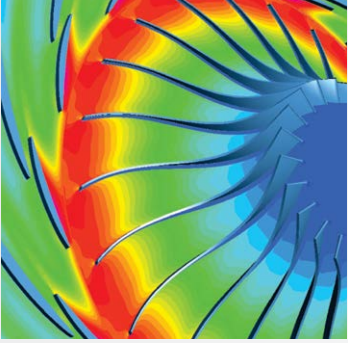




Aftermarket Services

OEM Parts, Field Service, Service Centers, Upgrades, Accessories



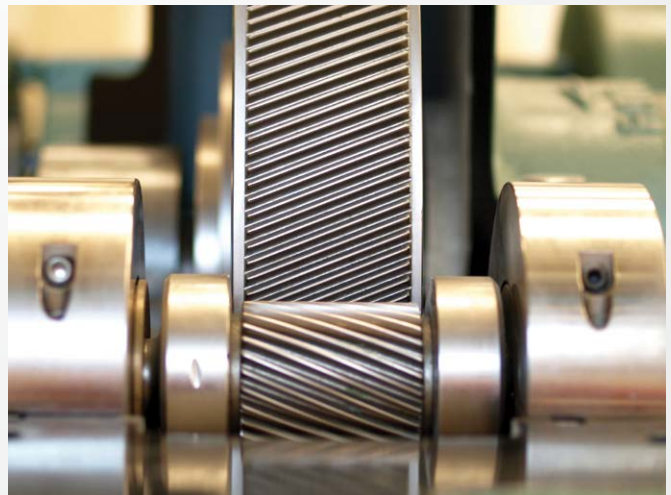


You have many distinct advantages when you partner with Ingersoll Rand for your centrifugal compressor needs.

Ingersoll Rand manufactures centrifugal air and gas compressors and provides aftermarket products and services for a broad customer base around the world. The cutting-edge solutions we deliver for air, industrial and process gas requirements are made possible by the unique blend of product quality, engineering talent and dedicated teamwork brought to every customer.

CENTRIFUGAL COMPRESSORS

With our main manufacturing facility in Buffalo, N.Y., and distribution in more than 80 sales and service locations worldwide, Ingersoll Rand is a global company with a commitment to meeting your needs with exceptional centrifugal compressor technology while exceeding your expectations with unequalled service and support.



Over 60 years, Over 14,000 Compressors

Ingersoll Rand has been a leading global manufacturer of centrifugal compressors since 1955 when the Joy Manufacturing Company began operations in Buffalo, New York. Our product portfolio is comprised of two main product lines; the MSG® TURBO-AIR® compressor product line is designed to fulfill requirements for standard plant air applications, and our MSG® (multi-stage geared) compressors are application engineered for specific compressed air or gas performance. Our product portfolio is complemented by our extensive aftermarket service, support and solutions.



PackageCARE™

Service Contracts

PackageCARE™ is a fixed-cost, no-surprises service contract designed to eliminate the inconvenience associated with maintaining and servicing your compressed air system. With PackageCARE, Ingersoll Rand takes care of your system, enabling you to focus on your business, not your equipment.
(Page 2)



PlannedCARE™

Ingersoll Rand's PlannedCARE™ service program gives you a more cost-effective plan for scheduling and executing annual servicing requirements for your compression equipment. It combines scheduled maintenance with predictive diagnostics to minimize costly disruptions and keep your compression equipment running smoothly.
(Page 3)



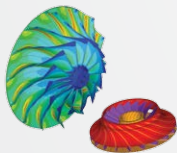
Field Service

Who better to trust with your field service needs than the company that designed and manufactured your compressor? We employ an ever-increasing staff of highly motivated, factory-trained service technicians located around the globe. A full-time technical support staff is available 24 hours/day, 365 days/year.
(Page 4)



