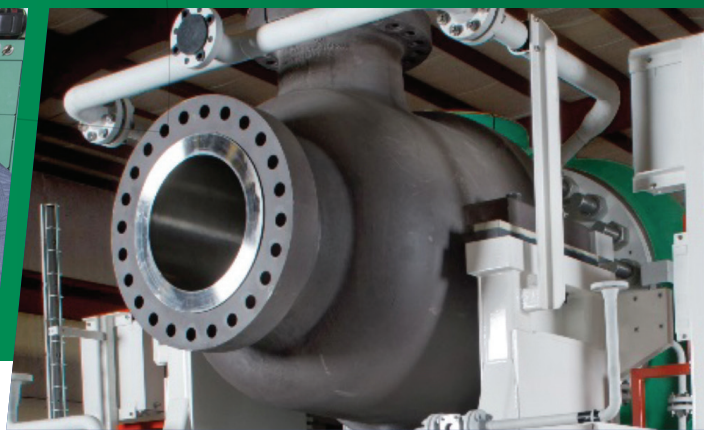
ROTOFLOW TURBOMACHINERY

Compressor-Loaded Turboexpanders



World-Class Performance

Rotoflow's high-pressure compressor-loaded turboexpanders (companders) deliver high value by providing refrigeration for the most efficient air separation and liquefaction facilities in the world. Our companders offer world-class efficiency, high reliability, and low cost, and are simple to operate and maintain. Features include high-efficiency expansion (up to 92%) and high refrigeration capacities.

Design/build expertise, operational insight, and unrivaled experience work together to create Rotoflow's comprehensive line of turboexpanders, serving the full spectrum of turbomachinery markets and applications.

Typical Design Capabilities

	ASU	Hydrocarbon
Power	12 to 14,000 kW (16 to 18,774 hp)	8 to 12,977 kW (11 to 17,403 hp)
Speed	Up to 70,000 rpm	Up to 105,000 rpm
Inlet Pressure	4 to 100 barg (60 to 1,450 psig)	1.7 to 210 barg (25 to 3,045 psig)
Temperature	-200 to +150°C (-320 to +300°F)	-270 to +340°C (-454 to +644°F)
Outlet Flow	282 to 20,883 am^3/hr (166 to 12,292 ACFM)	138 to 70,190 am^3/hr (81 to 41,312 ACFM)
Impellers	89 to 422 mm (3.5 to 16.6 in.)	17 to 1,168 mm (0.65 to 46 in.)

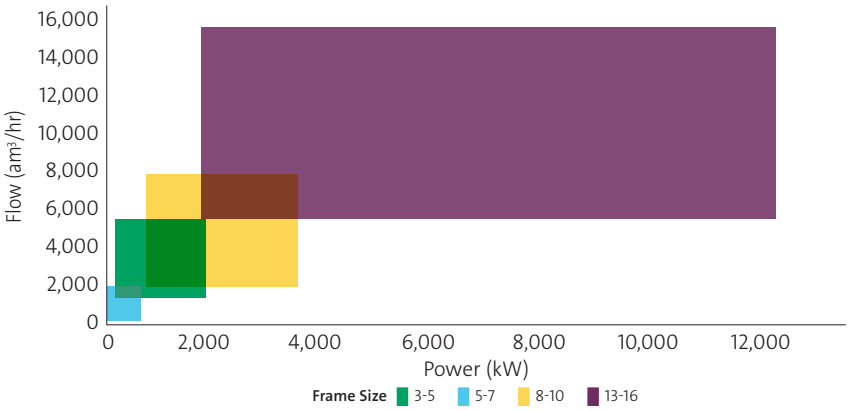
Benefits

- Broad operating ranges from a portfolio spanning over 70 years
- Equipment aerodynamically optimized to the customer's process
- Reliability, 20 years MTBF
- Passive thrust control incorporates a balance piston to limit thrust loads through transient conditions
- Simplified design eliminates tuning or controlling instantaneous variables through a separate control system
- Robust rotor assembly, extensive rotor-dynamic analysis for all operating speeds
- Zero clearance inlet guide vanes generate accurate flows and efficiencies
- Seal designs utilize component coatings on sealing surfaces for complete segregation of oil and process fluid
- Compliance with safe area or hazardous area conditions
- Fully skidded packages can be supplied for customer-specific conditions
- ISO 9001 certified since 1997 (currently ISO 9001:2015)

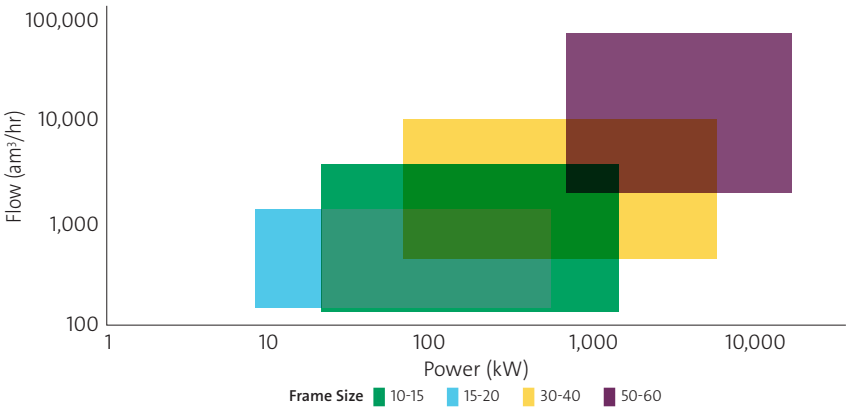
ROTOFLOW
An Air Products Business

Compressor-Loaded Turboexpanders

ASU Product Operating Range



Hydrocarbon Product Operating Range



Engineered to order for customer-specific applications. Represented is an overview of our turbomachinery capabilities. Please contact us to discuss your specific needs.

Technical Highlights

- Intrinsically reliable passive thrust balancing design eliminates the need for active thrust control
- Proven bearing designs handle steady-state and transient thrust loads
- High-strength wear-resistant materials and antifriction coatings
- High-load-capacity, low-loss bearings ensure stable operation and high overall efficiency
- Robust impeller attachment, stiff shaft rotor design and torque transmission design for high reliability
- Electric-actuator-controlled inlet nozzle guide vanes for precise flow control through the expander with peak efficiency over wide operating conditions
- Allowable nozzle loads up to 10 times NEMA SM-23

Options

- Spare mechanical center section
- International code compliance
- Inlet strainers
- Inlet trip valve
- Safe area or hazardous area location
- Package control system
- Cryogenic testing
- API compliant on request

Experience more. *Together.*

Rotoflow, an Air Products business, combines one of the industry's most trusted names in turbomachinery with world-leading industrial gas expertise. We're transforming the hydrocarbon, LNG, petrochemical, and industrial gas markets with superior equipment performance and unrivaled reliability, safety, and value. Our combined capabilities are the key to this new level of quality. Technological innovations expertly integrated with decades of know-how are the foundation for Rotoflow's valued products, proven performance, and world-class service. This synergy helps customers around the world reach their unique technology and operational targets more efficiently than ever before.

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