BOC
A Linde company

Laser Gases
Supply Solutions

Complete Laser Supply Solutions

Whatever the laser and the process used, BOC can provide expert guidance and capability in laser gases to increase productivity and reduce cost. BOC has over 40 years of experience as a supplier of laser gases. We work closely with customers and laser manufacturers to improve all laser fabrication processes and support future developments. From laser cutting of thick or thin plate stainless and mild steels to welding of aluminium alloys – BOC can meet all laser customers gas requirements.

BOC helps its customers to grow by delivering, maintaining and updating tailored cost effective solutions to support their future plans.

For the Laser industry BOC has a range of solutions that provide the right combination of:

- Reduced downtime – continuous and reliable supply options and equipment
- Maximisation of laser lifetime – high purity lasing gases
- Improved productivity – a range of supply options that can meet different process requirements to give best output
- Improved quality and efficiency – the right type and purity of gas with the right supply option to give best results

Lasers explained

The word **LASER** is an acronym meaning:
Light **A**mplification by **S**timulated **E**mission of **R**adiation

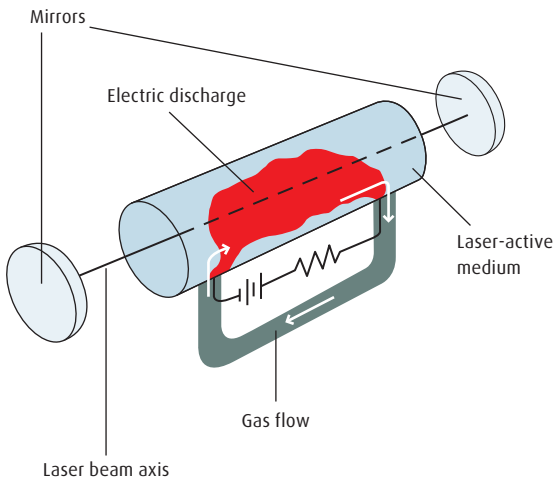
This acronym explains that a laser excites atoms, which then emit a specific kind of light - laser light. Light amplification by stimulated emission of radiation is basically a process that converts one form of energy to another. The medium in which the atoms are excited determines the type of laser light produced and the application it is used for. For industrial material processing there are four main types of laser:

- Carbon Dioxide (CO_2)
- Neodymium Yttrium Aluminium Garnet (Nd:YAG)
- Excited Dimer (Excimer)
- Fibre

Most industrial lasers need gases both to generate the laser light (lasing gases) and to assist in the process, be it cutting or welding (assist gases). All BOC laser gases are produced at ISO 9002 accredited facilities and are designed to meet and exceed the specifications of laser manufacturers.

Key elements of a laser

Whether you have a CO_2, Nd:YAG, excimer or diode laser, gases of the correct quality are important not only to maintain the lasers reliability but also to ensure the highest process productivity. The range of gases and services available from BOC has been designed to do just that.



Principal structure of a resonator (example: CO_2 laser)

Lasing gases

CO_2 and excimer lasers use gases for generating the laser beam. BOC provide a range of mixed and pure gases for lasing purposes. It is important for the purity of lasing gas to be extremely high to avoid contamination of laser components and resultant impaired laser performance. Moisture and hydrocarbons are particularly detrimental to performance of CO_2 lasers. BOC lasing gases have a high purity which exceeds manufacturer specification ensuring high reliability and maximisation of optics life. BOC supplies a variety of pre-mixed gases and an extensive range of specialist gas mixtures for all major lasers. If your mixture is not listed please contact us directly.

Lasing gas for CO2 lasers

Gas Description	Gas Contents	Pressure (bar)	Valve
Grade A Helium 99.996%	1.81m^3	200	BS3 – 5/8" BSP RH
	9.10m^3		
	194.7m^3	300	
CP Grade Helium 99.999%	1.81m^3	200	BS3 – 5/8" BSP RH
	9.10m^3		
	194.70m^3	300	
Laserpure Nitrogen 99.9992%	9.45m^3	200	BS3 – 5/8" BSP RH
Laserpure Carbon Dioxide 99.995%	35kg	50	BS8 – 0.860" RH

Premixed gases (purity 99.995% or higher)

