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**TECHNICAL INSIGHT / COMPRESSED AIR EFFICIENCY**

# **Ingersoll Rand RTe Series: The Engineering Behind Lower Compressed Air Energy Costs**

Compressed air generation is one of the significant electricity costs in many industrial facilities. For compressors operating 8,000 hours annually, even modest improvements in specific power can translate into substantial reductions in annual operating expenditure.

The Ingersoll Rand RTe110 -132ne variable-speed rotary screw compressors have been developed to improve the efficiency of compressed air generation through advanced two-stage compression, interstage cooling, an innovative GD10-DS airend and an IE4 efficiency-class motor.

The result is a compressor range designed to deliver more compressed air for each kilowatt of electrical energy consumed.

## **1. Why Two-Stage Compression Reduces Energy Consumption**

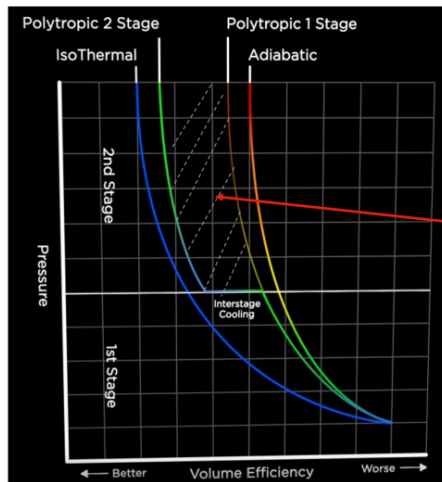
Conventional single-stage rotary screw compressors raise the air pressure in one compression process. Although injected oil removes some of the heat generated, the compression process still requires more energy than the theoretical ideal of isothermal compression.

The RTe series divides compression into two stages, with cooling between the stages. This reduces the compression work required to reach the final discharge pressure.

## New Frame 6 RTe 110-132kW



### Why two stage compression is more efficient



If it were possible to eliminate all the heat from the compression process, efficiency would follow something called the isothermal compression curve.  
If the compression process happened without cooling the air, it would follow something called the adiabatic compression curve. Adiabatic means that no heat is extracted, and the temperature is allowed to increase exponentially.

With single stage oil lubricated compressors, the oil surrounding the rotors removes some of the heat, and efficiency actually follows a curve somewhere in between, called the polytropic curve.  
On a two-stage compressor, the air is also cooled between the two compression stages. The polytropic curve shifts closer to the ideal isothermal compression curve.

The area between the two different polytropic curves is where energy savings are made.

Two stage compression apart from high efficiency can offer additional benefits like:

- Less overheating cause of inter stage cooling
- Lower pressure ratios in each stage and less wear
- Less moisture build up as cooler air has a lower moisture content

*Up to now to choose a two stage compressor was difficult cause of its high cost and very big footprint that cannot fit in all budgets or room layouts .....*

Figure 1: Theoretical compression curves illustrating the reduced compression work achievable through two-stage compression and interstage cooling.

### What the chart demonstrates:

- Lower compression work: Interstage cooling moves the compression process closer to the ideal isothermal curve.
- Reduced operating temperatures: Cooling between stages helps limit temperature increases within the airend.
- Lower pressure ratio per stage: The total pressure increase is divided between two compression elements.
- Reduced electricity consumption: Less compression work means less electrical energy is required to generate a given volume of compressed air.

The efficiency improvement becomes particularly valuable on installations operating continuously or for extended production hours. A reduction of just 10 kW in average electrical demand saves €16,000.00 annually at 8,000 operating hours and €0.20/kWh.

## 2. The GD10-DS Airend: Engineering for Efficiency

At the centre of the RTe series is the GD10-DS compact two-stage airend, developed by Ingersoll Rand in Simmern, Germany. Its engineering features include two compression stages within a compact assembly, dedicated oil injection, interstage cooling and a dual-gear drive arrangement designed to optimise operating conditions.

The semi-integrated design also incorporates oil management components, reducing external pipework and connections.

The engineering benefits include improved compression efficiency, a compact package, reduced potential leakage points and accessible servicing arrangements.