Global Services Centers

We recognize that you depend on our compressors to keep our operations running, and that any unplanned shutdown requires prompt attention. That is why we operate fully-equipped and staffed service centers strategically located around the globe. Our service centers offer a complete range of services and specialize in quick turnarounds.
(Page 5)



Upgrades

Whether your compression requirements have changed, or you are looking for increased efficiency, Ingersoll Rand offers a variety of performance-enhancing solutions that can improve operating efficiency.
(Page 6)



Control Systems

MAESTRO™ control systems offer optimal protection and control for your compressed air system. The MAESTRO suite contains a model that is sure to be in tune with your needs.
(Page 7)



OEM Parts & Accessories

We maintain detailed records for every compressor we have ever built. Whether you have replaced an o-ring or modified a rotor, we recorded the work. We conduct this carefully detailed effort to ensure we provide the exact parts you need.
(Page 9)



PackageCARE™

Eliminate the Inconvenience

Transfer Risk and Increase Reliability with PackageCARE

The system-wide fixed cost solution for any operation

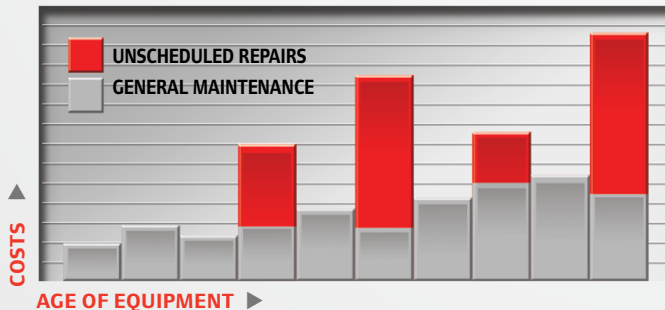
Unlike traditional maintenance agreements that basically provide a service for a fee, the Ingersoll Rand PackageCARE business model is a risk transfer agreement that's beneficial to both the customer and supplier. PackageCARE allows both parties to do what each does best: Ingersoll Rand manages the air, and you manage your business. It's that simple.

A compressed air system is a significant investment, no matter what type of business you manage. PackageCARE can help you get the most out of your investment. It's a fixed-cost, no-surprises service contract designed to help you:

- Control costs and keep your equipment running at peak efficiency
- Protect yourself from unexpected repair and replacement expenses over the life of the agreement
- Increase the operational efficiency of any compressor — regardless of age, make, or model
- Focus your resources on taking care of your customers

UNPREDICTABLE MAINTENANCE AND REPAIR COSTS

For many companies it's hard to anticipate — and budget for — the costs of maintaining and repairing a compressed air system. These unpredictable costs can significantly impact your bottom line.



PackageCARE DELIVERS PREDICTABLE PEACE OF MIND

With Ingersoll Rand working with you, you'll know exactly what your maintenance and repair expenditures will be from year to year. There are no surprises.



Run Smarter With a Better PLAN!

The Ingersoll Rand PlannedCARE diagnostic and maintenance service program gives you a more cost-effective plan for scheduling and executing all required compressed air equipment services over the course of a year.



One Choice, Multiple Benefits

With Ingersoll Rand managing the details of your compressed air equipment service, you will be able to:



- PLAN** on more uptime
- PLAN** on reliable equipment
- PLAN** on a lower overall cost of ownership
- PLAN** on eliminating surprises!

While PackageCARE provides 100% risk transfer, PlannedCARE gives you a increased confidence at an affordable total cost.

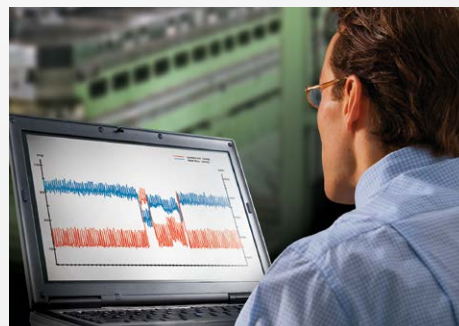
It combines the best of scheduled maintenance and predictive diagnostics to reduce costly disruptions and keep equipment running smoothly.