Gas Description	Gas Contents	Pressure (bar)	Valve
Lasermix 1	0.25m^3	137	BS3 5/8" BSP RH
4.5% Carbon Dioxide, 13.5% Nitrogen, Balance Helium	1.25m^3		
	8.8m^3	200	
Lasermix 2	1.26m^3	137	BS3 5/8" BSP RH
9% Carbon Dioxide, 13.5% Nitrogen, Balance Helium	8.88m^3	200	
Lasermix 3	1.26m^3	137	BS3 5/8" BSP RH
12% Carbon Dioxide, 12% Nitrogen, Balance Helium	8.95m^3	200	
Lasermix 4	1.82m^3	200	BS3 5/8" BSP RH
5% Carbon Dioxide, 40% Helium, Balance Nitrogen	8.95m^3		
Lasermix 5	8.78m^3	200	BS3 5/8" BSP RH
3.4% Carbon Dioxide, 15.6% Nitrogen, Balance Helium			
Lasermix 6	7.69m^3	200	BS4 5/8" BSP LH
8% Carbon Dioxide, 4% Carbon Monoxide, 60% Nitrogen, Balance Helium			
DC Premix for Rofin Sinar Laser	1.35m^3	150	DIN1 21.8mm LH

This is only a small sample of premixed laser gases available from BOC, please contact us directly to discuss your specific requirements.
BOC is an approved supplier for the Rofin DC premix. Only Rofin approved suppliers are permitted to provide this product.

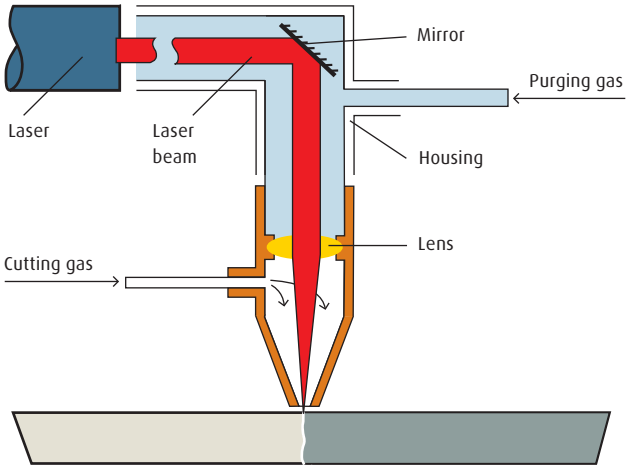
Lasing gases for excimer lasers

Gas Description	Gas Contents	Pressure (bar)	Valve
5% Fluorine, Balance Helium	1.17m^3	134	DIN 8 1" RH
5% Hydrogen Chloride, Balance Helium	1.16m^3	137	BS14 3/8" BSP RH
5% Hydrogen Chloride, 1% Hydrogen, Balance Helium	1.38m^3	150	BS15 3/8" BSP LH

BOC provides a range of lasing gases for use with excimer lasers. The lasing gases consist of a halogen donor; a rare gas buffer and inert gas dilutent. Rare gases (neon, krypton and xenon) in pure form or as a mixture to your own specification are available from BOC.

Assist gases

Assist or process gases are used at the point where the laser interacts with the material. The choice of assist gas is extremely important and can have a significant effect on the process quality and productivity.



Laser cutting uses the intense light beam from a laser to melt and/or vaporise material, and an assist gas flowing at pressure through a nozzle to remove the molten or vaporised material. One of the determining factors of the cutting speeds achievable is the laser power. The purity of assist gas used, the supply pressure and flow rate are also important for attaining required cutting speed and quality for specific material thickness. Laser nozzle standoff distance and nozzle diameter affect the gas supply requirements. The main gases used for cutting are oxygen and nitrogen, while special applications may require argon.

- → When cutting mild steel, using oxygen can enable cutting at higher speeds and greater thickness at lower pressure and flow rate than nitrogen
- → Nitrogen and other inert assist gases prevent surface oxidation producing a higher quality finish requiring minimal preparation for other fabrication processes (such as welding) and surface treatment

Lasers can cut a wide range of materials including ferrous and non-ferrous metals, plastics, wood and ceramics. The choice of assist gas depends on the material being cut.

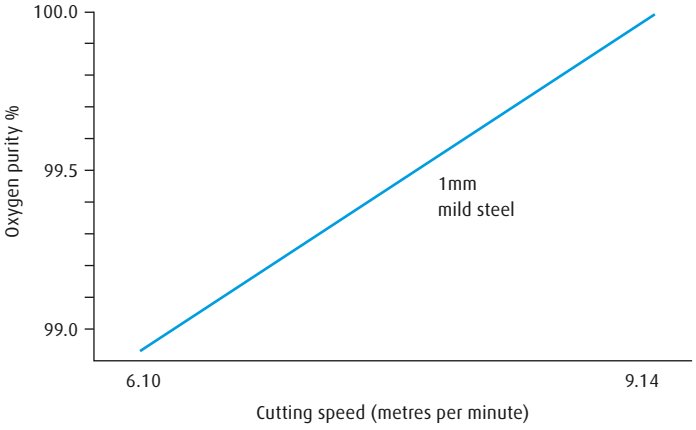
Assist gases for laser cutting

	Oxygen	Oxygen (High purity)	Nitrogen	Argon
Mild steel	●	●	●	
Stainless steel	●	●	●	
Aluminium			●	
Titanium				●
Copper	●	●		

*Nitrogen or compressed air is normally used for cutting non-metallic materials.

