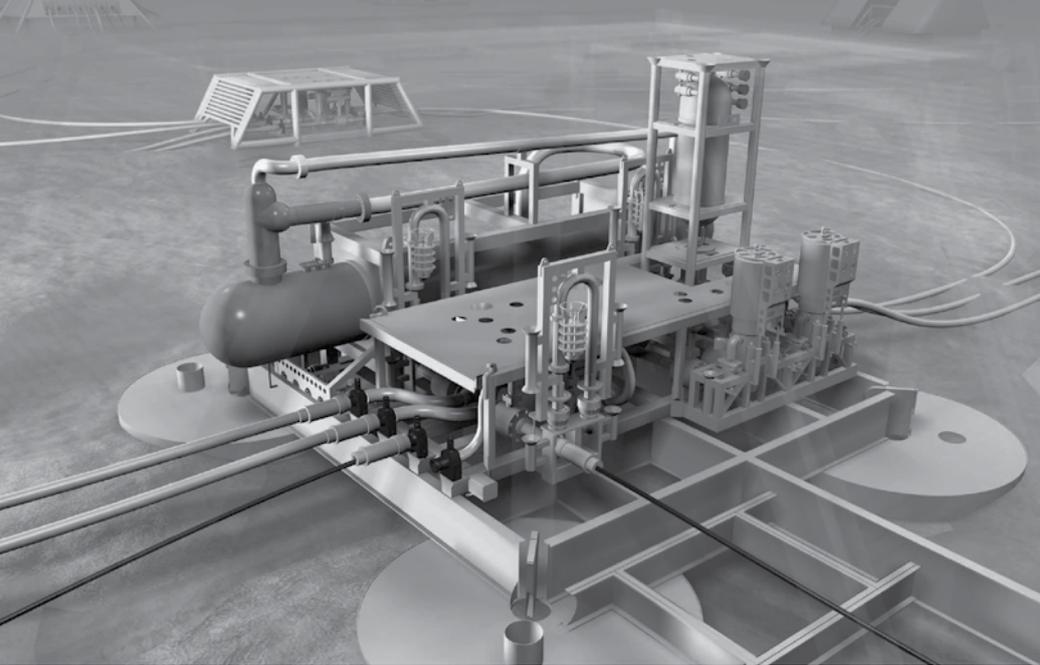


topside

“ as the industry pushes for more processing to be done subsea, many technologies fall by the wayside. With no moving parts or power requirements, ejectors are ideally suited to this challenging environment.

- Philip Ainge, Technical Sales Director

subsea



Qualified for Subsea Processing

With no moving parts and no maintenance Transvac's Ejector technology is an ideal solution for subsea processing. To ensure trouble-free operation, all Transvac subsea Ejectors are designed, manufactured and tested in-house.

Operating rotating mechanical equipment subsea requires huge amounts of energy, often megawatts of power. Ejector technology can operate using existing energy and therefore operating costs can be negligible. Rotating mechanical equipment also requires special designs for performing subsea. Ejector designs change very little whether subsea or topside.

In some applications, Ejector flows can be simply calculated using pressure drop data across the Ejector, thereby negating the need for flow metering instrumentation.

Materials of construction and mechanical design meet project specific subsea piping standards and are fully qualified. Transvac also provides ceramic nozzle and diffuser components for abrasive applications which have been proven over many years on topside applications.

Transvac supplied the world's first subsea processing Ejector on the TORDIS project for Statoil and a unique, patented multi-nozzle Ejector for Petrobras' Marlim Project.

Transvac subsea Ejectors are fully proven and qualified to TRL Level 7 for use subsea.



Subsea Ejector for Petrobras - Marlim Field
Mechanical Design: 345 barg



Subsea Ejector for Statoil - Tordis Project
Mechanical Design: 200 barg



“ we are focused on turning innovative designs into proven solutions.