Professional Inspection



Advanced Diagnostics



Field Service

Ingersoll Rand's field service team offers the expertise and skills required to ensure proper compressor operation and process integration. Our field service technicians are trained experts specializing in the technical coordination of on-site compressor installations, repairs, overhauls, upgrades and start-up commissioning.

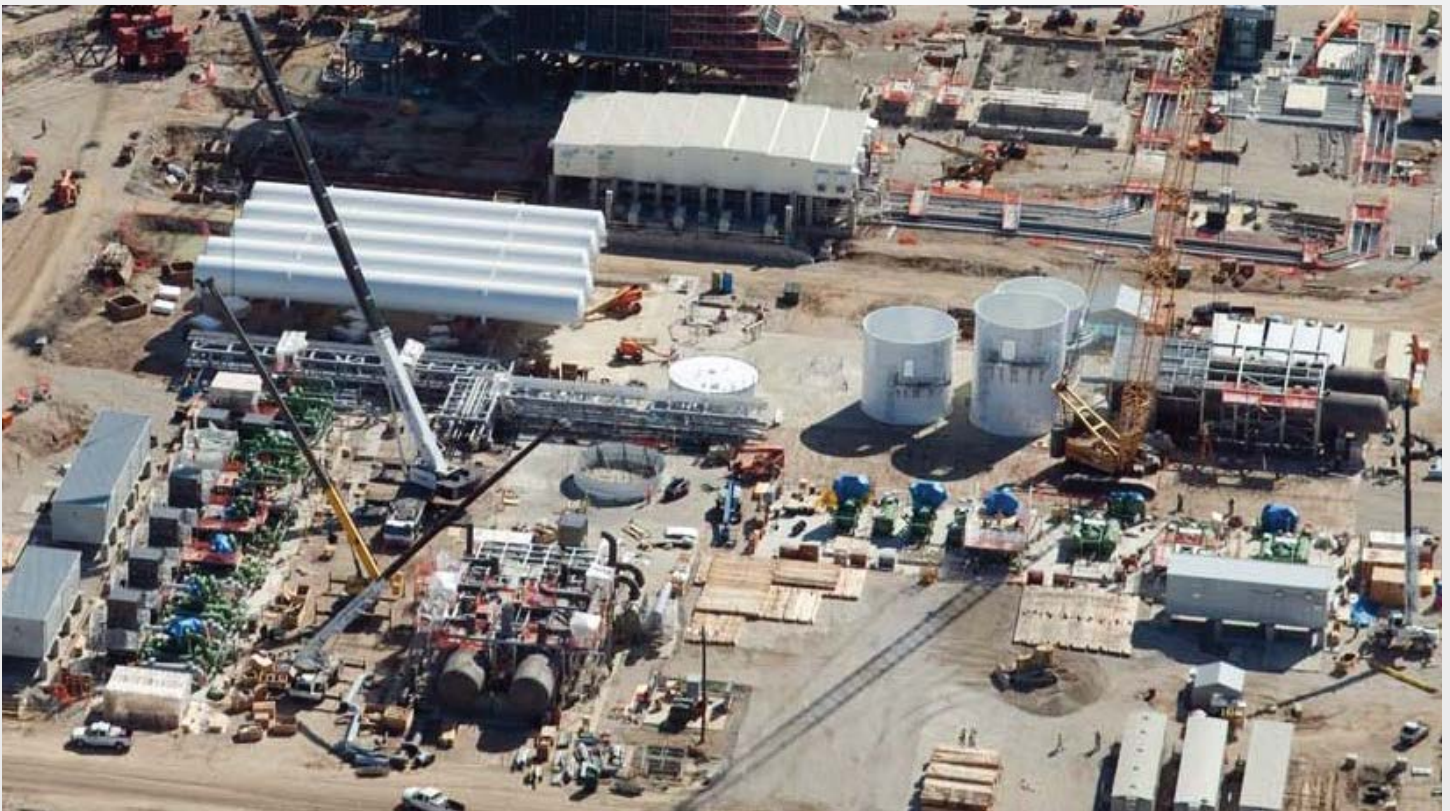
Ingersoll Rand has clearly defined processes and procedures for all required site service work. Each field service technician is required to document control panel settings and corrective actions associated with the site work in accordance with these procedures. All work performed and any parts used during a service visit are reviewed directly with the on-site contact.

