DRIVING EXPANDER TECHNOLOGY



Atlas Copco Gas and Process Solutions

Atlas Copco

تاسیس ۱۳۶۲
جهان کمپرسور
خدمات مستمر
Jahan Compressor
Since 1983



Driving Expander Technology

Atlas Copco Gas and Process is continuously working to improve and extend the capabilities and performance of radial in-flow turbines, or turboexpanders. As a market leader for this technology, we see it as our responsibility to help our customers achieve superior productivity in their processes.

To achieve this goal, we foster innovation and engage in a close dialog with our customers early in the design process. With thousands of our machines in operation worldwide, we are your ideal partner to drive turboexpander technology further.

Building Productive Partnerships

When you choose Atlas Copco turboexpanders for your process, you initiate a continuing partnership that extends well beyond design, delivery, and installation. From project initiation through design, delivery, and commissioning, total quality management is fundamental to every Atlas Copco project.

Utilizing our worldwide manufacturing and packaging facilities, we provide the highest quality in the custom-engineered turbomachinery world.

Even after our machine is operating in the field, we maintain our commitment to this partnership: through the support provided by Atlas Copco's global sales engineers, and the facilities and personnel of Atlas Copco service centers. These centers offer timely support for scheduled and emergency services, 24 hours a day.



Here's an overview of our turboexpander technology:

- Custom-engineered solutions designed to fit your application
- High efficiency
- Robust construction
- Wide operational range
- Highest quality
- Reliable performance
- Thousands of references worldwide

Exponential Expander Power

Even years after the acquisition of Mafi-Trench Corporation (MTC), Atlas Copco Gas and Process is proving time and again that it is one of the world's premier turboexpander technology companies.

Here's a look at the two companies' histories and pedigree:

Atlas Copo Energas

- Located in Cologne (Germany)
- Began in 1936 as the KT Division of Linde AG
- Has designed, manufactured, and commissioned thousands of turboexpanders
- Market leader in turboexpander technology, especially in air separation and integrally-geared applications

Atlas Copco Mafi-Trench Company LLC

- Located in Santa Maria (USA)
- Has produced more than 700 hydrocarbon turboexpanders since 1975
- Known as the preferred supplier of hydrocarbon turboexpanders to the world for more than 35 years
- Global leader in large single-stage high-horsepower applications

"We foster innovation and engage in a close dialog with our customers to achieve sustainable productivity."

Industrial Gases

In the industrial-gas industry, efficiency is key. Our expanders boost productivity and maximize cold power for your plant.

Our solutions for the industrial-gas market are designed with increased customer value in mind. Compact and highly efficient designs provide our customers with advantages in their process operations.

Our expander design is simple and provides even and efficient air inlet and outlet. Furthermore, innovative insulation is employed at the expander casing and various other locations within the machine, achieving optimal results.

We were, after all, the first expander manufacturer that successfully employed dry-gas seals in cryogenic applications. In the bigger picture, our solutions help generate superior cooling capacity in cryogenic processes and subsequently a greater product yield in your industrial-gas process.

Atlas Copco turboexpanders maximize cold power for your plant and are simple to install, operate, and maintain. We also provide compressors for air-separation plants, giving customers a complete turboexpander solution.

"The highly efficient Atlas Copco turboexpanders minimize energy consumption."



Single-stage ETB 190 NS



Oil and Gas

Our expanders offer a host of reliable solutions that support every link in the hydrocarbon value chain.

In the oil and gas business, performance and reliability are the name of the game. That's why all of our solutions are created to ensure the highest reliability and satisfy your requirements. Incorporating the latest technology, our aerodynamic designs maximize machinery performance without sacrificing dependability.

Custom-engineered solutions for the oil and gas industry are designed to meet a wide variety of customer requirements and provide many years of reliable service.

Hydrocarbon applications:

- Liquefied Petroleum Gas (LPG)
- Natural Gas Liquids (NGL)
- Dew-point Control (DPC)
- Liquefied Natural Gas (LNG)
  - Base load / peak shaving
  - FPSO – FLNG
  - Regasification
- Nitrogen rejection

"When you choose Atlas Copco Gas and Process, you choose technology solutions that satisfy your process requirements."