For improved cut quality when using oxygen to cut greater material thickness it is recommended that oxygen pressure be reduced to avoid overly high temperatures and burning effects. When cutting with nitrogen increased pressure is required to cut larger material thickness.

Effect of oxygen purity on cutting speed

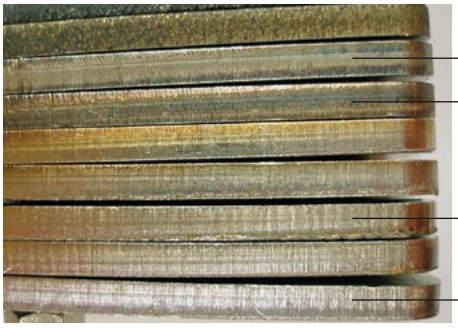


Nitrogen purity

A higher quality finish can be achieved with high purity nitrogen.

→ Compressed industrial nitrogen 99.998%

→ Liquid nitrogen 99.999%



Oxidation of the cuts is evident at 100 ppm purity.
The edge becomes rough at 0.1% purity (1000 ppm).

Laser assist gases for welding

Laser welding is increasingly being used in industrial production as it offers many benefits over resistance welding. These include low distortion (due to low heat input), high welding speed, high quality weld properties and enables complex weld geometries to be achieved. A laser welds by focusing its high energy light beam to melt metal forming a strong joint between components. Assist gas for laser welding is used to shield the molten weld pool and surrounding metal from the atmosphere, therefore inhibiting oxidation and suppressing plasma formation. Shield gases can also support the stability of welding conditions and improve the mechanical properties of the weld. In addition, the assist gas shields the focusing optics of the laser from being damaged by proximity to the process.

The choice of assist gas can have a significant effect on both the weld quality and the process productivity. The main assist gases that are supplied are helium and argon, although for specialised applications, mixtures may give enhanced performance. BOC technical specialists will be able to advise on the best solution for any specific application.

Gases for laser welding

	Helium	Argon
CO_2	●	●*
ND:YAG		●
Fibre	●**	●
Diode		●

* Suitable for low power, thin sheet welding applications. ** Seek BOC advice.

Focusing on laser technology

BOC acknowledged the importance and growth of laser technology early on and has been working with laser users and manufacturers for many years, developing new products and processes to increase quality and productivity.

As a part of The Linde Group, BOC has a global network of process experts and close links with worldwide research establishments and academia. Furthermore BOC now benefits from unprecedented access to The Linde Group laser research and development facility in Unterschleissheim, Germany. BOC experts have a wide range of experience covering all the key lasers, materials and processing applications. Process knowledge spans from high speed ‘clean cutting’ of thin section stainless steel up to thick section laser cutting (>50mm) of mild steel, and new processes for laser welding and surface treatment. The expertise of BOC is available at all times to advise and support customer operations.