#### New GD10-DS

#### Unique advantage

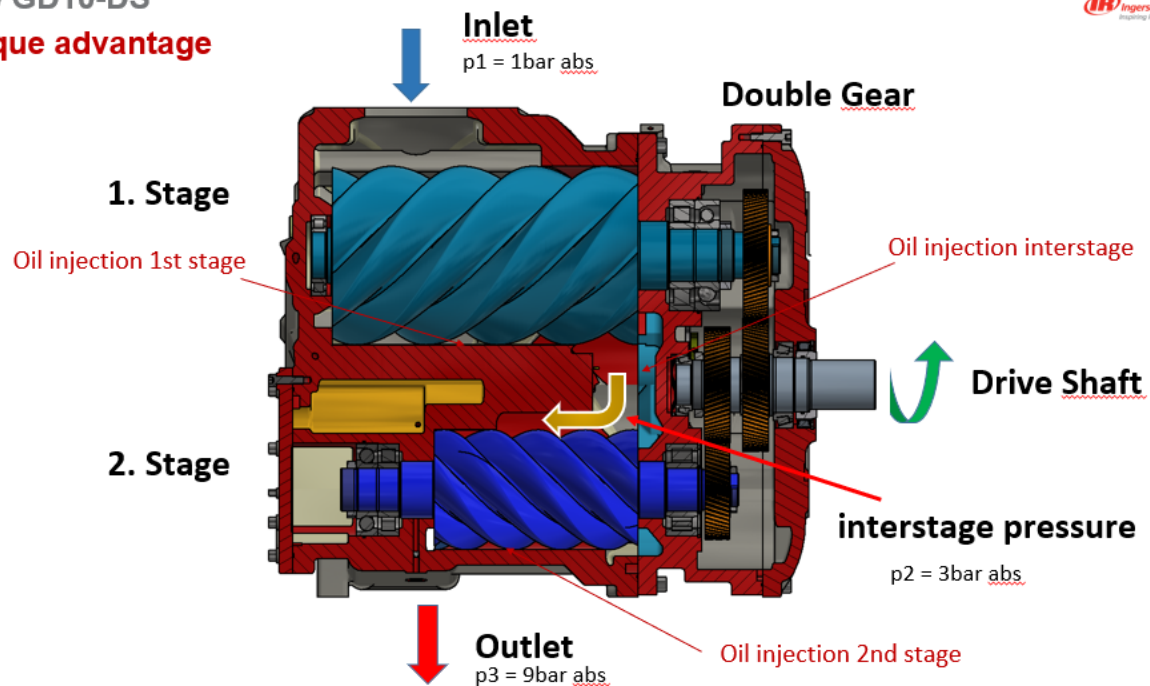


Figure 2: Inside the GD10-DS Airend

### 3. Variable-Speed Performance: Specific Power and why it Matters

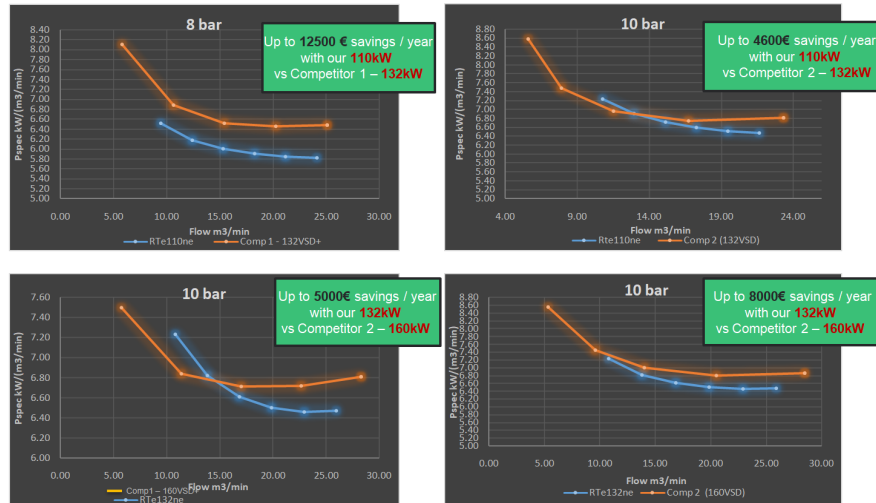
A compressor's motor rating does not, by itself, determine how much electricity it will consume. The more meaningful measure is specific power, expressed in  $\text{kW}/(\text{m}^3/\text{min})$ . This indicates the electrical power required to produce a given compressed air flow. Lower specific power means less electricity consumed for the same delivered air volume.