Overall machine condition status and recommendations regarding compressor maintenance, recommended spare parts, and future service work is offered as well.

On-site Services Offered

- Installation
- Startups
- Vibration analysis
- Turnaround inspections
- Field balancing
- Drive motor alignment
- Control system services
- Performance evaluation
- Preventative maintenance
- Diagnostic checks

A field service technician evaluates instrument readings on a 5-stage MSG-3 carbon monoxide compressor.



Global Service Centers

Servicing centrifugal compressors requires high levels of expertise and precision to maintain tight manufacturing tolerances and ensure compressor performance. As a centrifugal compressor OEM, Ingersoll Rand has facilities, equipment, and experienced technicians strategically located throughout the globe to provide a complete range of services from simple parts inspections to complete compressor overhauls.

We have established a set of policies and procedures that provide a disciplined approach to both compressor and component servicing to ensure quality inspection and establish a clear scope of work. When a compressor or component is received at one of our facilities, it will be disassembled, cleaned and inspected (DCI). During inspection, components are measured and an engineer is designated to review the data, machine service history, and any modifications made to the machine since the last servicing. A detailed report that describes the condition of the inspected components, documented with photographs, is issued along with a quotation for the required services needed to repair the components.

Benefits of OEM Service Centers

- **Knowledge and Expertise** - Over 60 years of experience manufacturing and servicing centrifugal compressors
- **Proprietary Technology** - Access to original design specifications with strict adherence to proper equipment tolerances
- **Complete Service History** - Meticulous maintenance of service record history to ensure accuracy
- **In-house Rework** - Servicing is performed at an OEM facility with proper equipment and experienced technicians
- **Inspection Summary** - Each service proposal is provided with a comprehensive breakdown of the required scope
- **OEM Replacement Parts** - Service centers contain extensive inventories of OEM replacement parts
- **Experienced Workforce** - Fully dedicated teams of engineers and technicians devoted to repair and overhaul services
- **Testing Capabilities** - Full mechanical and aerodynamic testing capabilities to prove compressor performance
- **Globally Located** - Strategically located facilities in Buffalo, NY, US; Houston, TX, US; Milan, Italy; Ahmedabad, India; Shanghai, China



Performance Enhancing Upgrades

Whether your compression requirements have changed, or you are looking for increased efficiency, Ingersoll Rand offers a variety of performance-enhancing solutions that can improve operating efficiency.

Aerodynamic Modifications

As plant processes or job site locations change, so do compressed air requirements. Ingersoll Rand offers a variety of aerodynamic modifications to adjust your existing performance to meet current compressed air demands with optimal operating efficiency.

- **Re-rates** - Compressors can be re-rated to meet higher or lower pressure/flow requirements
- **TA-38/48 Enhancement** - We can replace a TA-38/48 airend with a new MSC® TURBO-AIR® 6000 airend to provide a greater turndown range and increased rise to surge.
- **5-axis Milled Impellers** - Custom-designed, precision-milled impellers can provide improved performance