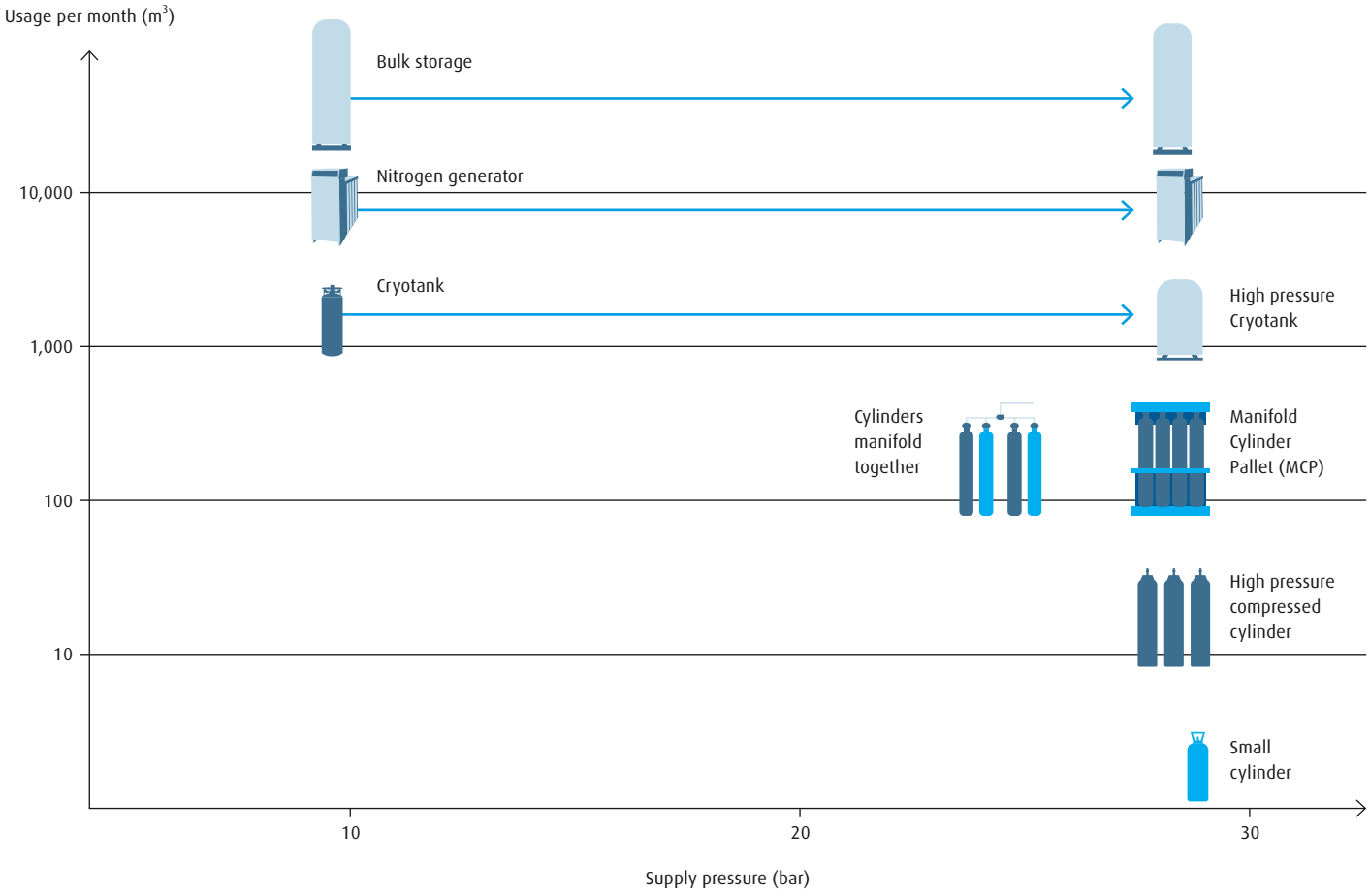
The Right Supply Option Can Reduce Cost and Increase Performance

BOC has a complete range of gas supply options available that include single cylinders, liquid supply and on-site generation. Whatever the key drivers are behind the supply of gas – be it process, quality, productivity or cost – BOC can provide advice and guidance on selecting the most effective solution. BOC remains committed to developing and tailoring its services to customers, now and in the future, to help support increased productivity and growth.

Lasing gases are frequently required in smaller quantities and therefore are usually purchased in cylinders. Assist gases are used as part of the process and therefore much larger amounts are needed. The selection of supply modes is of particular importance for assist gas usage and will be influenced by the particular requirements of the process being used.

BOC is uniquely positioned in being able to provide an objective evaluation of all potential gas supply solutions. The chosen supply scheme can be tailored depending on the purity, pressure and flow rates required, taking into account the specific application and the constraints of the working environment.

Choosing the right gas supply (illustration only)



Compressed cylinders

BOC supplies the most extensive range of gases used in the laser industry and ranges from high purity gases for mixing by the laser to pre-mixed gases bespoke to particular OEMs. They can be used as a supply of assist gas but are more commonly used as lasing gases.

Manifold Cylinder Pallets (MCPs)

MCPs typically contain 15 cylinders providing a single source of gas.

- Compact, providing increased storage capacity
- Significantly reduced cylinder handling costs
- Enables immediate supply set up with a high flow regulator
- Available for most pure gases and gas mixtures

In addition to the standard range of gases. BOC provide 300 bar nitrogen MCPs, providing 30% more product than that of 230 bar nitrogen cylinders. This provides opportunities for process improvements, increasing efficiencies and improved cylinder management. The 300 bar nitrogen MCPs use NEVOC outlet connection adapters.

MCPs are recommended for low volume users requiring flexible supply and as a back up for other solutions. With effective stock management MCPS can provide a continuous cost effective solution.

Product	Pressure (bar)	Volume (m^3)
Oxygen	230	166
Nitrogen	230	147
	300	192

High flow regulator panel

This innovative product from BOC has been designed specifically for laser customers using MCPs. It is a portable unit with two inlets capable of attaching to one or two MCPs.