Expander compressor with magnetic bearings for a gas-processing plant in Saudi Arabia



(Photo: Kjetil Alsvik – Statoil)

Chemical / Petrochemical

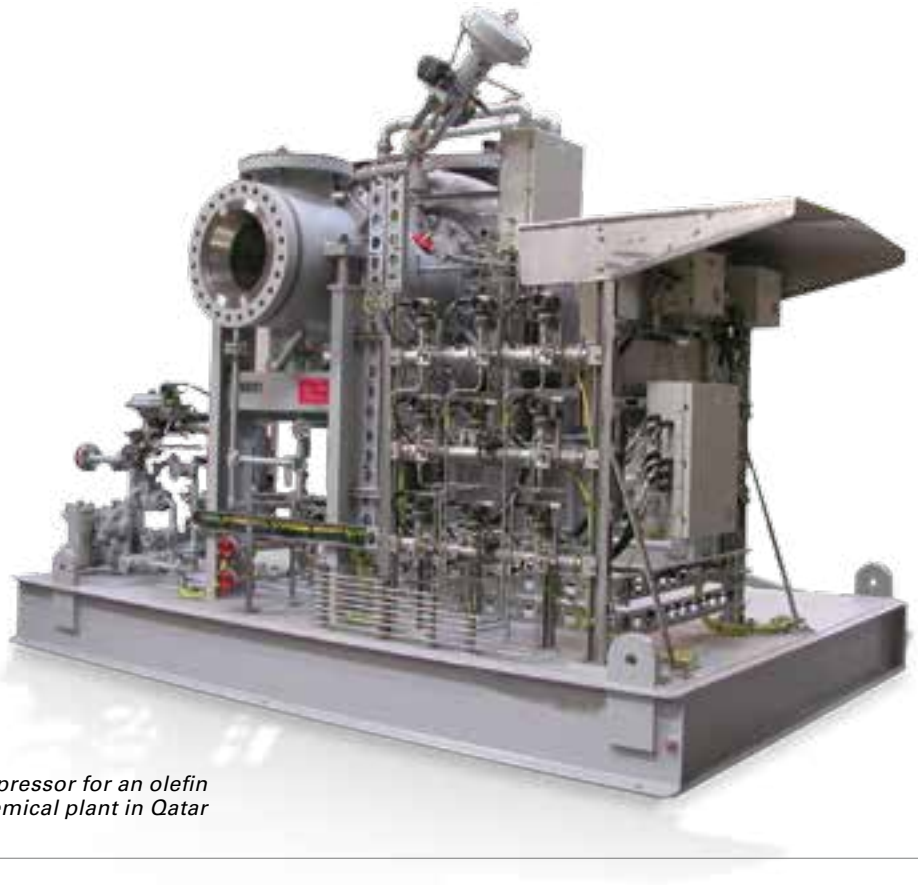
In this complex sector, reliability and safety are more crucial than ever. Our expanders help you meet every challenge.

Few markets are as complex as chemical / petrochemical. The industry's broad range of applications is covered by Atlas Copco Gas and Process turboexpanders.

Our key areas of expertise include ethylene-olefin recovery, ammonia purification, carbon-monoxide purification, propane dehydrogenation, and hydrogen recovery.

Within the realm of oxidation processes and hot gas applications, Atlas Copco Gas and Process machinery covers numerous areas, including terephtalic acid (PTA), phenol, hydrogen peroxide, ammonia, nitric acid, and caprolactam.

"We supply turboexpanders for many applications within the highly complex and demanding chemical / petrochemical market."



Expander compressor for an olefin petrochemical plant in Qatar



(Photo: The Linde Group)

Energy Recovery

Renewable energy is gaining traction across the world. Our innovative expanders make your plant fit for the future.

For many years, Atlas Copco Gas and Process has helped customers around the world in unlocking the vast potential of renewable-energy sources. Whether you want to produce electricity from a geothermal resource or recover power in a pressure-letdown application, Atlas Copco turboexpanders provide reliable solutions that meet your needs.

Waste heat is an often-untapped energy source that can be converted to useful electric energy using turboexpanders in closed-loop conversion cycles such as the Organic Rankine Cycle (ORC).

Potential heat sources to drive this application include tail gas from industrial furnaces or combustion engines, waste vapor from chemical and petrochemical processes, gas turbine exhaust, and solar heat from flat or parabolic reflectors.