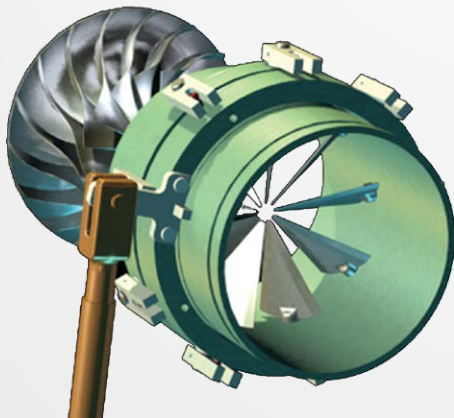
Additional Upgrades

- **Duplex Oil Filters** - Simplify maintenance and maximize uptime with on-the-fly filter replacement
- **Duplex Oil Coolers** - Keep your compressor running during routine oil cooler maintenance
- **Control Valves** - Improve control precision with stepper motor and modulating blow-off valve technology
- **Cooler Bundles** - Improve performance or guard against corrosion with a variety of material and coating options

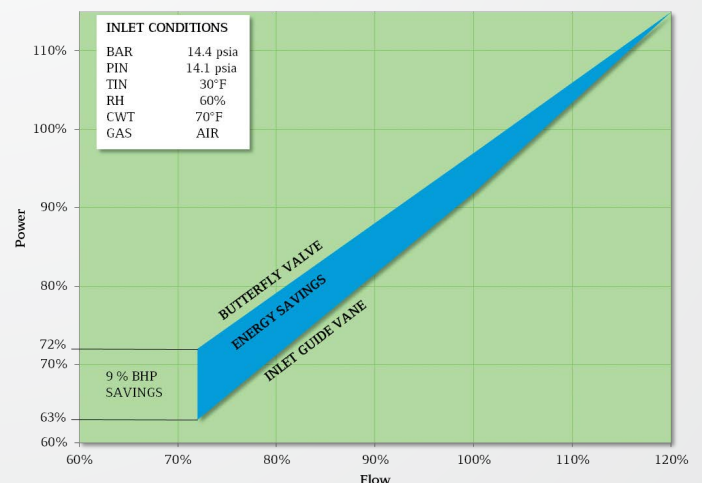
Inlet Guide Vanes

Our innovative inlet guide vanes (IGV) replace conventional inlet butterfly valves (IBV) with substantial potential for energy savings (up to 9%). IGVs impart a whirling motion to the inlet flow in the same rotational direction as the first stage impeller. As a result, less input power is required when operating in turndown. This allows the compressor to take advantage of opportunities for energy savings when reduced flow is permitted or on days when the ambient conditions are favorable versus the design day.

Favorable conditions exist when the inlet air temperature, coolant temperature or humidity are lower than the design day conditions, or when atmospheric air pressure is higher than the design day conditions. When these conditions exist, the compressor can actually produce more compressed air than your system is designed to consume. In these cases your compressor will need to operate in turndown to avoid overpressurizing your system. In some cases, as the chart to the right indicates, favorable ambient conditions can enable your compressor to produce up to 120% of its design flow. It is in these cases where the IGV can generate significant savings.



Energy Savings
INLET GUIDE VANE versus BUTTERFLY VALVE
3-Stage Compressor at Constant 100% Pressure



Control Systems

We introduced the first microprocessor control system for centrifugal compressors over three decades ago, and today, we bring you our most advanced control system technology with the MAESTRO suite of control systems.

MAESTRO controls are the current standard for MSG TURBO-AIR compressors and are available as an upgrade for existing centrifugal compressor installations.

We offer two distinct MAESTRO models, each designed for your specific compressor control needs:



MAESTRO UNIVERSAL

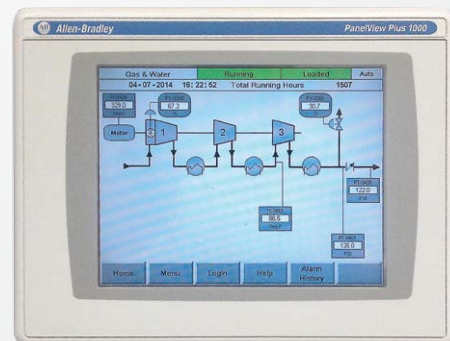
A state-of-the-art compressor control system with web-enabled monitoring capabilities, offering optimal protection and control. The MAESTRO Universal provides a built-in web server allowing compressor monitoring using your local intranet. Designed for easy setup, the Universal provides a convenient wizard for quick configuration.