- Allows immediate set up of an assist gas supply
- Is compatible with both 230bar and 300bar nitrogen MCPs
- Includes two inlets and a high performance regulator allowing high flow and high pressure capability
- Enables two MCPs to be connected giving increased gas storage capability

The high flow regulator panel is recommended for new customers requiring the immediate supply of assist gas to commission the laser and start production allowing time to assess supply needs before selecting the most effective longer-term supply mode. It can also be used as a high flow, high pressure supply for occasional use in cutting large thickness material with nitrogen assist gas (usually 6mm and above stainless steel).

The high flow regulator panel

Supply pressure	Up to 32 bar
Max flow rate	Up to 200m^3/hour*

*When connected to two MCP outlets

Cryogenic Supply

Gas is stored in liquid form in cryogenic vessels supplied by Cryospeed and is converted into gaseous form for use as a laser assist gas. Cryogenic vessels are available for argon, oxygen and nitrogen in a range of sizes and pressures suitable for laser applications:

- Medium pressure (up to 16 bar) – for argon, oxygen and nitrogen
- High pressure (up to 24 bar) – for argon, oxygen and nitrogen
- Ultra high pressure (up to 35 bar) – for nitrogen only

Advantages of cryogenic liquid supply:

- High purity gas supply
- Eliminates manual handling of cylinders
- Supply pressures of up to 35 bar are available
- Smaller footprint than the equivalent number of compressed cylinders
- Vessels can be manifolded together to increase storage capacity and flow rates

Cryogenic vessels are more cost effective than MCPs for laser users requiring continuous, flexible, low to medium gas flow rates. High pressure vessels are suitable for higher volume higher flow rate requirements such as stainless steel cutting.

Medium to high pressure vessels (up to 24 bar)

- Available for argon, oxygen and nitrogen
- Filled on site providing a continuous product supply with no process interruption
- Can be manifolded together to increase storage capacity
- Vessel maintenance requirements included in rental agreement with BOC
- Quick and easy installation for start up
- Flow rates can be changed depending on vaporiser used

Medium to high pressure vessels (up to 24 bar)

	Cryotank 200	Cryotank 230	Cryotank 950	Cryotank 2000
Liquid capacity	200 litres	230 litres	950 litres	2000 litres
Nominal gas capacity	Argon 164m^3	Argon 190m^3	Argon 784m^3	Argon 1652m^3
	Oxygen 168 m^3	Oxygen 194m^3	Oxygen 801m^3	Oxygen 1686m^3
	Nitrogen 136m^3	Nitrogen 157m^3	Nitrogen 641m^3	Nitrogen 1350m^3
Max allowed working pressure (medium pressure vessel)	16 bar	16 bar		
Max allowed working pressure (high pressure vessel)	23 bar	24 bar	24 bar	24 bar
Flow rate*	Argon 9m^3/hour	Argon 11m^3/hour	Argon 25m^3/hour	Argon 25m^3/hour
	Oxygen 10m^3/hour	Oxygen 11m^3/hour	Oxygen 25m^3/hour	Oxygen 25m^3/hour
	Nitrogen 11m^3/hour	Nitrogen 11m^3/hour	Nitrogen 25m^3/hour	Nitrogen 25m^3/hour
Duty cycle	8 hours	8 hours	8 hours	8 hours

*Flow rate shown are for stated duty cycles and standard vaporiser

Ultra high pressure vessels (up to 35 bar)

	Cryotank 950	Cryotank 1500	Cryotank 2000
Liquid capacity	950 litres	1500 litres	2000 litres
Nominal gas capacity	Nitrogen 641m^3	Nitrogen 1013m^3	Nitrogen 1350m^3
Max allowed working pressure	32 bar	32 bar	32 bar
Flow rate*	Nitrogen 25m^3/hour	Nitrogen 100m^3/hour	Nitrogen 100m^3/hour
Duty cycle	8 hours	8 hours	8 hours

*Flow rate shown are for stated duty cycles and standard vaporiser

Cryospeed from BOC

With Cryospeed, BOC has been designing and developing cryogenic gases, equipment and applications for over forty years. Liquid product is delivered into the cryogenic vessels directly on customer sites reducing the hassle and manual handling incurred during cylinder change over.

Delivered by the largest mini-bulk fleet in the UK and Ireland, Cryospeed can be found in more places more often than any other supplier. Our operators will deliver your product without assistance and have the experience and flexibility to provide true security of supply.