Driven by our integral-gear expertise, our turboexpanders can be configured with one to four stages on a single gearbox to achieve the lowest cost-per-kilowatt power-train solution. Power generation reaches up to 25 MW per unit.

Energy Recovery Applications:

- Geothermal
- Organic Rankine Cycle
- Kalina Cycle®
- Pressure letdown
- Heat recovery
- Waste-heat recovery

"Driven by our integral-gear expertise, our turboexpanders are configured to achieve the lowest cost-per-kilowatt solution."



Expander generator for a geothermal power plant in Nevada (USA)



High-Efficiency Impellers

Our impeller designs are the most reliable in the industry and meet a wide range of process requirements.

High efficiency is a fundamental requirement for all processes involving turboexpanders. We achieve this performance through the use of the latest technology tools and a vast experience base.

Precision That Meets Your Needs

To ensure top efficiency, we utilize computational-fluid dynamics (CFD) and finite-element analysis (FEA) in the design of our impellers, and the latest 5-axis computer-aided manufacturing processes.

As an established turbomachinery manufacturer, we can choose from a wide variety of proven impeller designs in our data base to precisely match your process needs. This combination of experience and technology ensures that our customers receive maximum efficiency and the most reliable impellers available in the industry.

"To ensure top efficiency, we use CFD and FEA in impeller design."



Expander impeller



Mechanical center section



Impellers undergoing a quality check

Variable Inlet-Guide Vanes

Our inlet-guide vanes adjust to changing process conditions to maximize expander efficiency.

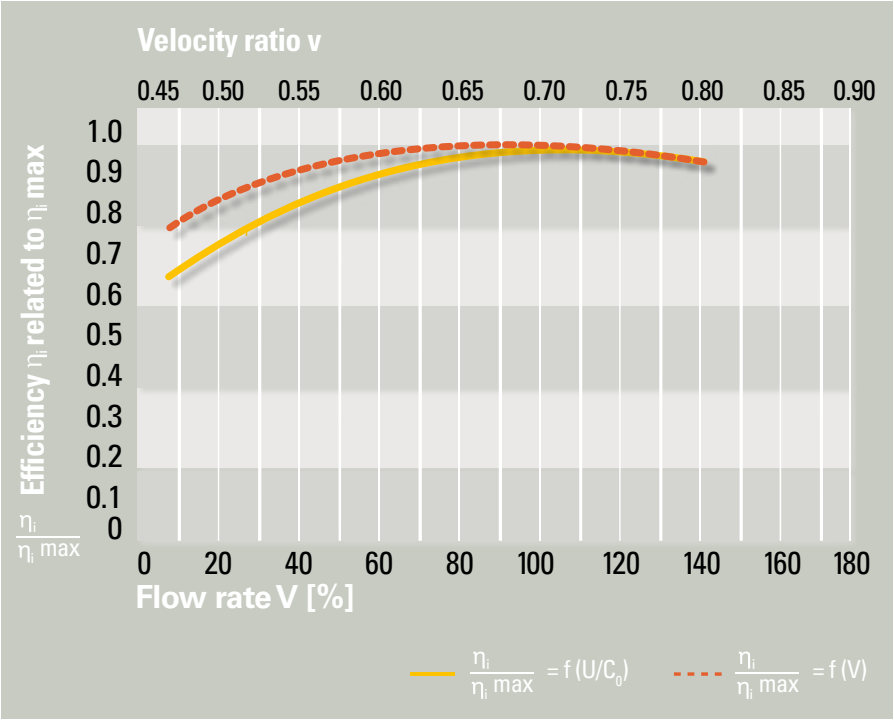
To compensate for the varying operating conditions found in many processes, turboexpanders must deliver efficient off-design performance.

Atlas Copco turboexpanders use variable inlet-guide vanes (IGVs) engineered to produce optimum flow patterns and provide precise, continuous control across the full range of operation.

Full Control Over Your Process

Apart from an optimal control range and excellent efficiency for all parts, our IGVs feature a wide range of regulation capabilities and excellent partial performance. Combined configuration ensures maximum control flexibility.

"Atlas Copco turboexpanders use variable inlet-guide vanes to provide optimum flow patterns and precise, continuous control across the full range of operation."