- Gary Short, Design & Innovation Director



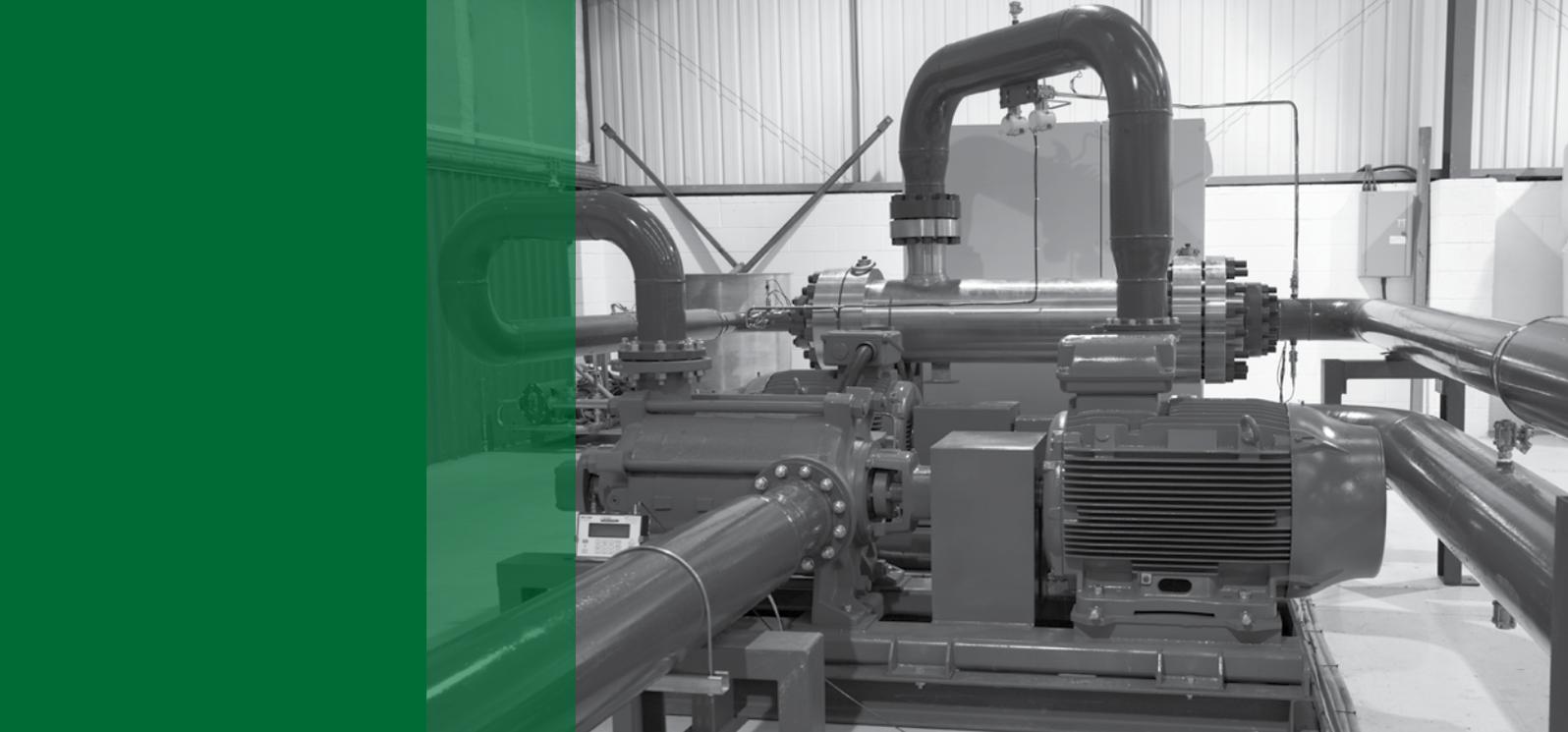
R&D Test Facility

Transvac officially opened its R&D Test facility in April 2010. The state-of-the-art test facility primarily develops new oil & gas Ejector technology for subsea processing, flare gas recovery, sand slurry pumping and enhanced recovery & production solutions.

Ejector applications for the nuclear, bio-fuel, chemical and wastewater industries are also under development.