Most Cryospeed customers rely on the simplicity and security of our scheduled delivery service. Our operators are experts in understanding customer usage patterns and adapting to changing requirements, so they'll look at your demand and schedule regular deliveries to ensure security of supply.

As a BOC customer, you'll have a dedicated Cryospeed operator who'll not only deliver your product when you need it, but will be a regular point of contact. You'll even get their mobile number.

Bulk delivery service

For laser customers with high gas volume requirements a bulk cryogenic storage vessel can be installed on site. Through our extensive national distribution network we can supply bulk gases whenever and wherever required. Our dedicated Delivery Planning Centre can offer you a flexible range of supply options to fit in with your business and ensure that your supply is maintained at all times. Utilising the BOC Tel-Tank system, means BOC can monitor your product usage remotely and schedule deliveries accordingly. BOC has an extensive range of bulk vessels available in different capacities and supply pressures.

Advantages include:

- → High purity gas
- → Supply can be managed by BOC
- → Ability to run multiple lasers from one supply source
- → High pressure vessels offer high flow nitrogen with near continuous operation through well planned delivery scheduling

Bulk vessels are the most cost effective cryogenic solution for continuous medium pressure, high volume supply. High pressure vessels require the pressure to be reduced for filling but offer a cost effective solution for processes requiring increased supply pressure.

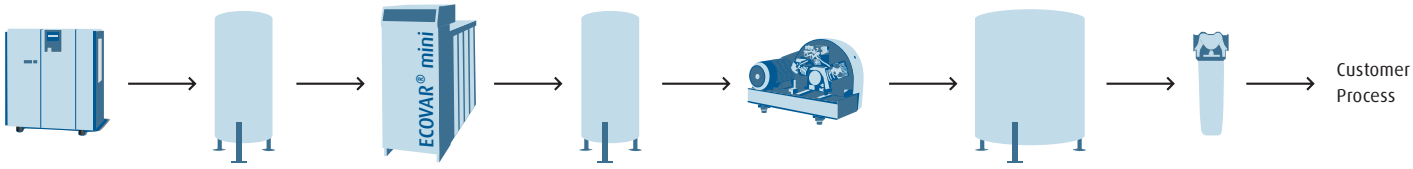
On site nitrogen generation

BOC's on-site nitrogen generation solution provides a continuous, independent and reliable gas supply. From commissioning to installation, BOC provides a turn key solution; including service, maintenance and backup alternatives to ensure security of supply and peace of mind.

- Purity up to 99.999%
- Flow rate: up to 90m^3/h, this can be increased by using multiple generators
- Supply pressure: up to 35 bar (g)

Nitrogen on-site generation is based on the pressure swing absorption (PSA) process which separates nitrogen from air by preferential adsorption/desorption of oxygen and other gaseous atmospheric components. Adsorbers with a proprietary multi-layered bed system, when pressurised with air, adsorb oxygen and permit nitrogen to pass through as product. Before becoming saturated with oxygen, the adsorber bed is regenerated by reducing the pressure, which releases the oxygen-enriched waste gas to vent.

- Turn key solution including delivery, commissioning and installation of the equipment in a suitable area
- Flow rate and purity are permanently monitored to guarantee the system is performing according to the process requirements
- Equipment is CE marked and installation complies with legislation (PED and PSSR)
- BOC provides in-depth training for safe operation
- Preventive and corrective maintenance, including spares and replacement parts
- Backup alternatives supported by BOC's product availability and security provided by a nationwide network of engineers
- 24 hour UK based emergency contact number



An air compressor module including fridge dryer and oil scrubbers ensure that the PSA receives clean and dry compressed air for an optimum operating effieciency.

An air receiver is used to meet peak demand during the PSA cycle and to properly match air supply to varying PSA demands.

The PSA module separates the nitrogen from the compressed air at the required flow rate. An internal sensor maintains the required purity.

Nitrogen feed buffer receives the nitrogen product from the PSA and provides a steady supply for the booster.

Booster compresses the nitrogen to a pressure ready for use according to the customer's requirements.

High pressure buffer stores the generated nitrogen to smooth fluctuations in demand for gas and to ensure that the required flow rates can be met.

Post booster oil filtration removes any residual oil vapour that may have contaminated the nitrogen from the booster. Not required if oil free booster used.

High quality laser gas control equipment

BOC produces a range of laser gas regulation equipment which is carefully designed and engineered to meet or exceed the high quality standards specified by today's laser manufacturers. It is important that the correct equipment is used. The BOC assist gas regulators are engineered to match both flow and pressure requirements and are tailored to the gas supply mode recommended for you. BOC's lasing gas regulators contain stainless steel diaphragms, which help prevent contamination of the laser resonator, maximising laser performance. Our range of gas control equipment ensures that the purity of the gas you use is maintained from point of delivery to point of use.