The typically flat turboexpander efficiency characteristic with various flow rates is illustrated here. Efficiency vs. the velocity ratio v (ratio tip speed to spouting velocity) is also shown.



Variable inlet-guide vanes

Bearing Systems

We offer multiple bearing designs that have a proven operating history for reliable, continuous use in diverse applications.

Atlas Copco Gas and Process bearing designs include hydrodynamic bearings as well as Active Magnetic Bearings. Final bearing selections are made specifically for your process applications.



Active Magnetic Bearings

Oil Bearings

We offer horizontally-split, high-speed pinion bearings featuring five self-centering pads that ensure stable rotation. Horizontally-split bearings are especially easy to inspect and maintain.

Tilting-pad bearings, which are used on high-speed shafts, and sleeve bearings, used on low-speed shafts, ensure reliable performance, efficiency, and optimal speeds for each process.

Active Magnetic Bearings

Atlas Copco also offers designs using active magnetic bearings. Active Magnetic Bearings generate a magnetic field to align the shaft in its centerline. This eliminates friction and the need of lubrication. The electromagnets of Active Magnetic Bearings are controlled with rotor position sensors by a digital control cabinet.

The resulting combination of lower maintenance, higher reliability, and increased durability boosts equipment performance. Our dedicated service team supports customers at every step, before and after installation.



Combined radial / axial bearing for a hydrocarbon gas expander



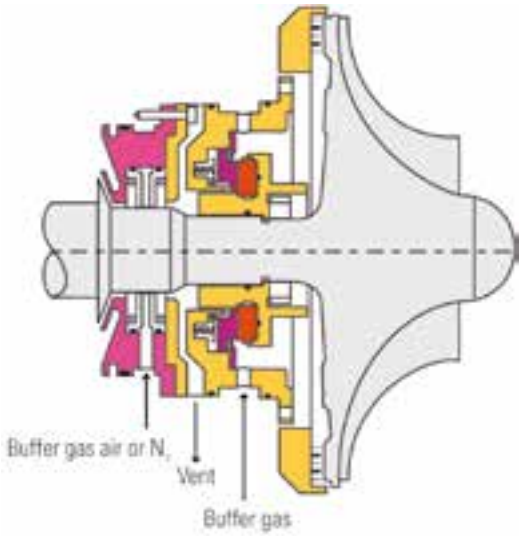
Radial bearing for an integrally-geared unit



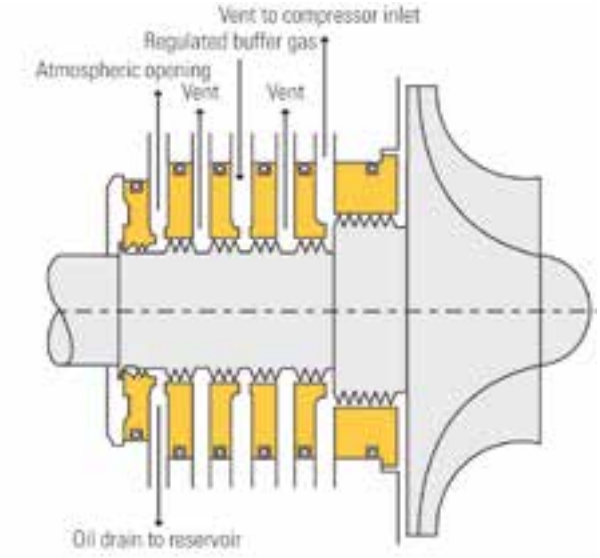
Combined radial / axial bearing for air-separation turbines

Shaft Seals

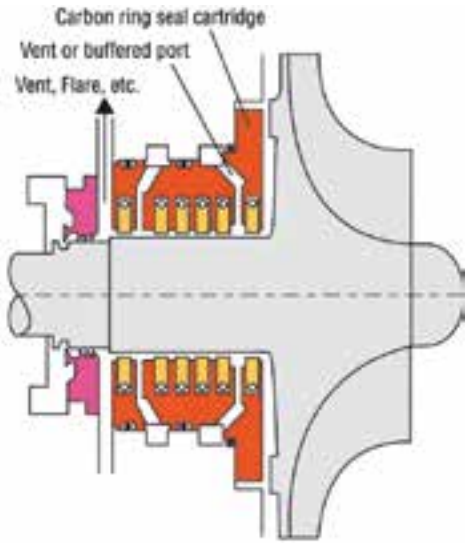
Our uniquely tailored shaft-seal solutions ensure maximum efficiency and prevent gas leakage and air intrusion – even in volatile environments.