- Windows CE driven system includes a built-in web server and set up wizard for quick configuration
- Able to handle multiple stages and designed for many makes and models of compressors
- 10" color graphic display provides easy monitoring
- Built-in USB port for system configuration and data logging
- Capable of monitoring and controlling the total system across multiple units
- Seamless integration with customer host systems
- Global design to conform to worldwide standards and languages
- Main logic module contains up to: 30 digital inputs, 33 digital outputs, 39 analog inputs, 12 analog outputs, 10 RTD inputs and a motor current input

MAESTRO PLC

Utilizes an open architecture Allen-Bradley® PLC (Programmable Logic Controller) which enables you to use off-the-shelf components that may better match other controls and best practices in your plant. The MAESTRO PLC combines the power of our knowledge of compressors with industry wide acceptance of Allen-Bradley's line of PLC hardware.

- Utilizes an Allen-Bradley CompactLogix™ platform with: 16 digital inputs, 16 digital outputs, 16 analog inputs, 4 analog outputs, and 12 RTD inputs
- Comes standard with an Allen-Bradley PanelView Plus™ 1000 10" touchscreen
- Networking software available for automation of multiple units and total system automation
- Optional stainless steel enclosure available
- Setup wizard for quick configuration
- User interface supports multiple languages
- VNC client for control and monitoring through network-connected devices

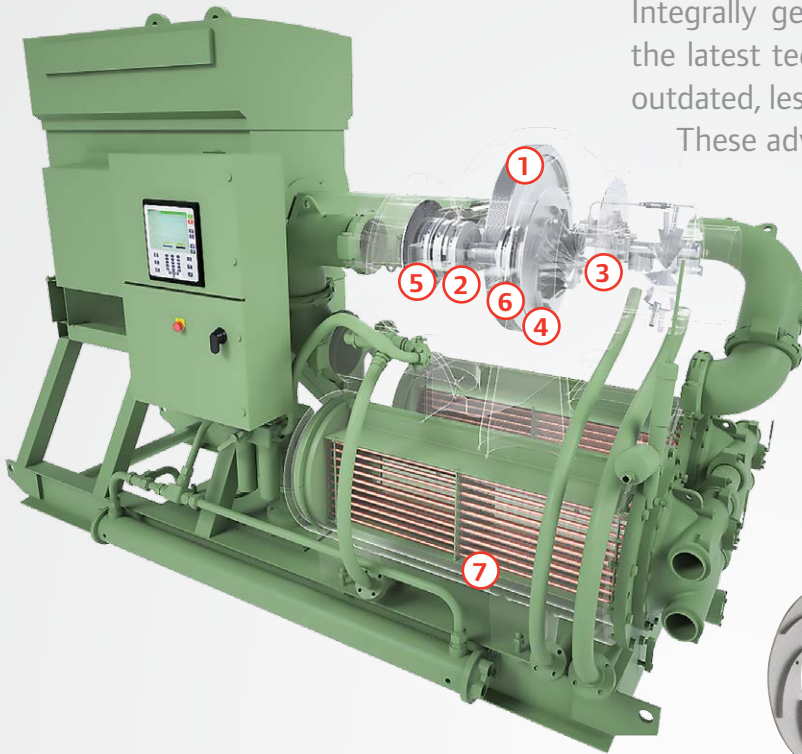


Anatomy of a Centrifugal Compressor

Integrally geared centrifugal (IGC) compressors represent the latest technology, offering significant advantages over outdated, less-efficient and more costly compressor designs.

These advantages are inherent in the centrifugal design and are further enhanced by Ingersoll Rand's more than 60 years of centrifugal expertise.