Laser assist gas equipment

Multi-stage Oxygen regulator – Series 9500

Benefits and features

- For oxygen use
- Constant and accurate delivery of the required pressure of gas
- Accurate performance up to 10 bar
- No need for continuous re-adjustment
- Two stage pressure reduction for precise pressure control independent of cylinder content
- Extra sensitive neoprene diaphragms for quick response to changes in pressure
- Chrome-plated forged zinc bonnet for maximum durability

Performance

Maximum inlet pressure: 300 bar
Outlet pressure: 0–10 bar
Max outlet flow (at 150 bar): 72m^3/hour

High pressure nitrogen regulator – Series HP Multi Stage

Benefits and features

- For nitrogen use
- Provides precise control of high pressure nitrogen supply
- Constant and accurate delivery of the required pressure of gas up to 42 bar
- Stainless steel diaphragms on first and second stage
- No need for continuous re-adjustment
- Designed to give adequate dissipation of any cooling as result of the pressure reduction of the gas

Performance

Maximum inlet pressure: 300 bar
Outlet pressure: 0–42 bar
Max outlet flow (at max pressures): 320m^3/hour

Lasing gas equipment

Wall mounted regulators and changeover manifolds

Benefits and features

- For 'Laserpure' gases, helium lasing gases and laser mixtures
- Wall mounting of equipment using backing panels provides ergonomic and safety benefits when compared with cylinder mounted equipment
- Automatic changeover manifold for continuity of gas supply
- Effective two stage regulation for precise outlet pressure control independent of cylinder contents
- Stainless steel diaphragms on first and second stages to minimise inboard diffusion of atmospheric contaminants
- Interstage relief valve
- Flexible hoses with stainless steel lining to maintain gas purity
- Connection to cylinders via flexible hoses with non return valves to minimise ingress of impurities at cylinder change

Performance

Maximum inlet pressure: 230 bar (300bar options available)
Changeover pressure: nominal 14 bar
Outlet pressure: 0–10 bar (other ranges available)
Max outlet flow (at max pressures): 16m^3/hour
Operating temperature: -20°C to +60°C