The R&D test facility includes high and low pressure equipment for handling water, oil, gas, multi-phase and slurry. Test programmes are supported by CFD studies and include fundamental University research.

The Transvac facilities include liquid flow lines for high, medium & low pressure testing (in excess of 300 barg) and solids handling systems. A dedicated R&D team now includes 5 full-time CFD Engineers.



Test Facilities

- ▶ 9 x flow loops
- ▶ 9 x VSD water pumps
- ▶ Pump pressure up to 300 bar
- ▶ Liquid flows up to 700 m³/h
- ▶ Sand slurry flows up to 60 m³/h [up to 60% SVF]
- ▶ Nitrogen 320 barg @ 200 kg/h
- ▶ Instrument Air 12.5 barg @ 70 Am³/h
- ▶ 400 KvA stand alone generator
- ▶ Stainless Steel Test Rig - 60 m³/h up to 25 barg feed
- ▶ 2 x 9 m³ clean water tanks
- ▶ 1 x 35 m³ slurry / water tank
- ▶ 1 x 6 m³ calibrated weigh tank
- ▶ 7 x coriolis meters (liquid / gas) 1/2" to 4", 5 to 150,000 kg/h
- ▶ 1 x 16m³ 27.5 barg pressure vessel for closed loop multi-phase testing
- ▶ High pressure in-line solids / phase separator [150 barg and 100 m³/h]
- ▶ Fully automatic control and data acquisition system using ASi field bus system (LabView)
- ▶ Flow assurance : flow accuracy 0.1 - <1.0 % FS / Pressure Accuracy 0.1% or better



About Us

Transvac Systems Limited is a privately owned Ejector Solutions provider formed in 1973.

As both a designer and a manufacturer of Ejectors, Transvac has full in-house control over process and mechanical design, supply of raw materials, manufacturing, scheduling and testing. With all of our procedures certified to BS EN ISO 9001:2015 the quality of the final product is assured.

Transvac is accredited to Module H of the Pressure Equipment Directive (PED) and our products are CE marked where appropriate. We are also 1st Point Assessment (FPAL) and Achilles registered.

All products are custom designed to suit the process and mechanical requirements of each application to ensure maximum operating efficiency.

Transvac offers standard and exotic materials of construction including Hastelloy, Duplex, Super Duplex, Titanium etc.



- Quote Request
- Gas Ejector Screening**
- Gas Ejector History
- Gas Ejector History
- LIP Screening History
- Logout

Gas Ejector Screening

[Instructions](#)

Motive (HP)

Pressure Bar (a) ▼

Temperature °C ▼

Molecular Weight kg/kmol

Estimate as light hydrocarbon

Cp (if known) kJ/kg °C ▼

Cp/Cv (if known)

Discharge (MP)

Pressure Bar (a) ▼



Suction (LP)

Pressure Bar (a) ▼

Temperature °C ▼

Molecular Weight kg/kmol

Estimate as light hydrocarbon

Cp (if known) kJ/kg °C ▼

Cp/Cv (if known)

Specified Flow Rate

Suction Flow Rate ▼ kg/hr ▼

Client Reference (optional)



“ “ The online tools
give our clients direct
access to the very latest
Ejector designs.

- Jonathon Cooper, Project Engineer

Online Ejector Software

Are you missing opportunities? No longer do you need to wonder...

Transvac now offers a suite of free online Ejector software that allows access to the very latest in Ejector design. Using the screening tools, you can check to see if your application works providing valuable information such as motive flow requirements, discharge pressure or LP compression, to name a few.

A more detailed Ejector sizing program is also available, which allows for full gas composition data to be included in the calculations. Your results can be saved and a data sheet can be printed or emailed to your inbox.

If you would like access to this software, please contact sales@transvac.co.uk.



Transvac Systems Ltd., Monsal House, 1 Bramble Way, Alfreton, Derbyshire, DE55 4RH, UK
Tel: +44 (0) 1773 831100 | **Email:** sales@transvac.co.uk | **Web:** www.transvac.co.uk

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