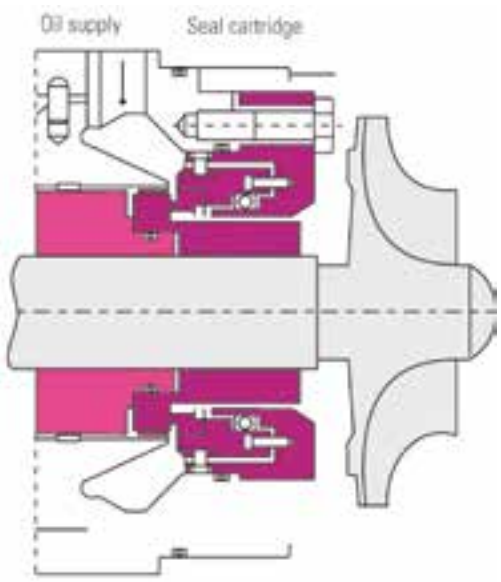
Dynamic dry-gas seals



Labyrinth seals



Floating carbon seals



Oil-lubricated seals

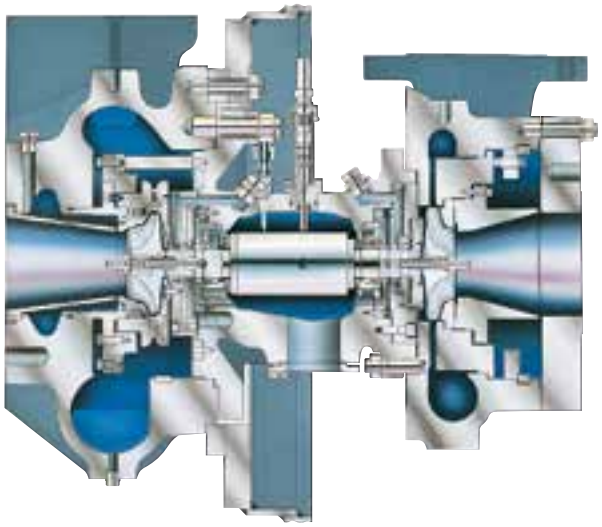
Configuration Options

Our turboexpander configurations provide the right match for your application.

Atlas Copco Gas and Process turboexpanders are offered in compressor-loaded, generator-loaded, and hydraulic brake-loaded configurations to accommodate specific applications. In most cases, the turboexpander is skid-mounted with its auxiliary support system to simplify transport and help reduce installation costs.

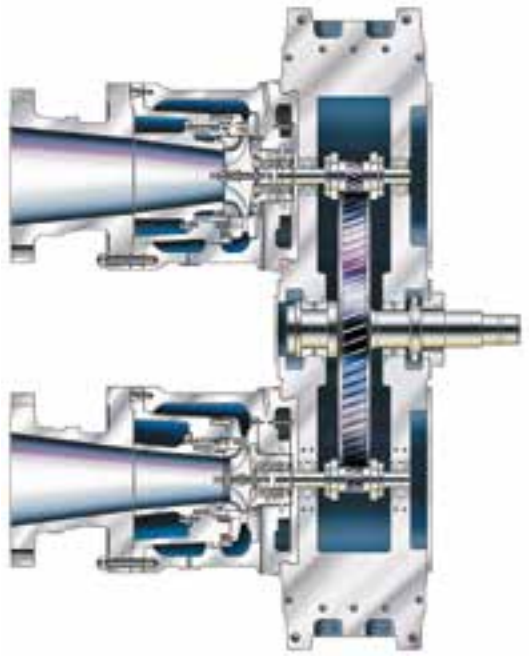
Compressor-loaded expanders
Expander is loaded by a single-stage centrifugal compressor through a common shaft.