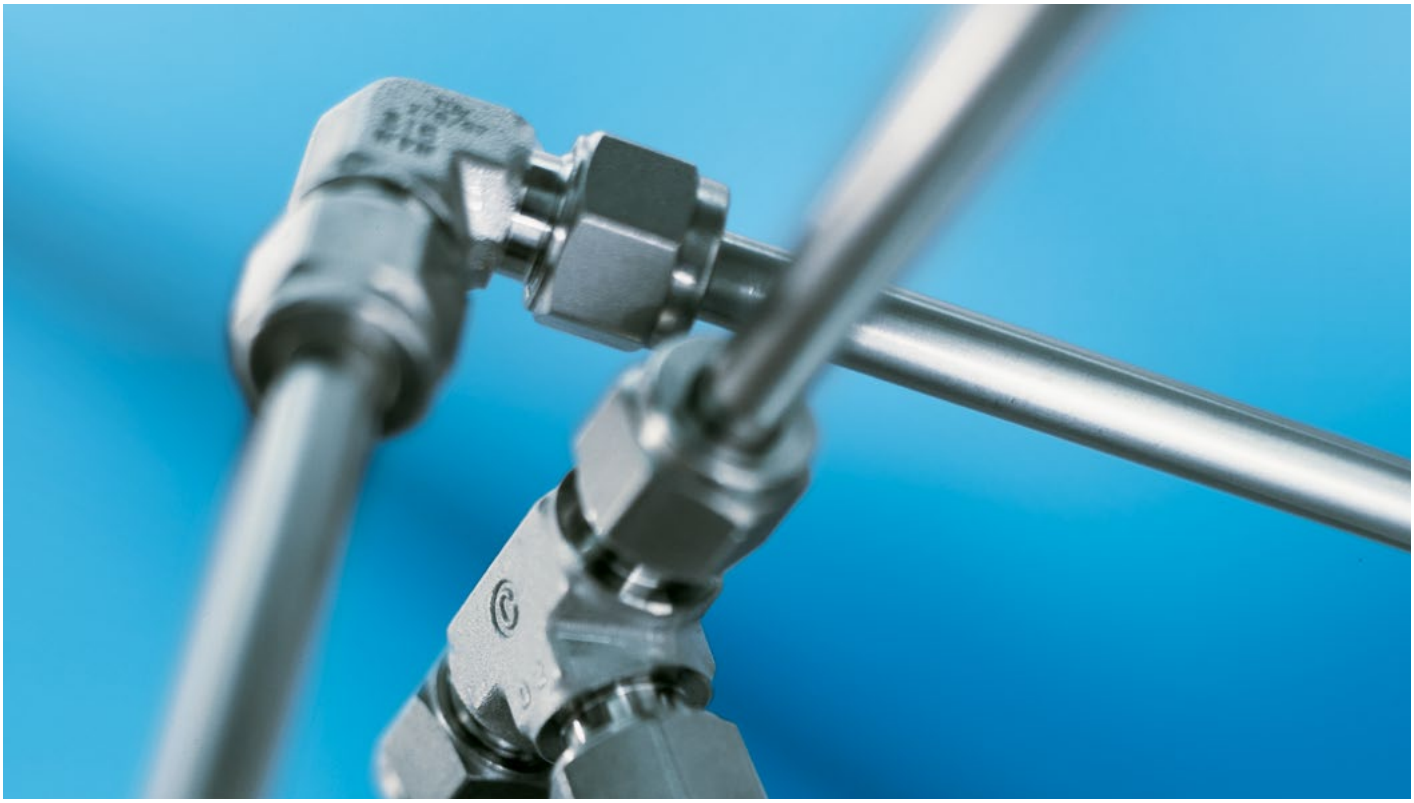
C106X/2B – The high purity regulator

Benefits and features

- For 'Laserpure' gases, helium lasing gasses and laser mixtures
- Chrome plated brass body for improved purity
- Two stage pressure reduction for precise outlet pressure control independent of cylinder contents
- Stainless steel diaphragms on first and second stages to minimise inboard diffusion of atmospheric contaminants
- Capsule seat with integral 10 micron filter for increased reliability
- Interstage relief valve
- Side inlet connection to provide correct orientation with laser gas cylinders
- Wide choice of outlet pressure ranges to closely match application
- Wide choice of outlet fittings to match outlet tubing removing the use of adaptors
- Custom options including panel mounting

Performance

Maximum inlet pressure: 230 bar (300 bar options available)
Outlet pressure: 0–10 bar (other ranges available
Max outlet flow (at max pressures): 16m^3/hour
Operating temperature: -40°C to +60°C



Customer Engineering Services

At BOC we bring together the experience, technology and people to offer customers unrivalled capability in design, engineering procurement, project management, gas supply equipment and process control. We can support you at every stage of your operation, from engineering design to installation, start-up to routine operation, maintenance and emergencies. We offer the full choice of standard and customised gas, cryogenic and safety equipment including vessels, vaporisers, regulators, manifolds, valves and purging systems. And to ensure that you're operational and legal at all times, we will advise you on the most suitable maintenance package for your business.

OnStream from BOC

BOC recognises that safety is the top priority and complying with safety legislation such as Pressure Systems Safety Regulations 2000 (PSSR) can be complex and time consuming. We understand exactly what's required to conform to PSSR legislation and have developed our OnStream service to help you achieve full compliance.

BOC's OnStream service is available for fixed pressure systems ranging from simple systems with a single regulator and short distribution pipework to longer, more complicated systems with many control and outlet points. Even if your equipment is currently in poor condition, we can help you achieve proper system safety and hassle free PSSR compliance whilst allowing you to concentrate on your core business.

System design and installation

Our engineers will work with you to design a gas distribution system that meets your specific needs. We will ensure that it's installed efficiently and a series of rigorous operational and safety checks will be carried out to ensure it meets industry regulations and legislative requirements.

Breakdown response

We want to make sure that you're operational at all times. So if a problem arises, our engineers are equipped with the experience and tools to respond to breakdowns of both BOC and, by agreement, customer-owned equipment. If the problem can't be resolved over the telephone, we'll arrange a site visit.

BOC is a Linde company, the Leading Global Gases and Engineering Business with a Mission to Make the World More Productive

We are the UK and Ireland's largest provider of industrial, medical, and special gases as well as related equipment, engineering services, and solutions to support them.

We produce, package, and distribute thousands of different types of gases to our customers every day. Our unrivalled range includes atmospheric gases, high purity gases and mixtures, refrigerants, and chemicals, for applications as diverse as cooling magnets in hospital MRI scanners to fuelling zero emissions vehicles and much more.

BOC offers tailored supply solutions for every size of customer; our cylinder customers enjoy a nationwide delivery and collection network; bulk customers the reassurance of 24/7 delivery; and for our high-demand customers we offer onsite production or dedicated pipeline supply.

And all of this is backed up by industry leading customer service, expert technical support and best-in-class levels of safety and environmental performance – the basis on which we have earned our reputation as a reliable and trusted partner.

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