The RTe series combines its two-stage airend with variable-speed control to improve performance across changing air demands.

## New Frame 6 RTe 110-132 kW Competitive Analysis



New range offers the opportunity for **smaller compressor sizes vs competitors**  
→ competitive solution and less TCO



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Figure 3: Specific power versus delivered air flow for selected variable-speed rotary screw compressors at comparable operating pressures.

Manufacturer comparison basis: 5,000 operating hours per year at €0.20/kWh.

### Comparison 1 | RTe110ne (110 kW) vs Competitor 1 (132 kW VSD) | 8 bar

- **Specific power:** The RTe110ne operates at lower specific power over the common flow range shown, meaning less electrical input is needed for equivalent compressed air output.
- **Air delivery:** The 110 kW RTe110ne can match the competing 132 kW unit's flow in the illustrated comparison. Motor rating alone therefore understates the RTe's delivery capability.
- **Financial benefit:** Potential savings of up to €12,500 per year at 5,000 hours and €0.20/kWh. This is equivalent to approximately 12.5 kW less average electrical input under the stated assumptions.

### Comparison 2 | RTe110ne (110 kW) vs Competitor 2 (132 kW VSD) | 10 bar

- **Specific power:** The RTe110ne shows an efficiency advantage across the overlapping flow range illustrated. Compare the curves at the same delivered flow rather than comparing motor ratings.
- **Air delivery:** The RTe110ne almost matches the larger 132 kW competitor's maximum flow.
- **Financial benefit:** Potential savings of up to €4,600 per year at 5,000 hours and €0.20/kWh, equivalent to approximately 4.6 kW less average electrical input under those assumptions.

### Comparison 3 | RTe132ne (132 kW) vs Competitor 1 (160 kW VSD) | 10 bar

- **Specific power:** The RTe132ne delivers competitive efficiency against a compressor in the higher 160 kW motor class.
- **Air delivery:** The chart demonstrates an opportunity to consider the smaller 132 kW motor class where its available flow satisfies the application.

- Financial benefit: Potential savings of up to €5,000 per year at 5,000 hours and €0.20/kWh, equivalent to approximately 5 kW less average electrical input under those assumptions.

#### **Comparison 4 | RTe132ne (132 kW) vs Competitor 2 (160 kW VSD) | 10 bar**

- Specific power: The RTe132ne exhibits lower specific power across a substantial part of the common operating range, supporting reduced electricity use at matched air output.
- Air delivery: The RTe132ne approaches the flow of the 160 kW competitor. Confirm the required peak flow before selecting the smaller motor-rated package.
- Financial benefit: Potential savings of up to €8,000 per year at 5,000 hours and €0.20/kWh, equivalent to approximately 8 kW less average electrical input under those assumptions.

\*Note: Potential savings will be higher in cases where machines run 8,000 hours P.A. and electrical costs exceed €0.20/kWh

## **5. Additional Engineering Advantages**

Beyond compression efficiency, the RTe series incorporates features designed to support reliable long-term operation. These include automatic motor-bearing lubrication, a compact and serviceable compressor package, inverter-driven cooling fans, integrated condensate management and Helix remote monitoring.

Heat recovery options can provide a further opportunity to reduce energy costs where a suitable demand for recovered thermal energy exists.

## **6. Conclusion: Evaluate the Cost of Air, Not Just the Motor Rating**

The Ingersoll Rand RTe series demonstrates how two-stage compression, intelligent air end design and variable-speed technology can improve compressed air generation efficiency. For facilities operating compressors over long production hours, the financial advantage can be substantial.

At O'Neill Industrial, we recommend evaluating compressors using delivered air flow, specific power across the operating range and total annual electricity consumption rather than motor rating alone.

Contact O'Neill Industrial to arrange a technical review of your compressed air system and an energy-cost comparison based on your operating pressure, air demand and electricity tariff.

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