Typical applications:
Air separation
Ethylene / olefin recovery
LPG / NGL recovery
Dew-point control
Rated power: up to 22,000 kW



Integrally-geared generator-loaded expanders
Connected to an electric generator through speed-reducing gears, integral-gear technology offers the additional benefit of multi-staging (one to four stages) for high efficiency.

Typical applications:
Energy recovery
Chemical / petrochemical
Air separation
Rated power: 25,000 kW



Generator-loaded expanders

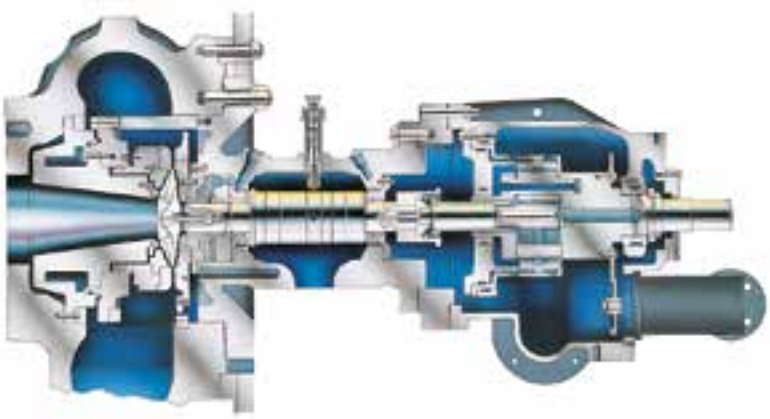
Expander stage connected to an electric generator through an epicyclic gear.

Typical applications:

Air separation

Energy recovery

Rated power: 4,000 kW



Hydraulic-braked expanders

Expander is braked by the presence of oil in the chambers surrounding the rotor shaft.
Used for cryogenic applications in low power ranges.

Typical applications:

Air separation

HyCo Syngas (CO_2, H_2)

Rated power: 250 kW

Oil and Gas

Hydrocarbon Gas Processing

Expander compressor with a magnetic bearing installed in a large LNG-regasification terminal in Lake Charles (USA).

Frame / type: Single-stage ECM-5.0
Speed: 10,900 RPM
Flow: 461,984 kg/hr (1,018,500 lb/hr)
Inlet pressure: 96.9 bar(a) (1,405 psia)
Inlet temperature: -27 °C (-16.6 °F)
Power: 7,303 kW (9,794 HP)



Oil and Gas

Hydrocarbon Gas Processing

Expander compressor for gas processing installed in Nigeria.

Frame / type: Single-stage EC-5.0
Speed: 13,400 RPM
Flow: 367,863 kg/hr (811,000 lb/hr)
Inlet pressure: 79.6 bar(a) (1,155 psia)
Inlet temperature: -18 °C (-0.40 °F)
Power: 8,936 kW (11,983 HP)



Oil and Gas

Hydrocarbon Gas Processing

Expander compressor for gas processing installed in Thailand.

Frame / type: Single-stage EC-6.0
Speed: 9,300 RPM
Flow: 388,275 kg/hr (856,000 lb/hr)
Inlet pressure: 37.5 bar(a) (544 psia)
Inlet temperature: -49 °C (-56.2 °F)
Power: 7,860 kW (10,540 HP)



Oil and Gas

Liquefied Natural Gas (LNG)

The compander's expander stage is an essential component in an on-board LNG-reliquefaction plant.

Frame / type: Three-stage GT 032 N3D0 / Single-stage ETG 150 MS
Flow: 94,375 Nm^3/hr (58,723 scfm)
Inlet pressure: 56.35 bar(a) (817 psia)
Inlet temperature: -110 °C (-166 °F)
Expander cold production: 1,096 kW (1,469 HP)



Pressure Letdown

Integrally-geared generator-loaded turboexpander in a pressure-letdown application in Italy.

Frame/Type: Three-stage ETG 190 MS-3
Inlet pressure: 51 bar(a) (740 psia)
Inlet Temperature: 170 ˚C (338 ˚F)
Flow: 60,582 Nm^3/hr (37,699 scfm)
Recovered Power: 4,526 kW (6,070 HP)



Energy Recovery

Geothermal Power

Single-stage integrally-geared generator-loaded turboexpander in a geothermal ORC application in Nevada (USA).