The diagram to the left and subsequent descriptions below identify components that are vital to the efficient aerodynamic and mechanical operation of the compressor.



1. Bullgear

High-speed, helical-type gear coupled directly to the main driver. Allows each pinion gear to rotate at optimum speed, as determined by the flow and efficiency characteristics of the impeller.



2. Rotor

Each rotor assembly consists of a pinion gear and shaft, to which one or two impellers are attached. Pinion gears are precision-ground to meet AGMA and ISO quality specifications.



3. Impeller

5-axis milled impellers designed using computational fluid dynamics (CFD) software and finite element analysis (FEA) to ensure efficient, reliable performance.



4. Diffuser

Optimized, low solidity diffusers convert kinetic energy from high-velocity air/gas from the impeller into pressure. Diffusers are designed to match the aerodynamic characteristics of the matching impeller.



5. Seals

Non-contacting, non-wearing labyrinth air and oil seals, with atmospheric gap, require no buffer air for oil-free air, and eliminate the need for periodic replacement of carbon-ring seals and instrument air for permissive starting. Babbitted, carbon-ring, or dry-face seals can also be used for high pressure or process gas applications.



6. Bearings

5-pad tilting pad bearings or patented, hydrostatic-squeeze-film bearings are pressure lubricated and provide high reliability and stability of rotating shafts over wide ranges of loading.



7. Intercoolers

ASME-coded intercoolers (PED, China Code Pressure Vessel Certification, GOST, KOSHA, and others, as required) provide efficient cooling between compression stages and are designed to be accessible for inspection and cleaning.

OEM Replacement Parts & Accessories



As the OEM for MSG TURBO-AIR and MSG compressors, Ingersoll Rand can provide exact replacement parts for your maintenance and service requirements. We've got you covered for everything from a replacement bullgear to a missing bolt.

We've maintained detailed records for every compressor we have ever built since the day it was delivered. This is done so we can provide the exact part you need. All parts are cross-checked against unit assembly and maintenance records to ensure accuracy.

Our high-quality, genuine OEM parts are designed and produced in the US for the last 60 years. We maintain extensive inventories in strategic locations around the world backed by our OEM guarantee.

TurboBlend Centrifugal Compressor Lubricants

Oil contaminants, even if microscopic, act as sandpaper on your gearing and bearings. Lubrication oil plays a critical role in compressor performance and longevity of parts. TurboBlend™ compressor lubricants have been specifically formulated and extensively tested and field proven to facilitate reliable operation of MSG TURBO-AIR and MSG compressors.

TurboBlend 46

TurboBlend 46 is a uniquely formulated ISO 46 oil with a proprietary blend of additives to provide the specific properties required by MSG TURBO-AIR and MSG compressors to ensure reliable compressor operation.



Nonfood Compounds
Program Listed H-1
148025

TurboBlend Food Grade Formulation

TurboBlend Food Grade is a particular formulation that is certified H-1 through NSF for incidental contact with food. It is the preferred choice for MSG TURBO-AIR and MSG compressors operating in food processing or packaging environments.



ECO-FILTER Intake Filtration System

The ECO-FILTER™ intake filtration system utilizes high-quality primary and secondary filter elements to provide reduced energy costs and longer on-stream life over substitutes.

The primary element has a removal efficiency of 99% @ 10µm, and can be washed clean of dirt for reuse during maintenance intervals.

The secondary element has a 40% lower clean pressure drop than substitute products and an 89% higher dust holding capacity.



Ingersoll Rand (NYSE:IR) advances the quality of life by creating comfortable, sustainable and efficient environments. Our people and our family of brands—including Club Car®, Ingersoll Rand®, Thermo King® and Trane®—work together to enhance the quality and comfort of air in homes and buildings; transport and protect food and perishables; and increase industrial productivity and efficiency. We are a \$13 billion global business committed to a world of sustainable progress and enduring results.



IngersollRandProducts.com

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