Frame/Type: Single-stage EGI-8
Inlet Pressure: 31.4 bar(a) (455 psia)
Inlet Temperature: 127 ˚C (260.6 ˚F)
Flow: 707,604 kg/hr (1,560,000 lb/hr)
Fluid: Isobutane
Recovered Power: 14,541 kW (19,500 HP)



Energy Recovery

Pressure Letdown

Integrally-geared generator-loaded turboexpander in a pressure-letdown application for the Middle East.

Frame/Type: Two-stage ETG 360 MS-2
Inlet Pressure: 50 bar(a) (725 psia)
Inlet Temperature: 125 ˚C (257 ˚F)
Flow: 165,000 Nm^3/hr (102,668 scfm)
Recovered Power: 9,488 kW (12,718 HP)



Energy Recovery

Pressure Letdown

Turboexpander for a pressure letdown application in Heidelberg (Germany).

Frame/Type: ETG 190 MS-2
Inlet Pressure: 45 bar(a) (653 psia)
Inlet Temperature: 75 ˚C (167 ˚F)
Flow: 45,000 Nm^3/hr (28,000 scfm)
Fluid: CH_4
Recovered Power: 2,530 kW (3,391 HP)



Energy Recovery

Oil and Gas

Fertilizer Production

Expander generator for an ammonia-fertilizer plant in Australia.

Frame / type: Single-stage EG-6.0
Flow: 141,974 kg/hr (313,000 lb/hr)
Speed: 3,000 RPM
Inlet temperature: -129 ˚C (-200.2 ˚F)
Inlet pressure: 34.5 bar(a) (501 psia)
Power: 634 kW (850 HP)



Oil and Gas

Petrochemical

Expander compressor with magnetic bearing for a petrochemical plant in Saudi Arabia.

Frame / type: Single-stage ECM-4.0
Flow: 54,975 kg/hr (121,200 lb/hr)
Speed: 13,000 RPM
Inlet temperature: -102 ˚C (-151.6 ˚F)
Inlet pressure: 14.9 bar(a) (216 psia)
Power: 1,161 kW (1,557 HP)



Industrial Gases

Industrial Gases

Compressor-loaded turboexpander installed in an air-separation plant in Chile.

Frame / type: Single-stage ETB 190 NS
Inlet pressure: 7.3 bar(a) (106 psia)
Inlet temperature: -120.7 ˚C (-184 ˚F)
Flow: 11,300 Nm³/hr (7,030 scfm)
Cold production: 207 kW (278 HP)



Industrial Gases

Industrial Gases

Integrally-geared generator-loaded turboexpander installed in an air-separation plant in the Netherlands.

Frame / type: Two-stage ETB 560 NS-2
Inlet pressure: 2.8 bar(a) (41 psia)
Inlet temperature: -90 ˚C (-130 ˚F)
Flow: 55,593 Nm³/hr (34,590 scfm)
Cold production: 1,280 kW (1,717 HP)



Our Product for Your Market

Industry	Expander with Booster Compressor		Expander Generator		Expander Hydraulic Braked	
	ETB	EC ECM	ETG	EG	ETF	EHB
Oil and Gas						
LPG / NGL recovery		●		●		
Gas processing		●		●		
Gas treatment		●				
Dew-point control		●				
Floating LNG FPSO	●	●		●		
LNG reliquefaction (nitrogen brayton cycle)		●		●		
LNG liquefaction		●				
LNG peak shaving		●	●			
Gas aromatics			●			
Inorganic	●		●			
Refineries		●		●		●
Gas to Liquid	●		●			
Energy Recovery						
Pipeline (pressure letdown)			●			
Geothermal				●		
Heat recovery				●		
Cold energy recovery				●		
Industrial Gases						
Cryogenic expansion	●		●		●	
Steel	●		●		●	
Electronics	●		●		●	
GTL / Syngas	●		●		●	



COMMITTED TO SUSTAINABLE PRODUCTIVITY

We stand by our responsibilities towards our customers,
towards the environment and the people around us.
We make performance stand the test of time.
This is what we call — Sustainable Productivity.

Atlas Copco Gas and Process Division
Schlehenweg 15, 50999 Cologne, Germany
+49 2236 96 50 0
www.atlascopco-gap.com

Atlas Copco

© Atlas Copco 02/2015 Printed in Germany.
B03/004/24/0215